

The Economics and Externalities of Agricultural Land in the Urban Fringe

by

Tracy Stobbe

B.J., Carleton University, 2000

M.P.P., University of California, Berkeley, 2003

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Supervisory Committee

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Abstract

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The preservation of agricultural land, especially that which lies close to cities (in the so-called urban fringe), is a concern in many jurisdictions around the world. Agricultural land values change dramatically as farmland is located nearer to urban areas and development pressure has increased on these lands as urban populations have expanded. In British Columbia, Canada, a provincial-wide zoning system forbids the development or non-agricultural use of land without special permission. This system is explicitly designed to protect the capability of the land to produce food in the future, but it also implicitly protects the positive spillovers from agricultural land such as environmental services and open space. Three empirical papers comprise the original research in this dissertation. They seek to answer related questions about agricultural land values in the urban fringe. First, a statistical investigation is conducted into the factors that are associated with successful applications for exclusion from the agricultural zoning system. This study finds that a measure of distance (metres from the main highway) is highly significantly correlated with a parcel's chances of being excluded. Next, a paper

examines the trend of hobby farmers springing up in the urban fringe. Two different models seek to illuminate common trends in the types of parcels that hobby farmers choose, and the price that hobby farmers pay for the land, respectively. This study finds that hobby farmers seem to be very selective about the parcels they choose, likely trying to take advantage of favourable taxation rates for agricultural producers in place in the province. Lastly, a study seeks to understand how residential parcels' values are influenced by the nearness to and view of agricultural land. Agricultural land in the study does not appear to exhibit an open space premium, though this could be influenced by uncertainty about the future use of the land. All the empirical work in this dissertation utilizes geographic information systems (GIS) technology that allows the calculation of distances to features of interest. Hedonic pricing models and binary choice models are the main statistical tools used.

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1. Introduction - The Economics and Externalities of Farming in the Urban Fringe

Introduction

Farmland near cities is under increasing pressure. As cities grow, they require more land to house an increasing population as well to expand their industrial bases and upgrade their transportation infrastructure. Many farms have already been converted, prompting some preservation actions by various levels of government, but the remaining farms in the “urban fringe” provide a host of benefits for the nearby urban residents while also placing costs on them. This chapter will introduce the issues addressed in this dissertation starting with discussing public values for farmland, then outlining the major spillovers (both positive and negative) associated with farmland and finally discussing the types of programs and their costs that have been used to preserve farmland.

Public values for farmland

There is a high demand by the public for programs or measures that protect agricultural land near cities (Roe, Irwin and Morrow-Jones 2004; Bergstrom, Dillman and Stoll 1985). The vast majority of jurisdictions in North America have laws or policies that provide farmland with preferential tax assessments, while referenda that increase public funding for agricultural preservation programs are routinely passed in the United States (Wu, Adams and Plantinga 2004). Research has been conducted on public preferences to discover which specific features or amenities of farmland people are most interested in preserving. These studies reveal that environmental and aesthetic concerns

are more important to most people than simply the agrarian aspects. One study (Kline and Wichelns 1996) found the following ranking of amenities of farmland preservation programs (in descending order of importance) for residents of Rhode Island:

- protecting groundwater
- protecting wildlife habitat
- preserving natural places
- providing local food
- keeping farming as a way of life
- preserving local character
- preserving scenic quality
- slowing development

Clearly, farmland carries with it values beyond merely food production. People recognise and appreciate the land's natural qualities and environmental benefits (such as wildlife habitat) and aesthetic properties, as well as its more tangible outputs (local food and other products). Many of these environmental and aesthetic benefits fall into the category of externalities or public goods.

Externalities on the Urban Fringe

The classic definition of an externality is “a divergence between the marginal social net product and the marginal private net product... where one person in rendering a good or service to another person, also renders services or disservices to other persons such that payment cannot be extracted or compensation enforced” (Pigou, 1920).

Early economists conceived that any divergence between social benefits or costs

and private benefits or costs constituted a market failure. In today's terminology, effects such as those observed on the urban fringe can be classified into two broad types: externalities and public goods (though some effects do fall into a grey area between the two).

An externality today is usually thought of as an external cost or benefit bestowed upon a third party. If it is a cost, the third party is forced to bear it unwillingly. If it is a benefit, the third party is able to gain utility from it and the bestower is unable to require payment for it. Sometimes the same phenomena can be a positive externality to some and a negative externality to others, depending on their tastes. An example with farmland is the sounds, sights and smells can be either pleasant and nostalgic or an annoyance depending on individual preferences.

The usual definition for a public good is a good or service that is impossible to exclude anyone from experiencing and which is non-rival in consumption among all experiencing it. This public good definition can also be cast in the negative (a "public bad"). Some effects of farmland near the urban fringe can be classified as either an externality or a public good, or both.

Effects of farms on cities

Farmland and agricultural activities near developed areas provide a host of benefits, including positive externalities and public goods, for the nearby urban population. (Urban here includes the surrounding suburban areas as well.) Many of these benefits relate to environmental or aesthetic amenities, such as open space (for views from houses or commuting corridors) and wildlife habitat (which provides both wildlife viewing opportunities and existence value) (Ready, Berger and Blomquist 1997,

Lichtenberg, Tra and Hardie 2007).

Urbanities also benefit from nearby farmland by being able to buy fresh, local produce (sometimes directly from farmer's markets), and being able to enjoy agri-tourism opportunities (such as U-pick berries, pumpkin patches, corn mazes, and vineyard wine tastings). These benefits are not public goods or externalities since consumers are paying for the opportunities in most cases or the benefits are capitalized in house values, but to the extent that they do confer benefit on the urban population, they can be thought of as utility-enhancing elements of farmland. People might also receive benefit from knowing (and feeling good about) how their food is produced. Many people are concerned about labour, environmental, public health and safety standards in less-developed parts of the world. By buying local food, they can be assured it was not grown in ways that degrade the natural environment or human dignity.

On the flip side, farmland also confers negative externalities on residential and urban areas. Most of these relate to agricultural activities, not to the land directly. For instance, nearby residents often complain about the unpleasant odours associated with manure, fertilizers and animal operations, and the noise from farm equipment and animals. Other negative externalities include slow-moving farm traffic impeding local traffic and non-point source pollution from fertilizers and pesticide usage.¹

Effects of cities on farms

In the same way, cities contribute various positive and negative externalities on agricultural land. On the negative side, nearby residential communities can make

¹ Not included here are negative externalities that only affect a relatively small number of people due to their atypical preferences. For instance, if someone dislikes wildlife, farmland providing wildlife habitat would actually represent a negative externality. Likewise, people who abhor any pesticide or fertilizer usage on principle would experience that additional negative externality from nearby non-organic farms even if they did not result in non-point source pollution.

farmers' lives a nightmare through incessant complaints about the smells and sounds emanating from agricultural activities. Some communities have even restricted farmers' activities through by-laws brought forward by neighbours. This situation has been recognized in both Canada and the U.S. and increasing number of states and provinces have passed "right to farm" laws that prohibit infringement on normal agricultural practices. For instance, in B.C. farmers are protected by the *Farm Practices Protection (Right to Farm) Act (1996)* that is part of the Strengthening Farming initiative.

Another negative effect from cities on nearby farmland is related to land values. As the land values in cities increase (particularly in cities where the supply of housing is restricted in some way), the value of the adjacent farmland also increases as more people are willing to commute longer distances to avoid the relatively high price of inner city houses. This then fuels speculation on the part of developers who see demand for suburban housing increasing. Suburban housing demand also increases as a function of shifting preferences if inner city houses are perceived to be undesirable (due to crime, pollution or other factors). As land values increase, agriculture becomes a less feasible or profitable activity. The farmer is less able to expand his farming enterprise because land is too expensive to buy. The opportunity cost of farming also increases dramatically when the land's best use becomes housing or development.

Related to land values is a fragmentation externality. As more farmland is bought up by urbanities leaving the city and is developed into either subdivisions or large semi-rural estates, the remaining farmland becomes a patchwork of non-contiguous parcels. Fragmentation hinders the expansion of farming operations and farmers who do expand often find they must purchase or lease land that is spatially disconnected from the rest of

their land. This then increases the costs of transporting equipment between fields, reducing agricultural efficiency, and also increases the likelihood of nuisance complaints from neighbours as more farmland borders on residential land.

Being near a city does have some advantages for farmers though. The largest of these is that they are close to their market. This enables the nearby population to buy directly from the farm (direct farm marketing) and generally reduces transportation costs for agricultural products. It also means farms can expand beyond traditional commercial agriculture into specialized crops or systems (e.g. organic farming, for which certain segments of urban populations are willing to pay a premium) or into agri-tourism.

New farmers voluntarily accept this situation because they are making a location choice that is associated with certain (generally known) costs and benefits. However, this issue of urban growth affects long-term farmers who chose their location long before the city started expanding. For example, a third-generation berry farmer in the Fraser Valley has seen the city of Vancouver expand extraordinarily since the time his grandparents worked the land. All of these changes have brought unsolicited costs and benefits with them.

Another benefit to farmers of being near a city is the theoretical ready supply of labour. However, labour supply issues persist for many farmers, perhaps because profit margins are so tight at the urban fringe that they can not afford to pay their workers high enough wages to attract them from urban opportunities. For instance, during the summers of 2006 and 2007, several newspapers stories reported that farmers on the Saanich Peninsula faced critical shortages of fruit pickers for their bumper strawberry crops (Times-Colonist 2006; Wilson 2007).

Other supposed benefits of farmland preservation

To conserve all the positive aspects of farmland on surrounding areas, farmland preservation programs attempt to withhold land from development. Apart from the ones already detailed, three other benefits of farmland preservation are commonly mentioned.

First, food security is often cited by proponents of these programs as a compelling reason to preserve farmland. The argument suggests that in the event of a worldwide disruption in food production and/or distribution, each region (that is capable of doing so) should have enough active agricultural land to feed its own population. However, it is not clear that this reasoning is not just a scare tactic or the product of an overly risk-averse sub-group (Gordon 2006). Even after severe natural catastrophes, the worldwide food market has recovered quickly – certainly long before enough time has passed that a region would have needed (or been able) to become food self-sufficient. Nevertheless, even if this argument is a red herring, farmland preservation may still provide utility to some people who perceive food security to be a major issue.

A second perceived benefit of farmland preservation is its use as a tool for controlling urban growth. However, this use is likely to create economic inefficiencies since it is an indirect effect of agricultural preservation and, in general, targeted policies are more efficient than roundabout ones. As will be discussed in chapter two, farmland preservation programs that are being used as proxies for urban containment may lose their effectiveness because, if the land is not being utilized for agriculture, prospective developers can argue the land should not be in the agricultural protection program.

A final perceived benefit of farmland preservation is maintaining the option value on the land for future development or use. Option values specify that benefits flow from

the fact that more information on public preferences and land use alternatives will become available in the future and that, by delaying development, one can take advantage of that information in the future. Since most development is irreversible, preserving farmland gives its owners (and the public at large who control zoning policies) the widest range of possible decisions on land use in the future.² As Isgin and Forster (2006) detail, there is value in postponing decisions until after some of that uncertainty is resolved.

Farmland as a public good

Many of the benefits of farmland fall into the public goods category and are likely to be under-provided if left to the market. Though every person could have a positive willingness to pay to preserve the benefits of farmland, there is no mechanism to avoid free-riding. Since it is impossible to exclude someone from the benefits of farmland preservation (e.g. a view from a commuting highway, wildlife sightings, or the utility of living in an agrarian community), there is reduced incentive for them to contribute to its protection. This strategic behaviour on the part of some people will result in less farmland than is economically efficient. The classic answer to a public goods problem is to have the government coercively collect taxes and provide the good.

Farmland Preservation Options

Every farmland preservation program or system is associated with costs, both fiscal and non-pecuniary. The most obvious of these costs is the forgone monetary

² It is true that if information was perfect and complete, the current price would incorporate any uncertainty as to land use needs in the future and prices would be bid up to reflect potential alternate uses. However, information is not perfect or complete as technology is constantly evolving which could impact on land use requirements in the future. Also, as is known from bounded rationality theory, people do not always behave rationally and so markets are far from perfectly competitive when dealing with uncertainty and option values.

windfall its owners are being denied when land use is regulated or that they are choosing to sacrifice (in the case of voluntary or market-based programs). In the latter case, it must be true that these landowners derive higher overall utility from preserving the farmland than from the financial gain they would realize by selling it to a developer. But in the case of government regulation, real harm is being done to landowners who would not choose to continue farming otherwise. In a democratic society, whenever an individual is having his or her rights restricted, it must be counted as a cost.

Apart from the landowners, agricultural preservation programs also impose costs on society as a whole. In cases where land is scarce, housing supply will be restricted and its price will increase. This can be a boon for current homeowners who see their property values increase dramatically over the years, but this rise imposes hardships on those who are trying to enter the market (young adults and new immigrants to the city).

Once such a decision has been made to protect farmland in a formal way, there are numerous structures to choose from that have been employed around the world. In the most straightforward system, the government simply buys the land. The downfall is that ownership is not required to preserve benefits in many cases, and thus superfluous money is spent and so less land can be protected with the same pool of funds. In a twist on simple fee-purchase, many jurisdictions in the U.S. use a system of purchasable development rights (PDR). In these cases, the government merely buys the rights to develop the land and the landowner retains the title (with restrictions on it). This allows the land to continue to be privately farmed while costing much less than outright purchase (Daniels 1991).

Another system employed in the U.S. is transferable development rights (TDR).

In this case, the government establishes a market for land development rights and lets landowners trade with developers to arrive at an efficient price for the rights. The government usually establishes “sending” and “receiving” areas which dictate where development may occur and where it may not. Thus, development in the sending areas is restricted but the landowners are compensated for their loss of the full use of their land because developers must buy their credits in order to build elsewhere (McConnell, Walls and Kopits 2005). The TDR system is a combination zoning-market system that is used to mitigate the income redistributive effects of zoning (van Kooten and Folmer 2004).

The most widespread system of farmland preservation is the use of zoning. Almost every jurisdiction in the western world uses some form of zoning to control what type of development can happen on what type of land. Usually zoning happens on the local level, but there are exceptions, such as in British Columbia, Canada. Zoning can be very effective, but it carries with it equity costs because landowners are usually not compensated for the loss of the unrestricted use of their land (Hanna 1997).

A final mechanism for retaining land in agricultural use is preferential property tax schemes that reward landowners for engaging in agriculture. The greater the difference between the taxes levied on agricultural and non-agricultural lands, the more powerful this tool will be in preserving farmland (Anderson 1993). However, some researchers have found preferential taxation to be counterproductive to long-term agricultural preservation because it can lead to more speculation on farmland as speculators can hold land in agricultural use for many years and pay low taxes until the optimal time for development comes (Blewett and Lane 1988).³

³ One mechanism used by some jurisdictions to counter this incentive to speculatively hold farm properties is to charge back-taxes on the land if it is developed.

The Road Ahead

Some specific questions that will be asked throughout this work include: Does the available data support the existence of speculation on agricultural land? Does the spatial pattern of agricultural land, hobby farms and development indicate that fragmentation of farmland is a problem? What characteristics of agricultural parcels contribute to the land's value (e.g. parcel size, proximity to other farms, proximity to Victoria, etc.)? Are people willing to pay more to live near agricultural land, and if so, how much? Do houses that are near to or adjacent to agricultural land exhibit an open space premium, the same way that houses near parks and natural spaces have been documented to do? Is this open space premium different for land that is in an agricultural preservation program versus land that is not included in a program?

This dissertation will examine these and other related questions and issues regarding agriculture and agricultural land on the urban fringe. Vital to any inspection of agriculture is the institutional environment in which the land is found. Therefore, chapter two details the background of the zoning system used in the study area and outlines the current issues facing agriculture there. The next chapter diverges slightly from this focus and takes a historical look at land rent theory from the earliest periods in economic history up to modern times. It ends with an application of land rent theory to the zoning system under investigation in this dissertation. Chapter four explains the data sources used in the following three empirical chapters and discusses the GIS models that were constructed to analyze the spatial data. Chapter five examines the decision process at work in the Agricultural Land Commission, which adjudicates land use applications in B.C., and seeks to determine if some application characteristics are more likely to be

associated with exclusions than others. Hobby farmers in the urban fringe is the subject of chapter six and this paper seeks to understand the property characteristics that hobby farmers tend to have and the land prices they command. Finally, chapter seven looks at agricultural land protection from the perspective of nearby residential land users and asks if homebuyers display an observable preference for open space in the form of farmland (as has been well-documented for park land) and if that preference depends upon the protection status of the farmland. Finally, a conclusion in chapter eight sums up the dissertation and recaps the main policy implications of the work to provide policy-makers with improved knowledge and guidance.

2. An Overview of Agricultural Trends in British Columbia

British Columbia is widely known for its jagged snow-covered mountain peaks, its old-growth rain forests and its stunning coastlines, but farmers and agrologists also know it is home to some of Canada's most fertile land for agriculture. (Runka 2006) B.C.'s agricultural landscape is as varied as its natural landscape – it contains land eminently suitable for growing fruits and vegetables in the southern interior and coastal areas, land adapted for growing grains and oilseeds in the northern regions, and land fit for pasture and ranching in many areas.

In terms of economic output, primary agriculture in 2005 only contributed about 0.74% of provincial GDP and generated \$2.4 billion in receipts to farmers (MAL 2006). In terms of jobs, about 36,600 people were employed directly by agriculture in 2005. However, these figures belie the importance of agriculture to the provincial economy. When food processing, wholesaling, retail, and the food service industry are taken into account, the totals balloon to \$33 billion a year with more than 280,400 jobs provided by these industries (MAL 2006).

British Columbia's main crops (in terms of sales in 2005) were floriculture and nursery products (\$403 million), potatoes and vegetables (\$401 million), greenhouse vegetables (\$224 million) and berries and grapes (\$154 million). The main outputs of the province's animal agriculture were dairy products (\$401 million), poultry and eggs (\$366 million) and cattle and calves (\$285 million). The gross receipts of some commodities within these sectors have grown at astonishing rates between 1996 and 2005; for example, greenhouse tomatoes (418.7% growth), greenhouse peppers (306.7% growth), sweet cherries (246.1%), calves (242% growth), grapes (214.6% growth) and blueberries

(166.6%) (MAL 2006).

Interestingly, the number of farms in B.C. has been growing over time – a trend opposite of that in the rest of Canada. (Table 2.1) This is likely due to the availability of relatively small parcels of agricultural land near the cities on which many hobby farms have been established. The total number of farms in B.C. increased by 10.3 % between 1971 and 2001, although there was a small decline between 2001 and 2006 (by 2.2%). Of the current 19,844 farms, almost half report gross farm receipts of less than \$10,000 a year, and about a quarter are less than 10 acres (4 hectares) in size. (Table 2.2) This likely means that though the number of farms in B.C. has grown, the new farms being established are likely hobby farms. (See below for more discussion of hobby farms.)

Table 2.1 Selected Human Population and Farm Statistics, Canada and B.C.

		1971	2001	2006	Change (from 1971 to 2006)
Canada	Population	21,568,311	29,639,035	31,241,030	44.85 %
	Total	366,110	246,923	229,373	-37.35 %
	Number of Farms				
British Columbia	Population	2,184,621	3,868,875	4,074,385	86.5 %
	Total	18,400	20,290	19,844	7.85 %
	Number of Farms				

Source: Statistics Canada Census and Census of Agriculture, 1971, 2001, and 2006

B.C.'s total land area is about 98.74 million hectares (MAL 2006b). However, only a very small fraction of the province is suitable for agriculture. The Canada Land Inventory (CLI) soil and climate classification system rates land based on its capability to grow a range of crops, with class 1 being the most fertile and receiving optimal precipitation and class 7 having no agricultural capability. Only 2.7% of B.C.'s land is capable of growing a "reasonable range of crops" (classes 1 to 4) and only 0.6% is class 1

Table 2.2 Selected Farm Characteristics by Province, 2006

	Farms reporting total farm area < 10 acres	Percent of farms in province	Farms reporting total gross farm receipts < \$10,000	Percent of farms in province	Total number of farms
Newfoundland and Labrador	115	20.61	208	37.28	558
Prince Edward Island	85	5.00	402	23.65	1,700
Nova Scotia	319	8.41	1,357	35.76	3,795
New Brunswick	193	6.95	991	35.70	2,776
Quebec	1,895	6.18	4,554	14.85	30,675
Ontario	3,163	5.53	14,500	25.34	57,211
Manitoba	568	2.98	3,426	17.98	19,054
Saskatchewan	431	0.97	5,443	12.28	44,329
Alberta	1,063	2.15	9,791	19.81	49,431
British Columbia	5,353	26.98	9,466	47.70	19,844

Source: Statistics Canada Census of Agriculture, 2006

(Runka 2006).

Farmland in the urban fringe is under development pressure around the world. This global trend is particularly pronounced in B.C., especially near Vancouver (the Fraser Valley), Victoria (the Saanich Peninsula) and Kelowna (the Okanagan Valley). The reasons can be found by looking at the intersection of geography and history. Due to the mountainous terrain in most of the province, early European colonists settled in valleys to be near fertile land to produce food and to be near accessible waterways for trade. As these colonies, such as Fort Langley, New Westminster and Victoria, have grown into cities, development has spilled onto the adjacent farmland in the Fraser Valley and Saanich Peninsula. (The relatively level farmland has much lower construction costs than building up the sides of the mountains.) It is ironic that the same features (access to waterways, being near agricultural land) that attracted settlers to build these cities, now

hinders those cities' expansion, at least if preservation of farmland is important.

Across Canada, the loss of farmland to development is a growing concern. In 2001, half of Canada's urban land (about 14,300 sq kms) was situated on what had previously been dependable agricultural land (Hofmann, Filoso and Scholfield 2005). The total loss of good agricultural land over time has been mostly attributed to rural and urban development (57 %), although transportation and utilities also take a considerable bite (29 %), and protected areas and campgrounds take a smaller portion (8 %) (Hofmann, Filoso and Scholfield 2005).

History of the Agricultural Land Reserve

In the early 1970s, it was estimated that B.C. was losing about 6,000 hectares of agricultural land each year to urban development (Hanna 1997). In late 1972, the freshly elected New Democratic Party (NDP), which had run on a platform of agricultural preservation and zoning, passed an order-in-council prohibiting the subdivision of all agricultural land in preparation for more comprehensive zoning legislation. (This was to counter a run on agricultural land and rezoning applications that their electoral victory had caused.) Premier Dave Barrett ushered in the *Land Commission Act* in 1973 which created a five-member Land Commission with the authority to designate an Agricultural Land Reserve (ALR). The Land Commission relied on the Canada Land Inventory (CLI) ratings to decide what land would be zoned agricultural. It included only lands two acres or larger classed between ratings one and four and those lands that were presently classified either by B.C. Assessment as having farm class status or by a local government as agricultural – an area totalling 4.7 million hectares (out of the province's 30 million

hectares of agricultural land).

The first few years of the Land Commission's existence was marked by an activist approach to integrating agricultural promotion with land protection. As well as purely agricultural lands, it also had some authority over parks, greenbelts and land banks if they were government-owned. It had the ability to acquire land and it bought more than 8,000 hectares of farmland (at a cost of \$10,974,000) to lease out for farming purposes as part its goal to maintain a viable farm economy. It also had the authority (and budget) to conduct research into land use planning and encouraged the development of experimental land use (Garrish 2003).

The activist period of the commission's history was soon over as the NDP lost the provincial election in 1975 and the Social Credit Party regained power. They cut funding for the Land Commission drastically and through Bill 88, the *Land Commission Amendment Act* (1977), curtailed the ability of the commission to devise integrated land use policy. The commission no longer had authority over parks or greenbelts, and lost its ability to purchase or lease land. Its name was changed to the Agricultural Land Commission (ALC) and its new objective, “the key to preservation of the agricultural land base ... is to be found in retaining the *options* for agricultural use” (quoted in Garrish 2003), reflected its new role as agricultural protector instead of agricultural promoter.

Perhaps the most visible change made by the Social Credit government to the agricultural zoning system was the ability of an individual to appeal an ALC decision directly to an elected body. Anyone unsatisfied with the outcome of an exclusion or subdivision application could appeal directly to the Minister of Environment and the

cabinet. The argument for this change was that it was undemocratic for an individual *not* to have this recourse. However, “this provision naturally raised fears that the removal of land from the ALR would become simple, that an appeal could proceed against the wishes of the ALC and municipalities, and that fairness and consistency in administering the ALR would be jeopardized by political inference” (Garrish 2003). After this change, the ALC found more than 3,000 applications for exclusion were being filed annually and some high profile exclusions were approved by cabinet, such as the Spetifore Lands in Tsawwassen.⁴

In 1984, while the province suffered from a recession, the ALC budget was further slashed to \$785,681 from more than \$3,629,127 in 1976. The Social Credit government passed an order-in-council in 1988 that approved the building of golf courses on the ALR, arguing it would help create buffers between residential uses and agricultural uses. On the contrary though, “the speculation that ensued ... drove up land values, removed land from production, and generally increased the hardships faced by established farmers” (Garrish 2003). The Municipality of Delta alone received 18 applications for golf courses.

The NDP returned to power in 1991 to find that only 2.4 million hectares of the ALR (a little under half) remained in active production. They placed a moratorium on all golf course developments that year, and in 1993 passed the *Cabinet Appeals Abolition*

⁴ The Spetifore Farm in Tsawwassen was removed from the ALR in 1981 against the recommendation of the ALC, and some say, by the political sway of George Spetifore. Because of community outrage, the Greater Vancouver Regional District (GVRD) went back on a promise to allow the land to be rezoned and all was quiet until 1989 when a development company proposed building 1,895 houses, an 18-hole golf course, a 250-room hotel, and a 220-acre park on the farmland. After the longest recorded public hearing in Canada (25 days, more than 400 speakers, 800 written submissions and more than 2,800 letters), the proposal was eventually defeated. However, this does not mean that drama over that parcel of land is over. In the fall of 2006, Sean Hogkins, a local developer, started to hold new public meetings in an effort to soften the ground before formally submitting his own development proposal for the beleaguered former-ALR land.

Act. Instead of individuals being able to appeal ALC decisions, the government could consider applications if they were deemed to be of “provincial interest”.

Over time, it became clear that some municipalities were much more supportive of development than others. When an ALR-exclusion or subdivision proposal came forward from a local government or government agency, its chances of approval were a good deal better than a private application. Between 1974 and 1993, 88% of the land exclusions applications by government were successful while only 30% of private applications succeeded (Hanna 1997). Some municipalities, such as Delta, have a strong reputation for zealously guarding farmland, while others, such as Surrey and Langley, are much more cooperative with developers (Gordon 2006).

With the Liberals sweeping to power in 2001, the ALC’s responsibilities were sub-divided into six regional panels and more responsibility for local land-use planning was devolved to local governments. The rationale for the six three-person panels instead of one larger provincial panel was to make the system more regionally responsive. Commissioners would now be able to visit the parcels in question and would have more local knowledge of land use needs. Indeed, research supports this theory and highlights how local interests are better served as a result of lower transaction costs when making decisions (van Kooten and Scott 1995).

However, the change to a regional panel system has not been seen as an improvement by everyone and many are concerned about increased pressure on regional commissioners, their lack of provincial perspective, and, in some cases, conflicts of interest. SmartGrowthBC puts it thus: “Regional panels are more susceptible to pressure from local interests, which do not always represent a strong voice for farmland protection

and rarely reflect the provincial perspective upon which the ALR was founded. This structural change to a panel system has been accompanied by notable increases in applications (and approvals) for exclusion, subdivision and non-farm use of ALR lands” (SmartGrowthBC 2005).

The most recent statistics available for the ALR show it has grown from its inception size in 1974 of 4,716,516 hectares to 4,759,236 hectares (a net increase of 42,720 hectares) (ALC 2008). However, since the Campbell government has come to power, the ALR and its administration has become the source of increasing controversy. Proponents of the reserve say the structural changes to the ALC have eroded the ability of the reserve to withstand the pressures of urban development and cite some contentious exclusions in the Kootenays, on southern Vancouver Island and in the Fraser Valley as examples (Campbell 2006; Green 2006).

One widespread criticism is that the land reserve has grown due to inclusions of land in the more arid north of the province, while most of the exclusions have come from the fertile southern portions which are under the most development pressure. Statistics from the ALC seem to bear out these concerns. All areas of the province show net losses in ALR land except for a few districts in the north which show considerable gains. (Table 2.3)

Trends in Agricultural Land Values in B.C.

Some commentators have claimed that the ALR is the only thing standing between farmers and complete extinction of agricultural activities in several areas of the province (Gordon 2006). The veracity of this statement is difficult to assess. On one side, the

Table 2.3 Area Included/Excluded from the ALR by Regional District, 1974 to 2006

Regional District	Area at Designation (ha)	Total Inclusions (ha)	Total Exclusions (ha)	Net Change (ha)	Net Change as Percent of Area at Designation	ALR as of Year End 2006 (ha)
Alberni-Clayoquot	7,935	805	1,041	-236	-2.97	7,699
Bulkley-Nechako	297,611	70,500	2,172	68,328	22.96	365,939
Capital	19,595	284	2,817	-2,533	-12.93	17,063
Cariboo	925,506	18,405	18,400	5	0	925,510
Central Coast	4,453	53	65	-12	-0.27	4,442
Central	71,539	799	8,388	-7,589	-10.61	63,949
Kootenay						
Central	33,077	210	7,203	-6,993	-21.14	26,084
Okanagan						
Columbia	67,409	1,364	17,905	-16,541	-24.54	50,868
Shuswap						
Comox-Strathcona	43,725	4,778	8,192	-3,414	-7.81	40,310
Cowichan Valley	21,984	443	4,676	-4,233	-19.25	17,751
East Kootenay	272,510	297	7,437	-7,140	-2.62	265,370
Fraser-Fort George	349,636	42,425	11,613	30,812	8.81	380,448
Fraser Valley	76,803	415	5,389	-4,974	-6.48	71,829
Greater Vancouver	66,839	233	6,158	-5,925	-8.86	60,914
Kitimat-Stikine	64,170	3,146	838	2,308	3.60	66,478
Kootenay-Boundary	55,061	291	1,973	-1,682	-3.05	53,379
Mount Waddington	1,741	17	120	-103	-5.92	1,638
Nanaimo	21,053	1,879	4,460	-2,581	-12.26	18,472
North Okanagan	70,283	1,535	5,946	-4,411	-6.28	65,872
Northern Rockies	45,554	603	981	-378	-0.83	45,176
Okanagan-Similkameen	86,478	2,165	5,309	-3,144	-3.64	83,333
Peace River	1,453,434	26,641	2,461	24,180	1.66	1,477,614
Powell River	14,130	502	5,086	-4,584	-32.44	9,546
Skeena-Queen Charlotte	43,887	80	187	-107	-0.24	43,780
Squamish-Lillooet	27,126	939	2,923	-1,984	-7.31	25,141
Sunshine Coast	6,275	17	2,249	-2,232	-35.57	4,044
Thompson-Nicola	568,705	2,134	4,249	-2,115	-0.37	566,589
Total	4,716,516	180,955	138,236			4,759,236

Source: Agricultural Land Commission 2008

Fraser Valley produces \$1.6 billion annually in agricultural products and is Canada's top raspberry, cranberry and greenhouse pepper-producing area and is North America's second biggest blueberry-producing area (Gordon 2006). With record-high prices for blueberries in the summer of 2006 due to growing international demand, the Fraser Valley is currently witnessing a berry-planting boom.

But on the other side, Vancouver and the Fraser Valley saw more than 8,700 hectares of agricultural land excluded from the ALR since 1973 and Richmond lost one-third of its farms between 1981 and 1996 alone (Gordon 2006). And this was in the presence of a zoning commission whose mission it is to protect agricultural land. Without a system like the ALR, it is easy to imagine development covering significantly more of the lower mainland.

One trend that is visible in the Fraser Valley (and is starting to be noticeable on the Saanich Peninsula) is the growth in the number of hobby farms or large rural estates. Under rules for the ALR, an agricultural parcel may contain only one dwelling plus some other buildings (such as barns). The one dwelling is supposed to be a farmhouse for the farmer who resides on his land. However, with housing prices in Vancouver and Victoria reaching unheard-of levels, wealthy urbanities or ex-urbanities are buying the relatively smaller ALR parcels and building new, large houses on them. (Photos 2.1 and 2.2)⁵ In some cases, the owners lease the remaining farmland back to a farmer to be kept in production. But in many cases, the land is either left fallow or is used as a hobby farm with little or no production or agricultural revenue. It is due to the growth of these hobby farms that B.C. has seen its total number of farms increase over time while its average farm size fell (the only province to witness either of these phenomena) (Hanna 1997).

⁵ Photos taken by Tracy Stobbe, January 2007.



Photo 2.1 House on ALR land in Abbotsford, B.C. (Huntingdon Road)



Photo 2.2 House on ALR land in Abbotsford, B.C. (Townline Road)

By and large, farmers were strongly opposed to the creation of the ALR. They saw their land as their retirement nest egg and faced substantial losses when its price plummeted due to the new restrictions (Garrish 2003). However, due to increasing urban demand that is driving up even ALR land values, many farmers currently are able to sell to speculative developers at high prices. As the opportunity cost of the land increases, and farm income in many cases is insufficient to cover the cost of the land (mortgage payments) plus variable farm costs, farming becomes a less appealing option. So, “much of the ALR may be left idle because returns from farming are insufficient to cover costs of capital invested on land purchased at prices that reflect a demand for land for other uses” (Hanna 1997). This trend of land sitting idle due to high land values has been dubbed the “impermanence syndrome”, because farmers are unwilling to make capital investments on their land when they expect to sell it in the future, or because of inadequate profits from farming.

As capital stock fails to be maintained or enhanced and as land stewardship declines, the productivity of the land and potential of the farm to be commercially viable deteriorates. This then fuels the speculators’ arguments that the land should be removed from the ALR and rezoned at the municipal level because it is marginal or unproductive land. As more land is developed, farmers find it increasingly difficult to continue farming due to the resulting fragmentation of agricultural land, the nuisance complaints from neighbours, and the inability to expand their operations. (See Figure 2.1)

Farmers wishing to continue operating at the urban fringe have responded to these challenges in various ways. In order to increase their income, some farm families diversify by having some members of the family work off-farm in the nearby urban

centre (Meert *et al.* 2005). Others switch crops to produce more profitable outputs (such as growing berries in the Fraser Valley) or switch cropping systems. Building greenhouses is a permitted use of ALR land and greenhouse agriculture is growing rapidly in B.C.⁶ Organic farming is also an increasingly popular alternative because of the appeal its products have among the wealthy and educated living in urban centres. The organic industry is growing by double-digits and its products generally enjoy a price premium over non-organic products (COABC 2007).

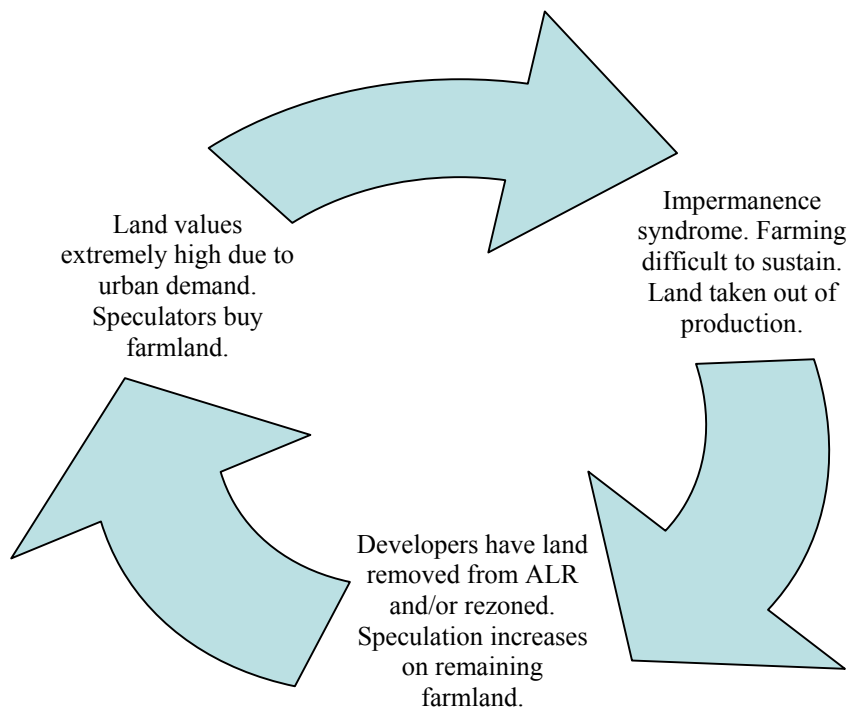


Figure 2.1 The Cycle of Impermanence and Development at the Urban Fringe

Another response from farmers near the urban fringe has been to broaden their horizons beyond commercial agriculture into agri-tourism. In one of its simplest forms, farms create on-site markets for their products which not only brings utility to those

⁶ It should be noted, however, that many do not look upon the advent of greenhouse agriculture with a favourable eye. Some are concerned about the pollution they cause, the amount of fuel they consume in the winter, and the fact they do not provide wildlife habitat.

wishing to buy “fresh from the farm”, but also reduces their transportation costs and cuts out middlemen. (An example of this can be seen at Michell’s farm market on the Patricia Bay Highway on the Saanich Peninsula). A more complicated agri-tourism venture can be seen in Saanich (off Blenkinsop Road) at Galey’s farm, which has a farm market as well as corn mazes and other agriculture-related attractions. Another example is Le Couteau farm in Central Saanich which hosts an annual pumpkin patch where you can not only buy pumpkins (and many other products), but also has a corn maze, haunted house, pony rides and exhibits such as an apple-tasting booth where a plethora of apple varieties can be sampled. The Saanich Peninsula also has several wineries (many of them opening just in the past decade) where visitors can do wine-tasting, stroll around the vineyard and rent the facility for events. Some even operate a bed-and-breakfast side-business, such as Vineyard B&B near Elk Lake. Wineries and other agri-tourism opportunities are also found in the Fraser Valley and in the Okanagan Valley.

The various attempts of farmers near the urban fringe to stay in business have not gone unnoticed by those seeking to reduce their tax bills for other reasons. Because farm class status can reduce property taxes by a substantial amount (with “farmers” paying only 15% to 20% of what non-farmers pay), large rural estates and hobby farmers have sought out parcels which allow them to meet the threshold to avoid paying much the property tax normally due on the land. This means that the tax code, which is supposed to be aiding the survival of viable agriculture, may be contributing to its demise by making land relatively cheaper for large rural estates. This phenomenon has started to be addressed by B.C. Assessment in November 2007 by dividing some properties into farm and non-farm sections with different tax rates, though this has raised the ire of small

farms (Cardone 2007). (The taxing authority seems to be back-peddalling though, away from controversy. In December 2007 it agreed to review the 119 properties it reclassified (Westad 2007).)

3. History of the Theory of Land Rent: From Classical Origins to Modern Application

Introduction

The price of land is intimately connected to the concept of rent in classical and neoclassical thought. This is due to the fact that land is a primary factor of production in largely agriculturally based societies. Even in the industrial revolution, land was still in such a large supply (especially so in North America) that its price was strongly related to its ability to produce food or other products in an efficient manner (due to fertility or location). It is only in relatively modern times that land scarcity has become the driving force behind land prices. For these reasons, to understand the theory of land prices, it is important to study the theory of land rent.

The classical economists thought the price of any good, say food, is derived from its cost of production. Therefore, that food which can be produced at low cost, when the overall market price is high, enjoys high profit or rent. Land that is capable of producing at low cost will then have this rent capitalized into its value and will have a high price. Marginalists later generalized this idea to all factors of production and saw rent as the inframarginal surplus that comes from land, just as wages are the surplus from labour and profit is the surplus from capital.

The concept of rent was framed as an unearned increment going back to the mid-18th century and was a source of much controversy throughout that century and the next two. While returns on labour and capital have been seen by some as a healthy incentive for investment, rent has been seen as a stroke of luck and, perhaps, a source of revenue

for government coffers.

The definition of rent alone caused many heated words to be penned, particularly in the late 19th and early 20th centuries. The application of rent theory to improving the distribution of wealth by economists like Henry George helped spur on the neoclassical school of thought whose members vehemently disagreed with George's ideas. Thus rent theory is important not only to the development of land price theory, but to the history of economic thought as a whole.

In this paper, the concept of rent and its controversial history will be outlined through a chronological tour of the development of rent theory as it applies to land. In the final section, a modern application of the concept will be presented to help explain the land speculation and development pressures facing the Agriculture Land Reserve in British Columbia, Canada.

Adam Smith

One of the first detailed discussions of land rent appears in Smith's seminal 1776 work, *An Inquiry into the Nature and Causes of The Wealth of Nations*.⁷ Smith had spent three years living in France and was heavily influenced by the Physiocrats during this time. Their work centred on agricultural returns and the structure of the economy around the rural landscape. They believed it was through agriculture that nations became rich due to the net surplus agriculture furnished over its costs. In *The Wealth of Nations*, Smith echoes many of these ideas; for instance, Smith says that land producing food will always have rent.

⁷ Smith's contribution was not the first published analysis of rent. Henry Home (Lord Kames)'s book, *The Gentleman Farmer*, which displayed a good understanding of the nature of land rent predates Smith (Hartwick 1989).

Smith did not explain his rent-as-a-differential concept as clearly as later writers, but his role as a pioneer is undoubted. In discussing the potential of mines to provide rent, he is exactly in line with later thinkers in saying rent comes purely from circumstance (“fertility” of the mine) and spatial location (which impacts transportation costs). Similar to many other ideas in *The Wealth of Nations*, Smith believed the interests of landlords are bound up in the interests of society in general because greater agricultural output results in greater rent. As society is demanding more or better food (due to population growth or an increase in income), rent also increases. Therefore, “progress” is coincident with greater rent and landlords and society work toward this common goal without any of the class struggles present in later thinkers’ work.

Smith has been criticized by many because he apparently contradicts himself in his own book. He states that rent is a differential surplus as a result of fertility and situation (and so it is price determined) but also claims that rent is price-determining because land that is not receiving adequate rent is withdrawn from cultivation (Blaug 1996). Smith let this difficulty stand throughout all the subsequent editions and in the face of overt criticism from his friends and colleagues.

A later commentator, D. H. Buchanan, claims that Smith left this seeming contradiction in his work because he was actually discussing rent from two points of view: price and distribution. When looking through the price lens, he contemplates “particular” commodities but when considering distribution, he thought of the “annual produce”. Buchanan argues that given the economic situation and class structure at the time, the two points of view are valid and natural for someone like Smith to consider. Buchanan’s thesis will be discussed in more detail later in this paper.

The Corn Laws Debate and Thomas Malthus

Further developments in the theory of land rent came in response to a practical public question of the day – the debate surrounding the English Corn Laws. The Napoleonic Wars (1804 to 1815) had cut off regular supplies of wheat from the continent and the price of farm products had risen dramatically. English supply increased due to both more intense cultivation of existing farmland and the cultivation of previously unfarmed land. Farmers and landlords had purchased more land (often with heavy mortgages) in expectation of sustained high prices. However, after the war, when continental supply resumed, prices fell and hardship ensued, they started calling for the government to increase duties on foreign wheat.⁸ This was an unpopular move with a new rising class in English society – the manufacturers, merchants, ship owners, and bankers of the Industrial Revolution. They were starting to challenge the landed aristocracy for political, economic and social control of the nation and opposed any measure that could result in higher costs of production or wages.

A parliamentary committee was set up at this time to examine the issue. Four economists published their own works and commentaries on the situation: Thomas Robert Malthus, Edward West, Robert Torrens and David Ricardo, the last of whose work became a pivotal exposition in the history of economics. Each of these economists had observed first-hand the rising prices of food and the increase in cultivated land, followed by the diminishing returns which resulted (Blaug 1996).

Malthus is most famous for his work (and dire warnings) on population growth.

⁸ The Corn Laws had been in place since Mercantilist times but tariff levels had not been binding during the Napoleonic Wars due to the imported supply (from Europe) being restricted. When the wars ended and supply was re-established, the price of wheat fell below the set price floor and tariffs were re-imposed (Rima 1991).

His theory of rent is similar to Smith's and Ricardo's in many ways – he explains that rent is a surplus of price over the costs of production and that price is determined on the margin of cultivation. Rent is due to Nature's bounty, not scarcity, according to Malthus, and so when there are more people demanding food (and other necessities of life), the price of food rises above its costs of production.

Malthus disagreed with Smith in that he felt that rent should not be categorized as a monopoly. He argued that rent arises from three factors: 1) the land yields more of the necessities of life than are required to feed the people producing the food, 2) the necessities of life create their own demand, and 3) fertile land is comparatively scarce (Lackman 1976).

David Ricardo

Though Ricardo was not the first to express the rent concept as due to differential fertility or to point out the importance of the extensive margins of cultivation, he is the most famous. His 1815 pamphlet, *Essay on the Influence of a Low Price of Corn on the Profits of Stock*, laid down the basic ideas that he later expanded in his central work, *Principles of Political Economy*. "Rent is that portion of the produce of the earth which is paid to the landlord for the use of the original and indestructible powers of the soil", wrote Ricardo. He explained that where the ratio of population to land is small (such as in a new country or territory), there will be no rent. As the population grows, the supply of food and other products from the best land, which is utilized first, will be inadequate and will force the cultivation of additional, inferior land. The second plot of land produces less output with the same quantity of capital and labour due to its reduced fertility (the

extensive margin).

Since the price of agricultural products is determined by their cost of production and since the last unit costs more to produce than the first, the market price reflects the cost of growing the last unit, and so the first unit receives more than its costs. This surplus of price over costs for the inframarginal units is rent.

Likewise, Ricardo pointed out, if you decide to intensify cultivation on the first plot instead of expanding production onto the second (the intensive margin), by the law of diminishing returns, each additional application of capital (fertilizer) or labour will be less productive than the first and the differences in productivity between the applications will be rent (O'Brien 1978).

Thus, rent would not exist if there was enough land of high quality to produce all the agricultural products desired or if capital and labour did not exhibit diminishing returns. Rent will be reduced when technological improvements in agriculture make the cultivation of inferior land more productive or the additional applications of capital on fertile land are made more effective.

Ricardo disagreed with Smith on several points. Firstly, Ricardo attacked the idea that land producing food always yields rents. He agreed with Smith's treatment of mines but thought the concept of differences in fertility applied equally to land of all descriptions, not just lands for food production. Secondly, Smith maintained that by switching to a crop which produced more abundantly on the same amount of land, one could increase the land's rent. Ricardo asserted that this cannot be – not until the population expands and demand swells will an increased quantity of food be grown. Finally, Ricardo disagreed with Smith's belief regarding the interests of landowners.

Ricardo asserted that the interests of landowners are always opposed to that of society because their aim is high rent payments. High rent results from high price that results from high production costs on the margin of cultivation. But high price is not to the benefit of consumers or manufactures who must then pay higher wages (Lackman 1976).

Malthus also ran afoul of Ricardo's theory in several respects. Malthus claimed that higher rent is caused by increases in fertility, but according to Ricardo, rent comes from relative fertility and not absolute fertility. If an improvement renders some land more fertile, it will only receive more rent if, relative to the last plot under cultivation, its position has changed. If the improvement is a general technological change, it is possible that the last plot's fertility will increase by a greater share and thus, the penultimate plot receives less rent, not more. Ricardo also disagreed with Malthus' emphasis on the idea that population only changes through the provision of additional food and also on his three causal factors of rent (Lackman 1976).

The only kind of rent considered by Ricardo and his contemporaries is agricultural rent. As they deemed land to have no competing uses and to be freely taken up when needed and otherwise sitting idle, they overlooked the issue of opportunity cost. Thus, rent is price determined and not price determining. Or, as Ricardo put it, "[The price of] corn is high not because a rent is paid, but rent is paid because [the price of] corn is high." Because land is inexhaustible and homogenous (except for fertility and locational differences), rent is not a payment for the use of resources. Thus, it is an unearned increment and it would make no difference if all the landlords were thrown to the wolves (Blaug 1996). Therefore, in theory, the expropriation of rents by the state

would not affect production or the cost of production.⁹ However, such a redistribution would alter spending patterns and incentives and hence demand for agricultural products. Since the location of the intensive and extensive margins is a function of the demand for food, the marginal cost of production would alter. Ricardo tried to close this gap by saying demand for food is perfectly inelastic – the limits of one’s stomach. But, for all intents and purposes, this difficulty was ignored (Blaug 1996).

The Policy Implications of Ricardian Theory

A number of economic thinkers called attention to the fact that Ricardo’s theory rests on several critical assumptions (Lackman 1976). These include Richard Jones, Frederic Bastiat, and H. C. Carey. Carey, in particular, pointed out that in a new country with immense areas of unsettled, unexplored land, such as North America, over-population and diminishing returns are inconceivable. Also that in such places, the poorest lands tend to be cultivated first because thin soils need no drainage and less clearing. As population and wealth increases, the better lands are cleared and utilized.

Besides critics, Ricardo’s theory also attracted followers who sought to extend its implications into government policy for redistributing wealth. James Mill was the first to conceive that all future increments to rent from a base year can be taxed away without serious harm, and his son, John Stuart Mill, extended this idea to propose that future increments to rent be taxed by taxing capital gains on land values (Blaug 1996).

The most notorious policy suggestion to arise from Ricardo’s work came from Henry George, who was concerned with the unequal distribution of wealth in society. He

⁹ This was an assumption of economists at the time. However, in practice, how a rent is collected may distort production.

took Mill's idea further and called for the confiscation of all rents by government, claiming it would abolish poverty and that the proceeds from this single tax would defray the entire expense of the state (Aslanbeigui and Wick 2001). The intention was to put all property on equal footing, regardless of its location or fertility. George's ideas were widely misunderstood to represent a complete nationalization of all land, in part from his poor job of explaining and defending them (Blaug 1996). Indeed, the backlash against George helped form the neoclassical school of economic thought.

Other economists, including Leon Walras and Philip H. Wicksteed, favoured land nationalization. Wicksteed wrote to George and said that, though he did not agree with every conclusion in it (such as those regarding the Malthusian population threat as being non-existent), his book had crystallized his thinking and that he would join the "new crusade" (Newton 1971). This was in the early days of the neoclassical revolution and before Wicksteed became a disciple of William Stanley Jevons. Walras wanted to compensate landlords with bonds equal to the current price of the land. Over the course of time, policy ideas such as these died out.

Early Marginalists

J. S. Mill's writing had expanded the theory of land rent to admit the opportunity cost of land, but it was not until the time of Jevons and other early marginalists that rent theory had a major overhaul. Jevons argued that land is a factor of production (with a supply price) like any other input and the return on it cannot be less than what the land could earn in the most remunerative alternate use. Earnings in excess of this opportunity cost constituted rent. From the firm's point of view, rent is determined by the cost of

production and from society's point of view, rent is price determined and may be taxed away without affecting supply (Blaug 1996).

Jevons used the term "transfer earnings" to mean that part of a person's income which would be paid in the next best position. Thus, if a worker's skills are fixed and specific, "transfer earnings" are zero and the whole of their salary is rent. But no agent is ever so completely incapable of adapting to other employment – it depends on the time frame involved. Similarly, in the short run, machines may earn rent, but in the longer run, new machines replace older ones and older ones can often be put to new purposes so rent is eroded away. In practice, it is difficult to distinguish between transfer earnings and rent.

In contrast to Ricardo, Jevons saw sharply competing uses of land and looked at shifting land use between different kinds of crops as well as other uses. While Ricardo was interested in the relation between rural rent and the prosperity of urban classes, Jevons was concerned with rent payments and the supply and price of particular commodities to whomsoever might buy it. He was critical of past thinkers for what he supposed was unclear thinking and one-dimensional assumptions about land's competing uses. For instance, he wrote, "... that able but wrong-headed man, David Ricardo, shunting the car of economic science on to a wrong line – a line, however, on which it was further urged towards confusion by his equally able and wrong-headed admirer, John Stuart Mill" (Buchanan 1929).

Another key early marginalist who wrote extensively on rent theory was the German economist, Johann Heinrich von Thünen. Although Ricardo had recognized that rent accrues to land that is closer to its market due to lower transportation costs, he

devoted most of his thinking to rent emanating from differences in fertility. In contrast, von Thünen started to develop ideas about how various (resource-based) uses of land are possible and how the highest bidder will possess the land in each case. He classified rent at any site as the difference between the value of the marketable product and the production and transportation costs incurred to bring the product to market (Thrall 1987). Due to language and distance barriers, von Thünen's leading work, *Der Isolierte Staat* (The Isolated State), which anticipated not only location theory but also marginal productivity theory, was largely unnoticed (Rima 1991).

John Bates Clark is most famous for his work on marginal productivity theory and the distribution of income. Clark recognized that the marginal productivity theory of distribution is a generalization of Ricardo's theory of rent (Rima 1991). In Ricardo's theory, rent arises (on the intensive margin) from the fact that intramarginal applications of capital and labour to land yield diminishing returns. Inverting the Ricardian analysis so that the input of labour is fixed while land is allowed to vary, Clark showed that one can consider the marginal product of land declining with wages as the residual surplus. Clark, along with Wicksteed (who was working on very similar ideas), concluded that all factors will be compensated at their marginal productivities. Clark also translates this analysis into an ethical argument for a natural law of income distribution: that everyone should receive the value of the resources they create (their marginal product) (Rima 1991).

Alfred Marshall

Marshall's name is most closely associated with the development of a new era in economic thinking (neo-classicism). However, he himself held fast to many classical

ideas, including some relating to rent. He used a parable of meteoric stones to explain his theories regarding rent, quasi-rent and interest.

As an illustration of a pure rent, meteoric stones (which are useful in production) fall from heaven, are easily found in one location and are indestructible. Thus, they are a free gift from nature à la Smith and they are fixed in supply à la Ricardo. The income derived from them is rent in the strictest sense. Like with land in Ricardian rent theories, a uniform tax can be applied on all the alternative uses of the stones which will not affect their allocation among several uses.

Marshall changed some of the assumptions about the stones to explain his concept of quasi-rent. Now the stones are not infinitely long-lived and additional stones can be found if significant search costs are born. Quasi-rent appears as a residual on capital (the stones) because the initial conditions of its acquisition change. The owners suffer a loss if the income expected off the capital declines; it is even possible that they become worthless and the owners do not recover their outlay (search costs). Conversely, if the price rises, the income received from them is a quasi-rent. It is quasi in nature because the supply of stones is not fixed, nor will they last forever (Marshall 1890).

Marshall sought through the use of his meteoric stones thought experiment to reconcile classical theory with neoclassical theory. He succeeds, but his accomplishment rests on several (quite restrictive) assumptions. These are that all landlords must have the same preferences and must all offer their land on the market regardless of prevailing rent levels; that the land's produce must be homogenous or behave as a composite commodity (so that a price change in one crop will not result in the reallocation of land between uses or crops); and that the rental income of landlords cannot affect other market prices (so

that a rent change will not change the price of the produce off the land) (Dooley 1991).

A Potential Reconciliation of Rent Theories

Debates about land rent theory raged from the time of Adam Smith up the early 20th century (Brown 1931; Holland 1930; Sandwell 1928). Even in the 1920s, journal articles and commentaries appeared which quibbled about someone else's "misuse" of land rent theory. Conflicting definitions and emphases hampered the development of theory and the value of the discussion (Bye 1940). In time it became apparent, though, that different writers were thinking about land in different ways. This is clearest when looking at their assumptions about land and its alternative uses. According to Ricardian theory, a landowner must accept whatever rent accrues from one use of the land or else return the land to nature and receive nothing. Later thinkers such as Jevons saw land uses competing with one another. These differences were elucidated by Buchanan in the late 1920s.

Buchanan explains that each rent theorist's position is logical and natural given their historical context. Ricardo's work was generated out of the debates surrounding the Corn Laws when issues of distribution of wealth between social classes dominated the discussion. The central question on his mind was what determined the price of farm output to the urban population and so he considered only rural or agricultural rent. (Urban rents were small at this time and had little to no importance or relation to the Corn Laws. Whereas returns to agriculture were divided up between wages, profits and rents, manufacturing just divided its returns between wages and profits.) For this reason, Ricardo did not consider alternate uses of the land or even alternate crops.

John Stuart Mill lived during a time of transition. He was educated in the Ricardian system and subscribed to it for the majority of his life, but a wider set of influences were at play at this time and new problems and conditions brought new points of view to the forefront. In his heart, Mill was not a political economist at all, but rather a social philosopher (Buchanan 1929). He was not as concerned with the practical problems of his nation (like Ricardo had been) but instead the general welfare of all humankind.

Mill started down the road of looking at non-agricultural rents and said that the output of land must receive its highest return from agriculture (which is akin to opportunity cost) to remain in food production. In doing so, he strayed from the Ricardian position and made rent an expense of production which would affect price. Therefore, Buchanan points out, during his lifetime, Mill discussed rent from the same two points of view that Smith had originally considered it and arrived at Smith's conclusions.

Jevons and later writers lived under different circumstances still and were interested in different aspects of economic study. The Corn Laws had been abolished (1845) and the debate forgotten when Jevons wrote. The dominant problem was no longer balancing landlord incomes and urban incomes (a distribution problem). Buchanan argues that it was impossible for Jevons to appreciate the presuppositions with which Ricardo and Mill had treated rent and price. Jevons was intrigued by the problem that had first moved Smith – the theory of exchange. According to Buchanan's explanation, Smith ought never to have been maligned for his work containing contradictions, but was instead far ahead of his time for recognizing both points of view on land rent.

Twentieth Century Contributions to Rent Theory

Rent theory did not disappear in the flurry of new economic thinking in the 20th century, but it did lose the prominence it once held. Where once the biggest names in political economy had devoted considerable space to discussing and elaborating the theory, it is seldom mentioned in the economic literature today.¹⁰ Articles on rent theory became scarcer and scarcer as the century progressed, with the exception of a brief resurgence of interest surrounding the concept of “rent-seeking” in the 1970s and 1980s. Recently, significant contributions to rent theory have come from, ironically, the area where it was first applied – natural resource and agricultural economics.

One of the most substantive contributions to rent theory in the 20th century came from Robert M. Haig who expanded on von Thünen’s ideas in his 1926 book, *Principles of City Land Values*. Haig focused on the accessibility and location of land and pointed out the strong complementarity of rent and transportation costs. As he termed it, the “friction of space” is overcome by transport and, thus, the optimal site for production is one that balances the level of accessibility with the lowest costs of friction (i.e. transport). Others have commented that though Haig’s theory works well for agriculture and manufacturing, it does not fit as well into retail uses of land (William 1964). Nevertheless, Haig’s work was pivotal and he is credited with starting the field of land economics, which continues to thrive today, though it does not centre on rent.

Articles on rent theory continued to pop up over the next half-century but often were simply commenting on classical theory, for instance, teasing out previous writers’ definitions (Formby 1972). But in 1972, Nobel laureate George J. Stigler wrote his

¹⁰ Rent concepts maintain more of their popularity in European circles.

seminal article on rent-seeking activity. He showed how governments can create rent through their policies and regulations which amount to awarding a monopoly to a fortunate company (Stigler 1971). Where these monopoly rents are possible, firms or industries will lobby to obtain these benefits. This causes losses to society as firms use their resources for no productive gain, and this lobbying will dissipate any rents to be had anyhow. (It will be rational for a firm to spend resources on lobbying up the point where the expected gains from monopoly rents are outweighed by the lobbying costs.)

Following Stigler's lead, for a time many economists such as Gordon Tullock and Richard Posner examined rent-seeking and rent-dissipation activities (Crain and Zardkoochi 1980). But rent theory again died down to a barely audible murmur. It is significant to note that rent-seeking theory does not relate directly to the price of land as rent theory did for the classic economists such as Smith and Ricardo.

Agricultural Rent Re-evaluated

Agriculture and other resource-based uses of land (such as mining) were first used to illustrate rent concepts (and the price of land) and remained the dominant exemplar of rent theory for the first 150 years of its existence. Eventually, agriculture gave way to urban economics and urban uses of rent theory. So it is fitting perhaps that some of the most significant embellishments to rent theory in modern times have come from agricultural economics.

One of the main differences in agricultural economics between now and Ricardo's day is the much larger array of inputs available to enhance production on a piece of land. In the form of capital, there is all manner of soil additives, fertilizers, and pesticides,

machinery for planting, irrigating, and harvesting, and other technological improvements such as genetically-modified crops. Despite this, some essential characteristics of land, such as location, climate and elevation, still relate to land price and thus result in differential rent; this category has been renamed the perdurable component (or pure flow) (van Kooten 1993). It is possible to tax this portion of rent away entirely without distorting incentives.

A second source of rent comes from the conservable flow which is a resource which requires maintenance to remain in its original condition but which is worth the investment because the cost of replacement is greater than the cost of maintenance together with the present value of the future income (which is enabled by those investments). An example of conservable flow is the water table used for irrigation of croplands. The net rent is calculated to be the income attributable to the conservable flow minus the conservation costs. Rent can be taxed away without affecting production decisions, though this is difficult to measure in practice (van Kooten and Folmer 2004).

The final source of modern agricultural rent is called the expendable surplus (van Kooten 1993). This surplus is akin to the perdurable component in that it can be viewed as free gift of nature, but it differs in that the expendable surplus is finite (though usually very large) and it is not economical to replace when depleted. An example is a thick layer of topsoil which can be used for growing sod which is then sold to homeowners, sports facilities and others for grassy surfaces. The production of sod depletes the land of a layer of topsoil for every crop harvested. Rent is defined as the income from the resource minus a depletion charge (the liquidation value when the resource becomes exhausted, discounted to the present), which it is possible to tax.

These sources of rent can be compared to straightforward applications of capital (such as fertilizers) which provide returns to farmers. These returns can not be taxed as if they were rental payments without leading to reduced investments and distorting incentives for input usage.

A problem with discussing the taxation of rent in the modern context is that rent is capitalized into the land values that the current owner has paid, and would result in substantial losses if tax is applied (van Kooten and Folmer 2004). This equity issue arises from the fact that today land tends to change hands relatively frequently compared to Smith and Ricardo's day when land often stayed in wealthy or aristocratic families for generations.

Conclusion

Land rent theory has evolved in fits and starts during its approximately 250-year history. Smith's pioneering work in the 18th century contained two versions of rent theory, though one was largely overlooked until much later. Writers such as Malthus and, most notably, Ricardo expanded and articulated these ideas and helped apply them to economic quandaries of the day. But a generation later, when conditions had changed, writers such as Jevons, who revisited the ideas, were very critical of what they saw as gross misrepresentations and errors in thinking. The confusion and disagreement arose mainly from the fact that they were discussing different questions than their forbearers had addressed. The essential difference is that in one question land has an alternate use and in the other it has none.

The concept of equilibrium is distinct for each of these positions. For Ricardo the

only shifts that happen are on the extensive margins of cultivation. The land on this margin is so poor (either due to fertility or location) that it is just worth it to expend the necessary capital and labour in farming it. For Jevons, the most crucial point was that the margins of cultivation must provide enough returns to reward the owners of labour and capital what they could earn elsewhere (opportunity cost). For von Thünen, who was largely unnoticed by his English contemporaries, location is a primary factor as return will equal the market price less the cost of production and the cost of transportation. He realized the importance of competing land uses and can be said to be the intellectual grandfather of modern land economics. Clark, Wicksteed and other marginalists built upon Ricardo's ideas and generalized rent concepts to conclude that any factor of production will be valued according to its marginal productivity.

Classical economists were interested in rent for two main purposes: explaining land prices and proposing taxation policy. The marginalists drew from the former to explain the level of compensation that all factors of production should receive and so pointed out that the price of land is related to the price of labour or capital. Today, this link between the price of land and its returns has broken down. As will be detailed in the next section, the price of land – especially land near cities – comes from its spatial location and development potential, not its agricultural potential.

Introduction to the Agricultural Land Reserve

As discussed in chapter two, agricultural land in B.C. has been under a special provincial-wide zoning scheme since 1973 when it was realized that approximately 6,000 hectares of farmland was being lost annually to development (Runka 2006). Since

farmland is scarce in the mountainous province of B.C. – only about 3% of land is capable of growing a reasonable range of crops – and since the farmland that does exist is some of the most fertile in Canada and enjoys the most temperate climates, it was decided by the government of the day that subdivision, conversion, and non-farm uses of agricultural land should cease. The Agricultural Land Reserve (ALR) was created to preserve farmland indefinitely and promote agriculture in B.C. The reserve is administered by a politically-appointed commission to hear applications for exclusions and non-farm uses of the land. Land in the ALR is privately-owned but no compensation was paid out at the time of its creation for the loss of property value that land owners suffered when their land was restricted. The ALR in B.C. and agricultural land near the urban fringe in general offers a chance to apply rent theory to illuminate some issues in the contemporary land use debate.

Rent on Agricultural Land Today

Rent in classical thinking was earned by the fortunate landowner whose land enjoyed higher fertility or closer location to market than the most marginal land in production. Because of its higher fertility (which means fewer input costs) and its good location (which means less transportation costs), rent-earning land received its increment based upon the profit garnered from the produce and outputs coming off the land. Thus, rent was a stream of income to be enjoyed as long as the land was producing.

Agricultural land near the large and growing urban areas of Vancouver, Victoria and Kelowna enjoys some benefits from being near a major market but also has additional costs put on it. On the benefit side, having ready access to a market for

traditional distribution techniques (through wholesalers and retail grocery stores) as well as direct farm-marketing (at farmer's markets and on-site sales) mean that farms in the urban fringe experience fewer transportation costs. Another source of rent may accrue from additional sources of farm revenue unavailable to farms farther from the cities such as agri-tourism opportunities like U-pick berry and pumpkin patches, corn mazes, and vineyard wine-tastings and bed-and-breakfasts.

However, agriculture in the urban fringe also suffers negatively from being in close proximity to urban development. Farmland adjacent to residential development is often the source of complaints¹¹ as neighbours are not pleased about the smells and sounds emanating from agricultural activities. The growth of residential developments reduce the profitability of farms by fragmenting the farmland, which increases the perimeter of land that abuts developed land and increases the potential for conflict. Fragmentation also results in successful farmers being unable to expand their operations and take advantage of economies of scale (Brabec and Smith 2002). Hence, being near an urban area comes with benefits as well as costs that add to and reduce agricultural land's rent.

Despite the costs of being near the urban fringe, agricultural land values near the urban fringe have dramatically increased over the past half-century. If the market was left to itself, there is little doubt that a large percentage of the prime farmland near the urban fringe in B.C. would have been converted to other uses because the market value of the land's agricultural potential is swamped by the market value of the land's development potential. It is only when land use is restricted in some way (such as how the ALR zoning

¹¹ Most provinces in Canada and states in the United States have passed "right-to-farm" legislation to prevent municipalities from restricting farm activities through bylaws due to complaints (Gov. B.C. 1996).

restricts it) that it is perhaps possible to see classical rent theories in practice. Research has shown that ALR land in the urban fringe with better soil quality or with agricultural investments made on the land sells for a relatively higher price per hectare than vacant land or land with lesser soil quality (Cotteleer, Stobbe and van Kooten 2008). Since agricultural investments and soil fertility are not related to development potential, farmland clearly displays a rent gradient, capitalized into land values, on these dimensions. So in some limited circumstances, land price may still be related to the cost of production, as envisioned by classical economists in years past.

The spatial distance to the city is another dimension of key interest to classical thinkers and research informs us that land closer to the urban area is more highly valued than land farther away. But this finding may not indicate an agricultural rent gradient because land closer to the city reduces commute time for residents as well as transportation costs for vegetables. One residence is permitted on ALR land and the areas around Victoria and Vancouver have seen a marked increase in the number of hobby farmers over time (Stobbe, Cotteleer and van Kooten 2008). This indicates that land value is driven up by its alternative use as large-lot residential land as opposed to enjoying rent from being near a city.

The capital gains that have flowed to landholders from increases in land value over time do not constitute rent in the classical sense. Rent is only defined as an income flow which accrues to a factor of production. The ALR system does however give a clear view of how unrestricted land will flow to its most valuable use. The opportunity cost facing land which is denied the possibility of conversion is so high, some owners will spend considerable resources trying to have their land removed from the reserve. There is

evidence that developers have bought land on speculation of its removal in the future (Gordon 2006). Neoclassical thinkers who focused on the opportunity cost of land would not be surprised by this trend in ALR land in B.C.

In conclusion, though it is possible to witness agricultural land rents in the world today as envisioned by classical thinkers, farmland values in the urban fringe do not come from differential rents but from the development potential of the land. Policies on capital gains from land values though are similar in some ways to rent. The increase in land value near the ever-expanding urban fringe is indeed an “unearned increment” which is the result of circumstances beyond the control of the agricultural land owner and can be successfully taxed without altering the incentives of the farmer. Indeed, some jurisdictions have used taxation as a way of preventing land conversion by implementing a policy of levying the capital gains in the land’s value if it leaves agricultural use. Thus, the insights gained from classical land rent theory can still applied to agricultural land today.

4. Data and GIS Models

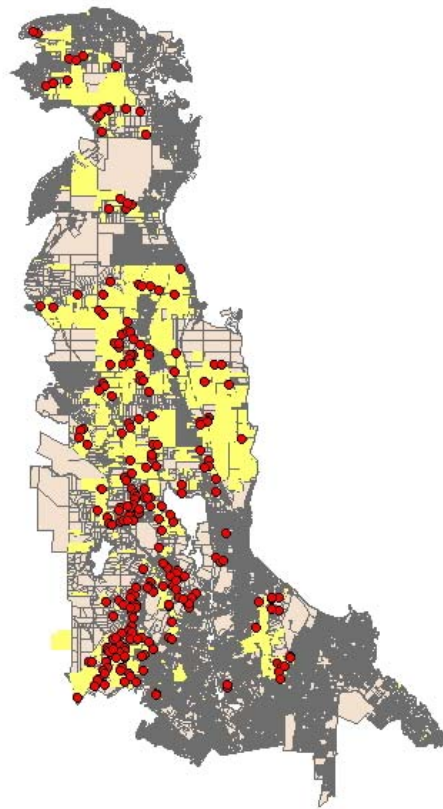
Overview

This dissertation uses a collection of datasets from various levels of government and private sources. These datasets are linked based on several fields and then are analyzed using a GIS (geographic information systems) program to study spatial patterns. Finally, statistical trends are investigated using econometric techniques aided by computer programs. (Econometric methods are discussed in each empirical chapter separately.)

Data Sources

The primary data provider was the government of British Columbia with a few different ministries and agencies within the provincial government supplying different data sets. First, the Ministry of Agriculture and Lands (MAL) provided the Land Use Inventories (LUI) for both the Saanich Peninsula (2004) and Abbotsford (2003). These are parcel-by-parcel inventories which are done on a drive-by basis, which means that the data collectors will record the activities and practices they observe rather than rely on stated information from landowners. (This has both advantages and disadvantages as will be discussed below.) (See Map 4.1)

The LUIs record not just land uses but also the geographical coordinates of the land. On this basis, the information is transformed into spatial cadastral data using a GIS program, supplied to this project as a shape file (a layer). A layer showing the boundaries of the ALR was also supplied by MAL with permission from the ALC (the data's owner).



Map 4.1 Illustration of spatial data in ArcGIS: the Saanich Peninsula with farms (yellow) and hobby farms (red dots)

Another key governmental data source was B.C. Assessment, which is the property assessment authority in the province which determines land and improvement values for taxation purposes. B.C. Assessment evaluates each property annually and calculates increases in value based a host of variables, the most important being the market values in the neighbourhood in the preceding year, the neighbourhood itself, the lot size, the house's size and the effective year/age. (A major renovation will decrease the house's effective age.) B.C. Assessment's determinations, therefore, should be close to market values for houses of average quality for their neighbourhoods, with a six-month lag between when the assessments are done and when they are released to the public.

The main data set directly obtained from B.C. Assessment was a list of properties

with farm class status¹² that were sold from 1974 to 2006 with sales prices and date. This comprised the core of the market data for farmland sales. B.C. Assessment is also responsible for assessment data on residential properties, but uses a private company, LandCor, to handle all inquiries related to this data. LandCor operates a for-profit business by selling this information to real estate agents and people wishing to sell their home. LandCor generously agreed to supply data to this project for research purposes at a reduced rate. Thus, data on residential properties – characteristics, assessment values from 2000 to 2006, and complete sales history with sales prices – was technically from LandCor, although it originated with B.C. Assessment.

One piece of information that B.C. Assessment records is the land's current use, including agricultural use in the case of agricultural land. This field is not meticulously updated though as it does not affect the monetary assessment of the land. Because of this, the MAL data may reflect more current agricultural practices on farmland. The MAL data will be limited by the fact that observers may not accurately code the farm type or may not have full information about farm activities based on one observation.

Another important data provider for this project was the Capital Regional District. They also maintain cadastral data for the Saanich Peninsula as well as many spatial layers of regional geography such as rivers and waterways, parks, and points of interest including schools, golf courses, and recreation centres.

The Agricultural Land Commission provided information on applications for exclusion for both the Saanich Peninsula and Abbotsford for the history of the ALR (up

¹² Farm class status reduces the assessment of the land which reduces the tax bill placed on it by municipalities. In most cases, the land's taxes are reduced to about 15% of their previous level. The threshold for obtaining farm class status is a revenue level that the land generates at least every two years. See the chapter six on hobby farms for more details and discussion of farm class status and its policy implications.

to 2006). The applications were in hardcopy format (in files) which could not leave the ALC's office in Burnaby. This required two trips (one in November 2006 and one in August 2007) to photocopy relevant pages of the applications and then many hours of combing through them and coding to compile the information into a dataset. As this data was still not in a spatial format, many more hours were spent manually creating spatial layers to represent the applications in the Saanich and Abbotsford GISs.

Minor datasets, in the form of elevation layers, were also obtained from the three municipalities on the Saanich Peninsula (Saanich, Central Saanich, and North Saanich). Additionally, data was downloaded from the internet from the Bank of Canada (mortgage rates and interest rates), Statistics Canada (CPI index, GDP, income data, population data, farm census data, and a spatial road network layer) and B.C. Statistics (municipal population data).

In total, more than twenty datasets were used throughout this project from eight different providers. (See Table 4.1) These datasets were compiled and used to construct two separate GIS maps – the Saanich Peninsula and Abbotsford. The Saanich dataset was used in all the empirical studies in this project and the Abbotsford dataset was used in studying the ALC applications.

Data Compilation and Spatial Analysis (GIS)

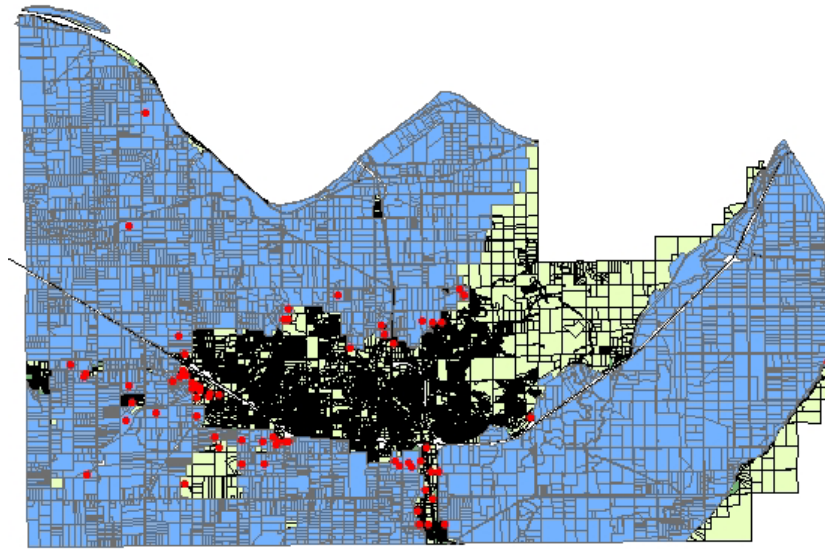
Since half of the datasets were spatial in nature, analysis of them necessitated the use of a spatial analysis program. ArcGIS, an industry-wide standard, was chosen because all the data was already in this program's format. ArcGIS allows layers from different datasets to be linked and overlapped for complex spatial investigations. It also

Table 4.1 Data by Source

Data Source	Data Description
1 Ministry of Agriculture (MAL), Province of B.C.	Land Use Inventories (Saanich 2004, Abbotsford 2003); ALR boundary layer (Saanich 2005)
2 LandCor	Saanich Peninsula property information (residential), sales history, and assessment history (2000 to 2006)
3 BC Assessment	Farmland sales history (Saanich), assessments (Saanich 2006, Abbotsford 2006), actual use codes (agricultural activities)
4 Capital Regional District (CRD)	Cadastral information (2005), water feature layer, park layer, and points of interest layer (schools, recreation centres, etc.)
5 Municipalities (North Saanich, Central Saanich and Saanich)	Elevation data (2005)
6 Statistics Canada	Road network layer (2005), population data (national and provincial) (2006), agricultural census data (national and provincial) (2006), income by municipality (2006), GDP (1973-2007), CPI index (1973-2007)
7 B.C. Statistics	Population (municipal) (1973-2006)
8 Bank of Canada	Mortgage rates and interest rates (1973-2007)

contains many tools and features which proved useful during the analysis for detecting patterns, calculating new variables, and imputing information onto maps. (See Map 4.2)

The first step after collecting the datasets, though, was to link all parcel-level data. This was primarily accomplished through the use of Microsoft Access and ArcGIS. Fortunately, B.C. Assessment assigns each parcel a “jurol” number which most other levels of government also use to identify parcels. This unique jurol, in theory, should have made linking datasets a relatively straightforward task. But in practice it was arduous as many data “gremlins” popped up in the form of missing jurols, multiple jurols for the seemingly same parcel, jurols used multiple times to describe several parcels and jurols with missed digits. ArcGIS helped in this task because sometimes problem parcels could be linked via geographic coordinates, legal description or address.



Map 4.2 The use of GIS to add data to an existing map: Abbotsford with ALR boundary (blue) with ALC applications imputed (red dots)

After linking parcel-level data in Access, the data could be imported into ArcGIS for mapping. At this stage, additional spatial layers were included such as roads, waterways, point of interest and elevations, which are not associated with specific parcels but are necessary for calculating distances. The main rationale for using spatial data is to investigate the effects of proximity to features of interest on land values. In some cases, these were computed as simple distance measures and in other cases, more sophisticated measures were used, such as the Reilly index. (Table 4.2 summarizes all the variables that were created using GIS.)

The Reilly index is based on the idea of gravitation where larger bodies create a large force of attraction and the strength of gravity is inversely related to the distance between bodies. William J. Reilly used it in 1931 when studying retail markets to explain how consumers' travel time is traded off for gaining access to a larger retail base. In this project, the Reilly index is adapted so that both distance to feature of interest (such as a park) and size of the feature is taken into account. The creation of Reilly indices are only

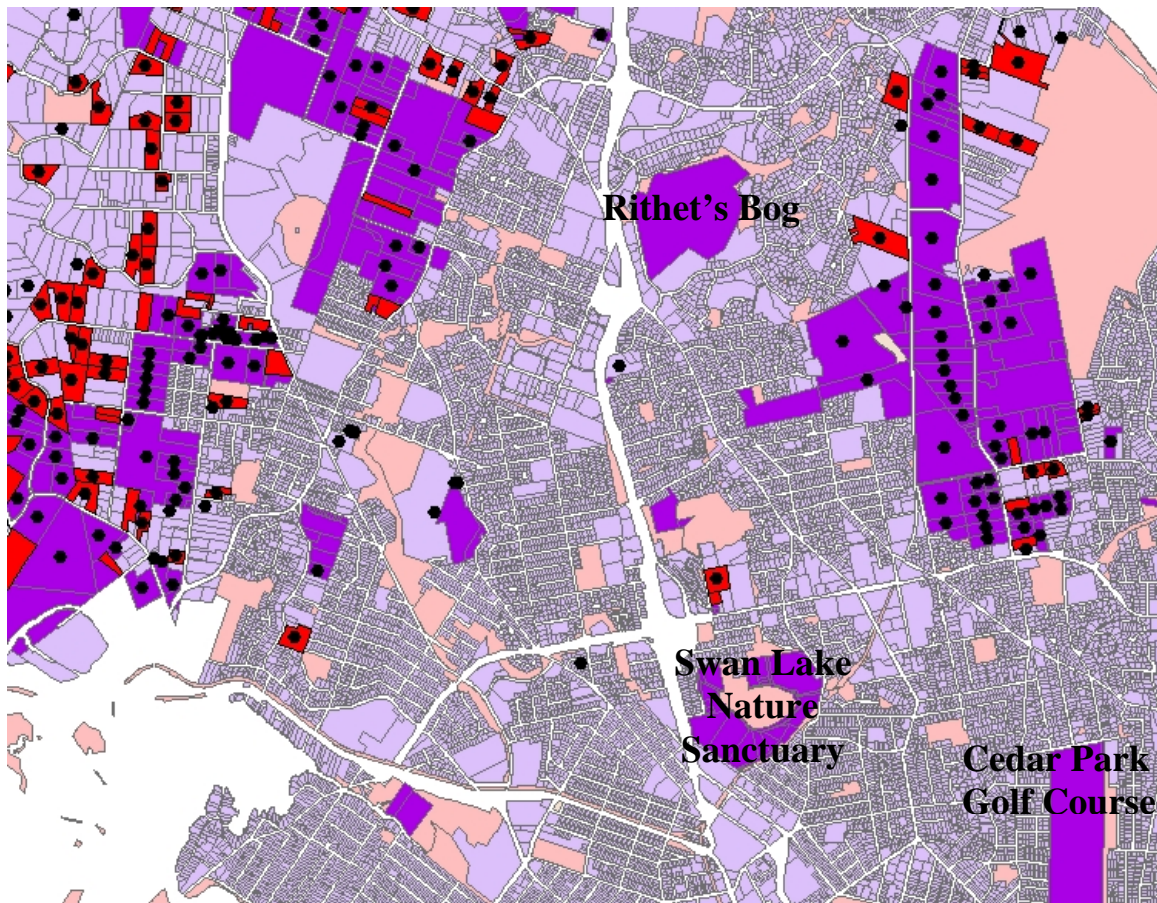
possible with spatial data because they require that the distance to every park, farm and golf course be measured for each parcel. (See Map 4.3)

Table 4.2 Spatial Calculation of Variables in ArcGIS

Variable description	Variable type
Distance from residential parcels to parks (three categories: larger than 50,000 m ² , between 2,000 and 50,000 m ² , and smaller than 2,000 m ²)	Reilly index (3)
Adjacency of park to residential parcel	Dummy
Distance from residential parcels to farms (two categories: those with animal agriculture and those without animal agriculture)	Reilly index (2)
Distance from residential parcels to golf courses	Reilly index
Adjacency of golf courses to residential parcels	Dummy
Distance from farm parcels to the ALR boundary (from within the ALR and from outside the ALR) (m)	Distance measure (2)
Fragmentation index (measure of isolation of farmland parcels)	Index
Distance from all parcels to Ferry terminal (km)	Distance
Distance from all parcels/applications to highway (km)	Distance
Being within a distance of 100 m of highway (buffer)	Dummy
Distance from all parcels/applications to City Hall (km)	Distance
Distance to nearest public school (km)	Distance
Being within a distance of 100 m of school (buffer)	Dummy
Distance to nearest recreation centre (km)	Distance
Being within a distance of 100 m of recreation centre (buffer)	Dummy
Distance from residential parcels to Victoria International Airport (km)	Distance
Maximum elevation of each parcel (m)	Height
Difference of maximum and minimum elevation of each parcel (m)	Height

Another type of variable that was created using the spatial data was the farmland fragmentation index. Two variables were combined in this index (percentage of a farm's edge which borders other farmland, and the size of the total block in which it is part) to give a better indication of how isolated a farm is in the landscape. The creation of this variable required that a buffer be placed around each farm in order to account for roads which traverse the landscape but do not isolate farms.

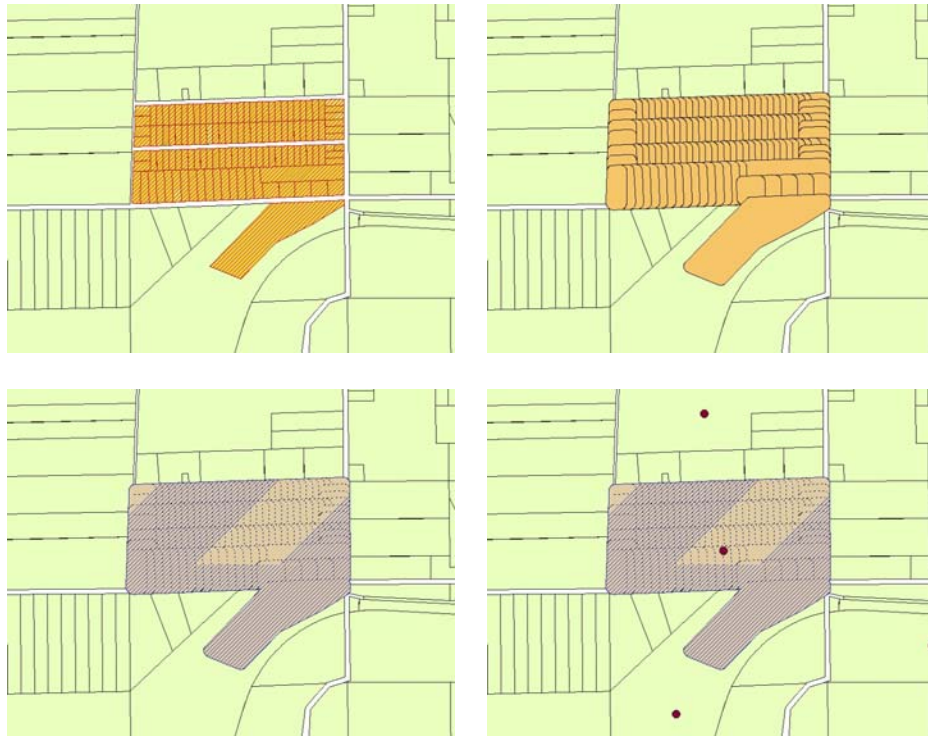
Buffers were also used when creating spatial variables for the ALC applications data. In some case, several parcels (which may be separated by roads) are part of the



Map 4.3 A portion of Saanich showing parks (pink), ALR boundary (purple), farms (dots) and hobby farms (red)

same exclusion application. To study the application as one point, the individual parcels are buffered and dissolved into one layer. (See Map 4.4)

A final way that spatial data played a role in this project was the ability to create variables within a certain distance of a feature. For instance, the effect of the proximity to a highway may be negative within a given buffer but may be positive overall. GIS data allowed these trends to be investigated.



Map 4.4 Buffering. A layer for an ALC application is created in the upper left panel which is comprised of multiple parcels. In the upper right panel, a 25-metre buffer is placed around the parcels to account for the roads which separate the parcels. In the lower left panel, the buffered parcels are dissolved into one layer for analysis of the application. Finally, in the lower right panel, a point tool is used to locate the centre of the new block in order to calculate distances to features of interest.

5. Farmland Preservation Verdicts – Rezoning Agricultural Land in British Columbia¹³

Introduction and Literature Review

Protection of agricultural land near urban areas is a policy goal of many local and provincial/state jurisdictions in North America. Many jurisdictions rely on market-based approaches, such as taxes and subsidies, tradable development rights (TDR), purchase of development rights (PDR) and purchase of conservation easements, but regulation is a frequently used option, particularly in Canada (Barichello, Porter and van Kooten 1995; Hardie, Parks and van Kooten 2004). The goal of preferential land taxes is to make agricultural use of the land relatively more attractive in the hopes of preventing or delaying development, but research indicates that taxation alone is not an effective method of preserving agricultural land (e.g. Anderson 1993; Conklin and Leshner 1977). Taxation distorts property values and subsidizes speculation on farmland (Blewett and Land 1988; Nelson 1992), allowing farmers to hold out for the highest price. While tax policies might increase net farm revenue, they do not encourage farmers to make their land more productive. Indeed, Plantinga and Miller (2001) conclude that the only way to fully deter farmland loss is to compensate landowners for foregone development returns.

To this end, TDR and PDR programs have been applied successfully in some areas to protect agricultural land (Brabec and Smith 2002). However, Nickerson and Lynch (2001) found no impact on farmland prices from a PDR program in Maryland.

¹³ This chapter is based on a paper by Tracy Stobbe, Alison J. Eagle, Geerte Cotteleer and G. Cornelis van Kooten submitted for possible publication in *Canadian Public Policy*.

This was likely due to the possibility of removing land from the program after 25 years, if the land can be shown to be unprofitable for agriculture at that time. Therefore, buyers may be willing to pay more than would be justified by agricultural returns alone. Nelson (1992) argues that while PDR and TDR programs may preserve open space, they do not necessarily protect an active farming economy due to voluntary or random application of the programs, speculation on the land, and attractiveness of the farms to rural-estate holders.

Zoning for exclusive agricultural use should, in theory, reduce land values so that they reflect the agricultural potential of land rather than its development potential. Zoning should have a negative effect on land prices since the permissible uses of the land are restricted; many studies have concluded that zoning rules become capitalized into land prices (Henneberry and Barrows 1990). In general, when land use is restricted near cities, land values are lower than for similar parcels without restrictions. Exclusive farm-use districts were established in Oregon in 1973, where all development must be proven to improve agricultural production. Not surprisingly, building density twenty years later was significantly reduced inside the farmland zone (Kline 2005).

A drawback of zoning is that it creates an incentive to lobby the authority for exclusions and variances to the zoning regulations (Blewett and Land 1988). Speculation on land that developers believe has a high probability of being excluded can increase farmland values well beyond the agricultural returns from the land, thus undermining one of the main reasons for zoning – to keep agricultural land prices low for farmers.

Providing more insight into the effectiveness of different conservation methods, researchers have also looked at factors that predict conversion of farmland to residential

and other non-farm uses. If farm characteristics are shown to be the most important factor, this means farm profitability plays a large role in land-use and land-use change. Higher soil quality and other agronomic characteristics corresponded with lower rates of land conversion into acreages for large lot development near cities in Nebraska (Drozd and Johnson 2004). Using country-wide data, Tweeten (1998) found that farm income and farm population were more significant factors than urban population in predicting changes in cropland area from 1949 to 1992.

Using a probit model, Isgin and Forster (2006) identified several factors that were significantly correlated with rural-to-urban land conversion in Ohio. Farmland conversion was more likely with a greater proportion of the population living in urban areas, larger county size (area), higher median family income, and greater observed per-acre land prices; but the likelihood of conversion declined when a higher proportion of the county was classified as farmland. These and other studies (e.g. Shi, Phipps and Colyer 1997) confirm the intuition that there are strong effects of the local urban economy on the rural land market and that population pressure partly drives farmland conversion.

Research has focused primarily on the creation of agricultural zones and the land to be included in protection schemes, with very little reference to exclusions of land from agricultural protection. Since most North American agricultural zoning has been in place for less than 35 years (those in Oregon and BC were among the first in 1973), the removal of land from exclusively agricultural zones as local conditions changed has not been common, but has also not been studied to any extent. Yet, the need on occasion to remove land from agricultural protection has been acknowledged by Libby and Sharp (2003), for example, who consider the value of social capital in maintaining a sense of

fairness in rezoning decisions. To our knowledge, no one has yet examined the factors that impact outcomes of proposed exclusions.

In particular, there has been very little if any statistical and academic analysis related to zoning systems such as the Agricultural Land Reserve (ALR) in British Columbia. Most of the literature concerning agricultural zoning in British Columbia is of a legal, political or advocacy nature. For instance, Green (2006) examined BC's ALR and, in particular, focused on four specific exclusions that happened in 2004 and 2005, concluding that the current structure of decision-making regarding agricultural land was flawed and thus calling for a provincial inquiry to examine it. According to Green, the zoning body approved 70.5% of the hectares that were proposed for exclusion between April 2002 and March 2005, and that ALR exclusion rates have increased over time. In one of the few academic journal articles written about BC's agricultural zoning, Hanna (1997) found that public applications are approved at a much higher rate (88%) than private ones (30%), although the primary focus of this study was on economic incentives and compensation issues rather than statistical analysis. The current study constitutes the only known statistical analysis of agricultural zoning in British Columbia, and thereby makes an essential empirical contribution to contrast the politics, lobbying and rhetoric that have occupied the center stage of agricultural land preservation in the province.

In this study, we examine zoning decisions in the urban fringe and the factors that impact decisions to change land zoning from agriculture to other uses. We incorporate factors such as the political party in power, whether an application for exclusion has municipal support, and reasons for the exclusion application. We employ a Geographic Information System (GIS) to assess spatial characteristics for 81 exclusion applications at

the urban-rural fringe over a period of 33 years in two provincial jurisdictions.

Study Area and Background

As discussed in chapter two, British Columbia's Agricultural Land Reserve (ALR) was established in 1973 under the New Democratic Party that then governed the province. The main impetus for its inception was the growing concern over urban sprawl and the associated loss of farmland near cities. It was estimated that BC was losing 4,000 to 6,000 hectares of farmland annually (Garrish 2003). Assuming that all of this land was in crops, the loss accounted for 0.9 to 1.4% of BC's total cropland (1971 Census of Agriculture), similar to estimated losses in the Northeast region of the USA (0.98% annual loss), but higher than country-wide USA estimates of losses to urbanization (0.16% annual loss) (Dideriksen 1976).

In its early years, the Agricultural Land Commission's (ALC) main function was that of fine-tuning the set of parcels included in the ALR. Since then the administration of the ALR has changed, as has the size and composition of some of the lands in the ALR. The most profound change was likely the move in 2002 from a single province-wide commission comprised of at least seven members to an ALC consisting of six regional panels of three members each.

At the time of its formation, the ALR included 4,716,516 hectares, but it had grown to 4,759,235 ha by 2007, a net increase of 42,720 hectares. (ALC 2008) Critics assert that these figures belie the true state of agricultural protection, however, since most of the land excluded over time has come from the fertile south while additions have been primarily in the colder, more arid and less productive northeast. The current ALC has

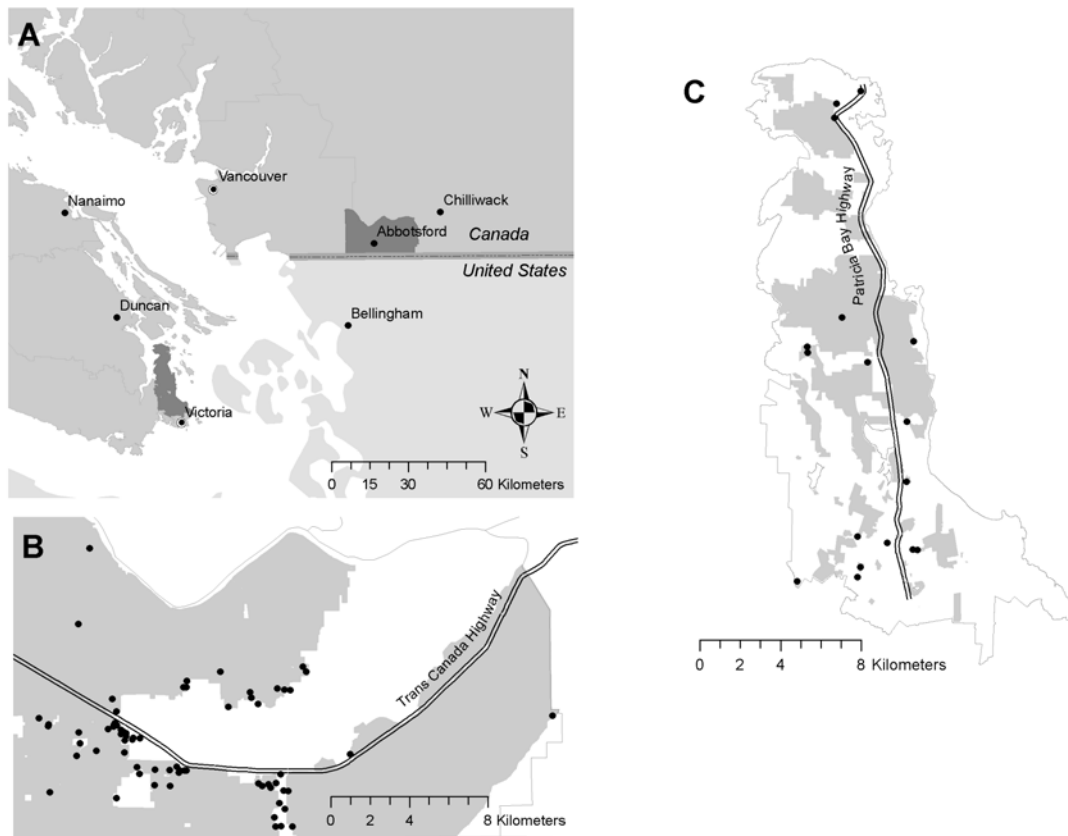
been accused of allowing the removal of too much high quality land from the ALR in the recent past (Green 2006). Other critics argue that not enough land is being let out and that housing prices in Vancouver and other urban areas are inflated due to the lack of land for new housing (Lazaruk 2008).

In this paper, we examine ALR exclusion information from two agricultural regions near significant urban centres – Greater Vancouver and Victoria. Both Abbotsford, in the Fraser Valley, and the Saanich peninsula, on Vancouver Island, enjoy some of Canada's mildest temperatures and most fertile soils. Farmers in the Abbotsford region grow a variety of field crops and there is intensive livestock production, but the region is perhaps best known for its berry production, particularly raspberries, blueberries and cranberries. The Saanich peninsula hosts many floriculture and nursery businesses as well as livestock, field crops and specialty crops such as wine grapes. Both face mounting developmental pressures from the nearby expanding urban centers of Vancouver and Victoria, respectively.

Data and Methods

Data for this inquiry were obtained from the Agricultural Land Commission's files and entered manually into a GIS database. The data comprise all applications for exclusion from the ALR on the Saanich peninsula and in the Abbotsford municipality from 1973 to 2006. The Saanich peninsula data include applications from three municipalities (Saanich, Central Saanich and North Saanich). There were 65 applications for exclusions in Abbotsford and 16 for the Saanich peninsula. (Map 5.1) While most applications were treated as individual observations, three applications (one from the

Saanich peninsula and two from Abbotsford) were split into 12 separate observations for this study, because they consisted of spatially separate distinct blocks that were ruled on separately by the ALC. Hence, we have a total of 90 observations.



Map 5.1 Southwestern British Columbia with highlighted study areas (A), the City of Abbotsford (B), and the Saanich peninsula (C). The Agricultural Land Reserve (ALR) is indicated by the shaded area on regional maps, and ALR exclusion applications are shown as dots. (Source: Ministry of Agriculture and Lands and the Agricultural Land Commission, edited map)

A list of variables included in the dataset is provided in Table 5.1, along with summary statistics. The ALC permitted partial or total exclusion of farmland from the ALR for 60 observations, while denying 30 applications. Of the 60 parcels granted some form of exclusion, the average parcel size was substantially smaller than in the case of

applications that were denied – respective parcel means of 14.02 ha and 30.55 ha. Since the support of local government for applications fell into three categories (local government supports the application, local government does not support the application, and no information was given), an explanatory variable was constructed where local support equalled 1, local opposition equalled –1 and no information was coded as 0. Applications are coded by the ALC as being public or private depending on if they come

Table 5.1 Explanatory Variables and Summary Statistics

Continuous Variables	Mean	Standard Deviation	Minimum	Maximum
Requested Area (ha)	19.53	31.47	0.2	182.2
Requested Area as Percentage of Total (%)	86.3	27.37	4.6	100
Total Size of Parcel (ha)	31.44	80.22	0.2	519
<i>Soil (Classes 1 to 7) combined</i>	2.76	1.07	1	6.35
Abbotsford	2.68	1.30	1	5.4
Saanich peninsula	3.07	1.49	2	6.35
Year	1990	11.14 yrs	1974	2006
Distance to Highway (m)	1,834.52	1,576.44	59.4	6,759.38
Distance to (relevant) City Hall (m)	6,368.39	5,464.50	2,039.85	28,791
Annual Provincial Population Growth (%)	2.10	0.80	0.83	3.42
Other Variables	Number of Observations (n=90)	Mean Requested ha		
Public Applications	28	48.75		
Private Applications	62	6.33		
Support of Local Government	68	16.03		
Opposition of Local Government	9	10.64		
<i>Intended Uses</i>				
Industrial	33	23.09		
Residential	41	21.18		
Commercial	6	2.21		
Other	10	11.43		
Abbotsford Applications	73	20.95		
Saanich peninsula Applications	17	10.63		

from an individual or from a local government (often as part of a long-term planning exercise).

The distance variables examined in this study were constructed with ArcGIS using data provided by the B.C. Ministry of Agriculture and Lands in their Land Use Inventory for Abbotsford and the Saanich peninsula. This parcel-level dataset was overlaid with additional GIS datasets from the Federal Government showing the road and highway networks. Following common practice (Cho, Bowker and Park 2006), distances were transformed to log distances to reduce potential distortion from significant outliers.

Not all variables are available for all observations. For instance, in earlier applications (pre-1983), information about soil quality was rarely provided in the application. While Canada Land Inventory (CLI) classification maps exist for the regions, the scale available is not sufficiently detailed to allow for parcel-specific analysis. Because each parcel consisted of different proportions of varying soil classifications, a soil index was calculated for applications that contained soil data (using a simple weighted average). With the Saanich peninsula and Abbotsford treated separately, the mean soil index score for parcels in each area was then imputed for the 32 applications missing this information.

The data for the variable which indicates support of the local government (and presumably the majority of the people living in the area) was also not complete. In 68 of the applications the ALC file recorded local government support and in 9 cases, opposition was noted, leaving 13 applications with no information on this variable. The data was coded to reflect this gap with a dummy variable assigned a score of -1 if there was local government opposition, 0 if there was no information, and 1 if the local

government supported the application.

A logistical binary (logit) model is utilized in the analysis, with the dependent variable taking on a value of 0 if the application was refused and 1 if the application was fully or partially approved. Using the logistical distributional function, we can write the probability of an application's success as:

$$P_i = E(Y = 1 | X_i) = \frac{1}{1 + e^{-(\beta_1 + \beta_2 X_i)}},$$

where β_1 represents the coefficient on an intercept term and β_2 represents a vector of coefficients on the vector of regressors, X . Using maximum likelihood procedures, the coefficients can be estimated and probabilities calculated for the significance of the explanatory variables on the acceptance rates of the dependent variable (Gujarati 1995).

Empirical Results

The final logit regression models were selected on the basis of both theoretical considerations and statistical fit. Several variables were eliminated from the model for various reasons. For instance, total parcel size was removed because it was highly correlated with hectares requested for removal. Soil classification was dropped from the models because results were statistically insignificant in all cases (likely because average soil class was employed for 32 observations). Distance to city hall was also dropped because it was highly insignificant in every case, perhaps due to modern Abbotsford being a conglomeration of three historically separate entities (Abbotsford, Matsqui and Clearbrook), each with its own town center. Hence, distance to the current city hall is not a good measure of the distance to the commercial centre.

Table 5.2 Logit Model Estimation Results (n=90); Coefficient shown (with p-value in parentheses).

Variables	Full model	Time trend, lags	Time trend, no lags	No time trend
Requested hectares	-0.017 (0.244)	-0.016 (0.248)	-0.015 (0.270)	-0.017 (0.189)
Percentage of total parcel that is part of application	-0.029** (0.039)	-0.028** (0.039)	-0.028** (0.039)	-0.029** (0.027)
Location (0 Abbotsford, 1 Saanich peninsula)	3.263* (0.090)	0.741 (0.466)	0.831 (0.402)	0.928 (0.341)
Applicant (0 public, 1 private)	1.379 (0.238)	1.850* (0.100)	1.878* (0.090)	1.491 (0.156)
Log of distance to highway	-1.127** (0.012)	-1.174*** (0.006)	-1.176*** (0.006)	-1.177*** (0.005)
Political party – Social Credit dummy (0 no, 1 yes)	1.824* (0.062)	2.094** (0.030)	2.202** (0.020)	1.668** (0.042)
Political party – Liberal dummy (0 no, 1 yes)	1.116 (0.423)	0.022 (0.985)	0.296 (0.780)	1.113 (0.202)
Support of local government (-1 no, 0 other, 1 yes)	.476 (0.354)	0.499 (0.330)	0.514 (0.315)	0.540 (0.267)
Commercial intended land use dummy (0 no, 1 yes)	-1.492 (0.378)	-2.407 (0.110)	-2.512* (0.093)	-2.278 (0.126)
Residential intended land use dummy (0 no, 1 yes)	0.650 (0.546)	0.352 (0.731)	0.248 (0.802)	-0.240 (0.803)
Industrial intended land use dummy (0 no, 1 yes)	1.983 (0.114)	1.710 (0.148)	1.587 (0.163)	1.132 (0.299)
Year	0.165** (0.033)	0.066 (0.134)	0.059 (0.158)	
Lag of excluded hectares (sum of previous two years)	0.0001 (0.993)	0.006 (0.606)		
Population growth rate	1.031 ⁺ (0.109)			
Constant	1.821 (0.733)	7.918** (0.042)	8.140** (0.035)	9.798*** (0.008)
Pseudo R ²	0.373	0.346	0.344	0.325

Note: ***, **, and * indicates statistical significance at the 0.01, 0.05 and 0.1 levels respectively, ⁺ indicates borderline statistical significance

Four model specifications are presented in Table 5.2. The full model includes factors relating to various hypotheses affecting ALR exclusions. Political party was included to test whether the government in power at the time impacted approval rates (as suggested by numerous pundits). A time dimension is included to determine if the rate of approval of applications increases over time. Lag of excluded hectares records the number of hectares excluded in the previous two years – the historical memory. It was hypothesized that, because of the nature of ALC board membership, a succession of successful applications might lead to more success because the ALC may be more inclined to favour development. Lastly, regional population growth rate is included, measured as a five-year moving average, as an indicator of demand for new housing and increased development pressure. Several restricted models were also tested and are presented in Table 5.2.

The first finding is that the size of the application (number of ha requested for exclusion) does not seem to impact on an application's chance of approval. This variable is not significant in any model specification, however the proportion of the parcel that is part of the application is quite statistically significant in every model. Applications comprising the entire parcel, or very large proportions thereof, are rejected more often than applications requesting the removal of a small portion of the parcel.

Although the success rates of private and public applications appear to be similar – 69.4% acceptance rate for private applications and 60.7% for applications by the municipality – in two of the four models, private applications have statistically significant higher rate of success than public ones, *ceteris paribus*. This contradicts findings in Hanna (1997) who used summary statistics to find that public applications were more readily approved, although he included information from the entire

province and not just two areas. A further difference is that Hanna used data for 1973-1993 whereas the current investigation has an additional 13 years of data (up to 2006).

The most significant variable in all of the models is distance to the main commuting corridor. In the case of the Saanich peninsula, this is the Patricia Bay Highway and for Abbotsford it is the TransCanada Highway. Applications to exclude parcels farther from the highway had a significantly reduced chance of acceptance.

Another significant finding relates to the political party in power. The New Democratic Party (NDP) founded the ALR in 1973, but soon thereafter lost power to the Social Credit (Socred) party, which governed the province between 1975 and 1986. The NDP again formed the government from 1986 to 2001 at which time the Liberals came to power. The dummy variable representing the period that the Socred party was in government is statistically significant in all of the four models, indicating that the chance an ALR application was approved under the Socred party was significantly greater than under any other party. However, when population growth is taken into account in the full model, the significance of the party variable is reduced. That indicates that exclusions permitted by the ALC during the time the Socreds were in government is likely influenced by the elevated demand for residential development caused by high rates of population growth. A further anomaly to mention in regard to political party is that two years (1975 and 2005) had abnormally high numbers of applications. When the full model is run without those two years, Socred becomes insignificant.

Whether or not an application had the support of the local government appears to have minimal impact on the likelihood of the application receiving approval. This variable is statistically insignificant in two of the four models and only moderately significant in the others. The fact that local government support does not appear to be

pivotal may be seen as contrary to the ALC's stated goal of conducting land use planning in conjunction with local governments (Green 2006; ALC 2008b). It could indicate that the considerable time and effort spent by local government to make a decision about whether to support an application is inefficient and the time and money spent on holding public hearings and council meetings on the topic is better allocated elsewhere. It could also be that local governments only get involved when there is significant public controversy over a proposal; our current data set does not record any information about the amount or degree of local government involvement before declaring support or non-support of an application to the ALC.

Intended use forms another category of variables analysed. To avoid perfect multicollinearity in the data, the dummy on the 'other' category was integrated into the intercept term. (The 'other' category contained several applications from a university-college wishing to expand and applications for transportation infrastructure expansion.) The negative coefficient on commercial use indicates that this intended land use is associated with lower levels of approvals, whereas the positive coefficients on residential and industrial use suggests that these land uses are associated with a higher likelihood of approval compared to other uses. In particular, we can say that commercial land uses are approved at significantly lower rates in the model without lags than other types of applications.

It is interesting to note that in the full model data on the population growth in the respective regions was included and while this variable was only borderline significant, its inclusion caused both the location variable and the year time trend to be statistically significant factors.

The marginal effects (evaluated at the mean) were calculated for the significant variables from the full model. (Table 5.3) A marginal effect can be

interpreted as the change in the probability of an application being accepted by a change in the variable of one unit or a dummy variable flipping categories. Table 5.3 indicates that the probability of acceptance decreases 0.47% for each additional percentage of the total parcel that is included in the application. Being located on the Saanich peninsula increases the chances of acceptance by 29.9%. The distance to the highway has a major effect on the probability of exclusion. Evaluated at the mean, there is a 18% reduced likelihood of acceptance by increasing the distance one unit. Since this variable is a log of distance, this means that increasing distance from the highway from 1,149 metres (the mean of the log) to 3,123 metres is associated with 18% less chance of the application being approved.

Overall, an application's chances fare better under the Socreds (25.5% more likely to be accepted). Year also seems to play a part as each year that passes increases an application's chances by 2.6%. Finally, the regional growth rate marginal effect shows that when the population is growing 1% faster, an application is 16.5% more likely to be accepted.

Next marginal effects were computed for two additional distinctions in the data – public vs. private applications and applications in Abbotsford vs. the Saanich peninsula. First, the marginal effects for different application types show that the effect of almost every variable is more pronounced for public applications than private. The acceptance rate for public applications seems to be more sensitive to location, distance to highway, political party, year and population growth rate. Similarly, the marginal effects for different locations show that Abbotsford applications seem to be more sensitive to the significant variables.

Table 5.3 Marginal effects of significant variables from the full model

Variable	Marginal effect	Marginal effects for public applications	Marginal effects for private applications	Marginal effects for Abbotsford applications	Marginal effect for Saanich peninsula applications
Percentage of total parcel that is part of application	-0.0047	-0.0070	-0.0035	-0.0063	-0.0005
Location (0 Abbotsford 1 Saanich peninsula)	0.2992	0.5012	0.2204		
Log of distance to highway	-0.1804	-0.2687	-0.1358	-0.2438	-0.0193
Political party - Socred	0.2551	0.3888	0.1925	0.3476	0.0279
Year	0.0264	0.0393	0.0198	0.0356	0.0028
Population growth rate	0.1651	0.2459	0.1243	0.2231	0.0177

Policy Implications and Conclusions

The findings raise some interesting policy issues. First, land that is highly accessible to a major commuting route (i.e., is near a major highway) is more likely to be excluded from the ALR. This correlates with the finding by Stobbe, Cotteleer and van Kooten (2008) that distance to a highway is a significant factor in distinguishing between whether a farm is used for hobby purposes or for conventional agricultural production. Hobby farmers in the ALR appear to locate either close to a highway or much farther from it, indicating that hobby farmers fall into one of two groups: commuting and non-commuting. The growth of hobby farms indicates increasing fragmentation of farmland and increasing encroachment of the urban residents onto rural land. Thus, it is not surprising to learn from the current study that farmland near

highways is excluded from the ALR at a higher rate than land farther away. This finding has an important policy implication: In locating future roads, the government needs to take into account the potential impact this has on the likely conversion of prime farmland.

An application for exclusion is more likely to succeed if it is intended for non-commercial use, is located near to the highway and pertains to only a portion of the parcel to which it belongs. It is interesting to note that in the full model, year is quite significant. According to this finding, applications do have a significantly higher chance of being approved in later years than in earlier years, though the actual magnitude of probability change involved may be small (as illustrated by the small coefficient on year).

The variable on the political parties is interesting because many critics of the current ALC state that the Liberal government (which has been in power since 2001 and is responsible for the major restructuring of the ALC into regional panels) has been subtly dismantling the ALR (Campbell 2006; Green 2006). The coefficient on Liberals however was highly insignificant in all permutations, indicating that land was no more likely to be excluded in our study under the Liberals as than under the NDP. The founders of the ALR, the NDP, are a left-of-centre party on the political spectrum while the Social Credit party was right-of-centre. (In recent times, the Liberals have replaced the Social Credit party as the right-of-centre party.) So it is fascinating that the dummy for the Social Credit party was significant in all four models but the dummy for the Liberals in power was not. While it is certainly possible that the current ALC's critics are mistaken, our study cannot conclusively determine that. We can say that the panels which decide applications in our study area (the Island Panel and South Coastal Panel) have not been approving applications at a greater rate in our

study area under the Liberals than under the NDP. Our findings cannot speak to other areas of the province and further research would need to be conducted to determine if there is a province-wide effect.

6. Hobby Farms and Protection of Farmland in British Columbia¹⁴

Introduction

Zoning is the most widely used instrument for protecting agricultural land from development. One of the downsides of zoning is that it creates an incentive for landowners to lobby for variances so they can transfer land from lower-valued agricultural uses to more valuable ones. In jurisdictions where the probability of being granted an exclusion is high enough, those wishing to develop the land or change land uses have bid up the price of farmland beyond its agricultural value. In B.C., the primary policy response to speculation has been to provide landowners with tax breaks (farmland is taxed at much lower rates than developed land) to encourage retention of land in active agriculture. But this creates a whole other set of incentives, especially near the urban fringe.

The relatively lower tax burden placed on farmland has been partially responsible for the growing number of hobby farms and large rural estates in the urban fringe. In some jurisdictions, the threshold for qualifying for preferential taxation rates is set deliberately low to make agriculture an attractive land use, although this has the unintended consequence of subsidizing wealthy landowners pursuing a rural lifestyle in proximity to the urban area (Cotteleer, Stobbe and van Kooten 2008). Given that property taxes account for about 40 per cent of municipal budgets in B.C., residents might not support tax regulations that favour hobby farmers. Nickerson and Lynch (2001) indicate that residents dislike the fact that tax

¹⁴ This chapter is based on a paper by Tracy Stobbe, Alison J. Eagle and G. Cornelis van Kooten presented at the Canadian Economics Association Annual Meeting (June 2008) and is closely related to a paper by Tracy Stobbe, Geerte Cotteleer and G. Cornelis van Kooten submitted for possible publication in the *Canadian Journal of Regional Science*.

dollars are spent on hobby farmers who do not use the land in pursuit of 'traditional' agricultural activities that provide food for citizens.

When surveyed, B.C. residents show strong support for agricultural land protection; for instance, in 1997, 90 per cent said they favoured limits to urban development to protect farmland (Quayle 1998) and, in 2005, 94 per cent of Central Saanich residents said they felt agriculture contributed greatly to the community (Walker 2005). However, researchers and policy-makers alike should question why so many people favor protection of agricultural land as a matter of principle. If the purpose of agricultural land protection is to slow development and retain open space the expansion of hobby farming might be a positive development, as long as hobby farms are not a first step in the direction of eventual conversion to urban use. If, on the other hand, the purpose of the ALR is to help support a viable farm economy, growth in hobby farming could be considered a step in the wrong direction as it could exert pressure on farmland values within the ALR thereby driving out conventional farmers.

In this research, we study the pattern of hobby farm placement within and in close proximity to the ALR and question whether or not the establishment of hobby farms is detrimental to the goal of agricultural land preservation. We first identify those property characteristics generally preferred by hobby farmers and then ask what implications this has for the effectiveness of the ALR and other policy measures to protect agriculture in the urban fringe. We employ two models to investigate the divergence between conventional and hobby farmers. First, a binary choice model is used to determine differences between the characteristics of properties used by conventional versus hobby farmers. Second, the hedonic pricing model employed by Cotteleer, Stobbe and van Kooten (2008) is extended to allow for divergence between

the two farming types.

The outline of the remainder of the paper is as follows. In the next section, we consider why government intervention is needed to protect farmland and what form public policies might take. In the following section, we provide background information about B.C., the ALR and other policy measures that are in place to preserve agricultural land. The data are discussed in the next section, and the regression models and estimation results are subsequently provided. The conclusions follow in the final section.

Government interference and externalities at the urban-rural fringe

Legislation, policies and other instruments to protect farmland are justified on the grounds that such protection is a public good, with farmland being underprovided if left to markets and private individuals. The main output from farmland is marketable goods, but farmland also provides a variety of positive ‘spillovers’. One might identify four types of value associated with agricultural land protection (Kline and Wichelns 1996): (i) agrarian values relate to food production and protection of the agricultural heritage and traditions of an area; (ii) environmental values concern protection of wildlife habitat, flood prevention and other environmental services; (iii) aesthetic values focus on the preservation of open space; and (iv) anti-growth values see land protection as a safeguard against urban sprawl. Roe, Irwin and Morrow-Jones (2004), Irwin (2002), Curran (2001), and others have shown that citizens are willing to pay significant amounts to protect these amenities.

While positive externalities can be used to justify zoning and other legislation to protect farmland (such as beneficial tax regimes for agricultural producers), it is more difficult to justify protecting agricultural land because society needs to retain the

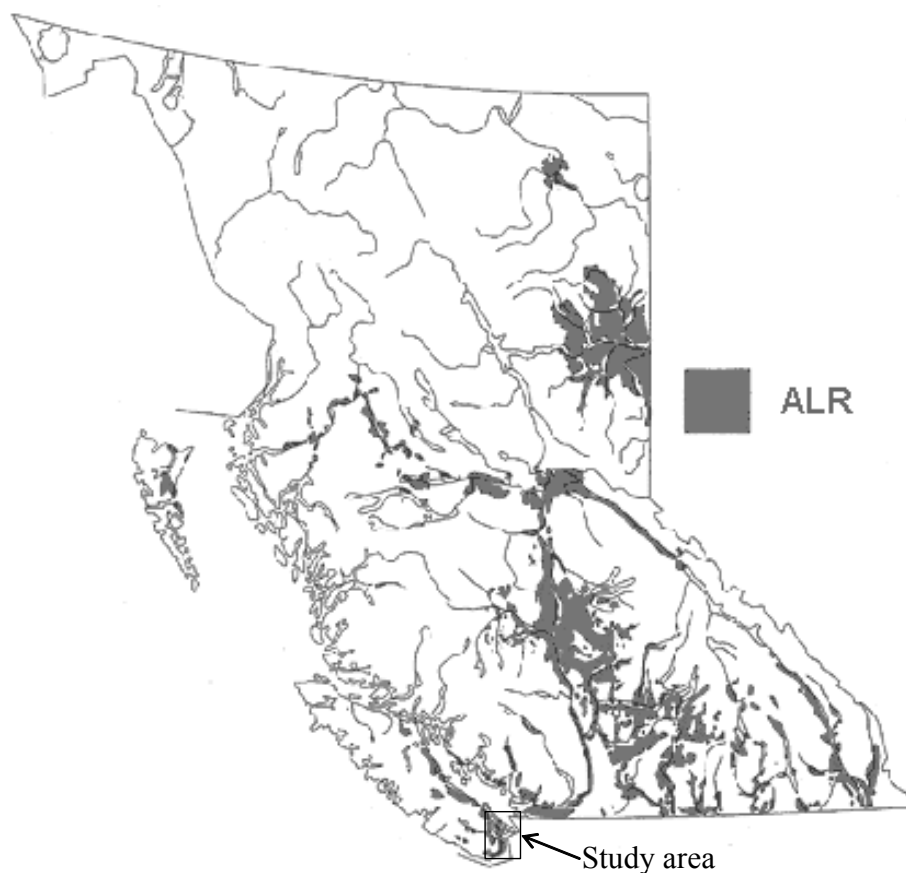
ability to produce farm products in the future (though many make this argument). For example, in a study completed for the provincial government, Quayle (1998) concludes that agricultural land should be preserved at all costs and that golf course development should not be permitted because it violates the ALR mandate. She argues that the magnitude and importance of the province's agricultural sector represent a sufficient reason to preserve all farmland via the ALR instrument.

Protection of agricultural land for the purpose of maintaining future agricultural production potential cannot be viewed as a public good because, if this is indeed a concern, the value of land in agriculture would rise relative to that in other uses in anticipation, thereby causing more agricultural land to be protected privately. Although agricultural production is important in some jurisdictions, especially where food security is a concern, the impetus for protecting farmland in B.C.'s urban fringe has more to do with a desire to protect a way of life, open space, access to farms for educational purposes, and other factors.

Agricultural Land Protection in British Columbia

British Columbia is Canada's westernmost province. It is characterized by rugged terrain, fertile valleys and, in some areas, the country's mildest climates. Its arable regions include part of Canada's grain belt (in the northeast), an intermountain region of livestock grazing and forage production, a Mediterranean inland lake region (the Okanagan Valley) noted for its orchards and vineyards, and wet mild areas in the southwest of the province. The latter consists primarily of the Fraser Valley on the mainland (near Vancouver) and the Saanich Peninsula near Victoria on southern Vancouver Island that offers a climate capable of growing the widest variety of crops in Canada. The ALR is shown in Map 6.1.

According to Statistics Canada's (2006) Agricultural Census, the number of farms in B.C. has increased by 7.8 per cent since 1971 – a trend opposite that of the rest of Canada, although some turnaround in this trend was seen in the last agricultural census.¹⁵ This suggests that farms are being subdivided to the extent allowed by the ALC, which is consistent with the observation that more hobby farms are found near major urban areas. As a result, the increase in farms is not necessarily an indication that the farm sector is thriving, but rather that it is dwindling, especially near urban centers.



Map 6.1 B.C.'s ALR and the study area (Source: SmartGrowthBC 2004, edited map)

¹⁵ The number of farms in B.C. declined by 2.2 per cent between 2001 and 2006, while the number of farms in Canada declined by 7.2 per cent during the same period, and by 37.3 per cent since 1971 (Statistics Canada 1971, 2001, 2006). So clearly B.C. farms are being lost or amalgamated at a slower rate than the rest of the country.

Besides zoning policies to preserve farmland, B.C. also utilizes beneficial property tax regulations to reduce farmers' financial burdens. A farm property attains farm class status (and thus lower taxes) if it meets the restrictions described in Table 6.1. The gross agricultural income threshold is quite low and a property between 0.8 and 4.0 ha can meet it, for example, by harvesting and selling approximately 0.07 ha of Christmas trees, the eggs from approximately 70 chickens, alfalfa from about 1.2 ha, a few head of livestock (depending on quality and species), or a combination of products.¹⁶ It is also possible to attain farm status if the land is leased to another operator who meets the threshold, as long as the land makes a "reasonable contribution" to the overall farm operation (BCA 2005).

Table 6.1 Thresholds for properties to qualify for farm class status

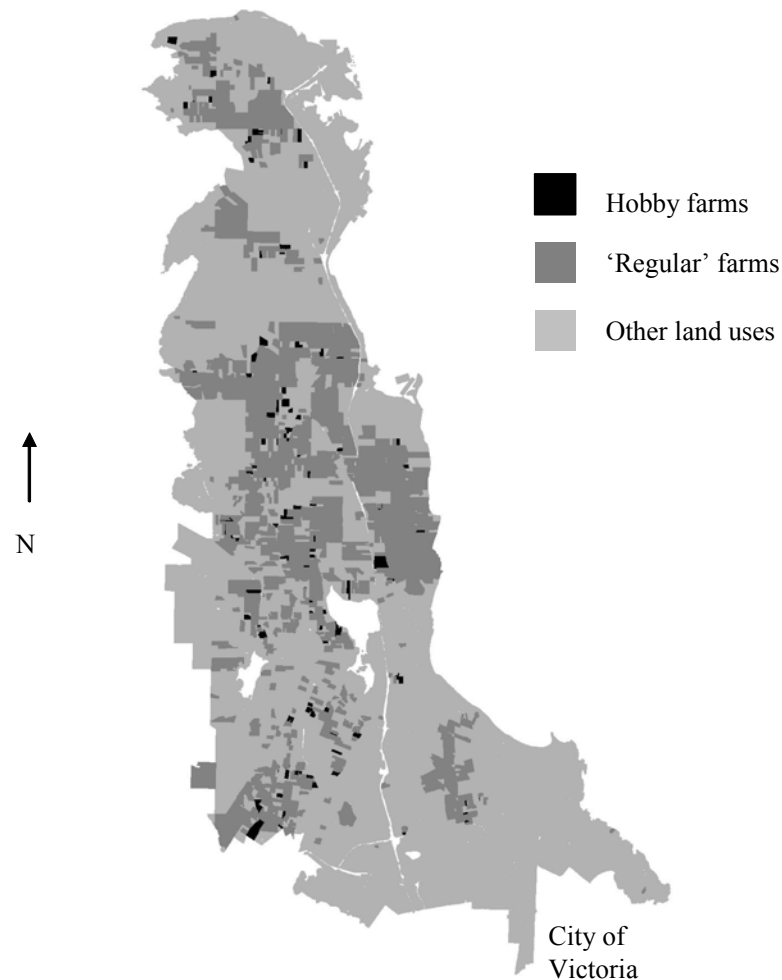
Parcel size	Annual revenue threshold to be met once every two years
< 0.8 ha	Gross farm revenues \geq \$10 000
\geq 0.8 ha, < 4 ha	Gross farm revenues \geq \$2 500
\geq 4 ha	Gross farm revenues \geq \$2 500 plus five per cent of land's assessed value

Data, Methods and Variables

The Saanich Peninsula study area consists of approximately 17,593 ha north of Victoria, the provincial capital, on southern Vancouver Island. (See Map 6.1) It enjoys Canada's most temperate climate and contains some of the province's best farmland, growing a variety of crops such as fruits, vegetables and floriculture, as well as supporting livestock. In Map 6.2, we provide a GIS map of the Saanich Peninsula that highlights land use and shows where hobby farmers are located. In

¹⁶ This information comes from a 2007/2008 survey of twenty-five Saanich farmers and discussions with various provincial government staff. We discovered a certain laxity in the enforcement of farm status requirements. This may be to prevent developers from making a case before the ALC that some ALR lands should be excluded because they cannot meet minimal farm-status standards.

addition, regular farmland is distinguished from all other uses of land including residential, commercial and First Nations' lands (formerly known as Indian reservations).



Map 6.2 Distribution of land use on the Saanich Peninsula, Vancouver Island (Source: Ministry of Agriculture and Lands and the Capital Regional District, edited map)

A variety of GIS and more traditional databases were used to develop the covariates of the regression equations. Data were obtained from, among other sources, the B.C. Ministry of Agriculture and Lands, the B.C. Assessment Authority, other government agencies, the Capital Regional District (CRD), and private sources (such as LandCor). We use ArcGIS to link datasets, calculate distances, and analyze other

spatial relationships in the data.

Two models are employed to investigate the presence of hobby farmers on the urban fringe. The first is a logit model that distinguishes factors that discriminate between hobby farmers and other agricultural producers. The second model is an OLS regression that estimates a hedonic price function. Hedonic price functions are used to parse out effects of covariates that determine the prices of farmland to derive shadow prices for property characteristics. In the model, we include a dummy variable indicating whether a farm parcel is inside the ALR or not and one indicating whether the farm is a conventional or a hobby farm. We include both dummies in the hedonic pricing model to highlight price differences paid by disparate types of farm operations and landowners inside or outside the ALR. We also include an interaction term between the ALR and the hobby farm dummy variable to test whether the use of land for hobby purposes affects land prices differently within than outside the ALR.

If the farmland has development rights so that it could be converted to residential use at any time, there is a potential endogeneity problem in the hedonic price equation (Lynch, Gray and Geoghegan 2007). That is, the distribution of land use for residential versus agricultural purposes might be an endogenous process. Endogeneity with respect to the ALR variable is not considered a problem however, because of historical factors and the fact that the ALR is a zoning ordinance that prohibits subdivision and non-agricultural uses. Subsequently, in Saanich until 2006, there had been only 16 applications to the ALC to remove land from the ALR, constituting a total of 228 ha; while 13 applications were successful, total exclusions amounted to only 76 ha (as the ALC might not grant a request to remove the full amount in the application). Clearly land cannot be easily converted to residential use nor has a large proportion of the ALR in the study area been in land use flux.

We also might worry about the potential endogeneity of the hobby farm variable. It is possible that hobby farmers select parcels to buy based on unobserved characteristics that are also affecting the prices of those parcels directly. This issue was of key interest to Stobbe, Cotteleer and van Kooten (2008) who used the same dataset as here but a different approach in order to focus on this potential problem. The results of that study, which utilizes a propensity-matching scoring method, ruled out endogeneity as a problem in the current dataset.

The dependent variable in the logit model (and also a variable of interest in the hedonic price model) is a binary variable that takes on a value of one if the land parcel is used for hobby purposes and zero if it is used for conventional farming. Although there is no one universally accepted definition of a hobby farm, Statistics Canada classifies a hobby farm as one in which the main operator reported 190 or more days of off-farm work and no other labor was employed year-round (Boyd 1998). In Canada, hobby farmers tend to cluster around certain crops and animals as evidenced by the fact that 35 per cent of all horse operators were labeled as hobby farms in 1991, and more than 30 per cent of all sheep and goat enterprises were hobby farms; among hobby farms, cattle rearing is most pronounced, accounting for 30.8 per cent of hobby farmers, followed by wheat (12.2%) and horses (9.7%) (Boyd 1998). Other studies have used different definitions of what constitutes a hobby farmer, generally based on farm size or gross receipts. The 2006 Agricultural Census found that 9,466 of B.C.'s 19,844 farms reported less than \$10,000 in gross farm receipts and that 5,335 were less than 4 hectares in size (Statistics Canada 2006).

The Agricultural Land Use Inventory (2004) compiled by the former B.C. Ministry of Agriculture, Food and Fisheries provides information about whether or not properties are hobby farms. Their description of a hobby farm is a property “with

agricultural activity, but for amenity use only, i.e. no indication of farm products for sale (e.g. residential property with one horse).” The distinction between hobby and conventional farms is determined somewhat arbitrarily, but, given no other information, we must rely on the government’s own assessment.

The dependent variable in the hedonic price model is the logarithm of farmland price per ha adjusted for inflation using the Consumer Price Index with base year 2005. The hedonic price model also included dummy variables to capture price variation over time. Explanatory variables in both the hedonic price model and the logit model are roughly similar and include, among others, size of the farmland parcel, topographical features of the land, distance to Victoria, distance to the highway, and an ALR dummy variable. Also included in the model are dummy variables indicating the type of agricultural activity occurring on the parcel in 2004.

A farm fragmentation index was also constructed for use as an explanatory variable in both models. Although fragmentation indices have previously been used to study wildlife habitat in the natural sciences, they have not been adapted for use in a farmland context. It is hypothesized that hobby farms might be more prevalent under highly fragmented conditions where farmland blocks are broken up by other uses. A fragmented landscape reduces the agricultural productivity of an area (Brabec and Smith 2002; Nelson 1992). The constructed index is designed to capture the importance of both adjacency to other farms and the total size of the farm block to which the parcel is connected. This index is calculated as follows:

$$\text{FI} = \text{proportion of perimeter bordering other farmland} \times \text{size of total farm block of all adjacent farmland measured in ha}$$

An example of the construction and interpretation of the fragmentation index is given in Figure 6.1 and Table 6.2. Higher numbers on the fragmentation index indicate less

fragmented landscapes for agriculture while a score of zero would indicate a completely isolated agricultural parcel.

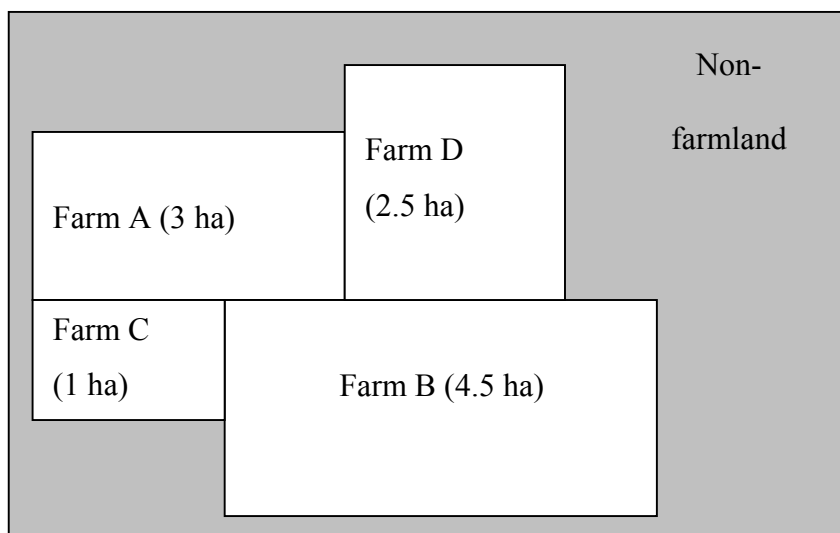


Figure 6.1 Scenario to illustrate farmland fragmentation

Table 6.2 Value of the fragmentation index for different parcels

Parcel(s)	Size (ha)	Attached farmland (ha)	Proportion of perimeter bordering other farmland	Index
A	3.0	8.0 (B, C & D)	0.50	4.0
B	4.5	6.5 (A, C & D)	0.34	2.2
C	1.0	10.0 (A, B & D)	0.50	5.5
D	2.5	9.5 (A, B & C)	0.42	4.0
A & D	5.5	5.5 (B & C)	0.34	1.9
A, B, C & D	11.0	0.0	0.00	0.0

Based on actual use codes recorded by B.C. Assessment, a total of 1,017 parcels of agricultural land on the Saanich peninsula are included in the analysis. We had to exclude parcels due to linking problems with other datasets or because the full set of explanatory variables was not available for each observation. In addition, sales of multiple parcels bundled together were excluded because it was not clear how we could attribute the total price to the separate parcels in the bundle. The final dataset

comprised 893 observations of sales that took place in the period 1973-2006 for use in the hedonic pricing model and 934 observations of parcels for use in the logit model.

Several alternative hedonic pricing models are examined in order to sort out various explanations of land prices. One restriction imposed in some cases is that only the most recent sale is included when the parcel was sold multiple times between 1974 and 2006. The reason for this is that the status of the land may have changed over time because the information on agricultural activities and on whether or not it is a hobby farm comes from the 2004 Land Use Inventory. (It is reasonable to assume that if the current owner is a hobby farmer, they likely purchased the property with that aim in mind.) By including various alternative explanations, we also investigate whether the results of the restricted model, which has a higher degree of certainty, differ from the results of the full model, where we are less certain about the status of the land in the past.

Empirical results

In this section, we will first discuss some summary statistics regarding hobby farms versus conventional ones. Then we will provide the results of the binary choice (logit) model that estimates the likelihood that a property is used by a conventional versus a hobby farmer. Finally, the results of the extended hedonic pricing model will be considered.

Of the 934 observations of farmland that were used in the logit model, 119 are categorized as hobby farms, with the remainder considered conventional farms.

Hobby farmers seem to differ from conventional farmers in several ways. One is that hobby farmers are more often located outside the ALR than conventional ones. From Table 6.3, we see that 78.2 per cent of all hobby farmers use non-ALR land compared

to 16.8 per cent of regular farmers. This result provides one important clue to a question concerning the ALR: How do (numerically) so many farms survive outside the ALR? The reason appears to be that many farms outside the ALR are not commercial enterprises but hobby farms.

Table 6.3 Summary statistics for farmland parcel sizes, conventional and hobby farms in and outside the ALR

	Number of observations	Mean size (ha)	Standard Deviation	Minimum	Maximum
<i>Hobby farms</i>					
Within the ALR	26	1.752	1.034	0.295	5.261
Outside the ALR	93	2.012	1.138	0.340	6.718
<i>Conventional farms</i>					
Within the ALR	678	5.184	6.691	0.049	71.556
Outside the ALR	137	2.310	2.537	0.085	16.260

Another way that hobby farms differ from other farms is in the amount of land they occupy. Hobby farms tend to be smaller than conventional farms as indicated by the summary statistics in Table 6.3. There is no significant difference between the sizes of hobby farms within the ALR and outside the ALR, but the opposite is true for conventional farms; average farm parcel sizes are larger when they are located in the ALR (5.2 ha) than when they are located outside the ALR (2.3 ha). Likely in response to tax incentives, there is a tendency for hobby farms to fall in the size range of 0.8 to 4.0 ha (85% of hobby farmers are in this range versus only 59% of conventional farmers).

Not unexpectedly, it appears that the optimal size of hobby farms is smaller than that of conventional farms, even though the conventional farmer may be unable to earn sufficient income to cover the opportunity costs of land. There is also considerably more variation in parcel size for conventional than hobby farms with a standard deviation of 2.54 ha to 6.69 ha for regular farms and 1.03 ha to 1.14 ha for hobby farms.

From the logit model results provided in Table 6.4, we find that hobby farmers are significantly less likely to be located inside the ALR. This is likely due to the lack of appropriately sized parcels since hobby farmers seem to gravitate toward smaller parcels based on the summary statistics. When hobby farms are located inside the ALR, the land tends to be located farther from the ALR-boundary (i.e. deeper in the ALR) than for conventional farmers, but they tend to be closer to the boundary than conventional farmers when they are located outside the ALR. A potential explanation for this result relates to the value of open space. Hobby farms almost exclusively support country residences and the owners may prefer to live near farmland (open

Table 6.4 Logit regression model comparing hobby farmers with conventional farmers, Saanich Peninsula (n = 934) and marginal effects evaluated with ALR=0 and ALR=1; Note: *significant at the 1 per cent; **significant at the 5 per cent; and *significant at the 10 per cent critical levels**

Dependent variable: Hobby farms (=1) and regular farmers (=0)	Parameter estimates	p-value	Marginal Effects ALR parcels	Marginal Effects Non-ALR parcels
ALR (= 1 if parcel is located within the ALR, 0 otherwise)	-3.261	***	0.000	
Distance to ALR boundary (km) from inside the ALR, 0 otherwise	1.736	***	0.003	.0258
Distance to ALR boundary (km) from outside the ALR, 0 otherwise	-1.124	**	0.043	-.2293
Fragmentation index	-.285	***	0.006	-.0042
Horse	1.024	***	0.001	.0219
Other livestock	1.887	***	0.000	.0657
Distance to Victoria city centre (City Hall) (km)	-2.017	***	0.000	-.0300
Distance to highway (km)	.100		0.288	
Log lot size (ha)	.111		0.567	
Maximum elevation level (m)	.0007		0.890	
Slope (difference in elevation) (m)	.020		0.238	
Constant	17.841	***	0.000	
LR $\chi^2(11)$	280.98			
Log likelihood	-215.766			
Pseudo R ²	0.394			

space) that is unlikely to be developed in the future.¹⁷ Since being near the ALR boundary or being surrounded by ALR land offers this type of protection, hobby farmers seem to prefer unimpeded views that are at least quasi-protected.

With respect to farm type, we find that hobby farmers are likely to have horses and other livestock (such as sheep, llama and goats). This is consistent with the trend found by Statistics Canada when examining hobby farms (Boyd 1998). Hobby farmers also appear to not mind being fragmented from other farmland, as indicated by the negative coefficient on the fragmentation index. This may indicate that hobby farmers are better able to survive in the urban-fringe than conventional farms.

Finally, we conclude from the binary choice model that hobby farmers are located closer to the city centre of Victoria than conventional farms. This result is consistent with the notion that hobby farmers are relatively wealthy ex-urbanities who want to pursue a rural lifestyle but still earn most of their income off-farm. Nearness to Victoria implies a shorter commute. On the other hand, the estimated coefficient on distance to the highway is not significant, which may imply that, while some hobby farmers prefer to reduce their commute time by living close to the highway, others wish to avoid the noise and air pollution associated with traffic and prefer to live farther from the highway.

For all the variables with statistical significance in the binary choice model, the marginal effects are calculated for two different scenarios: when the parcel is in the ALR and when the parcel is outside the ALR. (See Table 6.4) These effects can be interpreted as the change in the likelihood (expressed as percentage) that the land is a hobby farm from a change in one unit of the associated variable. These marginal effects are useful because they provide a sense of the magnitude of the effect of the

¹⁷ The vacant land variable is statistically insignificant in all models and is highly negatively correlated with hobby farms as vacant hobby farms are a rarity.

independent variable on the dependent variable. They show that for farms in the ALR, as you increase the distance from the ALR boundary by one km, there is an increased chance of being a hobby farm of 2.6%. For farms not in the ALR, as you increase the distance from the ALR boundary, it decreases the chance of being a hobby farm by 22.9%. This is consistent with the interpretation above that hobby farmers value open space and those outside the ALR desire land which is near other land which has some assurance of remaining undeveloped in the future (i.e. the ALR boundary).

The marginal effect on the fragmentation index shows that while both types of hobby farms (inside and outside the ALR) do not mind fragmentation, the effect of increasing fragmentation leads to much higher probabilities that the parcel is a hobby farm outside the ALR – the effect is almost 14 times stronger. The marginal effects on land use also show differentiated effects with the presence of horses and other livestock translating into a 23.2% and a 43.8% chance respectively of being a hobby farm outside the ALR, compared to just a 2.2% and 6.6% chance inside the ALR. The final marginal effect, on distance to Victoria, indicates that increasing the distance to Victoria has a much more pronounced effect on a farm's chances of being a hobby farm outside the ALR than within it.

To provide a more complete examination of hobby farming, a hedonic pricing regression model was used to decompose agricultural land prices into their constituent parts. The results are provided in Table 6.5, which is an extended version of the hedonic pricing model constructed by Cotteleer, Stobbe and van Kooten (2008). In this extended model, additional information about hobby versus conventional farmers is taken into account. In particular, we introduce cross-product terms between the hobby farms and some of the other covariates in the model. In general, the estimated coefficients in the hedonic pricing model indicate whether or not farmers are willing

to pay more or less for certain land characteristics. Positive coefficients indicate that farmers are willing to pay more if the amount of a certain characteristic is increased, whereas negative coefficients indicate the opposite. Multiple models are presented due to uncertainty in the data, as discussed in the previous section. Model 1 presents the full model with sales from the entire time frame examined. Model 2 restricts the data set to just the most recent sale on a property when it was sold more than once. Finally, models 3 and 4 contain no interaction terms and only one interaction term respectively since the number of interaction terms included in the model significantly affected the results for one of the main variables of interest – the hobby farm dummy. Note that time is an important factor in this equation and year dummies were included in each model of the hedonic price model to account for the effects of time. A majority of these dummies were significant but since there is no important interpretation to them beyond that they capture the effects of time, they are not presented in Table 6.5.

We conclude from model 1 that hobby farms sell for significantly higher prices than conventional farms per ha and that smaller parcels sell for more per ha than larger parcels. The ALR designation appears to have a counterintuitive effect on land prices. We would expect that land which is restricted is worth less than unrestricted land but the positive coefficient on ALR seems to indicate the opposite. However, the ALR designation does not have a linear effect on prices over time. In the earlier days of the zoning scheme, farmland in the ALR was worth more than non-ALR farmland, but this effect reversed in the 1980s. To account for changes over time, another variable ($ALR \times Year$) was included which shows the expected negative trend. (This was also found in Cotteleer, Stobbe and van Kooten (2008).) The highly negative effect of parcel size on land price is also shown in models 2, 3 and 4.

Table 6.5 Regression results of the hedonic pricing model, Saanich Peninsula, with robust standard errors; Note: *significant at the 1 per cent, **significant at the 5 per cent, and *significant at the 10 per cent critical levels**

Dependent variable: Log of price per ha	Model 1 n=893	p-value	Model 2 n=515	p-value	Model 3 n=515	p-value	Model 4 n=515	p-value
Hobby farm (=1 if a hobby farm, 0 otherwise)	.4360**	0.012	.0425	0.836	.0683	0.203	.1335*	0.084
Log of parcel size (ha)	-.7202***	0.000	-.7494***	0.000	-.7144***	0.000	.7120***	0.000
Log of parcel size × Hobby farm	.1379	0.149	.3309***	0.003				
ALR (= 1 if parcel located in the ALR, 0 otherwise)	.1616**	0.047	.2658**	0.030	.2848**	0.014	.2916**	0.011
ALR × Hobby farm	.0915	0.230	.2562**	0.013				
Distance to ALR boundary from inside the ALR (km)	.1600***	0.001	.1930***	0.002	.1853***	0.003	.1898***	0.002
Distance to ALR boundary from outside the ALR (km)	-.3934***	0.002	-.2771*	0.080	-.2757*	0.089	-.2766*	0.085
Fragmentation index	.0144**	0.015	.0205***	0.007	.0149**	0.042	.0148**	0.043
Fragmentation index × Hobby farm	-7.94 e-06**	0.019	-.00002***	0.001			-3.89 e-06	0.169
Horse	.0884**	0.001	.1124***	0.004	.0973**	0.011	.0993***	0.009
Other livestock	.0640	0.104	.0625	0.258				
Vegetable	-.1422**	0.005	-.1811**	0.011	-.1826**	0.011	-.1876***	0.009
Vacant	-.4955***	0.000	-.4632***	0.000	-.4755***	0.000	-.4714***	0.000
Log of distance to Victoria	-.1054**	0.012	-.1041**	0.050	-.1117**	0.030	-.1114**	0.031
Log of distance to highway	.0279**	0.003	.0173	0.199	.0140	0.272	.014785	0.246
Log of distance to highway × Hobby farm	-.0553**	0.022	-.0008	0.977				
ALR × Year	-.0138***	0.000	-.0175***	0.000	-.0172***	0.000	-.0173***	0.000
Slope of parcel	.0009	0.715	.0045	0.137	.0045	0.143	.0044	0.146
Maximum elevation of parcel	.0017***	0.001	.0019***	0.010	.0018**	0.012	.0019**	0.011
Log of interest rates	-.5236***	0.000	-.4835***	0.000	-.5208***	0.000	-.5140***	0.000
Older sale (=1 if not most recent sale, 0 otherwise)	-.0064	0.800						
Cash sale (=1 if noncash sale, 0 other wise)	-.0327	0.514	-.0783	0.320	-.0625	0.436	-.0621	0.439
Constant	15.1198***	0.000	15.1103***	0.000	15.2499***	0.000	15.214***	0.000
R-squared	0.7756		0.7988		0.7921		0.7927	

The insignificant findings on the “hobby farm” coefficient in models 2 and 3 imply that hobby farmers operate under the same market conditions as regular farmers and their land is not more valuable per ha than that of conventional farms. However, when more sales observations are included (model 1) or the interaction between fragmentation and hobby farms is considered (model 4), the hobby farm coefficient becomes significant. This interaction term was significant in the full model, so its inclusion can be deemed relevant. Regarding the inclusion of multiple sales of the same property, even if the farm-type status of the land has changed over time, the major characteristics of the parcel have not, so including all available sales is a viable option and provides more data points. Therefore, the best available models do indicate a real difference in pricing structure between the two types of farms.

The distance variables are consistent across models. In every permutation, farmland is worth more when it is closer to the ALR boundary when it is outside the ALR and it is worth more in the ALR when it is deeper inside the ALR. This makes sense as farmers wish to minimize the negative externalities that they experience when operating near residential areas. The fragmentation index also supports this as it points out that less fragmented farmland fetches significantly higher prices. The negative coefficient on the interaction term with hobby farm supports the results from the logit model; hobby farmers pay higher prices for more fragmented land. This finding indicates that perhaps hobby farmers do not experience negative spillovers from urban areas to the same extent as conventional farmers, and thus might survive more easily in an environment where urban areas are expanding at the cost of agricultural areas. Also note that some open space uses, such as golf courses, are permitted within the ALR; these do not constitute farmland (and thus reduce a parcel’s fragmentation score), but may be favoured by hobby farmers in search of open space while avoided by conventional farmers due to the

externalities associated with them.

The coefficients on distance to Victoria are negative and significant across all models which indicates that farmland is worth more when it is closer to the city. This is undoubtedly due to effect of land speculation on farmland by developers and those who believe the land's value will increase as the city expands. The effect of distance to the highway is only significant in model 1, with the interaction term indicating hobby farms are slightly more valuable when they are located closer to the highway compared to conventional farms.

Finally, we can conclude that land prices respond significantly to changes in the interest rate. When interest rates increase, the willingness to pay for land appears to decrease.

Conclusions and Discussion

In this research, we investigated the revealed preferences of hobby farmers in terms of spatial location and parcel characteristics with the goal of answering questions about whether the instruments used to protect farmland, such as the ALR and preferential tax regulations for farmers, are economically efficient and whether the establishment of hobby farms is problematic in this context. The empirical findings shed light on some average preferences and trends in hobby farming in B.C. The average hobby farm tends to be relatively small, lies outside the ALR and often supports some livestock. Hobby farmers do not seem to mind fragmentation of agricultural land as much as conventional farmers although they do seem to have a preference for being near open space, as evidenced by the fact they prefer to be closer to the ALR boundary when they are outside it or to be deeper inside the ALR. Since the ALR provides reasonable assurance of farmland preservation, hobby farmers likely prefer situating nearby the ALR to guarantee their open space views are protected.

The negative externalities facing agricultural producers living in the urban-rural fringe do not seem to bother hobby farmers as much as conventional farmers. They likely receive fewer complaints due to the less-intense nature of the enterprise. This indicates that hobby farming may be able to survive more easily in the rural-urban fringe in the long run, compared to commercial farming. The fact that hobby farmers are more often than not located outside the ALR means they currently contribute to open space preservation even without the ALR zoning ordinances.

Furthermore, hobby farmers benefit from B.C.'s favourable property tax treatment of agricultural land, which sets a low threshold for obtaining tax reductions. Indeed, it is clear that hobby farmers seek parcels that place them in the land-size category with the lowest threshold for qualifying for farm class status; thus, they tend to avoid parcels smaller than 0.8 ha that would place them into the category with the highest taxes. These factors all point to a picture of hobby farmers as active seekers of farm class status to reduce their property tax burdens.

When surveyed, B.C. residents show strong support for protection of agricultural land, but it is not clear how they would rank various values and reasons for preserving farmland. Kline and Wilchens (1996) provide a useful framework for defining agricultural land values (agrarian, environmental, aesthetic and anti-growth), but it is clear that sometimes these values can be in conflict. For instance, agrarian values are satisfied by highly productive greenhouse agriculture, but at the cost of environmental and aesthetic values; golf courses are desirable land uses from an aesthetic point of view, but not in terms of agrarian or anti-growth values. It is not clear which values B.C. residents hold most strongly with regard to the ALR, both in terms of the province as a whole and in the urban-fringe. Determining this is the subject of future research.

We argued that reasons to protect agriculture related to food production are not justifiable from an economic perspective. Agricultural production is a primary output and not an

externality, and government intervention is only justified when there is market failure. Therefore, the argument that hobby farming should be looked upon as a negative development, since they take land out of full-scale production and limit opportunities for conventional farms to expand, does not hold. On the contrary, if aesthetic values are most important, then hobby farming is a practice to be encouraged and the low threshold for achieving farm class status is to be applauded. It is also the case that hobby farms play a role in slowing urban sprawl, thus reducing conflicts and externalities imposed upon and by conventional farmers.

It remains an open question as to whether hobby farming should be promoted in the rural-urban interface as an alternative to more productive, commercial types of agricultural enterprises. Clearly, high land prices make it difficult to support a viable agricultural industry, perhaps even hobby farming. While hobby farming is not a new development, its scale in British Columbia in recent years is unprecedented. It is not entirely clear whether hobby farming is something to be encouraged because of the benefits that it provides society, or whether it simply constitutes 'rurbanization' of the countryside (urban development of rural areas subject to minimum lot size constraints) with all pretence of farming disappearing as farms rollover and local governments seek to expand their tax base. Further research and monitoring of this phenomenon is certainly warranted.

7. Open Space Premiums in the Urban-Rural Fringe¹⁸

Introduction

Hedonic pricing models are often used to estimate the value of open space and the externalities that different types of land use impose on one another because these values are at least partly tractable through market values of private properties. In particular, the prices of residential properties in close proximity to positive and negative externalities resulting from nearby land uses can be used to value these non-market amenities.

If we look at open space amenities provided by farmland near urban areas we observe that, as the urban fringe is pushed out, fragmentation of surrounding farmland increases as do incidences of trespass and vandalism. Externalities are also associated with the intensification of agriculture in the rural-urban fringe (Gillis 2004). Externalities flow in both directions, with urban development impacting farmland and agriculture affecting urban land. On the negative side, there are nuisance complaints from neighboring urban residents who object to the sounds and smells of farming operations and the added traffic congestion caused by slow-moving farm equipment traversing from one field to another some distance away (with the spatial fragmentation also adding to farming costs) (Hardie, Parks and van Kooten 2004). Nonetheless, Kline and Wichelns (1996) indicate that urban residents enjoy living near open spaces as these provide pleasant agrarian landscapes during commutes, opportunities for recreation and habitat for wildlife that facilitates viewing. Indeed, real estate brokers include farmland views and proximity to natural areas as selling features of houses. For example, a property in our study area

¹⁸ This chapter is based on a paper by Geerte Cotteleer, Tracy Stobbe and G. Cornelis van Kooten submitted for possible publication in *Regional Science and Urban Economics*.

was recently listed as follows: “Central Saanich – Victoria: This .28 acre view property ... overlook[s] the Martindale Valley and farm fields, Only 15 minutes from downtown and 10 minutes from ferry and airport....” (MLS 2007).

Nature parks and golf courses are other open space providers and both positive and negative externalities can be associated with these land uses. Nearby forest land was found to be negatively associated with house price in Geoghegan, Lynch and Bucholtz (2003), perhaps due to externalities associated with deer (landscape damage, car accidents and the spread of Lyme disease). This negative effect of nearby forest was also found in Paterson and Boyle (2002), indicating people do not enjoy views of trees. However, most studies have found positive impacts from nature areas, such as in Cho, Bowker and Park (2006) and Irwin and Bockstael (2001). With respect to golf courses, Nicholls and Crompton (2007) found a positive impact of golf courses due to its popularity as a recreational activity. However, golf courses can also be associated with negative externalities as recognized by Asabere and Huffman (1996). Hedonic pricing studies can be used to study whether people will pay more for a house with these open space amenities.

Hedonic pricing models require actual property transaction data as inputs, because these values reflect property characteristics which can then be decomposed into their constituent parts. However, sales values are not always readily available; therefore, some researchers have employed approximations of sales values in hedonic pricing models. Thus, Chay and Greenstone (2005), and Isgin and Forster (2006), relied on a survey instrument to elicit estimates of property values. For practical reasons, it is very useful to know which approximations of property values will give valid and consistent results when transaction data is not available.

Using assessed values as approximations of market values has the advantage that these

values are available for each property in each year. So, the estimation of a hedonic panel data model, including dynamic effects, is possible if this strategy is valid. In addition, the use of assessed values would facilitate non-market valuation since assessed values are much more widely available, at least in jurisdictions where properties are assessed annually for tax purposes. In some jurisdictions, a government agency may collect information on sale prices, but in others, where information on selling price is not readily available for a large data set, it would be helpful if researchers could use assessed values in place of market price with confidence. Some studies support the idea that assessments and market values work in step (Berry and Bednarz 1975). Nicholls and Crompton (2007) visually compared estimates for the value of open space based on an equation with sales values versus assessed values as the dependent variable. However, they did not develop test statistics to compare these estimates.

The objective of this paper is therefore to formally test whether assessed values are good proxies for actual sales values in a hedonic pricing model that is used to estimate the value of open space on the Saanich Peninsula, British Columbia, Canada. The value of open space provided by farmland is compared to that provided by parkland and golf courses. We estimate a Seemingly Unrelated Regression (SUR) model with two equations, one with actual market values as the dependent variable and one with assessed property values, and compare the resulting estimates of shadow prices for open space amenities.

A variety of authors have estimated open space premiums using a proxy variable to measure open space benefits. Irwin and Bockstael (2001) and Irwin (2002) use percentage of open space within a specified buffer zone around each property, while Ready and Abdalla (2005) construct an index that allows the value of the open space amenity to decrease to zero in a nonlinear fashion as distance increases up to a certain point, beyond which open space is

assumed to no longer effect residential property price. The problem with distance measures, like that used by Ready and Abdalla (2005), is that large and small open space areas are treated equally; the problem with area percentages, like that used by Irwin (2002), is that arbitrary buffer zones around each property have to be specified and open space outside those boundaries is not taken into account. We address this issue by explicitly combining the distance and percentage measures using a Reilly index. In this way, all nature areas, parks, farmland and golf courses are taken into account, insuring that both the size and distance measures are represented.

Methods

Given that both the distance to a particular open space and its size influence residential property values, we construct a Reilly index that combines these two aspects of open space. The Reilly index derives from Newton's law of gravitation, where gravity is stronger for larger 'bodies' and gravitational strength is inversely related to the distance between 'bodies'. It was originally applied to the study of retail markets (Reilly 1931), to reflect the attractiveness of different retail areas (cities) in terms of the tradeoff between consumers' travel costs and the size of alternative retail areas. In this case, Reilly's law is:

$$(1) \quad \frac{R_{xi}}{R_{xj}} = \frac{Pop_i}{Pop_j} \left(\frac{D_{xj}}{D_{xi}} \right)^2.$$

R_{xi} and R_{xj} are the retail sales at location x which are frequented by residents of cities i and j ; Pop_i and Pop_j are the respective populations (size) of the two cities; and D_{xi} and D_{xj} are the distances from the retail location x to cities i and j , respectively. In this case, it is possible to determine the location of retail center x so as to attract the most customers. This optimal location or 'breaking

point' is given by $d_{xj} = \frac{d_{ij}}{1 + \sqrt{P_i/P_j}}$, where the breakpoint lies at distance d_{xj} from the centre j , d_{ij}

is the total distance between the two retail centres, and, of course, $d_{xj} < d_{ij}$.

Shi, Phipps and Colyer (1997) were the first to employ the concept of gravitation in a hedonic pricing model. However, they modified the concept in order to evaluate the impact of multiple urban centres on farmland values. Their Reilly index is specified as: $R_i =$

$\sum_{j=1}^J (Pop_j / D_{ij}^2)$, where R_i is the Reilly index for property i , Pop_j is the population of the j^{th} urban area, and D_{ij} is the distance from property i to the j^{th} urban center.

We modify the Reilly index to calculate the impact of open space (farmland and parkland) on residential property values. Rather than distance to urban centers, we employ distance to open areas and, rather than population, we use size of the open space (measured in square metres). Thus, we specify $R_i = \sum_{j=1}^J (S_j / D_{ij}^2)$, where R_i is the value of residential property i and D_{ij} is the distance (in meters) from residential property i to open space j that is of size S_j (in meters squared). Thus, we can take all parks and farmland within our research area into account, insuring that both the size and distance measures are represented.

For golf courses we also constructed a measure similar to the Reilly index. The only difference is that instead of using the size of the golf course, we specified S_j as 1 for 9-hole golf-courses and 2 for 18- or 19-hole golf-courses.

Model specification

To investigate the open space premium associated with residential properties, prices from actual market transactions are usually employed as the dependent variable. However, we also specify a model that uses assessed property values as the dependent variable, as this enables us to

investigate the validity of assessed values in lieu of market values in hedonic pricing models. For each of the properties for which actual sales and assessed values are both available, we paired the actual and assessed values and specified a SUR model. By working with both equations in one model, relevant test statistics can be derived to test the hypothesis that parameters in the equation with actual market prices as the dependent variable are equal to the parameters in the equation with assessed values as the dependent variable.

Properties are also spatially related. An assumption of spatial econometrics is that observations that are located closer to each other are more correlated than observations that are farther apart. Spatial autocorrelation is often caused by unobserved variables. For example, if several residences have a beautiful view because they are located on a hilltop, and there is no variable in the model that takes this view into account, then their error terms will be correlated.

To address this issue, we first define the spatial SUR model, including a spatial autocorrelation component, as follows:

$$(2) \quad P_m = X\beta_m + \varepsilon_m, \quad \varepsilon_m = \rho_m W_m \varepsilon_m + \mu_m, \quad \mu_m \sim N(0, \sigma_m^2) \ni (I_N - \rho_m W_m) \varepsilon_m = \mu_m,$$

where P_m is a vector of property prices, X_m a matrix of property characteristics, β_m a vector of associated parameters to be estimated, and ε_m is the spatially auto correlated error term. Further, m identifies the equations with market values ($m=1$) and assessed values ($m=2$) as dependent variables. We assume that $Cov(\mu_{1i}, \mu_{2j}) = \sigma_{12}$ for $i=j$ and $Cov(\mu_{1i}, \mu_{2j}) = 0$ for $i \neq j$; where μ_{mi} reflects the i -th error term in the m -th equation.

Choice of the spatial weighting matrix

The spatial weighting matrices W_1 and W_2 have to be specified for each of the equations *a priori*. There are many potential candidates, but the choice is rather limited in this study, because

we have more than 10,000 observations in our dataset. We have to specify sparse weighting matrices with non-zero weights in each of the elements of the $10,000 \times 10,000$ matrices. W_1 and W_2 are the same as they are based on the five nearest neighbours to each observation, with elements for each of the five-nearest neighbours assigned a 1 and all other observations a 0 in the weighting matrices. Further, the weighting matrices are row-standardized (each row sums to 1) for computational reasons.

Other empirical issues

Another empirical issue to be addressed concerns the choice of functional form, and there is little theoretical guidance regarding this choice (Taylor 2003). Although goodness-of-fit criteria can be used to choose a functional form, Cassel and Mendelsohn (1985) argue that this strategy does not necessarily lead to more accurate parameter estimates. The debate also concerns the choice of a simpler versus more advanced functional form. While the choice of a simple linear form overlooks statistically significant relationships (Halstead, Bouvier and Hansen 1997), Rasmussen and Zuehlke (1990) argue that the parameter estimates might be less precise when unnecessary nonlinearities are introduced and the problem becomes over-parameterized. Further, Cropper, Deck and McConnell (1988) found that, when some variables are not observed or proxies are used, simple (linear or double-log) functional forms perform better. Nonlinear functional forms are generally preferred over linear ones because linear functional forms have the disadvantage that they assume that parcel characteristics can be easily repackaged, precluding nonlinearities as a result of arbitrage (Rosen 1974). Because we already have a high number of explanatory variables (and parameters to estimate), we consider a linear functional form with transformed explanatory variables. An advantage of these simple forms is that interpretation of the results is more straightforward.

Finally, we need to take into account the endogeneity problem identified by Irwin (2002). Endogeneity could result if the open space has development rights so that it could be converted to residential use at any time. In that case, the same factors that determine the value of nearby residential property also influence the likelihood that the open space will be developed. We assume that endogeneity is not a problem because both parks and farmland are under zoning restrictions and cannot be easily converted to residential use. Developments rights on the other hand are more flexible than zoning in allowing for changes in land use.

Data and variables

The setting for our study is the Saanich Peninsula. The farmland in the ALR partly contributes to open space views, but the views are not protected with 100% assurance since it is widely known that land can be removed from the ALR. Other sources of open space came from parks and golf courses.

In total 511 nature areas and parks were taken into account in the analysis. All parks were either located on the Saanich peninsula, or within a boundary of 3.5 km of our research area. Of these 511 nature areas, 152 were small parks (less than 2,000 m²), 301 were medium sized parks between 2,000 and 50,000 m² and 58 were parks with an area over 50,000 m².

Furthermore, golf seems to be a very popular recreational activity, since there are 16 golf courses on the southern part of Vancouver Island. Of these 16 golf courses only seven are nine-hole golf courses, the others have 18 holes. Furthermore, eight golf courses are located within the study area and the other eight are located either in Victoria, or further north on Vancouver Island.

The current study employs parcel-level GIS data collected from the Ministry of Agriculture and Lands, data on assessed values and house characteristics from B.C. Assessment,

market values from a private company (LandCor), and other sundry GIS datasets such as elevations, roads and parks from the Capital Regional District government and the Federal Government. Distance data were constructed using spatial location information from GIS.

An example of the construction and implementation of the Reilly index is given in Table 7.1 and Figure 7.1. In Figure 7.1 two residential properties are shown in proximity to four different parks. Distances between the residential properties and the four parks are given in Table 7.1. From Table 7.1 and Figure 7.1, it is apparent that the Reilly for property 2 is much larger than for property 1 because property 2 is located much closer to one of the parks. Although park 2 is not the largest park, the short distance from property 2 to this park is largely responsible for the larger Reilly score for this property. The Reilly index for parks is constructed for small, medium and large parks. The reason is that small parks are expected to attract only the locals that live nearby while larger parks also attract people that live farther away. With respect to the Reilly index for farmland, we construct separate measures for animal farms and for non-animal farms because animal farms are assumed to impose more negative externalities on their neighbours, such as bad smells from manure.

Table 7.1 Reilly index, an example

	Park size (m²)	Property 1		Property 2	
		Distance (m)	Size / distance²	Distance (m²)	Size / distance²
Park 1	1000000	1000	1.000	1400	0.510
Park 2	500000	2100	0.113	400	3.125
Park 3	200000	600	0.556	700	0.408
Park 4	900000	1200	0.625	900	1.111
Reilly index		2.294		5.154	

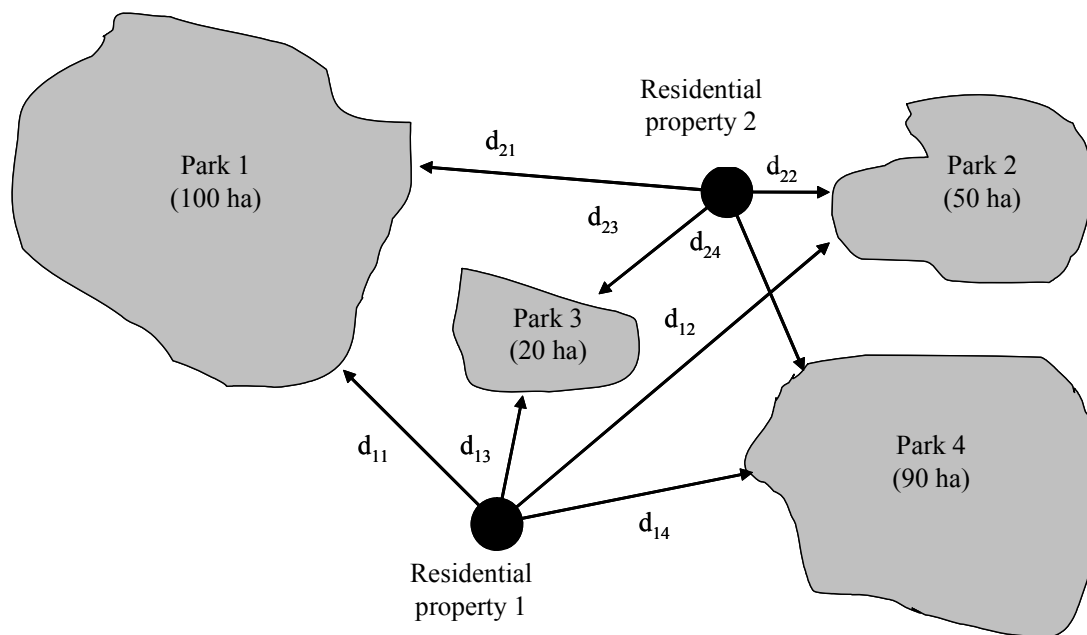


Figure 7.1 Example of the Reilly index

B.C. Assessment attempts to value all residential properties at their market value. Although farm properties can qualify for beneficial tax regulations by meeting certain agricultural income thresholds, here we focus on residential uses and ignore other uses. It is important to note that property assessment systems may be very different in other jurisdictions in North America or Europe, which could affect the validity of applying these results to other locations.

In British Columbia assessors take into account many factors when deciding on a property's assessed value. Properties are primarily categorized by the year in which they are built or the year of the last major renovation; whichever it is, we refer to this as the effective year. The reason for using effective year is that building codes and construction materials and methods change over time. Properties are then subcategorized on the basis of age, design and quality.

After that, the number of bedrooms and other structural characteristics become important. At this point, market values of properties in the same subcategory and in the same 'market area' (as defined by B.C. Assessment) enter the equation. An overview of all the variables included in the hedonic pricing model can be found in Table 7.2.

Because properties at the urban-rural fringe are our main interest, we include properties in the municipalities North Saanich, Central Saanich and Saanich in our analysis. Properties in the city of Victoria are excluded as this is an urban area not part of the urban-rural fringe. The data consist of actual transactions and assessments of residential properties for the period 2000 to 2006. The LandCor and B.C. Assessment databases record 19,246 transactions for 2000 to 2006 for which both sales and assessed values are available. The data were filtered so that only 'single-cash' transactions are included, because we felt transactions that do not involve cash or involve the sale of multiple properties at once are not suitable for hedonic analyses. Next, we incorporated only detached family dwellings in the analysis; strata blocks, duplex buildings, seasonal dwellings and apartment blocks were excluded to focus the analysis on more homogeneous properties. This reduced the sample to 13,532 transactions. Upon excluding properties with missing information on some of the variables of interest, and focusing only on transactions between \$100,000 and \$5 million (CA), we are left with 13,254 observations. This number of observations was further reduced if measures of lot size differed by more than 100 m² between the two datasets. Properties without three or four piece bathrooms were removed as well. This reduced the number of observations to 12,628.

Finally, the number of observations was reduced due to the spatial dependence in the model. In order to construct the spatial weighting matrix, properties cannot be incorporated in the analysis more than once. Therefore, if a property is sold more than once during 2000 to 2006,

Table 7.2 Summary statistics dependent and explanatory variable(s), n = 10,133

Explanatory variable	Mean	St dev	Min	Max
Sale amount (\$CA millions)	0.33108	0.15517	0.09625	2.8085
Assessed value (\$CA millions)	0.27727	0.11651	0.03156	1.7134
Lot size (ha)	0.11	0.12	0.02	3.16
Effective year: last major renovation of the property (years)	1973.15	19.22	1901	2005
Finished area (m ²)	189.72	75.51	35.49	886.29
Number of 3- or 4-piece bathrooms	1.73	0.78	1	7
Number of 2-piece bathrooms (toilet and wash basin)	0.46	0.58	0	4
Number of bedrooms	3.52	1.09	1	10
Number of multi car garages	0.42	0.51	0	3
Number of single car garages	0.31	0.47	0	2
Number of car ports	0.19	0.40	0	2
Pool (=1 if there is a pool, 0 otherwise)	0.01	0.11	0	1
Other buildings (=1 if there are other buildings, 0 otherwise)	0.10	0.29	0	1
Corner lot (=1 if the lot is at the corner of a street, 0 otherwise)	0.10	0.31	0	1
Waterfront lot (=1 if the lot is on the waterfront, 0 otherwise)	0.02	0.13	0	1
Reilly for parks larger than 50,000 m ²	35.10	302.35	0.16	12686.23
Reilly for parks between 2000 and 50,000 m ²	5.12	23.59	0.06	897.14
Reilly for parks smaller than 2000 m ²	0.08	0.50	0.001	14.35
Adjacent to a park (=1, 0 otherwise)	0.14	0.34	0	1
Reilly for farms with animals	1.90	19.36	0.06	1002.46
Reilly for farms without animals	6.97	39.19	0.16	1694.98
Distance (m) to the ALR boundary if property is located within the ALR boundary, 0 otherwise	33.48	184.42	0	1657.48
Distance (m) to the ALR boundary if property is located outside the ALR boundary, 0 otherwise	617.79	555.62	0	3042.90
Reilly for golf courses (multiplied by 1000)	0.001	0.004	0.00008	0.17
Adjacent to golf course (=1, 0 otherwise)	0.005	0.07	0	1
Distance to Victoria City Hall (km)	8.94	6.74	2.29	30.67
Distance to Pat bay highway (km)	2.11	1.73	0.0005	8.24
Pat bay highway within 100 m (=1, 0 otherwise)	0.09	0.29	0	1
Distance to nearest standard school (km)	0.70	0.49	0.01	3.69
Standard school within 100 m (=1, 0 otherwise)	0.01	0.10	0	1
Distance to nearest recreational centre (km)	2.09	1.90	0.07	8.88
Recreational centre within 100 m (=1, 0 otherwise)	0.001	0.03	0	1

Explanatory variable	Mean	St dev	Min	Max
Distance to Victoria airport (km)	17.05	6.10	0.97	24.99
Maximum elevation (m)	44.14	26.42	0	170
Elevation difference	1.59	4.23	0	50
Real interest rate (%)	1.62	1.19	0.31	4.45
Real GDP expenditure based (\$CA billions)	1.16	0.07	1.08	1.27

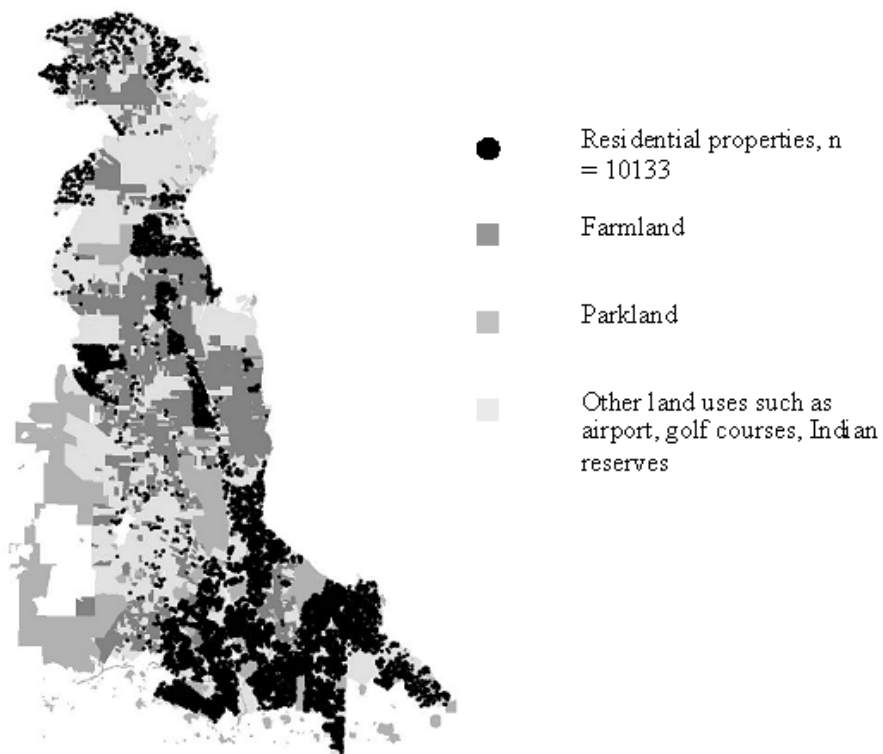
only the most recent transaction is included in the analysis. This refinement led to a total of 10,133 observations. The locations of these properties are indicated in Map 7.1, which also shows the locations of parks and farmland on the peninsula. Because our data span seven years, we had to adjust prices, assessed values, GDP and interest rates for inflation. We used the Consumer Price Index (CPI) to make the appropriate adjustments as others have done in this situation (e.g. Cho, Bowker and Park (2006)).

Empirical results

Assessed versus sales values

First we consider whether or not there are any significant differences between actual transactions and assessed values. The correlation coefficient between assessed and actual sales values for our 10,133 observations is 0.88. Though this is rather high, the overlap is not perfect. Actual transaction values are generally higher and have a larger standard deviation than assessed values, as indicated in Table 7.2. This is also apparent from Figure 7.2 where histograms of both assessed and sales values are provided. The distribution of assessed values has a mean closer to the mode and fewer observations in the tails of the distribution compared to sales prices. Though B.C. Assessment's stated goal¹⁹ is to have assessments match market prices, we believe the reason assessed values tend to be lower than market values is that the assessment authority wishes to avoid criticism and large numbers of appeals of assessments to reduce tax bills.

¹⁹ See their website <http://www.bcassessment.bc.ca/about/index.asp>



Map 7.1 Land use and location of residential properties on the Saanich Peninsula

Because B.C. Assessment uses sales prices as part of their formula to determine assessed values, we may also see less variation in the assessed values due to the fact that very expensive and very cheap properties are sold less often than average properties. Therefore, there are fewer such reference prices for B.C. Assessment to use compared to average properties.²⁰

In the SUR model, we partly correct for the difference between sales and assessed values by using a scaling factor (a) that minimizes $\sum_{i=1}^n (Assess_i - a \times Sale_i)^2$. This factor equals 0.81, so each assessed value was divided by 0.81. The corrected assessed values were then used in the SUR model with results presented in Table 7.3. A visual inspection of the parameter estimates in

²⁰ For instance, the lack of high property value benchmarks may suggest that assessors rate these properties closer to the average values than market prices would predict. There may be nonlinearities in prices for very large and luxurious houses and estates which are not captured well by B.C. Assessment's assessors.

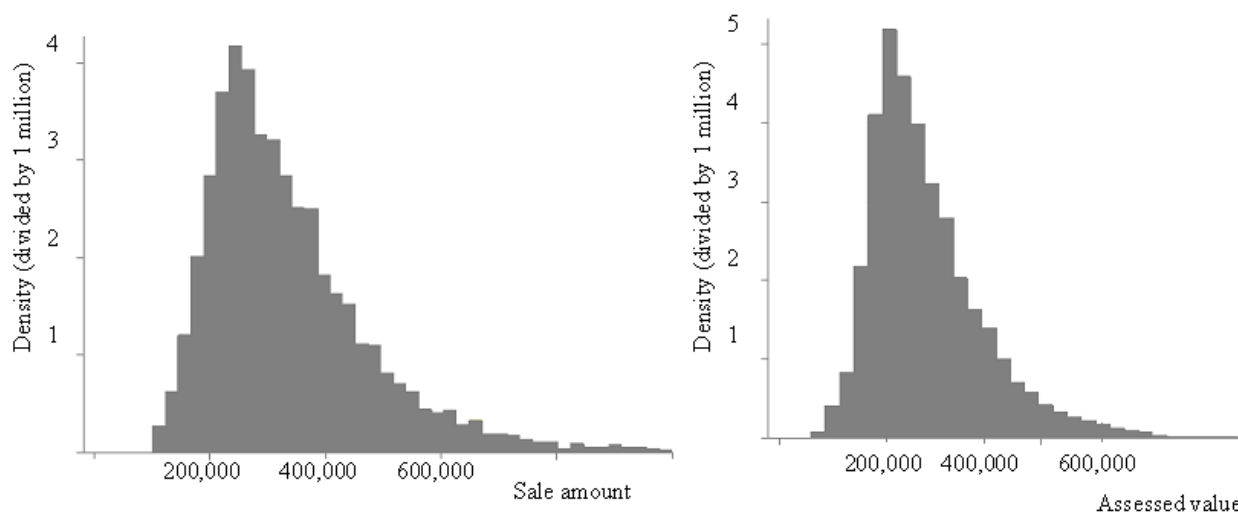


Figure 7.2 Histograms of assessed and sales values

the SUR model indicates that all parameters have similar signs in the actual sales and assessed values equations, except for the dummy variable of adjacency to a golf course, the log of distance to the highway and the log of distance to the nearest recreational centre, but these have no significant impact on sales or assessed values.

Based on the SUR model, however, we must reject the hypothesis that all 35 parameters included in the model (excepting the intercept) are equal across the two equations. The Wald statistic is 420.98 and, under the null hypothesis (that all parameters are equal), this is distributed as a χ^2 with 35 degrees of freedom. Therefore, we reject the null-hypothesis with near certainty. We also test for the parameters of particular interest – the Reilly indices for parks, farms and golf courses, adjacency dummy variables for parks and golf courses, and the distances to the ALR boundary. The Wald statistic for this test is 8.59 and is distributed as a χ^2 with 10 degrees of freedom; under these assumptions, we fail to reject the null-hypothesis that the parameter estimates are equal. (The p-value of the statistic is 0.57.) We conclude, therefore, that on first inspection the signs and sizes of estimated parameters look rather similar in the assessed and

Table 7.3 Estimation results for the spatial Seemingly Unrelated Regression (SUR)
 *** significant at 1% ** significant at 5% * significant at 10%

Dependent variable	Sales values (\$CA millions)		Adjusted assessed values (\$CA millions)	
	Parameter	t-stat	Parameter	t-stat
<i>EGLS estimation</i>				
Log of the lot size (m)	0.0649 ***	21.410	0.0657 ***	25.035
Effective year: the last major renovation of the property (year – 1900)	0.0006 ***	7.330	0.0002 ***	3.675
Log of the finished area (m)	0.0867 ***	20.402	0.0827 ***	23.663
Number of 3- or 4-piece bathrooms	0.0102 ***	5.953	0.0112 ***	7.972
Number of 2 piece bathrooms (toilet and wash basin)	0.0081 ***	4.382	0.0087 ***	5.722
Number of bedrooms	-0.0029 **	-2.665	-0.0035 ***	-3.980
Number of multi car garages	0.0213 ***	7.512	0.0232 ***	9.951
Number of single car garages	0.0065 ***	2.597	0.0085 ***	4.166
Number of car ports	0.0029	1.031	0.0030	1.304
Pool (=1 if there is a pool, 0 otherwise)	0.0157 *	1.846	0.0422 ***	6.074
Other buildings (=1 if there are other buildings, 0 otherwise)	0.0151 ***	4.776	0.0052 **	2.018
Corner lot (=1 if the lot is at the corner of a street, 0 otherwise)	-0.0028	-0.930	-0.0034	-1.370
Waterfront lot (=1 if the lot is on the waterfront, 0 otherwise)	0.3345 ***	39.314	0.3182 ***	43.905
Log of Reilly for parks larger than 50,000 square meters	-0.0032 **	-2.654	-0.0023 **	-2.054
Log of Reilly for parks between 2000 and 50,000 square meters	-0.0026	-2.120	-0.0026 **	-2.297
Log of Reilly for parks smaller than 2000 square meters	0.0024 **	1.865	0.0003	0.225
Adjacent to a park (=1, 0 otherwise)	0.0114 ***	2.817	0.0095 ***	2.759
Log of Reilly for farms with animals	-0.0189 ***	-9.021	-0.0170 ***	-8.671
Log of Reilly for farms without animals	-0.0014	-0.866	-0.0033 **	-2.273
Inverse squared distance (meters) to the ALR boundary if property is located within the ALR boundary, 0 otherwise	1.5668	0.668	0.0261	0.013
Inverse squared distance (meters) to the ALR boundary if property is located outside the ALR boundary, 0 otherwise	2.7688	1.385	2.7248	1.619
Log of Reilly for golf courses	0.0112 ***	5.260	0.0096 ***	4.571
Adjacent to golf course (=1, 0 otherwise)	0.0016	0.098	-0.0015	-0.109
Log of distance to Victoria City Hall (m)	0.0800 ***	10.262	0.0869 ***	11.354
Log of distance to Pat bay highway (m)	-0.0086	-0.498	0.0014	0.868
Highway within 100 m (=1, 0 otherwise)	-0.0249	-3.033	-0.0155 **	-2.059

Dependent variable	Sales values (\$CA millions)		Adjusted assessed values (\$CA millions)	
	Parameter	t-stat	Parameter	t-stat
Log of distance to the nearest standard school (m)	0.0148 ***	5.910	0.0132 ***	5.381
Standard school within 100 m (=1, 0 otherwise)	0.0092	0.832	0.0123	1.315
Log of distance to nearest recreational centre (m)	-0.0024	-0.818	0.00008	0.027
Recreational centre within 100 m (=1, 0 otherwise)	-0.0375	-1.077	-0.0082	-0.275
Log of distance to Victoria airport (m)	0.0794 ***	12.078	0.0852 ***	13.183
Maximum elevation (m)	0.0004 ***	6.041	0.0005 ***	8.225
Elevation difference (m)	-0.0003	-1.003	-0.0004	-1.511
Real Interest rate (%)	0.0031 ***	4.059	0.0120 ***	19.072
Real GDP expenditure based Canada (billions (long scale) of CA\$)	1.1046 ***	81.636	1.0391 ***	93.925
Constant	-3.3217 ***	-30.255	-3.3840 ***	-31.443
R-squared	0.5754		0.6289	
Adjusted R-squared	0.5740		0.6276	
System R-squared	0.4880		0.4880	
Number of observations	10133		10133	
Σ	$\sigma_1^2 =$	$\sigma_1^2 =$	$\sigma_2^2 =$	
	0.0084	0.0045	0.0057	
<i>MM estimation</i>				
P	0.3363	30.0842	0.4544	46.577

sales equation. However, they are not similar enough to assume that they are all the same in both equations. Yet, for the parameters of interest, the hypothesis that the estimated effects are the same cannot be rejected.

Impact of open space and the ALR

The impact of open space on property prices is rather mixed (see Table 7.3). Residents assign positive value to being adjacent to open space provided by parks and they also enjoy small open spaces in their neighborhood. Small parks are frequently used by parents if there is a children's playground and by pet-owners to exercise their dogs. Larger parks, which frequently provide recreation benefits (such as hiking, picnicking and wildlife watching), are also valued

but these parks are often used by citizens outside the immediate neighborhood who access the park with a car. Larger parks therefore result in negative externalities associated with noise, parked cars, and so on. This explains the finding of non-significant signs for the medium sized parks and a significant negative impact of the Reilly index for large parks.

The impact of nearby farms on residential properties is negative. The parameter for the Reilly score for farms with animals is negative indicating that the detrimental impacts of noise, odors, dust and other negative spillovers are more prominent than the positive, open-space attributes of farmland. The Reilly index for non-animal farms has a negative impact on residential property values, though it is insignificant in the market sales equation. This may indicate that there is a lot of variation in the value people attach to open space provided by farmland, perhaps reflecting the variation in the types of externalities generated by agricultural activities. Another interpretation of these findings is that, although property owners value open space provided by agriculture, they do not have confidence that the farmland will remain in agriculture, or even worse, that farmland could be converted to a less desirable use in the future (e.g, a shopping center, high-rise apartment, industrial park). Nelson (1992) hypothesized that, if buyers of residential properties expect farmland to remain in agriculture, an open space premium should be observed, but if buyers expect that neighbouring land will be developed in the future, no such premium should exist. Given that speculation is happening on the Saanich Peninsula (Cotteleer, Stobbe and van Kooten 2007), this is not an implausible explanation.

The two variables that indicate the distance to the ALR boundary from inside and outside the ALR are both insignificant, indicating that the ALR boundary has no impact on residential property prices. The reason is that proximity to farmland is already taken into account directly in the model.

The final open space indicators are provided by the Reilly index for golf courses and whether the property is adjacent to a golf course. While the Reilly score has a significant and positive effect on the sales prices of properties, the adjacency dummy is not significant (and even negative but still not significant for assessed values). This is contrary to the findings of Nicholls and Crompton (2007) who found positive impacts on properties that were adjacent to golf courses. The insignificance of this variable in our model may result from negative spillovers caused by parked cars, noise from the clubhouse, and so on. On the other hand, golf is a popular recreational activity, especially with older demographics (which comprise a significant proportion of the area's population). Golf courses nearby seem to be desirable as evidenced by the positive impact on property prices by the Reilly for golf courses. Both distance to the golf course and the number of holes matter in the Reilly index. Therefore, we can conclude that golf courses are less attractive land uses as providers of open space than as providers of recreational activities. This is contrary to findings of Asabere and Huffman (1996) who found a positive impact of adjacency to golf courses, but a negative impact of the reciprocal of distance to the entry gate of the golf course.

Spatial allocation

It is important to be aware of potential problems concerning multicollinearity of the explanatory variables in hedonic pricing models. In the current data we find that some of the explanatory variables are correlated. This correlation is mainly due to the spatial location of properties and the time properties were developed. For example, newer and larger properties with multi-car garages instead of single-car garages are found farther north on the peninsula. Properties on hill tops were generally developed later than properties at lower elevation levels. Newer properties tend to be located farther out from the city centre, in areas where population

rates are (currently) low, and tend to be more spatially distant from standard schools and recreational centers.²¹ However, we do not find symptoms of severe multicollinearity in our data, such as low significance of explanatory variables and high R^2 s at the same time. Therefore, we will discuss individual findings separately to illuminate the impact that the correlation between variables has in our model.

Examining the findings of other studies (e.g. Ready and Abdalla 2005) we would expect that distance to Victoria would be inversely related to residential property prices because people value a shorter commute to work. Other spatial features, such as the Swartz Bay ferry terminal (which provides access to the mainland), the main commuting corridor (the Patricia Bay highway) and schools, are expected to have a positive effect on sales price. However, we find a negative effect of proximity to the main business district of Victoria. There are two explanations for this. The first is that the distance to the Swartz Bay ferry terminal and the distance to Victoria are almost perfectly negatively correlated. The ferry terminal is located at the northern tip of the peninsula and the city centre is located at the southern end. These are opposite effects, and currently the positive effect of Swartz Bay seems to be stronger than the positive effect of being close to the city centre. Another explanation is that in general more expensive properties are built farther north on the peninsula, both farther away from the city centre and most other facilities. This automatically influences the prices in different regions of the peninsula. Furthermore, being within a region of 100 meters from the highway has a negative effect on property prices, due to negative externalities of the highway such as noise and pollution. Proximity to standard schools also seems to have a significant negative impact on property values perhaps due to the vandalism and loitering associated with some schools.

²¹ Presumably, once the density is high enough and the population demographics demand it, schools and recreation centres will be built in areas of new subdivisions.

We did not only incorporate spatial explanatory variables in our model, we also included spatial error dependence. Sure enough, we did find evidence for this type of spatial dependence, meaning that the error terms of relatively close properties are correlated (though error terms of properties which are relatively farther away from each other do not show the same effects). This type of correlation is higher for assessed values than for sales values, which makes sense as assessments specifically take neighboring property values in account while sales prices do not.

Housing characteristics

Most housing characteristics in our model have the expected sign that past literature and intuition dictates. Lot size, finished area and the number of bathrooms all positively indicate a more valuable house as does the effective year. Beyond size and newness, there is a puzzling finding though. One would expect the number of bedrooms to positively affect housing value as they can be seen as indicators of property size and degree of luxury. However, we found negative effects. Perhaps buyers do not regard a bounty of bedrooms as positive because, for a given house size, they prefer fewer but larger bedrooms as opposed to more numerous and smaller rooms.

The impact of garages is fairly predictable with multi-car garages being more highly valued than single-car garages which are more highly valued than car ports. Car ports are more valued than no parking structures (though this difference is not significant). Also as expected, water front lots are significantly more highly valued than non-water front, owing to the views and the recreational opportunities. Similarly, the presence of other buildings or a pool on the lot adds to the overall property value. Though they tend to be slightly larger, corner lots are less private and experience more traffic and noise externalities, and so it is not surprising that they are valued less than non-corner lots (though this effect is not significant).

Data on some house characteristics which are likely to significantly influence price were not available. An example of this is the quality of the finishing used in the house such as the presence of teak floors versus outdated carpet or the presence of granite countertops versus laminate countertops. This missing information is incorporated into the error term and also explains why the R^2 is not 1.

Other characteristics

With respect to elevation levels, we find that properties that are located higher up on a hill sell and are assessed for more than similar properties located at lower elevations. Hilltop locations in this area afford views of farmland and the ocean and buyers are willing to pay a premium for these properties. Within-property elevation differences have a slightly negative though non-significant effect.

Because our data span about seven years, we included macroeconomic information (interest rates and GDP) to reflect the general state of the economy. To correct for inflation over this time period, both variables were adjusted by the Consumer Price Index (CPI). Real GDP has a significantly positive impact on property prices, indicating that the higher GDP rises, the higher the demand for houses is, which directly translates into increases in property prices. The impact of interest rates is also positive, which seems counterintuitive as mortgage rates and interest rates are linked and higher mortgage rates mean housing is less affordable. This could indicate that the interest rate is being endogenously determined by high housing prices. However, a possible exogenous explanation could be that the real interest rates were not very high during this period (varying between 0.31% to 4.45%). Therefore, paying a slightly higher interest rate did not scare people off from buying properties as the rate of increase in housing prices more than compensated for the money spent on interest payments on loans and mortgages.

Conclusion and Discussion

In this research we investigate whether assessed values are good proxies for actual sales values in a hedonic pricing model that we use to estimate the value of open space on the Saanich Peninsula, British Columbia, Canada. In particular, open space provided by farmland, parkland and golf courses is examined and also open space under semi-permanent protection in the Agricultural Land Reserve.

A spatial Seemingly Unrelated Regression model is estimated to construct a test statistic for the comparison of the parameters in assessment and sales equations. The results indicate that although not all parameters in the assessment and sales equations are the same, we fail to reject the hypothesis that the estimated impacts of open space on property values are the same using both measures. However, we do observe some differences between the distributions of assessed versus sales values. Specifically, we observe that average assessed values are lower than average sales values and the variation in assessed values is smaller than in the sales prices. To overcome the difference in means, we divided the assessed values by a factor 0.81, resulting from the factor

(a) that minimized $\sum_{i=1}^n (Assess_i - a \times Sale_i)^2$.

These findings imply that assessed values may be used in place of market values as the dependent variable in hedonic pricing models if one is interested in the impact of open space on property values. Though it may be necessary to scale the distribution of assessed values. To do this, average sales values can be used to scale assessed values. In our research the factor assessed / sales values results in 0.84, which is rather close to the factor we used (0.81). Using average sales values is not necessarily an insurmountable problem because these values are much more accessible than parcel-by-parcel information. Furthermore, it is important to note that property

assessment systems may be very different in other jurisdictions in North America or Europe which could affect the validity of applying these results to other locations.

With respect to open space we find somewhat mixed results. The reason is that open space in all three capacities (nature, agriculture and golf courses) imposes both positive and negative externalities on surrounding residential properties. Properties adjacent to nature parks sell for a premium, but people seem to prefer smaller parks instead of larger parks close to their homes. The smaller parks can be used for short term recreation but do not cause the inconveniences that large parks do when people visit them by car. Furthermore, open space provided by agricultural land is not valued positively by residents, at least as far as housing prices go. The negative externalities associated with farmland seem to override the positive externalities, especially for animal farms. The uncertainty surrounding future land uses of undeveloped land may also play a part in this finding. Finally, we find that golf courses provide positive benefits for residents. Residents pay higher prices for houses that are located closer to (larger) golf courses, although having a house adjacent to a golf course does not increase its value *ceteris paribus*.

The Reilly index used in this study is an improvement on past methods using buffer zones as it incorporates both distance between the parcel and the feature of interest and the size of the feature. This eliminates the arbitrariness of buffer zones and allows larger open spaces to have more influence *ceteris paribus*. One downfall of the Reilly index however, which limits its usefulness, is there is no simple interpretation of the coefficients. An increase in the Reilly index of one unit has an infinite number of possible meanings.

The inclusion of spatial autocorrelation in the model is very important. Spatial autocorrelation was taken into account in both the sales and the assessment equation. We found

highly significant positive spatial correlation between the error terms of properties that are located close to each other. With respect to spatial explanatory variables, we found that they are correlated with property characteristics. Newer properties are built further north on the peninsula, on higher elevation levels, are larger on average and more often come with multi car garages.

This research provides a geographic example of how housing prices respond to open space at the urban fringe and how agricultural land preservation systems (in this case zoning) interact with price. Answers to these questions can be used to inform urban planners, geographers, policy makers and others about issues related to taxes, urbanization and the preservation of agricultural land and parkland.

8. Conclusion

The urban fringe is an interface that frequently is the subject of controversy on local or regional levels. There are powerful forces which seek to develop land there such as real estate developers looking to make a profit, wealthy urban residents who wish to live in a more rural setting and/or on large estates, and housing advocates and politicians who wish to see housing prices reduced by increasing the supply of housing. On the other hand, there are different groups which strongly oppose the further encroachment of the city onto the surrounding farmland, such as environmental advocates, residents at the current urban fringe, and citizens concerned about preserving farmland for future use or other amenities it provides.

The debate over farmland preservation and development is very pronounced in British Columbia, where urban housing prices in Vancouver, Victoria and other large cities have been skyrocketing in the last decade and where farmland is distinctly identified and protected in the Agricultural Land Reserve. Because of B.C.'s geography and history, most cities are located along waterways and in the southwestern corner of the province which is the land most coveted for three main uses – human settlement and development, environmental protection and habitat, and agriculture. In some respects, the latter two (environment and agriculture) are compatible; waterfowl and raptors use fields for food, shelter and hunting grounds. It is the introduction of the third element (urban development) that is irreconcilable in most cases.

Agricultural land provides many advantages to nearby urban areas including open space, recreational areas, and environmental services such as flood protection. Many people also see agricultural protection as a stop gate against urban sprawl. These positive externalities are unpriced and largest uncompensated which means they are likely underprovided. Many benefits

of farmland also have a public goods aspect to them, which also predicts they would be undersupplied.

The classic economic solution to public goods and positive externalities is for the government to either provide the good directly or to subsidize the production of the good. In the case of farmland, the province of British Columbia has tried another approach – regulation of the good to prevent its conversion to alternative uses. This regulatory approach is less financially costly for the province than mechanisms like the purchase of development rights (PDR) that are employed in the U.S., but suffers from equity concerns (farmers were not compensated when the ALR was formed) and ultimately may not be as effective or permanent. Although surveys in the past showed high support for the ALR and for protection of farmland (Quayle 1998; Walker 2005), more recently there have been calls for more land to be excluded from the ALR to alleviate Vancouver's high housing prices (Lazaruk 2008). The major downfall of a zoning system like the ALR is it depends upon the political will of the day. If enough people are convinced that more low-density urban development (which necessitates a land base to build upon) is a higher priority than agricultural land preservation, the ALR could be undone relatively quickly. A system like a PDR that is built upon restrictive covenants and legal easements being placed on the land is more permanent for the land it does protect.

It is unknown and perhaps impossible to determine which system of agricultural land preservation, of all the ones in operation, is the best overall. The answer would depend very much on the preferences of the population seeking the preservation. Economic theory is also unable to assist in answering this question. Theory suggests that public goods and positive externalities will be underproduced in a free market. However, B.C.'s system of zoning and agricultural land regulation is hardly a free market. So it is possible to say that a free market

solution is not optimal, but it is not possible to say if the ALR has arrived at an optimal amount of preserved land or even what side of optimal it may be erring on. The ALR could be under-protecting farmland and thus short-changing the benefits it spreads to the nearby urban community, or it may be overprotecting land and causing housing prices to be inefficiently and unnecessarily high. If the ALR was water-tight and no land was ever permitted to leave the reserve, the price differential would indicate the value of development rights on the land. However, since the ALR has witnessed considerable shifting of land into and out of the reserve province-wide, this signal is also muted and polluted with the effects of speculation on the farmland.

Illuminating public preferences would help answer other questions as well, such as whether the growth of hobby farming on the urban fringe is desirable or not. If British Columbians are primarily concerned with slowing urban sprawl or open space preservation, the growth in the number of hobby farms is a positive step. If they are more concerned with safeguarding a way of life or agricultural output from the land, the growth of hobby farms is likely counterproductive. Therefore, one important further step in this line of research is to conduct a survey or somehow ascertain the preferences of the people of B.C. regarding agricultural land preservation.

The decision process surrounding the ALR has been another source of controversy in B.C. In recent years, many advocacy groups have focused their efforts on protesting against what they see as too lenient exclusions of land out of the ALR (Campbell 2006; Green 2006). The research in this dissertation, however, suggests that ALC decisions may not be associated with the factors that they are reported to be associated with. For instance, there is not compelling evidence in the data studied here that the political party in power at the time is a key factor in

whether an exclusion will be allowed. What does seem to be important is spatial relationship to the main transportation corridor. This could be seen as a positive finding for environmentalists and farmland advocates as it means that land that is adjacent to other major developments is more likely to be excluded. Developing this land, which itself likely suffers from negative externalities such as pollution and vandalism, and not land that is more remote from current development, will help sustain agriculture for longer in the urban fringe. Findings such as this also can help planners and policymakers when facing land use decisions. If they care about minimizing impacts on agriculture land, they ought to give careful consideration to road placement.

Protection of agricultural land has impacts not just on the micro level (the farmer) and on the macro level (society as a whole) but also on an intermediate level – those that live near the land and can benefit from or be harmed by externalities that emanate from it. Residents who have land bordering on or near to farmland may have higher property values due to the scenic views they enjoy but they also may have to deal with farm sounds, smells and slow-moving equipment. It is possible to observe the degree to which these externalities are capitalized into land values using hedonic pricing models. Higher values would indicate that people are willing to pay more to be near agriculture and lower values may indicate that the negative externalities are outweighing the positive benefits (Huang *et al.* 2006). Nelson (1992) hypothesized that nearby residents should be willing to pay more for open space views which are protected and less for ones which lack any protection status. This research was able to directly test that hypothesis by seeing if people pay more to live closer to parks than farmland and also by seeing if the distance to the ALR boundary (which is quasi-protected land) is significant. Chapter seven concludes that both nearby large parks and farms with animal agriculture provide more negative

externalities than positive ones which results in lower property values. Non-animal agriculture was not significant which could mean that either the positive externalities balance the negative ones, or that perhaps people are not willing to pay more to live near farmland because they do not have confidence it will remain so in the future. (See photo 8.1)



Photo 8.1 Urban fringe of development onto farmland, Fraser Valley

Academics and government policy researchers alike can benefit from the finding that assessed values seem to be an acceptable proxy for market values when considering the impact of open space on property values. Since assessed values are generally more easily obtained than market values, this could increase the accuracy and reduce the cost of conducting research into open space premiums. This could make research of this sort feasible for local governments to undertake which could help planning departments situate new parks and could help governments determine if more open space could be self-financing (through the increased property taxes which result from increase property values) (Geoghegan, Lynch and Bucholtz 2006).

The topic of agricultural land values in the urban fringe is a complex and multi-dimensional issue that could never be completely investigated in a single work. However, it is hoped that this dissertation has illuminated some aspects of the issue and will constructively add to society's body of knowledge about farmland preservation. Research often raises additional questions to be answered in subsequent work, and this dissertation is no exception. It is hoped that the author or other researchers will be able to build upon the foundation here and enrich policy-makers with even more answers and detailed information in the future.

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