

**The Provision of Goods
and Farm Policy in Canada**

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THE PROVISION OF GOODS AND FARM POLICY IN CANADA

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Introduction

Government intervention in the economy has a long history. This is true for the Canadian economy as whole and is very apparent in the agricultural sector. One of the drivers of government policy has been an attempt to address market failures in the production, marketing, and consumer demand for goods and services.

Government provides some goods and services (e.g. extension and food inspection), others are provided by a heavily regulated private sector (eg. railways, telecommunications), while still others are freely provided by the private sector (eg. machinery, fertilizer). Economic theory suggests that the need for various forms of intervention, and the effectiveness of various policies, differs by the type economic good in question. Indeed, the type of policy used to address market failures is often driven by the nature of the goods and services that are provided or that are used as key inputs.

1.1.1 Objectives of the Paper

The objective of this paper is to summarize how goods can be classified into four types using the attributes of excludability and rivalry. Using this classification the paper illustrates the policies that are often used to govern the various types of goods. The paper also provides specific examples of policies affecting the agricultural sector.

1.1.1 Scope of the Paper

Any paper written on the agriculture and food sector in Canada will be an abbreviation of the many problems, ideas, and political and social agendas of the day. This paper will be no exception. We will confine our analysis to a welfare economics perspective. While

dealing with a broad spectrum of policies, goods and services, we do not attempt to be fully comprehensive; rather we use specific examples to build our arguments.

1.1.2 Outline of the Paper

The paper is organized into four chapters. The remainder of Chapter 1 employs a welfare economics framework to describe how the attributes of rivalry and excludability can be used to classify goods into four categories – private, public, common pool and toll goods. Chapter 2 provides a review the policies that are often used in the economy to address the market failures associated with each type of good. This framework is then used in Chapter 3 to analyze Canadian agricultural policy. Goods and services important for agriculture are classified; this classification is then followed by a description of how policy has evolved to manage each of them. Chapter 4 concludes the paper by contemplating how changes in policies used to address public goods, toll goods and common pool goods has affected the competitiveness, the income levels, and the structure of the Canadian agricultural sector.

1.2 Applied Welfare Economics as Policy Framework

Markets have long been recognized as an effective mechanisms for the allocation of goods and services. Adam Smith (1776) pointed out that if competitive firms act in self interest, the resulting market prices will act as an “invisible hand” to guide the optimal production of goods and services. More recent economists have shown, via neoclassical economics and applied welfare economics, that under certain well-defined conditions the market will create the maximum economic surplus for a society, a result that is consistent with Smith’s findings.

At the core of this result are three assumptions: (1) that markets behave competitively; (2) that the demand for a product reflects both the marginal private benefit of the product and the marginal social benefit (i.e., the marginal social benefit equals the marginal private benefit); and (3) that the supply of a product reflects both the marginal private cost of production and the marginal social cost of production (i.e., that marginal social cost equals marginal private cost). When the first assumption holds, the equating of supply and demand in a market means that marginal private benefit equals marginal private cost. When the latter two assumptions also hold, the equating of marginal private benefit and marginal private cost means that marginal social benefit equals marginal social cost, and as a consequence social welfare is maximized.

Markets, however, will not result in maximum economic efficiency if either: (1) markets are non competitive; or (2) marginal private benefits (costs) deviate from marginal social benefits (costs), creating externalities. The first condition generally occurs when markets are highly concentrated – e.g., a very small number of firms possess most of the market share. The second condition occurs when some of the costs and benefits are external to the players that buy and sell products – hence the term externalities. These external benefits (costs) are reflected in marginal social benefits (costs) that do not match with the marginal private benefits (costs) used by individuals and firms in their decision-making.

These two features are important in agricultural markets. Outside of the primary farm production sector, most of the segments of the agriculture supply chain are highly concentrated (see MacDonald (2001) for empirical evidence, and Rogers and Sexton (1994) for a general theoretical explanation, of this concentration. Fulton and Giannakas

(2001) provide a detailed theoretical and empirical examination of concentration in the seed and chemical input industry). As will be shown in this paper, an important reason for the high degree of concentration is the nature of the goods that are used as inputs into the production processes used in each of the supply chain segments. The nature of a number of the products and services provided in the agriculture supply chain also means that private benefits (costs) can often diverge in important ways from social benefits (costs).

The next section explores the nature of goods and services and examines how this nature affects concentration and the equating of marginal social benefits (costs) with marginal private benefits (costs).

1.3 Classification of Goods

Economists classify goods based on two of their key characteristics – excludability and rivalry (see, for example, Romer (1990, 1994)). Excludability refers to the ability of one person to prevent another from using it; if a good is excludable, its owner can limit access to it. The degree of excludability depends on both the technological aspects of the good and the legal system.

Rivalry (also known as subtractability) refers to the extent that the use of a good by one individual precludes the use by someone else. If a good is purely rival, its use by one person or firm means another person or firm cannot use it. If the use of a good by one person or firm in no way restricts others from using the same good, then it is purely non-rival. Many goods and services are rival. For example, burning one litre of gasoline will mean this litre is not available to others to burn. Other goods are purely non-rival; one individual can use a broadcast television signal without reducing the availability to other

individuals. Although the degree of rivalry depends largely on the technological aspects of the good, goods may be rival or non-rival depending on their usage. A road is purely non-rival when not congested. As the road becomes somewhat congested it becomes somewhat non-rival as the use by one individual reduces the accessibility to other individuals. When a road reaches its carrying capacity it becomes a rival good because the use by one individual fully displaces access for another.

1.3.1 Implications of Non-rivalry and Non Excludability

If a good is excludable, the owner of the good can trade access to the good in exchange for a payment. If a good is non-excludable, other producers or consumers cannot effectively be excluded from the market and some will use it for free. The result is that there will be some spillover of either the benefits or the costs – i.e., an externality is present. Following from the earlier discussion, the consequence of the existence of non-excludable goods is that the market may not give rise to the efficient allocation of resources.

Non-rival goods have important implications for the cost structure of firms and hence industry concentration. When a firm makes use of non-rival input – a good example would be an information network – the average cost per unit of production decreases with output (i.e., there are economies of size). With this cost structure the marginal cost – i.e., the cost of the last unit produced – is always less than the average cost of production. Goods with this cost structure cannot be produced in a competitive market where price equals marginal cost, since this outcome would result in firms losing money. In order to earn non-negative profits, firms must become large enough (i.e., the industry must become concentrated enough) so that they have the market power to raise

price above marginal cost. The push to concentration is also strengthened because the economies of size that they possess provide an incentive to expand output. Since only firms that are roughly as large will be able to be cost competitive, the industry is soon composed of a small number of firms that are able to exert market power.

Non-rival goods can be also be more difficult to make fully excludable since purchasers of the good can share their purchase without cost. Sharing a rival good such as a sandwich reduces the consumption of those sharing the good, whereas sharing a digital copy of a favourite song or movie has no cost. Thus the properties of rivalry and excludability are often interrelated.

1.4 Types of Goods

Economists have used the properties of rivalry and excludability to classify goods into four types – *private goods*, *toll goods*, *common pool goods*, and *public goods* (see table 1). The unique combination of rivalry and excludability for each type of good creates specific issues with their management. Goods that are both rival and excludable are referred to as *private goods* because private individuals and firms are able to own and control them. Examples of a private good are fuel and sandwiches. *Toll goods* are excludable and non-rival – their excludability means that a toll or charge can be levied for their use. A good example of a toll good is a toll highway. *Common pool goods* are rival but non excludable. The fact that these goods are non excludable means private ownership cannot occur – the goods effectively are owned by everyone in a group. Ocean fish are a good example of a common pool good (only after scarcity sets in). Finally *public goods* are both non-excludable and non-rival. These goods are effectively owned

and used by everyone – hence their public nature. Free radio signals are an example of a public good (another example would be public laws or public policy).

Note that the classification of goods in table 1 is presented as four discrete types. However, given that both excludability and rivalry rarely exist in a pure form, a whole continuum of types exists. For instance a fully excludable good that is somewhat non-rival would be an impure form of a toll good.

These different types of goods have different implications for concentration and the creation of externalities.

1.4.1 Private goods

Since private goods are both rival and excludable, they typically do not cause the problems (e.g., externalities and concentration) discussed above. As a result, these goods will not be discussed in any detail in this paper.

1.4.2 Toll goods

The non-rival nature of toll goods means that they are likely to result in significant market concentration if they are used as key *inputs* into a production process. Figure 3

Table 1: The Classification of Goods Based on Rivalry and Excludability

	Rival	Non-rival
Excludable	Private good e.g., sandwich, fuel	Toll good e.g., toll highway
Non-excludable	Common-pool good e.g., ocean fish	Pure public good e.g., radio signal

shows the cost structure of a product that is produced using a toll good. Because the toll good input is non-rival, it only has to be purchased once. The result is that the average cost of producing the final output decreases with the quantity produced as the cost associated with purchasing the non-rival input is spread over more and more units. The declining average cost implies that large firms will always have a cost advantage over smaller firms. The lowest average cost can be achieved if the good were supplied by a monopoly. If a private monopoly is allowed to exist they can be expected to use their market power to maximize profits by setting quantity produced to the level where marginal revenue equals marginal cost (figure 3).

Normally an opportunity for profits attracts more firms into the industry, which in turn lowers prices and increases the average cost of production as firms share the market. The end result is typically an oligopoly, where price is approximately equal to average cost (i.e., no excess profits exist). A competitive outcome where price equals marginal cost will not exist for products produced using toll goods because marginal cost is always less than average cost. Given the market failure associated toll goods governments have at times provided these goods through state monopolies or regulated the price and quantity of the private monopoly or oligopoly.

The cost structure illustrated in Figure 1 occurs in many industries (examples from agriculture include railway service provision, grain marketing through multinational enterprises (MNEs), and seed and chemical production; these will be discussed in more detail below). Governments have responded to the market concentration caused by non-rival inputs in a number of ways including: price regulation (e.g., regulated power

utilities); mandated network sharing (eg. telecommunications); and government provision (e.g., power utilities and telecommunications).

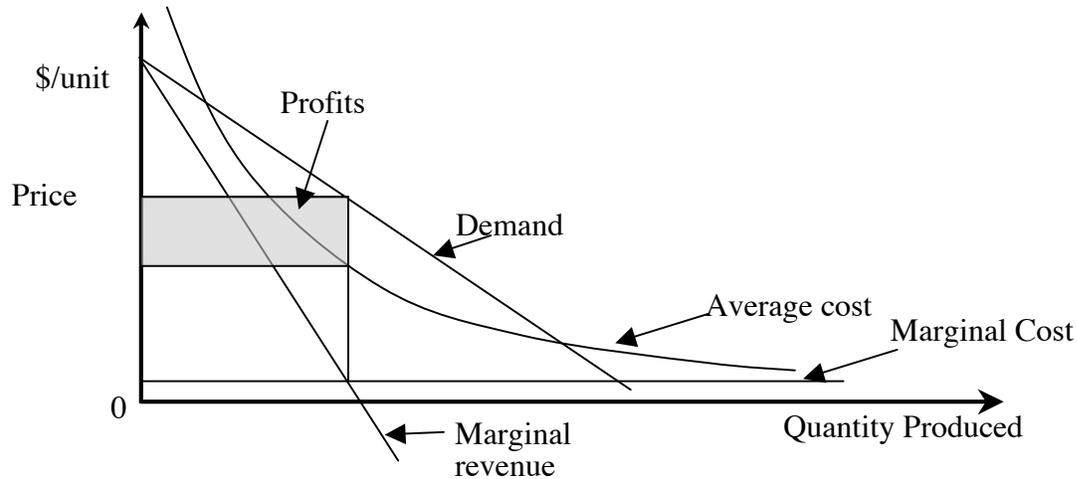


Figure 1. The supply and demand of a toll good

1.4.3 Common pool goods

Common pool goods are rival and non excludable. Many environmental and resource problems involve common pool goods. For instance, ocean fish supplies are a resource with unlimited access – hence they are non excludable. At the same time, fish supplies are rival goods because if one person catches a fish another person cannot catch it.

The lack of excludability creates the conditions for market failure. In the case of ocean fish supplies, the lack of excludability leads to over fishing –in economic terms, the marginal private cost of catching another fish is lower than the marginal social cost. Governments have addressed the market failure associated with common pool goods in a number of ways, including assigning property rights to the resource and regulating access.

1.4.4 Public goods

Public goods are both non-rival and non-excludable. Because of the non-excludability, a pure public good cannot be profitably produced through the market place – if were to be produced by a firm, for instance, the firm would be unable to earn any revenue in selling it. To address this problem, public goods are often produced by government agencies or non-profit entities; governments also attempt to make the good excludable, thus turning it into a toll good.

The choice of providing the good through government agencies or turning it into a toll good has very different ramifications for market structure. Consider the case where the public good is used as a key input into the production of another product. If the public good is turned into a toll good, then, as argued earlier, economies of size will be present in the production of the final product and a highly concentrated market will emerge. However, if the public good is provided at little or no cost by a public agency (i.e., taxpayers, through a public agency, incur the cost of producing the public good), then the same economies of scale will not be present and the industry will not become as concentrated.

CHAPTER 2. INSTITUTIONS TO MANAGE, PRIVATE, TOLL, PUBLIC, AND COMMON POOL GOODS

2.1 The role of property rights

Property rights are an essential element of a market economy. They are typically defined and defended through laws created by government and are only meaningful if the rights are enforced by the legal system. Property rights create excludability and therefore can change the classification of a good. For instance, if property rights are introduced for a common pool good, which is non-excludable and rival, the good becomes excludable and rival, moving it into the private good category. Similarly, if property rights are introduced for a public good, which is both non-excludable and non-rival, it is transformed into a toll good.

The ability of property rights to create efficient markets is heavily dependant on transaction costs. According to Williamson (1985), each market exchange has transaction costs including a search cost for the parties to find one another, a negotiation cost to determine the terms of exchange, a monitoring cost to verify that the terms of exchange were met, and finally enforcement costs to keep the parties honest. In a well-established commodity market, these transactions costs are low enough to be trivial. However, as Williamson (1985) points out, when transactions are large, idiosyncratic, and infrequent, the transaction costs associated with exchange may be large. Coase (1960) argues that transaction costs are important and influence the efficacy of alternative property allocations. For instance, firms are one way of combining steps in the supply chain when transactions cost are large.

Over time a number of institutions have been developed to address the market failures created by tolls goods, common pool goods and public goods. We discuss some

examples for each of the types of goods. Private goods have a full assignment of property rights.

2.1.1 Governance of Toll goods

The non-rival nature of toll goods means that a non-regulated private industry using these toll goods as inputs will be concentrated and the prices of the final product will exceed the marginal cost of production. The institutions that have been introduced to govern the provision of toll goods are perhaps the most diverse and interesting in economics. Five approaches commonly used are:

- 1) Government production of the toll good. Consumers are charged a price equal to marginal cost, with the remainder of the revenue made up by taxpayers. As shown as Q^* in Figure 2, such a pricing strategy equates the marginal cost of production with demand, resulting in the maximization of total economic surplus. Public transportation such as buses often operate this way.
- 2) Government production of the toll good as a non-profit state monopoly where consumers are charged a price equal to average cost (Shown as point Q_r in figure 2) In this case some of the consumer surplus is given up creating a dead weight loss; however this solution does not require taxpayer subsidization. Publicly owned electrical utilities were often provided this way.
- 3) Government grants a private firm the monopoly power to provide the good and then regulates the rate of return. The private firm may be able to manage the production more efficiently than government, but will demand a normal rate of return on their assets, thus the price level will have to cover this rate of

return. Private electrical utilities are often given a monopoly over the network and have a regulated rate of return.

- 4) Governments allow an oligopoly to produce toll goods with some regulations to enhance entry and competition among firms. Entry serves to limit the profit level in the industry, such that price is approximately equal to average cost. One important way of encouraging entry is through the support and development of co-operatives. Co-operatives and NGOs have played a significant role in the provision of toll goods. Historically, governments have supported the development of co-operatives through education, the provision of credit and supportive regulation. These co-operatives then operate in a mixed oligopoly providing additional competition for the other firms while providing a flow through of benefits to members. The grain industry, the dairy industry and the fruit industry are all examples of industries where co-operatives formed.
- 5) Governments provide the toll good input at a subsidized price, thus limiting the fixed costs and reducing concentration in the production of the final product. Government development of new varieties which are then released at virtually zero cost to seed growers is an example of this strategy.

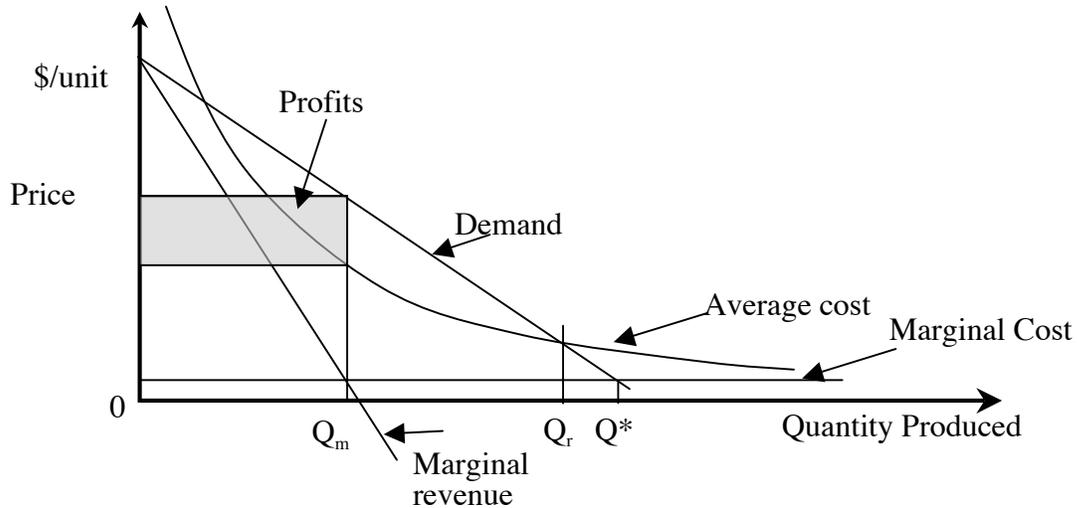


Figure 2: Alternatives for the provision and pricing of toll goods

2.2.2 Governing Common Pool Goods

A number of interesting institutions have been developed to govern the production and use of common pool goods because of the inadequate private incentives to produce or conserve these goods. Despite the progress in developing institutions many natural resources continue to be subject to environmental degradation, creating challenges for policy makers throughout the world. In modern economies governments often play a critical role in creation of institutions designed to limit access to, use of and/or to produce common pool goods. Specifically common pool goods are often governed through:

- 1) government regulation of access or limits to access (eg. hunting limits, fishing limits, pollution limits);
- 2) government taxation (subsidization) for the use (production) of common pool goods;

- 3) creation of a non-profit groups with the authority to regulate access – e.g., regional water authorities; land use councils:
- 4) the assignment of property rights (e.g., fishing quotas, privatization of land, and the creation of tradable emission permits).

In these arrangements the transactions cost of determining the optimal use, of monitoring, and of enforcement can be important. The need for local and user input into use decisions has often meant that local governments or user groups are actively involved in the management of these goods. Government regulation gives these groups the legal authority, which is often backed with enforcement and penalty provisions.

In addition to these institutions commonly facilitated by government, many societies, particularly Indigenous peoples, have developed social or religious norms that conserve the common pool resources deemed to be important for the society.

Despite the recognition of the causes of market failure for common pool goods and the remedies available, significant market failures continue to persist. Air pollution, water pollution, and general environmental degradation are persistent problems in many parts of the world. Perhaps the greatest problems are global where no international government exists to create and enforce regulations. Two obvious examples are the destruction of international fisheries and the emission of greenhouse gases. As these problems worsen and global society grows wealthier, there will be increased pressure to find solutions to these common pool problems.

2.2.3 *Governing Public goods*

A number of institutions have been developed to govern the provision public goods. The dual sources of the market failure (non-rivalry and non-excludability) make these goods particularly challenging to govern in a market economy.

In cases where property rights cannot be enforced without high transaction costs, even if they are created, public good provision has remained largely a role for government. This includes the provision of goods such as national defense or basic scientific research. In this case the government spends public resources to fund the production of public goods. To reach the optimal level, the government must gauge what is the social demand for the good. Without market signals the government must use indirect measures of social benefits to determine how much investment should be made in public goods and where the investments are placed. Because of the short run nature of the electoral process, long term investments in public goods are often under funded. Given the budget constraint of governments the efficiency cost of raising additional tax dollars also needs to be incorporated in the welfare analysis.

In some cases public goods are provided by a *club* where members agree to tax and to create a public good for the benefit of the members. Often these clubs receive either financial or regulatory support from the government.. In agriculture, voluntary levy-funded research organizations (eg. Saskatchewan Pulse Growers) and charitable conservation organizations (e.g., WWF) fall into the category of a club.

In of the case of some public goods it is feasible to assign and enforce IPRs – i.e., to transform the public good into a toll good. Where public goods were formerly produced by the public sector, the assignment of property rights is often part of a privatization strategy. Unfortunately, the assigning of property rights to a public good

cannot fully address the market failure, since markets will not efficiently manage toll goods.

CHAPTER 3. TOLL, PUBLIC, AND COMMON POOL GOODS IN CANADIAN AGRICULTURE AND POLICY OPTIONS

3.1 Introduction

In this chapter we use the classification scheme presented in Chapter 2 is used to describe the nature of the goods that are key inputs and outputs of the agricultural sector. The chapter also discusses how government policy has evolved to address issues related to non-rivalry and non-excludability of these goods using specific examples from the sector. Where relevant, the market implications of the policy choices are discussed.

Table 3.1 contains a classification of goods that are key to the agricultural sector in Canada. A number of the goods are key inputs for the sector while others are outputs for the sector. Some of these goods affect farmers directly, while other goods affect upstream and downstream upstream firms in the sector. The remainder of the chapter is written in four parts corresponding to the four quadrants in the Table 3.1.

3.2 Public Goods

There are many public goods that are important to Canadian agriculture. Some of these goods are inputs supplied by the environment such as sunlight and rainfall. For these inputs, policy plays little role in their provision. Other public goods, such as unprotected knowledge, public information, and public infrastructure, require financial resources to create. The inherent non-excludable nature of these good eliminates the private incentive to produce these goods. Policy therefore plays an essential role in the provision of public goods.

Table 3.1: The Classification of Goods in Agriculture Based on Rivalry and Excludability

	Rival	Non-rival
Excludable	Private goods <ol style="list-style-type: none"> 1. agricultural commodities 2. material inputs <ul style="list-style-type: none"> • land, • labour, • pesticides 	Toll goods <ol style="list-style-type: none"> 1. marketing and input procurement services- intelligence, information, promotion, logistics 2. management - agronomic and financial 3. intellectual property (IP) 4. regulatory compliance and reporting 5. Networks and specialized non-rival assets
Non-excludable	Common-pool goods <ol style="list-style-type: none"> 1. environmental protection 2. generic commodity quality 3. crop insurance 	Public goods <ol style="list-style-type: none"> 1. sunlight, rainfall 2. unprotected knowledge and know-how 3. public information statistics etc. 4. public infrastructure

When production of public good inputs are deemed to be important to the sector, governments have responded in largely one of two ways – they have invested directly in the provision of these goods or they have created and assigned property rights so that a private incentive is created to supply the goods. Three interesting examples to examine are crop genetics, agronomic extension, and public highways.

3.2.1. Crop Genetics

Most crop genetics are public goods, since they are both non-rival and non-excludable (one exception is hybrids – see below). Once a new superior genetic combination has been developed in the form of a new crop variety, the new genetic traits can be replicated for only nominal cost through the offspring. This non-rival attribute not only makes these innovations important for productivity improvement across the entire sector, it also makes it difficult to exclude others from using the innovation. The non-excludability of many crop improvements – seed can be easily shared among farmers or held over until

another year – means that there is very little private incentive for their production. Historically, governments have recognized the economic importance of these innovations, as well as the lack of private incentives to undertake the research. As a consequence, they have publicly funded crop research as an important aspect of an agricultural development strategy. The persistent high rates of return that are found in most crop breeding programs indicates that, despite significant expenditures, research continues to be under funded.

Beginning in the 1970s, governments began using another policy instrument, namely intellectual property rights, to encourage genetic crop research. All new crop varieties in Canada are now afforded some excludability through the use of Plant Breeders Rights based on UPOV 1978. Under these rules, variety owners have the exclusive right to advertise and collect royalties from the sales of their variety. However, farmers have the right to retain production for their own seed and an informal brown bag market is still active. These forms of arbitrage limit the ability of breeding firms to collect royalties from farmers, as high fees induce more farmers to multiply seed.

The excludability of genetics has increased with the introduction of stronger intellectual property rights, genomics, and hybrids that have allowed firms to protect and capture value from their genetic innovations. The ability of Monsanto to patent the herbicide tolerant RoundUp Ready© system has enabled this firm to charge an annual fee for the use RoundUp Ready© genetics through a technical use agreement. In the case of canola, Monsanto is able to capture approximately \$100 million dollars per year for the use of its technology.

Hybrids are another way in which excludability can be introduced. While hybrids have been around since the 1950s in crops such as corn, hybrid canola has only been introduced in the last few years. Hybrid technologies allow firms to capture value through the annual sale of seed without the use of patents and technical use agreements.

When crop genetics become excludable, they move from being a public good to being a toll good. The non-rival nature of the toll good creates economies of size and a tendency for market concentration. In the case of crop breeding that relies on biotechnology, the ownership of the research processes and tools serve as additional barriers to entry. As the experience in corn, canola and soybeans illustrates, these toll goods are the key inputs into the production processes of concentrated oligopolies (Fulton and Giannakas, 2001).

As the above discussion illustrates, there are a number of policy options for the governance of crop research. Public funding will remain important for basic research, where the output is by nature a public good. For applied crop research and variety development, the creation of intellectual property rights can create toll goods. While the creation of toll goods creates an incentive for further development, it also creates the conditions for the rise of concentrated oligopolistic market structures. Governments can respond to this concentration by letting them operate as is, by creating mixed oligopolies (e.g., by introducing public firms into the market), by undertaking public variety development and/or by encouraging levy funded research. In the case of crops where IPRs are poorly enforced, private research will not exist and government and/or levy funded research is required. In some cases new laws, such as those outlined in UPOV 1991 can enhance IPRs and stimulate private research in the short run.

Given the very sequential nature of crop research it is important to consider the potential holdup problems that could emerge under certain property right regimes and retard future research. In biotechnology, for instance, the requirement to combine a number of patented processes and genetic materials to create a new seed has resulted in multiple potential owners of a new product. Getting agreement among all the owners is often difficult and sometimes impossible to achieve, thus holding up commercialization. Golden Rice is an example. Multinational biotech firms have often addressed these holdup problems by acquiring the firms that own the various piece of IP. While this solution works well for the firm, it can have negative consequences for the industry since it often results in a very concentrated industry and in reduced freedom to operate for other firms and public institutions.

In non-transgenic crops, where breeding is dominated by public and producer controlled organizations, freedom to operate is currently far less of an issue. Varieties are typically protected, at least somewhat, through some means of collecting levies at the point of seed sale. Breeders typically have the right to use these genetics to breed future varieties. Under UPOV 1991, which has been ratified but never implemented, countries can give the crop breeders the right to claim IP over progeny from their varieties. If this policy is implemented, a variety could have sixteen owners within four generations, potentially causing holdup problems.

3.2.2 Agronomic extension

Once a discovery has been made, it must be communicated to the industry and adopted before it has value. While a pesticide firm may be willing to provide information regarding the efficacy of a new pesticide as part of its marketing strategy, this same firm

will not have an incentive to spend significant resources to show producers how they can reduce input expenditures. It may also be difficult to sell agronomic advice to producers, since other producers can easily mimic the successful strategies of their neighbors. Given the lack of private incentives for information dissemination, governments (generally provincial governments) have provided agronomic advice and extension services to farmers. The provision of this information has facilitated the adoption of cost saving technologies in the sector.

A good example of public extension activity occurred in the development and adoption of zero tillage in western Canada. AAFC research station personnel and provincial extension agronomists had active research and extension programs to share information about this technology as it was developing. During the 1980s it was not uncommon to have over one thousand farmers at AAFC field days where zero tillage cropping systems were being demonstrated. A recent study by Davies and Furtan (2006) provides statistical evidence that proximity to AAFC research stations increased the adoption of zero till. The widespread adoption of zero tillage technology has not only increased on-farm productivity, but it has led to the development of a significant manufacturing industry in western Canada, an industry that now exports zero tillage seeders throughout the world.

3.2.3 Public Infrastructure

As with most sectors in the Canadian economy, access to infrastructure is very important for agriculture. Government has played a role in the provision of infrastructure in a number of instances, particularly during a development phase. Governments were heavily involved in the provision of utilities, including electricity, telephone, natural gas, and

more recently Internet service. The provision of a legal system, including regulation, is also an important element of publicly provided infrastructure.

The public provision of low-density roads has long been seen as a role for government. While these roads are essential for the supply of inputs and the delivery of outputs for agriculture, there is little private incentive for their provision. As a result, governments recognized the importance of providing these roads. In Canada, the provision of roads is shared among the various levels of government. Local governments generally provide local road development, provincial governments provide provincial roads and the federal government plays a key role in the development of the inter-provincial road infrastructure. The agricultural sector benefits from the provision of roads and also shares in the tax burden required to build and maintain these roads.

The exceptions to the public provision of roads are toll highways and railways where access can be easily restricted. In these cases, non-rival, excludable goods have become toll goods – much as the “toll” highway name suggests. These toll goods are then operated as either private or public enterprises. The next section deals with the provision of toll goods.

3.3 Toll goods

There are many toll goods that are important for the agricultural sector. When used as inputs these non-rival goods represent mainly a fixed cost and result in firms having economies of size. This impact of this cost structure is felt at all stages of the supply chain; farm size is increased in the primary production sector, while firm size is increased in the processing, marketing and input supply sectors. In these latter sectors the result is an increase in industry concentration and non-competitive behavior.

As shown in Table 3.1 there are several types of toll goods relevant to agriculture. Most toll goods are related to the various forms of knowledge required to run a system, while some depend on key non-rival physical assets. In the function of product marketing, key inputs such as market intelligence, information, negotiation, brand promotion and logistics are toll goods because they are non-rival and excludable. Within every firm, components of production and financial management are toll goods. Several aspects of regulatory compliance such as the reporting function are toll goods. Intellectual property is a non-rival asset in many firms (patents or trade secrets make the ideas excludable). Physical inputs, such as large machinery, may also be toll goods - these machines have a large fixed cost component, but once purchased can be used over a very wide range of output. Thus, within the firm, these inputs are non rival.

As discussed above, toll goods – when used as inputs – create economies of size. Economies of size, in turn, have profound effects on industry structure that can affect the competitiveness of parts of the agricultural sector. Overtime, policies have evolved to address the issues and problems created by toll goods. Examples also exist where policies resulted in the creation of toll goods that in turn produced unintended consequences. To illustrate the complex interaction between policy and toll goods we examine each category of toll goods listed in Table 3.1.

3.3.1 Marketing services and input procurement

Product marketing and input procurement are very important to most firms. Effective sales and procurement programs require market intelligence, product development and promotion, negotiation with buyers or sellers, and logistics. Each of these functions can be thought of as inputs into the production of input procurement and/or output marketing.

These inputs tend to be non-rival in nature, meaning that once they have been put in place, adding extra sales or additional procurement can be done at very little marginal cost. For example, the cost of acquiring market intelligence is likely nearly the same regardless of whether a firm sells one tonne or 100 tonnes of product. The non-rivalry of these inputs thus creates a high fixed cost with very low marginal cost. The result is economies of scale that gives an advantage to larger firms, whether in grain farming, railway service provision or in international grain marketing.

Given the current debate around grain handling and marketing, it is useful to consider the role of toll goods in determining the structure of the sectors performing these structures. As described above, key inputs – such as a sales network, market intelligence, and financial services – for grain handling and marketing are toll goods because they are excludable and are non-rival. The non-rival nature of these inputs has given multinationals a cost advantage and created an oligopoly structure for international grain marketing.¹ Early in the 20th century, farmers in both Canada and the U.S. organized large co-operatives to provide grain handling services for wheat producers in an attempt to offset the power of the large grain companies (Fowke 1946). Grain marketing remained with the private sector in the U.S. – currently this industry is highly concentrated and dominated by multinationals. Hayenga and Wisner (1999), for instance, report figures that indicate that, in the 1990s, 81 percent of U.S. corn exports went through the facilities of the top four firms; these same firms accounted for 65 percent of U.S. soybean exports. For wheat, the top four firms handled 47 percent of U.S. exports.²

¹ Caves (1996) argues that multinationals arise specifically because they have intangible assets such as sales and market intelligence network that can be used in more than one country.

² All multinationals operate extensive information and market intelligence networks. They also operate vast networks of storage, handling, and transportation facilities that allow them to co-ordinate various aspects of

In Canada, grain marketing was transferred to the Canadian Wheat Board in 1943; the CWB was given an export monopoly for wheat marketed from western Canada. Although somewhat modified, the CWB remains in place today for wheat and barley. The other grains grown on the Prairies – e.g., canola, peas, flax – rely on the private sector for international grain marketing.

The current grain marketing debate in western Canada centers on providing marketing choice for wheat and barley producers. Given the toll good nature of marketing services and the lack of sufficient scale by the CWB, this option would eventually result in an oligopoly dominated by multinationals, much as is the case in the U.S. (Fulton 2006). The current flurry of merger and acquisition proposals and counter-proposals among the grain handling companies can be interpreted as an attempt by the current players in the industry to gain sufficient size and sufficient links to international marketing networks so that they can remain in the industry should its structure eventually change.

3.3.2 Management

Many aspects of firm management are toll goods. Every firm requires decisions to be made and executed. The management activity requires collecting information and developing knowledge, creating and implementing plans, and evaluating outcomes. While the management requirements in a firm do increase as output increases, many aspects are independent of firm output. The non-rival nature of management is a source of economies of size up to some level of output.

grain distribution and handling (Davies 1986). Proprietary assets such as information networks and personnel with specialized knowledge of the international market provide incumbent trading firms with economies of scale and cost advantages, which in turn implies that these firms possess market power (Fulton, Larue and Veeman 1999).

Beyond this level of firm size, management becomes inherently more complex, making it increasingly difficult to assemble the required information and more difficult to implement and evaluate plans. For the farm production sector, the family farm has remained the dominant economic structure in Canadian agriculture for over 100 years. This stability suggests that, at least historically, management complexity for grain production becomes an issue beyond one or two employees. As information becomes easier to collect and output becomes easier to monitor – these changes can be linked to changes in technology such as the development of global positioning systems – the scale of the farm can be expected to increase, perhaps dramatically.

3.3.3 Intellectual property

Intellectual property is a key asset for many input supply firms in the agricultural sector. The protected knowledge of how to produce a product allows these firms to exclusively sell something of value to the sector. This knowledge is, of course, a non-rival input – it can be used to produce many units of output.

Intellectual property is often protected through the use of patents or other legal methods. The creation of intellectual property *rights* means that intellectual property is now an excludable good. As a non-rival and excludable good, intellectual property is a toll good.

The creation of patents and plant breeder rights was a deliberate move by governments to create private incentives to invest in research by granting firms an exclusive right to the knowledge they have created for a specific period of time. Patents first became important in the pesticide industry during the 1950s and gave firms an incentive to do research and develop chemical pesticides. More recently, biotechnology

patents gave private firms an incentive to invest in plant and animal genetics. The pesticide firms were among the first to make large investments in plant genetics and now dominate the private crop breeding sector. In short, the non-rival nature of intellectual property has resulted in a very rapid consolidation of the seed industry (Fulton and Giannakas, 2001).

Hybridization has also been very important in protecting intellectual property in agriculture. Hybrid corn, developed by USDA researchers during the 1930s, was soon marketed almost exclusively by a concentrated private research sector by the 1960s. The chicken industry and the horticulture industry also rely on hybrids and the protection of the parent material to protect their intellectual property. More recently, hybrid varieties have become dominant in the canola industry. Since hybrid varieties yield more than conventional varieties, firms are able to charge a premium for the seed on an annual basis. They are able to charge this higher price because hybrids are excludable goods – the specific genetic make-up of the hybrid cannot be replicated when the seed is subsequently grown. Since the inputs going into hybrids are non-rival (knowledge of the specific cross required to generate a specific hybrid can be used to produce one bushel or a million bushels), hybrids are thus toll goods – and the structure of this industry and the pricing behavior of the firms in the industry is consistent with that of other toll goods.

3.3.4 Regulatory compliance and reporting

Regulatory compliance can also be a significant cost of doing business. Firms wishing to operate typically must comply with environmental, labour, financial reporting and food safety regulations. The regulations are typically established to address a real social concern or environmental problem. Unfortunately, virtually every regulation has a

compliance cost (this includes a reporting requirement). Because there is a large fixed (and sunk) cost component to regulatory compliance, and the marginal cost component is typically small, regulatory compliance creates economies of scale. These fixed/sunk costs are effectively toll goods. They are non-rival in the sense that, once the regulatory system has been developed and implemented, additional output can occur without further regulatory work. And they are excludable since the compliance efforts by one company cannot be used by another.

As expected, regulatory requirements have been shown to affect industry structure. Ollinger and Fernandez-Cornejo (1998) examine sunk costs and regulation in the U.S. pesticide industry. Using data over the 1972-89 period, they find that research costs and pesticide regulation costs negatively affect the number of companies in the industry and that smaller firms are affected more strongly by these costs than are larger firms. Research and regulation costs also encourage foreign-based firms to expand into the U.S. market and to force less profitable innovative firms to exit the market. Ollinger and Fernandez-Cornejo (1998) also point out that their results on the impact of regulatory costs generally match those found in other industries.

To conclude, regulations contribute to economies of size, entry barriers and industry concentration in the pesticide, biotechnology, and functional food industries. Regulation also has an impact on structure at the farm level. As Gray, Haggui and Fulton (2005) show, environmental regulation places the largest per unit cost on small and medium size firms, thus encouraging larger farms.

3.3.5 *Networks*

Physical distribution networks are often toll goods. Many utilities – such as electricity, water, and natural gas – have distribution networks that are toll goods. These non-rival networks create economies of size where service can be provided at lower cost with one network versus multiple overlapping networks. Governments have often been involved in building these networks and often continue to operate them. When governments no longer operate these networks, the private industry that takes over the industry has typically been regulated.

The provision of a rail bed is perhaps the most important toll good affecting Canadian agriculture. Rail beds are fully excludable, since the railways are able to keep others from using their networks. Rail beds are also, to a large extent, a non-rival input. While a massive investment is required to create the rail bed, once the rail bed is created additional rail cars can be operated on the bed with only a relatively small additional cost. Thus average costs of operation decline significantly with the volume of movement, creating the conditions for a concentrated market.

The market power of the railways is also enhanced in two other important ways. First, entry into the rail industry is virtually precluded given the necessity for a competitor to purchase a continuous corridor. Second, the demand for rail service to move bulk commodities, particularly in western Canada, is very price insensitive given the long distance to port.

The potential market power of the rail duopoly in Canada has typically been curtailed through regulated rates. At the current time the GTA enforces a “revenue cap” for each railway, where the average freight rate reflects cost plus a return on investment. While this regulation reduces the pricing power of the railways, it does not address the

reduced incentives for innovation and service provision that the railways have as a result of their significant market presence.

One policy alternative to govern the provision of this toll good is the government enforcement of running rights to the rail beds. Similar to regulations existing in the electrical industry, such a policy would allow firms to enter and use existing networks, thereby raising competition and increasing the incentives to innovate in service provision (see Fulton and Gray (1997) for details on the enforcement of running rights).

3.4 Common pool goods

Common pool goods are non-excludable and rival. The rival nature means they are subject to overuse, yet the non-excludability makes limiting use difficult. The result is that, in the absence of deliberate policy, common pool resources are subject to excessive exploitation.

3.4.1 Environmental protection

The environment is a common pool good that is significantly affected by the agricultural sector. The biological nature of agriculture creates a large interface with the natural environment. Agriculture occupies a large portion of the landscape, is a major user of water, is an important part of the carbon cycle, and the agricultural practices on the land can affect the quantity and quality of water that is available.

The ability of the agricultural crops to sequester large quantities of greenhouse gases (GHGs) – particularly carbon – will become increasingly important as governments implement policies to reduce GHG emissions. In the absence of a carbon market or other forms of government intervention that create property rights to carbon, soil carbon is

effectively a common pool good. As such, it is subject to exploitation – in this case, farmers do not conserve it to the degree that they should to meet carbon reduction targets.

The creation of property rights to carbon and the development of a carbon market would transform the common pool good to a private good. However, a key factor in the trading of carbon from agricultural land will be the risk that the carbon is released from the soil – large final emitters (LFEs) will not purchase carbon credits if the possibility exists that the carbon will be released. Pooling carbon from large amounts of land can reduce the risk to the LFEs. However, the management of the carbon pool is effectively a non-rival input; soil carbon now starts to take on elements of a toll good and an oligopoly structure in the supply and trading of this good could result. Provided it is facilitated by government, this industry could evolve as a mixed oligopoly if producer organizations are allowed to play a significant role in the trading of carbon.

3.4.2. Generic market promotion, food safety and quality control

There are several aspects of grain marketing that are by nature non-excludable because of information asymmetry. Consumers desire a high quality, safe food supply, but yet the lack of these traits are not always obvious at the time of purchase. Consumer must rely on labeling information to make their purchase; the result is that brand names and consumer confidence become important aspects of consumer demand. Given the nature of information any problems with a food product sold by one firm will quickly spill over to other firms. Similarly, an investment by one firm to convince buyers that a particular product is superior can be captured by any competitor selling the same product. Given this non-excludability, product quality and assurance have the properties of a common pool good and will be undersupplied by private industry.

Governments have responded to these common pool problems in a number of ways. First there are typically regulated standards and testing protocols for food safety. Second, governments have introduced industry standards and have provided grading and inspection services. Third, governments are often involved in market promotion activities where the Canadian brand is promoted. Finally, governments have often worked with industry associations to develop standards and promote products.

There is a whole spectrum of options that can be used to govern the provision of these common pool goods. A shift in the funding of required or regulated services such as product registration and grading shifts the cost burden from taxpayers to the industry. For non-regulated services such as product promotion, the withdrawal of government funding requires a voluntary system of industry funding. To the extent that this industry provision fails to develop, these promotional goods will be under provided. This could be a particular problem in today's food industry where innovation and the introduction of new products are important. The lack of adequate industry promotion also increases the demand for brand creation and the duplication of promotion efforts.

3.4.3 Crop insurance

All risk crop insurance has some degree of non-excludability and therefore has the attributes of a common good. The insurance pool is non-excludable because of both moral hazard and adverse selection which does not allow the insurance provider to eliminate bad risks from the insurance pool. Information asymmetry allows producers to practice moral hazard by reducing effort in growing an insured crop. The same asymmetry allows producers with the greatest risk to self select and purchase insurance. Both of these problems reduce the private marginal benefits below the social marginal

benefits. The resulting market failure has largely prevented private companies everywhere in the world from profitably offering all-risk crop insurance. Governments have responded to this market failure by subsidizing the premium cost of crop insurance.

Insurance pools by nature are also somewhat non-rival, as adding new members will increase the size of the risk sharing pool. The economies of size are further enhanced by the significant fixed costs involved in developing contracts and the networks required for sales and contract enforcement. Given this non-rival cost structure, crop insurance in Canada is typically delivered in each province through a single public agency.

An option for the provision crop insurance would be to adopt the U.S. model where governments subsidize premiums but the programs are sold and delivered through private firms. If this were to occur, one would expect that an oligopoly structure would develop.

3.5 Private goods

Most of the physical output sold by farmers fits into the category of private goods. Commodities are by nature both rival and excludable. Property rights are generally well defined, while regulations and grading systems are used to deal with quality issues.

The physical inputs of land, labour, machinery and other material inputs, purchased by farmers are private goods. The use of the land input is often restricted by zoning and environmental regulation. In a number of instances the Crown has retained the ownership of environmentally fragile land. Provincial legislation governs labour markets, often with special provisions for agricultural labour. Other material inputs are subject to environmental regulation and quality standards.

3.6 Summary

Public goods, toll goods, common pool goods and private goods all play an important role in the Canadian agricultural sector. Agricultural policy has evolved over time to address issues that arise from the non-excludability and/or the non-rivalry of goods.

Over time the nature of goods has changed and governments have modified their policies.

While some of these policy moves have addressed emerging issues, they have at times failed to address problems and have inadvertently created new issues.

In the final chapter we will briefly summarize the classification of goods and discuss the implications of this classification for agricultural policy.

CHAPTER 4. SUMMARY AND POLICY IMPLICATIONS

The characteristics of rivalry and excludability can be used to classify goods into four types; private goods, toll goods, common pool goods and public goods. As was shown in the previous chapter, the type of good affects the incentives for the provision of the good and/or the impact of its provision. Over the years, an important element of agricultural policy has focused on dealing with the effects that have resulted from the nature of the various types of goods.

The economic issues that are raised by rivalry and excludability are complex and are not easily addressed by policy. As well, the importance of these two characteristics differs from one good to another, which further complicates attempts to deal with their impacts using agricultural policy.

To provide an example, the public good nature of agricultural R&D means that the private provision of this activity is unlikely to occur unless changes are introduced to property rights to transform this good into a toll good. Such a policy decision has both costs and benefits. On the benefit side, government is able to reduce its expenditures on this activity, thus freeing resources for other priorities. As well, creating incentives for private provision has often resulted in considerably more R&D being undertaken. On the cost side, however, the encouragement of private investment will typically lead to increased concentration in the sector, an outcome that carries with it the possibility of less competitive prices. As well, for some commodities and products, the private incentive remains small and little if any additional R&D occurs. The magnitude of these impacts depends on the good or product under consideration. For some products, for example, the

change in corporate concentration may be small, while in others the impact in this area may be substantial.

The key implication of this differential impact is that no single policy response can be used in all situations. For some agricultural products, the appropriate policy response may be to create a toll good by strengthening intellectual property rights and then have the public sector largely withdraw from R&D funding. For other products, more attention might have to be paid to the ramifications of the toll good creation (the nature of intellectual property rights means that if new rules are applied to one product they must be applied to all products) – for instance, increased levels of public funding might be warranted to ensure adequate R&D, or efforts to encourage adequate competition (e.g., through the promotion of farmer associations) might be required. Simply put, agricultural policy cannot be created on a “one size fits all” basis; instead, agricultural policy must be tailored to fit the requirements of each product or each sector.

Another implication of the analysis is that agricultural policy has to have numerous elements in order to deal with the problems and issues highlighted in this paper. Agricultural policy cannot be just about intellectual property right policy, or about R&D funding expenditures, or about industrial structure (e.g., incentives to encourage greater competition). Rather, agricultural policy has to include all of these elements and more – everything from the rules governing certification to the legislation covering traceability to the skills training required by agricultural managers. Indeed, a mix of policy options will be required to effectively address the policy issues that arise in each of the agricultural sectors. And, as was stressed in the previous paragraph, the mix will differ by sector.

REFERENCES

- Caves, R.E. 1996. *Multinational Enterprise and Economic Analysis*. Cambridge University Press. Cambridge.
- Coase, R.H. 1960. "The Problem of Social Cost." *Journal of Law and Economics* 3: 1-44.
- Davies, K. and H. Furtan, 2006. Factors which affect the adoption decision of conservation tillage in the Prairie Region of Canada, unpublished paper Department of Agricultural Economics, University of Saskatchewan, Canada.
- Davies, Susanna. 1986. "The Grain Trading Companies." In *The International Grain Trade: Problems and Prospects*. Nick Butler, ed. London: Croom Helm.
- Fulton, M.E. 2006. "The Canadian Wheat Board in an Open Market: The Impact of Removing the Single-Desk Selling Powers." Working Paper, Department of Agricultural Economics, University of Saskatchewan. Available at www.kis.usask.ca.
- Fulton, M.E. and K. Giannakas, 2001. "Agricultural Biotechnology and Industry Structure." *AgBioForum* 4(2), 137-151.
- Fulton, M.E., B. Larue, and M. Veeman. 1999. "The Impact of Export State Trading Enterprises Under Imperfect Competition: The Small Country Case." *Canadian Journal of Agricultural Economics* 47(4): 363-73.
- Fulton, M.E. and Richard Gray. 1997. "Railways, Competition and the Hold-up Problem." Working Paper. Department of Agricultural Economics, University of Saskatchewan.
- Gray, R. F. Haggui, and M. Fulton. 2005. "The Impact of Targeted Environmental Enforcement on Industry Structure." Working Paper. Department of Agricultural Economics, University of Saskatchewan.
- Hayenga, M. and R. Wisner. 1999. "Cargill's Acquisition of Continental Grains' Grain Merchandising Business." Staff Paper #312. Department of Economics, Iowa State University, Ames, Iowa.
- MacDonald, J. 2001. "Agribusiness Concentration, Competition and NAFTA." Seventh Agricultural and Food Policy Information Workshop. Tucson AZ. Retrieved February 19, 2001 from the World Wide Web: http://www.farmfoundation.org/structural_change.htm
- Ollinger, M. and J. Fernandez-Cornejo. 1998. "Sunk Costs and Regulation in the U.S. Pesticide Industry." *International Journal of Industrial Organization* 16: 139-168.
- Rogers, R.T. and R.J. Sexton. 1994. "Assessing the Importance of Oligopsony Power in Agricultural Markets." *American Journal of Agricultural Economics* 76(5): 1143-50
- Romer, P.M. 1990. "Endogenous Technological Change." *Journal of Political Economy* 98(5, Part 2): 71-102.

- Romer, P.M. 1994. "The Origins of Endogenous Growth" *Journal of Economic Perspectives* 8(1): 3-22.
- Smith, Adam (1776). *The Wealth of Nations*. Edited by Edwin Cannan, 1904. Reprint edition 1937. New York, Modern Library.
- UPOV. 1978. *International Convention for the Protection of New Varieties of Plants*, Paris, December 2, 1961, as Revised at Geneva on November 10, 1972 and October 23, 1978
- Williamson, O.E. 1985. *The Economic Institutions of Capitalism*. New York, NY: The Free Press.