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Toll Goods and Agricultural Policy

By Murray Fulton and Richard Gray

The Issue

Economists use 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. Of particular interest are toll goods, for they are found in a number of different aspects of agriculture. Examples include marketing services, management, intellectual property, regulatory compliance, and networks (e.g., railways). The non-rival nature of toll goods means that they are likely to create concentrations in markets where they are used as important inputs. The question examined in this brief concerns how agricultural policy has addressed the problems created by toll goods.

Policy Implications and Conclusions

Governments have used five main approaches to managing toll goods:

- (1) Government produces the toll good through a subsidy.
- (2) Government produces the toll good through a non-profit state monopoly that receives limited subsidies.
- (3) Government grants a private firm the monopoly power to provide the good, but then regulates the rate of return.
- (4) Government allows an oligopoly to produce toll goods with some regulations to enhance entry and competition among firms. One important means of encouraging entry is through the support and development of co-operatives.

- (5) Government provides the toll good input at a subsidized price.

Examples of all five approaches can be found in agricultural policy.

Background

Economists classify goods based on two key characteristics—excludability and rivalry (see, for example, Romer, 1990, 1994). Excludability refers to the ability of one person to prevent another from using a good. Rivalry refers to the extent that the use of a good by one individual precludes its 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.

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 1 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. This means that the average cost of producing the final output decreases with the quantity produced because the cost associated with purchasing the non-rival input is spread over 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 is supplied by a monopoly. If a private monopoly is allowed to exist, it can be

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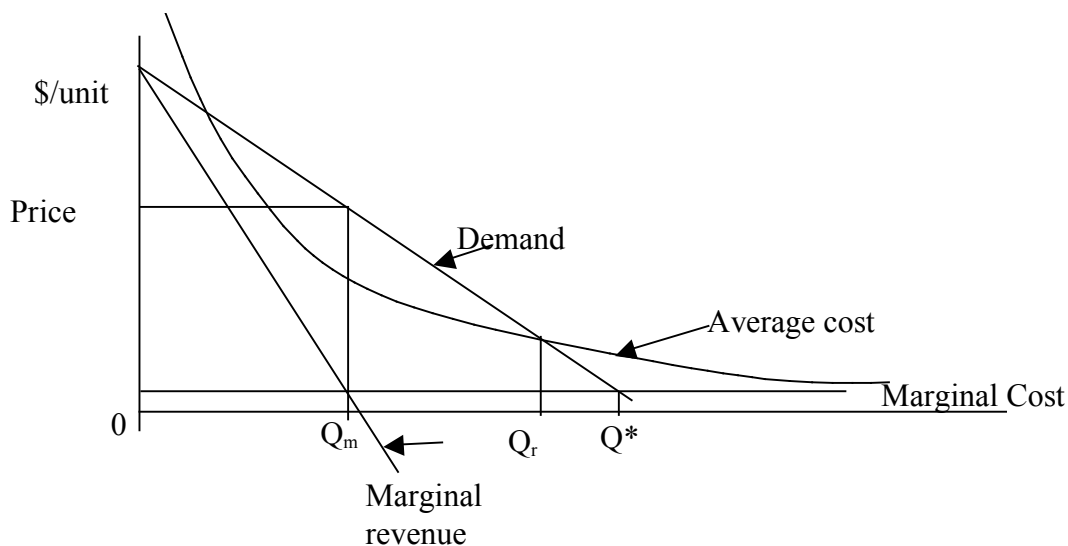
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Table 1: The classification of goods based on rivalry and excludability

	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

**Figure 1: Alternatives for the provision and pricing of toll goods**

expected to use its market power to maximize profits by setting the quantity produced to a level where marginal revenue equals marginal cost.

Normally an opportunity for profit attracts more firms into an 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 created using toll goods because marginal cost is always less than average cost.

The cost structure illustrated in Figure 1 occurs in many industries (agricultural examples include railway service provision, grain marketing through multinational enterprises (MNEs), and seed and chemical production; these are discussed in more detail below). 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 produces the toll good. Consumers are charged a price equal to marginal cost, with the remainder of the revenue made up by taxpayers. As shown in Figure 1, 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 operates this way.
- (2) Government produces the toll good as a non-profit state monopoly where consumers are charged a price equal to average cost. 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 monopoly power to provide the good, but 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 its 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) Government allows 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 non-governmental organizations 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 other firms while providing a flow through of benefits to members. The grain, dairy, and fruit industries are all examples of such co-operatives.
- (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.

Application to Agricultural Policy

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. The 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 processing, marketing, and input supply sectors. In these latter sectors, the result is an increase in industry concentration and non-competitive behaviour.

Most toll goods are related to the various forms of knowledge required to run a system, but 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 their 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. A good example of this is a rail bed for a railway. Once created, the rail bed can carry traffic up to the point of congestion at very little marginal cost.

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. Over time, policies have evolved to address the issues and problems created by toll goods. Examples also exist where policies result in the creation of toll goods that, in turn, produce unintended consequences. To illustrate the complex interaction between policy and toll goods, we use an example for each category of toll goods listed in Table 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, market intelligence likely costs nearly the same regardless of whether a firm sells one tonne or one hundred 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 give an advantage to larger firms, whether in grain farming, railway service provision, or international grain marketing.

Given the current debate around grain handling and marketing, it is useful to consider the role of toll goods in this sector. The current grain marketing debate in western Canada centers on providing market choice for wheat and barley producers. Given the toll good nature of marketing services and the lack of sufficient scale by the Canadian Wheat Board, 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 industry players to gain sufficient size and links to international marketing networks so that they can remain in the industry should its structure eventually change.

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 management requirements in a firm 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.

Beyond this level of firm size, management becomes inherently more complex, making it increasingly difficult to both assemble the required information and implement and evaluate plans. For the farm production sector, the family farm has remained the dominant economic structure in Canadian agriculture for over a century. 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.

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 sell exclusively 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.

Granting firms an exclusive right to the knowledge that they have devised for a specific period of time via patents and plant breeder rights was a deliberate move by governments to create private incentives to invest in research. Patents first became important in the pesticide industry during the 1950s and gave firms an incentive to conduct 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).

Regulatory compliance and reporting

Regulatory compliance can also be a significant cost of doing business. Typically, firms wishing to operate must comply with environmental, labour, financial reporting, and food safety regulations. Such regulations are typically established to address a real social concern or environmental problem. Unfortunately, virtually every regulation has a compliance cost (including 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. They are excludable because one company's compliance efforts 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 1972-1989 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 larger firms. Research and regulation costs also encourage foreign-based firms to expand into the U.S. market, forcing 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.

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 continue to operate them. When governments no longer operate these networks, the private industry that takes over 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 because 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 has been 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 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 railways’ reduced incentives for

innovation and service provision that result from their significant market presence.

Concluding Remarks

The non-rival nature of key inputs in production tends to create natural monopolies in the production of goods and services. Over time governments have created a number of different policy instruments to manage these natural monopolies. The type of the policy used has direct implications for incentives, pricing behavior and downstream industry impacts. Given these implications it is important to recognize the existence of toll goods and to understand the implications of various forms of policy intervention.

In agriculture many of the important inputs are supplied by industries employing toll goods as inputs. Some of these industries, such as the railways and energy utilities, are old and operate under a complex governance structure. Knowledge is a non-rival input gaining importance in the agriculture. Understanding the implications of this toll good, and developing appropriate institutions to manage the research sector, are important challenges for policy makers.

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