The Economics of the Grain Handling and Transportation System

Under Deregulation

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Abstract

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Grain transportation and handling is a large component of the export basis and is a large cost to western Canadian farmers. In the past, the components of this basis have been highly regulated. Recently, Canada has moved to deregulated elevator tariffs and ended the subsidy on the transportation of grain to port. Further deregulation of grain transportation is expected.

Public policy has long grappled with both the problem of lack of entry in the rail and elevator industries and the potential for market power of existing firms. The industries involved in getting grain to port have high sunk costs, which act both as barriers to entry and allow firms, once established, to have some market power. Governments have faced the difficulty of first getting firms into the industry, and then trying to limit their use of market power once the firms are established.

The rail industry benefited from some of the government intervention. Railways were given large subsidies of land and money to get started. The federal government in Canada protected the new Canada Pacific Railway (CPR) from competition. In the early days of freight rate regulation, railways were allowed to price discriminate on the basis of value of the product hauled, which improved their profits while serving the national interests of developing the West in both Canada and the U.S.. In both countries, regulation over freight rates also allowed railways to put a stop to rate wars that bit into their revenue.

More recently, governments in both countries have begun to return these industries to a more market-based framework. The current regulatory regimes in both countries are described. Some of the impacts of this shift to deregulation were discussed.

The U.S. deregulated its rail industry in 1980; this action provides some evidence of what can occur without rate regulation. Although freight rates have fallen in the years

immediately after deregulation, there is evidence that railways are price discriminating between routes and commodities and in some locations monopoly pricing is emerging.

This thesis describes the development of a model used to simulate the different components of the export basis. The model illustrates the setting of the tariffs charged for local and terminal elevation, and rail transportation. The charges are interdependent and together comprise the export basis.

The model is founded on a spatial model of heterogeneous products for each component sector of the basis. The heterogeneity allows each firm to set their own price for their product. The size of the demand faced by each firm will vary with the price they charge, the price competing firms charge, and the existing market shares of the firms. In equilibrium, it is assumed that all firms will have no incentive to move from charging the same price.

The model assumes that rates are set in a two-stage game. The terminals and railways are assumed to set their rates first, with *ex-ante* information about the reaction of local elevators. Local elevators are then assumed to take the railway and terminal charges as fixed, and set their tariffs accordingly. The result is rates at each level which are a weighted average of the intercept of the industry's derived demand, and the industry marginal cost. The weight considers a number of parameters of market power, such as the number of firms, market share, conjectural variation of the reaction of other firms to a change in price of any one firm.

The model is then used to illustrate a several scenarios. The model is calibrated for the 1997-98 crop year and is then used to anticipate what might occur without the freight rate cap on western grain. The model illustrates that railways would be expected to engage in various forms of price discrimination under deregulation. It is anticipated that railways will price discriminate by route and by value of commodity. Although the overall result of this deregulation is unknown, it is anticipated that railways will re-exert some of their market power if the freight rate cap is removed.

The model is also used to illustrate the impact of common running rights. It is shown that common running rights with a sufficient number of carriers may be able to replicate freight rate charges currently enjoyed under regulation.

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Chapter 1

Introduction

1.1 Setting

Grain transportation is a vital component of the western Canadian grains industry. Western Canada exports 70 to 80 per cent of its grain production, almost all of which needs to be transported to port position. Since Canadian producers are as far, or further, from tidewater than producers in any other grain exporting nation, getting grain to port is a costly proposition. The current cost of handling and transporting grain to port is roughly one third of the price received for the grain in port position.[1] This cost – often referred to as the export basis – is the largest input cost faced by farmers in Western Canada (Western Provinces 1998).

Because of the long distances to port and the lack of a western inland waterway, Canada relies on rail transportation to move grain to port. Historically, Canada has had legislative restraints on the railway industry, and particularly on the hauling of grain. These regulations have included legislated freight rates for grain and mandatory service provision. Recently Canada has moved towards deregulating its grain transportation system. The *Western Grain Transportation Act* (WGTA), which set freight rates along with service and infrastructure levels, was ended in 1995. The federal government is conducting a review of grain transportation and handling in 1998 which may result in further changes to the grain transportation system.

Along with these recent legislative changes, other reorganization has occurred in the industry. Over the past three decades rail and elevator infrastructure has been rationalized. Canada has lost 17 per cent of its branchlines since 1968 (Transport Concepts, 1995) and the number of elevators has fallen by 75 per cent. This rationalization is likely to continue. The two major railways have identified a further 20 per cent of the grain dependent branchlines to be discontinued, and the provincial

[1] The approximate export basis for grain in $75 per tonne (Western Provinces 1998). The estimated pool return as of March '98 for No. 1 CWRS 13.5% protein for the 1997-98 crop year was $208 per tonne.

governments anticipate that the number of elevators will continue to decline over the next five years (Western Provinces, 1998).

In the U.S. there has been an increase in the degree of vertical integration in the grain industry. Two decades ago, grain changed hands 10 to 15 times from producer to consumer; that number has now reduced to 2 to 3 (IBI 1994). In just this past year, Canada has seen new entrants in the grain handling industry with ConAgra, ADM and Louis Dreyfuss constructing grain handling facilities on the Prairies. As well, the uncertainty around the legislative authority of the Canadian Wheat Board raises questions about the future of the grain system. The impact of these changes on the export basis is yet to be determined.

This study will focus on the export basis. The export basis is defined as being the costs of getting grain to port. This includes such costs as marketing, elevation and handling charges and transportation. Although marketing costs do appear in the basis calculations, this study will primarily analyze the contribution of rail and elevator charges to the cost of getting grain to port.

1.2 Need for Study

There have been a number of recent reports that have attempted to make comparisons between the Canadian and U.S. grain export basis. The U.S. system was deregulated in 1980 with the passage of the *Staggers' Act*. Since then, its branchline and elevator infrastructure has gone through a large degree of rationalisation (IBI 1994; Transport Concepts 1995). Many of these studies find that the U.S. elevator system is cheaper than the Canadian system although Canadian freight rates are lower than those in the U.S. (ATKearney 1994; IBI 1994).

John Heads, in *The International Competitiveness of Western Canadian Transportation* (1994), makes comparisons of freight rates for grain between Canada and the U.S., as well as discussing freight costs and systems for other bulk commodities in Canada. Heads finds that freight rates on the U.S. for grain are higher than their Canadian counterparts, but makes the point that the competitiveness varies greatly with the exchange rate. He also discusses the results of the deregulation of freight rates and provision for confidential contracts for other bulk commodities in Canada, noting that shippers seem to be pleased with the deregulated system although it seems the other commodities are contributing more to the railways fixed costs than grain.

The IBI Report on "Grain System Efficiency for Alberta Agriculture" (1994) gives a general overview of the Canadian grain transportation and handling system and the trends in costs (under the Western Grain Transportation Act). IBI notes that Canada has higher charges for handling, both at the local and terminal level, yet has lower freight rates. The report states that there is 30 to 35 per cent overcapacity in the U.S. local elevator system. There is also four times as much terminal storage in the U.S. as compared to Canada. This leaves the U.S. with excess capacity at terminal location, yet new investments are being made in high-throughput terminal elevators. This study notes that there are a number of significant differences between U.S. and Canadian production and institutions, which hamper direct comparisons between the two systems. For example, Canadian production is much less dense and Canada has a much more detailed grading system, both of which have implications for local and terminal operations.

Although comparisons with other countries can give some insights, there is also a need for alternative analysis to discuss the impacts of moving to a market-based system of grain transportation and handling. There have been some studies that have looked at the impact of regulatory changes to the Canadian system.

Carter and Loyns (1996) discuss various components of the grain transportation and handling system and attribute different costs to various institutions. They conclude that the Canadian Wheat Board adds inefficiencies to the grain transportation and marketing would lead to decreased system costs to farmers.

The ATKearney report (1994) models a number of different combinations of grain handling and transportation services and attempts to estimate total costs of these different logistics systems which might occur under deregulation. The study attempts to determine the least-cost system. The report does not consider that the firms within the grain transportation and handling system might exert market power and price above cost.

In summary, there have been numerous studies discussing the potential impact of deregulation on Canada's grain transportation and handling system. Some of these studies have compared Canada's system to systems in other countries, which have already undergone deregulation. Other studies have looked at the costs within the Canadian system and how these might change under deregulation.

There has been less work done to model how railways and elevators would behave under deregulation. Considering that both of these sectors may have market power, there is need to investigate how these sectors might use this market power in setting prices. This study attempts to address this gap in the literature.

1.3 Objectives of the Study

- To present some public policy issues in the rail and elevator industries; their history and the current situation.
- To describe the current movement of grain to export position in Canada. The description will include the market structure of the various sectors involved in grain transportation and handling.
- To develop a theoretical model of how different components of the export basis are determined under a market system.
- To use the model to examine the potential impact of various forms of deregulation on Canada's grain transportation and handling system.

1.4 Organisation of the Study

The purpose of this study is to analyze the likely impact of deregulation and other structural changes on the export basis. Chapter 2 introduces some of the theoretical concepts needed to discuss the existence of market power in grain handling and transportation, followed by a presentation of the theory of regulation and some of its problems. Specific concerns arising from the cost structure of the rail and elevator industries are also discussed. Chapter 3 outlines how governments have historically addressed these public policy questions in the United States and in Canada. It reviews the role of government in the development of the railway industry. The history of government regulation of railways and elevators is presented to identify possible results of deregulation and recent moves towards deregulation in both countries are discussed. Chapter 4 presents the structure of the current grain transportation and handling industry and describes the institutions involved. Chapter 5 presents the theoretical foundation of the model used to analyse the grain export basis and its components. It also describes the various scenarios the model is used to examine. The mathematical model is then presented in chapter 6. The results of the various scenarios are presented in Chapter 7. Chapter 8 is the conclusion and summary.

Chapter 2

Theory of Market Power and Regulation

2.1 Introduction

The question of market power and regulation has been widely discussed over the past century. Economists have developed a number of theories to study the phenomenon of market power and its regulation by government. This chapter introduces theories of competition and market power that will be used to investigate the grain transportation and handling industry.

Market power can allow firms to price above their marginal cost. This is of interest to public policy markers because pricing above marginal cost generally implies a loss of welfare to society. The one exception is the contestable natural monopoly, where firms will price at average cost. There are a number of ways that a market can deviate from perfect competition. The theories considered in this chapter focus on the cost structure and barriers to entry in an industry and the effect they can have on competition.

This chapter first discusses the baseline of perfect competition. The theory of contestable markets developed by Baumol, Panzar and Willig (1992) is then presented. A contestable market is a market with no barriers to entry or exit. Contestable market theory is a baseline in determining whether a firm or firms in an industry have the potential for market power. Industries with large and/or few firms may be contestable, and thus, perform for the public interest without government intervention (OECD 1998).

The chapter focuses on barriers to entry caused by sunk costs. Different types of sunk costs are described, and how they can lead to bargaining power. As well, the hold-up problem will be introduced.

Regulation has often been used to overcome the misallocation of resources resulting from market power. But regulation is not always successful. The chapter discusses Stigler's theory of regulatory capture, which describes how inefficient regulation may come about.

Lastly, the cost structure of the rail and elevator industries is discussed. Several public policy problems arise from the sunk costs, and hence the barriers to entry, in these industries. The economic theories presented in this chapter are used to discuss the problems presented by the cost structure of the rail and elevator industries.

2.2 Competitive Markets

The baseline used in economic analysis is perfect competition. The assumptions underlying perfect competition are that all firms produce a homogeneous product, no single firm or buyer can influence price, all players possess perfect information, and there are no transaction costs or externalities. The assumption is also made that there are no barriers to any new firms entering or exiting the industry (Carlton and Perloff 1994). This last assumption will be addressed in more detail in the next section.

Consider a firm in a competitive industry with the cost structure illustrated in figure 2.1. If, in the short-run, the industry price is P_1, the firm produces output Q_1. Output Q_1 is the output at which price equals marginal cost. The intuition is as follows. The firm chooses its production so that the expected revenue of the last unit produced exactly equals its marginal cost of production. With an industry price, P_1, the firm makes a profit of the price equal to $(P_1 - AC)\ Q_1$, represented by the shaded area in figure 2.1. If the price falls below P_0, the firm will not produce in the long run. This is known as the shutdown point.

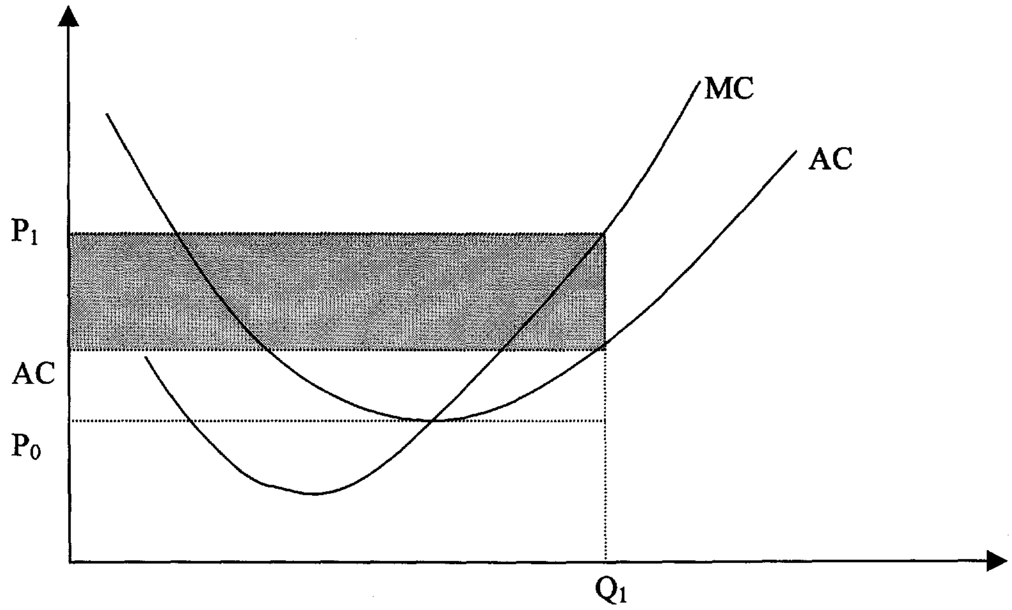

Figure 2.1 Profits with Marginal Cost Pricing

Suppose there are five firms in an industry. The industry supply curve is constructed by determining how much output the five firms will produce at any price. The supply curve is then the horizontal summation of the marginal cost curves for the five firms. The flat portion of the curve represents the shutdown point. The equilibrium industry price will occur at the intersection of the demand and supply curves giving a price of P_1 and quantity Q_1. The firms will each produce at the output level where marginal cost equals price as described above, and each firm will earn excess profits as illustrated in figure 2.1.

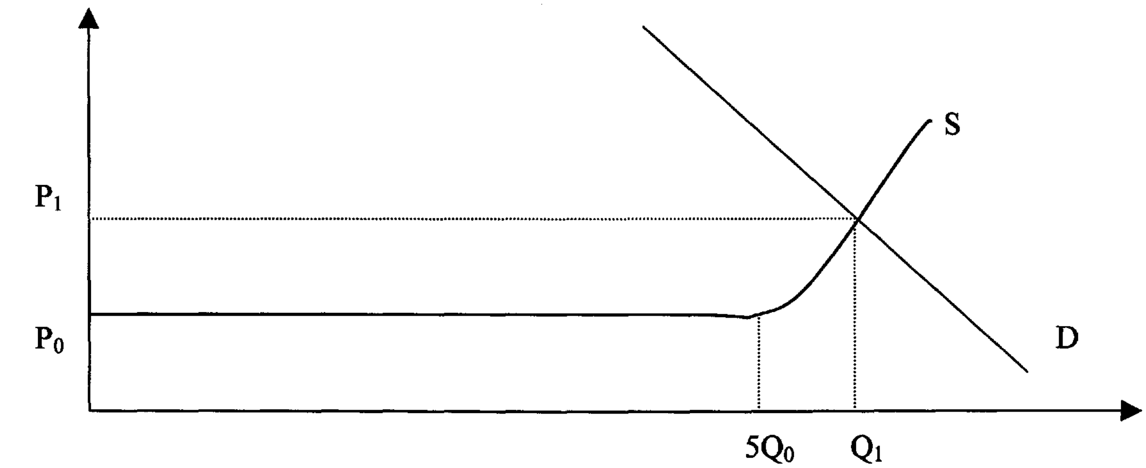

Figure 2.2 Market with Limited Number of Firms

Since perfect competition assumes there are no barriers to entry, a group of investors, seeing these firms earning excess profits, will be inclined to set up a 6th firm in the industry. Entry will continue as long as the incentive (excess profits) exist within the industry (see figure 2.3). The threat of entry will ensure that under perfect competition, price equals both marginal and average cost.

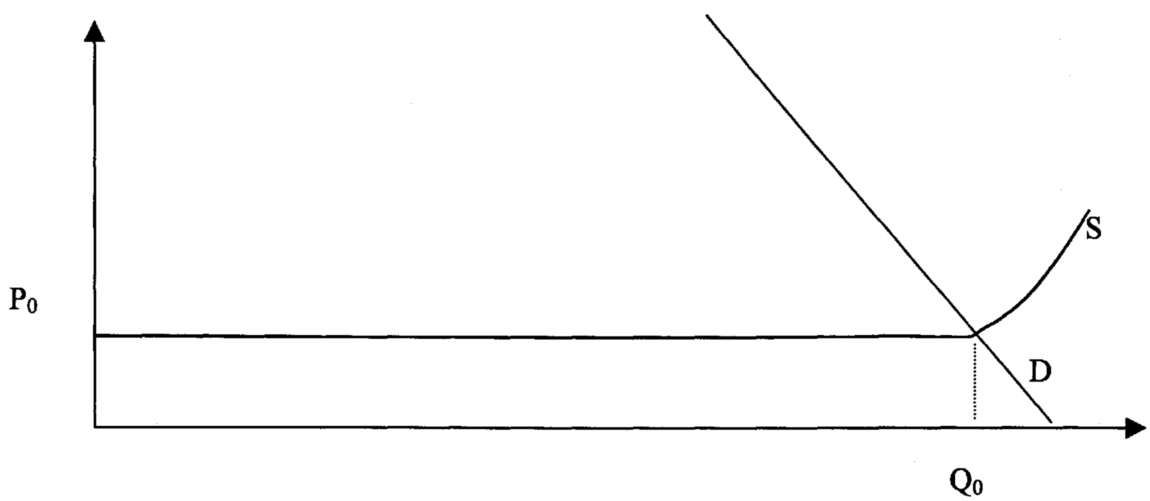

Figure 2.3 Market with Free Entry

2.3 Contestable Markets

For a market to be competitive, with equilibrium price equal to marginal and average cost, it must be contestable. A market is contestable when new firms face free entry and exit to and from the industry. The entrants must also have access to the same technology and the same costs of production as do the incumbent firms. Under these conditions, potential entrants will enter an industry if excess profits exist and if entry is reversible. Even if the excess profits only last a short time, the entrant will have made a profit, with the knowledge that they can exit if the profits drop to zero. Therefore, if there are excess profits in the industry, other firms will enter until those profits are dissipated. In fact, contestability theory suggests that the threat of entry will be enough to keep the firms already in the industry from making excess profits. The threat of entry is enough to keep firms within the industry pricing at average cost. Thus, one may have a contestable market with only one or a few firms. Baumol, Panzar and Willig (1992) note that an industry is contestable if it does not require sunk costs for efficient operation.

If there are barriers to entry or exit, firms already established within the industry may be able to set price at above average cost. Consider a potential entrant who sees that there are excess profits in an industry, but knows that they must pay an irretrievable cost to enter the industry. Unless the investor is assured of a return that will cover their irretrievable or sunk costs, they will not enter.

There is also a second scenario where a firm can enter a market with a higher cost of production than the incumbents. One reason the entrant may not be able to enter with the same cost of production is that the low cost of production requires technology that has a high initial cost and little salvage value. Thus the investment in the technology is not completely reversible. This market is not contestable, yet the price that the incumbent firms can charge is constrained by the efficiency of the second-best technology. Firms within the industry cannot charge a price that is higher than the marginal cost of production using the less efficient technology.

Regulations can also act as a barrier to an industry. For example, consider licence fees required by professional societies. This sort of licence fee is a barrier to entry, although perhaps not a restrictive one. Because this licence fee is not recoverable it is also a sunk cost.

The existence of a barrier to entry does not imply that there is no entry into a market. For example, assume there is a sunk costs associated with entering an industry.

If the firms in the industry are making profit larger than average cost plus the sunk cost needed to entry the industry, there will be incentive for firms to enter. Thus, the benchmark profit in the industry needed to induce firms to enter is higher than it would be in the absence of sunk costs.

Not all contestable markets have equilibrium price equal to marginal cost. As an example, some natural monopolies are contestable but not competitive. In a natural monopoly, it is efficient for a single firm to produce all the output (Carlton and Perloff 1994). Because of large initial fixed costs, the average cost curve remains above the marginal cost curve for the entire industry. Thus, as illustrated by the shaded area in figure 2.4, the firm will lose money if it prices at marginal cost. However, if there is the threat of entry, the firm will not be able to charge above average cost. If the firm tries to price at above average cost, it will create the incentive for other firms to enter. Thus, a natural monopoly can be contestable, and therefore limited to pricing at, or below, average cost. However, as will be discussed later, not all natural monopolies are contestable.

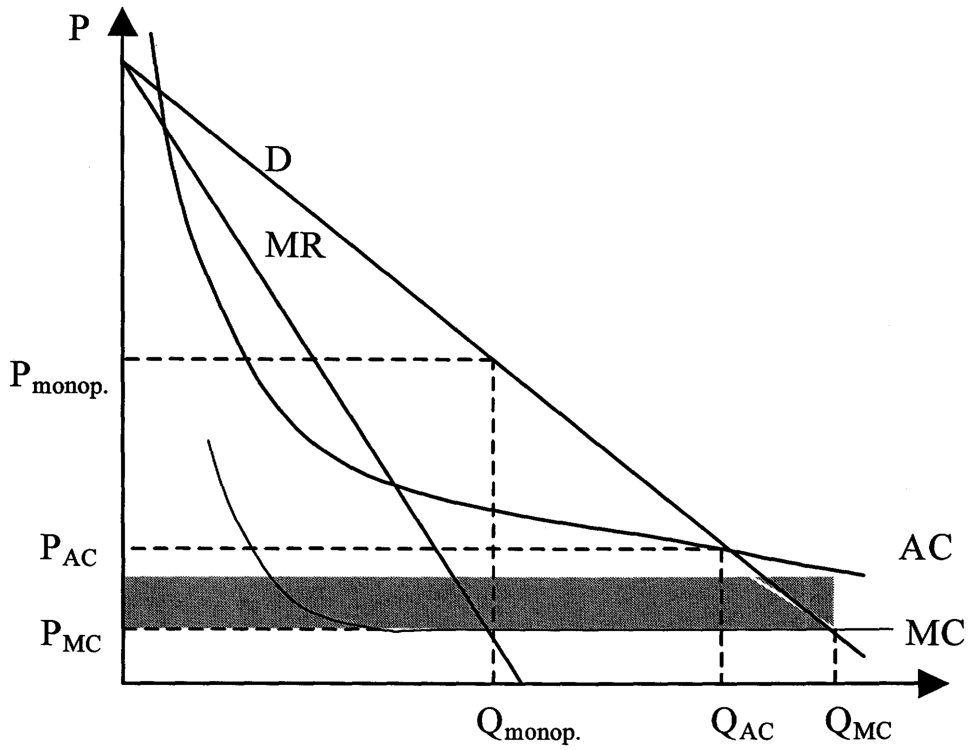

Figure 2.4 Natural Monopoly

Examples of natural monopolies are public utilities and industries such as railways. If railways are a contestable natural monopoly, price is expected to equal average cost, even without government intervention. However, if railways face large barriers to entry, then this is not a contestable market. As will be outlined in section 2.6, railways can be expected to face considerable barriers to entry.

2.4 Sunk Costs and the Hold-Up Problem

Sunk costs are costs that are irretrievable. An investment is rarely completely sunk, but can often contain a portion of costs that are irretrievable. Thus, if an investment has a salvage value equal to 75 per cent its original cost, then 25 per cent of the investment is sunk. Whether an investment is sunk or not depends on the length of time considered. In the short run, most fixed costs are sunk, in that there is little time to turn around and sell the fixed assets. In the long-run, however, just as fixed costs become variable costs, the portion of sunk costs decreases (Carlton and Perloff 1994).

Sunk costs are often linked with specific assets, which are inputs that are specific to a particular transaction or to the production of a unique good. Without the transaction, the assets have little or no value. Asset specificity is typically of a degree. Often, an investment may be partially reversible, but not fully. The portion that is not reversible is considered sunk. There are several factors that can create asset specificity:

1. Site Specificity
2. Physical Asset Specificity
3. Human Asset Specificity
4. Dedicated Asset Specificity (Williamson 1983)

Site specificity is specificity that is attributed to geographic location. Consider, for example, a grain elevator. Once the elevator is built at a certain location, it cannot be moved. Assume for a moment that the area in which it is built suddenly cuts its grain production drastically, leaving the elevator with insufficient handle volumes to make it profitable. While the elevator may have a salvage value if it were located elsewhere, in this specific location, its salvage value is quite low.

Physical asset specificity describes inputs that are specifically designed to produce a particular output. If an elevator decided to invest in a facility that pelletted screenings, with machinery that could only be used for that purpose, the investment would have a high degree of asset specificity. In short, it would imply that the plant's profitability is highly dependent on the cost of dockage and the market for pelleted screenings.

Human asset specificity is similar to physical asset specificity except that the asset being invested in is human capital. Any training that is specific to a certain task for a certain employer can be thought of as having a certain component of sunk cost attached.

Dedicated assets are investments which "would not be undertaken but for the prospect of selling a significant amount to a certain customer," (Williamson 1983, pg. 526). This investment could be in additional capacity needed to service a particular customer, without whom the capacity would become excessive. Thus, if a terminal elevator company expanded because it anticipated increased business from another local elevator company, that increased capacity may be, in part, asset specific.

Dedicated assets can lead to the hold-up problem. To explain the hold-up problem, consider two parties to a transaction, A and B, where A has a sunk investment in the transaction (thus a dedicated asset), and B does not. Party A will have more at stake in ensuring that the transaction occurs which, in turn, gives B more bargaining power after the investment decision has been made. Party B can undervalue the investment A has made, knowing that the investment has little alternative value. Thus, A is in part, captive to B.

To illustrate this problem, consider a situation where a short-line railway has bought a stretch of track in the middle of the prairies. The track only serves to carry port-bound grain traffic to the connecting mainline. The short-line only connects to one mainline. The track has little value outside of this use (thus its salvage value is low). The mainline carrier, knowing that the short-line has this sunk investment, will have a large degree of bargaining power when negotiating over rates. For instance, assume that the short-line carrier needs $15 per tonne to cover its investment in track and needs an additional $5 to cover its variable costs of hauling a tonne of commodity to the mainline. The value of the commodity hauled to port is $200; its cost at the track loading facility is $150. Assuming away elevator and port charges for the moment, the short-line needs to negotiate a mainline haul rate of $30 or less. Knowing the above costs, the mainline carrier also knows that once the short-line carrier has purchased the track, the carrier will haul the commodity for anything over the $5 marginal cost. Thus, the mainline carrier will potentially be able to refuse to haul the commodity to port for less than $30, and could negotiate the rate up to $45. It will likely force the short-line to take less than a normal rate of return on the investment in track.

If the party who has to make an investment suspects that the other party will act opportunistically after the investment is made, a hold-up problem can be created. If A suspects that B will undervalue its investment, A may decide to underinvest in the specific asset, or not invest at all, leading to a loss in efficiency.

Consider the above scenario with the short-line and the mainline. If the short-line operator knows, before investing in the track, that the mainline will likely undervalue the investment, the short-line operator may decide not to buy the track. This may occur even though there was enough profit in the operation to make both the mainline and short-line carrier better off. Thus one can end up with a situation where the investment is not undertaken at all even though the investment could benefit both parties if a proper transaction price was set in place (Williamson 1983). One way to set such a transaction price is through regulation.

2.5 Theory of Regulation

Regulation is often used to try and compensate for a market that is not perfectly competitive (Stigler 1974; Strick 1992). Regulation has often been used to attempt to limit market power. Market power can lead to problems of resource misallocation. Sometimes regulations will attempt to force the firms with market power to price as if they were in a competitive industry. But price regulation has not been without difficulty.

For regulators to accurately choose the level for a regulated price, they must know the cost structure of the industry. In an industry with a rising marginal cost curve, if the price is set too low, one may end up with the scenario where there is less product produced than demanded. In an industry that is a natural monopoly, a regulated price set at marginal cost will result in the firm losing money. If the government attempts to regulate a natural monopoly, it will have to set the price at average cost, or provide a subsidy so that the firm can price at marginal cost, or make other such arrangements.

To conclude, for a regulatory agency to regulate price, they need information about the industry. Much of that information will come from the firms already in place in the industry. These firms may have the incentive not to give the regulator full information about costs and industry structure. The asymmetry of information between regulator and regulated can lead to the problem of regulatory capture.

2.6 Regulatory Capture

Price regulation affects both the regulated industry and consumers. Often, the regulation has a more focussed effect on the regulated as opposed to the consumer group. This leads to the so-called interest-group theory, where concentrated groups of individuals affected by legislative decisions have an incentive to influence those decisions. Since there is a cost to information, there is also a cost to informing others. This implies that it takes resources to lobby policy decision-makers. Stigler (1971) proposes that the only people who will be willing to spend large sums of funds to present information to policy makers are those who stand to directly benefit from a certain policy decision. The greater the potential benefit, the more funds that the interest group is willing to spend, and thus the more influence they can have. Likewise, because garnering information is costly, regulators will not necessarily hear counter-arguments. Lastly, the information needed to regulate the industry often comes from the industry itself, giving the industry influence over the regulators. Thus, Stigler hypothesises that special-interest groups will have more influence over regulators than will the general public. This leads to the thesis of regulatory capture.

Stigler and Friedland (1962) present an example of where price regulation did not lead to lower prices, a result they attribute to regulatory capture. Studying the regulation of electrical pricing, they find that, except for one year, regulation did not lower the price. In that one year, 1937, although regulation lowered the rates to commercial and industrial customers, it did not lower price to domestic consumers (in Carlton and Perloff 1994). They hypothesised that this was an example of regulatory capture.

Regulation can also be used to grant existing firms market power. An example of regulation used to limit competition in the rail industry comes from the 1930s when trucking first started to compete with rail transport. Texas and Louisiana put a restrictive weight limit on trucks in a position to competing with railways, and allowed a high weight limit on trucks who were not competing with railroads (Carlton and Perloff 1994).

The railway industry has several specific problems that may lead to market power. Because of the large fixed costs and relatively constant marginal costs, the rail industry may be described as exhibiting some of the features associated with a natural monopoly. As Baumol, Panzar and Willig note, this would not be of concern to policy-makers if the market were also contestable. In the next section, it will be argued that the railway industry is not contestable.

The concern that railway companies have market power has lead governments to regulate railways in the past. Governments have attempted to regulate the prices charged by railways. There is some evidence that the regulators have not always been able to accurately peg the regulated price equal to average cost. As will be noted in the next chapter, there have been concerns about the railway industry capturing their regulators.

2.7 The Railway Policy Problem

Railways pose regulators with two key difficulties: (1) How to get firms started in the industry; and (2) How to ensure that the firms that are created do not act monopolistically. Both problems stem from the fact that it can be prohibitively expensive for a firm to build a railroad. Fulton and Gray (1997) note that a potential rail company needs to purchase all the land along a continuous corridor where the track will be built. If the original landowners have knowledge of the profits the railways can earn, the landowners will attempt to extract a share of these profits when negotiating the sale of the land. Since each landowner will try to obtain a share of the profits, the railroad firm will not be able to afford to purchase the land if it has to bargain with even a few landowners.

Because of this problem of entry into the industry, governments have responded by assisting firms to enter the industry. As will be seen in the next chapter, this assistance has taken numerous forms, including the granting of land to the railways, public investment in railways, loan guarantees, and expropriation. The problem of lack of entry into the rail industry has also created another problem, namely that those firms that have been given assistance to enter the industry have the potential to exert market power. Without the threat of entry, there is no threat of competition from emerging firms. In addition, because the incumbents have usually dealt with their rival firms for many years, they are often able to anticipate their rival's actions, thus diminishing the chance of competition even among existing firms. Chapter 3 will outline how governments have responded to this second problem through various forms of regulation.

Grain transportation also poses a special problem for policy makers in that it is one of the few bulk products where the producers of the commodity have very little bargaining power. This lack of bargaining power comes from the fact that producers are geographically dispersed, produce a homogeneous product, and are not the ultimate shippers of the commodity. In the transportation of other bulk goods, there are few enough shippers that each may have a degree of bargaining power. The threat to withhold their use of rail service may have an impact on rail revenues; therefore this threat is taken seriously. An individual grain producer cannot control enough volume to make an impact on rail revenue or to interest an alternative carrier to give them special treatment to get their business. This lack of bargaining power is made worse by the fact that grain producers produce a product indistinguishable from that produced by his/her neighbour. Although some shippers may have a degree of bargaining power with the railway, these same shippers will have market power vis-a-vis farmers. Thus, even if a break on rates can be negotiated, this break may not get passed back to the farmer.

2.8 The Potential for Elevator Market Power

Elevators also have the potential for market power. Entrants into the elevator industry do not suffer from the same hold-up problem facing new railways, but there are sunk costs associated with the elevator industry. In the early days of the elevator industry in both Canada and the U.S., one of the barriers to entry into the elevator industry was the uncertain provision of transportation from the elevator to port. This is not dissimilar to the hold-up problem faced by railways outlined above.

Once an elevator is built, some of its investment is sunk. The elevator relies on the railway to transport its grain to port at a price where the elevator can at least cover its costs, including a return to investment. But once the elevator is built, the railway knows that the elevator's next best alternative for transportation is prohibitively expensive. In this case, it might be expected that the railway would undervalue the elevator's sunk investment. This can lead to the hold-up problem. As with the railway industry, this hold-up problem can act as a barrier to entry facing new firms, and allow existing firms the ability to extract some excess rent.

Currently, there is another hold-up problem occurring between primary elevators and railways. Both elevators and railways are rationalizing their networks. Elevator companies are closing their small, wooden elevators on branchlines, and building larger, high-throughput concrete facilities on main and secondary mainlines. At the same time, railways are abandoning pieces of the grain-dependent branchline network. It is difficult for an elevator to be profitable without access to rail transportation, and equally, it is difficult for a branchline to be profitable without a delivery point located somewhere along its length of track. Elevator companies do not want to risk investment in facilities on rail lines which might be abandoned. Equally, railways are less likely to invest in branchlines that will lose their delivery points. Thus, this mutual reliance is leading to both parties de-investing in the branchline network.

In their dealings with elevators, farmers historically have had a weak bargaining position. If there is only one elevator at a delivery point, a producer's options may be limited. The degree to which the producer is 'captive' to an elevator will depend on the cost of moving his or her grain to the next best alternative. This varies not only with the distance traveled to any one elevator, but the expense involved. Thus, a producer who has the same costs to move their grain to either of two delivery points, has some ability to negotiate price. Once grain is at a specific point, producers have a certain amount of costs sunk into the location of the grain. This leads to the potential for market power to be exerted by the elevator.

Market power can also arise from the production of heterogeneous products. Heterogeneity can arise from location, brand loyalty, as well as an actual difference is the physical service. Consider that for a farmer in Girvin, grain handling at Davidson, Sask. is not considered the same as grain handling at Saskatoon. Many farmers are also loyal to one or another elevator company for ideological reasons. Even if the actual service provided is the same, it is perceived as heterogeneous due to brand loyalty. Elevators are also differentiating the actual service provided. As an example, consider that some elevator companies are offering credit for inputs as long as the grain is delivered to their facilities. This bundling of services differentiates the handling services offered by different elevator companies. A difference in service, whether perceived or real, allows firms to charge different prices from their competitors. The theory of product heterogeneity will be discussed in further detail in Chapter 5.

Unlike rail, the barrier to entry to the elevator industry is not barring entry all together. As we will note later in Chapter 4, there is entry into the Canadian local elevator industry. This does not, however, mean that elevators have no ability to exert market power.

The barrier to entry in the elevator industry resulted in a different set of solutions than those used in rail regulation. One solution to the hold-up problem is vertical integration between the elevators and railways, which did occur in the U.S. Government also attempted to address the hold-up problem by regulating the price charged and the service provided by the railways. Governments also encouraged the entry of new firms, including farmer-owned co-operatives. Co-operative elevators allowed farmers to access profits from the handling and marketing of their grain. The historical development of these solutions in the U.S. and Canada will be explored in the following chapter.

Public policy has long grappled with both the problem of lack of entry in the rail and elevator industries and the potential for market power of existing firms. This public policy concern has particularly been the case in grain transportation where farmers have little bargaining power and thus little chance of mitigating the market power of the railways through negotiations. The next chapter will outline the history of government intervention in grain transportation in the U.S. and Canada to address these problems. The discussion begins with the early days of railway construction and ends with the recent deregulation of the industry.

Chapter 3

History and Current Institutions

3.1 Introduction

In this chapter, the history of regulation in the U.S. and Canadian grain transportation and handling industries is reviewed to understand the rationale for early regulation. The results of the different forms of regulation are also discussed. The recent changes to each country's regulatory systems are presented and the literature on the impact of this recent deregulation is reviewed.

To study the current Canadian grain transportation and handling system requires an understanding of the history of structure and regulation in the industry. Understanding the original market structure and development will give clues to the initial intent of regulation and serves as a way to discuss whether regulation is justified today. Some of the public policy problems posed by the railway and elevator industry cost structure were raised in chapter 2. This chapter outlines how governments have historically addressed these public policy questions in the United States and in Canada.

3.2 History of Government Intervention in Railways and Elevators

As noted in the previous chapter, public policy has long grappled with the problem of market power in both the rail and elevator industries. In rail, governments have had to address both the lack of entry in the rail industry and the potential for market power of existing firms. Elevators do not suffer from the same hold-up problem facing new railway firms, but there are still sunk costs. This has led to the potential for elevators to exert market power, and has been of concern to farmers.

The U.S. and Canadian governments have tried many different forms of intervention to overcome the problems associated with an industry with large barriers to entry. In rail, both governments began by funding firms entering the industry, attempting to lower the barriers to entry. Once the firms were established in the industry, the government faced the second public policy problem outlined above, namely how to ensure the firms did not use their protected place in the industry to charge excessive freight rates. Numerous forms of regulation were tried. In both the U.S. and Canada, rail rates were directly regulated. At the shippers' request, the governments adopted independent arbitration. In Canada, federal ownership of one national railway was attempted. Both countries have now moved toward deregulation.

In the elevator industry, both governments attempted to try and encourage competition. Regulations were established to control the service provided by elevators. In Canada there was also regulation of pricing. Both countries also saw producers work to mitigate elevator market power through collective action through the formation of co-operatives. This section will explore U.S. and Canadian history of rail regulation. The current changes to rail legislation will also be discussed. Past elevator regulation will briefly be explored.

3.2.1 U.S. Rail History

In the early days of the rail industry, the U.S. government provided funding to help the construction of railroads. Although private capital was inadequate, the federal government was reluctant to directly invest in the railroads. It was both philosophically opposed to the idea of direct government intervention as well as being broke, having just recently emptied its coffers into the construction of canals and roads. Instead the government granted land amounting to about 22 million acres to the companies and loaned them public credit, supplying Union Pacific and Central Pacific with about $27 million (Benedict 1953). This was only one of what was to become many land grants to railways. In all, 131 million acres were ceded to the railways by the U.S. federal government. In addition, the state governments granted another 49 million acres to the railroads.

Once the rail firms were in place, concern arose over the level and equity of rates charged by the railroads. As Benedict outlines "faced with the necessity to earn money every possible way, the railroad companies charged exorbitant rates wherever other lines were unable to compete and, on the other hand, unfairly low rates where competition was keen" (Benedict, pg. 70). Because of the differential in rates, transport between large centres would often be cheaper than a shorter haul on the same line. "Wheat could actually be sent from Chicago to Liverpool for less than the cost of shipping from central points in Dakota to the Twin Cities" (Benedict, pg. 70). Other factors also focused attention on railway activities. Incidences of corruption of officials and dishonest manipulation of railroad finances were well known and widespread. This was aggravated by the appropriation of public land and generally bad railway public relations.

The first attempt to regulate the railroads came in 1870 out of Illinois, pushed for by the farm organisations popularly known as the Grange. The Illinois legislation attempted to set maximum freight rates, and limit discrimination between customers. After several years in court challenges the legislation was altered to create a commission in charge of setting and monitoring rates.

In 1887 the *Interstate Commerce Act* was enacted. This act placed all interstate traffic under federal jurisdiction. The Interstate Commerce Commission (ICC) was also created at this time for the purpose of regulating freight and passenger rates, setting both maximum and minimum rates for different groups of commodities. It required that rates be 'just and reasonable' and prohibited discrimination. Specifically the legislation disallowed discrimination between shippers, locations and the practice of charging more for a short haul than a long haul over a common line (Benedict 1953).

Not all price discrimination was outlawed, however. Value of service pricing, or the charging of different rates for hauling goods of different value, was allowed by the ICC. In fact, the railways were encouraged to price low and high-value goods differently. This price discrimination was sanctioned because it was seen as a way of fostering the development of the West. By hauling the agricultural and natural resource products more cheaply and the manufactured goods more expensively, the railways were encouraging the growth of the western natural resource industry while protecting the fledgling manufacturing sector in the East. At the same time, this form of price discrimination worked well for the railways. It allowed them to have higher rates on products with a more inelastic demand for freight and lower rates where the demand curve facing the railways is more elastic (Friedlaender 1969). The ICC freight regulation also helped eliminate price wars (Carlton and Perloff 1994). As will be noted below, regulation was often used to provide benefits to the industry being regulated.

In 1920, the railways were in financial difficulty, and the ICC was ordered to raise the allowable rates. It was directed to fix rates that would give a reasonable return to fixed cost (Carlton and Perloff 1994). Other changes to the ICC occurred over time, not all of them relating to rates. Car allocation occurred under 'common carrier obligations', i.e., first come first served, with no penalties assessed if shippers cancelled their cars. Railways were unable to abandon unprofitable services and mergers of railroads were controlled under the ICC. This continued until the Railroad Revitalisation and Regulatory Reform Act of 1976. The Staggers Act in 1980 furthered the deregulation of the rail industry.

The Staggers' Act

In the 1970s US railways were experiencing financial problems due to lost business to the trucking industry and lack of pricing flexibility and inability to abandon branch lines (Fulton and Gray 1997). Regulation had led to a pricing structure that did not take into account trucking competition and different costs of rail haulage (Boyer). As Elliot points out, "The *Staggers' Act* was a reaction to the plethora of bankruptcies that plagued the US railroads in the 1970s ... While there were some provisions in the Act that appeared to provide some relief to shippers, especially those that are captive to a single railroad, at its core, the legislation was designed, to quote an ICC official at the time ' to make sure that there are no more Penn Centrals, because the US government can't afford them" (Elliot 1994, pg. 3).

One of the key provisions of the *Staggers' Act* was the removal of the minimum price. This removal allowed railways to engage in variable pricing in an attempt to recapture some of the traffic they had lost to the waterways and to trucking. As noted above, in large part it was this variable pricing which had led to calls for rail regulation in the first place. However, it was felt that over time, the ICC, due to its concern about cross-subsidisation, had forced the minimum rail rates to be so high as to be non-competitive with other modes of transportation.

The *Staggers' Act* provided for shipper relief provisions, although these came with a number of access barriers. For example, the maximum rate provision can only be invoked when a railroad is revenue adequate." As well, confidential contracts are exempt from ICC regulations, although summaries of the contracts need to be filed.

Since the *Staggers' Act*, contracted rates have become the dominant method of specifying rates and services on railroad movements of grain. It is estimated that 63 per cent of all grain moved by railroads were moved under contracted rates (Hanson et al 1989). Hanson et al. asks whether savings from contracts were passed along to farmers. They found mixed results: some contracts had effects upon price, with their effect varying by type of contract (whether with the purchaser or the local elevator) and by crop. The pass through of savings from lowered freight rates to farmers was not automatic.

The increase in railroad pricing flexibility has had a mixed effect on the elevator industry. Larger, well-located terminals were able to negotiate lower rates, but some smaller elevators saw their margins decline (Sorenson 1984). Research has also noted that the variability in freight rates increased for some crops, and that the *Staggers' Act* did not result in improved price at the farm level (Sarwar and Anderson 1989).

There are a number of studies that have examined the impact of U.S. rail deregulation on freight rates. Elliot (1994) notes that from 1981 to 1991 US rail rates fell by one-third and 77 percent of productivity gains were passed on to shippers in the form of reduced rates and improved service. Although the exact amount differs, other studies also noted that there was a decrease in rates after the *Staggers' Act* for the period up through the mid-1980s. It has been noted, however, that productivity had been increasing, and freight rates decreasing, before the *Staggers' Act*, as well as after (Whiteside 1998). Deregulation did not affect all areas equally. MacDonald, Fuller et al. (1989), and Wilson (1994) found that deregulation reduced freight rates in the Plains region of the U.S. where intermodal competition was limited. Deregulation appeared to have little effect on rates in eastern Corn Belt areas where barges provided competition. The general conclusion is that the railways may have been able to use regulation to form effective cartels, which were broken up with deregulation. The view that regulation had allowed the railways to monopoly price where intermodal competition did not exist is also echoed by Friedlaender.

In the last few years, concerns about the railways' monopoly pricing practices have again arisen. George Paul of the Montana Farmers Union notes: "Some years ago the U.S. Interstate Commerce Commission ruled that Montana grain producers are captives of Burlington Northern because it is essentially the only railroad available for hauling heavy loads such as grain. The Burlington Northern doesn't have any competition to speak of [in Montana], so it charges significantly higher rates here than in Nebraska where it does have competition from other railroads. ... It is more expensive to ship wheat from Billings, Montana to Portland, Ore, than it is to ship wheat from Alliance, Nebraska to Portland, – even though both are major points, on the same line, and Billings is almost 500 miles closer to port" (NFU 1995, pg. 2).

In summary, there is general agreement that deregulation was followed by a decrease in many freight rates for agricultural commodities. This is in part due to the fact that a regulated minimum rate was removed and in part due to the fact that the railways have been able to influence the regulatory agency in ways that the industry found desirable. This last observation is a common one in the literature on regulation (Stigler 1971, Posner 1975, Carlton and Perloff 1994).

The current situation sees the return of some potential monopolistic pricing behaviour. Different rates are being charged for different routes of the same length (and presumably same cost) and for crops of different value. The Government of Saskatchewan (1997) examined three different points, all approximately the same distance from port, served by BN. They found that the points, which had competition from barge and other railways, had significantly lower rates than the point where BN was the sole bulk carrier. Their study notes that the rates at the points with intermodal competition have remained relatively constant over time whereas those captive point have raised considerably from 1990 to 1995, where the rate now closely reflects the cost of trucking. As well, the authors discuss the differences in price of movement of different crops. They compare freight for corn and wheat from one point and barley and wheat at another. Where there was competition, either from other railways or barges, rates for the crops were similar. At points where there was only one railway, the price charged to move the higher-value product, wheat, was higher than that charged to move the lower value products, corn and barley. This would indicate that the carriers are pricing to value.

3.2.2 Canadian Rail History

Unlike the U.S., grain transportation was given special treatment in Canada, due in part to the importance of the grain economy to the young nation and the development of its west. The history of Canadian grain transportation and marketing is intertwined with the history of western Canada and the development of prairie agriculture. To overcome the barriers to entry, the railroads were constructed with a large degree of public money and regulatory support. Through regulation and alternative ownership, producers and government have tried to mitigate some of that market power and recapture some of the rents.

Railroads in Canada had public support early in their development, and government restrictions to limit market power once the railways were developed. Like the US, the Canadian government helped railway construction with financing. After this early need by the railroads for government intervention, Canada has seen the development of a wide range of regulatory instruments, from the support of competition and contracting, to government ownership and direct regulatory involvement in setting freight rates (Cruikshank 1991).

Shortly after confederation in 1867, the Dominion of Canada decided it needed to quickly construct an east-west railway. The impetus to build the railway came, in part, from the west. The construction of a western railroad was a bargaining chip being used to encourage British Columbia to join confederation. But the urgency to complete the railway came from the south. The dominion government was worried about the United States gaining an upper hand in western transportation, which might threaten Canadian national development. Two U.S. railroads, the Union Pacific and the Central Pacific were linked to form a line to the pacific coast in 1869, and there were threats of a second transcontinental railway in the offing. The Northern Pacific was chartered in 1864 by the U.S. and targeted hauling products from British territory.

> *"The line of the North Pacific runs for 1500 miles near the British possession and when built will drain the agricultural products of the rich Saskatchewan and Red River districts east of the mountains and the gold country of the Fraser, Thompson and Kooteney rivers west of the mountains ... The possessions west of the 91st meridian. They will become so strongly Americanised in interests and feelings that they will in effect be severed from the new Dominion and the question of their annexation will be but a question of time."*
>
> American Senate Committee on Pacific Railroads 1869 (Fowke 1957, pg. 44).

With this policy interest in completing a Canadian east-west link, there was reason, or at least a rationale, for government assistance in the construction of the Canadian Pacific Railroad. This government support translated into both resources and regulatory support. The Dominion government supported the CPR construction with $25 million, substantial land grants in western Canada and tax exemptions (Kulshreshtha and Devine 1978). As well, the Dominion government agreed to fund the completion of lines under construction in 1881, a commitment amounting to 713 miles and a further $37.8 million (Fowke 1957). The transcontinental railway was finished four years later in 1885.

The CPR was granted a charter by the Dominion, which gave it protection against the construction of other rail lines in certain areas. The monopoly was primarily an attempt to halt the construction of connecting lines to the U.S. mainline system. MacDonald claimed that the clause was to stop U.S. railroads from building lines into the area beyond Manitoba. This clause came under attack by Western interests when the legislation was under discussion in 1880. When Winnipeg then chartered six railways after 1881, the Dominion disallowed the charters at the urging of the CPR. After continued pressure from the Manitoba Legislature, the monopoly was cancelled by agreement between the federal government and the CPR in 1888. In return, the government agreed to issue bonds for the CPR in the amount of $15 million.

The federal government believed that the CPR would act in the best interest of the western territories and encourage settlement and agriculture, and thus the Dominion should support CPR requests. Since the CPR had 25 million acres along the railway right of way or other areas 'fairly fit for settlement', it was thought that the railway would find it in its own interest to encourage settlement to create demand for the land, and hence, a demand for the rail services. The problem was that while the CPR did want to encourage settlement, it did not want to do so in areas or ways that jeopardised its monopoly position.

Fowke notes that this was one of the first instances where it was realised that the interest of western settlers might conflict with eastern interests. He argues that there were two dominion goals for the west; (1) to encourage maximum western economic development, and (2), to ensure that the development was integrated back into the national economy.

One government tool for western development that fit both the above criteria was the Crow's Nest Pass Agreement. In 1897 the federal government had entered into agreement with the CPR to construct the Crow's Nest Pass, and in return, the company agreed to reduce freight rates on wheat and flour moving east, and agricultural implements and settlers' effects moving west. This legislated differential pricing was meant to encourage settlement in the West as well as being helpful to an infant farm equipment manufacturing industry in the East

The Crow agreement was later interpreted to only cover the rail network existing in 1897. In 1925, the federal government changed the legislation to remove the statutory freight rate on settlers' effects and expand the rate for wheat and flour to all existing western rail lines and to cover wheat and flour being exported through the west coast

(Kulshrehtha and Devine 1978). With this change, the so-called 'Crow rates' became like the value of service pricing allowed under the ICC in the U.S.. The rates allowed the railway to charge lower rates for lower-value commodities, which have a more elastic demand for transportation, and have high rate on higher-value goods, which have a more inelastic demand for freight.

After 1900 the federal government further eroded the CPR monopoly by actively encouraging the construction of other railways. Canadian Northern entered the scene in early 1900s. William McKenzie and Donald Mann had constructed a network of prairie branchlines and had built to Port Arthur by 1902. At the same time, the Grand Trunk railway was running from Maine to Sarnia, Ontario. Both railways wanted to expand. The Grand Trunk expanded to the West Coast. This gave Canada three national railways, two of which were heavily in debt. The railways' financial difficulties were compounded by the war, leaving the federal government to heavily subsidise the Grand Trunk and Canadian Northern to keep them afloat. The two railways were then combined as part of a Canadian state railroad system which became Canadian National (CN).

In the early years of the rail industry, shippers felt that the best way to keep the railway market power in check was to encourage the construction of competitive lines. This was not always successful. Often these lines were constructed with the help of large sums of public funds, but instead of acting as competitors to the existing railway, they either colluded or outright amalgamated with the existing structure (Cruikshank 1991).

Because there were large amounts of public funds going into the construction of railroads, shippers and communities also felt that they would be able to use those funds to negotiate future lower rates. Although this had some success, the railways had sufficient bargaining power to keep rate concessions to a minimum. In some cases, rate agreements were simply later discarded. The construction of a railway promised economic opportunity and growth to a community. Therefore communities were reticent to turn down the offer of railway construction, giving the railways the upper hand in rate negotiations (Cruikshank 1991).

To deal with shipper concerns, the railways set up a self-regulatory body where shippers could bring grievances about freight rates. In the 1890s, the Canadian Freight Association was expanded to hear freight rate concerns. This process was unsatisfactory for the shippers as the adjudicators were the same people against whom the complaints were being brought. In fact, the addition of freight rate discussion to the railway industry body helped aid collusion among the railways (Cruikshank 1991).

There was also a legal option for shippers. Discriminatory freight rates were outlawed in Canada. But again, this proved unsatisfactory for shippers as the court system was unwieldy and costly. This lead to the call for an arbitration board.

The Railway Act of 1903 included the introduction of a federal railway commission to enforce and adjudicate freight rate regulations. The Board of Railway Commissioners was not dissimilar from the ICC in the U.S. *The Railway Act* indicated a shift in political power from the railways to the shippers.

This shift in shipper influence did not mean that the shippers could control the new commission. There was little further consensus from shippers, their demands breaking down on a regional basis. Often shippers ended up pitting themselves against each other, arguing against special treatment or deals. The railways also used the commission to argue against deals for lower rates that had been struck in the name of competition. Thus railways did have influence over the commission, and used it as roundabout route to enforce collusion. Yet shippers and regional governments were also a powerful interest group, which helped the commission from acting purely in the railway's interest. Instead the commission acted in the interests of its own survival. Therefore it ended up acting primarily as an arbitrator of disputes, trying to find solutions which would alienate neither of the two powerful interest groups – the shippers or the railways.

During the first world war, as occurred in the US, shippers became increasingly dissatisfied with their respective commissions. Due to the war, there was a great degree of upward pressure on prices, which caused the railways to go to the commission asking to increase their freight rates. It is noteworthy that the railways came to the commission two months after a rate increase had been granted in the U.S. by its parallel body, the Interstate Commerce Commission. The approval of this and subsequent increases heightened shipper concern. Regional concerns began to bypass the commission and be directed towards parliament, via federal rate agreements such as the Crow's Nest Pass Agreement.

These rate agreements became of increasing concern to the railways. Pressure from the railways led to a large litany of reviews and commissions held on the Crow rates and other regulated freight rates. In 1961 the MacPherson Commission recommended that freight rates not be directly regulated (West 1994), although it did not recommend suspending the Crow rates. These ideas around non-grain traffic were implemented in the *National Transportation Act* of 1967 (NTA '67).

The NTA'67 deregulated the non-grain freight rates with the only stipulation being that the freight rates were compensatory. If the shipper was 'captive' there was also a maximum schedule set (roughly variable cost plus 150 per cent). As well, rates had to be published. By 1984, no shipper had been granted captive status, and no rate had been investigated for being below cost.

In 1987 the Act was changed to allow for more pricing flexibility. This revised *National Transportation Act* (NTA '87) allowed for confidential contracts and intermodal competition (as did the *Stagger's Act* in the US). The NTA '87 also allowed for some shipper relief provision which will be detailed later. These provisions have not been much used.

While freight rates for other commodities were being deregulated by the NTA '67, the Crow rates were still in place. By the 1960s the railways were arguing for financial assistance in moving grain. They pushed for a subsidy to cover what has become known as the 'Crow gap', the difference between the cost of moving grain and the statutory rates. The railways also asked to be able to abandon parts of the prairie branch-line network. They brought this concern before the MacPherson Commission.

Provinces and farmers made arguments to the MacPherson Commission to the keep the Crow rates. The Commission ended up recommending that the federal government subsidise movement on grain-dependent branchlines. In 1969 the federal government introduced the subsidy along with prohibiting abandonment of 6,300 miles of track (Skogstad 1987).

Pressure continued from the railways to get rid of the Crow rates. Events came to a head in the 1970s when the railways stopped reinvesting in capital equipment designed to move grain. Grain dependent branch lines were deteriorating and the box-car fleet was rapidly diminishing. This caused the federal government to invest $891 million to upgrade a number of prairie branchlines. A combination of purchases by the Alberta and Saskatchewan provincial governments, the federal government and the Canadian Wheat Board produced a fleet of 13,000 grain hopper cars not owned by the railways.

A number of farm commodity organisations joined the railways in arguing that the Crow rates were non-compensatory and distortionary. By 1977 the Crow rates were covering only 32 per cent of the variable costs of movement, while another 18 per cent was covered by the federal government branch-line subsidies (Economic Council of Canada 1981). Because the rates were no longer compensatory, they helped lead to problems of under investment as discussed above. The low rail rates also encouraged rail use over road use, resulting in more delivery points than would otherwise be optimal (West 1994). Further, because the Crow rates were limited to grain and flour, they also acted to make the production of non-covered speciality crops relatively more expensive (Rosaasen 1983).

In 1984 the federal government replaced the statutory freight rates with a rail subsidy. The *Western Grain Transportation Act* (WGTA) was introduced which contained a series of regulations around the rail traffic in grain. The WGTA set freight rates for grain, charged shippers with about half of the cost, and covered the other half with a subsidy to the railways. This subsidy amounted to a high of $720 million, before being cut back in 1993 and 1994. Over time the shippers' share of the cost would rise. As under the Crow rates, freight rates continued to be set on a distance-related basis. Railways were to submit to a costing review every four years, upon which the annual freight rates would be set. This meant that any cost savings from productivity gains were passed along to producers in the form of lower freight rates every four years. As well, the Grain Transportation Agency (GTA), which had been introduced in 1979, reviewed the railway's grain movement quarterly, and had the ability to fine the railways ten percent of the Crow benefit if they were not meeting standards.

The WGTA did more than regulate freight rates and ensure service. Because of the government investment in hopper cars and branchlines, the WGTA also included controls over both of these two assets. Under the WGTA, Canada had a third-party rail car allocation system. The GTA acted as a single body co-ordinating the many aspects of the grain transportation system allocating cars on a ship-to-sales system and co-ordinating rail capacity and sales. The WGTA also regulated the abandonment of branchlines. Not all rates were set at the level set by the WGTA. There was the provision for agreements on variable rates to be reached between shippers and the railways. Elevators were sometimes able to obtain special rates for large volume movements, which often were shipped from the newly constructed inland terminals.

In 1995, due to budget considerations, the federal government ended the WGTA subsidy. The government also privatised its national railway, CN, and announced its intention to sell off the government-owned hopper cars. The federal government merged the WGTA with the NTA '87 to create the *Canadian Transportation Act* (CTA) which was passed in 1996. The passage of the CTA marked the end to grain's special regulatory treatment and moves it toward the deregulated environment faced by other bulk commodities since the NTA '67.

The Canadian Transportation Act

Although the CTA represents a move towards a deregulated grain transportation system, it still contains a number of regulations pertaining to grain movement. There is currently a cap on grain freight rates which keeps some of the pricing dictates of the WGTA. The new legislation also contains a number of shipper provisions first introduced in the NTA '87. Like the NTA, the CTA is an attempt to allow freight rates to be determined by a market mechanism, while allowing some government intervention to try to encourage competition.

The grain freight rate cap is based on a 1992 railway costing review and is designed to cover the railways' variable costs, plus a return on capital. Like the WGTA before it, the cap applies to both high and low-cost movement of grain, thus generally keeping rates distance-related. As well, the cap applies equally to all crops covered under the WGTA, thus limiting value-of-service pricing. The future of the freight rate cap is currently under federal review by a commission headed by former Supreme Court Justice, Willard Estey.

There are some possible exceptions to the freight rate cap. The implication of having maximum freight rates only apply to federal railways would seem to imply that short line rail companies (SLRs), even internal SLRs which are short lines who are subsidiaries of a main-line carrier, could charge more that the maximum freight rate.

The CTA still contains the shipper relief provisions – Interswitching, Competitive Line Rates (CLRs) and Final Offer Arbitration (FOA) – originally put in place under the NTA '87. These provisions were meant to encourage competition between the two railways. Interswitching and CLRs both allow shippers whom are captive to one railroad to force that railroad to take them to the nearest junction with another railroad at a set freight rate. Interswitching was the original provision which was only available to shippers who were no more than 30 km from the interchange (i.e. the junction between the two railroads). CLRs expanded the interswitching provision to shippers further away from the interchange. The idea is that if the captive shipper can negotiate a better rate with the competing railroad, they can use these provisions to ensure that their railroad 'captor' will not extract excess rent moving them to that other line. The Interswitching or CLR will be set by the CTA based on the average variable cost of the haul and past rates, and can only be used to the nearest interchange.

There are limits to the use of Interswitching and CLRs. Only one CLR is available per route; thus one cannot get a CLR at the origin and another at the destination. As well, CLRs can only be used for a maximum of 50% of the haul.

Therefore shippers cannot use these provisions to get a regulated freight rate for the entire trip (Aikins, MacAulay and Thorvaldson 1995).

There are barriers to accessing these provisions added in the CTA. To access these shipper relief provisions, the shipper has to be under threat of 'substantial commercial harm' if relief is not given. In a change from the NTA '87, all interswitching rates and CLRs must be deemed to be commercially fair and reasonable.

Final Offer Arbitration (FOA) is available for shippers who cannot reach agreement with their carrier. This provision certainly covers rates, although there is a question whether FOA applies to level of service provision. If the two parties cannot reach agreement, their dispute goes to an arbitrator who will choose between the final offer of the shipper and the railway. It is generally known that the arbitrator will not be likely to accept the shipper's final offer if the shipper has alternative means of transportation (Aikins, MacAulay and Thorvaldson 1995).

Under the WGTA, the freight rates paid to the railways were set based on a railway costs, which were reviewed every four years. In this way, any productivity gains made by the railways were passed back to the farmers. Under the CTA, the only productivity gains shared with producers are those garnered through branchline abandonment. For every mile of branchline abandoned, the railway revenue under the maximum freight rate is adjusted downward by $10,000. Any other productivity improvements accrue directly to the railways. Because of the accrual of gains in efficiency, it is currently estimated that the maximum freight rate caps are giving the railways over 40 per cent contribution to fixed costs, up from a 20 per cent contribution under the WGTA (Saskatchewan Highways and Transportation 1998).

Unlike the WGTA, the CTA does not have direct performance guarantees. The CTA does have a section – Subsection 113(1) – which requires a railway, according to its powers, to provide adequate and suitable accommodation for traffic.

The CTA also changes the regulations surrounding branchline abandonment. Since 1969, and later the Hall report in 1977, there has been a prohibition on the abandonment of a large number of branch-lines. Strict regulation surrounding branchline abandonment was also included in the NTA '87. The CTA changes this. Although railways are asked to indicate their plans for branchlines in a three-year plan, there is nothing holding the railways to that plan, thus implying that railways do not have to give advance notice before abandonment. Interested parties have 90 days to indicate interest in purchase.

The railway is no longer obligated to sell abandoned lines to a party (other than the government) wanting to operate the line. This is a significant change from the NTA '87 provisions that forced the railway to sell. A railway can also simply cut service to a line, an action known as 'demarketing'. This might be an option for a firm that does not want to risk turning over the line to a rival. Even the threat of demarketing might be enough to cause shippers along the line to halt investment in their facilities. There is no provision against demarketing in the CTA.

Community input on branchline abandonment is lessened under the CTA. Section s166 and 167 of the NTA '87 contained a large scope for discussion of community impact of branchline abandonment, namely: "no railway company shall abandon more than four percent of its total route mileage in the first five years after this section comes into force" (subsection 159 (4), NTA '87). There is no equivalent in the CTA.

The option of short line railways is often raised as an alternative to both branch-line abandonment and railway market power. However, there are a number of limitations in the CTA to the creation of short lines. While shippers can use FOA to get a rate from a short line end point along a federal railway, they cannot use the CLR provision. Short lines have a limited amount of time to mount a bid to purchase a branchline, and they have no ability to force the railway to accept their bid if the mainline carrier does not so wish. Finally, if the mainline carrier demarkets the line, there is no method to force the line to be available for sale to a short line carrier.

In summary, under the CTA, freight rates for bulk commodities with the exception of grain are deregulated. Increases in grain freight rates are still limited, but the future of this cap is uncertain. The CTA, like the NTA before, attempts to mitigate railway market power through encouraging competition. Shipper relief provisions and short-line railways are seen as means through which shippers may be able to reduce their reliance on a single main-line carrier, and thus be able to negotiate lower freight rates. Both these avenues to competition have barriers to access, whether legislative or economic. Lastly, there is particular concern as to the utility of these options for grain producers who will not negotiate over freight rates with the railways because they are not the shippers of their product.

3.2.3 Summary of Rail Regulation

The Canadian government has long been involved to various degrees in grain transportation. The grain industry has been important for Canada's economic development. Therefore the government has a special interest in ensuring that the industry was able to develop, grow and support settlement. Because Canada's grain sector has always been export-driven, transportation is an important component in the health of the grain industry. Rail transportation has barriers to entry, as well as the potential for market power. This has lead to government intervention, both in terms of aiding entry, and then regulation after the firms have been established.

Canada has tried many different forms of government intervention to overcome the problems associated with a high sunk cost industry. The government began by funding to encourage entry. It then moved to attempt to develop contractual arrangements on rates, which ran into difficulty because of railway bargaining power. At the shippers' request, the government adopted independent arbitration which was only able to deal with concerns on a case by case basis, and did not address the overall problem of rail market power. Federal ownership of one national railway was attempted. Direct freight regulation was also tried, which helped redistribute income from the railways to the producers, but therefore also lead to price distortion. And finally, with the NTA and now CTA, Canada is now attempting to engage market forces under deregulation.

In both Canada and the United States, government intervention in rail has been a mixed blessing for the industry. In both countries, the railways were constructed with a high level of government financial support to overcome the large initial costs in the industry. In Canada, early regulation created a monopoly for the new Canada Pacific Railway (CPR) in the name of nationalism. In the U.S., although freight rates were regulated, the railways were allowed to price discriminate on the basis of value of the product hauled, which improved their profits while serving the U.S. interests of developing the West. In both countries, regulation over freight rates also allowed railways to put a stop to rate wars that bit into their revenue.

Recently both countries have deregulated their rail industries. In the U.S. there is some evidence of a return to monopoly pricing by the rail industry. In Canada there is still a freight rate cap in place, constraining monopoly pricing.

Like rail, the elevator industry has suffered from barriers to entry and the potential for market power. Unlike the rail industry, elevators have not been subject to a high degree of price regulation. Instead governments have attempted to regulate entry. The following sections discuss the regulation of the elevator industry in the U.S. and Canada.

3.2.4 U.S. Elevator Regulation

In the U.S., farmers had long raised concern about monopolies, which prompted the early regulation of the railways described above. As the rest of the economy changed from small, privately owned firms to larger conglomerates in the 1880s, public concern about monopolies became more wide-spread. This public distrust of monopolies led to a broad-based regulatory action. U.S. public policy-makers tried to deal directly with the problem of monopolies through limiting horizontal integration. This resulted in the Sherman Antitrust Act passed in 1890.

U.S. farmers were concerned about deals between railways and elevator companies to decrease competition. In the U.S. there were many links between the railways and the elevator companies. The railroads would deny loading facilities or cars to producers trying to circumvent the existing elevator system. The U.S. attempted to address some of these concerns around elevator power through regulating the railways. Through disallowing incentive rates and regulating service, they attempted to ensure that all grain elevators had access to railway transportation (Benedict 1953).

Farmers were also beginning to try and lower some of their production costs through collective action. In 1871, members of the Grange began to buy farm supplies co-operatively to mitigate some of the market power of the farm input dealers. Shortly after the turn of the century, producers also began to form local co-operative grain elevators. Low prices in the early 1920s lead to further calls for collective action. In the summer of 1920, the American Farm Bureau Federation started to organise a large-scale co-operative for providing elevation services and farm inputs. The attempt was to bring local co-operatively owned elevators into the terminal market, allowing them to gain rents from the marketing, as well as the handling, of grain (Benedict 1953).

The U.S. tried a number of solutions to address the problem of the elevator hold-up problem and subsequent exertion of market power. The government attempted to direct legal action against market power through anti-combines legislation. With regard to the elevator industry, the U.S. saw a private solution to the hold-up problem – vertical integration. In order be ensured of transportation services, elevators became vertically integrated with the railways. A number of the railways had financial interests in the elevator companies (Benedict 1953). These interests ensured that the vertically integrated elevators would receive rail service. But this consolidation of did not alleviate the concern about market power. As mentioned above, competitors to these vertically integrated elevators did not receive adequate rail service, which acted as a barrier to entry into the elevator industry. The U.S. government addressed the hold-up problem limiting new entrants into the elevator industry through regulation of the railways. This allowed farmers to join together and form co-operative elevator companies to compete against the existing firms in the industry.

3.2.5 Canadian Elevator Regulation

Since the beginning of the wheat economy in Canada, farmers have been concerned about their lack of bargaining power. Grain producers had concerns about abuses of market power by both the grain trade as well as the input suppliers. In the grain trade, the basis was an early concern. The basis at that time was the difference between the Liverpool price and the Winnipeg spot price. There was recognition that while little could be done to increase the Liverpool price, but there might be some latitude for action on the basis. The most transparent part of the basis for western producers was the cost levied at the elevator. Farmers attempted to lower the basis, first through the call for regulation, and later through collective action and the formation of co-operatives.

The price a producer received from the elevator was determined by four factors: (1) bushel gross weight, (2) dockage and shrinkage, (3) grade, and (4) price per bushel. As Fowke notes "Every one of these factors has been the cause of dissatisfaction to the growers in the marketing of western grain." (Fowke 1957, pg. 110)

In his book on the history of the Saskatchewan Wheat Pool, Fairbairn (1984) writes about farmers' lack of bargaining power when dealing with their elevator. He tells how some farmers faced a 25 mile trip to the nearest railway delivery point with wagons that only held 50 bushels, one 100th of the production of a moderately sized grain farm. When the farmer arrived, the elevator agent would offer a lower price, grade, weight, or test a higher dockage than the farmer felt valid. But the producer had no other alternative. In one case where a farmer did go to another elevator to get a counter offer on grade, he saw the first elevator agent signalling the other agent the original grade bid. Scales were found to be distorted and bins for higher grade grain were claimed to be full. The distance between elevators was enough to give each elevator a large degree of market power, which in turn enabled the elevator to extract excess rents from producers.

In 1899 the Dominion appointed a Royal Commission which found that "... *in many cases there is little, if any, competition between elevators as to prices and that* *there is seldom any advance from other buyers ... Of late years there have been combinations of elevator owners into large companies."* (Fowke 1957, pg. 117)

There were also barriers to entry into the elevation industry. As an example, the CPR was limiting the use of the flat warehouses, which had acted as an alternative to the existing elevators. The railway made an agreement with any party who would build an elevator at a loading point that it would prohibit the loading of cars at that point either over the platform or through a flat warehouse. James Douglas, MP for Assiniboia East, argued that the railway was acting in collusion with the elevator companies to squeeze producers' incomes through widening the basis. The calls for government regulation of the elevator industry increased.

One of the more blatant problems resulting from elevator market power was inaccurate and inconsistent grading of grain. Regulation of elevators began early with a federal law of a general inspection act of 1873, which regulated the grading of grain. Grading regulation was expanded with the *Manitoba Grain Act* of 1900. This Act provided for the licensing, bonding and supervision of all grain dealers and established the office of the warehouse commissioner for administration.

The *Manitoba Grain Act* went further to limit opportunistic behaviour by the elevators. The Act required railways to supply cars without discrimination for loading platforms. Furthermore, if there was sufficient demand, railways were required to construct a loading platform and to make it available without charge. After 1902, each delivery point had to allow farmers to order producer cars. As Fowke notes, the *Manitoba Grain Act* "provided for a thorough system of regulation of the grain trade but... it contributed little toward the restoration of competitive balance in cereal markets." (pg. 118)

After protest from farmers, the Liberals introduced the *Canada Grain Act* in 1911, proclaimed by the conservatives a year later, which consolidated the *Grain Inspection* and *Manitoba Grain Acts*, created a board of grain commissioners and provided for public construction of terminals at the lakehead. This led to the creation of the Canadian Grain Commission (CGC), which is still in operation today. The legislation also allowed the CGC to set maximum charges for local elevators. These maximum tariffs were removed in 1994.

Along with lobbying for increased government intervention in the grain handling industry, producers dealt with their concerns by organising farm organisations, and then later, farm co-operatives. W.R. Motherwell organised the Territorial Grain Growers' Association in 1901. This later became the Saskatchewan Grain Growers Association. Ed Partridge decided that farmers could run and profit from the grain trade as well as anyone else and organised the Grain Growers Grain Company in 1906.

Producers also began to consider farmer co-operative elevator companies. Both Saskatchewan and Alberta launched co-operative elevator companies. The Manitoba government experimented with government ownership and bought 174 elevators between 1909 and 1912. The government tried to recoup its expenses solely through pricing of services and not getting involved in grain marketing. This proved unsuccessful in part due to high elevator purchase prices and bad location. The government turned the elevators over to the Grain Growers Grain Company, which also absorbed the Alberta co-operative elevators, prompting a name change to the United Grain Growers. The Saskatchewan Co-operative Elevator company was founded in 1911 (Fairbairn 1984). These elevator companies or their successors continue to operate today.

3.3 Summary

In this chapter, the history of regulation in Canada and the U.S. grain transportation industries was briefly reviewed in an attempt to understand the impetus behind early attempts at regulation. The industries involved in getting grain to port have high sunk costs, which act both as barriers to entry and allow firms, once established, to have some market power. Governments faced the difficulty of first getting firms into the industry, and then trying to limit their use of market power once the firms are established. The history of regulation in Canada and the U.S. grain transportation industries was discussed to give an idea of how governments have grappled with these problems in the past. The history in both Canada and the United States is peppered with attempts by government to develop the rail and elevator industries while constraining their market power.

The rail industry benefited from some of the government intervention. Initially, railways received large subsidies of land and money to get started. The federal government in Canada protected the new Canada Pacific Railway (CPR) from competition. In the early days of freight rate regulation, railways were allowed to price discriminate on the basis of value of the product hauled, which improved their profits while serving the national interests of developing the West in both countries. In both countries, regulation over freight rates also allowed railways to put a stop to rate wars that bit into their revenue.

More recently, governments in both countries have begun to return these industries to a more market-based framework. The current regulatory regimes in both countries are described. Some of the impacts of this shift to deregulation were discussed.

The U.S. deregulated its rail industry in 1980; this action provides some evidence of what can occur without rate regulation. Although freight rates have fall in the years immediately after deregulation, there is evidence that railways are price discriminating between routes and commodities and in some locations monopoly pricing is emerging.

As discussed in the previous chapter, historically, there has been difficulty with the hold-up problem limiting entry into the elevator industry. This barrier to entry allowed existing firms in the elevator industry the potential for market power. The government addressed the problem, not by funding the construction of elevators, but through regulation. Because the elevator hold-up problem resulted from railway market power, the government attempted to limit the use of that market power by railways. With regulatory provisions ensuring rail service, other firms could now enter the elevator industry. Producers organised to build co-operatively owned elevators in order to capture some of the rents from grain handling and marketing. The government also directly regulated elevator charges to address concerns about market power at the country elevator level.

The impact of elevator price regulation in Canada will be discussed in the following chapter. Chapter 4 describes the current market structure of the grain transportation and handling industry.

Chapter 4

Industry Structure and Institutions

4.1 Introduction

This chapter describes the industrial structure of the grain transportation and handling industry. It begins by giving a brief description of the flow of grain from farm to port. Then each sector in the industry is described. The cost structure and market structure in each sector is outlined. Finally, the institutions involved in grain transportation are discussed, including their impact on the grain transportation and handling industry.

4.2 Description of the Canadian System

Over 46 million tonnes of grain is produced in the prairie region, 70 to 80 per cent of which is exported.[2] The grain is produced on 40 million seeded hectares, which are approximately 1000 miles from tidewater position. The grain may be stored on farm for a considerable time before being brought to the elevator. Throughout the year, the export-bound grain is driven an average 25 km to a country elevator owned by one of 8 companies at one of approximately 800 delivery points across the prairies. At the elevator, the elevator manager offers a grade for the grain. The grain is elevated. If the farmer delivers a wheat board grain, the producer receives an initial payment. If the producer delivers an off-board grain, they receive the spot price.[3] These prices received will generally be the port price with deductions for elevation, removal of dockage, transportation, and terminal charges.

The grain will sit in the local elevator for anywhere from a few days to 10 weeks. Much of it is then loaded onto railcars to be transported to port. Representatives from the railways, elevators and farmers, in combination with the Canadian Wheat Board, allocate

[2] Based on 1995 figures for production and export of the six major grains and oilseeds (Canada Grains Council 1995).

[3] Futures markets are also an option for some grains.

railcars as sales are made. Cars for non-CWB grains are allocated on the basis of actual sales requirements.

The grain is transported to port by one of two main-line railways. It is delivered to terminal elevator facilities where the grain is inspected and officially graded by the Canadian Grain Commission. The grain is then cleaned and loaded onto ships for transport to the buyer. Some buyers will take possession at the export port, whereas others will take ownership when it reaches the importing country.

Prices for grain are set on the world market. Canada is a small country exporter in terms of total sales, but it has a relatively large share of the export market for some crops such as durum, canola, and high protein wheat.

The next sections will outline the different sectors involved in the grain transportation industry. Approximate costs of different services will be identified. Indications of the potential for market power will be presented. The chapter will then discuss the different institutions involved in grain movement and their effect on any future grain transportation system.

4.2.1 Farm

There are about 140 000 farms (120 000 CWB permit book holders) on the Canadian prairies. On average prairie producers have on-farm storage amounting to 1.2 times their annual production. With the need for segregation, this storage capacity is effectively less (Western Provinces 1998). Storage costs are estimated to be between \$4.29 and \$7.08 per tonne (Saskatchewan Agriculture and Food 1992).

Farm deliveries to elevators occur throughout the year with peak deliveries occurring during the fall. Deliveries are often limited in the spring due to road bans resulting from soft roadbeds. Farm trucking costs are estimated to range between \$2.70 to \$10.35 per tonne for a 15 km haul (Saskatchewan Agriculture and Food 1992). These figures do not include initial capital costs or depreciation. ATKearney estimated costs for these short hauls to be \$4.98 per tonne. The current average trucking distance from farm to elevator is estimated to be an average of 25 km, which will increase to 65 km with the current system rationalisation (Western Provinces 1998).

Farm costs of production vary by soil zone and cropping practice. Table 4.1 shows the on-farm costs of production in Saskatchewan:

Table 4.1 1997 Farm Variable Cost of Production by Crop and Soil Zone

Crop	Cropping Practice	Soil Zone		
		Black	Dark Brown	Brown
			($/tonne)	
Wheat	Fallow Seeded	95.84	93.73	82.54
	Conventional Stubble Seeded	120.79	132.9	138.81
	Direct Seeded	125.46	109.72	141.63
Canola	Fallow Seeded	177.80	195.86	--
	Conventional Stubble Seeded	240.62	336.32	--
	Direct Seeded	238.64	329.67	--

Source: Saskatchewan Agriculture and Food (1997) and Author's Calculations
Note: The costs presented in this table include labour.

Grain production goes both to the domestic market, for feed or processing, and to the export market. The dependence on the export market varies from crop to crop. From 1984 to 1994, over 12 million tonnes of barley was produced annually in western Canada. One third of the production was exported, while over half went for feed in Canada; another 2 million tonnes went to the domestic commercial market. Over the same time frame, western farmers produced an average of 26 million tonnes of wheat per year, 19 million tonnes of which was exported. Thus, only about 27 per cent of wheat went to the domestic market. Over half of the domestic disappearance of wheat went for feed, with a little over 3 million tonnes going to the domestic commercial market (Canadian Wheat Board 1995). Flour mills are the largest consumers, purchasing 2 million tonnes per year (Kennet 1997). Over 4 million tonnes of canola per year was produced during the same time period, half of which was exported. Of the amount remaining in Canada, 1.5 million tonnes were crushed (Canada Grains Council 1995).

Because of the large number of farmers and their production of a relatively homogeneous product, each individual producer takes grain and oilseed prices as being given. Nevertheless, producers do have two alternatives to delivering grain into the export grain transportation and handling system at any point in time: they can store the grain, feed in on-farm, or, they can deliver it to the domestic market.

4.2.2 Primary Elevators

The elevator system across the prairies underwent a dramatic change over the past couple of decades as it consolidated from many smaller elevators to fewer, larger elevators and inland terminals. In 1971/72, the prairies had 4,545 primary elevators at 1,666 delivery points with 10.8 million tonnes of capacity. In 1997 there were 1,146 elevators at 808 delivery points with 6.6 million tonnes of capacity. This is a 75 per cent drop in the number of elevators, a 50 per cent drop in the number of delivery points and a 40 per cent drop in capacity (Western Provinces 1998).

The average number of elevators per delivery point has declined from 2.7 to 1.4. This means that there are fewer delivery points with multiple elevator companies present. Elevators have become larger as older, wooden elevators get replaced with high-throughput concrete structures. The overall decrease in elevator capacity has coincided with an increase in grain deliveries. This means the average elevator has increased its annual turnover from 2.35 turns in 1971/72 to 5.47 turns in 1996/97 (Western Provinces 1998). A study by Agriculture Canada "Evolution of the Primary Elevator System in Western Canada" in 1984 estimates that an increase in turnover from 3 to 6 times decreases elevator cost per tonne by about 40 per cent. More recent work by Alberta Agriculture has indicated that elevators with a turnover ratio of 5.25 had approximately one-half the operating costs of an elevator with a turnover ratio of 2.25 (IBI 1994) (this study, however, did not include the increased depreciation costs of the newer, higher turnover facilities). The move towards higher throughput elevators with larger turnover ratios is not likely to end soon. Some industry observes state that a reasonable turn ratio is 8 to 10 times per year. (See, for example, Curt Vossen, president of Pioneer, quoted in the Western Producer Aug 21, 1997.)

Saskatchewan Highways (1992) has attempted to model the costs of the primary and terminal elevator industry. Table 4.2 compares the approximate country elevator costs to those of an inland terminal. The difference between cost structures implies there are some economies of scale in the elevator industry.

Table 4.2 Primary Elevator Costs

	Country Elevator 4,500 tonne capacity 5X turnover	Inland Terminal 13,600 tonne capacity 12X turnover
	($/tonne)	
Depreciation	1.10	2.50
Interest	0.65	1.20
Insurance	0.15	0.10
Taxes	0.40	0.35
Total Fixed Costs	*2.30*	*4.05*
Labour	3.10	1.10
Utilities	0.25	0.30
Repairs and Maintenance	0.65	0.65
Other	0.65	0.15
Total Variable Costs	*4.65*	*2.20*
Total Costs	6.95	6.25
ATKearney estimates	7.28	5.36

Source: Saskatchewan Highways and Transportation and ATKearney

The existence of economies of scale is consistent with the notion that primary elevators have a cost structure characterised by a high level of fixed costs. These fixed costs are larger for the newer, high turnover elevators. Variable costs, specifically labour costs, are lower with the newer elevators. A new high-throughput elevator costs about $7 to $10 million (Western Provinces 1998). IBI (1994) found that the typical sales price of a country elevator was 25 to 30 per cent of its replacement cost. This cost structure may imply there are some sunk costs in primary elevators.

The Western Provinces have anticipated that the rationalisation of the prairie grain handling industry will continue to the point where there will be only 100 to 200 delivery points five years hence. The facilities at these points will likely be all high-throughput elevators. The report also notes that very few of the new high-throughput elevators are located off main or secondary main rail lines. The report anticipates that the combined elevator and rail rationalisation will directly affect 25 per cent of grain exports.

The decrease in the number of elevators and delivery points may point to a decrease in the competition between elevator firms. Since there are fewer delivery points with multiple elevators, more elevators are separated by distance, making it more difficult for producers to force the elevators to compete for business. As has been discussed in the previous chapter, once a producer has transported his or her grain to a deliver point, they have incurred a sunk cost, which gives the elevator operator some bargaining power. On the other hand, farmers located equal distance between two or more delivery points, may be able to continue to force the elevators to compete for their business.

There is evidence that primary elevators have the ability to price above marginal cost. IBI (1994) found that primary elevator tariffs increased 46 per cent from 1983 to 1993 whereas over that same timeframe IBI states that costs have decreased. Charges for the removal of dockage have also more than doubled over that same time frame. Even if these numbers indicate that elevators are pricing above marginal cost, rates of return to investment are not exorbitant. IBI notes that the return on investment for the majority of existing primary elevators is rather low at 5 to 6 per cent although it can be three times as high at the newer high-throughput operations.

Until 1994, the Canadian Grain Commission set maximum tariff rates, with elevators pricing below these rates. Currently elevators must file a maximum charge with the CGC. The current filed maximums are higher than what was charged before 1994, but not exorbitantly so. Although there are currently filed tariffs that are above the 1994 cap levels, there are also rates that are below. The filed tariffs for 1997 are compared with the maximum tariffs in table 4.3.

Table 4.3 Tariff Cap versus 1997 Filed Tariffs for Wheat

		1994 Cap	1997 Max	1997 Min
		($/tonne)		
Wheat	Elevation	10.75	12.20	7.81
	Removal of Dockage	*3.11*	*4.10*	*2.61*
Canola	Elevation	17.20	18.35	11.45
	Removal of Dockage	*4.14*	*4.87*	*5.43*

Source: Vercammen et al. and Canadian Grain Commission (1998)

One trend, which has appeared since the removal of the maximum tariffs, is that the filed charges now differ between provinces. Alberta and Manitoba have consistently higher rates filed than Saskatchewan, as illustrated in table 4.4. If tariffs are set based on residual profit, it might be expected that regions with lower freight rates would have higher elevation tariffs.

Table 4.4 1997 Filed Tariffs for Selected Elevator Companies by Province for Wheat

	Cargill	Parish and Heimbecker	Pioneer	Provincial Pool	UGG
Manitoba	10.09	9.92	10.33	9.93	12.20
Saskatchewan	8.82	8.81	8.51	8.82	10.50
Alberta	9.37	9.36	9.40	9.37	11.25

Source: Canadian Grain Commission (1998)

If the elevation industry is a decreasing cost industry, a high level of market concentration might be expected. To determine the level of concentration in an industry, one often looks at the market shares of the firms in the industry. As a proxy for market share in the elevator industry, the storage capacity of a firm as a percent of the total prairie elevator capacity is considered. In 1998, SWP had the most elevator capacity at 1,918 thousand tonnes. AWP was second with 966 thousand tonnes of storage capacity. UGG had 883 thousand tonnes. Then came Pioneer with 665, Cargill at 526, Manitoba Pool at 515, Parish and Heimbecker at 240 and N.M. Patterson and Sons at 220. There are also a number of smaller elevator companies and locally owned elevators, which together had 419 thousand tonnes (Canadian Grain Commission 1998). Saskatchewan Wheat Pool has 31 per cent of the total prairie capacity and 53 per cent of the Saskatchewan capacity. Alberta Wheat Pool has 15 per cent of the total prairie capacity and 55 per cent of the Alberta and B.C. capacity. Manitoba Pool Elevators have 8 per cent of prairie capacity, or slightly under 50 per cent of the Manitoba capacity. UGG is the largest non-co-operative grain handling company with 14 per cent of the prairie capacity. If one considers each wheat pool company separately, the largest four companies have 70 per cent of the market. If measured by province, the market concentration is higher. The largest four companies in Manitoba have 85 per cent of the capacity, while the largest four companies in Saskatchewan have 84.1 per cent of the capacity. In Alberta and B.C., the largest four companies have 92.9 per cent of the capacity.

When considering whether firms have the power to set price above marginal cost, one should also consider whether they produce a homogeneous or a heterogeneous product. Much of the competition that occurs between elevators is in services, not posted tariff. The Saskatchewan provincial government (1992) notes that elevators have some ability to set price independent of their competitors because of "producer preference for hauling to the nearest point, high trucking relative to freight costs, priority given by grain companies to non-price strategies for maximising market share, and firm loyalty," (pg. 43).

There have been a number of dramatic structural changes in the elevator industry in the past few years. The co-operative elevators are undergoing change. The firm with the most capacity in the prairies, Saskatchewan Wheat Pool, has changed its financial structure and has listed non-voting shares on the Toronto Stock Exchange. As well, the three prairie pools are increasingly encroaching into each other's territory. Saskatchewan Wheat Pool has recently announced that it will construct several elevators in both Manitoba and Alberta, adding to the few already in place under the AgPro label. Manitoba and Alberta Pools have announced that they will merge and form a new co-operative will be called Agricore. One of Agricore's stated objectives is to expand into the Saskatchewan market.

Recently, there have been moves by multinational grain companies to entry the Canadian grain handling market. Louis Dreyfuss has recently announced the construction of three new elevator facilities across the prairies, with several more expected. Both ConAgra and Continental are also constructing facilities on the prairies. Archer Daniels Midland has bought 45 per cent of UGG. Alberta Wheat Pool and Cargill jointly own Cascade Terminal in Vancouver.

Business observers anticipate that there will be several mergers in the elevator industry over the next five to ten years. As an example, Dominion Bond Rating Service recently noted that it felt there were too many firms in the industry, and return on investment was too low (Western Producer 1998). Given the recent merger of U.S. elevator companies Harvest States and Cenex, increasing concentration may be a North American trend.

4.2.3 Rail

There are two primary main-line carriers in the Canadian rail system: CN and CP.[4] Like the elevator industry, the rail industry is in the midst of change. With the removal of the prohibition on branch-line abandonment, which occurred with the end of the WGTA, additional carriers have entered the system as short-lines. These short-line railways are generally captive to a single mainline operator; thus they cannot currently compete with the mainlines.

Railways are also making more north-south connections. As an example, CN has recently offered to purchase Illinois Central Corp for $2.4 billion. Illinois Central has track running from Chicago to the Gulf of Mexico. The CPR already owns the Soo Line Railroad Co. and the Delaware and Hudson Railway Inc. Combined, these two US railway companies give the CPR access to the Northeast and Midwestern states.

There is 29,600 km of track in the prairie rail system. Of this total, 8,900 km is grain dependent (a line is defined as grain dependent when over 60 per cent of the traffic

[4] BC Rail also operates in Western Canada, although the only grain delivery point on its trackage is Fort St. John B.C.

either originating or terminating on the line is grain) (Western Provinces 1998). A total of 5,565 km of rail line has been abandoned since the 1970s (Transport Concepts 1995). Further branchline abandonment is expected. Approximately 20 per cent of the grain dependent branchline network is listed as 'to be discontinued' and some industry observers anticipate that up to 50 per cent of the branchline network will be abandoned over the next five years (Western Provinces 1998).

Railways are an example of a declining-cost industry. There are high fixed costs associated with rail. Track is very expensive to build, as evidenced by the fact that there has been virtually no new track construction since 1963 (Transport Concepts 1995). As stated in the preceding chapters, it is speculated that railways also have a high degree of sunk costs.

Because of the lower volume shipped, total cost per tonne-mile of rail transportation is higher on grain-dependent branchlines than on mainlines. ATKearney (1994) estimated branch-line hauling costs to be \$0.11 per tonne-mile and branch to mainline interswitching costs to be \$0.40 per tonne. In total, they estimate the cost of a 75 km branchline haul to be \$8.39 per tonne and a main-line haul from Regina to Vancouver to cost \$22.00 per tonne (or \$0.018 per tonne-mile). ATKearney estimates BN costs to be about \$16.52 (or \$0.014 per tonne-mile) for that same mainline haul. Saskatchewan Highways and Transportation (1992) estimate the average cost of moving Saskatchewan grain to be \$5.75 per tonne for the branchline system and \$37.50 for the main line movement.

In 1992, the total rail cost for moving Western Canadian grain to port exceeded \$1 billion. Volume related costs were \$824.7 million (includes capital and depreciation), contribution to railway overhead (20 percent return on investment) accounted for \$164.9 million and the remaining \$81.9 million was for line-related costs. The line-related costs are meant to account for costs accruing from grain-dependent branchlines (Vercammen et al. 1996). Volume related costs amount to approximately 80 to 87 per cent of total costs.[5] The sum of these costs divided by the volume of grain shipped give a cost of approximately \$0.03 per tonne-mile in 1992, which became the freight rate paid to the railroads that year. In 1998, the freight rate cap (which is meant to be an approximation of total rail costs) is approximately $0.035 per tonne-mile.

Another factor in the cost of rail transportation is the cost of hopper cars. Grain is the only commodity where the public owns the majority of the rail cars. Since 1972, governments have provided a total of 19,192 hopper cars to railways for grain transportation. The railways use these cars for moving Canadian grain to terminal positions, paying only for the cars' maintenance. In the spring of 1994 the fleet was 26,400 cars: 18,600 of those were government (provincial and federal) and CWB hopper cars, 7,100 cars were owned and leased by the railways and the railways had 700 box cars (IBI 1994). The railways get extra cars from their fleet or from the U.S. in peak periods. The GTA estimated that the cost for a hopper car in 1992 was $80,000 compared to $54,000 in 1981. IBI estimated that the costs of the cars are $5,216 per car per year or $3.11 per tonne.

IBI (1994) showed that even after the NTA'87, which gave shippers of other commodities the ability to bargain with the railways, grain was still returning the railways less revenue per tonne-mile than non-grain commodities. The revenue for barley was between 2.42 and 2.24 cents per tonne-mile; for wheat it was 2.13 to 1.96 cents per tonne-mile. Compare this to coal, where the railways were garnering 3.03 cents per tonne-mile, potash where the revenue was 2.80 cents per tonne-mile and for sulphur where it was 3.61 cents per tonne-mile. These figures are particularly notable considering that the grain had to travel across low-density (and therefore high-cost) branchlines whereas the non-grain commodities travel primarily on main and secondary main lines. Thus, the regulated grain rates were still lower than the non-regulated rates for other commodities, even with the advent of shipper access provisions. This brings into question the ability of shippers to bargain the rail rate down to average cost.

The next-best option for shippers is trucking. ATKearney estimated direct trucking costs to be 5.5 cents per tonne-mile for a 75 km haul. Thus trucking is not currently cost-competitive. Trucking also poses the problem of unloading grain at port. West Coast ports are not constructed to handle large amounts of truck traffic. These

[5] Because the volume related costs as calculated by the NTA include a portion of fixed costs, the marginal

restrictions of the next-best alternative to rail transport implies that railways may have the ability to set price above marginal cost.

Canadian railways are generally believed to have a degree of market power. The lack of the threat of entry combined with a non-competitive next-best option implies that railways may have the ability to set price were freight rates to be completely deregulated (see Chapter 2). Because there are only two mainline carriers serving the Canadian prairies, this market power may be substantial.

4.2.4 Terminal Elevators

In 1994/95, Canada's ports handled 27.36 million tonnes of grain. Of this, Vancouver received 13.04 million tonnes; and Prince Rupert 5.27 million, making the total grain shipped through the west coast 18.31 million tonnes. Thunder Bay received 9.94 million tonnes and Churchill received 0.34 (Canada Grains Council 1995). Use of the west cost ports has increased over time. In the early 1980s, only 40 per cent of Canadian grain went through Vancouver and Prince Rupert, whereas in 1994/95 west coast movement had increased to 67 per cent. At its maximum, the West Coast moved 20 million tonnes through 1.1 million tonnes of storage capacity (1991). In 1998, the capacity at Thunder Bay was 1.3 million tonnes. Churchill has 140 thousand tonnes.

Overall, average turnover for all terminal elevators has grown from 7 to 10 since 1971/72. Turnover at west coast terminals is higher. From 1981/82 until 1992, the average turnover increased from 11 to 15 at Vancouver and from 20 to 26 at Prince Rupert. On the other hand, average turnover at Thunder Bay declined from 8 to 6 over that same time period.

There is some movement to increase west coast capacity. For example, AWP and Cargill plan to increase handling capacity at their West Coast facility from 4.2 million tonnes to 6 million tonnes.

There is concern about decreasing grain moving through the St. Lawrence. In 1996-97, the total grain shipments out of Thunder Bay totalled 10.2 million tonnes, of

cost of rail transport would constitute a smaller percentage of total cost.

which roughly 8 million tonnes were wheat. It is anticipated that in 1997-98, the port is looking at receiving only 5.5 million tonnes of CWB grains (Western Producer 1998).

Table 4.5 lists various estimates of west coast terminal costs. On top of these direct costs of terminal operation are other charges such as Canadian Grain Commission Inspection costs, estimated to be \$1.30 per tonne and marshalling costs at the port terminal, estimated to be \$1.00 per tonne (ATKearney 1994).

Table 4.5 Estimated Terminal Elevator Costs

	Terminal Elevator Costs
($/tonne)	
Depreciation	0.65
Interest	0.10
Insurance	0.30
Taxes	0.25
Total Fixed Costs	*1.30*
Labour	2.25
Utilities	0.35
Repairs and Maintenance	1.60
Other	0.65
Total Variable Costs	*4.85*
Total Costs	6.15
ATKearney estimates[6]	7.19
IBI estimates	7.50

Source: Saskatchewan Highways and Transportation (1992) and ATKearney (1994)

In 1998, there were 13 terminal elevators at port position, owned by 7 elevator companies. Most of the owners of terminal facilities also own local elevators across the prairies. Rail shipments are distributed to terminals in proportion to volumes originating at primary elevators owned by the same company. Locally owned elevators and other elevator companies that do not own terminal facilities pay for terminal handling.

Some elevator companies own a terminal at only one port. Cargill, the Saskatchewan Wheat Pool and UGG are the only companies to own elevators on both the lakehead and at the west coast. There are six terminals at Thunder Bay, five at

[6] Includes \$1.93 for rail to terminal transfer, \$2.02 for elevation, \$1.59 for cleaning and \$1.65 transfer to ship.

Vancouver, and one each at Prince Rupert and Churchill.[7] Ownership of terminal capacity is slightly more even than the country capacity. Saskatchewan Wheat Pool has the most capacity at 23 per cent, and UGG is second at 17 per cent. N. M. Patterson, ADM and ConAgra do not own terminal facilities.

Terminal market power is likely to be greater at the west coast, where terminals are operating at capacity, than at Thunder Bay and the St. Lawrence where terminals have excess capacity. The difference in market power between the ports can be illustrated by the maximum terminal tariffs in table 4.6. The charges at the West Coast are generally higher than those charged at Thunder Bay.

Table 4.6 Filed Tariffs for Various Thunder Bay and Vancouver Terminals

Terminal	Charge	Wheat	Canola
Thunder Bay			
Cargill	Elevation ($/tonne)	6.45	10.40
	Storage ($/tonne/day)	*0.052*	*0.063*
MPE	Elevation ($/tonne)	6.45	10.35
	Storage ($/tonne/day)	*0.052*	*0.063*
SWP	Elevation ($/tonne)	6.45	10.25
	Storage ($/tonne/day)	*0.052*	*0.063*
UGG	Elevation ($/tonne)	6.45	10.50
	Storage ($/tonne/day)	*0.052*	*0.063*
Vancouver			
AWP	Elevation ($/tonne)	6.71	10.41
	Storage ($/tonne/day)	*0.054*	*0.066*
Pioneer	Elevation ($/tonne)	6.85	10.60
	Storage ($/tonne/day)	*0.052*	*0.063*
SWP	Elevation ($/tonne)	6.78	10.60
	Storage ($/tonne/day)	*0.054*	*0.066*
UGG	Elevation ($/tonne)	6.80	10.50
	Storage ($/tonne/day)	*0.054*	*0.062*

Source: Canadian Grain Commission (1998)

[7] In this thesis, the two UGG terminals at Thunder Bay are considered as one.

4.3 Regulatory Organisations

The grains industry has a number of regulations and regulatory organisations not directly related to grain movement but which affect the structure and behaviour of the grain industry. These organisations include the Canadian Grain Commission, which administers Canada's grading and inspection system, and the Canadian Wheat Board (CWB). These institutions will be described to better understand the behavious and operation of the constraints on the grain transportation and handling system.

4.3.1 The Canadian Grain Commission

The Canadian Grain Commission, then called the Board of Grain Commissioners, was created in 1912. It was put in place to oversee the *General Inspection Act* of 1874. It establishes grain grades and is in charge of inspection and weighing grain at terminal position.

The CGC determines the grade of grain shipments by the measurement of five characteristics: (a) the weight; (b) the percentage weight of hard vitreous kernels; (c) the amount of foreign material; (d) the number of heated, broken or shrunken kernels; and (e) the number of diseased, damaged or sprouted kernels. The numerical grade given is determined by the factor with the lowest quality level. Thus if a sample had a number 1 level of HVD, but a number 2 amount of foreign material, it would be designated a number 2 (Hucq 1997). There are seven main classes of wheat, each with two to five grades; each grade is then split into different protein levels. The grade standards are set on an annual basis by an industry committee chaired by the CGC. The large number of grades and protein levels has implications for Canada's grain transportation and handling system, namely that there must be an ability to segregate these products throughout the system. The cost of an extra segregation was calculated to be between \$0.43 to \$1.28 per tonne. Equally, there are monetary benefits from this segregation. For example, the benefit of an extra protein segregation can range from \$2.30 to \$9.14 per tonne (Demmans and Roth 1998).

Varietal control falls under the *Canada Grain Act* and *Canada Seed Act*. Varietal selection in Canada is based on Kernel Visual Distiguishability (KVD), and has been in place since the beginning of the CGC. The basis of KVD is that varieties with different end-use characteristics must be visually distinguishable from each other. The adherence to KVD has meant that some varieties are not registered in Canada due to the concern that they could be confused with other varieties with different end-use characteristics, leading to a loss in quality control. An example is Grandin wheat, which looks similar to a variety with better baking characteristics, but is lower-yielding. Because of KVD, Grandin is not licensed for use in Canada. To be registered, the variety must be tested for production and end-use qualities and found to be better than an existing variety (Canada-U.S. Joint Commission on Grains 1995).

4.3.2 The Canadian Wheat Board

The Canadian Wheat Board (CWB) is the sole exporter of western Canadian wheat and barley. It also sells all western Canadian wheat and barley for human consumption within Canada. The single-desk selling authority of the CWB is legislated through an Act of Parliament: *The Canadian Wheat Board Act* (1943). This Act was most recently amended in 1998.

The CWB is involved in rail car allocation for board grains. It determines the number of cars get sent to which train runs. The elevators along those train runs then get allocated rail cars on the basis of past volume. Car turnaround times indicate that board-grains have a faster turnaround than off-board grains. CWB grains have a turnaround time of 17.9 days to the west coast, versus 29.9 days for speciality crops (CWB 1998).

The CWB also acts to ration the capacity constraint within the grain handling system. While western Canada exports about 30 million tonnes, 20 million of which is wheat, primary elevators only have a capacity of 6.5 million tonnes. The rail system is limited to what it can store in rail cars, and the terminal elevators have storage capacity for only 2.9 million tonnes (Demmans and Roth 1998). Thus the grain transportation and handling system cannot handle all grain being delivered at one time. Ninety-seven percent of the wheat brought to the primary elevator is delivered to the CWB (Hucq

1997). Under the CWB, all producers receive the same price for their grain regardless of when in the year they deliver. The result is that if producers have a discount rate greater than zero, they will have the incentive to deliver their grain as soon after harvest as possible. Thus, the CWB has to regulate the timing of deliveries throughout the year to ensure that the grain transportation and handling system does not get plugged.

In 1993-94, the CWB moved to a contract system for timing the sourcing of grain from producers. Producers sign a contract for a certain quantity and grade of grain, to be delivered before a specific date. There are four contract deadlines in the year. Within a few weeks after the last date to sign a specific contract, the CWB calculates the percentage of the contracted grain needed and calls it forward (Canadian Wheat Board 1994).

The CWB also plays a role in rationing the west coast port capacity. As was noted in section 4.2.4, there is limited capacity at the west coast ports. The Canadian Wheat Board (CWB) currently rations that capacity by directing more grain through the east coast than would by optimal if both ports had unlimited capacity. This port allocation is reflected to producers by the CWB who lowers the cost of using the St. Lawrence Seaway to grain farmers. The cross-subsidisation of the St. Lawrence is paid for by all grain producers through the price pooling system. The full cost of using the St. Lawrence Seaway is about \$20.00 per tonne of grain. The CWB instead charges a Freight Adjustment Factor (FAF) of \$11.55 per tonne to the cost of rail movement to Thunder Bay. Thus the CWB subsidises the use of the seaway by about \$8.45 per tonne. This cost is taken out of the pool accounts and amounts to about \$4.00 per tonne for wheat (Gray, 1997).

The effect of the west coast capacity constraint and the CWB subsidy is illustrated in figure 4.1. In figure 4.1, the horizontal axis represents western Canada from west to east. The left origin represents the West Coast (WC), and the right origin represents Thunder Bay (TB). The vertical axis represents the price for grain received at any point. The price paid for grain at the west coast is the world price (P_w) and the price paid for grain at Thunder Bay is the world price less seaway costs (P_w – SC). The diagonal lines represent the price producers receive for their grain at any point along the prairies; the slope of the diagonal lines is the freight rate per tonne-mile. Thus, the price the farmer receives is the price at the port less the freight rate, r, times the distance to port (for the purposes of simplicity, local and terminal elevator charges will be ignored in this diagram). Producers are assumed to ship to the port at which they will receive a higher price.

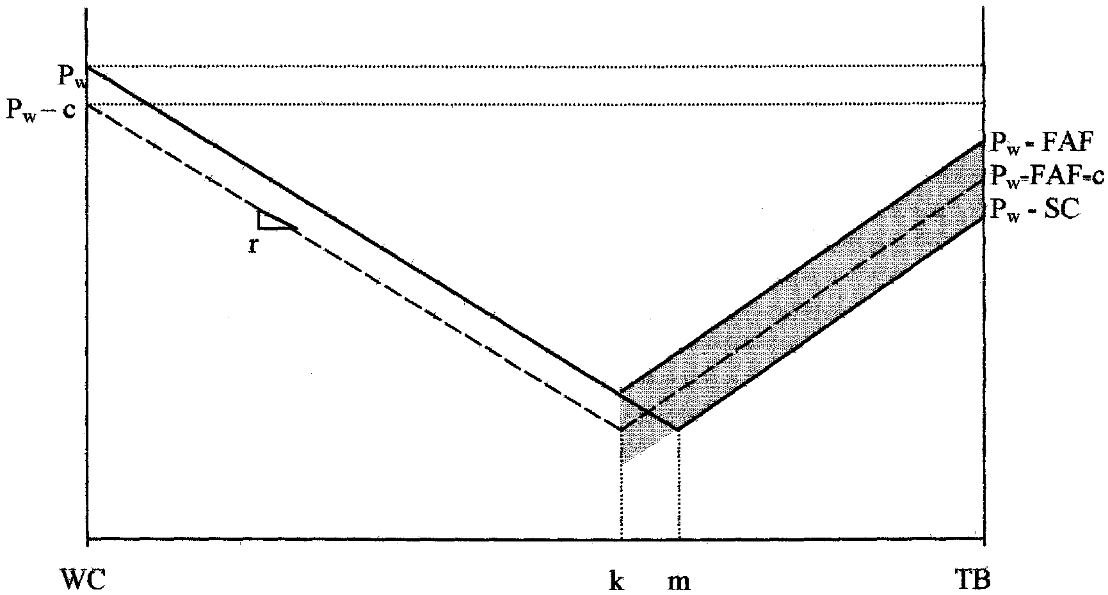

Figure 4.1 CWB Allocation of West Coast Capacity

If there was no west coast capacity constraint, and the full cost for the seaway is charged, producers at point 'm' are indifferent between which port they ship to (for wheat, point 'm' is approximately at Brandon, Man.) Point 'm' is determined by finding the point on the horizontal axis where the diagonal lines starting at P_w on the left and P_w – SC on the right intersect. Farmers located at point 'm' will receive the same price for grain whether the grain is shipped through the east or west coast.

Now assume there is a capacity constraint at the west coast such that only grain to the left of point 'k' can be accommodated. To ration the use of the west coast ports, the CWB subsidises the cost of using the seaway so that the mid-point is moved west to 'k'.

For wheat, point 'k' is approximately at Sintaluta, Sask. This increases the implicit price received at Thunder Bay from P_w – SC to P_w – FAF. [8]

The shaded area in figure 4.2 represents the total value of the transfer to pay for a portion of the seaway costs; the per tonne cost of the transfer is SC-FAF. To raise the funds for this subsidy, the CWB uses approximately $4.00 per tonne from the pool accounts. If this per tonne cost is denoted as 'c', then the deduction means a lowering of the realised FOB price to all farmers from P_w to P_w – c. This pooled cost in turn lowers the price received by all producers. Producers to the left of point k receive P_w - c – rd, where r is the per tonne mile freight rate and d is the distance from WC. Producers to the right of point 'k' face a farm price equal to P_w – c – FAF – rd*, where d* is the distance from TB. The dashed diagonal lines in figure 4.1 represent these farm prices.

With a deregulated freight rate, this restricted capacity would be rationed through higher prices to the west coast. It is uncertain whether the railways, the west coast terminals, or some other party would capture this rent. Figure 4.2 illustrates how the capacity constraint at the West Coast port can be rationed through price.

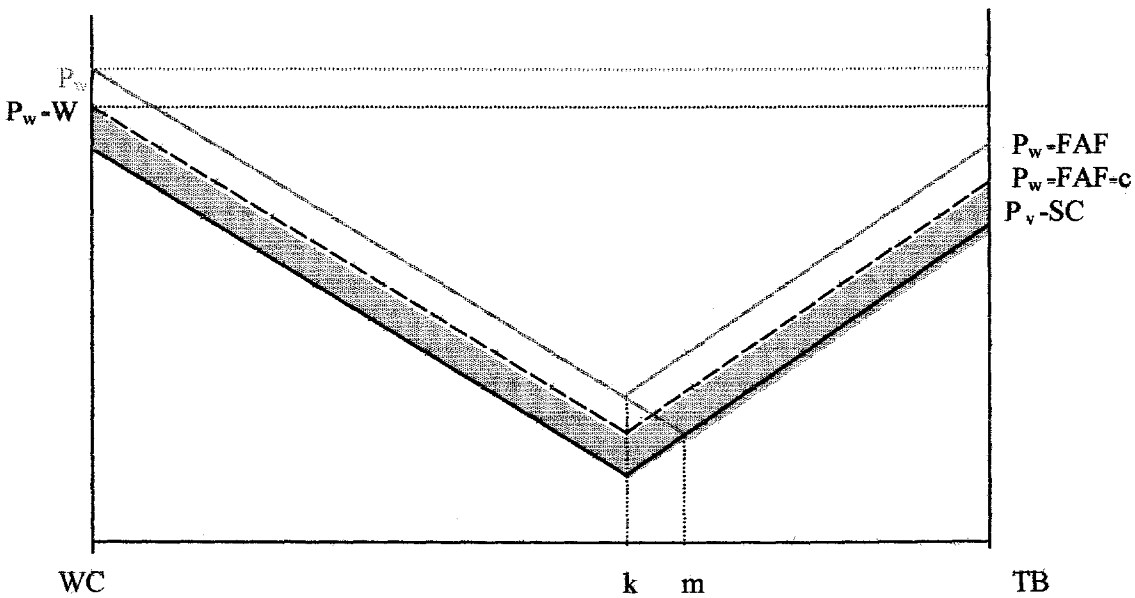

Figure 4.2 Market Allocation of West Coast Capacity

[8] In fact, the world prices are different at the west coast than at the east coast (thus the P_w at WC$\neq$ P_w at TB). The CWB takes these different prices into account and sets the FAF such that the mid-point of the catchment area remains at k.

As in figure 4.1, the dashed lines represent the farm gate price received under the CWB allocation of port use and seaway subsidy. If the full cost of the seaway is charged, the midpoint of the port catchment areas returns to point m. To ensure the mid-point is at point k, a charge must be levied on grain shipped to the west coast. This charge must be sufficient to entice those producers situated between points k and m to ship through Thunder Bay rather than through the west coast. In figure 4.2 this extra charge is illustrated by W. This charge may appear as a congestion charge on the freight rate or on hopper cars or as an increased charge at the west coast terminal elevators. Producers whose grain is shipped through the west coast will now receive less for their grain, as represented by the black solid line to the left of k.

The shaded area represents the loss to all producers from having the west coast capacity constraint allocated through a market mechanism. This area is not lost to the grain handling industry, but is transferred to those parties that are able to charge for the capacity allocation.

Because of the CWB's legislative authority over exported Western Canadian wheat and barley, it may have the potential for market power. Whether the CWB might have the ability to force lower freight and terminal rates under deregulation is an interesting question but beyond the scope of this thesis.

4.4 Summary

The majority of Canadian grain goes to the export market. Farmers deliver their grain to a country elevator, which then loads it on railcars and ships it to port. At port, the grain is unloaded into terminal elevators, where it is then loaded onto vessels. The elevator, railway and terminal sectors all have the potential for market power.

Various estimations of the costs of these industries were presented. As well, some of the organisations active in the grain transportation and handling industry were discussed. The description of the industry provides the basis of the theoretical model described in the next chapter.

Chapter 5

Theoretical Model

5.1 Introduction

This chapter describes a theoretical model of how rates are determined by the railways and elevator companies in a deregulated environment. The model incorporates pricing decisions by the firm within its horizontal market and within the vertical system from farm to port. This model developed in this paper is concerned with the cost of the total export basis and its components. The chapter is structured as follows. First, the vertical system as modelled is described. Then, the modelling of the interactions between firms in the same sector is discussed. This section relies upon the development of models of heterogeneous products, and uses some of these models as benchmarks to detail how this model divides sectoral demand between firms. Next, the derivation of the sector demand is described. Last, the scenarios illustrated by the model are described.

The model is based on the assumption that grain handling and transportation services, such as transportation, local and terminal elevation, are needed in equal proportions with physical grain located on the prairies to produce an end product of export grain at port position. In other words, to produce one tonne of grain at port requires one tonne of grain destined for export at the farm along with the services required to handle one tonne of grain at the local and terminal elevators and in the rail system. Each input is modelled as a link in vertical chain (see figure 5.1).

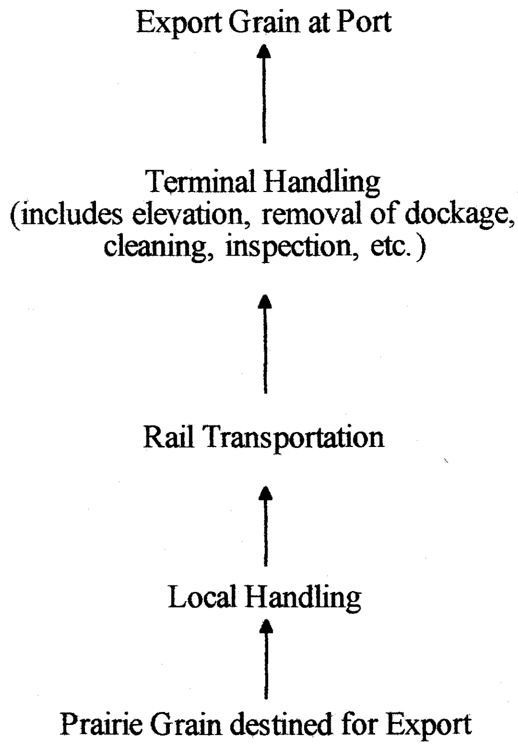

Figure 5.1 Vertical Chain in Grain Transportation and Handling

The model allows for various levels of market power within and between the sectors. The services provided by the different firms in each of the sectors (e.g. the country elevator companies, the rail companies and the terminal elevator companies) are assumed to be heterogeneous. Because of the spatial differences among country elevators and railways, as well as brand loyalty to certain elevator companies, the model assumes firms have the ability to set a price different from their competitors. Thus, the firms are assumed to choose price when maximising profit, as opposed to choosing quantity. Although the model assumes that any given firm can choose a price for its services that is different than its competitors, in equilibrium all firms providing the same service are assumed to set the same price.

5.2 Theory of Product Heterogeneity

There are a number of ways to model heterogeneous products. Different models incorporate different assumptions about the reaction of rival firms to a change in the price charged by any one firm. Heterogeneity is often modelled using variations of a spatial model. This section will first present a general model of heterogeneous pricing, and then discuss the impact of different conjectural variations on the model developed in this paper.

The model illustrated in figure 5.2 can be used to illustrate demand for differentiated products. Assume line AB represents the preferences for quality characteristics of a product such as trucks. Each consumer has a preference for a particular set of truck characteristics. To simplify the analysis, it is assumed that consumers are equally distributed along this line. Further, assume point A represents Ford trucks and point B represents Chevy. Thus, the consumer at point A prefers all the characteristics specifically embodied in a Ford and the consumer at point B prefers all the characteristics specifically embodied in a Chevy. A person's location is their first preference, thus consumers at point k have a first preference for a truck with a set of characteristics available in neither Ford nor Chevy, but they are closer to the set offered in a Chevy. Consumers at point k have to trade-off some of their preferences. Because these consumers are accruing an implied cost by not getting the exact combination of characteristics they want, they implicitly pay a higher price for the truck. The diagonal lines represent the implicit cost for any consumer of purchasing a pickup that does not meet their specific desired characteristics. The slope is the change in utility from moving to a good that does not have the preferred characteristics. If the cost of the characteristic trade-off is t_k and the price for a Chevy is P_B, then consumers at point k are effectively paying $P_B + t_k$ for a pick-up. Consumers located at point m are indifferent between the two products. At the indifference point 'm', the implicit price is P_A plus t_m.

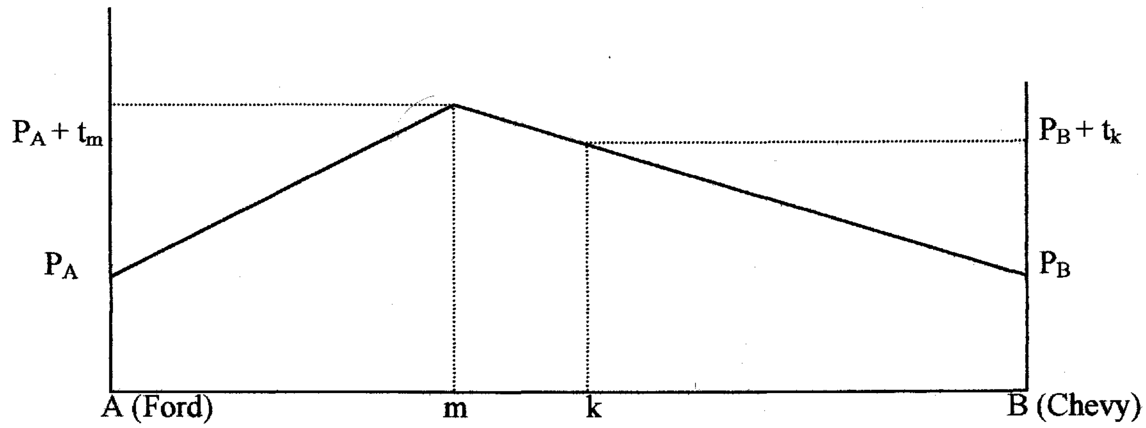

Figure 5.2 Model of Preferences for Heterogeneous Products

The implication of heterogeneous products is that one can have firms in the same market charging different prices. This sets spatial models apart from homogeneous, non-spatial models, where firms cannot charge a higher price without losing their entire market. In a homogeneous model, it is assumed that if one firm is charging a price lower than the others, they will receive all of the business (e.g. Bertrand pricing). When modelling heterogeneous products, this 'all or nothing' assumption is removed. Because of the preference trade-offs, only some of the customers will move their business in response to a change in one firm's price.

The model developed above assumes f.o.b. pricing; i.e., there is a single sticker price for both Ford and Chevy. Several ways that have been developed to model f.o.b. pricing decisions. Greenhut, Norman and Hung (1987) highlight three conjectural variations, two of which will be described here: the Hotelling-Smithies and Löschian conjectures.

The Hotelling-Smithies conjecture assumes that rival firms will not react to a change in price by one of the firms. This assumption is similar to that used in the Nash equilibrium. The implication of this assumption is that any one firm's market will change size as it changes its price. For example, if the Ford dealership lowers its price, it will expect to draw some customers away from Chevy. This means that the slope of the demand curve for the individual firm is more elastic than the total demand curve. Thus, in figure 3, if Ford lowers their price from P_A to P_A - w, and Chevy keeps their price at P_B, Ford's market will increase from m to n.

Löschian conjectures assume that each firm believes that the other firms will match any change in price. Therefore the size of the market facing any firm will not change as the firm changes its price. Consider the scenario where Ford anticipates that if it lowers its price for pick-ups, Chevy will follow suit. In figure 3 Ford is shown to drop its price to P_A – w and Chevy matches this with a drop in price to P_B – w. The indifference point remains at point m. Because the size of the market does not vary with price, the slope of the demand curve for a firm with Löschian conjectures is more inelastic than that for a firm with Hotelling-Smithies conjectures (Greenhut, Norman and Hung 1987).

There are numerous other conjectural variations. It is worth noting here that some assume in an implicit price decrease by other firms in reaction to a price increase by any one firm. An example of this is the Greenhut-Ohta conjecture.

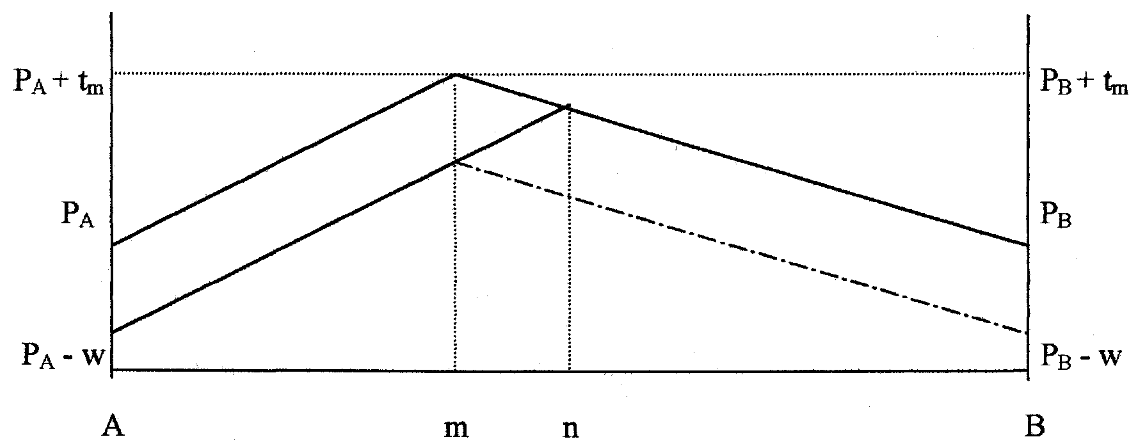

Figure 5.3 Model of Heterogeneous Products Using Hotelling-Smithies and Löschian Conjectures

In the model of the grain transportation and handling industry developed in this chapter, total demand for a product is assumed to be linear. Total demand is apportioned between firms on the basis of the price they charge and a parameter representing a base level market share. More formally, the sum of the quantity demanded from each firm (x^i)

is the total sector demand. Total sector demand is represented by $P = a - \beta X$, where $X = \Sigma_{i=1}^{L} x^i$, P is the market price and L is the number of firms.

The demand curve facing firm *i* is assumed to be

$$x^i = \frac{a}{L\beta} - \frac{P^i}{\beta} + \frac{1}{\beta}\sum_{k \neq i}^{L} \lambda^k P^k \qquad \forall i = 1..L$$

where λ^i is an inverse representation of market shares. The λ^i are assumed to sum to one; i.e. $\Sigma_{i=1}^{L} \lambda^i = 1$.

To get a sense of the impact of the market share parameter λ^i, consider several scenarios. If all firms charge the same price, (as we assume they do in equilibrium),

$$x^i = \frac{a}{L\beta} - \lambda^i \frac{P}{\beta}$$

If λ^i increases, the market share of firm *i* decreases.

If firm *i* charges a different price from all of its rivals, all of whom charge the same price P^k, then,

$$x^i = \frac{a}{L\beta} - \frac{P^i}{\beta} + \frac{1}{\beta}(1 - \lambda^i)\, P^k$$

To determine the effect on the quantity received by firm 'i' from a change in the price it charges, differentiate x^i with respect to P^i to get:

$$\frac{\partial x^i}{\partial P^i} = -\frac{1}{\beta} + \gamma^i \frac{(1 - \lambda^i)}{\beta} \quad \text{where } \gamma^i = \frac{\partial P^k}{\partial P^i}$$

Under the Hotelling-Smithies conjectures; $\gamma^i = 0$. Thus:

$$\frac{\partial x^i}{\partial P^i} = -\frac{1}{\beta}$$

If instead, Löschian conjectures were assumed, $\gamma^i = 1$. In this case:

$$\frac{\partial x^i}{\partial P^i} = -\frac{\lambda^i}{\beta}$$

In this model, γ is expected to range between $-\infty$ and 1. If $\gamma = -\infty$, the model is simulating perfect competition. If $\gamma = 1$, the model is simulating a monopoly.

5.3 The Model Description

Farmers are assumed to be located in a number of regions across the prairies. The regions are defined so all production from that region is shipped to the nearest port. Each region is assumed to have its own supply curve for grain, allowing the model to take different local costs of production into account.

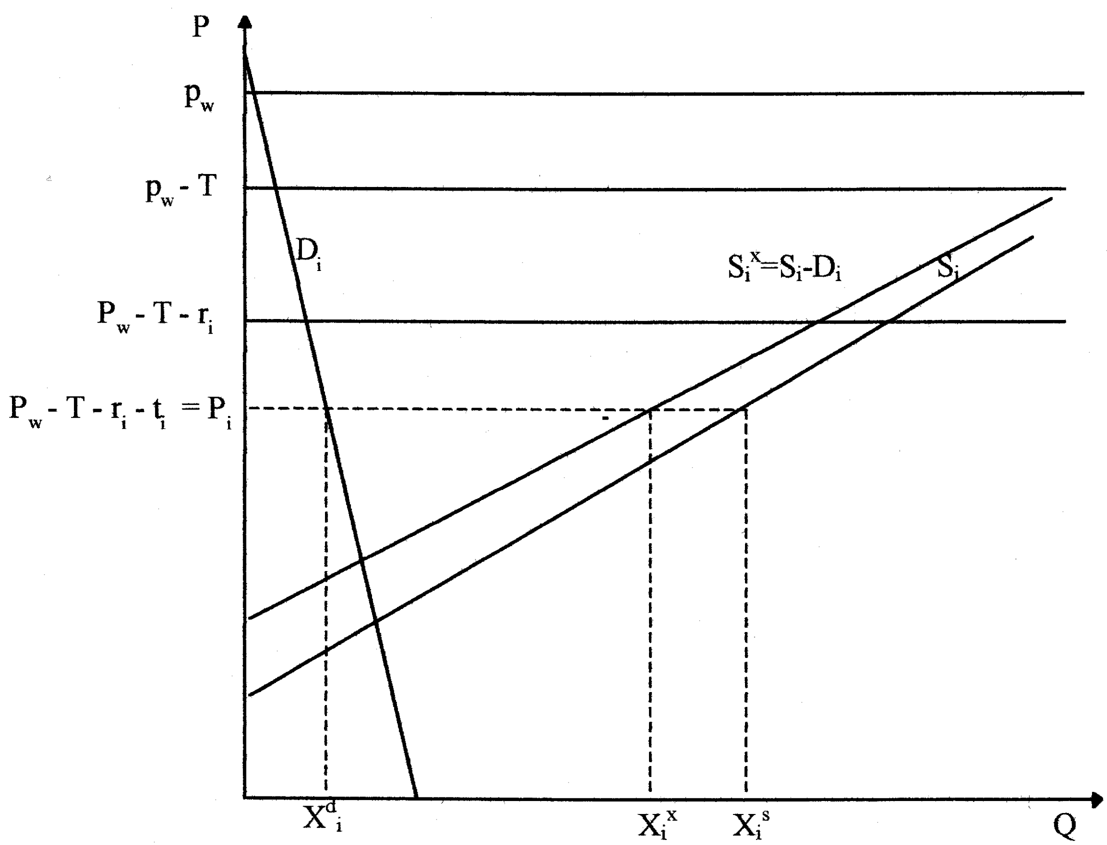

Figure 5.4 Determination of Grain Exports from a Region

Figure 5.4 shows the quantity of grain produced and exported from any given region. The price at port position, p_w, is assumed to be unaffected by the quantity exported. Local elevators charge a price t_i to handle and remove dockage in region 'i'.

Railways charge a price r_i to move the grain from region 'i' to port. Grain terminals at the port are assumed to charge a price T. For region i, the sum of these charges – ie., $T + r_i + t_i$ – make up the export basis. Thus a grain farmer delivering his/her grain for export in region 'i' will receive a price $p_i = p_w - T - r_i - t_i$. With a farm price of p_i, farmers in region i will produce quantity X^s_i, where X^s_i is a point on the region i supply curve S_i (Figure 5.4). The supply curve S_i is assumed to be a planning supply curve as opposed to the supply available at any single point in time. The rationale for using a planning supply curve is explained later.

Demand by local grain users in region i is given by X^d_i, where X^d_i is a point on the region 'i' demand curve D_i. Curve D_i shows the amount of grain demanded locally, either as feed or for domestic processing. Exports of grain from region 'i' are thus $X_i^x = X^s_i - X^d_i$, where X_i^x is a point on the export supply curve S^x_i. The export supply curve, S^x_i, is derived by taking the horizontal difference between X^s_i and X^d_i The export supply curve in the model is assumed to be linear and represented by the following equation:

$$p_i = \alpha_i + \beta_i X_i$$

Prices are determined in a two-period game. In the first period the railways and terminals simultaneously choose their prices to maximise profits. The prices chosen represent a Nash equilibrium in prices, in that at equilibrium no firm finds it optimal to change the price it is charging. Knowing the freight rates and terminal charges, the local elevators then set their prices in the second period. Once again, the prices that are chosen represent a Nash equilibrium.

The model assumes that the railways and terminals know how the local elevators will react to freight rates and terminal charges, and take this reaction into account when making their pricing decision. Formally, the railways and terminal elevators are leaders in the two period game, with the local elevators being the followers. All railway, local and terminal elevator firms are assumed to have the same cost structure. As a consequence, each firm in the same region will charge the same price in equilibrium.

The model incorporates the vertical integration found in the elevator industry. All the firms that own terminal elevators also own some local elevators, but not all local elevator companies own a terminal. The extra competition that results because of the presence of independent local elevator companies is taken into account in the model. As well, the model recognises that terminal elevator companies do not have to compete with each other for most of the business they do, since grain that is sourced in their local elevator system is funnelled through the terminal elevator.

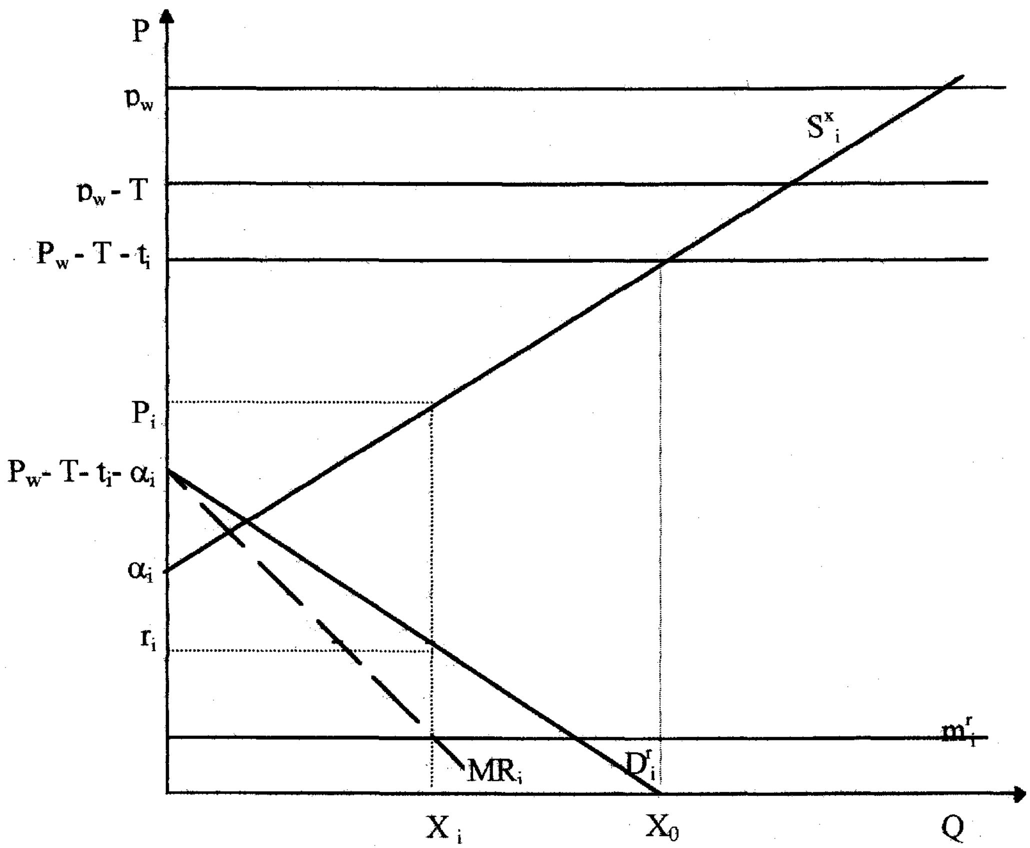

Figure 5.5 Derived Demand Curve for Rail

Figure 5.5 illustrates how a railway firm in region 'i' would set its freight rate. The analysis begins with the derivation of the derived demand facing a monopoly railway in region 'i'. The railway's derived demand curve, D^r_i, is given by the vertical distance between a vertical line at $P_w - T - t_i$ and the export supply curve S^x_i. The intuition is as follows. If the railways set rail rates equal to zero, the farm level price in region 'i' would equal $P_i = P_w - T - t_i$. With this farm level price, farmers would export quantity X_0. Thus, the point $(X_o, 0)$ represents one point on the derived demand curve. A second point on the derived demand curve can be found by noting that farmers in region i would export nothing if the rail rate were set equal to p_w - T - t_i less α_i, the intercept of the export supply curve. Thus, the point $(0, P_w - T - t_i - \alpha_i)$ represents another point on the derived demand. Connecting these two points gives the derived demand facing the railway. Given this demand curve, the railway sets its rail rate price r_i, where r_i is determined by the intersection of the railway's marginal revenue curve (MR_i) and marginal cost curve (m_i).

If more than one railway was operating in the region, the determination of price is slightly different, although the principle is the same. The demand curve facing all the firms operating in the region is derived first – this demand curve is curve D^r_i in Figure 5.5. From this curve, the demand for an individual railway can be determined, which in turn allows the construction of the marginal revenue curve facing an individual railway. Determination of local and terminal elevator derived demand is done in a similar fashion to that of the railways. For instance, the demand facing the terminal elevators is found by vertical distance between a vertical line at $P_w - r_i - t_i$ and the export supply curve S^x_i.

Because of the time lag between planning and resulting production, the supply curve for grain at any specific point in time is completely inelastic. However, this curve is not used for the determination of the export supply curve. Instead, the relevant supply curve is the *ex ante* or planning supply curve. The argument goes as follows. If the railways price off the highly inelastic actual demand, they will drive the price down below the point where producers would have chosen to produce. Assuming producers are rational, if the railways force their price below their shut-down point, they will expect this behaviour to occur again, and therefore will not produce. This model of behaviour is not dissimilar from the old adage, "fool me once, shame on you, fool me twice shame on me." Thus it is assumed that the railways and elevators will use the planning supply curve to set their prices, even in a fully deregulated environment.

5.4 Scenarios

The model will be used to simulate three scenarios. The first scenario simulated by the model illustrates the effect of the removal of the St. Lawrence Seaway subsidy and the end of the regulatory rationing of the west coast ports. The second scenario simulated by the model shows the change in rates resulting from the removal of the freight rate cap if the railways and elevators set rates on a profit-maximising basis. The third scenario modelled is the effect of competition in haulage through the imposition of common running rights.

The model is solved for two crops: a low-price crop such as wheat, and a higher value crop, such as canola. Because canola is not under a central desk marketer, its use of the west coast ports is already restricted through price. Therefore there is no separate scenario representing the west coast capacity constraint for canola.

5.5 Summary

A model is developed in this paper to illustrate the determination of the export basis and its components. The model constructs a simultaneous system from the component parts of the export basis, local and terminal elevation, and rail transportation. It assumes a fixed-proportions system, that is, there is no substitution between the components (e.g. an extra unit of rail transport will not substitute for a decrease in local handling).

At each individual component level, the model is founded on a model of heterogeneous products. The heterogeneity allows each firm to set their own price for their product. The size of the demand faced by each firm will vary with the price they charge, the price competing firms charge, and the existing market shares of the firms. A Nash equilibrium in prices is assumed. It is assumed that all firms will have no incentive to move from charging the same price.

Rates are assumed to be set in a two-stage game. The terminals and railways are assumed to set their rates first, anticipating the reaction of local elevators. Local elevators are then assumed to take the railway and terminal charges as fixed and set their tariffs accordingly. The result is rates at each level which are a weighted average of the intercept of the industry's derived demand, and the industry marginal cost. The weight considers a number of factors such as market share of each firm, conjectural variation representing the other firms anticipated reactions and the number of firms.

The next chapter further develops this model mathematically, which will allow the use of the model to illustrate the scenarios described above.

Chapter 6

Mathematical Model

6.1 Supply

As noted in the previous chapter, the model developed in this thesis assumes that export grain is produced by a number of inputs each in fixed proportions. The price that farmers receive for their grain is determined by the world price less the costs of the inputs of grain transportation and handling, less the producers' cost of producing the grain for export. This price determines the quantity of grain shipped to port. The prairies are split into '*N*' number of grain-producing regions. Thus aggregate supply for export from region '*i*', (X_i) will be determined by the price at the local level, p_i (which is determined by the export price, p_w, less the charges for freight from region '*i*' to port position, r_i, local and terminal elevation, t_i and T), by the local demand and by the local supply, which are both also functions of p_i.

$$X_i = f(p_i, X_i^d(p_i), X_i^s(p_i)) \quad \text{where}$$
$$p_i = p_w - r_i - T - t_i$$

Let aggregate export supply from region '*i*' be represented by:

$$p_i = \alpha_i + \beta_i X_i$$

Equating demand for export grain with the regional supply, one gets

$$\alpha_i + \beta_i X_i = p_w - r_i - T - t_i$$

Prices are not assumed to be independent between sectors. That is, when a terminal elevator is choosing the price for their service, they take the railway and local elevator charges into account, as well as considering how their own decision will affect the price in the other sectors. Price-setting is modeled as a two-stage game, where railways and terminal elevator s set their charges in the first period, and local elevators set their charges in the second period. Thus, local elevators take the railway and terminal charges as given. The railways and terminal elevators make some assumptions about the local elevators' reactions when they set their prices in the first period. When solving the model, one therefore first develops a reaction function for the local elevators that the railways and terminal elevators will use to determine the optimal rates they should charge.

6.2 Local Elevators

The derived demand for all local elevators in region 'i' is assumed to be determined by the export price less the charges for freight and terminal services, less the export supply.

(1) $$t_i = p_w - r_i - T - \alpha_i + \beta_i X_i \qquad \forall\ i = 1..N$$

Let p_w - r_i - T - $\alpha_i = a^t_i$ be the intercept of the derived demand faced by local elevators in region 'i'.

$$t_i = a^t_i - \beta_i X_i$$

There are L_i local elevator firms in region 'i' who split this demand on the basis of the price they charge, t_i^l, their size, represented by λ_i, and the price charged by the other local elevators and their relative size of operations. The parameter λ_i^l is an inverse representation of market share, where the sum of λ_i^l over all local elevator firms in region 'i' is one, thus $\Sigma_{l=1}^{Li} \lambda_i^l = 1$. The total amount of grain elevated in region 'i' is the sum of the amount elevated by each local elevator, 'l'.

$$X_i = \sum_{l=1}^{Li} x_i^l$$

(2) $$x_i^l = \frac{a_i^t}{L_i \beta_i} - \frac{t_i^l}{\beta_i} + \frac{1}{\beta_i} \sum_{k \neq i}^{\mathrm{Li}} \lambda_i^k t_i^k \qquad \forall i = 1 \ldots L_i \text{ and } i = 1 \ldots N$$

The profit for the local elevator operation in region 'i' is the local tariff revenue less the marginal cost of elevation less some fixed cost, F^t.

$$\pi_i^{tl} = (t_i^l - m_i^t)\, x_i^l - F^t$$

The country elevators will choose their handling charge to maximize profit.

$$\frac{\partial \pi_i^{tl}}{\partial t_i^l} = x_i^l + (t_i^l - m_i^t)\frac{\partial x_i^l}{\partial t_i^l} = 0$$

The change in quantity produced by elevator 'l' for a change in the price it charges, $\partial x_i^l/\partial t_i^l$, can be derived from equation (2). The country elevators choose their handling change, t_i, on the assumption that T and r_i are given, therefore

$$\frac{\partial a_i^t}{\partial t_i^l} = 0$$

$$\frac{\partial x_i^l}{\partial t_i^l} = -\frac{1}{\beta} + \frac{1}{\beta}\sum_{k \neq i}^{\mathrm{Li}} \lambda_i^k \frac{\partial t_i^k}{\partial t_i^l}$$

Let $\partial t_i^k/\partial t_i^l = \gamma_i^{tl}$ be the conjectural variation of the other elevator firms in region 'i' for a change in price charged by elevator 'l'.

$$\sum_{k \neq l}^{Li} \lambda_i^k = 1 - \lambda_i^l$$

From the above equations, $\frac{\partial x_i^l}{\partial t_i^l}$ can be determined

$$\frac{\partial x_i^l}{\partial t_i^l} = -\frac{1}{\beta}(1 - (1 - \lambda_i^l)\gamma_i^{tl})$$

Let $(1 - (1 - \lambda_i^l)\,\gamma_i^{tl}) = \theta_i^l$ be an indication of market power of firm 'l' in region 'i'. Thus,

(3) $$\frac{\partial x_i^l}{\partial t_i^l} = -\frac{1}{\beta}\theta_i^l \quad \forall\, l = 1 \ldots L_i \text{ and } i = 1 \ldots N$$

Substituting equation (3) into the first order conditions for profit maximisation, we obtain,

$$\frac{\partial \pi_i^{tl}}{\partial t_i^l} = x_i^l + (t_i^l - m_i^t) - \frac{1}{\beta_i}\theta_i^{tl}$$

From equation (2), we know that

$$x_i^l = \frac{a_i^t}{L_i\beta_i} - \frac{t_i^l}{\beta_i} + \frac{1}{\beta_i}\sum_{k\neq i}^{\mathrm{Li}} \lambda_i^k t_i^k$$

$$\frac{\partial \pi_i^l}{\partial t_i^l} = \frac{a_i^t}{L_i\beta_i} - \frac{t_i^l}{\beta_i} + \frac{1}{\beta_i}\sum_{k\neq i}^{\mathrm{Li}} \lambda_i^k t_i^k + (t_i^l - m_i^t)(-\frac{1}{\beta_i}\theta_i^{tl}) = 0$$

We can multiply through by β_i to get

$$\frac{\partial \pi_i^l}{\partial t_i^l} = \frac{a_i^t}{L_i} - t_i^l + \sum_{k\neq i}^{\mathrm{Li}} \lambda_i^k t_i^k + (t_i^l - m_i^t)(-\theta_i^{tl}) = 0$$

Assume that in any region '*i*' that all elevator charges will be the same in equilibrium, thus $t_i^l = t_i^k = t_i$. Then one can sum $\partial\pi_i^l/\partial t_i^l$ over all L_i firms. Again, note that $\Sigma_{k\neq l}^{\mathrm{Li}}\lambda_i^k = 1 - \Sigma_{l=1}^{\mathrm{Li}}\lambda_i^l$.

$$a_i^t - L_i t_i + (L_i - \Sigma_{l=1}^{Li}\lambda_i^l)\, t_i + (t_i - m_i^t)\, \Sigma_{l=1}^{Li}(-\theta_i^{tl}) = 0$$

But $\Sigma_{l=1}^{Li}\lambda_i^l = 1$. Let $\Sigma_{l=1}^{Li}(\theta_i^{tl}) = \theta_i^t$. We can now solve for t_i.

$$a_i^t - L_i t_i + t_i(L_i - 1) + (t_i - m_i^t)(-\theta_i^t) = 0$$

$$t_i(1 + \theta_i^t) = a_i^t + m_i^t\theta_i^t$$

(4) $$t_i = \frac{a_i^t}{(1+\theta_i^t)} - \frac{m_i^t\theta_i^t}{(1+\theta_i^t)} \qquad \forall\, i = 1 \ldots N$$

Note that t_i is a weighted average of the demand intercept, a^t_i, and the marginal cost m^t_i. The weight, θ^t_i, will range between 1 in a monopoly, ∞ in perfect competition where $\theta^t_i = \Sigma_{l=1}^{Li}(\theta^{t\,l}_i) = (L_i - \Sigma_{l=1}^{Li}\gamma^l_i + \Sigma_{l=1}^{Li}\lambda^l_i\gamma^l_i)$. In a Nash equilibrium, $\gamma^l_i = 0$, and thus $\theta^t_i = L_i$.

This gives one the same solution as the Cournot-Nash equilibrium when firms are choosing quantity to maximize profit. In a monopoly, $L_i = 1$, $\gamma^l_i = 1$, and $\lambda^l_i = 1$ thus $\theta^t_i = 1$. In perfect competition, L_i is approaching ∞, and therefore $\theta^t_i \rightarrow \infty$.

In equilibrium, we can solve for the amount shipped by elevator 'l'. From equation (2)

$$x^l_i = \frac{a^t_i}{L_i\beta_i} - \frac{t^l_i}{\beta_i} + \frac{1}{\beta_i}\sum_{k\neq i}^{Li}\lambda^k_i t^k_i$$

if $t^l_i = t^k_i = t_i$

$$x^l_i = \frac{a^t_i}{L_i\beta_i} - \frac{t^l_i}{\beta_i} + \frac{1}{\beta_i}(1-\lambda^l_i)t^l_i$$

$$x^l_i = \frac{a^t_i}{L_i\beta_i} - \frac{\lambda^l_i t_i}{\beta_i}$$

Now we can substitute solution for t_i from equation (4) into the above to solve for x^l_i

$$x^l_i = \frac{a^t_i}{L_i\beta_i} - \frac{1}{\beta_i}\lambda^l_i\left[\frac{a^t_i}{(1+\theta^t_i)} + \frac{m^t_i\theta^t_i}{(1+\theta^t_i)}\right]$$

$$x^l_i = \frac{a^t_i}{L_i\beta_i}\left[1 - \frac{\lambda^l_i L}{(1+\theta^t_i)}\right] - \frac{m^t_i\lambda^l_i\theta^t_i}{\beta_i(1+\theta^t_i)}$$

Let

$$\frac{1}{L_i \beta_i}\left[1-\frac{\lambda_i^l L_i}{(1+\theta_i^t)}\right]=\sigma_i^l$$

and

$$\frac{\theta_i^t \lambda_i^l}{\beta_i(1+\theta_i^t)}=\vartheta_i^l$$

(5) $$x_i^l = a_i^t \sigma_i^l - m_i^t \vartheta_i^l \qquad \forall\ l=1..L_i \text{ and } i=1..N$$

6.3 Vertically Integrated Elevators

Some elevator companies exist only at the local level, whereas some exist both locally and at the port. All port elevator facilities are vertically integrated and therefore all grain must go through some port facility. Vertically integrated elevators will choose T over both the quantity coming from their country elevators as well as some portion of the quantity coming from the independent elevators.

From equation (5) one can determine the quantity each vertically-integrated country operation, v, where $v = 1$ to V_i, will ship. For vertically integrated firms, they will choose T to get a country supply function.

(6) $$x_i^v = (p_w - \alpha_i - r_i - T^v)\sigma_i^l - m_i^t \vartheta_i^l \quad \forall\ v = 1...V_i \text{ and } i = 1...N$$

To get the total quantity shipped by independent country elevators from region 'i', y_i one sums the amount shipped by each independent country elevator (x_i^l) over the number of independents in the region, $L_i - V_i$.

(7) $$\mathrm{y_i} = \sum^{Li-Vi} x_i^v = a_i^t(\sum^{Li-Vi} \sigma_i^l) - m_i^t \sum^{Li-Vi} \vartheta_i^l \quad \forall\ l = 1...L_i \text{ and } i = 1...N$$

Note that $a^t_i = p_w - T - r_i - \alpha_i$. Let $a^T_i = a^t_i + T = p_w - r_i - \alpha_i$

$$\mathrm{y_i} = a_i^T(\sum^{Li-Vi} \sigma_i^l) - m_i^t \sum^{Li-Vi} \vartheta_i^l - T \sum^{Li-Vi} \sigma_i^l$$

Let $\sum^{Li-Vi} \sigma_i^l = \psi_i$

and let $\sum^{Li-Vi} \vartheta_i^l = \mu_i$

Therefore, let $a^T_i\ \psi_i - m^t_i\ \mu_i$ be the intercept of the total supply of grain coming from the independent local elevators in region 'i'.

$$y_i = a^T_i\ \psi_i - m^t_i\ \mu_i - T\ \psi_i$$

Each port facility will get some portion of y_i. The portion received will vary with the size of the port operation, ϖ_i^v.

$$(8) \qquad y_i^v = a_i^T \frac{\psi_i}{V_i} - m_i^t \frac{\mu_i}{V_i} - \psi_i T^v + \psi_i \sum_{w \neq v}^{Vi} \varpi_i^w T^w \qquad \forall\, v = 1 \ldots V_i \text{ and } i = 1 \ldots N$$

The terminal charge will be chosen over both of these quantities, x_i^v and y_i^v. Profit of the v^{th} vertically integrated elevator firm will be the terminal charge less the marginal cost of terminal operations times the quantities from both integrated and their portion from non-integrated country elevators from all the regions plus their country elevator charges less their marginal cost of country operations times the quantity from the integrated country operations less the fixed costs associated with both operations.

$$\pi^{Tv} = (T^v - m^T)\sum_{i=1}^{N}(x_i^v + y_i^v) + \sum_{i=1}^{N}\left[(t_i^v - m_i^t)x_i^v\right] - F^T - \sum_{i=1}^{N} F_i^t \qquad \forall\, v = 1 \ldots V_i$$

From equation (4) we know the country elevator charge which can be substituted into the above profit equation.

$$t_i^v = \frac{a_i^T}{(1+\theta_i^t)} - \frac{m_i^t \theta_i^t}{(1+\theta_i^t)} - \frac{\mathrm{T}^v}{(1+\theta_i^t)}$$

$$\text{Let} \quad z_i = \frac{1}{(1+\theta_i^t)}$$

$$\pi^{Tv} = T^v \sum_{i=1}^{N}(x_i^v + y_i^v) - m^T \sum_{i=1}^{N}(x_i^v + y_i^v) + \sum_{i=1}^{N}\left[x_i^v(a_i^T z_i + m_i^t \theta_i^t z_i - T^v z_i) - m_i^t\right] - F^T - \sum_{i=1}^{N} F_i^t$$

$$\pi^{Tv} = T^v \sum_{i=1}^{N} x_i^v (1-z_i) + \sum_{i=1}^{N} y_i^v - m^T \sum_{i=1}^{N} (x_i^v + y_i^v) + \sum_{i=1}^{N} x_i^v \left[a_i^T z_i + m_i^t(\theta_i^t z_i - 1)\right]$$
$$- F^T - \sum_{i=1}^{N} F_i^t$$

Terminal elevator 'v', will maximize profit by choosing their terminal charge, T^v.

Note that $\dfrac{\partial \sum_{i=1}^{N}(x_i^v + y_i^v)}{\partial T^v} = \sum_{i=1}^{N} \dfrac{\partial x_i^v}{\partial T^v} + \sum_{i=1}^{N} \dfrac{\partial y_i^v}{\partial T^v}$

$$\frac{\partial \pi^{Tv}}{\partial T^v} = \sum_{i=1}^{N} x_i^v (1-z_i) + T^v \sum_{i=1}^{N} (1-z_i) \frac{\partial x_i^v}{\partial T^v} + \sum_{i=1}^{N} y_i^v + T^v \sum_{i=1}^{N} \frac{\partial y_i^v}{\partial T^v} - m^T \sum_{i=1}^{N} \frac{\partial (x_i^v + y_i^v)}{\partial T^v}$$
$$+ \sum_{i=1}^{N} \frac{\partial x_i^v}{\partial T^v} \left[a_i^T z_i + m_i^t(\theta_i^t z_i - 1)\right] + \frac{\partial a_i^T}{\partial T^v} \sum_{i=1}^{N} x_i^v$$

Note that $a^T_i = p_w - r_i - \alpha_i$. Since t_i is assumed to be chosen in the second period, $\partial t_i/\partial T^v = 0$ in period 1. But freight rates and terminal elevator charges are both assumed to be chosen in period 1. Therefore $\partial a^T_i/\partial T^v = - \partial r_i/\partial T^v$. Let $\partial r_i/\partial T^v = \phi^{Tv}_i$ be the conjectural variation of a change in freight rates resulting from a change in the terminal charge charged by terminal elevator 'v'.

(9)
$$\frac{\partial \pi^{Tv}}{\partial T^v} = \sum_{i=1}^{N} x_i^v (1-z_i) + T^v \sum_{i=1}^{N} (1-z_i) \frac{\partial x_i^v}{\partial T^v} + \sum_{i=1}^{N} y_i^v + T^v \sum_{i=1}^{N} \frac{\partial y_i^v}{\partial T^v}$$
$$- m^T \sum_{i=1}^{N} \frac{\partial (x_i^v + y_i^v)}{\partial T^v} + \sum_{i=1}^{N} \frac{\partial x_i^v}{\partial T^v} \left[a_i^T z_i + m_i^t(\theta_i^t z_i - 1)\right] + \phi_i^{Tv} \sum_{i=1}^{N} x_i^v$$
$$\forall \;\; v = 1 \ldots V_i$$

From equation (7) we know x_i^v

$x_i^v = a^T_i\, \sigma_i^v - m^t_i\, \vartheta_i^v - T^v\, \sigma_i^v$

(10) $$\frac{\partial x_i^v}{\partial T^v} = -\phi_i^{Tv}\sigma_i^v - \sigma_i^v$$

From equation (8), we know y_i^v

$$y_i^v = a_i^T \frac{\psi_i}{V_i} - m_i^t \frac{\mu_i}{V_i} - \psi_i T^v + \psi_i \sum_{w \neq v}^{Vi} \varpi_i^w T^w$$

$$\frac{\partial y_i^v}{\partial T^v} = -\phi_i^{Tv} \frac{\psi_i}{V_i} - \psi_i + \psi_i \sum_{w \neq v}^{Vi} \varpi_i^w \frac{\partial T^w}{\partial T^v}$$

Let $\partial T^w / \partial T^v = \gamma^v$ be the conjectural variation of a change in the terminal charge of elevator 'w' resulting from a change in the terminal charge of elevator 'v'.

(11) $$\frac{\partial y_i^v}{\partial T^v} = -\phi_i^{Tv} \frac{\psi_i}{V_i} - \psi_i + \psi_i \sum_{w \neq v}^{Vi} \varpi_i^w \gamma^v \qquad \forall\, v = 1 \ldots V_i \text{ and } i = 1 \ldots N$$

We can now substitute x_i^v and y_i^v from equations (7) and (8) into the first order conditions of the profit function, equation (9).

$$\begin{aligned}
\frac{\partial \pi^{Tv}}{\partial T^v} = &\sum_{i=1}^{N} \left[a_i^T \sigma_i^v - m_i^t \vartheta_i^v - T^v \sigma_i^v\right](1 - z_i) + T^v \sum_{i=1}^{N} (1 - z_i) \frac{\partial x_i^v}{\partial T^v} \\
&+ \sum_{i=1}^{N} (a_i^T \frac{\psi_i}{V_i} - m_i^t \frac{\mu_i}{V_i} - \psi_i T^v - \psi_i \sum_{w \neq v}^{Vi} \varpi_i^w T^w) + T^v \sum_{i=1}^{N} \frac{\partial y_i^v}{\partial T^v} \\
&- m^T \sum_{i=1}^{N} \frac{\partial (x_i^v + y_i^v)}{\partial T^v} + \sum_{i=1}^{N} \frac{\partial x_i^v}{\partial T^v} \left[a_i^T z_i + m_i^t (\theta_i^t z_i - 1)\right] \\
&+ \phi_i^{Tv} \sum_{i=1}^{N} \left[a_i^T \sigma_i^v - m_i^t \vartheta_i^v - T^v \sigma_i^v\right]
\end{aligned}$$

From equations (10) and (11) we can substitute for $\partial x_i^v / \partial T^v$ and $\partial y_i^v / \partial T^v$

$$
\begin{aligned}
\frac{\partial \pi^{Tv}}{\partial T^{v}} = {} & \sum_{i=1}^{N}\left[a_i^T\sigma_i^v - m_i^t\vartheta_i^v - T^v\sigma_i^v\right](1-z_i) + T^v\sum_{i=1}^{N}(1-z_i)\left[-\phi_i^T\sigma_i^{tv} - \sigma_i^v\right] \\
& + \sum_{i=1}^{N}\left[a_i^T\frac{\psi_i}{V_i} - m_i^t\frac{\mu_i}{V_i} - \psi_i T^v - \psi_i\sum_{w\neq v}^{Vi}\varpi_i^w T^w\right] + T^v\sum_{i=1}^{N}\left[-\phi_i^T\frac{\psi_i}{V_i} - \psi_i + \psi_i\sum_{w\neq v}^{Vi}\varpi_i^w\gamma^v\right] \\
& - m^T\sum_{i=1}^{N}\left[-\phi_i^T\sigma_i^{tv} - \sigma_i^v - \phi_i^T\frac{\psi_i}{V_i} - \psi_i + \psi_i\sum_{w\neq v}^{Vi}\varpi_i^w\gamma^v\right] \\
& + \sum_{i=1}^{N}(-\phi_i^T\sigma_i^{tv} - \sigma_i^v)\left[a_i^T z_i + m_i^t(\theta_i^t z_i - 1)\right] - \sum_{i=1}^{N}\phi_i^{Tv}\left[a_i^T\sigma_i^v - m_i^t\vartheta_i^v - T^v\sigma_i^v\right]
\end{aligned}
$$

We can solve for T by summing $\partial\pi^{Tv}/\partial T^v$ over all V_i. In equilibrium, $T^v = T^w = T$.

$$
(12)\qquad T = \left\{
\begin{aligned}
& \sum_{i=1}^{N}a_i^T\left[\sum_{i=1}^{Vi}\sigma_i^v\left(1-2z_i\left[\sum_{v=1}^{Vi}\phi_i^{Tv}+1\right]+\psi_i\right)\right] \\
& \qquad - \sum_{i=1}^{N}m_i^t\left[\sum_{v=1}^{Vi}\vartheta_i^v(1-z_i(\phi_i^{Tv}+1)) + \mu_i V_i + \sum_{v=1}^{Vi}\sigma_i^v(\theta_i^t z_i - 1)(1+\phi_i^{Tv})\right] \\
& \qquad + m^T\left[\sum_{i=1}^{N}\sum_{v=1}^{Vi}\sigma_i^v(1+\phi_i^{Tv}) + \sum_{i=1}^{N}\psi_i(V_i(1-\sum_{v=1}^{Vi}\gamma^v) + \sum_{v=1}^{Vi}\gamma^v + \sum_{v=1}^{Vi}\frac{\phi_i^{Tv}}{V_i}\right]
\end{aligned}
\right\}
$$

$$
\div\left\{2\sum_{i=1}^{N}\sum_{v=1}^{Vi}\sigma_i^v\left[1-z_i(1+\phi_i^{Tv})+\frac{\phi_i^{Tv}}{2}\right] + \sum_{i=1}^{N}\psi_i\left[1+\frac{\phi_i^{Tv}}{V_i}+V_i(1-\sum_{v=1}^{Vi}\gamma^v)+\sum_{v=1}^{Vi}\gamma^v\right]\right\}
$$

6.4 Railways

The railways, like the terminal elevators, know the reaction function of the local elevators, therefore they base their decisions on a calculated local elevator tariff. The derived demand for all railways in region 'i' is assumed to be determined by the export price less the charges for local and terminal elevation services, less the export supply.

(13) $r_i = p_w - t_i - T - \alpha_i - \beta_i X_i$

Let $p_w - t_i - T - \alpha_i = a^r_i$ be the intercept of the derived demand faced by local elevators in region 'i'.

$$r_i = a^r_i - \beta_i X_i$$

There are R_i railway firms in region 'i' who split this demand on the basis of the price they charge, r_i^j their size, represented by δ_i^j and the price charged by the other railways and the relative size of operations. δ_i^j is an inverse representation of market power, where the sum of δ_i^j over all railways in region 'i' is one, thus $\Sigma_{j=1}^{Ri} \delta_i^j = 1$. The total amount of shipped from region 'i' is the sum of the amount carried by each regional railway, 'j'.

$$X_i = \sum_{j=1}^{Ri} x_i^j$$

(14) $$x_i^j = \frac{a_i^r}{R_i \beta_i} - \frac{r_i^j}{\beta_i} + \frac{1}{\beta_i} \sum_{h \neq j}^{Ri} \delta_i^h r_i^h$$

The profit for railway 'j' in region 'i' is the freight rate less the marginal cost of transportation less some fixed cost, F^r.

$$\pi^r{}_i^j = (r_i^j - m^r{}_i)\, x_i^j - F^r$$

The railways will choose their freight rate to maximize profit.

$$\frac{\partial \pi_i^{rj}}{\partial r_i^j} = x_i^j + (r_i^j - m_i^r)\frac{\partial x_i^j}{\partial r_i^j} = 0$$

We can determine $\partial x_i^j/\partial r_i^j$ from equation (14).

$$\frac{\partial x_i^j}{\partial r_i^j} = \frac{\partial a_i^r}{\partial r_i^j}\frac{1}{R_i\beta_i} - \frac{1}{\beta_i} + \frac{1}{\beta_i}\sum_{h\neq j}^{Ri}\delta_i^h\frac{\partial r_i^h}{\partial r_i^j}$$

Since $a_i^r = p_w - t_i - T - \alpha_i$, and t_i is assumed to be known $\partial a_i^r/\partial r_i^j = -\partial T/\partial r_i^j$. Let $\phi_i^{rj} = \partial T/\partial r_i^j$ be the conjectural variation of a change in the terminal charges for a change in freight charged by railway 'j'. Let $\partial r_i^h/\partial r_i^j = \gamma_i^{rj}$ be the conjectural variation of the change in price charged by other railway firms in region 'i' for a change in price charged by railway 'j'. Note that

$$\sum_{h\neq 1}^{Ri}\delta_i^j = 1-\delta_i^j$$

$$\frac{\partial x_i^j}{\partial r_i^j} = -\frac{1}{\beta_i}\left[\frac{\phi_i}{R_i} + 1 - (1-\delta_i^j)\gamma_i^{rj}\right]$$

Let $\frac{\phi_i}{R_i} + 1 - (1-\delta_i^j)\gamma_i^{rj} = \theta_i^{rj}$ be an indication of market power of firm 'j' in region 'i'.

$$\text{(15)} \qquad \frac{\partial x_i^j}{\partial r_i^j} = -\frac{1}{\beta_i}\theta_i^{rj}$$

We can substitute equation (15) into the first order conditions for profit maximisation to obtain:

$$\frac{\partial \pi_i^{rj}}{\partial r_i^j} = x_i^j + (r_i^j - m_i^r)\left[-\frac{\theta_i^{rj}}{\beta_i}\right] = 0$$

From equation (14), we know that

$$x_i^j = \frac{a_i^r}{R_i\beta_i} - \frac{r_i^j}{\beta_i} + \frac{1}{\beta_i}\sum_{h\neq j}^{Ri}\delta_i^h r_i^h$$

$$\frac{\partial \pi_i^{rj}}{\partial r_i^j} = \frac{a_i^r}{R_i\beta_i} - \frac{r_i^j}{\beta_i} + \frac{1}{\beta_i}\sum_{h\neq j}^{Ri}\delta_i^h r_i^h + (r_i^j - m_i^r)\left[-\frac{\theta_i^{rj}}{\beta_i}\right] = 0$$

We can divide through by $1/(\beta_i)$ to get

$$\frac{\partial \pi_i^{rj}}{\partial r_i^j} = \frac{a_i^r}{R_i} - r_i^j + \sum_{h \neq j}^{Ri} \delta_i^h r_i^h + (r_i^j - m_i^r)\left[-\theta_i^{rj}\right] = 0$$

Note $a^r_i = p_w - T - t_i - \alpha_i$. From equation (4) we know t_i.

$$t_i = \frac{a_i^t}{(1+\theta_i^l)} - \frac{m_i^t \theta_i^t}{(1+\theta_i^l)}$$

The solution for t_i can be substituted into the above first order condition. Again, note that

$$\sum_{h \neq 1}^{Ri} \delta_i^j = 1 - \delta_i^j$$

Assume that in any region 'i' that all railway freight charges will be the same in equilibrium, thus $r_i^j = r_i^h = r_i$. Then one can sum $\partial\pi_i^{rj}/\partial r_i^j$ over all R_i firms.

$$\begin{aligned} 0 = (p_w - T - \alpha_i)\left[1 - \frac{1}{(1+\theta_i^t)}\right] - \frac{m_i^t \theta_i^t}{(1+\theta_i^t)} \\ - r_i\left[-\frac{1}{(1+\theta_i^t)} + \sum_{j=1}^{Ri} \theta_i^{rj} + \sum_{j=1}^{Ri} \delta_i^j\right] + m_i^r \sum_{j=1}^{Ri} \theta_i^{rj} \end{aligned}$$

$$\begin{aligned} \frac{\partial \pi_i^{rj}}{\partial r_i^j} = \frac{p_w - T - \alpha_i}{R_i} - \left[\frac{p_w - T - \alpha_i}{R_i(1+\theta_i^t)} + \frac{m_i^t \theta_i^t}{R_i(1+\theta_i^t)} - \frac{r_i^j}{R_i(1+\theta_i^t)}\right] \\ - r_i^j + (1-\delta_i^j) r_i^h - r_i^j \theta_i^{rj} + m_i^r \theta_i^{rj} = 0 \end{aligned}$$

$$\begin{aligned} r_i\left[-\frac{1}{(1+\theta_i^t)} + \sum_{j=1}^{Ri} \theta_i^{rj} + \sum_{j=1}^{Ri} \delta_i^j\right] = \frac{p_w - T - \alpha_i}{R_i}\left[\frac{\theta_i^t}{(1+\theta_i^t)}\right] \\ - \frac{m_i^t \theta_i^t}{(1+\theta_i^t)} + m_i^r \sum_{j=1}^{Ri} \theta_i^{rj} \end{aligned}$$

But $\sum_{j=1}^{Ri} \delta_i^j = 1$

Let $\sum_{j=1}^{Ri} \theta_i^{rj} = \theta_i^r$

$$r_i \left[-\frac{1}{(1+\theta_i^t)} + \theta_i^r + 1 \right] = \frac{p_w - T - \alpha_i}{R_i} \left[\frac{\theta_i^t}{(1+\theta_i^t)} \right] - \frac{m_i^t \theta_i^t}{(1+\theta_i^t)} + m_i^r \theta_i^r$$

Note that $\left[-\frac{1}{(1+\theta_i^t)} + \theta_i^r + 1 \right] = \frac{\theta_i^r + \theta_i^t + \theta_i^r \theta_i^t}{(1+\theta_i^t)}$

Let $(\theta^r_i + \theta^t_i + \theta^r_i \theta^t_i) = \Omega_i$

$$r_i = (p_w - T - \alpha_i) \left[\frac{\theta_i^t}{\Omega_i} \right] - \frac{m_i^t \theta_i^t}{\Omega_i} + \frac{m_i^r \theta_i^r (1+\theta_i^t)}{\Omega_i}$$

$$r_i = (p_w - T - \alpha_i) \left[\frac{\theta_i^t}{\theta_i^r + \theta_i^t + \theta_i^r \theta_i^t} \right] - \frac{m_i^t \theta_i^t}{(\theta_i^r + \theta_i^t + \theta_i^r \theta_i^t)} + \frac{m_i^r \theta_i^r (1+\theta_i^t)}{(\theta_i^r + \theta_i^t + \theta_i^r \theta_i^t)}$$

(16) $$r_i = (p_w - T - \alpha_i - m_i^t) \frac{\theta_i^t}{\Omega_i} + m_i^r \frac{(\Omega_i - \theta_i^t)}{\Omega_i}$$

The three equations for the local, terminal, and rail rates, equations (4), (12) and (16) respectively, can then be solved simultaneously.

Chapter 7

Data and Results

7.1 Introduction

This chapter first introduces the data required for the simulation analysis, develops the supply and demand curves underlying the analysis and then presents the results of the model simulations. The variables required for the model include the number of firms operating in each region, the intercept and slope of the export supply curve, market power parameters and the marginal costs of rail, and local and terminal elevation.

The model is calibrated using the 1997-98 tariffs and capped freight rates and world prices for wheat and canola. The calibration produces values for some of the market power parameters used in the model. The model is then used to simulate three policy scenarios listed in Chapter 5: (1) the effect of the de-regulation of the west coast capacity constraint; (2) the removal of the freight rate cap; (3) the introduction of common running rights. Last, a sensitivity analysis is performed, illustrating the effect of an increase in domestic demand and changes in railway market power.

7.2 Data

For the purpose of this model, the prairies are split into nine regions. Regions are defined by crop district (or census area, in the case of Alberta) and by train run. Consistent with the current catchment areas for wheat, all regions west of approximately Indian Head, Saskatchewan are assumed to deliver to the west coast, while all points east are assumed to deliver to Thunder Bay. For canola, only southern Manitoba is assumed to ship east; all other regions are assumed to ship west (see table 7.1).

Table 7.1 Description of Regions

Regions	Crop	Direction Shipped	Soil Zone	Geographic Description
Peace River	Wheat	West	Black	Alta. Census Areas:
	Canola	*West*		14, 17-19
Southern Alta.	Wheat	West	Brown	Alta. Census Areas:
	Canola	*West*		1-4, $^{1}/_{3}$ area 5
Central Alta.	Wheat	West	Dark	Alta. Census Areas:
	Canola	*West*	Brown	$^{2}/_{3}$ area 5, areas 6-13, 16
Northern Sask.	Wheat	West	Black	Sask. Crop Districts:
	Canola	*West*		8b, 9a, 9b
Central Sask.	Wheat	West	Dark	Sask. Crop Districts:
	Canola	*West*	Brown	2b, ½ 3bn, 6a, 6b, 7a, 7b
Southwest Sask.	Wheat	East	Brown	Sask. Crop Districts:
	Canola	*West*		1a, 1b, 2a
Southeast Sask.	Wheat	East	Dark	Sask. Crop Districts:
	Canola	*West*	Brown	3as, 3an, ½ 3bn, 4a, 4b
East Sask./West Man.	Wheat	East	Black	Sask. Crop Districts: 5a, 5b, 8a
	Canola	*West*		Man. Crop Regions: 3, 4, 5, 6
Southern Man.	Wheat	East	Black	Manitoba Crop Regions:
	Canola	*East*		1, 2, 7-12

Sources: Provincial Ministries of Agriculture (1998), Gray (1997), and Author's Calculations

The elevator and rail competition existing in each region was determined using the number of firms assumed to be active in each region (see table 7.2). Approximate marginal costs for elevators, terminals and rail are also found. Table 7.3 provides a detailed list of the marginal costs used in the model.

Table 7.2 Elevator and Railway Market Structure By Region

Regions	# of Local Elevator Companies	# of Railways	# of Elevator Co.'s with Terminals
Peace River	5	1	4
Southern Alta.	7	1	4
Central Alta.	6	2	4
Northern Sask.	6	2	4
Central Sask.	6	2	4
Southwest Sask.	7	2	4
Southeast Sask.	8	2	4
East Sask./West Man.	8	2	3
Southern Man.	8	2	3

Sources: Canadian Grain Commission (1998), and Author's Calculations

Table 7.3 Marginal Cost of Operations Used

	Local Elevator (per tonne)	Rail (per tonne-mile)			Terminal Elevator (per tonne)
		track fee	carrier	total	
Marginal Cost	$5.00	$0.003	$0.025	$0.028	$6.00

Sources: Saskatchewan Highways and Transportation (1992), ATKearney (1994), Vercammen et al. (1992) and Author's Calculations

Using data from the 1995-96 crop year, regional supply and demand curves were developed. [9] The prices for each region were assumed to be the port price over the crop year, less the export basis. The export basis was determined by the maximum freight rate schedule, plus filed elevator tariffs for both local and port elevators. The quantity of spring wheat supplied from each region was determined using regional production data from the provincial governments. The intercept of the regional supply curves was assumed to be the regional variable cost of production, which was taken from Saskatchewan Agriculture and Food's estimates of cost of production by soil type. The elasticity of supply was assumed to be equal to that estimated by Yildirim (1991).

[9] The 1995-96 crop year was used as it was the first year of port price pooling, and the last year for which full data was available. Port price pooling lead to a change in relative export basis between the regions. For more information on port price pooling see Gray, (1995).

The quantity of wheat exported from the region was assumed to be equal to the quantity of wheat (not including durum) delivered to local elevators in each region. The domestic demand was assumed to equal the quantity produced in the region less quantity exported. Each region is assumed to have the same demand elasticity of wheat, -0.5. From this information, the domestic demand curves were constructed.

The regional supply and demand curves for canola were determined in a similar fashion. The regional price was assumed to be the port price for canola less the export basis for each region. Because 1995-96 canola prices were reported basis Saskatoon, the FOB price for canola was taken to be the Saskatoon price plus the export basis from Saskatoon to Vancouver. Regional supply was taken from 1995-96 provincial production data.

As data on the local deliveries of canola to elevators was not available, regional domestic demand was instead estimated. The location and capacities of the canola crushing plants across the prairies was found. Each crushing plant was assumed to turn over 16 times, which meant that, running at capacity, the sum of the demand for canola by the processing plants in 1995-96 amounted to the approximate domestic demand for canola of about 2 million tonnes. Each crushing plant was assumed to demand canola from the region(s) immediately bordering on its location. The elasticity of demand for canola was taken to be –0.1, and was assumed to be equal across the regions. From this, quantities of canola demanded by region were determined. The quantity of canola exported from each region was assumed to be the regional supply less the regional demand. The data used to construct the supply and demand curves are presented in tables 7.4 and 7.5.

Table 7.4 Regional Production, Exports, Demand, Price and Cost 1995-96

Region	Crop	Variable Cost of Production ($/tonne)	Farm Price ($/tonne)	Quantity produced (mmt)	Quantity regionally demanded (mmt)	Quantity exported (mmt)
Peace River	Wheat	96	213.48	1.34	0.79	0.55
	Canola	*180*	*357.48*	*0.58*	*0*	*0.58*
Southern Alta.	Wheat	106	217.90	2.05	0.87	1.18
	Canola	*185*	*348.73*	*0.47*	*0.24*	*0.23*
Central Alta.	Wheat	101	215.59	3.02	0.45	2.57
	Canola	*185*	*348.89*	*1.28*	*0.51*	*0.77*
Northern Sask.	Wheat	96	206.23	1.37	0	1.37[1]
	Canola	*180*	*348.88*	*0.71*	*0.60*	*0.11*
Central Sask.	Wheat	101	209.47	2.94	0	2.94[1]
	Canola	*185*	*351.75*	*0.89*	*0.14*	*0.75*
Southwest Sask.	Wheat	106	207.02	2.03	0.29	1.74
	Canola	*185*	*337.53*	*0.11*	*0*	*0.11*
Southeast Sask.	Wheat	101	207.74	1.04	0	1.04[1]
	Canola	*185*	*348.71*	*0.25*	*0*	*0.25*
East Sask./	Wheat	96	212.74	2.64	0	2.64
West Man.	*Canola*	*180*	*340.60*	*1.06*	*0.29*	*0.77*
Southern Man.	Wheat	96	154.59	2.20	0.02	2.18
	Canola	*180*	*348.41*	*0.83*	*0.27*	*0.56*

1. The wheat exports from regions Northern Saskatchewan, Central Saskatchewan and Southeast Saskatchewan (1.75, 3.27 and 1.38 million metric tonnes respectivley) exceeded production. In each case, it was assumed that the domestic demand was zero.

Sources: Author's Calculations, Canadian Wheat Board (1995) and Canada Grains Council (1995), Saskatchewan Agriculture and Food (1997).

To derive the supply and demand curves, a functional form must be assumed. While linear curves are often used, a problem exists in using this form for farm-level supply. The supply curve of grain is assumed to have a positive intercept reflecting the fact that grain will not be produced if the price falls below the variable costs of production. The imposition of a positive intercept on a linear curve implies that the elasticity must be greater than one. At the same time, the literature suggests the supply of grain is inelastic at the current price. Supply elasticities for wheat and canola are presented in table 7.5.

Table 7.5 Domestic Supply and Demand of Wheat and Canola (1995-96)

	Supply elasticity	Demand elasticity	Port Price ($/tonne)
Wheat	0.46	-0.5	272.00
Canola	0.07	-0.1	435.00

Sources: Yildirim 1990, Schmitz et al (1996), Storey et al. (1993), Canadian Wheat Board (1996), Saskatchewan Agriculture and Food (1996).

If a supply curve is assumed to have both a positive intercept, and is inelastic at the current price and quantity, it can be neither linear, nor logarithmic. Thus a hybrid formulation is used.

$$p_i = A^s{}_i + B^s{}_i X_i^{Gi}$$

Using the prices and quantities listed in table 7.3 and the elasticities in table 7.4, the regional values for A^s, B^s and G can be determined. These values are presented in table 7.6.

Table 7.6 Parameter Values of Domestic Supply Curves

Region	Crop	A_i^s	B_i^s	G_i
Peace River	Wheat	96	39.96	3.95
	Canola	*180*	*886.48*	*2.78*
Southern Alta.	Wheat	106	5.38	4.23
	Canola	*185*	*1587.88*	*2.83*
Central Alta.	Wheat	101	1.56	3.92
	Canola	*185*	*93.21*	*2.85*
Northern Sask.	Wheat	96	30.41	4.07
	Canola	*180*	*491.63*	*2.85*
Central Sask.	Wheat	101	1.17	4.20
	Canola	*185*	*254.23*	*2.91*
Southwest Sask.	Wheat	106	4.65	4.39
	Canola	*185*	*94984.73*	*2.89*
Southeast Sask.	Wheat	101	90.49	4.24
	Canola	*185*	*10616.06*	*2.90*
East Sask./	Wheat	96	2.20	4.04
West Man.	*Canola*	*180*	*155.56*	*2.85*
Southern Man.	Wheat	96	5.15	3.96
	Canola	*180*	*307.31*	*2.85*

Source: Author's Calculations and Saskatchewan Agriculture and Food (1997)

Since this thesis is concerned with the supply of crop going to export, the domestic demand for these commodities must be subtracted from the domestic production. The local demand curves are assumed to be linear:

$$p_i = A_i^d - B_i^d X_i$$

Using the prices and quantities listed in table 7.3 and the demand elasticity in table 7.5, the regional values of A_i^d and B_i^d can be determined. These values are presented in table 7.7.

Graphically, the export supply curve is derived by the horizontal subtraction of domestic demand from domestic supply. Mathematically, the export supply curve is given by:

$$X_i = \left[\frac{p_i - A_i^s}{B_i^s}\right]^{\frac{1}{Gi}} - \frac{A_i^d - p_i}{B_i^d}$$

The resulting elasticities, and intercepts of the inverse supply curves are responsible in table 7.8. These elasticities and intercepts were calculated numerically, since a closed-form analytical solution cannot be obtained. The intercept represents the price at which there would be no crop exported.

Table 7.7 Parameter Values of Regional Domestic Demand Curves

Region	Crop	A_i^d	B_i^d
Peace River	Wheat	640.44	541.16
	Canola	*4097.26*	*3.87×10^{10}*
Southern Alta.	Wheat	653.71	504.49
	Canola	*4127.59*	*1.53×10^5*
Central Alta.	Wheat	646.76	9.52
	Canola	*4095.67*	*7290.36*
Northern Sask.	Wheat	618.69	6.52×10^9
	Canola	*3992.49*	***6115.28***
Central Sask.	Wheat	628.40	7.23×10^9
	Canola	*4020.60*	*2.54×10^5*
Southwest Sask.	Wheat	629.88	1457.75
	Canola	*4041.50*	*5.47×10^{10}*
Southeast Sask.	Wheat	621.05	6.40×10^9
	Canola	*4024.83*	*5.55×10^{10}*
East Sask./	Wheat	623.21	5.70×10^6
West Man.	*Canola*	*3992.26*	*1.26×10^5*
Southern Man.	Wheat	638.23	2.19×10^5
	Canola	*3993.18*	*1.31×10^5*

Source: Author's Calculations and Saskatchewan Agriculture and Food (1997)

Table 7.8 Parameters Values of Export Supply Curves

Region	Crop	Export supply elasticity	Intercept ($/tonne)
Peace River	Wheat	1.83	108.83
	Canola	*0.70*	*180.00*
Southern Alta.	Wheat	1.16	107.67
	Canola	*1.56*	*218.04*
Central Alta.	Wheat	0.63	96.02
	Canola	*1.23*	*200.61*
Northern Sask.	Wheat	0.46	96.00
	Canola	*4.88*	*297.42*
Central Sask.	Wheat	0.46	101.00
	Canola	*0.85*	*186.06*
Southwest Sask.	Wheat	0.62	106.00
	Canola	*0.70*	*185.00*
Southeast Sask.	Wheat	0.61	101.00
	Canola	*0.70*	*185.00*
East Sask./	Wheat	0.58	96.00
West Man.	*Canola*	*0.99*	*185.13*
Southern Man.	Wheat	0.56	101.00
	Canola	*1.09*	*189.21*

Sources: Author's Calculations, Canadian Wheat Board and Canada Grains Council

The export elasticities vary considerably from region to region. Generally speaking the elasticities are larger the greater the amount of regional consumption. The Peace River region is a good example. The export elasticity for wheat is relatively large because this region exported less than half of its crop in 1995-96.

The model was calibrated using the current elevator tariffs, capped freight rates and approximate prices for 1997-98. The price used for wheat was $210 per tonne and the $420 per tonne was the price used for canola. The 1997-98 basis charges were put into the model, and the model was back-solved for the various market power parameters. Market power parameters (γ and ϕ) for local and terminal elevators were calculated for each crop and for each region. The conjectural variation, or the reaction of other firms to a change in any one firm's price (γ), was assumed to be the same for each firm within the same region.

The market power parameters for rail were set equal to zero for most regions, implying that: (1) each railway assumes that the other rail firm will not react to a change in its own; and (2) each railway assumes the terminals will not change their tariff if the railway changes its freight rate. The implication of the first assumption is that the model assumes that the railways do not collude with each other. The effects of this assumption will be illustrated later in the chapter. The market share parameter, λ, was assumed to be equal for both railways, thus in a region where both railways are active, $\lambda = ½$.

In one region, the conjectural variation, γ, was assumed to be less than zero, implying a higher degree of competition than in the other regions. In southern Manitoba γ was assumed to be -1.5. The change in the parameter reflects the increase in transport competition due to the access to the U.S. rail system and the U.S. domestic market. The values for the parameters used in the model are presented in table 7.9.

Table 7.9 Parameters for Local Elevators, Railroads and Terminal Elevators by Region

Region	Crop	Local Elevator	Rail		Terminal	
		γ	γ	ϕ	γ	ϕ
Peace River	Wheat	-1	0	0	-10	1
	Canola	*-1*	*0*	*0*	*-13*	*1*
Southern Alta.	Wheat	-1	0	0	-10	1
	Canola	*-1*	*0*	*0*	*-13*	*1*
Central Alta.	Wheat	-3	0	0	-10	1
	Canola	*-1*	*0*	*0*	*-13*	*1*
Northern Sask.	Wheat	-4	0	0	-10	1
	Canola	*-1*	*0*	*0*	*-13*	*1*
Central Sask.	Wheat	-4	0	0	-10	1
	Canola	*-1*	*0*	*0*	*-13*	*1*
Southwest Sask.	Wheat	-3	0	0	-10	1
	Canola	*-1*	*0*	*0*	*-13*	*1*
Southeast Sask.	Wheat	-2	0	0	-55	1
	Canola	*-1*	*0*	*0*	*-13*	*1*
East Sask./	Wheat	-3	0	0	-55	1
West Man.	*Canola*	*-1*	*0*	*0*	*-13*	*1*
Southern Man.	Wheat	-3	-1.5	0	-55	1
	Canola	*-1*	*-1.5*	*0*	*-17*	*1*

Source: Author Calculations and Canadian Grain Commission, 1998.

Since trucking acts as a limit to railway market power, it is also assumed that trucking rates act as a cap on freight rates for all regions. Trucking rates were assumed to be 0.07 cents per tonne-mile. This amount is slightly higher than other estimates of trucking costs (such as the estimated from AT Kearney quoted in Chapter 4), to include extra fees which would be incurred by trucking grain to post, e.g. the fees charged by terminals for truck-unloads.

7.3 Results

7.3.1 Solution Procedure

The endogenous variables in this model are the rates charged for rail, and local and terminal elevation. With these rates, the quantity exported from each region is also determined. The endogenous variables can be written as a linear combination of the exogenous variables as seen in equations (4), (12) and (16) in Chapter 6. These equations can be put into matrix format and solved to determine the various component charges of the export basis.

While the theoretical model developed in Chapter 6 assumes linear export supply curves, non-linear export supply curves are used in the emperical analysis of this chapter. The following procedure was used to allow the use of a linear model in a non-linear framework. An initial point on the non-linear supply curve was chosen, giving a price, quantity, and slope. Using the slope from the non-linear export supply curve, the intercept of a linear export supply curve was determined. In figure 7.1, the initial quantity is illustrated as Q_1, and the initial slope is illustrated as β_1. The quantity and slope give rise to an intercept α_1. This slope and intercept are then used in the model to determine the tariffs and rail rates set by the various companies. The resulting basis is then used to calculate a regional price, P_1, which in turn is used to generate a second quantity on the non-linear export supply curve. This quantity, Q_2, and the corresponding slope, β_2, are again used to calculate an intercept α_2 in the linear model and used to generate another local price, P_2. These iterations continue until convergence of successive local prices is obtained.

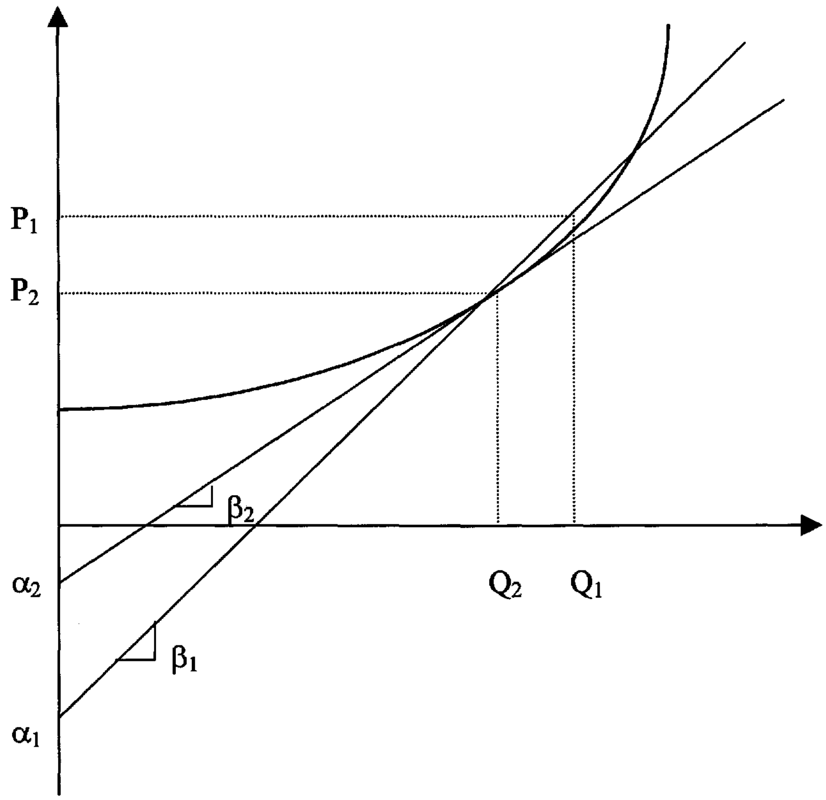

Figure 7.1 Graphical Illustration of the Iteration Procedure Used to Solve the Simulation Model

7.3.2 Simulation Results of Deregulation

Using the above costs and parameters, the model was used to simulate various policy scenarios. The current situation with the freight rate cap in place is illustrated first. Second, the effect of the market regulation of the west coast capacity constraint is simulated. Next, the simulated results of the removal of the freight rate cap are presented. Last, the effect of the imposition of common running rights with various levels of carrier competition is simulated. The results are presented below for wheat and canola, in tables 7.10 to 7.14.

The results in table 7.10 can be interpreted by taking southwest Saskatchewan as an example. With the freight rate cap in place, the simulation shows this region to have a local elevator charge (which would include elevation and handling as well as removal of dockage charges) of approximately $9.82 per tonne. The capped rail charge is approximately $37.84 per tonne and the terminal elevation charge, which would include all port functions is $13.39. The cross-subsidisation of the seaway by the CWB costs all producers $4.00 per tonne. This gives a total export basis for wheat from southwest Saskatchewan to Vancouver of about $65.05 per tonne.

If the west coast capacity was being rationed through price as opposed to CWB administration, producers shipping west will pay an extra $8.45 per tonne, but will not longer have the $4.00 cost to contend with. Under this scenario, producers face a local elevator charge of $9.45 per tonne, a capped railway charge of $37.30 per tonne and a terminal charge of $12.77 per tonne. The $8.45 per tonne will be portioned out between the railways and terminal elevators depending where the constraint lies and which sector has the ability to capture the rents. The total export basis will be $67.98 per tonne.

Southwest Saskatchewan has access to one railway – CP. If CP were to use full market power with the loss of the freight rate cap, freight rates would rise from $37.84 per tonne to $77.00 per tonne, a rate on par with trucking costs. Local elevator charges would decrease to $6.43 per tonne and terminal elevator charges would fall to $8.27 per tonne. This amounts to a total basis of $91.70, up over $26.50 from the current $65.05 per tonne.

Table 7.10 Simulation of Freight Rates and Elevator Charges for Wheat, Before and After Removal of the Freight Rate Cap

Regions	Scenarios	Elevator Tariffs	Rail Rates	FAF/ Seaway	Terminal Charge	CWB/ Capacity	Total Basis[10]
			($/tonne)				
Peace River	*With cap*	*8.55*	*30.33*		*13.39*	*4.00*	*56.26*
	WC constraint	8.16	29.61	N/A	12.77	8.45	58.99
	Without cap	7.57	47.42		8.27	--	63.25
Southern Alta.	*With cap*	*10.01*	*28.52*		*13.39*	*4.00*	*55.91*
	WC constraint	9.60	28.02	N/A	12.77	8.45	58.85
	Without cap	7.81	56.00*		8.27	--	72.08
Central Alta.	*With cap*	*12.03*	*29.99*		*13.39*	*4.00*	*59.41*
	WC constraint	11.63	29.64	N/A	12.77	8.45	62.49
	without cap	9.63	59.50*		8.27	--	77.40
Northern Sask.	*with cap*	*11.58*	*40.79*		*13.39*	*4.00*	*69.76*
	WC constraint	11.15	40.32	N/A	12.77	8.45	72.70
	without cap	8.14	76.51		8.27	--	92.92
Central Sask.	*with cap*	*11.48*	*37.89*		*13.39*	*4.00*	*66.76*
	WC constraint	11.04	37.41	N/A	12.77	8.45	69.67
	without cap	8.07	72.73		8.27	--	89.07
Southwest Sask.	*with cap*	*9.82*	*37.84*		*13.39*	*4.00*	*65.05*
	WC constraint	9.45	37.30	N/A	12.77	8.45	67.98
	without cap	6.43	77.00*		8.27	--	91.70
Southeast Sask.	*with cap*	*11.35*	*26.57*	*11.55*	*11.12*	*4.00*	*64.56*
	WC constraint	10.92	26.21	20.00	10.90	--	68.03
	without cap	7.94	52.50*	20.00	10.61	--	91.05
East Sask./ West Man.	*with cap*	*11.14*	*25.54*	*11.55*	*11.12*	*4.00*	*63.35*
	WC constraint	10.69	25.10	20.00	8.53	--	66.70
	without cap	8.32	49.00*	20.00	8.03	--	87.94
Southern Man.	*with cap*	*11.32*	*20.11*	*11.55*	*11.12*	*4.00*	*58.10*
	WC constraint	10.71	19.52	20.00	8.53	--	61.14
	without cap	9.56	35.00*	20.00	8.03	--	75.18

Source: Author's Calculations

* means that the freight rate has increased to the trucking rate

[10]Total Basis is a sum of the local and terminal elevator tariffs, rail freight rates plus (1) CWB freight adjustment factors and pooled cost under the 'with cap' scenario, (2) seaway charges plus capacity charge under the 'WC constraint' scenario, or (3) seaway cost under deregulation.

Table 7.11 Simulation of Freight Rates and Elevator Charges for Canola, Before and After Removal of the Freight Rate Cap

Regions	Scenarios	Elevator Tariffs	Rail Rates	Seaway Charge	Terminal Charge	Total Basis
			($/tonne)			
Peace River	*with cap*	*15.85*	*30.31*		*17.86*	*64.01*
	without cap	14.33	59.50*	N/A	14.70	88.52
Southern Alta.	*with cap*	*13.62*	*28.07*		*17.86*	*59.54*
	without cap	12.03	56.00*	N/A	14.70	82.72
Central Alta.	*with cap*	*15.50*	*29.49*		*17.86*	*62.84*
	without cap	13.61	59.50*	N/A	14.70	87.80
Northern Sask.	*with cap*	*7.48*	*40.05*		*17.86*	*65.39*
	without cap	6.84	57.54	N/A	14.70	79.08
Central Sask.	*with cap*	*15.81*	*36.36*		*17.86*	*70.02*
	without cap	13.38	77.00*	N/A	14.70	105.07
Southwest Sask.	*with cap*	*16.00*	*37.11*		*17.86*	*70.97*
	without cap	13.70	77.00*	N/A	14.70	105.39
Southeast Sask.	*with cap*	*15.88*	*39.84*		*17.86*	*73.58*
	without cap	13.28	84.00*	N/A	14.70	111.97
East Sask./ West Man.	*with cap*	*14.07*	*42.33*		*17.86*	*74.25*
	without cap	11.42	91.00*	N/A	14.70	117.12
Southern Man.	*with cap*	*15.21*	*20.58*	*20.00*	*17.64*	*73.43*
	without cap	14.31	35.00*	20.00	13.39	86.02

Source: Author's Calculations

A number of conclusions can be inferred from the results presented in tables 7.10 and 7.11. First, freight rates are expected to increase in the wheat price scenario by anywhere from about $15 per tonne to over $40 per tonne. At the same time, the elevator tariffs and terminal charges fall. Nevertheless, under deregulation the overall basis is predicted to increase.

Secondly, freight rates are expected to increase more in regions where one railway has a monopoly. For instance, compare the expected change in freight rates for Central Saskatchewan, where both railways have lines, to Southwest Saskatchewan, where CP has a monopoly. Rates are expected to increase $34.84 per tonne for Central

Saskatchewan, and \$39.16 per tonne in Southwest Saskatchewan. This effect is muted somewhat by the fact that freight rates in many regions reach the ceiling imposed by trucking rates. Thus a corollary is that railways may price discriminate by route and region.

Third, freight rates in regions with greater levels of domestic demand increase less than in those regions with little domestic demand. The Peace River region exports a relatively small portion of its wheat. The result is that even with access to only one mainline railway, the predicted freight rates for wheat are far less under deregulation than those of its neighbouring region, Central Alberta. Equally, the freight rates for canola in Northern Saskatchewan do not increase as much under deregulation as rates do those in the neighbouring regions of Central Saskatchewan and Central Alberta. Northern Saskatchewan has three (four if one includes the Cargill plant at Clavet) crushing plants in the vicinity, which can consume a large portion of the canola produced in the region. This large domestic demand implies that the export supply curve is more elastic, which mitigates the market power of the railways.

Fourth, freight rates and handling tariffs are expected to increase dramatically for higher value crops such as canola. Because there is a greater margin between the port and regional, the railways and elevator companies will attempt to extract some of that margin in the form of higher prices. It should be noted, however, that even these higher freight rates are still in line with the current rail rates for wheat from Montana.

Table 7.12 outlines the different quantities exported under the various scenarios. One interesting result is the large decrease in wheat exports with a loss in the CWB allocation of west coast capacity. Wheat exports fall 0.29 million metric tonnes with market allocation of west cost capacity. They fall a further 1.83 million metric tonnes with the removal of the freight rate cap. An interesting result is that the largest decrease in quantity comes from the wheat shipments going west. This result is due to the fact that the derived export supply curves are more elastic for the regions in Alberta than the regions in Manitoba.

It should also be noted that the wheat production in Alberta under the status quo (the "With Cap" scenario) is predicted to be down substantially from the production in

1995-96. This is because the world wheat price has dropped from $272 per tonne in 1995-96 to approximately $210 per tonne for 1997-98, the price used in the model. Thus, even the large changes in basis predicted by this model can be overshadowed by the changes in world price.

Table 7.12 Simulation of Wheat and Canola Export Quantities Under Various Policy Scenarios

Regions	Crop	Rail Cap	WC Capacity	Deregulation	Common Running Rights		
			(mmt)		2 Firms	6 Firms	Unlimited
Peace River	Wheat	0.22	0.20	0.17	0.21	0.25	0.27
	Canola	*0.56*	*N/A*	*0.53*	*0.53*	*0.53*	*0.56*
Southern Alta.	Wheat	0.69	0.66	0.50	0.58	0.69	0.76
	Canola	*0.21*	*N/A*	*0.19*	*0.19*	*0.19*	*0.22*
Central Alta.	Wheat	1.95	1.92	1.70	1.68	1.84	2.05
	Canola	*0.73*	*N/A*	*0.66*	*0.66*	*0.66*	*0.74*
Northern Sask.	Wheat	1.10	1.08	0.91	0.91	1.03	1.14
	Canola	*0.10*	*N/A*	*0.08*	*0.08*	*0.10*	*0.11*
Central Sask.	Wheat	2.35	2.31	1.97	1.93	2.19	2.42
	Canola	*0.72*	*N/A*	*0.65*	*0.65*	*0.65*	*0.72*
Southwest Sask.	Wheat	1.29	1.26	0.90	1.08	1.23	1.37
	Canola	*0.11*	*N/A*	*0.10*	*0.10*	*0.10*	*0.11*
Southeast Sask.	Wheat	0.85	0.83	0.68	0.68	0.77	0.85
	Canola	*0.24*	*N/A*	*0.21*	*0.22*	*0.21*	*0.24*
East Sask./	Wheat	2.18	2.13	1.84	1.84	1.97	2.19
West Man.	*Canola*	*0.73*	*N/A*	*0.63*	*0.62*	*0.66*	*0.74*
Southern Man.	Wheat	1.80	1.75	1.64	1.64	1.73	1.82
	Canola	*0.53*	*N/A*	*0.51*	*0.51*	*0.51*	*0.54*
Total	Wheat	7.60	7.43	6.15	6.39	7.23	8.01
West Coast	*Canola*	*3.40*	N/A	*3.05*	*3.05*	*3.10*	*3.44*
Total	Wheat	4.83	4.71	4.16	4.16	4.47	4.86
East Coast	*Canola*	*0.53*	N/A	*0.51*	*0.51*	*0.51*	*0.54*
Total	Wheat	12.43	12.14	10.31	10.55	11.70	12.85
	Canola	*3.93*	N/A	*3.56*	*3.56*	*3.61*	*3.98*

Source: Author's Calculations

7.3.3 Simulation Results of Common Running Rights

Last, the imposition of common running rights was considered. Common running rights is modelled here as a separation between the ownership of rail track and rail carrier. It is assumed that carriers pay a regulated per-mile fee for the use of the track, whereas the rates charged by carriers is assumed not to be regulated. This scenario was run for different levels of competition among carriers. The existence of two, six and an unlimited number of carriers was simulated. There are currently two main-line carriers in Canada, and a further four carriers in the U.S. If the majority of the fixed costs involved in rail transport are imbedded in the track, and if there were free entry into the carrier business, this last scenario would theoretically result. The results for wheat are presented in table 7.13 and the results for canola are presented in table 7.14.

Table 7.13 Simulation of Tariffs for Wheat under Common Running Rights with Various Levels of Carrier Competition

Regions	Scenario	Number of Carriers	Elevator Tariffs	Rail Rate	Track Fee	FAF/ Seaway	Terminal Charge	Total Basis
				($/tonne)				
Peace	*With Cap*	1		*8.55*	*30.33*	*0*	*13.39*	*56.26*
River	Without Cap	1		7.57	47.42	0 N/A	8.27	63.25
	Common	2		8.40	36.88	2.55	9.44	57.28
	Running	6		9.22	27.72	2.55	12.02	51.51
	Rights	Unlimited		9.67	21.25	2.55	14.94	48.41
South	*With Cap*	1		*10.01*	*28.52*	*0*	*13.39*	*55.91*
Alta.	Without Cap	1		7.81	56.00*	0 N/A	8.27	72.08
	Common	2		8.70	44.86	2.40	9.44	65.41
	Running	6		10.03	31.25	2.40	12.02	55.70
	Rights	Unlimited		11.05	20.00	2.40	14.94	48.39
Central	*With Cap*	2		*12.03*	*29.99*	*0*	*13.39*	*59.41*
Alta.	Without Cap	2		9.63	59.50*	0 N/A	8.27	77.40
	Common	2		9.49	56.95*	2.55	9.44	78.44
	Running	6		10.86	42.74	2.55	12.02	68.18
	Rights	Unlimited		13.06	21.25	2.55	14.94	51.80
North	*With Cap*	2		*11.58*	*40.79*	*0*	*13.39*	*69.76*
Sask.	Without Cap	2		8.14	76.51	0 N/A	8.27	92.92
	Common	2		8.08	72.13	3.60	9.44	93.26
	Running	6		10.16	53.53	3.60	12.02	79.31
	Rights	Unlimited		12.83	30.00	3.60	14.94	61.38
Central	*With Cap*	2		*11.48*	*37.89*	*0*	*13.39*	*66.76*
Sask.	Without Cap	2		8.07	72.73	0 N/A	8.27	89.07
	Common	2		7.85	69.79	3.30	9.44	90.39
	Running	6		9.80	52.66	3.30	12.02	77.78
	Rights	Unlimited		12.32	30.80	3.30	14.94	61.36

Table 1.3 Continued

South-west Sask.	*With Cap*	1	*9.82*	*37.84*	*0*		*13.39*	*65.05*
	Without Cap	1	6.43	77.00*	0	N/A	8.27	91.70
	Common Running Rights	2	7.62	61.95	3.30		9.44	82.32
		6	9.16	45.74	3.30		12.02	70.23
		Unlimited	10.89	27.50	3.30		14.94	56.63
South-east Sask.	*With Cap*	2	*11.35*	*26.57*	*0*	*11.55*	*11.12*	*64.56*
	Without Cap	2	7.94	52.50*	0	20.00	10.61	91.05
	Common Running Rights	2	7.94	48.60*	3.60	20.00	10.61	91.05
		6	9.66	35.82	3.60	20.00	10.61	78.34
		Unlimited	11.41	18.75	3.60	20.00	11.18	63.59
East Sask./ West Man.	*With Cap*	2	*11.14*	*25.54*	*0*	*11.55*	*11.12*	*63.35*
	Without Cap	2	8.32	49.00*	0	20.00	10.61	87.94
	Common Running Rights	2	8.32	45.10*	3.90	20.00	10.61	87.94
		6	9.26	38.07	3.90	20.00	10.61	80.03
		Unlimited	11.27	17.50	3.90	20.00	11.18	62.04
South Man.	*With Cap*	2	*11.32*	*20.11*	*0*	*11.55*	*11.12*	*58.10*
	Without Cap	2	9.56	35.00*	0	20.00	10.61	75.18
	Common Running Rights	2	9.56	33.50*	1.50	20.00	10.61	75.18
		6	10.45	24.20	1.50	20.00	10.61	66.76
		Unlimited	11.48	12.50	1.50	20.00	11.18	56.66

Source: Author's Calculations

Table 7.14 Simulation of Tariffs for Canola Under Common Running Rights with Various Levels of Carrier Competition

Regions	Scenario	Number of Carriers	Elevator Tariffs	Rail Rates	Track Fee	Terminal Charge	Total Basis
				($/tonne)			
Peace River	*With Cap*	1	*15.85*	*30.31*	*0*	*17.86*	*64.01*
	Without Cap	1	14.33	59.50*	0	14.70	88.52
	Common Running Rights	2	14.34	50.25*	2.55	14.66	88.50
		6	14.29	50.25*	2.55	15.02	88.81
		Unlimited	16.20	21.25	2.55	18.31	69.09
Southern Alta.	*With Cap*	1	*13.62*	*28.07*	*0*	*17.86*	*59.54*
	Without Cap	1	12.03	56.00*	0	14.70	82.72
	Common Running Rights	2	11.99	53.60*	2.40	14.66	82.65
		6	12.23	50.11	2.40	15.02	79.76
		Unlimited	13.95	20.00	2.40	18.31	54.65
Central Alta.	*With Cap*	2	*15.50*	*29.49*	*0*	*17.86*	*62.84*
	Without Cap	2	13.61	59.50*	0	14.70	87.80
	Common Running Rights	2	13.63	56.95*	2.55	14.66	87.79
		6	13.59	56.95*	2.55	15.02	88.12
		Unlimited	15.86	21.25	2.55	18.31	57.94
Northern Sask.	*With Cap*	2	*7.48*	*40.05*	*0*	*17.86*	*65.39*
	Without Cap	2	6.84	57.54	0	14.70	79.08
	Common Running Rights	2	6.84	57.55	3.60	14.66	79.05
		6	7.42	40.47	3.60	15.02	66.51
		Unlimited	7.41	30.00	3.60	18.31	59.65
Central Sask.	*With Cap*	2	*15.81*	*36.36*	*0*	*17.86*	*70.02*
	Without Cap	2	13.38	77.00*	0	14.70	105.07
	Common Running Rights	2	13.40	73.70*	3.30	14.66	105.06
		6	13.36	73.70*	3.30	15.02	105.38
		Unlimited	16.15	27.50	3.30	18.31	65.27
South-west Sask.	*With Cap*	1	*16.00*	*37.11*	*0*	*17.86*	*70.97*
	Without Cap	1	13.70	77.00*	0	14.70	105.39
	Common Running Rights	2	13.71	73.70*	3.30	14.66	105.37
		6	13.67	73.70*	3.30	15.02	105.69
		Unlimited	16.37	27.50	3.30	18.31	65.49

Table 7.14 Continued

South-	*With Cap*	2	*15.88*	*39.84*	*0*	*17.86*	*73.58*
east Sask.	Without Cap	2	13.28	84.00*	0	14.70	111.97
	Common	2	13.30	80.40*	3.60	14.66	111.96
	Running	6	13.27	73.73*	3.60	15.02	112.30
	Rights	Unlimited	16.24	30.00	3.60	18.31	68.15
East	*With Cap*	2	*14.07*	*42.33*	*0*	*17.86*	*74.25*
Sask./	Without Cap	2	11.42	91.00*	0	14.70	117.12
West	Common	2	11.38	87.10*	3.90	14.66	117.19
Man.	Running	6	12.10	75.13	3.90	15.02	106.15
	Rights	Unlimited	14.37	32.50	3.90	18.31	69.09
Southern	*With Cap*	2	*15.21*	*20.58*	*0*	*17.64*	*73.43*
Man.	Without Cap	2	14.31	35.00*	0	16.65	86.02
	Common	2	14.37	33.50*	1.50	16.65	86.02
	Running	6	14.38	32.65	1.50	16.66	85.18
	Rights	Unlimited	15.59	12.50	1.50	18.09	67.69

Source: Author's Calculations

The advent of common running rights does allow the terminal elevator tariffs to increase. The more carriers in operation, the higher the tariffs. The increase in tariffs is more dramatic for the higher value crop, canola, than for the lower value crop, wheat.

The introduction of common running rights with only two carriers does not greatly affect the basis, and therefore does not increase wheat exports from the deregulation scenario (see table 7.12). More carrier competition is needed to move the exports back to the level currently enjoyed with the freight rate cap. There is no difference in volume of exports under a common running rights scheme with two carriers versus deregulation. If more carriers are allowed, the quantity exported increases, but at six carriers, still does not reach the level of exports currently experienced under rail rate regulation. However, if there are no barriers to entry, the threat of entry should be enough to keep the current carriers pricing at cost. In this case, freight rates drop below the current capped values and export volumes increase.

7.4 Sensitivity Analysis

The above results assume that there is a static amount of investment in the domestic use of grains and oilseeds. There may be new firms entering the domestic feedlot and processing industries, which would impact the domestic demand for wheat and canola. This increased investment would shift the domestic demand curve to the left, increasing the price at which there would be no crop exported. The effect of building an extra processing firm in each region is modelled for both wheat and canola. The processing plant for wheat was assumed to be the size of the Prairie Flour Mills plant at Elie, Manitoba, which has a capacity of 12,000 tonnes, and is assumed to increase regional demand by 0.19 million tonnes. The canola plant was assumed to be the size of the Cargill plant at Clavet, Saskatchewan with a capacity of 9,000 tonnes, and is assumed to increase regional demand by 0.14 million tonnes. The deregulated export basis is simulated for the current and the increased demand, and the results are presented in tables 7.15 and 7.16.

Table 7.15 Simulation of Freight Rates and Elevator Charges for Wheat with Increased Levels of Domestic Demand

Regions	Domestic Demand	Elevator Tariffs	Rail Rates	FAF/ Seaway	Terminal Charge	Total Basis
			($/tonne)			
Peace River	status quo	7.57	47.42		8.27	63.25
	added firm	*6.25*	*35.31*	N/A	*7.83*	*49.39*
Southern Alta.	status quo	7.81	56.00*		8.27	72.08
	added firm	*7.24*	*52.48*	N/A	*7.83*	*67.54*
Central Alta.	status quo	9.63	59.50*		8.27	77.40
	added firm	*9.21*	*59.50**	N/A	*7.83*	*76.54*
Northern Sask.	status quo	8.14	76.51		8.27	92.92
	added firm	*7.93*	*73.59*	N/A	*7.83*	*89.34*
Central Sask.	status quo	8.07	72.73		8.27	89.07
	added firm	*7.99*	*71.62*	N/A	*7.83*	*87.43*
Southwest Sask.	status quo	6.43	77.00*		8.27	91.70
	added firm	*6.20*	*77.00**	N/A	*7.83*	*91.03*
Southeast Sask.	status quo	7.94	52.50*	20.00	8.03	91.05
	added firm	*7.75*	*51.27*	*20.00*	*10.31*	*89.33*
East Sask./	status quo	8.32	49.00*	20.00	8.03	87.94
West Man.	*added firm*	*8.29*	*49.00**	*20.00*	*10.31*	*87.60*
Southern Man.	status quo	9.56	35.00*	20.00	8.03	75.18
	added firm	*9.54*	*35.00**	*20.00*	*10.31*	*74.88*

Source: Author's Calculations

Table 7.16 Simulation of Freight Rates and Elevator Charges for Canola with increased levels of Domestic Demand

Regions	Domestic Demand	Elevator Tariffs	Rail Rates	Seaway Charge	Terminal Charge	Total Basis
			($/tonne)			
Peace River	status quo	14.33	59.50*		14.70	88.52
	added firm	*12.09*	*59.50**	N/A	*10.88*	*82.47*
Southern Alta.	status quo	12.03	56.00*		14.70	82.72
	added firm	*7.10*	*56.00**	N/A	*10.88*	*73.98*
Central Alta.	status quo	13.61	59.50*		14.70	87.80
	added firm	*12.07*	*59.50**	N/A	*10.88*	*82.45*
Northern Sask.	status quo	6.84	57.54		14.70	79.08
	added firm	*5.56*	*40.85*	N/A	*10.88*	*57.29*
Central Sask.	status quo	13.38	77.00*		14.70	105.07
	added firm	*11.84*	*77.00**	N/A	*10.88*	*99.72*
Southwest Sask.	status quo	13.70	77.00*		14.70	105.39
	added firm	*5.11*	*35.54*	N/A	*10.88*	*51.54*
Southeast Sask.	status quo	13.28	84.00*		14.70	111.97
	added firm	*8.09*	*84.00**	N/A	*10.88*	*102.97*
East Sask./	status quo	11.42	91.00*		14.70	117.12
West Man.	*added firm*	*10.22*	*91.00**	N/A	*10.88*	*112.10*
Southern Man.	status quo	14.31	35.00*	20.00	13.39	86.02
	added firm	*14.31*	*35.00**	*20.00*	*13.39*	*86.02*

Source: Author's Calculations

As can be seen in the above tables, an increase in domestic demand for either wheat or canola has little affect upon the rail rate in most regions. Only regions with an already elastic export supply showed much change, whereas the regions where the freight rate was previously at the trucking rate were not effected. The increase in domestic demand does affect the local and terminal elevator tariffs charged, especially in the case of canola. It should be noted, however, that the addition of an extra processing plant for canola in Northern Saskatchewan and Southwest Saskatchewan meant that very little canola was left to go for export, and thus the rates for these regions are unreliable. In conclusion, an increase in investment in industries that demand domestic grains and oilseeds may not greatly impact rail rates in most regions, but may have the effect of lowering the elevator tariffs for higher value crops.

All the above results assume that railways do not vary their prices for a change in the price charged by other railways, and thus the parameter γ is set at 0 for most regions (see table 7.9). Although this implicitly assumes that railways are not colluding, it also implies that they are not competing as much as they might. The second sensitivity analysis presented illustrates the effects of different choices for the parameter γ on the export basis under deregulation. These results are presented in tables 7.17 and 7.18.

Table 7.17 Simulation of Freight Rates and Elevator Charges for Wheat with Increased Levels of Rail Competition

Regions	Rail Competition (γ)	Elevator Tariffs	Rail Rates	FAF/ Seaway	Terminal Charge	Total Basis
			($/tonne)			
Peace River	0	7.57	47.42		8.27	63.25
	-2.5	*7.53*	*47.12*	N/A	*8.84*	*63.49*
	-5	7.52	46.96		9.12	63.60
Southern Alta.	0	7.81	56.00*		8.27	72.08
	-2.5	*7.71*	*56.00**	N/A	*8.84*	*72.55*
	-5	7.72	56.00*		9.12	72.84
Central Alta.	0	9.63	59.50*		8.27	77.40
	-2.5	*10.57*	*51.02*	N/A	*8.84*	*70.42*
	-5	11.37	43.82		9.12	64.31
Northern Sask.	0	8.14	76.51		8.27	92.92
	-2.5	*9.83*	*62.91*	N/A	*8.84*	*81.57*
	-5	10.70	55.86		9.12	75.61
Central Sask.	0	8.07	72.73		8.27	89.07
	-2.5	*9.74*	*59.58*	N/A	*8.84*	*78.15*
	-5	10.61	52.72		9.12	72.45
Southwest Sask.	0	6.43	77.00*		8.27	91.70
	-2.5	*6.37*	*77.00**	N/A	*8.84*	*92.21*
	-5	6.35	77.00*		9.12	92.47
Southeast Sask.	0	7.94	52.50*	20.00	8.03	91.05
	-2.5	*9.46*	*41.58*	*20.00*	*10.35*	*81.43*
	-5	9.87	36.31	20.00	10.46	76.64
East Sask./	0	8.32	49.00*	20.00	8.03	87.94
West Man.	*-2.5*	*8.84*	*44.37*	*20.00*	*10.35*	*83.57*
	-5	9.48	38.16	20.00	10.46	78.10
Southern Man.	0	9.56	35.00*	20.00	8.03	75.18
	-2.5	*9.59*	*35.00**	*20.00*	*10.35*	*74.94*
	-5	9.72	33.55	20.00	10.46	73.73

Source: Author's Calculations

Table 7.18 Simulation of Freight Rates and Elevator Charges for Canola with increased levels of Rail Competition

Regions	Rail Competition (γ)	Elevator Tariffs	Rail Rates	Seaway Charge	Terminal Charge	Total Basis
			($/tonne)			
Peace River	0	14.33	59.50*		14.70	88.52
	-2.5	*14.27*	*59.50**	N/A	*15.72*	*89.48*
	-5	14.25	59.50*		16.37	90.12
Southern Alta.	0	12.03	56.00*		14.70	82.72
	-2.5	*11.95*	*56.00**	N/A	*15.72*	*83.67*
	-5	11.87	56.00*		16.37	84.40
Central Alta.	0	13.61	59.50*		14.70	87.80
	-2.5	*13.53*	*59.50**	N/A	*15.72*	*88.74*
	-5	13.73	56.23		16.37	86.33
Northern Sask.	0	6.84	57.54		14.70	79.08
	-2.5	*7.27*	*46.72*	N/A	*15.72*	*69.71*
	-5	7.42	42.59		16.37	66.38
Central Sask.	0	13.38	77.00*		14.70	105.07
	-2.5	*13.30*	*77.00**	N/A	*15.72*	*106.01*
	-5	13.46	74.33		16.37	104.16
Southwest Sask.	0	13.70	77.00*		14.70	105.39
	-2.5	*13.63*	*77.00*	N/A	*15.72*	*106.35*
	-5	13.58	77.00		16.37	106.95
Southeast Sask.	0	13.28	84.00*		14.70	111.97
	-2.5	*13.19*	*84.00**	N/A	*15.72*	*112.91*
	-5	13.20	83.97		16.37	113.54
East Sask./	0	11.42	91.00*		14.70	117.12
West Man.	*-2.5*	*11.52*	*88.56*	N/A	*15.72*	*115.80*
	-5	12.31	74.00		16.37	102.68
Southern Man.	0	14.31	35.00*	20.00	13.39	86.02
	-2.5	*14.31*	*35.00**	*20.00*	*13.39*	*86.02*
	-5	14.31	35.00*	20.00	13.39	86.02

Source: Author's Calculations

As can be seen in the above tables, an increase in competition (thus an increase in the absolute value of γ) between the existing number of railways has little affect upon the rail rate. Like the increase in domestic demand simulated above, the larger impact occurs in regions with more elastic export supply curves. This effect is tempered somewhat by the fact that some regions with elastic export supply only have access to one railway (e.g. Peace River and Southern Alberta) and therefore are unaffected by competition between railways. For wheat, the increased domestic demand has little impact on any components of the basis. The increased rail competition did allow elevator tariffs, both at the terminal and in some regions, to increase. In conclusion, an increase rail competition may not greatly impact rail rates but may have the effect of allowing some elevator tariffs to increase.

7.5 Summary

In conclusion, the model shows the potential of railway market power to increase the freight rates for grain under deregulation. It further illustrates the potential of railways to engage in forms of price discrimination, including value-of-service pricing. Elevator companies, however, face decreases in tariff rates under rail deregulation. It is only when one introduced increased rail competition that the elevator companies can be expected to raise their tariff rates at both primary and terminal elevators.

The imposition of common running rights can work to mitigate the market power of the railroads. The model illustrates a common running rights regime with a sufficient number of carriers may be able to bring freight rates, and the export basis, to a level currently enjoyed with regulation.

Chapter 8

Conclusions

8.1 Summary

The Canadian grain transportation and handling industry is changing. Much of this change is a result of a shift in government policy away from direct regulation to a more market driven system. The question arises as to the effect of deregulation on the grain transportation and handling industry and the export basis faced by producers.

In this thesis the public policy problems associated with an industry with large barriers to entry are discussed. Governments face the difficulty of first getting firms into the industry, and then trying to limit their use of market power once the firms are established. The history of regulation in Canada and the U.S. grain transportation industries is then reviewed to give an idea of how governments have grappled with these problems in the past. The history in both Canada and the United States is peppered with attempts by government to develop the rail industry while constraining this market power. These regulations have met with mixed success. More recently, governments in both countries have begun to return these industries to a more market-based framework. The current regulatory regimes in both countries are described.

The U.S. deregulated its rail industry in 1980, which gives some evidence of what can occur without rate regulation. Although freight rates have fallen overall, some railways appear to be returning to forms of monopoly pricing involving price discriminating between routes and commodities.

The structure of the Canadian grain transportation and handling industry is described. Currently both the elevator and rail sectors are concentrated. The top four elevator firms have more that 80 per cent of the country capacity in each of the provinces, and there are only two mail line railroads in Western Canada. Given the cost structure of both the elevator and rail sectors, there may be the potential for market power. This potential for market power is of particular concern to grain producers, given that many farmers are producing a relatively homogeneous product in Western Canada, implying that their ability to exert market power is limited. Evidence illustrating that firms are pricing above marginal cost is presented.

The grain industry falls under a number of different regulations not directly related to grain movement but which affect the structure of the grain handling industry. The Canadian Grain Commission (CGC) administers Canada's grading and inspection system. The fact that Canada has a large number of grades and a rigorous varietal control system implies that the grain transportation and handling system must have the ability for a large number of crop segregations. Another organisation that affects the grain transportation and handling industry is the Canadian Wheat Board. The CWB rations system capacity through the timing of its contract calls, and through limiting its use of the west coast ports which is reflected back to producers through the cross-subsidisation of the St. Lawrence Seaway.

8.1.1 Model

The model developed in this thesis illustrates how the rates charged by the railways and elevator companies are determined. It is based on a fixed proportions model where export grain on the prairies, transportation, and local and terminal elevation are needed in equal proportions to produce an end-product, export grain at port position.

The model allows for various levels of market power within and between the sectors. The services provided by the different sectors (e.g. country elevation, rail transport, and terminal elevation) are assumed to be heterogeneous. Because of the spatial differences among country elevators and railways, as well as some brand loyalty to certain elevator companies, this model assumes firms have the ability to set a price different from their competitors. Thus the firms are assumed to choose price to maximize profit, as opposed to choosing quantity.

Because the sectors are modelled as links in a vertical chain, the decisions of one sector affect the others. Thus the model illustrates the interplay between the sectors when setting price in a deregulated environment.

The prairies are split into a number of regions allowing the model to describe what may occur in areas with different firm concentrations, different marginal costs of service and different production costs. This flexibility allows the model to consider branch-line versus main-line movement and the difference that access to two versus one railway might make to a region and other scenarios.

The model is limited in that only producers annual results and therefore cannot model the intra-year grain movements. This limitation restricts its ability to consider the impact of different logistics scenarios. The model also assumes that Canadian producers have no effect on the world price of grain.

8.1.2 Results

Using the information about industry structure, the model is first calibrated for the current year and is then used to simulate various scenarios. The first scenario examined is the impact of the west coast capacity constraint. Given that the CWB is currently rationing the use of the west coast ports, the model illustrates what might occur if that capacity was instead rationed through price. The simulation shows that a price wedge will appear for grain moving to the west coast, inducing some grain to move east. The price-based rationing of the west coast capacity will lead to an increase in the export basis.

The second scenario examined is the removal of the freight rate cap. The model illustrates that railways would be expected to engage in various forms of price discrimination under deregulation. It is anticipated that railways will price discriminate by route and by value of commodity. Rail rates are illustrated to increase more in regions that have access to only one railroad versus regions that have access to two. As well, freight rates for a higher-value crop such as canola are expected to increase more than the rates for wheat.

The third scenario simulated is the impact of common running rights on the export basis. The imposition of common running rights can act to replicate the current regulated freight rates if there are sufficient competing carriers. The number of firms needed to simulate the current rate cap varies by region and crop. Regions with more inelastic export supply curves, along with higher valued crops, will need to have more carriers to lower the freight rates to levels under the freight rate cap. Without a sufficient number of carriers, the export basis from some regions may increase for higher value crops, as freight rates remain at trucking levels, and terminal elevator tariffs increase.

In conclusion, the export basis will be effected by further changes to te regulation of railways and elevators. After helping to establish the rail industry, governments have attempted a number of different forms of regulation to restrict the market power of the railways. The results of these regulatory attempts have been mixed. Now governments are hoping that competition can be encouraged, and are turning the industry back over to the market. Although the overall result of this deregulation is unknown, the potential for railways to re-exert some of their market power is a critical determinant of the outcome.

8.2 Limitations and Suggestions for Further Study

There are several caveats to this research. This model assumes the quantity exported will not affect the world price. It should be noted, however, that a downward sloping demand curve for grain at export position would only serve to increase the potential for firms involved in the export basis to exert market power.

The model is based on a planning supply curve, and does not take intra-year variations into account. Thus, results should be viewed as long-run. The model is equally unable to consider variations in service that might occur under deregulation.

This thesis only presents the results from a few scenarios simulated with this model. The impact of number of other policy or market structure changes could be illustrated. For example, this model could be used to simulate mergers in the local elevator industry, or increased vertical integration among local and terminal elevators. Due to a lack of data, this thesis did not assume large regional variations in domestic demand. The impact of a processor or feed-lot entering a specific region could be simulated and discussed.

Given the complexity of the grain transportation and handling system, a number of interesting questions are ignored in this thesis. The issues around the ownership of the government hopper cars and car allocation are examples. There are many logistical questions that cannot be addressed with a model like the one developed here. These issues are left for others to explore.

References

ATKearney. September 1994. *Grain Logistics Strategy, Final Report.* Prepared for Saskatchewan Highways and Transportation, Regina.

Aikins, MacAulay and Thorvaldson. 1995. "Seminar on Canada Transportation Act."

Baumol, Panzar and Willig. 1992. *Contestable Markets and the Theory of Industry Structure.* New York: Harcourt Brace Jovanovich, Inc.

Benedict, Murray R. 1953. *Farm Policies of the United States 1790-1950.* New York: Twentieth Century Fund.

Carlton, Dennis W. and Jeffrey M. Perloff. 1994. *Modern Industrial Organization.* New York: HarperCollins College Publishers.

Carter, Colin and R. M. A. Loyns. 1996. *The Economics of Single Desk Selling of Western Canadian Grain.* A Report for Alberta Agriculture, Edmonton.

Canada Grains Council. 1995. *Canadian Grains Industry Statistical Handbook.* Winnipeg: Canada Grains Council.

Canadian Grain Commission. 1998. "Elevator Tariffs," http://www.cgc.ca/Regulatory/Tariffs/tariffs-e.htm.

Canada-U.S. Joint Commission of Grains. 1995. "Final Report." Ottawa: Ministry of Agriculture and Agri-Food.

Cruikshank, Ken. 1991. *Close Ties: Railways, Government and the Board of Railway Commissioners, 1851 - 1933.* Montreal and Kingston: McGill - Queens University Press.

Demmans, Maurice and Roth, Clarence. 1998. "Meeting Customers' Quality Requirements with Quality Segregations." A Paper for the Canadian Wheat Board, Winnipeg.

Eley, Ron, Murray Fulton and Ken Perlich. 1997. "Market Power in the Provision of Rail Services for Grain Transportation." Submitted Paper for the CAEFMS/AAEA Joint Meetings, Toronto, July 27-30.

Elliot, Andrew. November 1994. "Deregulating Grain Transportation in Canada." A Paper for Transport Canada, Ottawa.

Elliot, Andrew. November 1994. "Deregulating Grain Transportation in Canada: Lessons from the U.S. Experience, 1980 - 1994." A Paper for Transport Canada, Ottawa.

Fairbairn, Garry Lawrence. 1984. *From Prairie Roots: The Remarkable Story of the Saskatchewan Wheat Pool.* Saskatoon: Western Producer Prairie Books, Saskatchewan Wheat Pool.

Fowke, Vernon C. 1957. *The National Policy and the Wheat Economy.* Toronto: University of Toronto Press, reprinted in 1973.

Friedlaender, Ann E. 1969. *The Dilemma of Freight Transport Regulation.* Washington D.C.: The Brookings Institution.

Fuller, S., D. Bessler, J. MacDonald and M. Wohlgenant. 1987. "Effect of Deregulation on Export-Grain Rail Rates in the Plains and Corn Belt." *Journal of the Transportation Research Forum* 28(1), 160-67.

Fulton, Murray and Richard Gray. 1997. "Railways, Competition and the Hold-up Problem." University of Saskatchewan, Saskatoon.

Greenhut, Melvin, George Norman and Chao-Shun Hung. 1987. *The Economics of Imperfect Competition: A Spatial Approach.* Cambridge: Cambridge University Press.

Hanson, Steven D., C. Phillip Baumel and Daniel Schnell. 1989. "Impact of Railroad Contracts on Grain Bids to Farmers" in *American Journal of Agricultural Economics*. Vol. 71, No. 3 (August) 638 - 46.

Heads, John, Transport Institute. 1994. "The International Competitiveness of Western Canadian Transportation." A Report for Western Economic Diversification Canada, Winnipeg.

Hucq, Andre Louis Eugene. 1997. "An Economic Enquiry into Blending Rents at Primary Elevators in Western Canada: A Spatial Approach." PhD Thesis, University of Saskatchewan, Saskatoon.

IBI Group. 1994. "Grain System Efficiency." A Report for Alberta Agriculture. Edmonton.

Kennett, Julie. 1997. "An Examination of Bread Wheat Quality and Its Effects on Vertical Coordination in the Wheat Supply Chain." M.Sc. Thesis, University of Saskatchewan, Saskatoon.

Kulshreshtha, S. N. and D. G. Devine. 1978. "Historical Perspective and Propositions on the Crowsnest Pass Freigt Rate Agreement." *Canadian Journal of Agricultural Economics* Vol. 26, No. 2. (July) 72 - 83.

MacDonald, J. M. 1989. "Railroad Deregulation, Innovation and Competition: Effect of the Staggers Act on Grain Transportation." *Journal of Law and Economics* 32(April), 63-95.

National Farmers Union. 1995. "Submission to the Standing Committee on Transportation on Bill C-101, the Canadian Transportation Act." Ottawa.

Kessides, Ioannis and Willig, Robert D. 1998. "Railways: Structure, Regulation and Competition Policy." Paper for the OECD Competition Roundtables. http://www.oecd.org//daf/ccp/railw18.htm.

Posner, Richard A. 1975. "The Social Costs of Monopoly and Regulation." *Journal of Policital Economy.* Vol. 83. 807-27.

Rosaasen, Ken A. 1983. "The Pepin Plan - Its Impact on Saskatchewan Farmers." A Paper Presented at the SCRAD Symposium, Saskatoon.

Sarwar, Ghulam and Dale G. Anderson. 1989. "Railroad Rate Deregulattion and Uncertainty of Farm-Level Prices for Corn." *American Journal of Agricultural Economics* Vol. 71, No. 4 (November) 881 - 91.

Saskatchewan Agriculture and Food. 1997. *FarmFacts: Crop Planning Guide.* Regina: Saskatchewan Agriculture and Food.

Saskatchewan Highways and Transportation and Saskatchewan Agriculture and Food. December 1992. "A Description of the Grain Handling and Transportation Industry." Regina.

Schmitz, Andrew, Richard Gray, Troy Schmitz and Gary Storey. 1997. "The CWB and Barley Marketing: Price Pooling and Single-Desk Selling." A Report for the Canadian Wheat Board, Winnipeg.

Skogstad, Grace. 1987. *The Politics of Agricultural Policy-Making in Canada.* Toronto: University of Toronto Press.

Sorenson, L. Orlo. 1984. "Some Impacts of Rail Regulatory Changes on Grain Industries." *American Journal of Agricultural Economics* Vol. 66, No. 5 (December) 645-56.

Stigler, George J. 1974. "Theories of Economic Regulation" *Bell Journal* (Autumn); reprinted in Stigler, George J. 1975. *The Citizen and the State: Essays on Regulation.* Chicago: University of Chicago Press.

Stigler, George J., and Claire Friedland. 1962. "What Can Regulators Regulate? The Case of Electricity." *Journal of Law and Economics* 5:1-16, in Carleton, Dennis W. and Jeffrey M. Perloff, *Modern Industrial Organization.* New York: HarperCollins College Publishers.

Storey, Gary, Hartley Furtan, Kenneth Rosaasen and Julia Taylor. 1993. *An Econometric Model of the Canadian Oilseed Sector.* Working Paper 2/93. Ottawa: Agriculture Canada.

Strick, John C. 1990. *The Economics of Government Regulation: Theory and Canadian Practice.* Toronto: Thompson Educational Publishing.

Transport Concepts. 1995. "Impact of Prairie Branch Line Abandonment." A paper prepared for the Brotherhood of Maintenance of Way Employees, Ottawa.

Vercammen, James, Murray Fulton and Richard Gray. 1996. *The Economics of Western Grain Transportation and Handling*, 1996 Van Vliet Publication Series, University of Saskatchewan. Saskatoon.

West, Douglas S. 1994. *Modern Canadian Industrial Organization: A Supplement to Carleton and Perloff Modern Industrial Organization.* New York: HarperCollins College Publishers.

***Western Producer.* 1998.** March 19.

***Western Producer.* 1998.** February 28.

***Western Producer.* 1997.** August 21.

Western Provinces. 1998. *Submission to the Federal Grain Review.* (March)

Wheeler, John. 1996. "Deregulation of the Railways and the Rail Car Ownership Question: A Welfare Analysis." Unpublished MSc. Thesis, University of Saskatchewan, Saskatoon.

Whiteside, Terry. 1998. "U.S. Rail Deregulation." A Presentation to the Farming for Profit? II Conference, Moose Jaw, Saskatchewan, June 23.

Williamson, Oliver E. 1983. "Credible Commitments: Using Hostages to Support Exchange." *American Economic Review* (September) pp. 519-540.

Wilson, Wesley W. 1994. "Market-Specific Effects of Rail Deregulation." *The Journal of Industrial Economics* 42(1), 1-22.

Yildrim, T. 1990. "The Impact of Trade Liberalisation on Saskatchewan Agriculture: An Econometric Analysis: 1950-1987." Department of Agricultural Economics, University of Saskatchewan, Saskatoon.