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TWO PAPERS IN AGRICULTURAL ECONOMICS
GRAIN MIXING AND GRADING; ECONOMIC MOTIVATIONS FOR THE
CANADIAN WHEAT POOL OF 1923/24;
TESTING HYPOTHESES USING LOGIT

&

ESTIMATION OF AGRICULTURAL SUPPLY PRICE
FROM PRICE OF TRADED QUOTAS;
IMPLICATIONS FOR WELFARE IMPACT OF MARKETING BOARDS
AND COMPETITIVENESS UNDER TRADE LIBERALISATION

by

Daniel Hiroshi Hara, B.A., M.A.

A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfilment of
the requirements for the degree of

Doctor of Philosophy
Department of Economics

Carleton University

Ottawa, Ont.

December 16, 1993

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submitted by

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in partial fulfilment of the requirements
for the degree of Doctor of Philosophy

Chair, Department of Economics

Thesis Supervisor

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2 May 1994

Abstract^a

This thesis presents two papers in agricultural economics. The first paper examines economic motivations for the formation of the Canadian Wheat Pool of 1923/24. It is hypothesized that a collective motivation by farmers to establish the Pool was to bypass an industry whose competitive practices degraded the quality of wheat and reduced the value of the Canadian crop on the world market. A model of grain mixing and grading is developed to show how industry practices may have lead to lower farm incomes. The case is made that farmers of higher quality wheat bore a greater share of the income losses from degrading the quality of wheat, and would have been more likely to join the Pool. The hypothesis is tested in a logit model of individual farmer choice to join the Pool. Membership rates for the Province of Saskatchewan in 1925 are used as a dependent variable. Results support the hypothesis. Other motivations for farmers joining the Pool are also tested. It is found that farmers who expect to harvest early were also more likely to join. Appendices provide an innovation in logit weighting procedures, and historical statistical data. The second paper reviews and refines the relationship between farm supply price and the observed market value of production quota. Past estimates of Canadian supply price in dairy and poultry are reviewed and found to have not correctly accounted for tax benefits and undiversifiable risk to quota holding, including the risk of changes in the political regime. As a result, some of the principal estimates of welfare losses from Canadian marketing boards are inaccurate. An alternative approach to estimation based on "used" and "unused" quota prices is proposed, and applied to the case of Ontario milk production. Supply price is estimated to be only 58.4% of farm price, suggesting that previous supply price estimates have been too high, and welfare loss estimates too low. The estimated supply price is also found to be less than comparable U.S. milk prices, suggesting that Ontario milk production would be a viable sector under liberalised trade.

^a A detailed abstract precedes each paper.

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Volume II: Estimation of Agricultural Supply Price from Price of Traded Quotas; Implications for Welfare Impact of Marketing Boards and Competitiveness under Trade Liberalisation

^b A detailed table of contents precedes each paper.

Volume I

GRAIN MIXING AND GRADING ECONOMIC MOTIVATIONS FOR THE CANADIAN WHEAT POOL OF 1923/24; TESTING HYPOTHESES USING LOGIT

Abstract*

This paper examines economic motivations for the formation of the Canadian Wheat Pool in 1923/24. This farmer cooperative organization grew to handle over half Canada's wheat crop until its financial collapse in 1931. Two questions are addressed: What was the collective motivation for establishing the Pool when substantial farm cooperative organizations for the handling of grain already existed? and What caused individual farmers to join or not join? It is hypothesized that a collective motivation for the Pool was, at least in part, an attempt to bypass an industry whose competitive practices degraded the quality of wheat and reduced the value of the Canadian crop on the world market. A model of grain mixing and grading is developed as an example of how industry practices may have led to lower incomes to farmers. The hypothesis is tested in a model of individual farmer choice to join the pool. The case is made that farmers of higher quality wheat bore a greater share of income losses from the degrading of wheat quality, and would have been more likely to join the Pool. Tests of the determinants of Pool membership support this proposition, showing that farmers of higher quality wheat were more likely to join the Pool. Membership rates for the Province of Saskatchewan in 1925 are used. Another hypothesis is also tested: That the Pool was an attempt to combat noncompetitive practices by grain elevator companies. This is tested using the number of elevator firms at the local shipping point as a measure of competitiveness. This hypothesis was not supported by the evidence, supporting instead historical assessments that farmer cooperative grain companies preceding the Pool had provided effective competition to the private grain trade. Other motivations for individual farmer choice to join the Pool are also explored. It is found that farmers who expect to harvest early, because of climate or access to temporary labour, were less likely to join the Pool. Appendix A develops a formal model of grain mixing and grading, with implications for the public regulation of grades. Appendix B develops a method for correcting heteroscedasticity in ordinary least squares logit when the dependent variable is not made up of independent trials. Appendix D provides unique reconciled lists of the names and locations of shipping points in Saskatchewan, and the borders of Wheat Pool districts, and associated data.

* An earlier version of this paper was presented to the *Fifteenth Conference on the Use of Quantitative Methods in Canadian Economic History*, McMaster University, March 20-21, 1987.

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KEY TO VARIABLES

These variables are referred to in this paper. Appendix D elaborates on definitions, methods of calculation, and data sources.

CAV25	=	The average number of competing elevator firms per shipping point within a Pool Subdistrict, weighted by elevator capacity at each point.
DGDAY	=	Mean degree days above 42 degrees Fahrenheit from May 1 to Sept 30 for years 1921 to 1950.
FITX	=	The fitted values for Pool sign-up rates produced by the model (regressing LSRA5 against DGDAY, LAT, POPSQ, and PNML2).
HD1	=	Harvest date. Mean day of "first swathing" by crop district averaged from 1952 to 1968.
HPRMAP	=	A dummy variable indicating the Subdistrict has wheat of the highest protein class.
LAT	=	Median latitude of Pool Subdistrict.
LSRA5	=	The proportion of acreage "in wheat" signed by the Pool, transformed for logit by ordinary least squares.
PNMLN	=	A measure of relative quality of wheat through price differences which are not accounted for by harvest date or protein. It is the residual of a regression of mean price per bushel for 1920, 1925, and 1930 against (DGDAY, LAT, POPSQ, and HPRMAP)
PNMLN2	=	A measure of relative quality of wheat through price differences which are not accounted for by harvest date (but not protein). It is the residual of a regression of normalized mean price per bushel for 1920, 1925, and 1930 against (DGDAY, LAT, and POPSQ)
POPD6	=	A relative measure of rural population density.
POPSQ	=	The square of POPD6.
RMCI VALI	=	A measure of the capital intensity of the farm. The dollar value of improvements per improved acre.

**GRAIN MIXING AND GRADING
ECONOMIC MOTIVATIONS FOR THE CANADIAN WHEAT POOL
OF 1923/24;
TESTING HYPOTHESES USING LOGIT**

This paper examines the economic motivations for the formation of the Canadian Wheat Pool in the 1920's.¹ The Wheat Pool was a cooperative effort by farmers to market their wheat independently of the private grain trade and of prices determined in the Winnipeg futures market. The Pool may be regarded as the apex of the farmer cooperative movement during this period. Members of the Pool bound themselves to deliver their grain to their provincial pool organization for a contract period of five years, and to accept a price based on the average or "pool" price realized on the sale of grain that year (for the farmers' particular grade of wheat). At its height, the Pool handled the marketing and export of approximately half Canada's wheat crop.

The economic motivations for the Pool's formation are of interest both from a historical perspective, and from an economic perspective. From a historical perspective, the

¹ The name Canadian Wheat Pool, or "the Pools" were the names of common usage at that time, and in the literature documenting this period. The Pool was actually comprised of three provincial organizations and a 'Central Selling Agency'. Their legal names were "The Alberta Co-operative Wheat Producers Ltd.", "The Saskatchewan Co-operative Wheat Producers Ltd.", and the "The Manitoba Wheat Producers Ltd.". The legal name of the Central Selling Agency was the "Canadian Co-operative Wheat Producers Ltd.". Each of the provincial organizations had its own Pool contract with farmers. The Central Selling Agency was a subsidiary jointly owned by the three Provincial Pools. MacGibbon (1932) documents the name "Canadian Wheat Pool" and follows the convention of using the name for the collective identity of the wheat pool organizations. (pg. 329).

farmers' cooperative movement was a significant event in the political history of Canada that influenced many subsequent developments. From an economic perspective, we may ask whether there were valid motivations for farmers to want alternatives to private markets in handling of their grain. The Wheat Pool has been viewed as a private attempt by farmers to establish a Wheat Board that would regulate prices and grades.² An understanding of the origins of the Pool may shed light on the policy rationale for a Wheat Board and on the workings of the alternative: the private market.

1 ORGANIZATION OF PAPER

There are twelve sections. Following the introduction, Section Two begins with historical background, describing the previous history of the farmers' cooperative movement and the market conditions of the grain trade at the time the Wheat Pools were formed. Section Three examines traditional explanations and finds them unsatisfactory given that other successful farmer cooperative vehicles already existed. Other possible explanations are then posed. In Section Four, the hypothesis is offered that the Pool was, in part, an attempt to bypass an industry whose competitive practices degraded the quality of wheat and reduced the value of the Canadian crop on the world market. Mixing of grain of different grades is explored as a possible example of industry practices motivating the Pool's formation. Sections Five to Nine develop a model to test hypotheses concerning

² Wilson (1978), pg. 211.

the Pools formation using a model of individual farmer choice to join or not join the Pool. Section Ten tests the grain quality hypothesis by linking it to the hypothesis that individual farmers with higher quality wheat would be more likely to join the Pool. Section Eleven tests the hypothesis that lack of competition at the shipping points was a motivation for the Pool. Section Twelve summarizes results.

2 HISTORICAL BACKGROUND

The development of farmer cooperation in western Canada has been well documented by other authors, and will be reviewed only briefly here.³

2.1 Events preceding the Pool

In the late 19th and early 20th centuries Canadian prairie farmers faced difficult conditions in marketing their wheat. After harvest the typical farmer hauled his wheat to a local country shipping point and sold it to a grain elevator company.⁴ It was alleged that the grain elevator companies often acted as a cartel. Barriers to entry were provided

³ Notably Mackintosh (1924), and Patton (1928).

⁴A grain elevator stores grain and elevates it to a height above a railway car so that the grain may be conveniently poured in.

by the railways who owned the land by the railway tracks and offered monopolies as incentive for the early establishment of grain elevators.⁵ At the turn of the century "The farmer was acutely aware of the fact that, because of the agreement between railway and elevator companies, he had no alternative but to ship his grain through, or sell his crop to the latter, who had come to form a more or less complete combine."⁶

Farmers could avoid the elevator firms if they obtained a railway car and filled it themselves, with the assistance of a loading platform. However, the railways faced a shortage of rolling stock during the harvest season and allocated cars preferentially to the elevators, who could fill cars more rapidly. In addition "In a country where a 'hired man' was a luxury, direct loading was uneconomical, and only the operator of a large farm could fill a car."⁷ Much of the crop was therefore marketed to the elevator companies as "street wheat", wheat in less than carload lots. (The term "street wheat" is in contrast to wheat "on track", that is, wheat loaded into a railway car by farmers or a local elevator and consigned to a commission agent or buyer.)

⁵ "With a view to relieving the acute seasonal strain on its limited rolling stock, the C.P.R. made it known that to any individual or company erecting at any shipping point a 'standard' elevator of not less than 25,000 bushel capacity equipped with steam or gasoline engine and cleaning machinery, special concessions would be extended in the form of a free lease of site on the railway's property, and of an agreement not to allow cars to be loaded through flat warehouses, or direct from farmers' wagons, or otherwise than through such elevators." Patton (1928), Pg. 14.

⁶ Patton (1928), Pg. 17.

⁷ Mackintosh (1924), pg. 17.

To meet this problem farmers turned to cooperative efforts in marketing their grain. At the political level, farmer pressure led to the Manitoba Grain Act of 1900. The Act set regulations for the grain trade, requiring the railways to construct loading platforms within their station yards on petition of ten farmers, and to allocate cars to all applicants.⁸ Subsequent amendments and court cases expanded the legislation and its application.

While legislation improved the farmer position, farmers were still left contending with a limited ability to load their own wheat and subject to the prices and grades offered by the elevator companies on street wheat. Farmer suspicion of the elevator firms was reinforced by the practices of the North-west Grain Dealers Association. This association was established in 1901 by the large elevator firms. According to its members, its purpose was to save telegraph costs. At shipping points where more than one firm had an elevator, the local operators received one joint telegram from the Association setting the day's prices on each grade of wheat.⁹ Farmers arriving at a shipping point would be met with a single posted price list. Ownership of country elevators was fairly concentrated. The Royal Commission on the Shipment and Transportation of Grain (1900) reported that of 447 country elevators in the Manitoba inspection district, 301 were controlled by five firms.¹⁰ The case for the North-west Grain Dealers Association acting as a combine was never proven. However, instances of revenue pooling by some elevator

⁸ Mackintosh (1924), Pg. 12.

⁹ Wilson (1978), pg. 47.

¹⁰ Cited in Wilson (1978), pg. 15.

firms were uncovered, the object according to one participant "to sustain our margin to 3 cents a bushel over price paid."¹¹

Farmer cooperative efforts led to the establishment of farmer grain companies designed to compete with the "line" elevator companies.¹² Three successful companies were the Grain Growers Grain Company (incorporated in Manitoba), the Saskatchewan Cooperative Elevator Company, and the Alberta Co-operative Elevator Company. The Grain Growers Company was the first major farmer owned agent. It acted as a private company, but its charter limited voting rights to one farmer, one vote, whatever the number of shares. Following the success of the Grain Growers Company, Saskatchewan and Manitoba created provincial cooperative elevator companies to establish a farmer owned network of grain elevators to receive and market grain. The Saskatchewan Cooperative Elevator Company was typical. It limited shares to 20 per farmer and limited dividends to 6% of capital. In 1916, the Grain Growers Company and the Alberta Cooperative amalgamated as the United Grain Growers Company (UGG), a federal corporation.¹³

¹¹ Testimony cited in Mackintosh (1924), pg. 29.

¹² The term "line" elevator refers to the large firms who owned many country elevators.

¹³ Patton (1928), Chapters 8, 9, 11.

The farmer grain companies grew to a substantial size, competing at 45% of country shipping points¹⁴ and handling more than one third of the crop in 1916 and 1917.¹⁵ They were also profitable, even after accounting for government financial assistance.¹⁶ Their operations extended to all levels of the grain trade, including country elevators, commission houses, terminal elevators, and export sales.¹⁷

The competition they provided appeared to remedy some of the farmers' complaints. Mackintosh (1924) comments, "Some figures could be cited to show that the spread between track and street prices, always a cause of complaint, has been gradually reduced. It seems probable that the competition of farmers' companies has contributed to that result but better transportation facilities and the general development of the grain trade have also played a part."¹⁸ He goes on to give specific examples of aggressive competitive practices of the farmers' companies. He also cites the leadership of farmers' companies in expanding services to farmers. Patton (1928) comments " . . . their extended and centralized competition had been effective to a very large degree, in improving marketing

¹⁴ Patton (1928), pg. 189.

¹⁵ Mackintosh (1924) pg. 85.

¹⁶ Mackintosh (1924), pgs. 73-75.

¹⁷ Mackintosh (1924) pg. 73.

¹⁸ Pg. 77.

services, in lessening discriminations, and increasing marketing returns to growers generally."¹⁹

2.2 The Wheat Board Movement and the Pool

The success of the farmers' companies lends interest to the question addressed by this paper. If markets for grain had been made reasonably competitive by the previously established farmers' companies, why did farmers feel the need to establish the Pool? This section will examine the historical sequence of events and the public reasons given by farmers for the establishment of the Pool. Subsequent sections will question the completeness of these explanations.

A complaint of western grain farmers was that the seasonal variation in wheat prices, produced unduly low prices for grain at harvest time. During each fall, as the harvest progressed, wheat prices would tend to decline. This was caused, at least in part, by the transport problems exporting the crop. The cheapest method of transport to foreign markets was by water, particularly from the head of the lakes at Fort William and Port Arthur to Buffalo, and hence by rail to U.S. ports.²⁰ Other principal routes, including

¹⁹ Pg. 189.

²⁰ Snodgrass (1926), pg. 180. Snodgrass (1926) analyzes the seasonal variation in transport costs and their relationship to wheat prices in some detail.

those leading to Montreal, Quebec, or St. John, also involved lake transport.²¹ Lake transport was available only seasonally, concentrated between April and December, due to the close of navigation during the winter months.²² Since the volume of the Canadian crop exceeded the ability to export all before the close of navigation, grain that was harvested late incurred either a higher all-rail transport cost to the sea, or a storage cost until spring. Demands placed on transport because of this deadline also caused the price of lake transport to rise before the close of navigation. Rising transport costs and anticipated storage costs contributed to the seasonal decline in grain prices as the harvest progressed.

From the perspective of the Canadian farmer, the seasonal drop in prices meant that grain prices dropped just at the point when many farmers were selling it, and rose again when the farmer was out of the market. This seemed odd given that consumers seemed to pay a consistent year-round price for bread. A popular remedy for this phenomenon was "orderly marketing", a phrase that became a slogan for Pool organizing campaigns.

The hypothesis of "orderly marketing" was that the current system dumped a disproportionate amount of grain on the market at harvest time, depressing its price temporarily. The visible manifestation of this process was the hedging activities by grain companies on the Winnipeg Grain Exchange. To protect themselves from price variation.

²¹ Ibid.

²² Ibid.

the grain companies would sell futures in grain as they bought grain at country points, thus "dumping" grain on the market as the harvest progressed. This process was visible to the farmer since the daily quotes on the Winnipeg Exchange were the basis for posted prices at the shipping points. The orderly marketing argument was also shaded with the suspicion of outright market manipulation of prices on the Winnipeg Exchange. Patton (1924) comments "During the pool sign-up campaigns, few claims were more frequently made than that prices were invariably depressed through the dumping of grain during the fall months, and that under a pooling system sales could be more evenly distributed throughout the year. In its more naive statement, the principle of 'orderly marketing' was represented as the selling of approximately uniform quantities each month . . ."²³

Western grain farmers had had direct experience with an alternative "pool" system during the compulsory Wheat Board in force after the First World War. During the crop years of 1917 and 1918, the selling of futures on the Winnipeg Exchange was suspended, and grain prices were subject to the control of the federally appointed Board of Grain Supervisors.²⁴ With immediate postwar markets still unstable, the crop of 1919 was also marketed under federal supervision, through the establishment of the Canadian Wheat Board. The payment scheme of the Canadian Wheat Board provided a precedent for the Pool. Unlike the previous Board of Grain Commissioners, the Board purchased the Canadian crop from farmers, using the existing grain trade as its agents. An initial payment of \$2.15 per bushel (basis wheat graded No. 1 Northern, in store, Fort William)

²³ Pg. 267.

²⁴ See for example Wilson (1978), Chapter 5.

was given to farmers, along with a "participation certificate". The participation certificate entitled the farmer to a share of additional revenue should the Board dispose of the crop at a higher average price.²⁵ As a result, farmers were paid an average or "pooled" price for the sale of wheat that year. Initially, many farmers expected the participation certificates to be of little value and sold them at low prices.²⁶ In the end they proved to be of significant worth, returning 48 cents per bushel in addition to the initial payment of \$2.15.

Farmers had several reasons for satisfaction out of the Wheat Board experience. The healthy postwar market had yielded \$2.63 per bushel, a good price historically. Before the war, the cash price of No. 1 Northern had ranged between \$.80 and \$1.20. During the war, price had been fixed by the Board of Grain Supervisors at less than \$2.²⁷40. Thus \$2.63 was a good price. The Wheat Board was established to handle the 1919 crop only, and prices fell significantly following its end in August 1920. Price fell from \$2.78½ per bushel in Sept. to \$2.32 in Oct., \$2.05 in Nov., \$1.93½ in Dec. and \$1.76½ in April 1921.²⁸ Besides being high, the "pooled" price had also avoided the seasonal variation

²⁵ Patton (1928), pg. 196.

²⁶ Wilson (1978), pg. 162.

²⁷ Wilson (1978), pg. 182.

²⁸ Average monthly cash price of No. 1 Northern on the Winnipeg Exchange. Dominion Bureau of Statistics. Cited in Patton (1928), pg. 199.

in prices usually experienced in the fall. In addition, the Board had also maintained fixed price spreads between street and track wheat, at historically narrow levels.²⁹

In the subsequent years farmers and their organizations sought the reestablishment³⁰ of the Wheat Board. A memorandum forwarded by them to the federal government included this passage:³¹

"The Wheat Board is necessary because it would mean a more orderly marketing of the wheat crop, thus enabling Canada to meet the changed conditions of the consuming foreign markets and of the domestic market as well. We need the machinery that will make possible a twelve-month system of marketing our wheat production instead of a three or four-month system as is now under existing conditions. Immediately after the Canadian harvest almost every financial institute and collecting agent is employed to force the farmer to market his wheat. Accordingly . . . the bulk of farmers' wheat is thrown on the market between September and the close of navigation on the Great Lakes early in December. With the uncertainty of export demand from abroad, and the well-directed operations of the representatives of foreign buyers on our exchange, the period of heavy receipts of farmers' wheat in the autumn months is bound to be characterized by needless declines in prices and consequent losses to the farmer and the numerous interests dependent upon him."

²⁹ Patton (1928), pg. 196.

³⁰ Patton (1928), pg. 199.

³¹ Canadian Council of Agriculture, *Memorandum to the Dominion Government regarding the reestablishment of the Canadian Wheat Board*, March 15, 1922. Cited in Wilson (1978), pg. 174.

Efforts to reestablish the Wheat Board succeeded in having enabling federal legislation passed, but foundered on opposition within the Manitoba legislature to provide necessary complementary legislation.³²

Having failed to reestablish the Wheat Board, farmers then turned to cooperative means to establish voluntary wheat pools. For example, Crerar, leader of the farmers' National Progressive Party, commented at the beginning of 1923 that "nothing could be done by government boards which could not be achieved by co-operation."³³

Thus, 1923 saw the beginning of the campaign to establish the Wheat Pool. The campaign took the form of a drive to sign farmers to a Pool contract. Under the contract, the grower agreed to deliver all his or her wheat to the Pool for five years, and receive an average price for the season for that grade of wheat, subject to the usual adjustments of dockage for impurities, etc. For example, in the Alberta contract the grower undertook to "consign and deliver to the Association or its order at the time and place designated by the Association all of the wheat and the warehouse or storage receipts covering it produced or acquired by or for him in the Province of Alberta, except registered seed wheat, during the years 1923, 1924, 1925, 1926 and 1927."³⁴

³² Patton (1928), pg. 208.

³³ Cited in Wilson (1978) pg. 211.

³⁴ Section 4 of grower's contract, Alberta Co-operative Wheat Producers Ltd. Full text is provided in Patton (1928), Appendix E.

The Pool undertook to make an advance payment "at such rate per bushel according to grade, quality, and place of delivery as, in the discretion of the Association it shall deem proper" and to pay in addition "his proportion of the proceeds of wheat of like variety and grade sold by the Association in each season . . . less all handling and other proper charges . . .".³⁵

Thus the payment system was similar to the previous Wheat Board arrangement, with an advance payment and further participation payments. In practice, further payments would be made in several stages rather than a single additional payment at the close of the crop year.

To ensure that the Pool did not proceed without sufficient volume of participation to support it, the contract was not compulsory unless 50% of the acreage "in wheat" of the respective province had been signed to the contract.³⁶

The Alberta Pool was the first to get underway, bringing contracts into force on October 29, 1923, well into the harvest. Despite its late start, it handled 26% of the 1923 crop from Alberta.³⁷ Saskatchewan and Manitoba Pools were underway for the 1924 crop with similar contracts. The three pools established a common Central Sales Agency, the

³⁵ Ibid. Section 12.

³⁶ Ibid. Section 2.

³⁷ Patton (1928), pg. 218.

Canadian Cooperative Wheat Producers Ltd.³⁸ Other subsidiaries for insurance, terminal operations, other grains etc. followed over the course of the Pools' development. These organizations were, collectively, known as the Wheat Pool.

The Pool operated successfully through two contract periods until the crop year of 1929. From 1925/26 to 1929/30 they handled between 51% and 53% of Canada's wheat crop.³⁹ The principle of orderly marketing called for the farmers' agent to manage the grain from the local elevator to sale to the final user, bypassing the futures market and the grain trade. To this end, the Pools engaged in building a vertically integrated structure, beginning with the operation of their own country elevators and moving up through terminal and storage facilities and direct selling to foreign buyers through their central selling agency. MacGibbon (1932) lists the assets controlled by the Pool as including 1,655 elevators at local shipping points, with terminal elevators totalling 35 million bushels capacity located in Port Arthur, Fort William, St. Boniface (across from Winnipeg), Vancouver, Victoria, and Buffalo.⁴⁰ The Central Selling Agency maintained sales offices and agents in Europe. The concept of orderly marketing found its expression in the policy of "direct selling". For example, 80% of Canadian wheat shipped to France

³⁸ Patton (1928) pg. 221.

³⁹ Canadian Wheat Pool Year Book, 1930. From table cited in Wilson (1978), pg. 225.

⁴⁰ Pgs 344-345.

in 1925-26 was purchased directly from the Pool.⁴¹ The Pool established or arranged for 28 agencies in fifteen importing countries.⁴²

The end of the Pool experiment came as a result of too high an initial payment for the crop of 1929, followed by a decline in grain prices through 1929 and 1930. In the August of 1929 the Pool set an initial payment of \$1.00 per bushel for the 1929 crop. At this time the comparable Fort William price was \$1.56 and seven eighths.⁴³ There still existed large stocks of unsold wheat from the 1928 crop held by both the Pool and the rest of the trade. The Pools' stocks were largely unhedged in the futures market as a result of its policies of direct selling to final users. At the same time, sales of Canadian wheat had slowed due to a large Argentine crop.⁴⁴ Prices subsequently declined. In January 1930, prices were in danger of falling below the \$1.15 per bushel required by the banks to maintain margins for Pool financing. The Pool survived the crisis with the assistance of debt guarantees by the three provincial governments.⁴⁵ This crisis left the Pool in weakened financial condition, and still holding significant stocks of grain before the 1930 crop. Further price declines in 1930 brought the price of wheat down to 65 cents by November 1930, a significant blow given the unsold portion of the 1929 crop

⁴¹ Patton (1928) pg. 272.

⁴² Patton (1928) pg. 273, citing Canadian Cooperative Wheat Producers Department of Publicity.

⁴³ MacGibbon (1932), pg. 353.

⁴⁴ Wilson (1978), pg. 265.

⁴⁵ Wilson (1978) pgs. 266-267.

for which an advance of \$1.00 had been paid. This put additional financial pressures on the Pool, ultimately requiring federal intervention and debt guarantees. By 1931, control of the Central Selling Agency was effectively in federal hands, and the policy of direct selling to the final users was ended. The Central Selling Agency remained as an instrument of federal price stabilization activities in the futures markets, and ultimately formed the basis of the later Canadian Wheat Board. Individual provincial Pools survived with losses. The losses were converted into interest bearing bonds placed with the government, who in turn assumed the Pools' debt to the banks. The provincial pools continued operation, but on a hedged basis, selling futures as they bought grain in the same manner as private elevator companies, bringing the Pool experiment to an end.⁴⁶

2.3 Conditions for the Sale of Grain

Before turning to analysis of reasons for the Pool's formation, it is useful to review conditions for sale of grain faced by farmers at that time. A farmer with grain to sell faced the following alternatives under the regime established by the Canada Grain Act.⁴⁷

- **Sell to the elevator operator based upon agreed grade and "dockage".**

Dockage refers to the percent of cracked grain, dirt, weed^d seeds, or other

⁴⁶ Wilson (1978), chapter 14.

⁴⁷ MacGibbon (1932), Chapter 5.

foreign matter and cracked grain that must be cleaned from the grain to meet standard grade requirements.

- **Accept a storage receipt based upon agreed grade and dockage.** The storage receipt could then be sold or redeemed for wheat of the same grade at a later date. This approach had the disadvantage of not preserving the identity of the wheat. Wheat within a grade varied within a range of quality. It is possible that the wheat returned in answer to the storage ticket would be closer to the bottom of the grade than the wheat that was sold.
- **Accept a storage receipt subject to inspector's grade and dockage.** The Canada Grain Act entitled the farmer to require a sample be forwarded to a government inspector for grading. It would also be possible to the sell to the elevator operator based upon inspector's grade and dockage, if the elevator agent were willing.
- **Special Bin.** At the elevator agent's option, the farmer might have his or her grain put in a special bin, so that the identity of the grain was preserved. The storage ticket for this grain might then be sold, or redeemed later for loading into a car and sale through commission agent.

Special binning was a special service of elevators and required carload lots of grain.

- **Obtain and load own car.** Difficulties involved in this have been noted above.

Although the prices of grades tended to be fixed by posted daily prices from the Winnipeg Exchange, the provision for dockage allowed substantial room for both bargaining and exploitation. MacGibbon (1932) comments: "where a number of agents are in keen competition with each other for grain, the agent may deliberately overgrade in order to hold the business. In other instances, he may offer the producer an alternative. He may offer to give him No. 1 Northern with a dockage allowance of three or four percent, or No. 2. with a dockage of 1%."⁴⁸ MacGibbon reports that it was a typical practice of country elevator agents to overgrade. As evidence he cites a table drawn from the Royal Grain Inquiry Commission of 1924, comparing total receipts and total shipments of country elevators by grade. The three highest grades show lower shipments than receipts from farmers, and the three lowest grades show the opposite.⁴⁹

⁴⁸ Pg. 96.

⁴⁹ Ibid.

3 ANALYSIS OF REASONS FOR THE POOL'S FORMATION

In historical sequence, the Pool's formation arose from the failure to obtain the reestablishment of the Canadian Wheat Board. The experience with the 1919 Wheat Board also undoubtedly opened the door for the establishment of a voluntary Pool, by providing farmers with a practical demonstration. The question we wish to examine is farmers' underlying motivations for wanting a Pool. Given the success of the existing farmers' companies in rendering markets competitive, why the need for a Wheat Pool?

This section examines potential explanations for the Pool. Its objective is to identify economic benefits that the farmer might have good reason to expect from the Pool. This may be contrasted with the possibility that farmers established the Pool based on mistaken ideas about the grain trade. While the latter is possible, an explanation based on reasonably anticipated economic benefits would be more credible.

3.1 Orderly Marketing

The Pool's organizing campaign used "orderly marketing" as a principal theme. Bypassing the price setting mechanism of the futures market and selling directly to the consumer was to free the farmer from unreasonably depressed prices during the harvest.

The orderly marketing proposition fails to satisfy. In order to offer an economic benefit, the seasonal depression in prices would have to be more than was justified by the cost of storage and transportation brought about by the closure of great lakes navigation in December. If the Winnipeg futures market was competitive, and capital markets sufficiently liquid to provide risk-neutral speculative funds, then prices would have fairly reflected these real costs, and a Wheat Pool would have had to pay them whether or not it made use of the futures market.

Therefore, in order for orderly marketing to offer an economic benefit, two conditions must be met. The first is that Winnipeg futures prices must have been manipulated or inefficient such that they did not reflect costs of storage and transport. Given this, it should also be shown that the existing farmers' organizations were insufficient to correct the situation, and that going to the expense of establishing a new vertically integrated organization was worthwhile.

There is some doubt whether Winnipeg futures prices systematically deviated from storage and transport costs. Two papers of interest examining the subject are Working (1937) and Snodgrass (1926). Working examines the harvest price depression of wheat on the Winnipeg market and compares it to that of Liverpool, England, an export market for Canadian wheat. His analysis of average prices over 15 years shows a marked decline of the spread between Liverpool and Winnipeg prices during the Canadian harvest.⁵⁰

⁵⁰ Working (1937), Chart 2, pg. 41.

Citing the earlier work by Snodgrass, Working comments that the seasonal variation in the spread "doubtless reflects chiefly the seasonal variation in shipment costs."⁵¹ To examine whether "hedging pressure" was a cause of the seasonal price decline, Working calculates the correlation between seasonal price decline and the rate of country deliveries.⁵² Since elevator companies other than the pool hedged their purchases daily on the futures market, the volume of country deliveries represents "hedging pressure" on the futures market. If seasonal price declines are caused by hedging pressure, he expects prices to decline during the period of heavy deliveries and recover as country deliveries tail off. He finds that prices do indeed decline with the increase in the rate of country deliveries, but do not decrease as deliveries tail off.⁵³ He also notes that this pattern was unaffected during the years of Pool operation. The Pool influence seemed "to have failed to produce effects which were clearly expected."⁵⁴ Working does find some evidence of a hedging pressure effect in the years 1933 to 1936, he finds "the degree of influence small".⁵⁵ However, he concludes "as regards the absorption of hedging pressure; the Winnipeg futures market, operating without restraint, seems to have

⁵¹ Pg. 42.

⁵² It is not clear what Working means by his analysis of "hedging pressure". The implication appears to be that the supply of speculative capital is limited at any given moment, resulting in a risk premium to holding futures when the sale of futures is at a peak.

⁵³ Pg. 53 to 54.

⁵⁴ Pg. 63.

⁵⁵ Pg. 61.

worked very well."⁵⁶ We may note the observed pattern of prices not rising following the decline of country deliveries more closely fits the pattern expected from an explanation based on transportation and storage costs. Snodgrass (1926) makes a closer examination of price spreads between Canada and Liverpool and shipment costs. She examines rail, lake shipping, and ocean rates for the principal routes. She concludes "So far as may be judged from the erratic figures, however, the average spread tends to equal costs of shipment during August and until the new crop reaches the Winnipeg Market, when Winnipeg prices shift to the new crop basis and Liverpool remains for a time on the old crop basis, resulting in a wider spread".⁵⁷

If we disregard this evidence and grant that harvest prices were systematically and unduly depressed, we still face the question whether the Pool was an appropriate instrument to deal with the problem. As previously noted, the farmers' existing grain elevator companies were major players in the grain trade and active traders on the futures market. Significant and systematic depression of prices at harvest would create an opportunity for speculative profit by the farmers companies, who could have bought low, or hedged losses, during the harvest and sold at a higher price later. Profits from this enterprise could have financed further expansion in the volume of the activity, providing the competitive antidote usually expected from inappropriately depressed prices. Thus, the cure for

⁵⁶ Pg. 65.

⁵⁷ Pg. 191.

depressed harvest prices was within the power of existing farmer companies and did not require a new vertically integrated organization.

We may conclude that "orderly marketing" does not provide a complete explanation for the establishment of the Pools. There lacks evidence of unduly depressed harvest prices, and the existing farmer companies had it within their power to correct such matters if the problem had existed.

3.2 Pooling the risk of harvest date

A principal feature of the Pool contract was to pay an average price for the season. Pool farmers would receive the same price for grain of the same grade, regardless of the day of delivery within the season. Late harvesters would benefit from this arrangement, since the average price would be above the low prices experienced late in the season. Early harvesters would experience a penalty. One effect of the Pool contract was to cross insure Pool members against harvesting late and experiencing a poor price because of the seasonal depression in prices.

Was this insurance effect a credible motivation for the formation of the Pool?

Harvest date is, in part, a matter of uncertainty due to variations in the weather, and the hazards of farm operation. Expected harvest date, however, varies systematically between farms depending on the local conditions of land and climate. In a pool, there would be a mix of high and low risks, with the low risk persons implicitly subsidizing the high risk people. Farmers who tend to harvest late in the season due to conditions of their land or climate, would be more likely to benefit from receiving a "pool" price. Farmers who tend to harvest early in the season would be less likely to benefit. To be successful, the increase in security of income offered by such a pool would have to be high enough to persuade enough low risk harvesters to join. If it is not, then a Pool proposition faces a danger of collapse through "adverse selection", a potential problem in insurance markets. As fewer early harvesters join, the pooled price among the remaining potential members declines because their average harvest date is later. The fall in expected pool price can cause the relatively early harvesters still in the pool to drop out, further lowering the pool price of the remainder. In the extreme case, everyone opts out of the insurance contract. Viewed from this perspective, the requirement of the Pool contract that the Pool sign-up 50% of the wheat acreage in the province may have been more than an exercise in democracy. It may have ensured that adverse selection would not cause collapse of the pool organizing effort by guaranteeing that sufficient participation would exist for a reasonable pool price if the contract came into force.

While the insurance aspect of pooling is a valid potential motivation for farmers wanting a pool contract, it is less than a satisfactory explanation of why a separate vertically

integrated organization was found necessary. A contract to pool prices received on deliveries could have been offered by the existing farmer owned elevator companies, or by the private trade.

While it may be possible to construct some agency cost argument to suggest that the Pool was a preferable organization to a profit-maximizing agent, there would remain the question of why the Pool took the particular form it did. Central to the idea of "orderly marketing" was vertical integration and direct selling to customers. The Pool's avowed purpose was to bypass the futures market and all intermediate agents to market grain directly to millers and consumers, especially overseas. This has no apparent connection to the insurance effect of the Pool contract.

3.3 A logical step in the evolution of cooperation

It might also be suggested the Pool was the obvious next step in farmer cooperation. Historically, the Pool emerged out of a great deal of discussion within the farmers' cooperative movement. Catalytic events were the 1923 and 1924 speaking tours by Mr. Aaron Sapiro, an American proponent of co-operation and a very effective orator. Mr. Sapiro's effectiveness as a speaker combined with existing farmer dissatisfaction to produce a broad-based movement among farmers to establish the Pool.⁵⁸

⁵⁸MacPherson (1979), pages 73 to 74.

Patton advances the idea that the farmers found their elevator companies too businesslike and lacking in cooperative spirit:

"...The very facility and success with which the latter (the United Grain Growers and the Sask. Coop.) had adapted their operations to the competitive conditions of the grain trade were regarded by some as a compromise of growers' interests and of true cooperative principles with the profit-seeking incentive and the corporation outlook."

Patton, Pg. 191.

As noted previously, the United Grain Growers and the Saskatchewan Cooperative Elevator Company were organized on a share capital basis. Profits were distributed through dividends, whether or not the farmer made use of his or her own company. Patton notes that when the private elevator firms, "reconciling themselves to the participation of farmers' companies, offered inducements to growers at competing points, in the form of higher street prices, better grades, or extra services, not a few farmer shareholders, being bound to their organization neither by contracts nor by the expectation of patronage dividends, were disposed to deliver their grain to whichever agency offered the greatest direct advantage".⁵⁹

⁵⁹ Patton (1928), pg. 191.

By shifting to payment of benefits on the basis of patronage (bushels of wheat marketed through the organization) it might be suggested that the organization would be motivated by maximization of benefits to the user members, rather than profit. This would be a purer form of "cooperation" than the farmers' share capital based companies.

Cooperative principles alone do not provide a satisfactory motivation for the Pool. The value of cooperation is usually found in the benefits to those cooperating, rather than for its own sake. While the Pool definitely met cooperative principles by being organized on a patronage basis instead of share capital, this does not show what benefits it offered to farmers over private competitive markets, or why the development of farmer cooperation took this particular course.

The question remains: What advantage did the Pool offer that uniquely required the establishment of a vertically integrated organization selling directly to millers and consumers?

4 GRAIN MIXING AND GRADING AS A MOTIVATION FOR THE POOL

This paper offers the hypothesis that the Pool was, at least in part, an attempt to bypass an industry whose competitive practices degraded the quality of wheat and reduced the value of the Canadian crop on the world market.

Economies of bulk transport, and the desire by millers to have secure sources of supply, led the industry to sell most wheat before its arrival in Europe or other markets. Wheat that arrived on the continent on an unsold basis was "distressed" and usually had to be disposed of at a discount.⁶⁰ The grading system served as a basis for advance contracting of a particular grade or quality of wheat. As a result, wheat was typically sold in advance of actual inspection by the buyer, opening the way to potential abuse by intermediate agents subject to the limitations and effectiveness of the inspection and grading system.

For example, a particular industry practice that reduced the quality of wheat marketed, and earned the ire of farmers, was that of "mixing". Mixing involves the mixing of high quality wheat with lower quality wheat, and having the result graded again by government inspectors. As discussed further below, this practice leads to the marketing of a lower quality of grain within a given grade of wheat, which may lower farm incomes under some circumstances. Remedying this may have been one motivation for formation of the Pool. To examine this hypothesis, it is useful to review the relationship between grading systems, the practice of mixing, and the quality of grain.

⁶⁰ See for example Wilson (1978), pg. 265.

4.1 The function of grades

A grading system establishes a set of discrete minimum standards which grain must meet to be certified as a given grade. Grades simplify bulk handling of grain over distances and time. With a minimum quality assured, grain may be traded without the presence of the actual product. A paper claim on No. 1 Northern wheat may be sold by objective description, rather than inspection of a specific lot of wheat. The claim may be presented to the storage place and any bushel of No. 1 will settle the claim. This allows grain to be shipped in bulk. Since grain originates in small quantities from many separate farms, each delivery of varying quality, it would be difficult to assemble bulk shipments of fixed quality without first sorting the deliveries from farms into standardized grades. Once the grain marketing system has sorted grain into grades, any quantity of No. 1 may be mixed into a ship's hold and the quality of the shipment will still be known, within the limits permitted by the grade. Millers may buy the quantity they need, and contract in advance for delivery of a specific grade of grain. The conversion of grain into a homogeneous product allows the specification of futures contracts, which enable grain dealers to insure their stocks of grain against fluctuating grain prices.

If it were not for the economies of scale in bulk handling and trading, there would be little need for a system of discrete grades of grain. Grading and inspection might still exist for reasons of information and minimizing agency costs, but descriptions could be specific to each lot of wheat, with precise quantitative descriptions. It can be shown that

if these economies of scale are absent, and if there are no other technical economies or market imperfections, the welfare maximizing solution is to sell each lot of grain according to its individual quality.⁶¹

4.2 Grading creates incentives to "mix" grain.

The practice of mixing is the combining of two different grades of grain, and having the result graded again by government inspectors. Note that forbidding "mixing" does not eliminate the physical process, since bulk handling and transport mean that grain from different farmers will still be mixed. When mixing is forbidden, wheat of a given grade is mixed only with wheat of the same grade.

Once standards for grades become established, there is an incentive to dilute the quality of wheat so that it just meets the minimum standard for a grade. If one has a contract to deliver No. 1 Northern, then one is obligated to deliver only the minimum quality required by that grade. If a seller possesses quality higher than the minimum, he or she purchases cheaper grain and mixes it in, so that the average quality just meets the standard. Through this practice, the seller ends with more bushels of high grade grain, and fewer bushels of lower grade grain.

⁶¹ See Appendix A.

This practice may be anticipated by the buyer from the terms of the contract. The price the buyer and seller agree upon incorporates their mutual expectation that the quality will be at the grade minimum.

If mixing were forbidden, then grain of a given grade may not be mixed with grain of another grade. The expected quality of a given grade is then the average quality within the grade, rather than the minimum acceptable defined by the regulations. As a result, mixing has two effects on a grading system: It

- reduces the price of each grade on the international market by reducing the average quality of each grade; and
- increases the proportion of the crop sold as the higher grades.

These two effects have opposite impacts on total revenue to the crop. Appendix A, discussed further below, develops a formal model of grain mixing and grading to establish the impact of mixing. The net impact on revenue will depend on the responsiveness of demand price to quality, the frequency distribution of available wheat stocks over quality, and where grade minimums are set.

Mixing also improves one function of the grading system since it makes the observed quality of each grade more homogeneous. After mixing there will be less quality

variation within grades.⁶² Problems will arise when mixing is illegal. Then there will be some random variation of quality within the grade. Taking advantage of this, some companies will indulge in mixing, since its results will not be distinguishable from the random variations. Uncertainty by buyers will increase as this practice becomes prevalent, and reduce the utility of having grades.

Appendix A shows that mixing is compatible with a grading system which maximizes the total revenue for which a crop is sold. To be compatible, grade minimums must be set appropriately, in anticipation that mixing will result in the average quality of each grade marketing being equal to those minimums.

4.3 Evolution of Canada's mixing policy

The Manitoba Grain Act of 1900 made mixing of grain of different grades illegal⁶³ However, subsequent changes to legislation indirectly opened the possibility of legalized mixing, leading to its widespread practice

⁶² An exception would be the very lowest grade, usually animal feed, which would consist of excess poor quality grain not required for mixing.

⁶³Patton (1928), pg. 24.

The Canada Grain Act of 1912 opened the door to mixing by permitting the licensing of private "hospital" elevators. These were intended to be facilities that would improve the quality of grain that was wet or damaged. Hospitals would dry, clean, or otherwise treat the damaged grain. The Act permitted grain emerging from such terminals to be reinspected and graded according to the standard grades. The net result of the new regulations was to allow mixing of all sorts. MacGibbon (1932): "The important thing to observe out of all this, is that the attempt to provide for off grade and tough grain led to the development of hospital elevators. When these obtained the right to ship out straight grades, the private elevators secured hospital licenses and gradually absorbed the function of handling these off grades. Thereby, they were able to mix grain, and the shipping of grain so mixed under a straight grade certificate became possible at the lake ports."⁶⁴ Patton notes of the 1912 Act "Private terminal elevators were not recognized under the act. They were able, however, to obtain licenses as 'hospital elevators', and their number increased markedly after the passing of the act."⁶⁵ Before the 1912 legislation there were only three private terminals at Thunder Bay, a centre of terminal operations. Four more were built in 1912. By 1926, 25 of 35 terminal elevators were private and mixing had become an industry practice.⁶⁷

⁶⁴ MacGibbon (1932), pg. 164.

⁶⁵ A Straight No.1 Northern is distinct from a Rejected No. 1 Northern or a Tough No. 1 Northern.

⁶⁶ Patton (1928), pg. 144.

⁶⁷ *Report of the Royal Grain Inquiry Commission*, page 77. Also reported in Patton (1928).

The 1912 Act recognized the possibility of mixing and allowed that if grain "was being systematically reduced in quality below the general average quality of grain of similar grades in the bins of *public* terminal elevators, the Chief Inspector may allow no such grain to pass inspection except on a lower grade." (*italics added*).⁶⁸ This provision would have been difficult to enforce. Terminal elevators with public licenses were storage facilities and forbidden to mix. We may anticipate that a portion of the highest quality grain would have been diverted to private hospital terminals to dilute with lower quality wheat. The result of the diversion would have been a lowering of the average quality wheat shipped directly into public terminals. Thus, the standard for judgement was not independent of the prevalence of the practice of mixing.

The history of mixing was investigated by the Royal Grain Inquiry Commission of 1925. On the question of enforcement of the provision against mixing in the 1912 Act, the Commission reported that "This section is definitely not connected by any reference in the Act or by rule to the private elevators . . . however, in practice the Inspection Department have always interpreted this rule to apply to private terminals."⁶⁹ The Commission investigation of the application of this rule revealed significant difficulties. Each year, around October, the Chief Inspector's office in Winnipeg issued standard samples to guide grading.⁷⁰ Mr. F. Symes, inspector in charge of terminals at Fort

⁶⁸ Canada Grain Act, Section 99.

⁶⁹ *Report of the Royal Grain Inquiry Commission* (1925), pg. 94.

⁷⁰ Until these samples were issued, inspectors relied on the previous years samples.

William and Port Arthur, testified that he provided "composite" samples to deputy inspectors as guidelines for inspecting grain out of private terminals. The composite samples were made up of three parts the standard samples issued by the Chief Inspector, which Mr. Symes interpreted to be the minimum of the grade, and one part a direct sampling of the grain being shipped into public terminals at the head of the lakes. The declared intention was to provide a sample guide that was "a little better" than the standard samples. However, experts retained by the Commission saw little difference between the standard samples and the composite samples, except to note that as millers, they would have a slight preference for the standard sample.⁷¹ Thus, in practice there appeared to be no material distinction between the minimum of the grade and standard applied to the outflow from private mixing terminals. In addition, there is the implication that the addition of grain being shipped into public elevators slightly degraded the standard sample rather than increasing its quality. This evidence supports the expectation that diversions of higher quality wheat to private terminals would have lowered the quality of shipments into the public terminals. Mr. Symes is also reported as testifying as follows: "In reply to a query as to what he would do if a sample of a cargo from a mixing house were laid before him that weighed sixty pounds and had sixty per cent of hard Red Fife Wheat in it . . . and, in brief, complied with the definition of One Northern found in the Act, Mr. Symes said he would have to pass it."⁷² Mr. Symes testified that he had turned down samples of grain that had not been up to the average of the

⁷¹ Ibid, pg. 94.

⁷² Ibid, pg. 94.

composite samples, but had been overturned on appeal. "These samples were below the average going out of public terminals, but above the minimum of the grade defined by the Act."⁷³

The Commission report also provides tables comparing grain received by private terminals to grain shipped out, broken down by grade.⁷⁴ They show extensive promoting of grades through mixing. MacGibbon (1932) reports several of these tables, and concludes that substantial mixing had taken place.⁷⁵

The prevalence of the practice of mixing may also be seen in that the Grain Growers Company, the Saskatchewan Coop., and the Pool all mixed grain despite vocal opposition from their members.⁷⁶⁷⁷

⁷³ Ibid, pg. 95.

⁷⁴ Ibid. pgs. 86-92.

⁷⁵ Pgs. 173-175.

⁷⁶ Patton (1928), pgs. 149,183.

⁷⁷ For Pool mixing policy see *The Western Producer*. Nov. 24, 1927, Pg. 26.

4.4 Farmer opposition to mixing

Farmers had a longstanding antipathy to mixing. Patton (1928) comments on the complaints of farmers concerning terminal elevators before the 1912 legislation: "Thus, it was claimed, the average quality of grades exported from the terminals was lower than that on which the farmers' grain was sold . . . Not only, it was inferred, did mixing and undercleaning of graded grain mean higher profits to dealers at the expense of growers, but it further reacted to the detriment of the latter by so affecting the reputation of Canadian grain on foreign markets as to lower the price its standard grades commanded abroad, which was in return reflected in lower prices received by producers on the Winnipeg market or at country points."⁷⁸ Wilson (1978) speaks of farmer reaction to the passage of the Canada Grain Act of 1912: "To add to their disappointment, producers' representative learned that the mixing of grades would not be effectively prohibited".⁷⁹ Reporting on dissatisfaction of farmers with their cooperative companies prior to the establishment of the Pool, Patton reports "At annual meetings the directors repeatedly found themselves called upon to justify the company's participation in mixing operations, and its profits from terminal "overages" and screenings."⁸⁰ The term "overages" refers to the sale of more high grade wheat than was purchased, a result of mixing. Text box

⁷⁸ Patton (1928), pg. 131.

⁷⁹ Wilson (1978), pg. 44.

⁸⁰ Patton (1928), pg. 192.

1 in the next section provides an article on the Pool's antipathy to mixing from the Pool's organ, the *Western Producer*.

4.5 The increase in mixing may have lowered farmer revenue.

While the Canada Grain Act of 1912 opened the door to mixing, it left the statutory definition of grades unchanged.⁵¹ For example, No. 1 Manitoba Hard Spring Wheat remained as 75% hard Red Fife weighing at least 60 lbs. per bushel.^{52 53} Thus, as mixing became more widespread, the average quality of each grade of wheat must have fallen from somewhere around the midpoint of the quality range for a grade to the lowest permitted level. *Ceteris paribus*, the demand price of Canadian grades of wheat must have fallen.⁵⁴

What would the impact have been on revenues to farmers? Appendix A develops a model to demonstrate that the impact would likely have been negative. The model simplifies by assuming either zero or fixed costs of handling and mixing per bushel. It is based on the profit maximization of a competitive grain mixing and exporting firm

⁵¹ Irvine (1983), pg. 54.

⁵² Ibid. pg. 55.

⁵³ Red Fife was a type of wheat representing the standard of quality at the time.

⁵⁴ Other factors of supply and demand will have produced additional impacts on prices.

where Canada is a price-taker in international markets. Farm price for grain as a function of quality is derived from the marginal revenue product of grain to the firm. Key results are reviewed below, followed by a less formal explanation of why the results obtain.

Appendix A assumes that economies of scale in transportation and other considerations have determined a fixed number of grades which is practical. For a given number of grades, Appendix A shows that:

- The price of grain must rise at an increasing rate with respect to quality. If $P\{Q_i\}$ is the demand price of wheat as a function of quality, then $(dP\{Q_i\}/d^2Q_i > 0)$. As a result, the price of higher grades is more sensitive to variations in quality than lower grades, and it would pay individual grain holders to increase the grade minimum of their grade.
- If grading standards are set reasonably correctly for revenue maximization before permitting mixing, then permitting mixing lowers the quality of the grain marketed below optimum, and lowers total revenue to farmers.
- Farmers of high quality wheat bear the highest proportion of the burden when the quality of grades marketed is too low.

- If grade minimums are set sub-optimally by the regulator, they may not be sustainable. If a private agent can attain sufficient scale, the agent can profit by marketing their own grades.

The principal results of Appendix A may be understood as follows:

If quality does not command a premium price, it does not make sense to market separate grades. The advantages of third party inspection can be had by marketing one grade, and guaranteeing that grain sold in advance will be of a minimum quality equal to the average quality of the crop. This, in fact, was the method of marketing both the Australian and

Figure 1: Demand Price is Convex

Argentinean crop. Each season, samples would be sent to importing countries representing "fair average quality", usually cited by its initials *f.a.q.* Under the *f.a.q.* system, importers had recourse if they received less than *f.a.q.* on a shipment.⁸⁵

⁸⁵ *Report of the Royal Grain Inquiry Commission*, pg. 175.

For marketing grain in grades of different quality to be profitable, the demand price for grain must be convex with respect to quality. This is shown in Figure 1. The function $P\{Q_i\}$ is the rising demand price for grain with respect to quality (Q_i). Consider two lots of wheat of quality Q_1 and Q_2 . By mixing Q_1 and Q_2 in varying proportions, any quality of grain can be obtained between the two. The average cost per bushel is given by the chord connecting the two points on $P\{Q_i\}$, represented by the dashed line. Note that the dashed line is above $P\{Q_i\}$ at all points, because of the convexity of that function. The opportunity cost of mixed wheat is higher than price that can be realized for the resulting average quality. Under these circumstances, it pays to market wheat under separate degrees of quality. Were it not for the economies of scale that marketing by grades provide, one would prefer to market each lot of wheat according to its individual quality, and do no mixing at all. If $P\{Q_i\}$ were concave, instead of convex, selling a single grade of average quality would yield higher revenue than marketing separately.

If grain is marketed by grade, then, for reasons discussed earlier, mixing will tend to occur so that grain delivered is equal to the minimum acceptable of the grade. Because the mixing process is one of proportions, the resulting demand price for wheat of varying quality at the farm level will tend to be a linear function of the difference between the quality of the grain and the minimum quality of the grade it will be mixed to. This makes the farm price of wheat a kinked linear function of quality ($F\{Q_i\}$ in Figure 2). Figure 2 illustrates one possible outcome for three grades in a single dimension of quality. G_1 and G_2 represent the grade minimums for the top two grades. The third grade is a

remainder with average quality Q_n and the grading system non-binding. $F\{Q_i\}$ is flat on the lowest segment because any grain in this range may be sold as the lowest grade, and there is no "mixing value" for one bushel's ability to promote another bushel by mixing. Note, as illustrated in Figure 2, that it is quite possible for the farm price of

Figure 2: Farm Price is Linear

a given quality to exceed the value that would be placed on grain of that quality in the international market. This arises from the mixing value of such wheat in the promotion of wheats of lower quality.

Figure 2 assumes that the farmer and the elevator purchasing agent know the quality of grain being delivered by the individual farmer. This assumption is a reasonable representation of the situation at points of delivery in the 1920's. Industry practices documented in Section 2.3 suggest that elevator agents and farmers were able to distinguish quality to a finer degree than the quality intervals of the grading system. For example, a "high" number two grade might be given the Winnipeg Exchange price for No. 1, and then assessed a higher dockage than would otherwise be called for. The combination of over-grading and over-assessment of dockage would have allowed a smooth variation in price.

Since price rises with an increasing rate with respect to quality, the price of higher grades of grain are more heavily affected by a decline in the quality of the grades.

Figure 3 illustrates "optimal" setting of grade minimums. Revenue is maximized for a given set of grades when the regulator sets them such that the farm price function $F\{Q_i\}$ is tangent to the $P\{Q_i\}$ at the points representing the grade minimums. Tangency is a condition of revenue maximization for the sale of the crop, but there is no market force requiring the regulator to set grade minimums at these levels.

Figure 3: Optimal Grades Establish Tangency

If the quality of grades is allowed to vary from these levels, such as through a general decline in grading standards, then total revenue to the crop will fall. In such a case, Appendix A shows that the greatest burden will tend to fall on farmers with grain of higher quality. This arises from the higher price sensitivity of the higher grades. In the extreme case, the price of the lowest grade of grain may be unaffected when its price is a function of the price of substitute animal feeds.

If the grades are set at levels other than revenue maximizing levels, it follows that an alternative agent marketing a set of optimal grades can realize higher revenues, and purchase the crop at a set of offer prices that dominate the farm prices resulting from the sub-optimal grades.

Given the above, it is possible that the introduction of mixing following the Canada Grain Act of 1912, lowered the standards of grain marketed below optimum. This more likely given that mixing was not deliberately introduced, but became widespread as a byproduct of the provision for hospital elevators.

The introduction of mixing would have effectively lowered the standards of all grades by roughly half a grade, as the average quality fell from the mean of the grade to the minimum of the grade. If we assume that the grades were reasonably spaced ("well-separated" in terms of Appendix A) prior to the legalization of mixing, then the lowering of standards of all grades would have lowered total revenue to the crop. Because all standards were lowered simultaneously, separation would have been maintained and this would not necessarily lead to unutilized grades or other obvious signals of sub-optimality.

Restoring a higher grading standard would have restored farm incomes. To market alternative grades it would be necessary to establish a vertically integrated structure to control the identity of the grain, and to have sufficient volume to take advantage of the

scale economies in transport and storage created by grades. The Pool met these requirements by requiring a commitment by farmer members to market through the Pool, and requiring a 50% control of total volumes before the contract was activated. With assurance of sufficient volume, it would be feasible to establish a vertically integrated structure to hold the identity of grain separate until sold to foreign customers. Holding the identity of grain separate is necessary to prevent higher standard wheat from being diluted with lower standard wheat which was technically within the same official government grade.

The marketing of separate grades by a Pool would also find potential benefits in taking advantage of the non-sustainability of grade prices, as noted above. The Pool, with its assured supply, would have been able to market grades with quality levels chosen to take advantage of gaps between farm price and demand price created by the public grading system. Interestingly, Appendix A shows that such gaps will occur at quality levels approximately half way between the official grade minimums. These are also the approximate quality levels which would be established by not "mixing".

It is worth noting that a farmer organization faced a higher incentive to undertake this project than a profit maximizing firm, even one that was farmer owned. If a profit maximizing firm goes to the effort and expense of establishing and marketing alternative grades, part of the benefits will be reaped by other firms following in its path. Competition will, in the long run, ensure zero profit for all competitive firms. The real

beneficiaries are the farmers, whose land rents will increase as a result of the higher profitability of their grain. Thus a common agency for farmers internalizes the externality of establishing a more optimal set of grades, capturing a larger proportion of the benefits than are available to a single firm.

Thus, a desire to restore higher quality grading standards may have been a collective motivation behind the formation of the Pool. An organization with assured supply and a commitment to vertical integration would be necessary to do this, and would be markedly different from the existing farm organizations.

Farmers were certainly aware of the impact of mixing on grain quality and grain prices. Articles in the *Western Producer* were often devoted to explaining to Pool members why the Pool was opposed to mixing, but mixed. Box 1 excerpts text from a transcript of a radio play printed in the *Western Producer*. The *Western Producer* was the weekly newspaper organ of the Pool.

The Pool mixed because it had not attained a level of vertical integration necessary to preserve the identity of its grain, although this was a requirement of "orderly marketing". The Pool continued to expand its vertical control during its life. As discussed above, prior to the financial crisis of 1930 which brought the Pool to an end, the Pool had managed to establish a system of country houses and terminal elevators from Vancouver to Buffalo. Thus they controlled the identity of grain exiting from the West Coast, but

had not yet established control over the identity of grain exiting from the Atlantic ports.

4.6 Relationship to Special Binning and Spreads for Street Wheat

In the world grain market, grain of premium quality commanded a higher price. If the quality of Canadian grades marketed abroad were too low to maximize revenue to the crop, this would have affected farmers of all sizes. For example, farmers who were able to "special bin" their crop or obtain and fill their own car (see Conditions for the Sale of Grain above), were better positioned to obtain a premium for grain that was high within its grade, but that

Excerpt from the a transcript of a Pool radio-play *Western Producer*, December 26, 1928. Pp. 12 & 13. (Italics added).

"THE WHEAT POOL AND THE GRADING SYSTEM

Questions and answers -- a dialogue conducted over CJBR, the Saskatchewan Wheat Pool Broadcasting Station

...
Visitor: ... But say, I've been thinking quite a lot about the grading question and some of the folks down our way think the Pool should do more to improve our grading system than it is doing ... Now, what I want to know is this. Why can't the Pool do away with this business of mixing?

Announcer: The Pool wants to do away with it. Did you see the report of our last delegates' meeting, when the delegates unanimously went on the record as being opposed to the mixing process in the Grades 1 to 6?

Visitor: No, I didn't see it, but I am mighty glad to hear of it.

Announcer: Well, the delegates instructed our Board of Directors to secure legislation to make mixing in the grades from 1 to 6 absolutely illegal.

Visitor: Why does it need legislation for the Pool to abolish mixing?

Announcer: Because it would very unfair to Pool members if the Pool Terminals were not allowed to mix and other terminal elevators could continue doing it. You see *the identity of Canadian grain is not preserved once it gets out of the terminals at the Head of the Lakes* and if the Pool did not mix, while others were mixing down to the minimum of the grade, it would simply mean that the higher quality of Pool wheat would be used to raise the lower quality of non-Pool wheat. Consequently, either the buyer in Europe would receive a better quality of wheat than he was paying for, or else the non-Pool terminals would receive a higher price than they are entitled to for their lower quality wheat.

Visitor: Well, why not abolish mixing in all grades, instead of just the first 6?

Announcer: Well, the main thing is to secure for the Canadian farmer the highest possible price for his wheat, and then *we also want to prevent the deterioration in the quality of Canadian wheat that we believe has come about partly through mixing.*

Visitor: Yes, that's right.

...

Box 1

premium would have been based on the price for the respective grade of wheat.⁸⁶ Improving the grades such that the total revenue to the crop was higher would have improved the position of all farmers, regardless of their relative advantage.

4.7 Historical evidence for a decline in the quality of grades.

Historical evidence for a decline in the quality of grades is mixed. The Royal Grain Inquiry Commission of 1925 investigated this matter specifically, sending one of their number (Commissioner Rutherford) to Britain and Europe to consult the grain trade on this issue. Rutherford's report is appended to the main report.

Rutherford's report cited consistent commentary by millers that Canadian grain of given grades emerging from "Atlantic ports" was of lower quality since the war. However, the Commission's report chose to not lend weight to these comments, finding "We cannot say from the evidence we have that the quality or reputation of Canada's grain and therefore the price, has suffered in Britain as a result of mixing in private elevators being allowed."

Rutherford's report includes this quote from an English miller:

⁸⁶ These farmers could bypass bargaining with the local elevator agent and send their grain directly to a commission agent to market to one of the terminals.

"I have talked with a number of millers" he said, "who say that Manitoba from Atlantic ports are not nearly so good as they were pre-war. We feel comparatively certain that Canadian wheats are 'whankled'(water added, soft wheats added, etc.) in Philadelphia. ... We specify when possible to get wheat through Vancouver. We pay more for it."⁸⁷

Reporting another's English miller's comment:

"Your Manitoba via Atlantic ports are not so good as they used to be; moisture is greater and gluten strength is not so good."⁸⁸

A Glasgow merchant comments:

"Shipments of Manitoba of the same grade through Atlantic ports are not as good as they were pre-war -- more moisture and lower gluten strength and the same grades are poorer now than they were last season up to December."⁸⁹

Glasgow merchants also expressed a "decided preference" for Vancouver origin.⁹⁰ The only exception to these comments was a view reported from Holland (based apparently on a lack of awareness that Alberta grain was shipped out through Vancouver): "Vancouver is on the Pacific Coast. Our understanding has always been that only soft wheats are grown on the Pacific Coast and we are afraid of mixtures of soft wheats with Manitoba." Rutherford reports of his Dutch contacts that "They preferred Atlantic

⁸⁷ *Report of the Royal Grain Inquiry* (1925), pg. 178.

⁸⁸ *Ibid*, pg. 179.

⁸⁹ *Ibid*, pg. 180.

⁹⁰ *Ibid*, pg. 181.

shipments through all Canadian channels, as did so many others, but not to the extent of bidding a higher price to secure them in that way or of specifying through Canadian Atlantic ports."⁹¹

Rutherford remains agnostic on the truth of these views in his Appendix, but does note that the variation in crop quality from year to year makes interpretation of trends in quality difficult, and that comments were influenced by a recent incident involving 100,000 bushels of Manitoba 1 received via Philadelphia which was badly mixed, "some of it as low as No. 3 Northern".⁹² He also notes that the Alberta harvest, which ships out through Vancouver, was of high quality that year.

The difference between Vancouver origin and Atlantic Coast origin prices is reported "worth a shilling and a quarter over Atlantic, and Vancouver threes have been nearly as good as Atlantic twos".⁹³ Rutherford also reports seeing shipment samples from Vancouver and Atlantic ports being displayed separately in British Grain markets.⁹⁴

The difference between Vancouver and Atlantic Coast prices reported by Rutherford may result from mixing. Private terminals were concentrated at the head of the lakes on the

⁹¹ Ibid, pg. 181.

⁹² Ibid. pg. 179.

⁹³ Page 178.

⁹⁴ Ibid, pg. 159.

Atlantic route.⁹⁵ Some evidence in the report implies tampering with grades in the United States, however the absence of a reported price difference between Canadian Atlantic and U.S. Atlantic ports is noteworthy. It suggests that the Canadian grain out of Americans ports was not systematically different from the same grades of grain out of Canadian ports. The Commission also followed up the possibility of tampering in the U.S., and concluded that the U.S. administration of grain in bond was "alert and strict", and that the total number of incidents "had not been large" and were associated only with the ports of Baltimore and Philadelphia..⁹⁶

Mr. Rutherford's report is somewhat misrepresented in the main text of the Commission's report when it comments, prior to its conclusions on mixing, that "Undoubtedly from time to time, English millers may be found who may think Canadian grain has deteriorated, but both Chief Inspector Serles and Commissioner Rutherford were on official mission, charged to meet the trade and the millers. It was known they were in England for that purpose. They were in the way of hearing complaints if there were any serious ones, to be made. Both agree that the reputation of Canadian grain stands high on the English market." The latter sentence is something of a non sequitur, since the high reputation of Canadian grain was not at issue, only the relative impact of mixing on the quality of the grades. Mr. Rutherford did indeed report that the Canadian grading system received

⁹⁵ The Commission's recitation of the increase in private terminals speaks of Port Arthur and Fort William, and makes no mention of private terminals on the Pacific.

⁹⁶ Ibid, pgs. 108-109.

a high degree of respect, but his report also includes the comments by millers cited above on changes in the quality of the grades.

The difference between the details of Rutherford's findings and the conclusion of the Commission is difficult to reconcile. It appears to be associated with the general level of confidence in the Canadian grading system reported by Rutherford, and the Commission's conclusion that the mixing process as a whole was not harmful to the trade: "We find...the quality of grain shipped out of the mixing houses is slightly lower than that shipped out of the public terminals"⁹⁷ "The conclusions that we come to after studying ..the evidence presented on this vexing but important problem is that the private terminal elevators should be legalized." "...we do not think the private terminal elevators should cease to enjoy the privilege of receiving straight grade certificates on the outward inspection of their grain..."⁹⁸ The latter conclusion was crucial to the continued practice of mixing.

5 THE BASIS OF AN EMPIRICAL TEST

The grain mixing and grading hypothesis is an example of the broader hypothesis that the Pool was, at least in part, an attempt to bypass an industry whose competitive practices

⁹⁷ Ibid, pg. 98.

⁹⁸ Ibid, pg. 106.

degraded the quality of wheat and reduced the value of the Canadian crop on the world market.

While this is a hypothesis on the collective motivation for the Pools formation, it may be tested by examining individual farmer motivations to join or not join the pool. As the mixing model shows, growers of higher quality grain had more to gain from improving the quality of wheat that ultimately reached buyers. Farmers of higher quality wheat bear a greater proportion of the burden when the quality of the grades is too low.

Therefore, if a desire to restore higher grades was a collective motivation for the Pool, farmers of high quality wheat would have been more likely to join. This is a testable hypothesis, since there is information available on the price and quality of wheat in different regions of the prairies.

6 EMPIRICAL TESTS

To test the hypothesis, we construct an empirical model of the individual farmer's decision to join or not join the Pool. If restoration of higher grades is a collective motivation for establishing the Pool, then we expect that individual farmers will be more likely to join the higher the expected quality of their wheat.

The dependent variable for our model is the percentage of wheat acreage signed onto Pool contracts in each Pool administrative Sub-district of Saskatchewan. The total Saskatchewan acreage under contract in December 1925 was published in the *Western Producer*, Jan. 14, 1926 (Page 7). The acreage under contract is compared to the total wheat acreage reported in the 1926 Census for the same areas. Acreage was tracked by the Pool because the Pool contract did not come into effect until 50% of the acreage in the province was signed up. "Township cards" were maintained, mapping the Pool acreage in each municipality.

The model must also account for another factor we have identified as important to the individual farmer's decision, the harvest date. Price for wheat tended to fall as the harvest progressed. Farmers who expect to harvest early will be less likely to join the Pool, since early harvesters would receive a higher price for their grain than the averaged Pool price.

Thus our model of a farmer's decision to join the pool predicts that the percentage of acreage signed by the pool is higher the later the expected harvest date and the higher the quality of wheat.

$$\% \text{ Membership in acres} = f\{\text{harvest date, quality of wheat}\}$$

In addition, we test an alternative hypothesis: It might be suggested that the original complaints of farmers about competition at the country elevators was not satisfied by their share-capital companies, and that the Pool was motivated by the old complaint of a lack of competition at shipping points. In this case, the Pool might have been another collective attempt to bypass exploitive conditions at the shipping point. To test this hypothesis, the average number of firms at the shipping point is used as a proxy for competition. If the hypothesis is correct, then we expect to see higher Pool sign-up rates in districts where the average number of elevator firms per shipping point is low.

In the text below, we first review major features of the data and methodology employed, and then report the results of the tests. Appendix D provides specific detail on data sources and development, as well as a complete listing of data. The data includes unique lists of Saskatchewan shipping points reconciled from a number of sources.

6.1 Estimation Method

A logit estimation technique is used. Logit is appropriate since the proportion of acreage signed to the pool is bounded by zero and one. The decision of the farmer to join or not

join may be considered a Bernoulli process. The proportion of acreage signed up is thus a product of a Bernoulli process and may be regarded as a grouped data case for logit.⁹⁹

Logit may be estimated by ordinary least squares after the appropriate transformation. However, some innovation was required to handle the adjustment for heteroscedasticity. The logit relation is naturally heteroscedastic, but standard adjustments depend on the fact that the sample size is directly related to the number of Bernoulli trials. For instance, had the dependent variable been the proportion of farmers signed up, the total number of farmers in each region would have been used to calculate weights for weighted least squares. Unfortunately, only acreage data was available, and each acre cannot be regarded by itself as an independent trial. The adjustment for this is outlined in Appendix B.

6.2 The Problem of Averages

The logit regression essentially asks "What is the probability of a randomly picked acre of land in this region belonging to the Wheat Pool?" The observed proportions of acreage are treated as the means of repeat trials of selection.

⁹⁹ Logit fits an S-shaped curve to data, rather than a straight line. The curve approaches 0 and 1 asymptotically at either tail, thus satisfying the boundary conditions.

This probability may vary with such factors as average protein or average harvest date in the region. However, the connection will be tenuous, since Pool joiners may be unrepresentative of the average in the region. This represents a handicap for the model since average data are used. However, it may lend more weight to the results if statistically significant relationships are found in spite of this handicap.

6.3 Organization and Weighting of the data

The Saskatchewan Wheat Pool was organized into 16 districts, each with 10 sub-districts, for a total of 160 sub-districts. Data on acreage signed up was published for each of these sub-districts.

Figure 4 shows the borders of the Wheat Pool districts within Saskatchewan. Number 1001 indicates the first subdistrict of the 10th district. Northern borders are approximate, and the borders between 406 & 409 and 1002 & 1003 are uncertain due to conflicting sources (see notes to BORDER variable in Appendix D).

The regression was conducted on the basis of these districts; however, much of the data used was available on a different geographic basis.

Four other types of geographic breakdowns were encountered; rural municipalities, census enumeration areas, crop districts, and shipping points.

Figure 4
**Saskatchewan Wheat Pool
Subdistricts**

It was necessary to aggregate geographic information to the Pool Sub-district level in order to match the dependent variable, proportion of Pool acreage by Pool Sub-district.

Wheat pool districts were made up of rural municipalities.¹⁰⁰ Any data available on a municipality could be aggregated to the Pool District level. The method of aggregation was to take a weighted average. The weight employed was based on the estimated wheat acreage in the municipality.¹⁰¹

Census enumeration areas and crop districts were also based on municipalities. Information on these bases were assigned to their constituent municipalities and then weighted up to the Pool District Level.

Some difficulty was encountered with shipping point data. There were 888 shipping points with warehouses or elevators in 1925/26.¹⁰² The list was assembled from records of the Board of Grain Commissioners of Canada for each railway, then consolidated according to common geographic location using a number of historical and current sources (see Appendix D). This process required the tracing of alternative names, and determining

¹⁰⁰ The map of Pool sub-districts was assembled from maps and printed lists published by the Pool at various times in its newspaper, *The Western Producer*. For a list of sources, see discussion of variable RMDSSUB, in the rural municipality variable tables of Appendix D.

¹⁰¹ Including an estimate of fallow land. See the discussion on the dependent variable below.

¹⁰² Calculated from *List of Licensed Elevators and Warehouses in the Western Grain Inspection Division 1925/26*, Board of Grain Commissioners of Canada.

when places of the same name were not the same place. For example, the shipping point listed as Bellwood on the CPR had its name changed to Dendron in Feb. 1926¹⁰³ and Biggar on CPR was more than a mile from Biggar on the Grand Trunk.

An additional problem was that the service area represented by each point could cover more than one municipality. The approach taken was to assume that any shipping point within one mile of a rural municipality border served both rural municipalities equally. Thus, when calculating the average number of firms per shipping point in a given municipality, points serving two municipalities would receive a weight of .5 in the average. This was regarded as an improvement over arbitrarily assigning each shipping point to the rural municipality in which it was located.

Shipping point data was weighted up to the sub-district level on the basis of elevator capacity. For example, to determine the average number of competitors faced by a farmer at a country shipping point, we would ideally want to weight the number of competitors at each shipping point by the acreage it served.¹⁰⁴ Since the acres served by a given shipping point is unknown, the combined capacity of the elevators at each point was taken as a proxy. Elevator capacity at each point was calculated from individual firm capacity

¹⁰³ According to a CPR official citing a reference referred to as *Designated numbers of stations*.

¹⁰⁴ Note that the dependent variable is proportion of acres rather than farmers.

at each point as reported in *List of Licensed Elevators and Warehouses in Western Canada, 1925-26* by the Board of Grain Commissioners of Canada.

7 THE DEPENDENT VARIABLE

The dependent variable was the proportion of wheat acreage covered by the pool contract. Pool acreage was published in the *Western Producer* for Dec. 1925, and wheat acreage for 1925 was published in the 1926 *Prairie Census*. The Pool acreage data was based on a declaration made by each farmer when they signed the Pool contract. Unfortunately, the two definitions of wheat acreage were not the same.

The Census gave estimates for acres "sown to wheat", while pool contracts asked for a declaration of "acres in wheat". An initial calculation using the two sets suggested that 74.9% of Saskatchewan wheat acreage had signed up to the pool. However this figure included many Pool Subdistricts with sign-up rates in excess of 100%. In addition the Pools handled only 55.6% of total wheat deliveries in Saskatchewan during the 1925-26 crop year.¹⁰⁵

¹⁰⁵ Patton (1928), pg. 340.

One hypothesis explaining the discrepancy would be rampant cheating on the part of Pool organizers, since the Pool contract would only come into effect if over 50% of the acreage signed up. This hypothesis was rejected on two grounds. First descriptions of record keeping found in the Western Producer showed a meticulous system including "township cards", maps of municipalities showing the precise location of Pool acreage.¹⁰⁶ Second, the acreage data was itself used for internal organizing, such as further sign-up campaigns.

It was assumed that pool organizers were counting fallow land that was being rotated through wheat as being "acres in wheat". This would not be an unreasonable act, given the multi-year nature of the contract. Although the contract was tied to the signator and not the land, this point may not have been clear to people.

It was therefore necessary to estimate the amount of such fallow land "in wheat" in each Rural Municipality in order to obtain the denominator of the dependent variable. Although the total fallow acreage was published in the Census, no distinction was made as to the intended purpose of the land.

The question of how fallow land was estimated was important because the proportion of fallow land to field crops varied widely according to climatic conditions and risk aversion by the farmer. Since fallow land would have varied systematically between sub-districts

¹⁰⁶ See sources for dependent variable under RMDSSUB in Appendix D.

due to climate, it was inappropriate to apply a general deflation to Pool statistics. The amount of fallow land being rotated through wheat had to be estimated for each rural municipality. The estimation technique had to be such that it was independent of the subsequent regressions testing our hypotheses.

Fortunately, both fallow acreage and total field crop acreage is available in the census. The number of acres sown to wheat was increased by the proportion of fallow acreage to total field crop acreage in each rural municipality. Thus total acreage in wheat for each rural municipality in 1925 was (RMTW5)

$$\text{RMTW5} = \text{RMACRE}(1 + \text{RMFALO}/\text{RMFCROP}) \quad (1)$$

where RMACRE is the acres sown to wheat in 1925, RMFALO is the acres fallow land in 1926, and RMFCROP is the acres field crop in 1926. All right hand side variables were reported by the *Census of Prairie Provinces, 1926*.

Following this adjustment, only one district showed a sign-up rate greater than 100% and the share of total acreage was 53.4%, in line with the Pool's reported share of the crop.

8 SAMPLE

Some of the subdistricts were dropped from the sample. Of the 160, eleven were eliminated because their borders could not accurately be determined. These were the northern border sub-districts, plus 406, 409, 1002, and 1003 (see discussion of **SAMPLE** variable for precise list, and **BORDER** variable for contradictions between sources, in Appendix D). An additional three subdistricts were dropped because their sign-up rates were too high, raising doubts about their accuracy and placing too much weight on their characteristics under logit. Under the ordinary least squares transformation of logit, an observed value of 100% for the dependent variable becomes equal to infinity, and high percentages approach infinity asymptotically. Districts 905, 907, and 1405 were excluded with sign-up rates of 99%, 97%, and 102% respectively. 905 and 907 are in central Saskatchewan, while 1405 is in the northeastern Saskatchewan. Figures 4 illustrates their location.

The remaining sample provided 146 observations.

9 A MODEL BASED ON HARVEST DATE

As discussed earlier, grain prices varied seasonally, falling as the harvest became more intense. Working (1937) found that between 1921/22 and 1936/37, the average price of

No. 1 Manitoba fell from 115.6 cents per bushel in August to 103.8 cents per bushel in December.¹⁰⁷

Because the Pool paid a "pool" price for the season on a given grade of wheat, it would have acted as an insurance contract against a late harvest and correspondingly low price. Early harvesters would be less likely to join since their low-risk position meant they would likely do better than the average price for the season paid by the Pool.

While the importance of the insurance effect in motivating the Pool is not clear, we may say that, given the existence of the Pool contract, harvest date was a relevant consideration for the individual farmers decision to join. As a result, model development proceeded in two stages. First, a model predicting pool membership on the basis of harvest date alone was developed. Then, variables were added to the model to test whether the mixing and grading hypothesis or the competition hypothesis added significant explanatory power.

A regional breakdown of harvest dates for the 1920's was not available. Data for crop districts was obtained from Statistics Canada beginning in 1952, but these dates apparently would not be representative of the harvest dates of earlier years.¹⁰⁸ Comparison of the period 1952-1968 to the period 1969-1985 showed that the regional

¹⁰⁷ Table 1, Appendix Tables.

¹⁰⁸ Mean day of "first swathing", CANSIM matrix number 2646, Statistics Canada.

difference in average harvest date had narrowed from 14.2 days to 8.5 days. This raises the possibility of a long run trend to the narrowing of harvest dates between north and south, possibly due to the development of new breeds of wheat and other technological improvements. As a result, harvest dates from this series could not be used to proxy for regional variation in harvest dates in the 1920's.

To proxy for harvest date, a theory of the determinants of harvest date was introduced and independent variables influencing harvest date were used.

9.1 Determinants of harvest dates

The principal determinants of harvest date are climatic. The amount of heat accumulated over the summer will have a strong influence on the rate of growth. A simple theory of plant growth suited to the available data is based on a measure of cumulative heat called "degree-days". A base temperature is chosen to represent the minimum temperature at which a plant will grow. 42 degrees fahrenheit is a common base. If the mean temperature is 52 degrees on a particular day, ten degree days have accumulated. Each type of plant has a certain number of degree-days that it requires to reach maturity. Whenever a sufficient number of degree days have accumulated, the plant is probably

ready for harvest. Degree-days provide a good rule of thumb when other data is missing, and are often used by agriculturalists to predict harvest dates.¹⁰⁹

An additional influence is the total length of the freeze free period, since that will govern when crops may be planted.

A series on degree days was constructed from an iso-bar map showing the mean number of degree-days above 42 degrees F from May 1 to Sept. 30, based on data from 1921 to 1950.¹¹⁰ The freeze-free period was approximated by use of latitude.¹¹¹ The series were calculated for each municipality.

To check the relevance of these two series, an OLS regression was run with the mean harvest date data for 20 crop districts from 1952 to 1968 as dependent variable.¹¹² The independent variables were calculated as the simple mean of the degree days and latitude for the rural municipalities making up the crop districts. The results were:

¹⁰⁹ For a more complete discussion of degree-days and more sophisticated models of plant development see G.W. Robertson, "A biometeorological time scale for a cereal crop involving day and night temperatures and photoperiod." *International Journal of Biometeorology*, 1968, vol. 12. and *Growing degree-days and crop production in Canada*, a pamphlet by Agriculture Canada, 1978-1635.

¹¹⁰ G.A. MacKay, *Climatic Maps of the Prairie Provinces for Agriculture; Climatological Studies #1*. Dept. of Transport, Meteorological Branch, 1965.

¹¹¹ Elevation would have allowed additional accuracy, but was not used.

¹¹² Mean day of "first swathing", Cansim Matrix #2646, Statistics Canada.

$$\text{CDHD1} = \underset{(36.2)}{254.58} + \underset{(4.5)}{0.13480 \times \text{CDLAT}} - \underset{(4.3)}{.011839 \times \text{CDDGDAY}} \quad (2)$$

$R^2 = .886 \quad F = 65.9$

where CDHD1 is the harvest date by crop district, CDLAT is latitude by crop district, and DGDAY is degree days by crop district. The t-statistics are in brackets below. It is evident that the relationship is quite strong, with the signs of the coefficients correct, and t and F statistics passing a 1% level of significance. An F-test for the impact of dropping CDLAT from the regression yields an F statistic, of 18.71, indicating that CDLAT contributes significantly to the explanatory power of the regression at the 1% level. A printout of summary statistics is in Appendix C.

Figure 5 illustrates mean degree days by Pool Subdistricts. Altitude, prevailing winds, bodies of water, and other geographic features cause degree days to have a distribution significantly independent of latitude. The hottest areas are in the central basin, with warmer temperatures extending north along the lower level river valleys. We expect the hot central areas to show lower membership in the Pool because of the higher probability of being early harvesters. While we expect membership rates to increase in more northerly areas with the shorter growing season, we also expect relatively lower northern memberships in the warmer river valley areas.

Figure 5

Saskatchewan Mean Degree Days 1921 to 1950

In addition to climatic influences, labour and capital were potential influences on harvest dates. As noted previously, "a hired man was a luxury" for the western grain farmer.¹¹³ A labour shortage would have slowed planting and delayed harvest. Since capital can be substituted for labour, one would expect that areas with highly capitalized farms and good access to labour would harvest earlier and be less likely to join the pool.

To account for the availability of labour, there was little available information. As a result, a rough proxy was used: A measure of rural population per total land area was calculated (POPD6, mnemonic: population density 1926) from census data and the census map of Saskatchewan.

To account for capital intensity, the total value of farms, less the value of land, was divided by the number of "improved" acres for each Census Enumeration Area. This provided the value of improvements per improved acre (CIVALI).

These four independent variables (LAT, DGDAY, POPD6, CIVALI) were tested against the proportion of wheat acreage signed up to the pool. LSRA5 is the proportion of wheat acreage signed up in 1924, after the logit transformation. These result was

$$\text{LSRA5} = \begin{matrix} 1.556 \\ (1.67) \end{matrix} - \begin{matrix} 0.0007366 \times \text{DGDAY} \\ (2.33) \end{matrix} + \begin{matrix} 0.01336 \times \text{LAT} \\ (3.96) \end{matrix} \quad (3)$$

¹¹³ Mackintosh (1924), pg. 17.

$$+ 0.02678 \times \text{CIVALI} - 0.0001903 \times \text{POPD6}$$

(1.70) (2.34)

$$R^2 = .246 \quad F = 11.51$$

The coefficients have the right signs, except for CIVALI. The CIVALI coefficient appears to say that the more developed an area, the more likely are farmers to join the pool. However, CIVALI and the constant also fail a two tail t-test at the 5% level.

A positive coefficient for CIVALI might be explained as follows. Farmers with less capital improvements on their land may have had immediate needs for their money and did not wish to postpone income by joining the Pool.¹¹⁴ But this seems unlikely because the claim against the Pool provided an asset which could be acceptable collateral to the banks.¹¹⁵ More likely is that the variable CIVALI does not capture the intended variation in capitalization. It is not specific to wheat or field crop operations, and is calculated only for the 17 census enumeration areas, which does not allow a lot of variation over the 146 Wheat Pool Subdistricts. This feeling is supported by the variable's relatively poor t-statistic.

¹¹⁴ Farmers were paid an advance on their wheat, but the full amount was not paid until the entire crop had been sold.

¹¹⁵ Patton (1928) reports that "to an increasing extent, however, creditors of pool farmers are showing a disposition to adjust themselves to the new system, by taking assignments of growers' participation certificates . . ." (pg. 371).

In addition, it is possible that population density is proxying for capital intensity as well as labour. Higher population density areas will tend to be more developed, and POPD6 is specific to each rural municipality, increasing its sensitivity to variations in capital intensity compared to available data used to calculate CIVALI.

The sample size was large enough to consider non-linear specifications of the relationship. Some tests were run using polynomial expansions of the variables in (4). One improvement which was retained was the substitution of POPD6 with its square POPSQ.

Substituting POPSQ and dropping CIVALI yielded

$$\begin{aligned} \text{LSRA5} = & 2.471 - 0.0010056 \times \text{DGDAY} + 0.01412 \times \text{LAT} - 2.945\text{E-}08 \times \text{POPSQ} \\ & (3.45) \quad (3.68) \qquad (4.18) \qquad (1.99) \end{aligned} \quad (3)$$

$$R^2 = .238 \quad F = 14.75$$

The t-statistics of the β 's range all pass a 5% test, from a 4.7% level of significance for POPSQ to 0.1% for DGDAY and LAT.

Equation (3) illustrates that harvest date was indeed a significant determinant of Pool membership. The warmer the summer, the earlier was the harvest and the lower was Pool membership. The further north the Pool Subdistrict, the later the harvest and the higher was Pool membership. The greater the population density, the more elastic the supply of labour and capital, the sooner the harvest, and the lower was Pool membership.

(3) provided our test-bed for testing the mixing and grading hypothesis and the competition hypothesis.

10 TESTING THE MIXING AND GRADING HYPOTHESIS

We wish to test the hypothesis that the Pool was, at least in part, an attempt to bypass an industry whose competitive practices degraded the quality of wheat and reduced the value of the Canadian crop on the world market. If this is the case, we expect that individual farmers with higher quality wheat would have been more likely to join the Pool.

10.1 The protein question

The question of high quality wheat is complicated by farmer concern over protein. Protein content was a close proxy for gluten content, a factor that improves the ability of flour to absorb water and produce bread both of finer texture and greater quantity.^{116 117} It was possible to chemically test samples of wheat for protein content through a test for the presence of nitrogen. Canadian wheat tended to command a premium on world

¹¹⁶ See for example Alsberg (1926).

¹¹⁷ Alsberg (1926), pg. 164.

markets partly for its high protein content. Bakers would mix high protein flour with "weaker" flours to produce bread of desired quantity and quality.¹¹⁸

Protein was not a factor in grading at that time. Grades focused on soundness and hardness of the wheat. Hardness was partly a function of the moisture content and condition of the grain, and partly a function of the type of grain. For example, 1925 revisions to the Canada Grain Act defined the No. 1 Manitoba Hard as being made only of varieties of hard red spring wheat, and having 75% hard vitreous kernels. No. 1 Manitoba Northern, a lower grade, was defined as 60% hard vitreous kernels. No. 2 Manitoba was 45%.¹¹⁹

Hardness was valued for both its own sake, and for its ability to proxy for gluten content. As a proxy for gluten, it was less effective than protein. Hardness itself was of value to the milling process. According to Irvine (1983), in his history *Wheat Grading in Western Canada* published by the Canada Grain Commission, hardness became valuable when the milling process changed from grindstones to a two stage process. Step one was to break the kernels into chunks and remove the bran with sieves and purifiers, producing pure "middlings" which were ground into flour in the second stage. "Now what was wanted in the grist was hard flinty wheat...since it did not produce much flour in the early

¹¹⁸ Alsberg (1926), pg. 165.

¹¹⁹ Irvine (1983), pg. 55.

'breaking' states of the milling process and gave the largest yields of purified middlings from which to grind the patent flour".¹²⁰

Premium prices were sometimes paid for high-protein wheat, but it is not clear how prevalent this was. In the United States, which had a substantial sample market, selling wheat by protein content was an established practice. "By the year 1921, so common had this practice become, at certain markets, the lack of a protein analysis for a car of wheat was tantamount to a confession that the protein content was so low that the seller did not wish to make it known."¹²¹ In Canada, sample markets did not develop despite provisions for them in the Canada Grain Act of 1912.¹²² Canadian millers did base their purchases partly on the basis of protein analyses which "established that each year certain districts produced wheat that was distinctly above the average crop in strength."¹²³ However, it is not clear the extent to which the price of wheat in these areas was affected.

This gives rise to two possibilities. One is that farmers were receiving protein premiums consistently from elevator operators. If this were true, then high-protein regions would be less likely to join the Pool, since the Pool paid the average price realized on the official grades. In this case, our hypothesis on high quality wheat holders being more

¹²⁰ Irvine (1983), pg. 2.

¹²¹ MacGibbon (1932), pg. 218.

¹²² *The Royal Grain Inquiry Commission* (1925), reports of sample markets that "none are at present in operation" (pg. 82).

¹²³ MacGibbon (1932), pg. 217.

likely to join the Pool would have to be qualified to exclude farmers in areas of high protein wheat.

The other possibility is that high protein farmers were unable to consistently obtain a premium value for their wheat. In this case, dissatisfaction with the grading and handling of wheat might lead them to consider the Pool. It is possible that the lack of a protein test in the grading of wheat might add to their dissatisfaction, and increase their likelihood of joining the Pool.

Therefore it is possible that protein should be incorporated into the model of Pool membership. Its sign could be either positive or negative, depending on whether protein premiums were consistently paid by the market.

10.2 Variables for quality and protein

To represent high protein areas, a dummy variable was introduced. The variable was equal to one for any area considered high-protein. These areas were determined from a map developed by the Grain Research Laboratory of the Board of Grain Commissioners for Canada.¹²⁴¹²⁵ This body conducted annually comprehensive sampling of grain at

¹²⁴ From Anderson & Eva (1943). *Variations in the protein content of Western Canadian Wheat 1927-1938; a study based on twelve annual protein surveys*. Board of Grain Commissioners for Canada, Grain Research Laboratory, 1943.

shipping points. The protein data for the years 1927-1938 were compiled into a report, which included the map. The map divided the prairies into 6 protein zones. Those Pool Districts with part of their area in the highest protein zone were represented by the dummy, HPRMAP. (Mnemonic: High Protein Map)

To represent high quality wheat, price data was used. The average price per bushel of wheat was available from the Census for the 17 Census Enumeration areas. Data for the three Census years, 1920, 1925, and 1930 were normalized for each year and then averaged to produce a price series in deviation form. The normalization was undertaken to avoid an increase in variance from changes in the overall price level.

This data could not be used directly to represent quality, since price would be determined by harvest date and possibly protein as well. To eliminate price variation due to harvest date, a regression was run on price as a function of the harvest date variables in (3).¹²⁶ The residuals from this regression were saved as a variable called PNMLN2 (mnemonic: price normal). A second series PNMLN, was developed by including HPRMAP among the independent variables. The virtue of doing this is that it prevents price achieving a significant t-statistic simply because of its collinearity with harvest date or protein. If

¹²⁴(...continued)

¹²⁵ The map was used instead of sample by shipping point because it incorporated analysis of grain "drainage" patterns associated with shipping points, and interpolation for missing data.

¹²⁶ This regression was run for unweighted subdistrict data, since the weights developed for logit were not relevant to this relationship

PNMLN is significant, it would indicate that quality variation was important without the ambiguity of collinearity. The choice of whether to include PNMLN or PNMLN2 depends on whether HPRMAP is included among the independent variables. If it is, then PNMLN is appropriate.

10.3 Results

The following was obtained.

$$\begin{aligned} \text{LSRA5} = & \begin{matrix} 2.530 & - & .001040 \times \text{DGDAY} & + & .01634 \times \text{LAT} \\ (3.53) & & (3.70) & & (4.76) \end{matrix} & (4) \\ & - 4.170\text{E-}08 \times \text{POPSQ} + .07205 \times \text{HPRMAP} + .5470 \times \text{PNML} \\ & \begin{matrix} (2.76) & & (0.74) & & (3.14) \end{matrix} \\ & R^2 = .290 \quad F = 11.46 \end{aligned}$$

Quality appears to be a significant variable. The sign of PNMLN is correct and the t-statistic is significant at a level of less than 1%. Interestingly HPRMAP is not significant and has a positive sign. This suggests that the farmers were not receiving protein premiums consistently, since that would produce a significant negative β . An F-test comparing (4) to the harvest date by itself (3) gives an F statistic of 5.21. The improvement from the addition of the two quality variables is significant at the 1% level.

Since HPRMAP had a positive coefficient, but a weak t-statistic, we reject the hypothesis that high protein farmers would be less likely to join the pool, but do not accept the

Figure 6
Proportion of Wheat Acreage Signed by Pool
December 1925

hypothesis that they would be more likely to join the pool. HPRMAP was therefore dropped from the model.¹²⁷ Dropping HPRMAP was also supported by the regression creating PNLM. Regressing normalized price of wheat against other variables produced:

$$\text{PNM} = \begin{matrix} 1.445 & -0.0495 \times \text{LAT} & -4.96\text{E-}05 \times \text{DGDAY} & -0.0667 \times \text{HPRMAP} \\ (4.05) & (28.86) & (0.36) & (1.42) \end{matrix} \quad (5)$$

If protein premiums are paid, we expect a positive coefficient between price and HPRMAP. The negative coefficient and poor T-statistic support the notion that protein premiums were not commonly paid. Instead, the HPRMAP is acting as another variable for degree-days. The high-protein regions are among the warmest areas.

Dropping protein provided a revised relationship of:

$$\begin{aligned} \text{LSRA5} = & \begin{matrix} 2.386 & - .000968 \times \text{DGDAY} & + .0158 \times \text{LAT} \\ (3.42) & (3.64) & (4.74) \end{matrix} \\ & \begin{matrix} - 4.29\text{E-}08 \times \text{POPSQ} & + .5232 \times \text{PNMLN2} \\ (2.84) & (3.03) \end{matrix} \end{aligned} \quad (6)$$

$$R^2 = .284 \quad F = 13.99$$

The signs of all β 's are correct and the t-statistic are all significant at better than 1%. An F-test comparing the improvement of adding our quality variable alone to the harvest date

¹²⁷ As an additional check, other variations of protein content were constructed from the same data source and tested, including average protein content. These too did not produce significant results.

equation of (4) produces $F=9.2$, significant at a level better than 1%. A low R^2 is not unusual for logit regressions.¹²⁵

Figure 6 compares the fitted values to actual values on a map of Saskatchewan. Each map is divided into quintiles from lowest to highest sign-up rates, and shaded according to the legend. The range of variation in the fitted values is lower than the actual values, possibly due to the high level of political volatility reflected in the disturbance term. Dividing into quintiles provides a clearer assessment of the fit.

The spatial distribution of the fitted values captures many of the characteristics of the actual values. The northern districts show higher sign up rates in both maps, as expected from the shorter growing season, and fewer degree days. Both maps show an exception in the warmer and higher population density in the north around Saskatoon. In both maps the middle southern basin is the lowest membership rate. Both maps also show relatively higher sign-up rates in the southeast and southwest corners. The fitted values show this more strongly in the southeast, while the actual values show it more strongly in the southwest. The pattern of differences in the South may depict a climatic shift in the distribution of degree days between the years preceding the Pool and the years covered by the degree day data used in the regression (1921 to 1950). The data from 1921 to 1950 was the earliest complete information available, based upon the accepted standard of 30 years and with sufficient information to create an isobar map.

¹²⁵ Maddala (1983), pages 37-41.

The most noticeable discrepancy between the two maps is in the northwest Saskatchewan. Low temperatures and northerly latitude would suggest a high sign-up rate, as predicted by the model. However, actual Pool sign-up rates were lower. The broader picture of the north does, however, reflect the expected higher sign-up rates.

The visual fit seems to match well in most places, complementing the significant statistical findings.

We may conclude that the data supports the hypothesis that the Pool was, in part, an attempt to bypass an industry whose competitive practices degraded the quality of wheat and reduced the value of the Canadian crop on the world market. As it predicts, farmers with high quality wheat were more likely to join the pool.

11 TESTING THE COMPETITION HYPOTHESIS

Another hypothesis is that the Pool was another attempt by farmers to deal with lack of competition among elevator companies. In favour of this hypothesis would be the fact that the previous farmer companies were share capital based and behaved largely the same as private firms. On the other hand, it would seem reasonable that farmer-owners of

shares in the farmer companies would constrain the company not to collude with the private companies. The latter appears to be the case according to historical commentary.¹²⁹

To test this collective motivation, we may again turn to the individual decisions by farmers. If the lack of competition at shipping points was a problem, farmers with less competition at their shipping points would have been more likely to join the Pool. To test this hypothesis a variable measuring competition at the local shipping point was developed.¹³⁰ The source of data was the *List of licensed elevators and warehouses in the western grain inspection division 1925-26*.¹³¹ The average number of competitors per shipping point in each area of Saskatchewan was calculated and named CAV25 (mnemonic: competition average 1925). The count was based on the number of firms licensed, and included the occasional unlicensed firm mentioned in the list.¹³²

Adding CAV25 to the regression yields

¹²⁹ Patton (1928), pages 190-195. See also sections of this paper on historical background.

¹³⁰ See Appendix D for methodology.

¹³¹ Board of Grain Commissioners for Canada.

¹³² The reason for including an unlicensed firm in the list is not clear. Presumably they were either buying privately on their own account or were potentially capable of entering operation.

$$\begin{aligned}
 \text{LSRA5} = & \quad 2.334 - .0010091 \times \text{DGDAY} + .01638 \times \text{LAT} & (7) \\
 & (3.35) \quad (3.77) & (4.88) \\
 & - 4.71\text{E-}08 \times \text{POPSQ} + .5767 \times \text{PNMLN2} + .04174 \times \text{CAV25} \\
 & (3.07) & (3.26) & (1.37) \\
 & & & R^2=.294 \quad F=11.64
 \end{aligned}$$

The t-statistic of CAV25 is not significant. More important, it is the wrong sign. An increase in the number of firms should increase competition and reduce the motivation to join the pool if the competition hypothesis is correct.

We may conclude the data does not support the competition hypothesis.

12 CONCLUSION

This paper asks the question why western Canadian farmers in the 1920's found it necessary to establish the Canadian wheat Pools. Traditional explanations concerning lack of competition at the shipping point were unsatisfactory given the success and market penetration of already existing farmer cooperative efforts. It was hypothesised that the Pool was, in part, an attempt to bypass an industry whose competitive practices degraded the quality of wheat and reduced the value of the Canadian crop on the world market.

2

PM-1 3½"x4" PHOTOGRAPHIC MICROCOPY TARGET
NBS 1010a ANSI/ISO #2 EQUIVALENT

PRECISIONSM RESOLUTION TARGETS

Such an effort would have required a Pool-like structure, vertically integrated with assured supply. These characteristics and objectives were consistent with the "orderly marketing" theme of the Pool's public campaign.

The hypothesis was tested in the context of a model of individual farmer motivation to join the Pool. If the collective hypothesis over the quality of wheat was true, then individual farmers of higher quality grain would have been more likely to join the pool. The tests supported this hypothesis. The tests did not support the hypothesis that the Pool was desired because previous farm organizations had failed to establish competitive conditions at the shipping point.

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APPENDIX A: A MODEL OF GRAIN MIXING AND GRADING

Demonstrating that Farmer Rents May Fall with a Decline In Grading Standards

This appendix develops a model for any good sold in bulk by discrete grades where quality is cardinal. Grain is the example. The model shows that price rising with quality is not enough to rationalize a grading structure. Price as a function of quality must be either convex or a "stair-case". If the latter, publicly provided grades are not necessary. In the former case, if the regulator does not establish optimal grades, the grading system may be contestable by a private agent entering the market at sufficient scale. Conditions for the welfare maximizing number of grades and grade levels are identified, along with observable signals when the grading system is sub-optimal. It is also shown that the benefits of a grading system are not uniformly experienced by all farmers. Conditions where some farmers have an interest in sub-optimal grading systems are explored. The Canadian Wheat Pool of the 1920's is used as a possible historical example of farmer response to changes in the grading system.

The selling of wheat by grade has a number of motivations. Grading converts a heterogeneous good into a number of descriptive categories, each of which may be

relatively homogenous (the grades). This allows wheat to be sold by description and handled in bulk. Rather than inspecting and buying several farmers' crops, one orders the desired number and grade of bushels in advance from a supplier. The creation of a standardized good also permits the writing of futures contracts, allowing the owner of wheat stocks to lay off risk in a futures market. Bulk handling was particularly important to overseas trade. The cheapest overseas transport was filling the bulwarks of a ship's hold with loose grain. With a grading system, the ships hold could be filled with wheat of a specific grade and sold in Europe while in transit.

Mixing is the practice of combining different grades of wheat and having the resulting mix re-graded. An important proposition of this paper is that farmers suffered a decline in rents when the legalization of mixing lowered the quality of Canadian wheat grades.

To demonstrate this possibility, we construct a general model of a "mixing" industry for wheat. Quality is assumed to be of one dimension, such as percentage hard red kernels.¹ Farmers' wheat is available as a continuous distribution over this quality. A "mixing" firm buys wheat of varying quality and mixes it to provide a particular average grade of wheat as an output.

The practice of mixing arises because, after leaving the farmer, wheat is sold by

¹Hard red kernels were easier to mill. The greater the % of hard red kernels, the higher the quality of wheat.

description. The contract will call for the delivery of a number of bushels of a specified grade of wheat. A grade of wheat could potentially cover a range of quality, but wheat need only meet the minimum quality required by its grade for contract fulfilment. A seller of wheat will minimize the cost of contract fulfilment by providing only the minimum quality required.

A seller of wheat of higher quality than the minimum can save costs by mixing it with lower quality grain. For example, suppose the minimum quality of grade No. 1 was 90% hard red kernels. A bushel of 100% hard red kernels could be mixed with two bushels of 85% hard red kernels to produce 3 bushels of No. 1.

Naturally, permitting mixing affects the price a buyer is willing to pay for the wheat. Buyers will base their offers on the expectation that the wheat they will receive will tend towards the minimum of the grade.

Thus, mixing has two results: lower prices for each grade of wheat, and increased quantities of the higher grades of wheat. The model established in this paper shows the net impact on revenues farmers realize for their crop.

THE MODEL

To determine the impact of mixing on farm revenues, we construct a model of a "mixing" industry and derive the prices that farmers receive for wheat of varying quality. The mixing industry buys wheat of varying quality from farmers and resells it on the international market in discrete grades. We assume that Canada is a price-taker in international markets. During the process of buying and reselling, the mixing industry has the opportunity to mix the wheat and have it re-graded before being sold for export. The quality requirements for each grade are set exogenous to the model.

Let "Q" be an index of quality of wheat ranging from zero to one. The mixing industry buys wheat from farmers in a competitive market where farm price (F) is a function of quality of the farmers wheat. The quality of an individual farmer's wheat is known both to the farmer and the purchaser. The wheat is also resold in a market where the price (P) is an increasing function of the average quality of the grade.

$$F_i = F\{Q_i\} \quad \text{where } Q_i = \text{average quality of wheat of farmer } i$$

$$P_j = P\{Q_j\} \quad \text{and} \quad \partial P_j / \partial Q_j > 0 \quad \text{where } Q_j = \text{average quality of grade } j \quad (1)$$

Consider the mixing problem of a single price-taking firm. The firm has purchased "m" lots of wheat of varying quality Q_i and quantity B_i . The firm will mix them to produce quantity B_j of each grade of wheat "j". There are "n" grades of wheat where "1" is the

highest quality grade and "n" is the lowest. The amount of wheat taken from a given lot "i" and mixed to produce grade "j" is B_{ij} . By definition

$$B_j = \sum_{i=1,m} B_{ij}$$

$$B_{ij} \geq 0 \quad (2)$$

Each grade is defined by a minimum quality G_j . The condition that the quality of the grade must equal or exceed the grade minimum is given by

$$Q_j = (\sum_{i=1,m} Q_i B_{ij}) / B_j \geq G_j \quad (3)$$

We will assume that there exists a lowest grade of wheat "n" such that

$$G_n = 0$$

This grade may either be a part of the official grading system, or the model's designation for a residual market for wheat not qualified under the official grading system. Note that since quality Q_i is defined as an index from zero to one, Q_i is greater than or equal to zero for all wheat and all wheat qualifies for sale as G_n . Since wheat not sold in higher grades may be sold as G_n , all wheat will be sold and

$$B_i = \sum_{j=1,n} B_{ij} \quad (4)$$

The firm seeks to maximize profit by mixing wheat (choosing values for the B_{ij} 's) and reselling it subject to (2), (3) and (4). The model assumes mixing is costless.² For a given purchase of wheat, profit (π) is maximized by maximizing total revenue.

$$\pi = P_j B_j = \sum_{j=1,n} P_j \left(\sum_{i=1,m} B_{ij} \right) \quad (5)$$

Since the mixing problem is linear, we may model the mixing industry as a single representative price-taking firm. The problem may be stated in Kuhn-Tucker form:

$$\begin{aligned} L = & \left(\sum_{j=1,n} P_j \left(\sum_{i=1,m} B_{ij} \right) \right) + \left(\sum_{j=1,n} \lambda_j \left(\left(\sum_{i=1,m} Q_i B_{ij} \right) / B_j \right) - G_j \right) \\ & + \left(\sum_{j=1,n} F_j \left(B_i - \sum_{j=1,n} B_{ij} \right) \right) \end{aligned} \quad (6)$$

where λ_j and F_j are Lagrangian multipliers for each grade constraint. We are able to use farm price (F_j) as the Lagrangian multiplier because it will be equal to the marginal revenue product of a change in B_j , and price will equal marginal revenue product in competitive markets.

² Results will hold for a model where the cost of mixing is fixed per unit of volume.

The Kuhn-Tucker conditions are:

$$B_{ij} \geq 0 \quad (7)$$

$$\partial L / \partial B_{ij} = P_j - F_i + (\lambda_j / B_j)(Q_i - Q_j) \leq 0 \quad (8)$$

$$(\partial L / \partial B_{ij}) B_{ij} = B_{ij} [P_j - F_i - (\lambda_j / B_j)(Q_i - Q_j)] = 0 \quad (9)$$

$$\lambda_j \geq 0 \quad (10)$$

$$\partial L / \partial \lambda_j = Q_j - G_j \geq 0 \quad (11)$$

$$(\partial L / \partial \lambda_j) \lambda_j = \lambda_j [Q_j - G_j] = 0 \quad (12)$$

$$\partial L / \partial F_i = B_i - \sum_{j=1,n} B_{ij} \geq 0 \quad (13)$$

Firms will mix to grade minimum for grades other than the lowest.

For all grades of wheat but the lowest grade, the average quality of the grade produced by the industry will equal the minimum grade standard. That is

$$Q_j - G_j = 0 \quad \text{for } j > n \quad (14)$$

We may show (14) by contradiction. For any grade of wheat "j" that has a positive quantity after mixing, there must be a (B_{ij}) greater than zero and quality greater than or equal to the quality of the grade. That is

$$B_{ij} > 0 \quad \text{such that } Q_i \geq Q_j \quad \text{where "i" is the lot of wheat purchased and "j" is the grade it is mixed to.} \quad (15)$$

From (8) and (9)

$$F_i - P_j = (\lambda_j / B_j)(Q_i - Q_j) \quad \text{for } B_{ij} > 0 \quad (16)$$

In addition, if any grade of wheat available after mixing has a quality greater than that required by the grade minimum ($Q_j > G_j$), we may show that the farm price of any grain lot "i" mixed to that grade is equal to the price the grade itself is sold for. That is, wheats of different quality mixed to this grade will have the same farm price. From (13) and (16)

$$\lambda_j = 0 \quad \text{for } Q_j - G_j > 0 \quad (17)$$

$$F_i - P_j = 0 \quad \text{for } B_{ij} > 0 \text{ and } Q_j - G_j > 0 \quad (18)$$

Now if the grading system includes a lower grade (j+1), then from (12) ($Q_i > Q_j > Q_{j+1}$) and from (8)

$$F_i - P_{j+1} \geq (\lambda_{j+1} / B_{j+1})(Q_i - Q_{j+1}) \geq 0 \quad (19)$$

From (1) the price and quality of grade j is higher than for grade j+1 ($P_j > P_{j+1}$). Therefore, from (16)

$$F_i - P_{j+1} < 0 \quad \text{for} \quad B_{ij} > 0 \quad \text{and} \quad Q_j - G_i > 0 \quad (20)$$

Since (19) and (20) cannot both be true, it is not possible for the average quality of a grade to be above the grade minimum if a lower grade exists and (14) is proven. All grades other than the lowest grade will be produced at a quality just equal to the minimum acceptable for the grade. Note that it is not necessary for the lower grade to actually be produced for (14) to hold.

Quality of the lowest grade is a residual.

Since all wheat is sold, the quality of the lowest grade is the average quality of the remainder of wheat. The quality of this grade may exceed the minimum requirements of

the lowest grade. If so, then the farm price of all grain being mixed to the lowest grade is the same (from (17) and (18)).

THE FARM PRICE OF WHEAT

$F\{Q_i\}$ is piece-wise linear.

The competitive price of wheat paid to farmers ($F\{Q_i\}$) is piece-wise linear. We may show this by defining a "mixing interval" M_j as the set of qualities of wheat which is mixed to produce a given grade of wheat j .

$$M_j = \{Q_i \mid B_{ij} > 0\} \quad (20)$$

We know from (7), (8) and (15) that for a given mixing interval M_j :

$$F_i = P_j + (\lambda_j / B_j)(Q_i - G_j) \quad \text{for all } B_{ij} > 0$$

$$F_i = P_n \quad \text{for } j=n \quad \text{and} \quad B_{in} > 0 \quad (21)$$

(21) is linear in form. Farm price of wheat within the mixing interval is a linear function of the quality of wheat (as it differs from the grade minimum), running through the international price of the grade P_j with a slope of (λ_j / B_j) . In the case of the lowest grade n , the grade minimum is not a constraint and λ_j and (λ_j / B_j) is equal to zero.

$F\{Q_i\}$ is weakly convex.

Consider any lot of wheat "k" that is not part of mixing interval M_j .

From (7)

$$F_k \geq P_j + (\lambda_j / B_j)(Q_k - G_j) \quad (22)$$

Subtracting each side of (21) from (22) yields

Figure A1: Farm price is a weakly convex set of line segments.

$$F\{Q_k\} - F\{Q_i\} \geq (\lambda_j / B_j)(Q_k - Q_i) \quad (23)$$

The right hand side of (23) is a linear function of the difference in quality ($Q_k - Q_i$). Thus (23) says that an increase in farm price is greater than or equal to a linear function of the change in quality. Similarly, a decrease in farm price is lesser than or equal to the same linear function. By definition, this is weak convexity.

$F\{Q_i\}$ is a kinked straight line.

The combination of piece-wise linearity and weak convexity mean that the farm price of wheat, plotted against wheat quality, is a kinked straight line. This is illustrated in Figure A1.

$P\{Q_i\}$ is weakly convex for $Q_i \in Q_j$

Although the demand price function in the export market is exogenous to the model, we may impute something of its shape from the shape of the farm price, since they share common points at (P_j, Q_j) . Weak convexity in $F\{Q_i\}$ implies weak convexity in $P\{Q_i\}$, at least for $(Q_i \in Q_j)$. The implication is that if export demand price as a function of quality is not concave rather than convex, then there will not be more than two grades produced after mixing. A convex function cannot share more than two points with a concave function.

OPTIMAL GRADING SYSTEMS

We may explore some of the characteristics of a welfare-maximizing grading system. In the context of selling in a price-taking market, welfare maximization consists of maximizing the value, or revenue realized, from the crop. The key questions are: When should a grading system occur? What are the optimal number of grades? and What standard should be set for each grade?

When discussing when a grading system should occur, we should note that there are two alternatives; a one grade system or selling each lot by its individual quality. As shown below, selling wheat by its individual quality provides more revenue than any grading system. Thus grading systems are only useful when economies of transportation and storage and the requirements of financial markets justify them.

Price should rise at an *increasing* rate with respect to quality.

A price which rises with quality is not enough to make a grading system worth-while.

Price must

must rise at an increasing rate.

$$\partial P\{Q_i\}/\partial^2 Q_i > 0 \quad \text{for } Q_i \in Q_j \quad (24)$$

(24) follows from the weak convexity of $F\{Q_i\}$ and $P\{Q_i\}$. While weak convexity allows a strictly linear relationship, it can be shown that total revenue for the crop is neutral to the number of grades under strict linearity.

Define any linear relationship of price to quality as

$$P\{Q_j\} = \alpha + \beta Q_j = \alpha + \beta ((\sum_{i=1,m} Q_i B_{ij}) / B_j) \quad (25)$$

where α and β are linear parameters. Now substitute (25) into total revenue "T" :

$$T = \sum_{j=1,n} P_j B_j = \alpha (\sum_{j=1,n} B_j) + \beta (\sum_{i=1,m} Q_i B_i) \quad (26)$$

In (24) total revenue is a function of the linear parameters α and β and the total volume and total quality of the harvest. T is independent of the number of grades. Therefore a grading system does not increase total revenue when $P\{Q_i\}$ is linear. Since there are costs associated with multiple grades, a single grade system should be employed.

Optimal Grading Standards

The condition for revenue maximizing grades is given by the partial derivative of the Lagrangian (6) with respect to each grade standard G_j . Let $P'\{Q_i\}$ represent $(\partial P\{Q_i\}/\partial Q_i)$. The Kuhn Tucker conditions are

$$\begin{aligned} G_j &\geq 0 \\ \partial L/\partial G_j &= B \times P'\{Q_i\} - \lambda_j \geq 0 \\ G_j (\partial L/\partial G_j) &= G_j (B \times P'\{Q_i\} - \lambda_j) = 0 \end{aligned} \quad (27)$$

Since G_j is greater than zero for all but the bottom grade n ,

$$P'\{Q_i\} = \lambda_j / B_j \quad j < n \quad (28)$$

From (21), we know that λ_j / B_j is the slope of $F\{Q_i\}$ within the mixing interval for Grade j . *To maximize the value of the crop, the standard for each grade above the lowest grade must be such that $F\{Q_i\}$ is tangent to $P\{Q_i\}$ at G_j .*

Recall from the preceding section that, although $P\{Q_i\}$ is exogenous to the model, it must have a shape where price rises at an increasing rate with respect to quality ($\partial^2 P\{Q_i\}/\partial^2 Q_i > 0$), if we see more than two grades being produced after mixing, and if we expect the grading system to be serving a function by increasing the total revenue to the crop.

Given that $(\partial P\{Q_i\}/\partial^2 Q_i > 0)$, it can be shown that the set of points satisfying (28) are unique for a given demand $P\{Q_i\}$ and a given crop.

First note that if price rises with quality at an increasing rate, then the slope of a tangent to $P\{Q_i\}$ increases as Q_i increases, and the slope of the tangent at any given point is unique. As a result the slope of $F\{Q_i\}$ at G_j is unique for each grade.

Figure A2: Mixing intervals are separate under optimal grades.

Now, from (21) the slope of $F\{Q_i\}$ is constant within the mixing interval for each grade. Since the slope is also unique for each grade and $F\{Q_i\}$ is convex, it follows that mixing intervals for each grade do not overlap. Since all wheat is mixed to some grade, the mixing intervals must also be continuous. *Optimum grades are characterized by contiguous non-overlapping mixing intervals as illustrated in Figure A2.*

Figure A2 illustrates three grades with revenue maximizing grade placements. $F\{Q_i\}$ is tangent at the $P\{Q_i\}$ at each grade except the lowest. Mixing intervals are defined such that x_j is the lower boundary for grade j , x_0 is the top quality (equal to one when measured as an index), and x_n is the lowest quality (equal to zero when measured as an

index). For example, all grain from quality x_1 to quality x_0 is mixed to produce grade G_1 .

Now let the given crop or stock of wheat be defined by

$$\begin{aligned} b'\{Q_i\} &= \text{The density distribution of the harvest over } Q \\ b\{Q_i\} &= \text{The cumulative quantity of wheat for } (Q \leq Q_i) \\ q\{Q_i\} &= \int Q_i b'\{Q_i\} = \text{The cumulative quality for } (Q \leq Q_i) \text{ (since quality} \\ &\quad \text{is cardinal).} \end{aligned} \tag{29}$$

From (14) we know that the quality of wheat sold will just equal the minimum permissible for the grade for $j > n$. Since the mixing intervals are separate,

$$G_j = (q\{x_{j-1}\} - q\{x_j\}) / (b\{x_{j-1}\} - b\{x_j\}) \quad \text{for } j < n \tag{30}$$

(30) provides $(n-1)$ linearly independent equations. Since the highest quality x_0 is known from the quality distribution of the crop, there are $(n-1)$ unknown x_j 's. For a given set of grade minimums, (30) would provide a solution for each (x_j) , defining each mixing interval.

Now let $F\{x_j\}$ be the farm price of wheat for quality x_j , as illustrated in Figure A2.

Since $F\{Q_i\}$ is a line kinked at the x_j 's

$$F\{x_j\} = F\{x_{j+1}\} + (x_j - x_{j+1}) \times [(P\{G_{j+1}\} - F\{x_{j+1}\}) / (G_{j+1} - x_{j+1})]$$

$$\text{for } j < (n-1) \quad (31)$$

$$F\{x_{n-1}\} = P\{Q_{j=n}\} = P\{q\{x_{n-1}\} / b\{x_{n-1}\}\} \quad (32)$$

(31) and (32) define (n-1) linearly independent equations. For given mixing intervals (x_j 's) and given grade minimums (G_j 's), the farm price of the (n-1) $F\{x_j\}$'s is unique.

Thus, for given grades, a unique solution for mixing intervals and for all of $F\{Q_i\}$ is determined. The grade optimality condition (28) defines (n-1) additional linearly independent equations, sufficient to uniquely determine the (n-1) grade constraints ($G_{j < n}$).

From (28) and (21)

$$P'\{Q_j\} = \lambda_j / B_j = [(P\{G_j\} - F\{x_j\}) / (G_j - x_j)] \quad j < n \quad (33)$$

For a given quality distribution of wheat ($q\{Q_i\}$) and a given demand for wheat ($P\{Q_i\}$), lines (30) to (33) define $3 \times (n-1)$ independent conditions, sufficient to uniquely determine revenue maximizing grade minimums, mixing intervals, and shape of the farm price of wheat function (G_j 's, x_j 's, $F\{x_j\}$'s).

Optimal Number of Grades

If it were not for economies of scale in transportation and storage, and the need for a homogenous good to support trading of risk in financial markets, a grading system would not be desirable. These economies of scale and transportation define the cost of maintaining additional grades, and set limits on what the optimal number of grades should be. The number of grades should be such that the marginal cost of maintaining an additional grade is equal to the increase in total revenue as defined by (30) to (33). Since grades are motivated by economies of scale in handling, the optimal number of grades is such that the volume of grain handled in each grade is sufficient to justify the grade.

The optimal number of grades to maximize revenue will depend on the shape of $P\{Q_i\}$. A grading system will increase revenues if $P\{Q_i\}$ is convex for the points at which quality equals the quality of the grades ($Q_i \in Q_j$). The mixing problem places no constraints on the shape of $P\{Q_i\}$ between grade/price points. We may separate cases into two types, according to the characteristics of the demand price function $P\{Q_i\}$ over its whole length. In the first case $P\{Q_i\}$ is strongly convex. In the second case $P\{Q_i\}$ alternates between convex and concave. We shall term the latter as a "staircase". Figure A2 illustrates a strongly convex $P\{Q_i\}$, while Figure A3 illustrates a "staircase".

If $P\{Q_i\}$ is strongly convex, and if introducing and maintaining a grade is costless, the optimal number of grades is infinite. Whatever the existing number of grades, a new grade will increase total revenue. If the existing grades are set optimally to maximize revenue, then $P\{Q_i\}$ will be greater than $F\{Q_i\}$ for any new grade, indicating that there is an improvement to be made from the existing solution.

Figure A3: When $P\{Q_i\}$ is a "staircase", public regulation may not be necessary.

Geometrically, the process of adding grades when $P\{Q_i\}$ is convex is a process of approximating $P\{Q_i\}$ with increasingly fine line segments of $F\{Q_i\}$, each tangent to $P\{Q_i\}$. In the limit, $F\{Q_i\} = P\{Q_i\}$. Maximum revenue is the revenue that would be realized if it were feasible to market each lot of wheat directly. The net value of the shaded areas between $F\{Q_i\}$ and $P\{Q_i\}$ in Figure A2 is a measure of the lost potential revenue from having to grade.

If $P\{Q_i\}$ is a stair-case, a second consideration may dominate. If grades are costless to introduce and maintain, the optimal number of grades will be determined by the number and size of the "stairs" in the stair-case. For example, if the stairs are of the same

magnitude then the optimal number of grades is equal to the number of stairs. Since grades are not costless, and require a minimum volume to justify themselves, it is possible that the number of bumps in the staircase exceeds the number of grades which the volume of grain justifies.

Some farmers may benefit from sub-optimal grades.

It is interesting to note that some farmers may receive a higher price under a sub-optimal grading system than they would if wheat was marketed directly at $P\{Q_i\}$, or if the grading system was optimal. This is illustrated in Figure A4. Tangency of $F\{Q_i\}$ to $P\{Q_i\}$ is only a condition of optimality. The revenue maximization

Figure A4: Some farmers may gain from sub-optimal grades.

conditions do not require it.

Revenue is maximized for any given set of grades and grade prices, and will have the same solution for any $P\{Q_i\}$ which passes through the set of (P_j, G_j) . Any wheat which is of a quality where $F\{Q_i\} > P\{Q_i\}$, such as between G_1 and G_2 in Figure A4, receives a higher price than it would receive under direct marketing or an optimal grading system.

If farmers have prior knowledge of the range of the quality of wheat they are likely to produce, some may have an interest in altering the grading system, even if that alteration is away from the welfare maximizing solution. Some conditions for this are explored further below.

Non-separate mixing intervals a sign of sub-optimal grades.

The model offers regulators an immediate tool to determine if the grading system is sub-optimal. Since it was established above that mixing intervals are separate under optimal conditions, systematic overlapping of mixing intervals by the industry would indicate a sub-optimal grading structure.³ This is especially useful given, as shown further below, that separate mixing intervals also holds for grading structures that are close to optimal.

When is public regulation of grades necessary?

Grades may exist with or without a regulator. In what cases are publicly mandated and enforced grades necessary? When public grades exist, is it necessary to forbid competing private grading systems to maximize welfare?

³ In practice errors in acquisition of stocks will lead to some over-lapping of mixing intervals by individual firms. Wide spread overlapping, carried out in similar ways among several firms, would indicate sub-optimal grades.

If $P\{Q_i\}$ is a "staircase" as in Figure A3, then public regulation is not necessary.⁴ This is illustrated in Figure A3. In this case $F\{Q_i\}$ is lower than or equal to $P\{Q_i\}$ at all points when grades are optimal. Optimal grades sustainable against competition. Mixers in a competitive market will gravitate towards this solution without a public agency decreeing the grades. The solution is stable, once attained. Coordination might be facilitated by cooperative private institutions, such as financial markets specifying standard futures contracts. Thus private market equilibrium is both optimal and sustainable.

If $P\{Q_i\}$ is strongly convex, an interesting point of analysis is raised. It is apparent from A3 that when grades are at optimum, demand price ($P\{Q_i\}$) is greater than farm price ($F\{Q_i\}$) at all points except the grade-price points. This apparently opens the opportunity for a private firm to make economic profit by establishing its own grade. The firm would choose a grade level which fell between two of the official grades, and purchase grain in a surrounding quality range at an average cost of less than the demand price for the average quality. For example, establishing a grade at the mixing point x_2 in Figure A2 of the public grades would seem to achieve this. If such activity was possible, the optimal grades would not be sustainable by the public agency (or any other agency) without protection against private competition in the establishment of grades.

⁴ Note externalities other than the mixing and grading problem may motivate the provision of public grades. For example, there may be agency problems in international trade. Foreign buyers may find it cheaper to certify that government grades are trustworthy, than to validate a domestic private market grading agency.

However, minimum volume is a factor constraining private firms from offering grades competing with a public system. If grades have been optimally established, then there is only sufficient volume to justify each grade.⁵ A new grade, placed between two optimal grades points, will command insufficient volume so long as the two optimal grades continue to exist. Its mixing interval will cover a range of quality that includes less than the required volume, since the distance between the two optimal grades was only just sufficient to provide that volume. Therefore, optimal grades are sustainable against private offerings of sub-optimal grades, *if it can be shown that the optimal grades remain in use.*

The question of whether optimal grades can be eliminated by sub-optimal grades poses some difficulties. It is clear from the results of the Kuhn-Tucker that not all grades offered by a grading system will necessarily be used. Tangency of $F\{Q_i\}$ to $P\{Q_i\}$ is only a condition for the optimal setting of grades, it is not a requirement of private market equilibrium. If grades are sub-optimally defined, then $F\{Q_i\}$ will exceed $P\{Q_i\}$ in some ranges of quality, as illustrated in Figure A4. In this case, it is possible that a grade such as G^* in the figure can be defined by the grading system but unused by the industry. Can G^* be an optimal grade eliminated by a sub-optimal grade? If this is possible, then optimal grades may need to be protected from sub-optimal competition, and a public agency with monopoly power may be required.

⁵ The existence of an export flour industry may be an example of an indirect marketing of wheat which bypasses the volume problem. Flour was shipped in bags.

The question of sustainability of optimal grades under strong convexity is addressed later in this paper, after establishing some principles governing the response of farm price ($F\{Q_i\}$) to changes in the grading system.

Cheap mixing algorithm available.

The separateness of mixing intervals under an optimal grading system yields a cheap mixing algorithm for the mixing industry. If grades are optimal, the revenue maximizing solution may be obtained simply by maximizing the amount of each grade in sequence, beginning with the highest grade.

It may seem intuitively obvious that revenue be maximized by maximizing the number of bushels in the higher grades. However, when grades are not set optimally, the slope of $F\{Q_i\}$ may be the same for adjacent mixing intervals. In this case, maximizing the wheat in the highest grades in succession will not yield the highest revenue. Revenue maximizing mixing intervals can overlap.⁶

⁶ For example, consider the case where grades were optimally set, and then another grade is added such that it is below the grade whose current mixing interval contains it. The new grade will be used, to maximize revenue, since $P\{Q_i\}$ exceeds $F\{Q_i\}$ under the existing grades. However, maximizing the content of each grade in succession beginning with the highest would result in non-use of the grade, a sub-optimal solution

The availability of a computationally simple mixing method increases the credibility of the model's predictions, since it becomes feasible for firms to fulfil the maximization conditions without excessive cost. Further below, we will establish that this algorithm also works in a range of sub-optimal grading situations.

The practice of mixing is consistent with revenue maximization.

It has been alleged, from time to time, that mixing degrades the quality of wheat and lowers the total value of the crop.⁷ As long as the product must be sold in grades, some mixing will occur. "No mixing" in a bulk grade system simply means that the mixing intervals are between the Grade minimums instead of centred on the grade minimums. The average quality of a grade becomes the mean quality of wheat harvested in that grade. The same revenue maximizing solution for mixing intervals and grades can be achieved under "no mixing" by setting grade minimums equal to the mixing interval boundaries (x_j) that would occur under the revenue maximizing solution with mixing. Thus there is no reason to believe that mixing by itself lowers the revenue to a crop.

When moving from a system of non-mixing to mixing, what is relevant is the location of the grade minimums. If grade minimums were set to achieve maximum revenue under no-mixing, then permitting mixing without adjusting the grade minimums would

⁷ For example, this accusation was made frequently by Canadian farmers prior to the establishment of the Canadian wheat marketing board.

result in lowered revenues. If non-separate mixing intervals emerged, this would signal that the grades were sub-optimal for mixing permitted. If grade standards were higher than optimum, then permitting mixing would reduce them and potentially increase total revenue.

The advantage to the regulator of permitting mixing wheat of different grades is that the regulator does not have to calculate the optimum mixing intervals. It may set grades, let mixers adapt, and adjust grades when signs of sub-optimality reveal themselves, such as overlapping mixing intervals. If mixing is not permitted, these signals cannot emerge and the regulator may remain unaware that there grades are set sub-optimally.

IMPACT OF CHANGES TO GRADES WHEN MIXING INTERVALS ARE SEPARATE

Figure A4 illustrated the possibility that some farmers may benefit from a sub-optimal grading system. This possibility could lead to strategic collective behaviour in the market and in political arenas. To explore this possibility further, it is helpful to establish some points about how the grading structure changes as grading standards are shifted from optimum.

The analysis which follows assumes the case where mixing intervals do not overlap $[(\lambda_j / B_j) > (\lambda_{j+1} / B_{j+1})]$ and where $P\{Q_i\}$ is strongly convex. As shown above, this case includes the case of optimal grades where there is also a case for a public regulator of grades. The end of this section then discusses the degree to which the assumption of separation of mixing intervals may be extended to non-optimal grading structures.

Mixing intervals are recursive.

Mixing intervals for a given crop $q\{Q_i\}$ are determined recursively, beginning with the mixing interval for the highest grade. Recall that x_i is the lower bound of quality of the mixing interval for grade i . For wheat of the highest grade

$$G_1 = (q\{x_0\} - q\{x_1\}) / (b\{x_0\} - b\{x_1\}) \quad \text{where } x_0 = 1 \text{ in the quality index} \quad (34)$$

Since G_1 and the quality and quantity of the crop are given, (34) uniquely determines the quality at the bottom end of the mixing interval (x_1). Since x_1 is also the top end of the mixing interval for the next highest grade, the value of x_2 is determined in turn from x_1 , G_2 , and the specific distribution of the volume of the crop over the range of possible quality:

$$G_2 = (q\{x_1\} - q\{x_2\}) / (b\{x_1\} - b\{x_2\}) \quad (35)$$

The mixing interval for each grade is determined in turn according to the general form given by (30). The mixing interval of the lowest grade (n) is the residual.

It follows from the recursiveness of mixing intervals that a change in the mixing interval of a grade k affects only the mixing intervals of lower grades ($j > k$). Therefore, an increase in the standard of a particular grade (G_k) would affect its own mixing interval and that of lower grades, but leave the intervals of higher grades unaffected. From (30)⁸

$$dG_k/dx_k = (G_k b'\{x_k\} - q'\{x_k\}) / B_k = (G_k b'\{x_k\} - x_k b'\{x_k\}) / B_k > 0 \quad (36)$$

(36) is positive since ($G_k > x_k$). As the grade standard increases, the mixing interval shortens by increasing its lower bound. For lower grades, assuming that grade minimums remain fixed, the mixing interval boundaries are inversely related. From (30)

$$dx_{j+1}/dx_j = -b\{x_j\}(x_j - G_{j+1}) / [b\{x_{j+1}\}(G_{j+1} - x_{j+1})] < 0 \text{ for } (n-1) > j \geq k \quad (37)$$

As the standard G_k increases, its own mixing interval shrinks as x_k rises. As x_k rises, the boundary of the mixing interval below (x_{k+1}) falls, resulting in an expansion of the mixing interval for the grade immediately below. Figure A5 illustrates the impact of an

⁸ $dG_k/dx_k = B_k^{-1}q'\{x_k\} + (q\{x_{k-1}\} - q\{x_k\}) B_k^{-2}b'\{x_k\} = (G_k b'\{x_k\} - q'\{x_k\}) / B_k$

Figure A5: Impact of an increase in G_1 ; the three grade case.

increase in G_1 for a 3 grade case. The solid lines are before the increase in G_1 and the dashed are afterwards. Intuitively, as higher quality grain is released by the shrinking higher grade into the next lower grade, the next lower grade must acquire a balancing

increase in lower quality grain to hold average quality equal to the minimum of the grade. This in turn will cause a shrinking of the grade below that, and increase in the next lower grade, and so on in alternation until grade (n), the residual. The impact on the quality of grade n will raise or lower the price of that grade, shifting the starting point of $F\{Q_i\}$. The new $F\{Q_i\}$ may be traced as a line from the new P_n through each grade-price point, changing slopes (kinking) at the borders of the mixing intervals (x_j).

Slope of $F\{Q_i\}$ is inversely related between mixing intervals.

The shift in mixing intervals from a change in the grade minimum for one grade affects the shape of $F\{Q_i\}$, affecting the price paid to farmers of all grades of wheat. Consider first the impact on the lowest grade. $F\{Q_i\}$ is flat, equalling the selling price of the grade (from (21)). If the mixing interval of the lowest grade increases, the quality of the grade increases, as does its price.

$$\begin{aligned}
 dP_n / dx_{n-1} &= P'\{Q_{j=n}\}(dQ_{j=n} / dx_{n-1}) = P'\{Q_{j=n}\}(d / dx_{n-1})(q\{x_{n-1}\} / b\{x_{n-1}\}) \\
 &= P'\{Q_{j=n}\}(q'\{x_{n-1}\} - Q_{j=n} b'\{x_{n-1}\}) / B_n \\
 &= P'\{Q_{j=n}\}(x_{n-1} - Q_{j=n}) b'\{x_{n-1}\} / B_n > 0
 \end{aligned} \tag{38}$$

(38) is positive since $(x_{n-1} > Q_{j=n})$. The impact on $F\{Q_i\}$ for the remaining grades is determined geometrically by tracing a line segment beginning from the new P_n at x_{n-1} through (P_{n-1}, G_{n-1}) to a point above x_{n-2} , then another line segment from that point through (P_{n-2}, G_{n-2}) to a point above x_{n-2} , etc. The change in the slope of $F\{Q_i\}$ within each line mixing interval depends on the segment is given by the change in the slope of the previous mixing interval, given the changes in the size of the mixing intervals. Let S_j be the slope of a $F\{Q_i\}$ within the mixing interval for G_j .

$$S_j = (P\{G_j\} - F\{x_j\}) / (G_j - x_j) > 0 \quad \text{for } j < n \quad (39)$$

$$F\{x_j\} = P_{j+1} + S_{j+1} (x_j - G_{j+1}) \quad (40)$$

Substituting (40) into (39) for grades higher than the second lowest, and taking the derivative with respect to S_{j+1} yields⁹

$$dS_j / dS_{j+1} = [(S_j - S_{j+1})(dx_j / dS_{j+1}) - (x_j - G_{j+1})] / (G_j - x_j) \quad \text{for } (dG_j = 0), \\ (j < n-2) \quad (41)$$

The sign of (41) depends on the sign of (dx_j / dS_{j+1}) since $(S_j > S_{j+1})$, $(x_j > G_{j+1})$ and $(G_j > x_j)$. Since $(dx_{j-1} / dx_j < 0)$ from (38)

⁹ The second lowest grade is excluded because the slope of the lowest grade is fixed at zero.

If $(dx_j/dS_{j+1} < 0)$ then $(dS_j/dS_{j+1} < 0)$

$$\text{and } (dx_{j-1}/dS_j = (dx_{j-1}/dx_j)(dx_j/dS_{j+1})(dS_{j+1}/dS_j) < 0) \quad (42)$$

Note that the second condition of (42) renews the sign of (dx_j/dS_{j+1}) for the next higher grade. This creates a potential continuity over any range of grades where the grade minimums are not changed. Thus, in considering the impact of a change to the grade minimum of a specific grade (G_k)

$$\text{If } (dx_{n-2}/dS_{n-1} < 0) \quad \text{then } (dS_j/dS_{j+1} < 0) \quad \text{for } (n-1 \geq j > k) \quad (43)$$

The sign of (dx_{n-2}/dS_{n-1}) can be shown to be negative *on average*, but subject to variation depending upon the density of the quality distribution of the crop ($b\{x_{n-1}\}$) at the particular point x_{n-1} . It can also be shown that the larger the discrete change in x_{n-2} , the more certain $(dx_{n-2}/dS_{n-1} < 0)$. From (38) (39) and (40)

$$\begin{aligned} dx_{n-2}/dS_{n-1} &= (dx_{n-2}/dx_{n-1})(dx_{n-1}/dS_{n-1}) \\ &= (dx_{n-2}/dx_{n-1})[(d/dx_{n-1})[(P_{n-1} - P_n)/(G_{n-1} - x_{n-1})]] \\ &= (dx_{n-2}/dx_{n-1})[S_{n-1} - dP_n/dx_{n-1}] / (G_{n-1} - x_{n-1}) \end{aligned} \quad (44)$$

The sign of (44) in turn depends whether $(S_{n-1} > dP_n/dx_{n-1})$. dP_n/dx_{n-1} is defined by (37) and the chain rule.

$$\begin{aligned} S_{n-1} - dP_n/dx_{n-1} &= S_{n-1} - P'\{Q_{j=n}\}(dG_n/dx_{n-1}) \\ &= S_{n-1} - P'\{Q_{j=n}\}(x_{n-1} - Q_{j=n})b'\{x_{n-1}\}/B_n \end{aligned} \quad (45)$$

Now since $P\{Q_i\}$ is convex, the slope of the chord connecting $(P_n, Q_{j=n})$ to (P_{n-1}, G_{n-1}) must be greater than the tangent at $P\{Q_{j=n}\}$. Since the slope of $F\{Q_i\}$ is zero over the mixing interval of the lowest grade ¹⁰

$$(P_{n-1} - P_n)/(G_{n-1} - Q_{j=n}) = S_{n-1} [(G_{n-1} - x_{n-1})/(G_{n-1} - Q_{j=n})] > P'\{Q_{j=n}\}$$

$$S_{n-1} > P'\{Q_{j=n}\}[(G_{n-1} - Q_{j=n})/(G_{n-1} - x_{n-1})] \quad (46)$$

¹⁰ In general the slope of the chord connecting two adjacent price/grade coordinates will be a weighted average of the two line segments of $F\{Q_i\}$ connecting the same two points.

$$\text{Slope of chord} = w_1 S_j + w_2 S_{j+1}$$

$$(P_j - P_{j+1})/(G_j - G_{j+1}) = [(G_j - x_j)/(G_j - G_{j+1})]S_j + [(x_j - G_{j+1})/(G_j - G_{j+1})]S_{j+1}$$

Incorporating (46) into (45)

$$S_{n-1} \cdot dP_n / dx_{n-1} > P'\{G_{n-1}\}[(G_{n-1} - Q_{j=n})/(G_{n-1} - x_{n-1}) - dG_n/dx_{n-1}]$$

$$> P'\{G_{n-1}\}[(G_{n-1} - Q_{j=n})/(G_{n-1} - x_{n-1}) - (x_{n-1} - Q_{j=n})b'\{x_{n-1}\}/b\{x_{n-1}\}] \quad (47)$$

The right hand half of (47) is certainly positive if (dG_n/dx_{n-1}) is less than one, since the other element in the brackets is greater than one.

(dG_n/dx_{n-1}) is less than one if the total wheat in the lowest grade (B_n) is greater than $((x_{n-1} - Q_{j=n})b'\{x_{n-1}\})$.

Figure A6: Conditions under which $(dG_n/dx_{n-1}) < 1$.

Figure A6 illustrates this case. If area a is lesser than area b, then (47) is positive. The sign appears to be governed by the height of $b'\{x_{n-1}\}$, which can be arbitrarily bigger than $b\{Q_{j=n}\}$ if the distribution is discontinuous. However, the relationship between the quality of the grade and the cumulative amount of wheat in the grade $b\{x_{n-1}\}$ imposes some constraints on (dG_n/dx_{n-1}) and the sign of (47).

(dG_n/dx_{n-1}) is always positive, its value varying depending on the arbitrary height of $b\{x_{j-1}\}$ at the particular point of the distribution. *On average* the quality of the bottom

grade ($Q_{j=n}$) will advance more slowly than the increase in the mixing interval boundary (x_{n-1}) since

$$\lim_{x \rightarrow 0} (Q_{j=n}) = 0$$

$$\lim_{d x \rightarrow -x} (dQ_{j=n} / dx_{n-1}) = Q_{j=n} / x_{n-1} < 1 < (G_{n-1} - Q_{j=n}) / (G_{n-1} - x_{n-1}) \quad (48)$$

Therefore, the expected sign of (44) is negative.¹¹ Let $E\{z\}$ be an operator for the expected sign of z .

$$E\{dQ_{j=n} / dx_{n-1}\} < 1 < (G_{n-1} - Q_{j=n}) / (G_{n-1} - x_{n-1}) \quad (49)$$

Note that (49) is increasingly certain the larger the discrete change in x_{n-1} . Consider the limit as x_{n-1} is increased from its current value to the grade minimum of the grade above (effectively eliminating the next higher grade by reducing its mixing interval to zero).

If x_{n-1} is increased to G_{n-1} , the new value of the average quality $Q_{j=n}$ must be less than G_{n-1} since ($Q_{j=n} = G_{n-1}$) would imply that no wheat of less than G_{n-1} existed.¹² Therefore [$dQ_{j=n} < (G_{n-1} - Q_{j=n})$] and

¹¹ Note also that $\lim_{x \rightarrow 1} (dQ_{j=n} / dx_{n-1}) < (1 - x_{n-1}) / (1 - x_{n-1}) = 1$

¹² Wheat of quality less than G_{n-1} must exist in order for both the lowest grade to have existed prior to increasing x_{n-1} . If it did not, then the model would treat G_{n-1} as the lowest grade and G_n would be irrelevant.

$$\lim_{x \rightarrow G} (dQ_{j=n} / dx_{n-1}) < (G_{n-1} - Q_{j=n}) / (G_{n-1} - x_{n-1}) \quad (50)$$

Combining (49) with (44) and (47)

$$E\{dx_{n-2} / dS_{n-1}\} < 0 \quad (51)$$

Thus (51) and (43) yield

$$E\{dS_j / dS_{j+1}\} < 0 \quad \text{for } (n-1 \geq j > k) \quad (52)$$

If we change the minimum standard for a given grade k , the slopes of the $F\{Q_j\}$ within mixing intervals of grades below k are inversely related.

Note that (52) is robust. First there is increasing certainty the larger the discrete change in G_k and consequent change in x_{n-1} (from (50)). In addition, the value of dx_{n-2} / dS_{n-1} may exceed zero by up to $[(x_j - G_{j+1}) / (S_j - S_{j+1})]$ and dS_j / dS_{j+1} would still be negative (from 41).

(52) is also *absolutely true* under a reasonable assumption. If $P\{Q_j\}$ is flat for the lowest grade, then P_n is fixed, dP_n / dx_{n-1} is zero, and (52) holds from (44). $P\{Q_j\}$ is likely to be flat if the lowest grade of wheat is used for non-wheat purposes, such as animal feed or some other use for which there are substitutes. In this case, the price of

wheat of the lowest quality will be fixed by the price of its substitutes, other available feeds. Note that the lowest grade of wheat refers to the lowest effective grade, not the lowest official grade. For example, if the lowest official grade excludes some wheat, the lowest grade in the model refers to the excluded wheat (i.e. $G_n = 0$ and accounts for residual wheat).

$E\{dS/dG_j\}$ is positive.

We may now turn to the impact of a change in G_k on the farm price of wheat within grade k 's own mixing interval. Differentiating S_k by $G_{j=k}$ (from (39) and (40))¹³

$$dS_k/dG_k = [(S_k - S_{k+1})(dx_k/dG_k) - (x_k - G_{k+1})(dS_{k+1}/dG_k) - (P'\{G_k\} - S_k)] / (G_k - x_k) \quad (53)$$

To sign (53) note that

$$\begin{aligned} S_k - S_{k+1} &> 0 && \text{by convexity of } F\{Q_i\} \\ dx_k/dG_k &> 0 \\ x_k - G_{k+1} &> 0 \\ E\{dS_{k+1}/dG_k\} &= dx_k/dG_k \times E\{dS_{k+1}/dx_k\} < 0 \\ &&& \text{from (41), (42) and (50)} \end{aligned} \quad (54)$$

¹³ Recall from the recursiveness of mixing intervals that $dx_{k,1} = 0$ for a change in G_k .

If grades begin at optimum, then $F\{Q_i\}$ is tangent to $P\{Q_i\}$ and $(P'\{G_k\} = S_k)$. For a change in G_k from optimum:

$$E\{dS_k/dG_k\} = [(S_k - S_{k+1})(dx_k/dG_k) - (x_k - G_{k+1})(dx_k/dG_k) E\{dS_{k+1}/dx_k\}] / (G_k - x_k) > 0$$

$$\text{for } (P'\{G_k\} = S_k) \quad (55)$$

Raising the standard of the grade above optimal levels increases the slope of the farm price as a function of quality within that grade.

Note again that (55) is *certain* if the price of wheat of the lowest grade is fixed by the availability of substitutes, such as alternative animal feed.

(55) will hold for additional changes beyond the optimum, so long as mixing intervals remain separate. To show this, note that convexity of $P\{Q_i\}$ requires that $P'\{G_k\}$ be greater than the chord connecting the two grade-price points (P_k, G_k) and (P_{k+1}, G_{k+1}) on $P\{Q_i\}$. Let the slope of this chord be $(C_{k,k+1})$. The slope of this cord must also be the weighted average of the slope of the two line segments S_k and S_{k+1} such that¹⁴

$$P'\{G_k\} - S_{k+1} > C_{k,k+1} - S_{k+1} = (S_k - S_{k+1})[(G_k - x_k)/(G_k - G_{k+1})] \quad (56)$$

Substituting (56) into (53), the sign of (53) for $(P'\{G_k\} \neq S_k)$ depends on whether

¹⁴ $C_{k,k+1} = [(G_k - x_k)/(G_k - G_{k+1})]S_k + [(x_k - G_{k+1})/(G_k - G_{k+1})]S_{k+1}$

$$(S_k - S_{k+1}) \times [dx_k/dG_k - (G_k - x_k)/(G_k - G_{k+1})] \geq 0 \quad (57)$$

If (57) is true, then (53) is positive. (57) will be positive if dx_k/dG_k is greater than $(G_k - x_k)/(G_k - G_{k+1})$, which in turn is lesser than one. At any given point, the specific value of dx_k/dG_k is given from (35).

$$dx_k/dG_k = B_k / [b'\{x_k\}(G_k - x_k)] \quad (58)$$

The value of (58) will vary arbitrarily depending on the value for $b'\{x_{j-1}\}$ at the particular x_k . However, for reasons similar to that for dQ_n/dx_{n-1} , the average value of dx_k/dG_k will be greater than one. As the value of G_k is increased to x_{k-1} , the amount of wheat in the grade will shrink to zero and x_k will approach G_k .

$$\lim_{G \rightarrow x(k-1)} (dx_k/dG_k) = (x_{k-1} - x_k)/(x_{k-1} - G_k) > 1 \quad (59)$$

Therefore

$$E\{dx_k/dG_k\} > 0$$

$$E\{dS_k/dG_k\} > 0 \quad (60)$$

Impact on grades higher than G_k

Recall that the mixing intervals are recursive and that changes in G_k do not affect the mixing intervals of higher grades. As the grade minimum for any G_k is increased, S_k will get steeper (on average). Since x_{k-1} remains unchanged, it is evident from the geometry that as $F\{x_{k-1}\}$ must rise and S_{k-1} must fall. From (40)

$$F\{x_{k-1}\} = P_k + S_k (x_{k-1} - G_k) \quad (61)$$

$$dF\{x_{k-1}\}/dG_k = P'\{G_k\} - S_k + (x_{k-1} - G_k)(dS_k/dG_k) \quad (62)$$

When grades are at optimum ($P'\{G_k\} = S_k$) and (64) is expected to be positive from (55) and (60). For discrete changes in G_k beyond the optimum, note that as G_k approaches its upper bound x_{k-1} ¹⁵

$$\lim_{G \rightarrow x(k-1)} (dF\{x_{k-1}\}/dG_k) = (P\{x_{k-1}\} - F\{x_{k-1}\})/(x_{k-1} - G_k) > 0 \quad (63)$$

Therefore, for discrete changes in G_k

$$E\{dF\{x_{k-1}\}/dG_k\} > 0 \quad (64)$$

¹⁵ Convexity of $P\{Q_i\}$ and linearity of $F\{Q_i\}$ require that $(P\{x_{k-1}\} > F\{x_{k-1}\})$ when $(P'\{G_k\} = S_k)$.

Given that mixing intervals remain fixed for grades higher than k , it follows that

$$E\{dS_{k-1}/dG_k\} < 0 \quad (65)$$

$$dS_{j-1}/dS_j < 0 \quad \text{for } j < k \quad (66)$$

Results hold for any "well separated grades".

The results for this section (from (34) to (66)) were derived assuming all mixing intervals were separate ($S_j > S_{j+1}$). This condition will hold for optimally set grades. To what extent do the results hold for sub-optimal grades?

Mixing intervals will be separate so long as the slope of the price function within intervals are not equal. From (60), we expect that discrete changes in G_k will produce a change S_k of the opposite sign. This will be more certain, the larger the change in G_k . As (G_k) increases, S_k becomes steeper at the same time as S_{k-1} also becomes shallower (from (67)). This suggests a range of tolerance above G_k as the value of S_k and S_{k+1} converge, since we begin with $(S_{k-1} > S_k)$. If the point of equal slopes is not reached, there is a critical point where G_k approaches the boundary of the higher grade's mixing interval (x_{k-1}). Once G_k exceeds x_{k-1} , the two mixing intervals must become common, or one grade must fall into disuse.

Examining reductions in G_k , we find that S_k will become shallower at the same time as S_{k+1} becomes steeper (from (54)). Again, this suggests a range of tolerance prior to slopes becoming equal. If this equality is not reached, the critical point comes when x_k , which is falling at a faster average rate than G_k , reaches G_{k+1} . At this point, the two mixing intervals must become joint, or one grade must fall into disuse.

Therefore, there is a range of tolerance around the optimal location for each grade where mixing intervals remain separate. Mixing intervals become joint when the grade minimums for two grades are placed too close to one another (such as within the mixing interval that would occur if grade quantities were maximized from the top down). Define "well separated grades" as grades whose minimums are spaced well enough apart to ensure separate mixing intervals.

The results of this section hold for well separated grades.

The significance of the range of tolerance is that signals of sub-optimality discussed earlier, such as overlapping mixing intervals and unused grades, signal more than just a lack of perfection in the placement of grades. They signal that grades are sufficiently out of line with optimum that the range of tolerance has been exceeded.

SUSTAINABILITY OF OPTIMAL GRADES & PUBLIC REGULATION OF GRADES

An earlier section of this paper raised the question of whether optimal grades were sustainable against the offering of non-optimal grades by firms or competing agencies.

It was determined that, because of minimum volume requirements, optimal grades were sustainable provided the introduction of a sub-optimal grade did not eliminate an optimal grade from use.

Using the results derived above, we may show that optimal grades are sustainable and not eliminated from use by sub-optimal grades. For a grade to be eliminated from use, the farm price for that grade must exceed the demand price, as for G^* in Figure A4. This requires that for the grade below G^* , the slope of $F\{Q_i\}$ be steeper than $P\{Q_i\}$. However, the introduction of a grade below G^* which eliminates G^* is equivalent to lowering the grade minimum G^* . (60) shows that the slope of $F\{Q_i\}$ at G^* may be expected to become shallower as G^* is lowered. If G^* is an optimal grade, it begins with the slope of $F\{Q_i\}$ at that point tangent to $P\{Q_i\}$. Therefore the lowering of G^* (e.g. to G_2 in Figure A4) may be expected to produce a local slope of $F\{Q_i\}$ that is shallower than $P\{Q_i\}$, rather than steeper as required for elimination of the optimal grade. We may conclude that the introduction of a sub-optimal grade below an optimal grade is not expected to eliminate the optimal grade from use. Similar logic holds for the introduction of a sub-optimal grade above an optimal grade.

As a result, *optimally set grades are sustainable against competition by sub-optimal grades.* As discussed earlier, optimal grades will have just the necessary minimum volume requirements to sustain them. Since the introduction of new grades will not eliminate optimal grades from use, the new grade would cover a mixing interval with less than the minimum volume required to justify the cost of maintaining a grade. It would not be viable.

Note the same cannot be said for sub-optimal grades. If the current set of grades is sub-optimal, it will be possible to introduce a competing set of grades which will dominate the current set. If the grades are set at levels other than revenue maximizing levels, it follows that an alternative agent marketing a set of optimal grades can realize higher revenues, and purchase the crop at a set of offer

Figure A7: Raising the standard of the grade raises farm price for the whole grade.

prices that dominate the farm prices resulting from the sub-optimal grades.

Thus optimal grades are sustainable and achievable by private market competition, if they can achieve sufficient scale.

If optimal grades are sustainable, is there any need for a public agency to maintain them? The implication of the above findings is that there is nothing inherent in the economies of scale for handling a commodity by grade that necessitates a public agency conducting the grading. A set of optimal grades does not require public protection. However, there are other potential reasons for public regulation of grades, including lower agency costs and anti-trust considerations. Exploration of these areas is beyond the scope of this paper.

STRATEGIC INTERESTS OF INDIVIDUAL FARMERS

The dynamics of the response of $F\{Q_i\}$ to changes in the grading structure yield some insight into the potential for strategic behaviour by farmers in seeking modifications to the grading system.

Raising the standard of a grade benefits farmers within the grade.

If we raise the minimum quality for grade k , we may expect that all wheat within that grade will receive a higher farm price ($G_{k-1} > Q_i > G_k$). Figure A7 illustrates this point. The solid lines are before the increase in G_k and the dashed lines are after the change. We expect S_k to rise and S_{k-1} to fall, with the result that $F\{Q_i\}$ is higher over the interval (G_k) to (G_{k-1}) . A similar diagram may be drawn for top grade wheat. Therefore it is in

the interest of farmers to raise the grade minimum for their grade, even if such an increase is sub-optimal for the revenue maximization of the whole crop.

Whether farmers will find it worthwhile to seek such changes will depend upon their degree of knowledge about the expected quality of their crop in advance of a harvest. If they cannot attribute a high probability to their crop falling within a particular grade, then there is no motivation for action. Such farmers are "behind the veil" in seeking political consensus on a grading regime.

The burden of lower than optimal standards are borne disproportionately by the higher grades.

The above analysis has dealt with a change in one grade minimum. What if all grade minimums are lowered or raised together?

By definition, sub-optimal grades involve lower revenues to farmers collectively. However, we may be interested in who bears the burden of

Figure A8: Slope S_j bounded.

grading standards which are generally lower or higher than optimum.

The direction of expected changes in the slope of $F\{Q_i\}$ for each segment are no longer clearly defined. The interdependence of the mixing intervals will mean that changes in each will effect the others. The net quantitative effect will depend on the specifics of the quality distribution of the harvest $b'\{x_{j-1}\}$.

However, we may state a general expectation of the impact on the slopes of each S_j which will grow in certainty the larger the collective deviation of grading standards either above or below optimum. To show this, note that convexity of $F\{Q_i\}$ and $P\{Q_i\}$ means that the slope of a given S_j is bounded by the slope of the chords connecting its grade/price point to the two lower points. This is illustrated in Figure A8. Let $S_{j,max}$ be the maximum value for S_j

$$C_{j,j+1} = [(G_j - x_j)/(G_j - G_{j+1})]S_{j,max} + [(x_j - G_{j+1})/(G_j - G_{j+1})]C_{j+1,j+2} \quad (67)$$

Therefore

$$S_j \leq [(G_j - G_{j+1})/(G_j - x_j)]C_{j,j+1} - [(x_j - G_{j+1})/(G_j - x_j)]C_{j+1,j+2}$$

$$S_j \geq C_{j,j+1} \quad (68)$$

Now as the grade minimums are lowered jointly, convexity in $P\{Q_j\}$ requires that the slopes of both chords in (68) also decline. In addition, the chords higher on $P\{Q_j\}$ will decline faster, so that the range limiting S_j will move down more quickly (and narrow more quickly) the higher is grade j . Therefore, on average, S_j will decline as grade minimums fall jointly and the higher the grade, the more swiftly S_j will fall. If grade minimums each fall by a full grade (equivalent to simply deleting the top grade and dividing the bottom grade in two), then a reduction in each S_j is forced.

Not all grain will suffer a loss in price. Grains of specific quality may benefit from the shallower slopes, either by being in the lower half of a mixing interval or by slipping into a higher grade's mixing interval as the grade minimums fall. However, top quality grain expects an unambiguous fall in price since the slope S_1 is expected to fall and the intercept at $P\{G_1\}$ falls with G_1 . The average fall in S_1 is also expected to be larger than any other S_j due, again, to convexity.

The lowest quality grain is either a loser, or breaks even. The shifting of other grade minimums down will reduce its mixing interval as higher quality grain is taken from it to mix with grade $n-1$. However, the fall in price will tend be less than that experienced by the top grade.¹⁶ If the price of the lowest grade is fixed by the price of substitute goods, such as alternative animal feed, then the lowest quality grain is unaffected.

¹⁶ Convexity, as before.

In general, since convexity implies higher sensitivity to price at higher levels of quality, the higher grades will tend to bear a greater portion of the loss from a reduction in the quality of the grades below optimal levels. The reverse is also true. Higher grades experience a greater proportion of the benefits from an increase in grade minimums from below optimum to optimum.

Figure A9: Surface of $F\{Q_i\}$ for 4 grades defined in terms of two dimensions of quality

THE MODEL EXTENDS TO "N" DIMENSIONS OF QUALITY

The model presented maximizes revenue under competitive conditions for a single dimension. Grading may happen in more than one dimension simultaneously, such as grading of wheat by moisture and protein content as well as percent hard red kernels.

The results of the one dimensional model must extend to any number of dimensions. If revenue is maximized for mixing in all dimensions, then revenue must be maximized for

mixing in any one dimension, given the mixing decision in other dimensions. Thus the n -dimensional model is simply the simultaneous application of one dimensional conditions for each dimension of quality.

For two dimensions of quality, the result may be visualized in three dimensions with $P\{Q_i\}$ being a curved surface such that price increases at an increasing rate in each quality dimension.¹⁷ $F\{Q_i\}$ will be a jointed plane whose shape is determined by the one dimensional model along the joints of the planes. The location of the joints will be determined by the definitions of grades. For example, if there is only one dimension of grades covering two dimensions of quality (e.g. grade one must have more than $x\%$ hard red kernels and less than $x\%$ moisture content), then the surface of $F\{Q_i\}$ will be a bevelled slope, as illustrated in Figure A9.

The only requirement is that all dimensions of quality be cardinal. If there is a qualitative discriminator, such as whether the grain has been subject to special treatments, then this class of grain effectively becomes a separate product with its own potential grading structure within the cardinal quality dimensions. (e.g. protein content for treated grain a separate set from protein content for untreated grain).

¹⁷ If price does not increase at an increasing rate in all dimensions, then the offending dimension will either not be used for more than one quality level or should be removed as neutral to revenue.

IMPLICATIONS FOR THE CANADIAN WHEAT POOLS

An important proposition explaining the establishment of the wheat pool is that the Pool was, at least in part, an attempt to bypass an industry whose competitive practices degraded the quality of wheat and reduced the value of the Canadian crop on the world market.

The findings of this Appendix support this notion. The legalization of mixing would have effectively lowered the standards of all grades by roughly half a grade, as the average quality fell from the mean of the grade to the minimum of the grade.¹⁸ If we assume that the grades were reasonably spaced ("well-separated") prior to the legalization of mixing, then the lowering of standards of all grades would have lowered total revenue to the crop. Because all standards were lowered simultaneously, separation would have been maintained and this would not necessarily lead to unutilized grades or other obvious signals of sub-optimality.

If the grading standards were reasonably well set before the advent of mixing, then the significant drop in standards would have meant lower than optimal quality for the grades of wheat Canada marketed internationally, and a consequent fall in farm income. Restoring a higher grading standard would have restored farm incomes. To market alternative grades it would be necessary to establish a vertically integrated structure to

¹⁸ Mixing was illegal prior to the Canada Grain Act of 1912. Following the Act, the practice of mixing spread slowly through a widening application of the definition of "hospital elevators".

control the identity of the grain, and to have sufficient volume to take advantage of the scale economies in transport and storage created by grades. These requirements were met by the Pool, and were distinct from earlier cooperative efforts. The independent control and marketing of wheat is also consistent with the requirements of "orderly marketing" the official reason for being of the Pool.

In addition, this paper has shown that, if the current grades are not optimally set, establishing and marketing alternative grades can be feasible and profitable.

This Appendix has also shown that the greatest proportion of benefits from restoring a higher quality grading regime would have gone to farmers of the highest quality grain. This would have been due to the greater sensitivity of price to quality for higher quality grain. In addition the lowest quality grain would receive little or no benefit if its price rested on a floor established by the price of alternative products, such as other animal feeds.

Therefore, farmers of higher quality wheat would have been more likely to join the Pool.

This hypothesis is tested in the main text.

APPENDIX B:
**APPLYING LOGIT TO GROUPED DATA WHEN GROUP ELEMENTS
ARE NOT INDEPENDENT TRIALS**

This appendix extends the class of models to which logit may be applied to cases of grouped data where group elements are not independent. Logit may be applied when a dependent variable is a qualitative decision, adopting a value of either zero or one. Logit may also be applied to grouped data, where the dependent variable is the average qualitative decision of a given group, ranging in value between zero and 100%. In the case of grouped data, observations must be weighted to account for heteroscedasticity. The usual weighting formula assumes that the elements making up each group are independent trials. This appendix examines a common case where the elements within group are making qualitative decisions which are not independent of the decisions of other members within each group. Two examples are survey data which has been weighted to improve the representativeness of the sample, and qualitative decisions regarding farm acreage, where the underlying decision unit is the farm. These examples are part of a general case where the dependent variable may be represented as a weighted average of the qualitative decision by each group element. The appendix develops a regression weighting formula to account for heteroscedasticity in such cases, extending the class of models to which logit may be applied.

The Usual Correction for Logit Heteroscedasticity

Logit is often used when a dependent variable is bounded between zero and one, such as the probability of an individual buying a particular brand of soap. The logit functional form is

$$p = (1 + e^{-(\beta X)})^{-1} \quad (1)$$

where p is the probability of an event occurring, X is a vector of independent variables determining p , e is the base of natural logarithms, and β is vector of parameters. An advantage of logit is that it may be transformed to a linear function and estimated by ordinary least squares:

$$\log\{p/(1-p)\} = \beta X_i \quad (2)$$

(2) is estimated by

$$\log\{\hat{p}_i/(1-\hat{p}_i)\} = \beta X_i + u_i \quad (3)$$

where $\hat{p}_i$ is the observed outcome for observation i . Since the left hand side of (2) is undefined for $(\hat{p}_i=1)$, this transformation cannot be used for dependent variables which are single decisions, such as individuals buying or not buying a brand of soap ($\hat{p}$ adopts a

value of zero or one). (2) can be used for dependent variables where each observation represents the average decision of a group of individual qualitative decisions:

$$\hat{p}_i = \sum_{j=1, \dots, n_i} \hat{p}_{ij} / n_i \quad (4)$$

where $\hat{p}_{ij}$ is the decision by member j of group i , and n_i is the number of elements in group i . Since $\hat{p}_{ij}$ adopts a value of either zero or one, $\hat{p}_i$ is also the proportion of elements in group i making a positive decision. $\hat{p}_i$ is therefore continuous between zero and one. Since all elements of group i share the same vector X_i ,

$$p_{ij} = p_{ik} = p_i$$

and

$$E\{\hat{p}_i\} = p_i \quad (5)$$

The disturbance term in (3) is known to be heteroscedastic for grouped data. Intuitively, the larger the number of elements in group i , the lower the variance of $\hat{p}_i$ from p_i . When the decision by elements of each group is independent, the distribution of $\hat{p}_i$ around p_i is binomial, and the variance is¹

¹ For demonstration see, for example, Maddala G.S., *Limited dependent and qualitative variables in econometrics* pages 29-31.

$$E\{u_i^2\} = (np_i(1-p_i))^{-1} \quad (6)$$

To correct ordinary least squares for this heteroscedasticity, observations may be weighted by the inverse of the standard deviation from (6) using $\hat{p}_i$ in place of the unknown p_i .

$$W_i = (n\hat{p}_i(1-\hat{p}_i))^{-1} \quad (7)$$

where W_i is the regression weight applied to observation i . The larger the number of elements in group i , the larger the weight to observation i .

The Problem

In many grouped data cases, the decision of group members is not independent from other groups, and weights developed from (6) will not correctly compensate for heteroscedasticity.

For example, consider an agricultural model where the dependent variable is the proportion of cultivated acres planted with a particular crop in each agricultural district. n_i would be the number of acres in each group i . The application of (6) would be inappropriate, since the decision to plant each individual acre is not independent of other acres. It may be more appropriate to consider the farmer the decision making unit (e.g.

does the farmer plant all of their acreage in the spring or not?). In this case, the model would ideally use the proportion of farmers planting, rather than the proportion of acres. However, available data may be in terms of acres rather than number of farms.²

This problem also occurs in a broad class of data: survey data that is weighted to achieve better representation. When a survey sample is not representative of the underlying population, results are often weighted to achieve a better estimate. For example, if 50% of the population is known to be female, but only 25% of the sample is female, then female respondents may be counted twice in the calculation of sample statistics. In this case, not all trials are independent. In addition, the sources of variance are asymmetric between male and female respondents, since every pair of female respondents has a covariance of 1 (between the original respondent and their duplicate).

² This is the question in the main paper. Farmers choose to join or not join a farm organization. The number of farmers joining the organization is unavailable as a dependent variable, but the number of acres controlled by the organization is. Thus the dependent variable is proportion of acres, but the underlying independent trials is the decision by each farmer. All the acres of a given farm made the same "decision" to (join/not join).

These examples fall into the broader case where the observed proportion of positive decisions in a group is a *weighted* average of independent decisions by elements of the group. That is

$$p_i = \sum_{j=1, n_i} w_{ij} p_{ij}$$

and

$$\hat{p}_i = \sum_{j=1, n_i} w_{ij} \hat{p}_{ij} \quad (8)$$

where w_{ij} is the proportional weight given to decision by element j of group i . In the case of farm acreage, w_{ij} would be the proportion of acreage in group i controlled by farmer j , and n_i would refer to the number of farmers in group i . In the case of survey data, the w_{ij} would be the proportionate weight given to survey respondent j in group i , and n_i would refer to the number of respondents.³

The usual case for logit grouped data (4) may be viewed as a special case of the more general (8), where weights are equal.

³ Note that some survey sample weighting procedures involve duplicating observations prior to calculation, rather than weighting in the calculation. For example, if women are under-represented, each female response is duplicated and treated as two separate records. In this case n_i refers to the original number of independent respondents, before record duplication.

This appendix develops an appropriate weighting formula to correct for heteroscedasticity in cases covered by (8). Appropriate weights are developed for both the full information case, and for cases where information on the stochastic process underlying the dependent variable is not known.

Developing Corrective Weights for the More General Case

To derive appropriate weights to correct for heteroscedasticity in the broader case, substitute (2) into (3):⁴

$$u_i = \log\{\hat{p}_i/(1-\hat{p}_i)\} - \log\{p_i/(1-p_i)\} \quad (9)$$

The first term in (9) can be approximated by a first order Taylor expansion around p_i , the true probability. This yields

$$\log\{\hat{p}_i/(1-\hat{p}_i)\} = \log\{p_i/(1-p_i)\} + (\hat{p}_i - p_i)(d/dp_i)\log\{p_i/(1-p_i)\} \quad (10)$$

Substituting (10) into (9) and simplifying:

⁴ This derivation is a generalization and extension of the proof for logit weights under ordinary grouped data. For example, see Maddala G.S. *Limited dependent and qualitative variables in econometrics*, pages 29-31.

$$u_i = (\hat{p}_i - p_i) / (p_i(1-p_i)) \quad (11)$$

Since the mean of the disturbance term is zero, the variance of the disturbance term is given by

$$E\{u_i^2\} = E\{(\hat{p}_i - p_i)^2 / (p_i(1-p_i))^2\} \quad (12)$$

By definition of the problem, the decision of each group element (p_{ij}) is now an independent trial. The covariance problem is defined by the unequal weights (w_{ij}) accorded to each trial within a group. Therefore, covariance between and the covariance of $\hat{p}_{ij}$ and $\hat{p}_{ik}$ is zero and we may define the numerator of (12) as

$$\begin{aligned} E\{(\hat{p}_i - p_i)^2\} &= E\left\{\left(\sum_{j=1,n} w_{ij}(\hat{p}_{ij} - p_i)\right)^2\right\} = \sum_{j=1,n} \sum_{k=1,n} w_{ij} w_{ik} E\{(\hat{p}_{ij} - p_i)(\hat{p}_{ik} - p_i)\} \\ &= E\{(\hat{p}_i - p_i)^2\} \sum_{j=1,n} w_{ij}^2 \end{aligned} \quad (13)$$

As a binomial distribution with only one trial,

$$E\{(\hat{p}_{ij} - p_i)^2\} = p_i(1-p_i) \quad (14)$$

Inserting (13) and (14) into (12) yields an expected variance of the disturbance term of

$$E\{u_i^2\} = (\sum_{j=1,n} w_{ij}^2) / (p_i(1-p_i)) \quad (15)$$

Appropriate regression weights to adjust for heteroscedasticity are the inverse of the standard deviation taken from (15), using the observed $\hat{p}_i$ in place of the unknown p_i .

$$W_i = [(\sum_{j=1, n} w_{ij}^2) / (\hat{p}_i(1-\hat{p}_i))]^{-.5} \quad (16)$$

where W_i is the weight given to observation i in the regression.

Note that (16) simplifies into the usual weighting formula (7) if weights are set equal to $(1/n)$. The usual model producing (7) is a special case of the more general model, where weights are restricted to be equal (i.e. a simple average rather than a weighted average).

It is not necessary to have knowledge of the individual weights (w_{ij}) to apply 7.1.

Suppose, for example, only the variance of weights within each group was known, along with the number of true independent trials in each group. In the farm example this would mean knowing the mean and variance of farm size, and the number of farmers, while having a dependent variable based on acreage. It can be shown that:

$$\sum_{j=1, n} w_{ij}^2 = N_i^{-1}(N_i^2 \sigma_i^2 + 1) \quad (17)$$

where σ_i^2 is the variance of w_{ij} for group i , and where N_i is the number of independent trials underlying in each group i underlying the data (e.g. farmers, not acres).⁵ Substituting (17) into (16) yields regression weights correcting for heteroscedasticity of

$$W_i = [(N_i \sigma_i^2 + N_i^{-1}) / (\hat{p}_i(1-\hat{p}_i))]^{-1/2} \quad (18)$$

In the simple case of independent equally weighted trials, ($N_i=n_i$) and ($\sigma_i^2=0$), and (18) simplifies to the usual regression weights given by (7). Thus the usual regression weights for grouped data under logit are a special case of the more general problem covered by (8).

Finding Appropriate Regression Weights under Limited Information

The information requirements for practical application of (16) or (18) are demanding. In the case of weighted survey data, the variance of weights in each subgroup will be known

⁵ By definition

$$\sigma_i^2 = N_i^{-1} \sum_{j=1, N} (w_{ij} - N_i^{-1})^2 = N_i^{-1} (\sum_{j=1, N} w_{ij}^2) - N_i^{-2} \quad (17.1)$$

Rearranging (8.1) yields

$$\sum_{j=1, N} w_{ij}^2 = N_i^{-1} (N^2 \sigma_i^2 + 1) \quad (17.2)$$

to the organization which generated the data.⁶ In other cases, information on σ_i^2 may not be available.

Consider the case where there is no information on σ_i^2 , but N_i is known for each group. In the farm acreage case, this would mean knowledge of the number of farms in each agricultural district, but lack of knowledge of the variance of farm size.

It is possible to develop correct regression weights to adjust for heteroscedasticity based on this limited information.

Let $\text{Cov}\{x,y\}$ be the notation for covariance between any x and y . From (13)

$$\begin{aligned} E\{(\hat{p}_i - p_i)^2\} &= \sum_{j=1,n} \sum_{k=1,n} E\{w_j w_k (\hat{p}_j - p_i)(\hat{p}_k - p_i)\} \\ &= \sum_{j=1,n} E\{(\hat{p}_j - p_i)^2\} E\{w_j^2\} + \text{Cov}\{(\hat{p}_j - p_i)^2, w_j^2\} \end{aligned} \quad (19)$$

If we assume that the outcome $\hat{p}_j$ of element j is independent of its relative weight w_j within group i , then the covariance term in (19) may be assumed equal to zero. This assumption of independence is consistent with the general logit approach to grouped data, where all elements of a given group i are assumed to have the same probability p_i . With this assumption, from (17) and (14)

⁶ Of course, such information may not have been retained by the organization.

$$\begin{aligned}
 E\{(\hat{p}-p)^2\} &= \sum_{i=1}^N E\{(\hat{p}_i-p)^2\} E\{w_i^2\} = p_i(1-p_i) E\{N_i^{-1}(N_i^2 \sigma_i^2 + 1)\} \\
 &= p_i(1-p_i) (N_i^{-1} (E\{N_i^2 \sigma_i^2\} + 1))
 \end{aligned} \tag{20}$$

Inserting (20) into (12):

$$E\{u_i^2\} = (N_i^{-1} (E\{N_i^2 \sigma_i^2\} + 1)) / (p_i(1-p_i)) \tag{21}$$

Now, let A_{ij} be the factor determining the weight assigned to each element of group i such that

$$w_{ij} = A_{ij} / (\sum_{j=1}^N A_{ij}) \quad \text{and} \quad M_i = N_i^{-1} \sum_{j=1}^N A_{ij} \quad \text{and} \quad V_i = N_i^{-1} \sum_{j=1}^N (A_{ij} - M_i)^2 \tag{22}$$

where M_i is the mean of A_{ij} for group i , and V_i is the variance. In our examples, A_{ij} might be the number of acres held by each farm, or the inverse of the response rate in the case of surveys (e.g. the number of duplicate records made in order to weight the survey, if that approach is used).

In the absence of information on systematic variation of the A_{ij} between groups, we may say that

$$E\{V_i/M_i\} = k \tag{23}$$

where k is a constant common to all groups. (If systematic information on A_i is available, then it may be possible to estimate σ_i^2 , and we may apply (18)).

From (22) and (23):

$$E\{N_i^2 \sigma_i^2\} = E\{N_i (\sum_{j=1}^N (w_{ij} - N_i^{-1})^2)\} = E\{V_i/M_i\} = k \quad (24)$$

Inserting (24) into (21):

$$E\{u_i^2\} = (N_i^{-1}(k+1))/(p_i(1-p_i)) \quad (25)$$

and the implied regression weights are

$$W_i = [N_i(p_i(1-p_i))(k+1)]^{-1} \quad (26)$$

The value for $(k+1)$ is unknown. However, the purpose of regression weights is to provide *relative* weights for observations. Relative weights are unaffected by multiplication by a constant, so we may multiply (25) by $(k+1)^{-1}$ and define regression weights for the case where only N_i is known as

$$W_i = (N_i(p_i(1-p_i)))^{-1} \quad (27)$$

using the observed values $\hat{p}_i$ as proxies for p_i yields

$$W'_i = (N_i(\hat{p}_i(1-\hat{p}_i)))^5 \quad (28)$$

(28) is similar to the usual weights described by (7), with the exception that N_i is the underlying decision making unit (e.g. farms), rather than the number of units n_i implied by the dependent variable (e.g. acres).

It is possible that the econometrician suspects that there is systematic variation in A_{ij} between groups i , but that there is insufficient information to estimate σ_i^2 . In this case the regression weights given by (18) cannot be estimated, and the assumptions underlying (28) are violated.

In such a case, it can be shown that the regression weights given by (28) are asymptotically accurate in N_i . The larger the number of elements in each group i , the more accurate a correction for heteroscedasticity is provided by (28).

To demonstrate the asymptotic accuracy of (28) note that, ceteris paribus, the value of σ_i^2 will vary with N_i . The larger N_i , the smaller the value of both individual weights w_{ij} and the mean weight M_i , and the smaller the resulting variance. If the underlying weighting factors A_{ij} are drawn from a different distribution for each group i , then we may say that

$$E\{(d/dN_i)w_{ij}\} = E\{A_{ij}(d/dN_i)(\sum_{j=1, N} A_{ij})^{-1}\} = -w_{ij}(\sum_{j=1, N} A_{ij})^{-1}E\{(d/dN_i)(\sum_{j=1, N} A_{ij})\} \quad (29)$$

Since the expected increase in $(\sum_{j=1, N} 1_{ij})$ from an increase of one in N_i is equal to the mean of A_{ij} , we may continue (29) as

$$E\{(d/dN_i)w_{ij}\} = -w_{ij}(\sum_{j=1, N} A_{ij})^{-1}M_i = -w_{ij}N_i^{-1} \quad (30)$$

For each group i , the value of each w_{ij} may be expected to fall proportionate to the inverse of N_i as N_i is expanded. From (30) it follows that the expected impact of an expansion in N_i on σ_i^2 to be

$$E\{(d/dN_i)\sigma_i^2\} = -3\sigma_i^2N_i^{-1} \quad (31)$$

and

$$E\{(d/dN_i)\sigma_i^2N_i^3\} = 0 \quad (32)$$

$$E\{\sigma_i^2N_i^3\} = k_i \quad (33)$$

where k_i is now a constant unique to each group i . Combining (33) with (20) and (12) yields:

$$E\{u_i^2\} = (N_i^2(k_i+N_i)/(p_i(1-p_i)) \quad (34)$$

The implied regression weight is

$$W_i = [N_i^2(p_i(1-p_i)(k_i+N_i)^{-1})]^5 \quad (35)$$

Again (35) simplifies to (7) in the simple case where weights w_{ij} are equal within each group i . In this case σ_i^2 is equal to zero, as is k_i .

k_i is unknown for all i , however the relative weight given to each observation by the regression weights is

$$W_i/W_k = [N_i^2(p_i(1-p_i)/N_k^2(p_k(1-p_k))]^5 [(k_k+N_k)/(k_i+N_i)]^5 \quad (36)$$

As both N_i and N_k approach infinity, the impact of the constant k_i 's on their ratio declines

$$\lim_{N_i, N_k \rightarrow \infty} (k_k+N_k)/(k_i+N_i) = N_k/N_i \quad (37)$$

and

$$\lim_{N_i, N_k \rightarrow \infty} W_i/W_k = [N_i(p_i(1-p_i)/N_k(p_k(1-p_k))]^5 \quad (38)$$

Since (38) is the same relative weight as given by (28), we may say that the regression weights provided by (28) are still asymptotically accurate when there is reason to believe that the distribution of weighting factors A_i vary between groups. The larger the number of elements N_i in the groups, the more accurate an adjustment for heteroscedasticity is provided by (28).

It is helpful to note that the N_i need not be very large to be relatively accurate, since the value of the k_i 's is likely to be low. When N_i equals 2, the upper limit on the value of σ_i^2 is .25, and the upper limit on the value of k is $(8 \cdot .25 = 2)$.⁷ Since the value of k is neutral with respect to N_i , and positive, we may say that for groups of any size

$$0 \leq k_i \leq 2 \quad (39)$$

CONCLUSION

This appendix has expanded the potential applications of logit by considering the case where the dependent variable is grouped data which does not represent independent trials, but can be characterized as a weighted average of independent trials. It was shown that the usual grouped data case for logit is a special case of this more general model.

⁷ For N_i equal to 2, the largest value for σ_i^2 is given by $w_{i1}=1$ and $w_{i2}=0$, with a consequent mean weight of .5. Then $\sigma_i^2 = [(.5)^2 + (-.5)^2]/2 = .25$.

Regression weights for the correction of heteroscedasticity were developed for both the full information and limited information cases.

When the mean and variance of weights within each group are known, then appropriate weights to correct for heteroscedasticity are:

$$W_i = [(N_i \sigma_i^2 + N_i^{-1}) / (\hat{p}_i(1-\hat{p}_i))]^{-5} \quad (18)$$

If only the number of underlying trials N_i is known, and if we can assume that the ratio of mean to variance of weighting factors does not vary systematically between groups, then appropriate weights are:

$$W_i = (N_i(\hat{p}_i(1-\hat{p}_i)))^5 \quad (28)$$

where N_i represents the number of independent trials underlying the dependent variable (farmers when the dependent variable is acres). If there is reason to believe there is systematic variation of ratio of mean to variance of weighting factors between groups, (28) is still asymptotically correct, and useful in relatively small group sizes.

APPENDIX C: REGRESSION RESULTS

This appendix reports regression results in the order that they are presented in the main text. Summary statistics, variance-covariance matrix and other tests are reported. A short key to variables is found immediately after the table of contents in the main text. Variables are fully defined and sourced in Appendix D. Method of transformation and weighting for logit under ordinary least squares is defined in Appendix B.

LS // Dependent Variable is CDHD1

Date: 9-07-1993 / Time: 18:57

SMPL range: 1 - 20

Number of observations: 20

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	254.58378	7.0264708	36.232098	0.0000
CDDGDAY	-0.0118393	0.0026567	-4.4564281	0.0003
CDLAT	0.1348022	0.0311574	4.3264839	0.0005
R-squared	0.885683	Mean of dependent var	229.0882	
Adjusted R-squared	0.872234	S.D. of dependent var	4.172021	
S.E. of regression	1.491262	Sum of squared resid	37.80567	
Log likelihood	-34.74604	F-statistic	65.85471	
Durbin-Watson stat	1.990431	Prob(F-statistic)	0.000000	

Coefficient Covariance Matrix

C,C	49.37129	C,CDDGDAY	-0.018591
C,CDLAT	-0.166037	CDDGDAY,CDDGDAY	7.06E-06
CDDGDAY,CDLAT	5.85E-05	CDLAT,CDLAT	0.000971

LS // Dependent Variable is CDHDI

Date: 9-07-1993 / Time: 18:58

SMPL range: 1 - 20

Number of observations: 20

```
=====
      VARIABLE      COEFFICIENT      STD. ERROR      T-STAT.      2-TAIL SIG.
=====
          C          277.63952          6.4512413          43.036604          0.0000
      CDDGDAY        -0.0199674          0.0026461         -7.5459119          0.0000
=====
R-squared              0.759810      Mean of dependent var      229.0882
Adjusted R-squared     0.746466      S.D. of dependent var      4.172021
S.E. of regression     2.100701      Sum of squared resid      79.43297
Log likelihood         -42.17058      F-statistic                56.94079
Durbin-Watson stat     1.757691      Prob(F-statistic)          0.000001
=====
```

```
=====
                        Coefficient Covariance Matrix
=====
C,C                      41.61851      C,CDDGDAY                -0.017025
CDDGDAY,CDDGDAY          7.00E-06
=====
```

LS // Dependent Variable is LSRAS

Date: 7-21-1993 / Time: 18:34

SMPL range: 1 - 35 37 - 38 40 - 84
 86 - 86 88 - 91 94 - 134
 136 - 147 151 - 152 155 - 155
 157 - 157 159 - 160

Number of observations: 146

Weighting series: WLOGAS

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	2.4708545	0.7158498	3.4516382	0.001
DGDAY	-0.0010056	0.0002735	-3.6769527	0.000
LAT	0.0141223	0.0033820	4.1756660	0.000
POPSQ	-2.945E-08	1.482E-08	-1.9871937	0.047

Weighted Statistics

R-squared	0.237619	Mean of dependent var	0.233016
Adjusted R-squared	0.221513	S.D. of dependent var	0.506481
S.E. of regression	0.446878	Sum of squared resid	28.35736
Durbin-Watson stat	1.533136	F-statistic	14.75287
Log likelihood	-87.53847		

Unweighted Statistics

R-squared	0.243634	Mean of dependent var	0.291472
Adjusted R-squared	0.227654	S.D. of dependent var	0.531588
S.E. of regression	0.467176	Sum of squared resid	30.99205
Durbin-Watson stat	1.188594		

Covariance Matrix

C,C	0.512441	C,DGDAY	-0.000194
C,LAT	-0.001247	C,POPSQ	-2.20E-10
DGDAY,DGDAY	7.48E-08	DGDAY,LAT	4.23E-07
DGDAY,POPSQ	-1.46E-13	LAT,LAT	1.14E-05
LAT,POPSQ	-1.54E-11	POPSQ,POPSQ	2.20E-16

LS // Dependent Variable is PNM

Date: 7-21-1993 / Time: 19:03

SMPL range: 1 - 35 37 - 38 40 - 84
 86 - 86 88 - 91 94 - 134
 136 - 147 151 - 152 155 - 155
 157 - 157 159 - 160

Number of observations: 146

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	1.4445619	0.3564007	4.0531954	0.000
LAT	-0.0495318	0.0017164	-28.858480	0.000
DGDAY	-4.960E-05	0.0001382	-0.3589186	0.720
HPRMAP	-0.0666717	0.0468714	-1.4224396	0.155

R-squared	0.888740	Mean of dependent var	0.091229
Adjusted R-squared	0.886390	S.D. of dependent var	0.608660
S.E. of regression	0.205156	Sum of squared resid	5.976615
Durbin-Watson stat	0.924285	F-statistic	378.0972
Log likelihood	26.12489		

=====

Covariance Matrix

=====

C,C	0.127021	C,LAT	-0.000264
C,DGDAY	-4.88E-05	C,HPRMAP	0.002888
LAT,LAT	2.95E-06	LAT,DGDAY	7.46E-08
LAT,HPRMAP	2.88E-05	DGDAY,DGDAY	1.91E-08
DGDAY,HPRMAP	-1.66E-06	HPRMAP,HPRMAP	0.002197

=====

LS // Dependent Variable is LSRA5

Date: 7-21-1993 / Time: 19:04

SMPL range: 1 - 35 37 - 38 40 - 84
 86 - 86 88 - 91 94 - 134
 136 - 147 151 - 152 155 - 155
 157 - 157 159 - 160

Number of observations: 146

Weighting series: WLOGAS

```
=====
      VARIABLE      COEFFICIENT      STD. ERROR      T-STAT.      2-TAIL SIG.
=====
          C          2.5299276          0.7174963          3.5260495          0.000
        DGDAY        -0.0010399          0.0002809         -3.7018120          0.000
          LAT          0.0163403          0.0034306          4.7631636          0.000
        POPSQ        -4.170E-08          1.511E-08         -2.7598700          0.006
        HPRMAP         0.0720533          0.0970876          0.7421472          0.458
        PNMLN         0.5469750          0.1739253          3.1448841          0.002
=====
```

Weighted Statistics

```
=====
R-squared              0.290422      Mean of dependent var  0.233016
Adjusted R-squared     0.265080      S.D. of dependent var  0.506481
S.E. of regression     0.434193      Sum of squared resid  26.39333
Durbin-Watson stat     1.522264      F-statistic           11.46006
Log likelihood         -82.29886
=====
```

Unweighted Statistics

```
=====
R-squared              0.280792      Mean of dependent var  0.291472
Adjusted R-squared     0.255107      S.D. of dependent var  0.531588
S.E. of regression     0.458799      Sum of squared resid  29.46948
Durbin-Watson stat     1.165099
=====
```

Covariance Matrix

```
=====
C,C              0.514801      C,DGDAY          -0.000200
C,LAT            -0.001041      C,POPSQ          1.72E-10
C,HPRMAP         0.016965      C,PNMLN          -0.003757
DGDAY,DGDAY      7.89E-08      DGDAY,LAT        3.28E-07
DGDAY,POPSQ     -3.29E-13      DGDAY,HPRMAP     -8.79E-06
DGDAY,PNMLN     1.74E-06      LAT,LAT          1.18E-05
LAT,POPSQ       -1.54E-11      LAT,HPRMAP       8.20E-05
LAT,PNMLN       8.88E-05      POPSQ,POPSQ      2.28E-16
POPSQ,HPRMAP    1.57E-10      POPSQ,PNMLN     -7.44E-10
HPRMAP,HPRMAP   0.009426      HPRMAP,PNMLN    8.46E-05
PNMLN,PNMLN    0.030250
=====
```

LS // Dependent Variable is PNM

Date: 7-21-1993 / Time: 19:05

SMPL range: 1 - 35 37 - 38 40 - 84
 86 - 86 88 - 91 94 - 134
 136 - 147 151 - 152 155 - 155
 157 - 157 159 - 160

Number of observations: 146

```
=====
VARIABLE      COEFFICIENT    STD. ERROR    T-STAT.    2-TAIL SIG.
=====
C              1.5322081      0.3522878      4.3493081    0.000
DGDAY         -0.0001000      0.0001340     -0.7464194    0.455
LAT           -0.0486565      0.0016080    -30.258905    0.000
=====
R-squared                0.887155    Mean of dependent var    0.091229
Adjusted R-squared       0.885577    S.D. of dependent var    0.608660
S.E. of regression       0.205888    Sum of squared resid     6.061775
Durbin-Watson stat       0.907144    F-statistic               562.1116
Log likelihood            25.09206
=====
```

```
=====
Covariance Matrix
=====
C,C              0.124107    C,DGDAY          -4.69E-05
C,LAT            -0.000304    DGDAY,DGDAY      1.80E-08
DGDAY,LAT        9.72E-08    LAT,LAT          2.59E-06
=====
```


LS // Dependent Variable is LSRA5

Date: 7-21-1993 / Time: 19:06

SMPL range: 1 - 35 37 - 38 40 - 84
 86 - 86 88 - 91 94 - 134
 136 - 147 151 - 152 155 - 155
 157 - 157 159 - 160

Number of observations: 146

Weighting series: WLOGAS

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	2.3862791	0.6966584	3.4253214	0.001
DGDAY	-0.0009680	0.0002662	-3.6357885	0.000
LAT	0.0158008	0.0033351	4.7377406	0.000
POPSQ	-4.292E-08	1.508E-08	-2.8461371	0.004
PNMLN2	0.5231504	0.1727349	3.0286311	0.002

Weighted Statistics

R-squared	0.284186	Mean of dependent var	0.233016
Adjusted R-squared	0.263879	S.D. of dependent var	0.506481
S.E. of regression	0.434548	Sum of squared resid	26.62528
Durbin-Watson stat	1.490615	F-statistic	13.99462
Log likelihood	-82.93761		

Unweighted Statistics

R-squared	0.283347	Mean of dependent var	0.291472
Adjusted R-squared	0.263016	S.D. of dependent var	0.531588
S.E. of regression	0.456356	Sum of squared resid	29.36482
Durbin-Watson stat	1.167698		

Covariance Matrix

C,C	0.485333	C,DGDAY	-0.000184
C,LAT	-0.001195	C,POPSQ	-8.41E-11
C,PNMLN2	-0.004824	DGDAY,DGDAY	7.09E-08
DGDAY,LAT	4.07E-07	DGDAY,POPSQ	-1.93E-13
DGDAY,PNMLN2	2.15E-06	LAT,LAT	1.11E-05
LAT,POPSQ	-1.71E-11	LAT,PNMLN2	9.57E-05
POPSQ,POPSQ	2.27E-16	POPSQ,PNMLN2	-7.69E-10
PNMLN2,PNMLN2	0.029837		

LS // Dependent Variable is LSRA5

Date: 7-21-1993 / Time: 19:07

SMPL range: 1 - 35 37 - 38 40 - 84
 86 - 86 89 - 91 94 - 134
 136 - 147 151 - 152 155 - 155
 157 - 157 159 - 160

Number of observations: 146

Weighting series: WLOGAS

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	2.3342774	0.6955473	3.3560295	0.001
DGDAY	-0.0010091	0.0002671	-3.7778254	0.000
LAT	0.0163808	0.0033517	4.8873213	0.000
POPSQ	-4.713E-08	1.534E-08	-3.0713404	0.002
PNMLN2	0.5766904	0.1765876	3.2657472	0.001
CAV25	0.0417417	0.0304919	1.3689430	0.171

Weighted Statistics

R-squared	0.293641	Mean of dependent var	0.233016
Adjusted R-squared	0.268414	S.D. of dependent var	0.506481
S.E. of regression	0.433207	Sum of squared resid	26.27359
Durbin-Watson stat	1.512166	F-statistic	11.63989
Log likelihood	-81.96693		

Unweighted Statistics

R-squared	0.291837	Mean of dependent var	0.291472
Adjusted R-squared	0.266545	S.D. of dependent var	0.531588
S.E. of regression	0.455262	Sum of squ' red resid	29.01695
Durbin-Watson stat	1.211903		

Covariance Matrix

C,C	0.483786	C,DGDAY	-0.000182
C,LAT	-0.001204	C,POPSQ	3.32E-11
C,PNMLN2	-0.006280	C,CAV25	-0.001158
DGDAY,DGDAY	7.13E-08	DGDAY,LAT	3.91E-07
DGDAY,POPSQ	-9.94E-14	DGDAY,PNMLN2	9.59E-07
DGDAY,CAV25	-9.10E-07	LAT,LAT	1.12E-05
LAT,POPSQ	-1.83E-11	LAT,PNMLN2	0.000112
LAT,CAV25	1.29E-05	POPSQ,POPSQ	2.35E-16
POPSQ,PNMLN2	-8.84E-10	POPSQ,CAV25	-9.38E-11
PNMLN2,PNMLN2	0.031183	PNMLN2,CAV25	0.001193
CAV25,CAV25	0.000930		

APPENDIX D: DATA TABLES

This Appendix provides the underlying data for calculation of independent and dependent variables in the text. Variables are first defined, and then listed in a series of tables.

ORGANIZATION OF DATA

Data is available on 4 geographic bases:

- **Shipping Point.** (Tables D7 and D8). There were 888 active shipping points for wheat on rail lines located in Saskatchewan.
- **Rural Municipality (RM).** (Tables D3 to D6) There were 376 Saskatchewan rural municipalities for which relevant census data was collected in 1926. Series collected on this basis are prefixed with "RM". For example, RMTW5 is the number of wheat farms by RM.
- **Census Enumeration Area (CEA).** (Included in D3 to D6). Rural municipalities were grouped into 17 CEA's for the 1926 Census. Some data was not published in detail by RM, but was available by CEA. These series are carried with the RM series, and are also prefixed by "RM".
- **Wheat Pool Subdistrict.** (Tables D1 and D2) The Saskatchewan Wheat Pool divided saskatchewan into 16 administrative district, each with 10 sub-districts, for a total of 160 geographic regions. Each subdistrict was assembled out of one or more rural municipalities. For identification, subdistrict 1 of district 1 is numbered 101, sub-district 10 of district 11 is 1110, etc. For a map of subdistricts, see main text. Data which has been aggregated from RMs has the prefix "RM" deleted from the name. For example TW% is the number of wheat farms by Wheat Pool Subdistrict.

Data is defined, sourced, and presented according to geographic basis. Wheat Pool Subdistrict variables are presented first, followed by consolidated RM and CEA based variables. Shipping point information, some of which is unique, is provided at the end of this Appendix.

WHEAT POOL SUBDISTRICT VARIABLES

The Saskatchewan Wheat Pool divided Saskatchewan into 16 administrative districts, each with 10 sub-districts, for a total of 160 geographic regions. Each subdistrict was assembled out of one or more rural municipalities (RM's). For identification, subdistrict 1 of district 1 is numbered 101, subdistrict 10 of district 11 is 1110, etc. Most of the variables Pool subdistrict are aggregated from data available by RM. Series by RM are indicated by the prefix RM in the name. Summing over RM to Pool Subdistrict is indicated by the notation ($\sum_{REP}$). A variable may also be aggregated from shipping point data, indicated by ($\sum_{SEP}$).

BASE SERIES

- DISSUB** = The Pool Subdistrict. See main text for map.
- SACRE25** = Signed acreage "in wheat" as reported by the Pool effective December 1925. *Western Producer*. Jan. 14, 1926. Page 7.
- BORDER** = A dummy variable assigned a value of one if the assignment of RM's to the Wheat Pool Subdistrict are considered reliable. There were some contradictions between sources (see discussion under RMDSSUB in the RM tables). The following subdistricts were considered to have unreliable information on borders:
- 406 and 409. There was a conflict between published maps and lists over the assignment of RM 141.
 - 1002 and 1003. A conflict between maps and lists over the assignment of RM 227.
 - All northern border sub-districts. It was not clear from sources how many of the most northerly RM's were included in the districts.
- SAMPLE** = A dummy assigned a value of one if the Subdistrict was used in regressions. Excluded were all subdistricts with uncertain borders (see BORDER above), plus three Subdistricts with very high reported sign-up rates (SRA%). Districts 905, 907, and 1005 were excluded with sign-up rates of 99%, 97%, and 102% respectively.

CALCULATED SERIES

Dependent Variables

- SRA5** = The proportion of acreage "in wheat" signed by the Pool. Acreage is defined to include fallow land being cycled through wheat. The pool signed acreage is divided by the sum of acres "sown to wheat" plus an adjustment for estimated fallow land.

$$\begin{aligned}
 &= \text{SRA5/TW5} \\
 \text{TW5} &= \text{Acres sown to wheat plus fallow land being cycled through wheat.} \\
 &= \sum_{\text{REP}} \text{RMTW5}
 \end{aligned}$$

Weighting Variables

$$\begin{aligned}
 \text{WLOGAS} &= \text{Weighting series for logit regression to adjust for heteroscedasticity. See Appendix B for derivation.} \\
 &= [\text{WF5} \times \text{SRA5}(1 - \text{SRA5})]^{-5} \\
 \text{WF5} &= \text{Estimated number of farms growing wheat.} \\
 &= \sum_{\text{REP}} \text{RMWF5}
 \end{aligned}$$

Independent Variables

$$\begin{aligned}
 \text{CIVALI} &= \text{A measure of the capital intensity of farm development. The average value of improvements per improved acre. Equal to farm value minus land value all divided by improved acreage.} \\
 &= \sum_{\text{REP}} \text{RMWTA5} \times \text{RMCIVALI} \\
 \text{DGDAY} &= \text{Mean degree days above 42 degrees Fahrenheit from May 1 to Sept 30 according to iso-bar map of data from 1921 to 1950.} \\
 &= \sum_{\text{REP}} \text{RMWTA5} \times \text{RMDGDAY} \\
 \text{HD1} &= \text{Harvest date. Mean day of "first swathing" by crop district averaged from 1952 to 1968. Saskatchewan has 20 crop districts in total. Source is CANSIM Matrix #2646, Statistics Canada.} \\
 &= \sum_{\text{REP}} \text{RMWTA5} \times \text{RMHD1} \\
 \text{HPRMAP} &= \text{A dummy variable indicating the Subdistrict has wheat of the highest protein class. Based on classifications established by protein map (see RMPRMAP). If mean protein class was greater than 5.1 out of a possible 6, then the dummy was assigned a value of one. Class 6 indicates protein content of 15% or more. 5.1 was used as a critical value in order to exclude RM's whose borders were entirely within Class 5, but included no Class 6. Using Lotus 1-2-3 notation for logic:} \\
 &= @IF(\text{PRMAP} > 5.1, 1, 0)
 \end{aligned}$$

LAT	=	Median latitude of Subdistrict. Assigned using RM section numbers common to maps of this time, numbered in rows from 1 to 64 where 64 is the most northerly of surveyed sections. Census of Prairie Provinces 1926; Map of Saskatchewan (1922).
	=	$\sum_{REP} RMWTA5 \times RMLAT$
PNM	=	A measure of relative quality of wheat through price differences. Mean price was calculated for each of 1920, 1925, and 1930 by dividing gross farm wheat revenue by bushels of wheat (e.g. RMR25/RMB25). To avoid distortion from monetary inflation/deflation and harvest conditions, series for each of the three years was converted to a standard normal variable (the mean was deducted and the result divided by the standard deviation), and the three year average taken subsequently for each RM.
	=	$\sum_{REP} RMWTA5 \times RMPNM$
POPD6	=	A relative measure of rural population density.
	=	$\sum_{REP} RMWTA5 \times RMPOPD6$
POPSQ	=	The square of POPD6.
	=	$POPD6^2$
PRMAP	=	Average protein content of wheat according to an isobar map. Classes range from 1 to 6 where 6 is highest, with protein content of 15% or more. When more than one isobar applied to an RM, an average weighted by land area was calculated using 36 mile square sections of land. Anderson & Eva. <i>Variations in the Protein Content of Western Canadian Wheat 1927-1938; A study based on 12 annual protein surveys.</i> (Board of Grain Commissioners for Canada, Bulletin No. 4, June 1943).
	=	$\sum_{REP} RMWTA5 \times RMPRMAP$
CAV25	=	A measure of competitiveness in the market for wheat faced by farmers at the shipping point (local rail head). It is the average number of competing elevator firms per shipping point, weighted by elevator capacity. The weighting was under taken to avoid giving too much importance to points with a low number of firms serving only a small area. In addition, an adjustment was made for points within a mile of a border between Pool Subdistricts. In this case, the elevator capacity was divided equally between Districts, and the point assumed to serve each of them. See introduction to variables by shipping point.
	=	$\sum_{REP} ELSBWT25 \times ELEV25$

RURAL MUNICIPALITY AND CENSUS ENUMERATION AREA VARIABLES

The tables which follow show variables defined on a rural municipality (RM) basis. There were a total of 376 rural municipalities for which relevant census data was collected. They were grouped into 17 Census Enumeration Areas (CEAs) for the 1926 census. Unless specified, the series has individual values for each RM. In some cases, census tables are reported by CEA only.

In this case the values will be the same for all RMs within the CEA (REC). RM's may also be aggregated to 160 Wheat Pool Subdistricts (REP).

BASE SERIES

RMDSSUB = The Pool Subdistrict to which the RM is assigned. Sources were drawn from the *Western Producer*, a weekly official organ of the Pool. Sources were:

- Nov. 5, 1925. Page 7. A list of RMs for Pool Districts 4,7,12, and 14 (and their constituent Subdistricts). This list had several evident typographical errors, and improperly reported RM's in Subdistrict 801 as Subdistrict 701.
- Nov. 12, 1925. Page 6. A list of RMs for the remaining Pool Subdistricts. This list appears to have been done with care. No evident typographical errors or improper assignments of subdistricts.
- Various issues, Sept. 23 to Nov. 11, 1926. Maps of RMs with Districts and Subdistricts outlined in marker were published each week over this period. Map borders did not fully conform to the printed lists above, even though this was prior to a reorganization of boundaries. The most northern districts were mapped with inconsistent conventions. Subdistrict 1508 was shown to include undeveloped territories further north than indicated by the RM lists of the previous year. At the same time Subdistrict 1510 is shown extending less far north than indicated by the lists.

To resolve conflicts, the Nov. 12 list was accepted over the maps and other list. The map was accepted over the Nov. 5 list. Doubtful cases were recorded for later exemption (see BORDER in variables by Pool Subdistrict).

RMNO = The rural municipality number. Part of the official designation of an RM.

RMACRE25	=	Acres sown to wheat in 1925. Census of Prairie Provinces 1926; Table 100.
RMAREA	=	Area of rural municipality. Measured in approximate 36 mile square sections, excluding large bodies of waters and large Indian Reserves. Census of Prairie Provinces 1926; Map of Saskatchewan (1922).
RMB20	=	Bushels of wheat harvested 1920 by CEA. Census of Prairie Provinces 1921; Table 99.
RMB25	=	Bushels of wheat harvested 1925 by CEA. Census of Prairie Provinces 1926; Table 99.
RMB30	=	Bushels of wheat harvested 1930 by CEA. Census of Prairie Provinces 1931; Table 26.
RMCF	=	Number of farms in CEA. Census of Prairie Provinces 1926; Table 78.
RMCLVAL	=	The dollar value of farm land in the CEA, 1925. Census of Prairie Provinces 1926; Table 94.
RMCWF	=	Number of farms growing wheat in the CEA. Census of Prairie Provinces 1926; Table 78.
RMDGDAY	=	Mean degree days of RM according to isobar map based on data from 1921 to 1950. A weighted average by 36 mile square sections where more than one isobar applied. G.A. MacKay, <i>Climatic Maps of the Prairie Provinces for Agriculture; Climatological Studies #1</i> . Dept. of Transport, Meteorological Branch, 1965.
RMF	=	Total number of farms, 1926. Census of Prairie Provinces 1926; Table 95.
RMFALO	=	Improved acres lying fallow or idle, 1926. Census of Prairie Provinces 1926; Table 97.
RMFCROP	=	Acreage in field crops, 1926. Census of Prairie Provinces 1926; Table 97.
RMHD1	=	Harvest date. Mean day of "first swathing". Average for crop district containing each rural municipality. Saskatchewan has 20 crop districts in total. Source is CANSIM Matrix #2646, Statistics Canada.
RMIMP	=	Number of improved acres. Census of Prairie Provinces 1926; Table 97.
RMP MAP	=	Average protein content of wheat according to isobar map. Classes range from 1 to 6 where 6 is highest, representing an average protein content of 15% or higher. Where more than one isobar applied to an RM, a

weighted average was calculated by 36 mile square sections. Map is based on data from 1927 to 1938. Anderson & Eva. *Variations in the Protein Content of Western Canadian Wheat 1927-1938; A study based on 12 annual protein surveys.* (Board of Grain Commissioners for Canada, Bulletin No. 4, June 1943).

RMLAT	=	Median latitude of RM. Assigned using RM section numbers common to maps of this time, numbered in rows from 1 to 64 where 64 is the most northerly. Census of Prairie Provinces 1926; Map of Saskatchewan (1922).
RMPOP	=	Rural population 1926. Census of Prairie Provinces 1926; Table 97.
RMR20	=	Gross farm revenue for wheat sales by CEA, 1920. Census of Prairie Provinces 1921; Table 99.
RMR25	=	Gross farm revenue for wheat sales by CEA, 1925. Census of Prairie Provinces 1926; Table 99.
RMR30	=	Gross farm revenue for wheat sales by CEA, 1930. Census of Prairie Provinces 1931; Table 26.
RMTVAL	=	The total value of farms in the CEA, 1925. Census of Prairie Provinces 1926; Table 94.

CALCULATED VARIABLES

Independent Variable

RMTW5	=	Estimated "acres in wheat" as per wheat pool membership contract, including both wheat and fallow land being cycled through wheat. It is calculated by increasing the acres "sown to wheat" in the census by the ratio of fallow land to total acreage in field crops. This variable forms the denominator of the percentage of wheat acreage signed by the Pool.
	=	$RMACRE(1+RMFALO/RMFCROP)$

Weighting Variables

RMWTA5	=	The proportion of "acres in wheat" accounted by the RM out of its Pool Subdistrict. This proportion is used as a weight when aggregating some variables from a RM basis to Pool Subdistricts.
	=	$RMTW5_R / (\sum_{RES} RMTW5_R)$

RMWF5 = Estimated number of wheat farms in RM. The census provides total number of farms by RM, but only provides the number of wheat growing farms by CEA. To estimate, the total number of farms in the RM is reduced proportionate to the ratio of wheat farms to total farms in the CEA. This variable is used to construct the regression weights for logit estimation.

= $RMF (RMCWF/RMCF)$

Dependent Variables

RMCIVALI = A measure of the capital intensity of the farm, it is the dollar value of improvements per improved acre. It is calculated by the dollar value of the farm, less the value of land, divided by improved acreage.

= $(RMTVAL25 - RMCLVAL) / RMIMP$

RMPOPD6 = A relative measure of population density in the rural population. Saskatchewan RMs were laid out on a grid pattern. Since most RMs were nine 36 mile square sections, total population was adjusted as follows:

= $RMPOP (9/RMAREA)$

RMPNM = A measure of average quality of wheat through price differences. Mean price for each year was calculated for each of 1920, 1925, and 1930 by dividing gross farm wheat revenues by bushels of wheat (e.g. $RMR25/RMB25$). To avoid distortion from monetary inflation and harvest conditions, each of the three series was normalized, and the three year average taken subsequently for each RM..

SHIPPING POINT DATA

In 1925 there were 890 separate railway shipping points with elevator capacity in Saskatchewan. elevator firms were licensed by the Board of Grain Commissioners of Canada, who published an annual survey of firms, elevator capacity and license status by shipping point. The data below was compiled from this survey, the *List of Licensed Elevators and Warehouses in the Western Grain Inspection Division* for the years 1923-24 and 1925-26. It is used to develop a quantitative measure of competitive conditions in the market for farmers' wheat at the rail head (see CAV25 in Pool Tables).

Blanks in the tables indicate a zero, with the exception of protein content. Blanks under protein content indicate no data available for that point.

Shipping points were listed by railway, without other location references. To establish rural municipality and Pool Subdistrict location, a variety of maps and other references were used, both historical and modern. Location and assignment involved some judgement and supplementary research by case. For example:

- Points within one mile of a Pool Subdistrict border were assigned to both subdistricts, since their service area likely included farmers from both regions. This is indicated in the following tables by duplicate rows with the same name and a "RECWT" of one half if divided between two districts (one third between three, etc.). The duplication of records was to facilitate the calculation and manipulation of data by subdistrict.
- Elevator lists of separate points had to combined when the points were, in fact, the same place. Points were listed separately by railway (CN, CP, & Grand Trunk). The rail line of each point is coded under R23 and R25 according to

1	=	CPR
2	=	CNR
3	=	Grand Trunk
>3	=	More than one railway

Where a point existed on more than one rail line, it is noted by a (b) beside the name.

- Some points with the same name were, in fact, different places. *If points on different rail lines were more than one mile apart, they were treated as separate points, even if they had the same name.* These cases are indicated by an (a) beside the shipping point name.
- Some points had more than one name, or changed name over time. Alternate names given to the same point are noted in brackets. The Comments column may contain historical notes.

After examination of maps and historical directories, a residual set of shipping points remained unlocated. This list was further reduced with assistance provided via the telephone by CP rail, quoting from a CP list: *Designated Numbers of Stations*. There remained two unlocated shipping points at the end; Factoria and Douai.

Not all of the data shown is used in this paper. The balance is offered as a data source for future research.

BASE SERIES

NAME =	Name of shipping point. Alternate names in brackets. Notation (a) indicates that two points of the same name are actually different places more than one mile apart. Notation (b) indicates that the two points on different rail lines are less than a mile apart and were deemed to be one place.
PTSUB =	The Pool Subdistrict to which the row is assigned. Note that a shipping point may have more than one row if it is within a mile of a border of a Pool Subdistrict.
RECWT =	The weight given to the record when aggregating to Pool Subdistrict. Normally equal to one. If a point was within a mile of the border of a subdistrict, the weight of the record was divided between adjacent RM's.
MUNREC =	The RM assigned to the record (row). Normally the RM in which the point is located, unless the point is within a mile of a Pool Subdistrict border.
MUN1 =	The RM where the shipping point is actually located.
R23,R25 =	Indicates the railway of the shipping point in 1923-24 and 1925-26 respectively. 1 = CPR 2 = CNR 3 = Grand Trunk >3 = More than one railway
PROTEIN =	% protein based on average of available years for each point from 1927 to 1938. Not available for all points, and varying numbers of years by point. Anderson & Eva. <i>Variations in the Protein Content of Western Canadian Wheat 1927-1938; A study based on 12 annual protein surveys</i> . (Board of Grain Commissioners for Canada, Bulletin No. 4, June 1943).
ELEV23,25 =	Number of elevator firms in 1923-24 and 1925-26 respectively. Includes unlicensed firms.

COMMENT	=	Exceptions, special sources, and historical comment.
UGG23,25	=	Dummy assigned a value of one when a United Grain Growers elevator was present. The UGG was a farmer owned grain company organized on a share capital basis. Farmers owned shares, but did not commit to patronize the UGG elevators.
COOP23,25	=	Dummy assigned a value of one where a Saskatchewan Cooperative Elevator Company elevator existed. This firm was another farmer owned venture preceding the Pool.
UNL23,25	=	Dummy assigned a value of one when an unlicensed elevator existed.
POOL25	=	Dummy indicating a Pool elevator in 1925.
ELCAP25	=	The combined elevator capacity of a point in bushels.

CALCULATED SERIES

ELSBWT25	=	A weight used to aggregate average number of competitors per shipping point (i.e. weight ELEV25 to calculate CAV25 in Pool Tables). It is the proportion of elevator capacity with the Pool Subdistrict provided by that point.
	=	$(\text{RECWT} \times \text{ELCAP25}) / (\sum_{S \in P} \text{RECWT} \times \text{ELCAP25})$

Table D1: Variables on Pool Basis

DISSUB	SACRE25	BORDER	SAMPLE	SRAS	TWS	WLOGAS	WFS	CVALL	DGDAY
101	78,843	1	1	43.9%	183,536	18.46	1,448	\$17.80	2513
102	53,890	1	1	48.2%	108,821	18.02	1,448	\$17.80	2414
103	44,595	1	1	86.4%	78,131	14.88	802	\$17.80	2400
104	78,747	1	1	52.9%	148,855	14.67	883	\$17.80	2526
105	66,147	1	1	48.7%	133,124	14.11	797	\$17.80	2381
106	60,171	1	1	42.3%	142,240	14.22	828	\$17.61	2897
107	62,346	1	1	51.9%	120,106	14.26	814	\$17.48	2427
108	68,357	1	1	38.7%	171,551	11.34	542	\$17.82	2544
109	75,467	1	1	39.9%	188,904	18.82	1,179	\$17.38	2598
110	48,184	1	1	41.9%	119,234	14.47	884	\$17.36	2800
201	67,224	1	1	39.8%	189,738	9.05	343	\$17.36	2441
202	66,080	1	1	45.9%	143,875	18.00	1,305	\$17.35	2800
203	63,089	1	1	42.5%	148,575	13.76	775	\$17.36	2800
204	73,891	1	1	39.3%	187,848	12.06	809	\$17.36	2429
205	62,553	1	1	56.4%	146,280	17.23	1,207	\$17.32	2800
206	65,501	1	1	48.4%	135,446	14.39	822	\$17.32	2800
207	77,652	1	1	57.8%	134,914	12.37	826	\$17.32	2800
208	81,397	1	1	50.7%	180,589	11.40	520	\$17.32	2563
209	62,293	1	1	54.0%	115,422	13.87	774	\$17.32	2800
210	62,917	1	1	52.4%	119,986	10.43	436	\$17.32	2844
301	51,336	1	1	49.9%	102,783	9.97	388	\$17.32	2467
302	91,927	1	1	41.1%	223,579	14.71	883	\$17.36	2800
303	72,082	1	1	58.9%	122,452	14.05	815	\$17.32	2529
304	72,382	1	1	37.9%	191,128	11.32	545	\$17.32	2800
305	63,675	1	1	47.3%	134,481	16.11	1,041	\$17.38	2511
306	53,741	1	1	70.3%	76,451	12.04	885	\$17.47	2472
307	75,482	1	1	67.4%	111,973	9.34	387	\$17.47	2800
308	50,689	1	1	51.8%	97,939	10.31	425	\$17.47	2388
309	65,085	1	1	61.7%	105,488	11.31	541	\$17.47	2504
310	41,386	1	1	57.2%	72,317	13.25	717	\$17.47	2323
401	87,932	1	1	29.7%	295,648	10.45	523	\$17.47	2805
402	45,088	1	1	36.8%	122,526	19.22	1,588	\$16.45	2800
403	37,739	1	1	54.8%	68,928	12.41	622	\$15.04	2867
404	88,902	1	1	38.8%	255,980	8.97	338	\$15.04	2563
405	71,802	1	1	51.8%	138,197	15.94	1,018	\$15.85	2850
406	63,921	0	0	54.3%	117,727	12.33	613	\$15.04	2800
407	90,975	1	1	43.2%	117,988	12.57	844	\$15.04	2754
408	52,356	1	1	48.7%	112,034	11.23	506	\$15.04	2767
409	112,185	0	0	44.2%	253,792	10.49	448	\$15.04	2700
410	78,737	1	1	35.9%	219,141	18.99	1,567	\$15.72	2800
501	58,182	1	1	29.5%	180,688	12.81	790	\$15.04	2800
502	45,909	1	1	39.9%	115,186	13.88	781	\$16.45	2810
503	62,750	1	1	43.3%	144,761	12.93	881	\$16.45	2828
504	81,188	1	1	44.7%	181,883	14.80	882	\$16.45	2809
505	35,578	1	1	32.7%	108,731	13.59	839	\$20.05	2800
506	65,975	1	1	76.9%	85,770	8.19	378	\$16.45	2800
507	51,253	1	1	48.4%	105,900	8.99	323	\$16.45	2800
508	48,779	1	1	55.8%	87,761	12.47	630	\$16.45	2800
509	92,885	1	1	49.8%	186,531	10.20	418	\$16.45	2800
510	43,797	1	1	58.0%	75,537	12.98	882	\$16.45	2800
601	54,237	1	1	64.7%	83,873	8.97	352	\$16.45	2546

Table D1: Variables on Pool Basis

DISSUB	SACRE25	BORDER	SAMPLE	SRA5	TWS	WLOGAS	WFS	CVALI	DGDAY
602	58,842	1	1	46.0%	128,480	15.93	1,019	\$24.20	2294
603	58,079	1	1	48.3%	122,183	16.54	1,376	\$24.20	2361
604	76,088	1	1	40.3%	188,836	13.03	708	\$21.58	2417
605	58,534	1	1	40.6%	138,268	16.52	1,132	\$21.23	2382
606	80,321	1	1	54.4%	147,781	10.44	438	\$20.05	2540
607	78,451	1	1	43.1%	177,478	9.10	338	\$20.05	2508
608	88,237	1	1	37.8%	280,039	14.32	873	\$20.05	2800
609	48,771	1	1	44.0%	113,218	13.05	682	\$20.05	2678
610	32,730	1	1	43.9%	74,954	9.72	384	\$20.05	2556
701	52,446	1	1	74.0%	70,808	8.30	358	\$20.05	2468
702	46,549	1	1	58.0%	78,881	17.08	1,203	\$24.20	2455
703	35,230	1	1	78.3%	44,411	11.93	888	\$24.20	2400
704	38,912	1	1	44.8%	87,324	15.36	955	\$24.62	2400
705	49,674	1	1	61.7%	80,470	18.18	1,388	\$24.88	2400
706	49,783	1	1	48.8%	102,513	14.07	792	\$24.58	2382
707	38,831	1	1	62.1%	63,816	17.97	1,372	\$24.63	2283
708	39,232	1	1	70.5%	55,674	15.83	1,174	\$24.98	2352
709	43,882	1	1	64.8%	67,967	15.48	1,047	\$25.02	2365
710	28,787	1	1	77.7%	37,056	12.95	967	\$24.98	2212
801	55,746	1	1	54.1%	103,081	18.36	1,357	\$25.08	2432
802	61,335	1	1	63.3%	95,864	15.47	1,030	\$20.68	2529
803	83,038	1	1	56.5%	111,589	12.88	854	\$20.05	2500
804	59,072	1	1	70.7%	63,486	9.81	465	\$20.05	2193
805	40,801	1	1	50.6%	80,265	15.35	943	\$22.87	2511
806	48,751	1	1	73.5%	65,289	10.11	526	\$20.05	2486
807	64,528	1	1	70.2%	91,986	8.71	383	\$20.05	2400
808	51,076	1	1	64.0%	79,809	9.72	410	\$22.87	2500
809	79,549	1	1	84.4%	94,294	6.28	298	\$17.02	2400
810	45,170	1	1	72.7%	62,132	9.14	421	\$22.87	2500
901	38,413	1	1	48.1%	80,291	8.87	315	\$17.02	2533
902	40,248	1	1	56.9%	70,887	8.75	312	\$17.02	2565
903	43,840	1	1	53.7%	81,613	7.94	253	\$17.02	2467
904	78,702	1	1	57.0%	138,146	8.56	298	\$17.02	2800
905	71,114	1	0	98.7%	72,060	2.41	448	\$17.02	2411
906	48,086	1	1	55.3%	85,922	9.84	382	\$17.02	2400
907	105,623	1	0	95.8%	109,305	3.82	448	\$17.02	2520
908	64,037	1	1	80.7%	105,547	8.45	300	\$17.02	2800
909	88,208	1	1	76.5%	89,173	7.86	344	\$17.02	2400
910	36,731	1	1	63.4%	57,967	9.96	428	\$17.02	2400
1001	53,299	1	1	61.7%	86,420	7.50	238	\$17.02	2800
1002	55,459	0	0	46.2%	120,132	10.95	482	\$16.45	2510
1003	59,482	0	0	88.2%	85,954	9.75	446	\$15.04	2883
1004	51,726	1	1	73.0%	70,815	8.75	389	\$15.04	2800
1005	25,736	1	1	88.1%	37,260	8.57	344	\$16.45	2800
1006	80,526	1	1	63.1%	127,529	7.16	220	\$16.45	2800
1007	85,756	1	1	82.0%	105,991	10.86	483	\$16.73	2800
1008	94,958	1	1	90.9%	127,621	9.54	364	\$16.73	2556
1009	82,137	1	1	70.1%	88,678	8.84	373	\$16.73	2800
1010	85,560	1	1	67.8%	98,122	9.01	372	\$16.73	2800
1101	86,432	1	1	55.2%	120,404	9.03	330	\$16.73	2517
1102	51,383	1	1	43.9%	117,135	12.15	589	\$16.02	2671

Table D1: Variables on Pool Basis

DISSUB	SACRE25	BORDER	SAMPLE	SRAS	TWS	WLOGAS	WFS	CIVALI	DGDAY
1103	46,235	1	1	53.6%	66,950	8.73	381	\$15.04	2567
1104	44,313	1	1	48.7%	68,079	8.86	314	\$15.04	2882
1105	74,737	1	1	56.8%	132,083	10.74	488	\$15.04	2447
1106	80,963	1	1	55.9%	80,458	11.78	583	\$16.02	2500
1107	63,210	1	1	67.9%	83,135	9.80	422	\$16.02	2567
1108	52,030	1	1	62.8%	82,843	9.40	378	\$16.73	2400
1109	42,549	1	1	69.9%	80,854	8.61	353	\$16.02	2389
1110	38,733	1	1	59.5%	81,748	8.05	288	\$16.02	2359
1201	37,726	1	1	73.8%	51,261	8.05	334	\$16.02	2417
1202	65,447	1	1	71.8%	91,188	6.37	200	\$16.73	2400
1203	50,948	1	1	73.8%	69,078	7.81	315	\$16.02	2343
1204	59,020	1	1	71.3%	82,745	7.88	305	\$16.02	2200
1205	42,224	1	1	63.3%	66,747	8.88	339	\$16.02	2200
1206	68,284	1	1	68.4%	98,889	7.72	276	\$16.02	2266
1207	74,762	1	1	48.6%	150,830	11.55	533	\$16.22	2250
1208	54,617	1	1	55.5%	98,343	14.36	635	\$13.02	2200
1209	48,644	1	1	64.3%	77,176	9.88	425	\$16.02	2200
1210	80,808	1	1	57.8%	156,635	9.07	337	\$16.02	2200
1301	40,681	1	1	76.9%	52,931	10.78	654	\$16.02	2557
1302	53,196	1	1	75.7%	70,249	6.13	204	\$17.02	2800
1303	71,408	1	1	76.5%	93,400	7.40	304	\$16.73	2444
1304	61,512	1	1	44.9%	136,865	9.44	380	\$17.02	2800
1305	68,121	1	1	65.7%	103,609	15.07	1,009	\$20.95	2800
1306	71,945	1	1	65.9%	109,130	9.83	430	\$16.73	2800
1307	51,892	1	1	65.7%	78,998	9.24	378	\$16.73	2567
1308	53,263	1	1	47.9%	111,180	11.79	557	\$16.73	2587
1309	42,851	1	1	58.4%	73,405	13.05	700	\$16.73	2800
1310	81,780	1	1	62.8%	130,735	9.84	413	\$16.73	2480
1401	35,705	1	1	57.9%	61,860	13.83	785	\$25.01	2156
1402	45,621	1	1	84.8%	53,922	11.46	1.0	\$22.87	2320
1403	47,295	1	1	67.8%	69,799	11.59		\$22.87	2222
1404	66,101	1	1	61.3%	107,753	10.23	442	\$22.87	2372
1405	61,267	0	0	102.0%	80,051	ERR	906	\$22.87	2174
1406	69,211	1	1	72.2%	95,850	19.09	1,816	\$25.81	2200
1407	38,362	1	1	61.9%	62,020	18.11	1,391	\$26.80	2400
1408	52,346	1	1	52.4%	99,823	9.64	373	\$17.02	2333
1409	87,388	1	1	61.2%	142,770	13.01	713	\$21.13	2400
1410	45,419	1	1	65.9%	88,950	13.88	857	\$20.55	2400
1501	65,203	1	1	79.9%	82,003	7.55	350	\$17.02	2223
1502	39,839	1	1	69.5%	57,329	15.41	1,119	\$29.18	2278
1503	30,225	1	1	71.7%	42,174	8.93	393	\$29.18	2389
1504	57,021	1	1	59.4%	95,978	11.14	543	\$29.18	2424
1505	51,085	1	1	62.2%	82,077	15.34	1,001	\$25.01	2449
1506	57,329	1	1	39.7%	144,561	16.29	1,109	\$25.01	2497
1507	51,861	1	1	29.9%	172,847	17.61	1,479	\$25.01	2524
1508	25,072	0	0	70.3%	35,680	16.93	1,372	\$25.01	2363
1509	90,551	0	0	57.7%	87,574	16.61	1,131	\$27.92	2301
1510	39,243	0	0	56.5%	69,421	19.67	1,574	\$24.45	2123
1601	47,790	1	1	71.4%	85,921	13.70	919	\$23.83	2533
1602	44,561	1	1	55.7%	80,067	9.22	344	\$23.83	2333
1603	47,084	0	0	90.0%	94,174	11.70	548	\$23.83	2077

Table D6: Variables by Rural Municipality					
RMDSSUB	RMNO	RMWF5	RMCIVALJ	RMPOPD6	RMPNM
408	172	234	\$15.04	2,508	0.174
410	231	588	\$15.04	2,831	0.174
410	232	190	\$15.04	2,325	0.174
501	131	408	\$16.45	2,061	0.207
501	161	372	\$16.45	2,253	0.207
502	132	148	\$16.45	1,838	0.207
502	162	280	\$16.45	1,844	0.207
502	163	272	\$16.45	1,752	0.207
503	133	241	\$16.45	2,130	0.207
503	134	331	\$16.45	2,618	0.207
503	164	290	\$16.45	3,120	0.207
504	190	418	\$20.05	2,115	0.343
504	221	421	\$20.05	2,441	0.343
505	191	378	\$16.45	2,603	0.207
506	222	323	\$16.45	1,884	0.207
507	165	382	\$16.45	1,844	0.207
507	195	237	\$16.45	1,680	0.207
508	194	416	\$16.45	2,306	0.207
509	193	382	\$16.45	2,680	0.207
509	223	300	\$16.45	2,565	0.207
510	224	352	\$16.45	2,180	0.207
601	121	346	\$24.20	2,241	0.776
601	122	294	\$24.20	1,776	0.776
601	151	380	\$24.20	992	0.776
602	123	345	\$24.20	1,127	0.776
602	124	362	\$24.20	1,663	0.776
602	153	303	\$24.20	2,446	0.776
602	154	366	\$24.20	2,540	0.776
603	125	322	\$24.20	2,166	0.776
603	126	384	\$20.05	1,926	0.343
604	155	371	\$24.20	1,180	0.776
604	156	367	\$20.05	1,225	0.343
604	157	384	\$20.05	1,982	0.343
605	127	439	\$20.05	2,234	0.343
606	128	338	\$20.05	1,656	0.343
607	158	495	\$20.05	1,942	0.343
607	159	378	\$20.05	1,759	0.343
608	129	322	\$20.05	1,585	0.343
608	130	389	\$20.05	1,933	0.343
609	160	384	\$20.05	1,307	0.343
610	189	358	\$20.05	1,420	0.343
701	152	286	\$24.20	1,437	0.776
701	181	333	\$24.20	1,144	0.776
701	183	604	\$24.20	1,485	0.776
702	184	418	\$24.20	915	0.776
702	185	450	\$24.20	2,218	0.776
703	211	428	\$24.20	1,487	0.776
703	241	527	\$24.99	1,026	-0.117
704	213	371	\$24.20	440	0.776
704	243	398	\$24.99	819	-0.117
704	273	630	\$24.99	521	-0.117

Table D1: Variables on Pool Basis

DISSUB	SACRE25	BORDER	SAMPLE	SRA5	TW5	WLOGAS	WF5	CIVALI	DGDAY
1604	68,990	0	0	56.3%	158,143	16.14	1,059	\$23.83	3317
1605	68,912	1	1	64.6%	106,734	16.64	1,210	\$23.83	2402
1606	48,331	0	0	60.4%	80,066	14.02	821	\$20.79	2080
1607	45,367	1	1	59.5%	76,219	17.01	1,201	\$23.47	2116
1608	61,962	0	0	66.4%	83,060	9.82	433	\$18.06	2076
1609	44,645	1	1	56.8%	78,557	17.27	1,216	\$23.35	2200
1610	52,248	1	1	58.4%	107,654	13.68	749	\$20.16	2200

Table D2: Variables on Pool Basis

DISSUB	HD1	HPRMAP	LAT	PNM	POP06	POPSQ	PRMAP	CAV25
101	224	0	3.36	1.19	1,340	1,796,835	5.00	2.94
102	224	0	7.86	1.19	1,340	1,796,835	5.00	3.44
103	230	0	10.60	1.19	1,466	2,148,140	4.79	1.60
104	224	0	4.36	1.19	1,668	2,781,915	5.00	1.85
105	227	0	11.00	1.19	1,850	3,424,014	5.00	3.74
106	224	0	3.13	1.18	1,460	2,130,703	5.00	3.34
107	224	0	8.00	1.19	1,528	2,335,520	5.00	3.11
108	224	0	3.49	1.18	1,436	2,066,482	5.00	2.33
109	224	0	8.97	1.18	1,308	1,953,018	4.98	3.74
110	224	0	11.00	1.18	1,636	2,684,392	4.11	4.80
201	224	1	3.77	1.12	2,121	4,498,641	5.71	3.10
202	224	1	8.00	1.18	1,182	1,397,113	5.28	2.25
203	224	1	11.00	1.18	2,140	4,580,870	5.29	4.38
204	224	1	3.88	0.88	1,818	3,306,000	6.00	4.41
205	224	1	9.05	0.88	1,485	2,205,052	5.88	3.04
206	225	1	9.35	0.88	2,333	5,440,920	5.95	3.68
207	224	1	8.00	0.88	1,938	3,754,895	6.00	5.24
208	224	1	7.00	0.88	2,959	8,755,681	6.00	6.13
209	225	1	11.00	0.88	1,973	3,893,271	6.00	4.42
210	225	1	11.00	0.88	2,119	4,490,161	6.00	6.58
301	226	1	4.12	0.87	2,364	5,588,496	5.93	1.50
302	226	1	9.50	0.88	1,165	1,357,974	6.00	6.34
303	226	1	7.17	0.88	2,226	4,957,173	6.00	6.69
304	226	1	11.00	0.87	1,397	1,952,232	5.35	5.10
305	226	1	7.52	0.86	1,755	3,079,151	5.94	5.76
306	227	1	5.00	0.86	1,355	1,837,267	5.23	5.00
307	226	1	10.00	0.86	1,028	1,055,803	5.22	5.19
308	228	0	8.00	0.86	1,881	3,538,161	5.00	4.26
309	227	1	2.73	0.86	1,270	1,613,215	5.45	3.80
310	228	0	4.50	0.86	738	543,949	5.09	2.62
401	227	1	15.24	0.21	446	198,863	5.67	3.91
402	227	0	14.00	0.17	2,398	5,748,030	5.00	3.78
403	227	0	18.00	0.17	2,218	4,918,415	5.00	5.00
404	226	0	12.79	0.40	1,289	1,661,521	5.00	6.57
405	227	1	17.50	0.17	1,382	1,911,028	5.36	4.66
406	225	1	16.59	0.17	1,418	2,009,306	5.17	2.00
407	225	1	20.50	0.17	1,155	1,334,920	5.23	6.47
408	225	0	21.00	0.17	1,286	1,603,972	5.00	3.56
409	225	1	14.63	0.36	1,093	1,195,086	5.48	3.80
410	225	1	20.89	0.17	1,306	1,706,213	5.22	5.17
501	228	0	15.73	0.21	2,062	4,252,570	4.81	2.30
502	227	1	16.68	0.21	2,001	4,002,719	5.34	3.27
503	225	1	14.77	0.21	1,529	2,337,368	5.77	3.22
504	228	0	21.66	0.34	1,402	1,986,260	5.00	3.42
505	228	0	19.50	0.21	2,063	4,255,865	5.00	4.04
506	228	0	22.50	0.21	1,656	2,742,336	5.00	5.58
507	227	1	17.75	0.21	1,933	3,735,523	5.84	6.43
508	225	1	20.00	0.21	1,864	3,472,673	6.00	4.00
509	226	1	21.15	0.21	1,759	3,004,081	5.21	3.93
510	225	1	23.00	0.21	1,699	2,887,136	5.56	3.72
601	230	0	14.93	0.78	1,420	2,016,699	4.19	3.43

Table D2: Variables on Pool Basis

DISSUB	HD1	HPRMAP	LAT	PNM	POPD6	POPSQ	PRMAP	CAV25
602	230	0	15 06	0.78	2,118	4,486,893	4.53	3.01
603	229	0	14 00	0.50	1,927	3,713,380	5.00	2.84
604	229	0	16 79	0.47	2,083	4,338,754	4.92	4.05
605	228	0	14.50	0.34	1,922	3,694,654	5.00	4.13
606	228	0	14 00	0.34	2,061	4,247,721	4.40	4.12
607	228	0	17 45	0.34	2,253	5,074,657	4.77	3.03
608	228	0	14 00	0.34	2,800	8,396,185	4.74	4.84
609	228	0	17 00	0.34	1,896	3,593,148	4.50	3.07
610	228	0	19.50	0.34	2,115	4,473,225	5.00	2.08
701	230	0	19 52	0.78	1,884	3,549,456	4.55	2.63
702	230	0	20 00	0.78	2,385	5,687,131	4.92	3.84
703	230	0	24 61	0.30	2,801	7,844,976	4.00	3.54
704	232	0	27 09	0.01	2,575	6,632,858	3.83	4.27
705	230	0	24 43	0.35	3,380	11,426,053	4.06	3.42
706	231	0	25 39	0.29	2,536	6,429,953	3.78	3.06
707	234	0	31.25	-0.12	2,894	8,373,728	3.28	4.84
708	234	0	32 77	-0.12	2,385	5,687,022	2.80	4.93
709	234	0	30 56	-0.12	2,926	8,562,131	3.80	3.73
710	234	0	33.81	-0.13	2,976	8,857,855	3.16	2.76
801	230	0	21 87	0.22	2,420	5,856,302	4.45	4.15
802	230	0	21 78	0.34	2,342	5,483,800	4.90	2.98
803	230	0	23 00	0.34	2,426	5,887,651	5.00	4.90
804	231	0	26 56	-0.20	2,660	7,072,940	4.64	3.59
805	228	0	22 50	0.34	1,985	3,941,728	5.00	3.79
806	228	0	23 00	0.34	2,565	6,576,795	5.00	4.74
807	228	0	26 00	-0.20	2,180	4,754,144	5.00	0.00
808	228	0	26 00	-0.24	1,970	3,880,900	5.00	5.16
809	228	0	29 00	-0.20	2,405	5,784,396	5.00	5.46
810	228	0	29 00	-0.24	1,949	3,798,601	5.00	2.86
901	228	0	26 00	-0.24	1,523	2,319,529	5.00	4.24
902	228	0	25 00	-0.24	1,869	3,491,759	5.00	5.41
903	227	1	26 00	-0.24	1,378	1,899,229	5.11	5.58
904	227	1	26 50	-0.24	1,284	1,648,656	5.27	4.89
905	228	0	29 00	-0.24	2,056	4,228,311	5.00	4.76
906	228	0	29 00	-0.24	1,757	3,087,049	5.00	4.17
907	227	1	30 00	-0.24	1,575	2,479,275	5.20	5.66
908	227	0	29.50	-0.24	1,610	2,582,422	5.00	5.27
909	229	0	31 50	-0.24	1,918	3,617,724	5.00	3.82
910	228	0	32 00	-0.24	2,087	4,387,409	5.00	5.00
1001	227	1	21.75	0.21	1,862	3,465,182	5.59	3.41
1002	227	1	24.36	0.17	1,288	1,859,918	5.46	4.00
1003	227	1	22.50	0.17	1,079	1,163,390	6.00	2.01
1004	227	1	25.00	0.21	1,385	1,919,001	5.10	3.04
1005	227	1	25.00	0.21	1,485	2,146,811	5.11	0.00
1006	227	0	28.50	-0.29	915	831,225	5.00	2.58
1007	227	0	28 50	-0.29	1,716	2,943,832	5.00	5.39
1008	229	0	29 00	-0.29	1,797	3,227,861	5.00	3.82
1009	227	0	32 00	-0.29	1,663	2,785,589	4.89	4.65
1010	229	0	32 00	-0.29	1,517	2,301,289	5.00	5.00
1101	228	1	27 73	-0.09	1,524	2,322,576	5.37	2.67
1102	229	0	25 00	0.17	1,279	1,634,729	5.00	3.81

Table D2: Variables on Pool Basis

DISSUB	HD1	HPRMAP	LAT	PNM	POPD6	POPSQ	PRMAP	CAV25
1103	229	0	25.50	0.17	1,093	1,194,337	5.00	4.79
1104	229	1	25.27	0.17	1,179	1,390,041	5.29	2.56
1105	229	0	29.00	-0.55	907	823,364	5.00	3.52
1106	229	0	29.00	-0.55	1,335	1,783,300	5.00	3.52
1107	229	0	32.00	-0.29	1,117	1,247,527	5.00	3.51
1108	229	0	32.00	-0.55	1,576	2,483,776	5.00	2.61
1109	229	0	32.00	-0.55	1,412	1,993,744	5.00	2.71
1110	229	0	32.00	-0.55	1,191	1,418,481	5.00	2.74
1201	231	0	35.00	-0.29	957	915,449	4.33	3.18
1202	231	0	35.00	-0.55	1,484	2,232,036	5.00	2.85
1203	231	0	35.00	-0.55	1,640	2,689,986	5.00	2.32
1204	231	0	35.00	-0.55	1,977	3,910,224	5.00	4.16
1205	231	0	35.00	-0.55	1,580	2,433,600	5.00	3.00
1206	231	0	38.00	-0.47	1,428	2,039,184	3.80	2.58
1207	231	0	39.04	-0.55	1,685	2,838,351	4.12	3.50
1208	231	0	38.00	-0.55	2,092	4,377,507	4.00	5.00
1209	231	0	41.00	-0.55	2,293	5,257,849	4.22	2.30
1210	231	0	39.68	-0.55	1,863	2,765,569	4.31	2.71
1301	228	0	33.00	-0.24	1,876	3,519,931	5.00	2.49
1302	227	0	32.00	-0.29	1,244	1,547,536	4.90	3.52
1303	228	0	35.00	-0.24	1,374	1,887,008	5.00	3.55
1304	227	0	37.48	-0.48	1,965	3,861,225	4.51	1.99
1305	227	0	35.00	-0.29	3,750	14,058,779	4.16	3.55
1306	227	0	35.00	-0.29	2,021	4,083,377	4.89	3.20
1307	231	0	35.50	-0.29	1,833	3,359,889	5.00	1.75
1308	228	0	38.26	-0.29	1,563	2,442,969	3.74	0.00
1309	227	0	38.00	-0.29	1,798	3,232,728	5.00	3.21
1310	234	0	38.50	-0.72	2,282	5,206,450	4.00	5.21
1401	234	0	29.00	-0.20	2,776	7,704,779	4.00	5.82
1402	234	0	31.90	-0.20	2,693	7,251,816	4.00	4.09
1403	234	0	31.00	-0.20	2,381	5,668,182	4.80	4.17
1404	229	0	33.58	-0.20	2,822	7,980,862	4.18	3.26
1405	234	0	36.63	-0.37	1,831	3,353,377	2.86	2.65
1406	235	0	38.41	-0.66	1,908	3,644,637	2.59	3.77
1407	228	0	32.00	-0.24	1,964	3,859,258	4.33	3.05
1408	231	0	36.54	-0.49	2,068	4,276,624	3.94	3.41
1409	230	0	36.04	-0.45	2,276	5,179,790	4.72	4.03
1410	228	0	35.00	-0.24	2,733	7,468,949	5.00	3.21
1501	238	0	45.54	-0.57	2,787	7,767,389	1.93	3.81
1502	238	0	44.00	-0.57	2,254	5,081,039	2.22	4.47
1503	238	0	47.00	-0.57	2,465	6,076,225	2.44	4.49
1504	234	0	45.21	-0.72	3,293	10,843,849	2.02	4.96
1505	234	0	43.94	-0.72	2,598	6,751,953	2.96	2.78
1506	234	0	42.42	-0.72	2,356	5,551,029	4.07	4.70
1507	229	0	42.48	-0.72	3,224	10,395,257	4.20	3.15
1508	237	0	49.85	-0.82	3,516	12,361,096	1.96	2.89
1509	235	0	49.27	-0.85	1,886	3,556,958	2.84	3.58
1510	235	0	48.45	-1.00	1,897	3,597,588	2.90	3.77
1801	235	0	40.50	-1.00	2,164	4,882,391	4.38	5.33
1802	235	0	44.00	-1.00	2,358	5,580,164	4.00	0.00
1803	235	0	45.40	-1.00	3,089	9,804,895	3.54	2.47

Table D2: Variables on Pool Basis								
DISSUB	HD1	HPRMAP	LAT	PNM	POPD6	POPSQ	PRMAP	CAV25
1604	235	0	43.21	-1.05	2,279	5,193,167	3.88	4.03
1605	234	0	43.42	-0.70	1,827	3,337,142	4.25	1.70
1606	235	0	47.99	-1.68	1,459	2,127,897	3.61	2.39
1607	235	0	44.70	-0.93	1,458	2,126,673	4.00	2.26
1608	235	0	50.81	-1.92	1,253	1,570,785	3.60	2.27
1609	235	0	46.76	-1.33	1,434	2,056,009	4.00	3.35

Table D2: Variables on Pool Basis								
DISSUB	HD1	HPRMAP	LAT	PNM	POPD6	POPSQ	PRMAP	CAV25
1610	235	0	47.45	-1.50	1,379	1,901,431	3.95	4.07

Table D3: Variables by Rural Municipality

RMDSUB	RMNO	CEA	RMACRE25	RMAREA	RMB20	RMB25	RMB30	RMCF	RMCLVAL
101	1	1	17,698	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
101	2	1	30,496	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
101	3	1	29,128	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
101	31	1	17,542	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
101	32	1	16,084	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
101	33	1	26,966	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
102	61	1	23,934	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
102	63	1	24,371	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
102	64	1	31,606	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
103	91	1	17,801	8.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
103	92	1	21,065	8.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
103	93	1	17,099	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
104	4	1	24,154	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
104	34	1	40,612	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
104	35	1	42,248	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
105	94	1	19,424	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
105	95	1	33,273	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
105	96	2	36,841	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
106	5	1	31,210	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
106	6	2	36,150	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
106	36	2	38,562	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
107	65	1	48,455	9.0	14,192,664	22,237,636	10,859,218	5,616	\$42,545,146
107	66	2	34,624	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
108	7	2	43,893	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
108	8	2	25,487	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
108	37	2	33,856	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
108	38	2	28,372	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
109	67	2	63,975	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
109	68	2	26,242	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
109	97	2	42,818	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
110	98	2	80,023	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
201	9	2	17,076	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
201	10	2	10,351	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
201	11	3	25,658	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,182,134
201	39	2	34,736	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
201	40	2	35,420	11.5	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
202	69	2	48,035	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
202	70	2	50,458	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
203	99	2	48,641	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
203	100	2	50,634	9.0	5,295,682	13,618,402	11,379,189	6,148	\$53,101,118
204	12	3	31,151	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,182,134
204	13	3	11,373	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,182,134
204	14	3	9,209	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,182,134
204	42	3	61,771	14.5	4,987,085	8,244,509	5,443,089	7,928	\$61,182,134
204	43	3	19,148	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,182,134
205	71	3	66,901	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,182,134
205	101	3	35,255	9.5	4,987,085	8,244,509	5,443,089	7,928	\$61,182,134
206	72	3	53,206	8.0	4,987,085	8,244,509	5,443,089	7,928	\$61,182,134
206	102	3	42,150	6.5	4,987,085	8,244,509	5,443,089	7,928	\$61,182,134
207	73	3	91,825	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,182,134
208	44	3	35,234	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,182,134

Table D3: Variables by Rural Municipality

RMDSUB	RMNO	CEA	PMACRE25	PMAREA	PMB20	PMB25	PMB50	PMCF	PMCLVAL
208	74	3	70,285	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,162,134
209	103	3	77,102	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,162,134
210	104	3	79,000	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,162,134
301	15	3	5,669	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,162,134
301	16	3	4,610	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,162,134
301	17	4	11,558	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
301	45	3	44,086	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,162,134
301	47	4	7,005	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
302	75	3	75,550	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,162,134
302	105	3	74,498	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,162,134
303	46	3	24,332	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,162,134
303	76	3	61,819	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,162,134
304	106	3	75,447	9.0	4,987,085	8,244,509	5,443,089	7,928	\$61,162,134
304	107	4	61,115	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
305	77	4	56,037	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
305	78	4	46,206	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
306	48	4	12,623	6.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
306	49	4	41,150	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
307	108	4	80,869	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
308	79	4	52,332	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
308	80	4	16,978	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
309	18	4	19,981	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
309	19	4	25,227	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
309	20	4	8,798	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
309	50	4	18,252	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
310	21	4	9,789	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
310	22	4	4,137	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
310	51	4	20,862	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
310	52	4	7,471	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
310	81	4	3,030	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
310	82	4	3,384	8.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
401	135	7	73,128	9.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
401	136	7	62,011	9.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
401	196	7	74,072	13.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
402	137	8	89,119	12.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
403	167	8	46,262	9.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
404	109	4	56,972	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
404	138	8	82,282	12.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
404	139	8	40,695	9.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
405	168	8	96,976	14.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
406	140	8	11,530	9.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
406	169	8	61,171	9.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
406	170	8	12,431	9.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
407	229	8	77,495	12.5	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
408	230	8	76,054	15.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
409	110	4	19,897	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
409	111	4	19,212	9.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
409	112	4	15,752	7.0	11,323,626	19,980,707	9,120,434	5,478	\$29,662,110
409	141	8	23,885	9.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
409	142	8	20,726	6.5	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
409	171	8	54,889	9.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085

Table D3: Variables by Rural Municipality

RMDSSUB	RMNO	CEA	PMACRE25	PMAREA	PMB20	PMB25	PMB30	PMCF	PMCLVAL
409	172	8	35,188	6.0	9,314,746	20,553,917	8,545,966	8,412	\$57,215,005
410	231	8	120,840	14.0	9,314,746	20,553,917	8,545,966	8,412	\$57,215,005
410	232	8	35,580	8.0	9,314,746	20,553,917	8,545,966	8,412	\$57,215,005
501	131	7	33,259	9.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
501	161	7	73,454	9.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
502	132	7	9,804	5.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
502	162	7	39,625	6.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
502	163	7	27,841	9.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
503	133	7	27,409	8.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
503	134	7	45,577	9.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
503	164	7	24,225	9.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
504	190	6	56,303	10.0	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
504	221	6	73,915	9.5	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
505	191	7	71,011	9.5	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
506	222	7	63,108	8.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
507	165	7	48,632	9.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
507	195	7	21,115	7.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
508	194	7	58,719	9.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
509	193	7	78,905	9.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
509	223	7	51,254	9.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
510	224	7	52,601	9.5	6,287,792	7,242,780	5,427,707	8,196	\$68,727,860
601	121	5	23,244	6.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
601	122	5	14,574	6.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
601	151	5	23,532	8.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
602	123	5	22,983	9.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
602	124	5	28,383	9.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
602	153	5	12,846	6.5	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
602	154	5	24,757	9.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
603	125	5	30,836	9.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
603	126	6	53,697	9.0	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
604	155	5	35,480	8.5	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
604	156	6	50,206	9.5	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
604	157	6	37,236	9.5	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
605	127	6	98,310	12.0	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
606	128	6	97,869	10.0	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
607	158	6	55,365	9.0	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
607	159	6	64,122	9.0	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
608	129	6	92,461	9.0	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
608	130	6	77,519	9.0	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
609	180	6	73,655	9.0	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
610	189	6	50,580	9.0	11,865,481	16,814,681	21,785,037	7,978	\$95,829,496
701	152	5	10,837	8.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
701	181	5	12,233	7.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
701	183	5	28,172	10.5	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
702	184	5	27,368	9.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
702	185	5	27,875	9.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
703	211	5	15,119	10.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
703	241	9	18,059	9.0	5,750,858	8,914,801	7,882,087	8,111	\$29,575,936
704	213	5	8,764	9.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
704	243	9	22,543	9.0	5,750,858	8,914,801	7,882,087	8,111	\$29,575,936
704	273	9	31,515	9.0	5,750,858	8,914,801	7,882,087	8,111	\$29,575,936

Table D3: Variables by Rural Municipality

RMOSSUB	RMNO	CEA	RMACRE25	RMAREA	RMB20	RMB25	RMB30	RMCF	RMCLVAL
705	214	5	28,697	9.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
705	244	9	27,203	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
706	215	5	32,389	9.0	7,694,419	20,305,632	7,816,771	7,516	\$47,010,342
706	245	9	22,377	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
706	275	9	19,172	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
707	271	9	23,793	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
707	301	9	13,871	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
707	301	9	11,651	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
708	303	9	31,864	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
708	333	9	12,374	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
708	363	14	328	9.0	2,252,704	6,621,525	5,759,206	5,571	\$21,488,146
709	274	9	24,390	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
709	304	9	26,036	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
710	305	9	12,091	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
710	334	9	13,889	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
710	335	9	3,754	9.0	5,750,858	8,914,601	7,662,087	8,111	\$29,575,936
710	364	14	371	9.0	2,252,704	6,621,525	5,759,206	5,571	\$21,488,146
710	365	14	204	9.0	2,252,704	6,621,525	5,759,206	5,571	\$21,488,146
801	186	6	39,848	8.0	11,665,481	16,814,681	21,785,037	7,978	\$95,829,496
801	216	6	13,580	7.0	11,665,481	16,814,681	21,785,037	7,978	\$95,829,496
801	246	10	17,347	9.0	3,666,670	8,171,227	6,411,075	6,505	\$35,097,491
802	187	6	26,706	6.5	11,665,481	16,814,681	21,785,037	7,978	\$95,829,496
802	217	6	40,071	9.0	11,665,481	16,814,681	21,785,037	7,978	\$95,829,496
803	218	6	77,941	10.0	11,665,481	16,814,681	21,785,037	7,978	\$95,829,496
804	247	10	20,303	9.5	3,666,670	8,171,227	6,411,075	6,505	\$35,097,491
804	248	10	26,011	8.0	3,666,670	8,171,227	6,411,075	6,505	\$35,097,491
804	278	10	13,656	6.0	3,666,670	8,171,227	6,411,075	6,505	\$35,097,491
805	219	6	56,608	9.5	11,665,481	16,814,681	21,785,037	7,978	\$95,829,496
806	220	6	46,490	7.5	11,665,481	16,814,681	21,785,037	7,978	\$95,829,496
807	249	10	96,724	9.0	3,666,670	8,171,227	6,411,075	6,505	\$35,097,491
808	250	11	56,860	6.5	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
809	279	10	88,654	9.0	3,666,670	8,171,227	6,411,075	6,505	\$35,097,491
810	280	11	46,309	9.0	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
901	251	11	59,079	8.0	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
902	252	11	52,231	8.0	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
903	253	11	58,125	9.0	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
904	254	11	96,318	10.5	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
905	281	11	55,366	9.0	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
906	282	11	63,221	10.5	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
907	283	11	82,008	10.0	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
908	284	11	78,379	9.0	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
909	312	11	67,151	9.0	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
910	313	11	44,348	6.0	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
1001	225	7	29,747	6.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,880
1001	226	7	32,456	11.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,880
1002	227	8	23,551	11.5	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
1002	257	8	53,061	9.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
1003	228	8	58,154	12.5	9,314,746	20,553,917	8,545,986	8,412	\$57,215,085
1004	256	7	50,829	10.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,880
1005	256	7	26,772	9.0	6,287,792	7,242,780	5,427,707	8,196	\$68,727,880
1006	285	12	93,512	12.5	5,778,999	18,468,084	16,596,208	6,701	\$55,292,281

Table D3: Variables by Rural Municipality

RMDSSUB	RMNO	CEA	RMACRE25	RMAREA	RMB20	RMB25	RMB30	RMCF	RMCLVAL
1007	286	12	73,551	8.0	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1008	287	12	84,242	9.0	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1009	316	12	65,514	9.0	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1010	317	12	71,950	9.0	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1101	258	8	32,648	9.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,095
1101	288	12	45,881	9.0	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1102	259	8	76,531	14.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,095
1103	280	8	58,024	12.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,095
1104	261	8	30,906	8.5	9,314,746	20,553,917	8,545,986	8,412	\$57,215,095
1104	262	8	26,343	12.0	9,314,746	20,553,917	8,545,986	8,412	\$57,215,095
1105	289	13	38,662	9.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1105	290	13	48,505	9.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1106	291	13	23,643	6.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1106	292	13	32,417	7.5	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1107	318	12	65,295	9.0	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1108	319	13	55,351	9.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1109	320	13	40,310	9.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1110	321	13	21,973	6.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1110	322	13	19,477	7.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1201	348	12	41,209	6.0	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1202	349	13	70,337	8.5	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1203	350	13	52,066	7.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1204	351	13	57,025	9.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1205	352	13	46,873	9.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1206	378	12	22,119	6.0	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1206	379	13	53,697	8.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1207	382	13	71,129	9.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1207	411	13	38,865	11.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1208	381	13	71,835	9.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1209	409	13	59,379	9.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1210	380	13	54,736	7.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1210	410	13	69,024	9.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1301	314	11	39,383	9.0	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
1302	315	12	53,896	9.5	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1303	343	11	72,205	9.0	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
1304	344	11	52,632	9.0	10,541,324	23,024,091	14,344,062	6,805	\$67,508,669
1304	374	15	52,591	8.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1305	345	12	81,363	9.5	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1306	346	12	77,469	9.0	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1307	347	12	57,658	12.0	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1308	376	12	61,300	9.0	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1308	377	12	22,065	9.5	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1309	375	12	53,884	8.5	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1310	372	15	44,058	8.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1310	373	15	51,684	8.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1401	276	10	21,134	9.0	3,886,670	8,171,227	6,411,075	6,505	\$35,097,491
1401	277	10	24,336	9.0	3,886,670	8,171,227	6,411,075	6,505	\$35,097,491
1402	306	10	8,343	6.0	3,886,670	8,171,227	6,411,075	6,505	\$35,097,491
1402	307	10	32,879	7.0	3,886,670	8,171,227	6,411,075	6,505	\$35,097,491
1403	308	10	51,744	8.0	3,886,670	8,171,227	6,411,075	6,505	\$35,097,491
1404	309	10	39,680	9.0	3,886,670	8,171,227	6,411,075	6,505	\$35,097,491

Table D3: Variables by Rural Municipality

RMDSSUB	RMNO	CEA	RMACRE25	RMAREA	RMB20	RMB25	RMB30	RMCF	RMCLVAL
1404	338	10	17,503	6.5	3,666,670	8,171,227	6,411,075	6,505	\$35,097,491
1404	339	10	23,612	9.0	3,666,670	8,171,227	6,411,075	6,505	\$35,097,491
1405	336	10	15,002	9.0	3,666,670	8,171,227	6,411,075	6,505	\$35,097,491
1405	337	10	11,800	8.0	3,666,670	8,171,227	6,411,075	6,505	\$35,097,491
1405	366	14	9,482	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1405	367	14	8,680	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1405	368	14	1,337	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1405	367	14	5,493	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1406	368	14	15,079	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1406	369	15	26,986	9.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1406	368	14	16,654	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1406	369	15	21,645	8.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1407	310	11	44,759	9.0	10,541,324	23,024,091	14,344,062	6,805	\$67,509,669
1408	340	11	34,169	9.0	10,541,324	23,024,091	14,344,062	6,805	\$67,509,669
1408	370	15	40,800	9.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1409	341	11	58,510	9.0	10,541,324	23,024,091	14,344,062	6,805	\$67,509,669
1409	371	15	47,233	9.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1410	342	11	50,951	6.0	10,541,324	23,024,091	14,344,062	6,805	\$67,509,669
1501	426	14	1,805	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1501	427	14	32,626	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1501	456	14	5,389	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1501	457	14	31,853	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1502	428	14	46,520	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1503	458	14	35,139	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1504	429	15	48,335	8.5	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1504	459	15	29,754	11.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1505	400	15	24,031	9.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1505	430	15	18,394	8.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1505	460	15	25,010	6.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1506	401	15	42,481	9.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1506	402	15	28,694	7.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1506	431	15	40,799	9.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1507	403	15	64,349	8.5	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1507	404	15	49,294	7.5	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1507	463	15	22,158	9.0	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1508	361	14	0	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	391	14	0	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	393	14	0	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	394	14	0	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	395	14	217	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	421	14	1	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	423	14	8	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	424	14	19	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	425	14	9	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	451	14	0	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	453	14	0	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	454	14	0	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	455	14	0	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	481	14	0	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	483	14	0	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	484	14	0	9.0	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146

Table D3: Variables by Rural Municipality

RMDSSUB	RMNO	CEA	RMACRE25	RMAREA	RMB20	RMB25	RMB30	RMCF	RMCLVAL
1508	485	14	0	90	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	486	14	900	90	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	487	14	19,159	95	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	488	14	771	85	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	489	15	28	90	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1508	490	15	9,023	70	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1508	511	14	0	60	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	513	14	0	90	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	514	14	0	90	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	515	14	0	90	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	516	14	0	65	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	517	14	516	125	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	518	14	0	90	2,252,704	6,621,525	5,759,205	5,571	\$21,488,146
1508	519	15	0	90	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1508	520	15	333	90	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1509	461	15	23,412	100	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1509	491	15	10,776	90	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1509	493	16	30,224	105	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1509	521	15	1,668	90	4,028,202	11,345,352	12,684,768	10,238	\$52,552,634
1509	523	16	3,505	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1509	553	16	0	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1510	464	16	30,914	80	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1510	494	16	22,600	80	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1510	524	16	2,504	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1510	554	16	7	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1601	406	16	53,225	80	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1602	434	16	59,525	85	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1603	435	16	49,552	105	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1603	465	16	7,171	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1603	495	16	9,021	80	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1603	525	16	5,366	50	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1603	555	16	289	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1604	406	15	62,165	80	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1604	456	16	48,887	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1604	466	16	6,582	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1604	496	16	3,472	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1604	526	16	2,403	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1604	556	16	0	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1605	408	12	16,107	100	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1605	437	16	47,462	95	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1605	438	12	19,405	90	5,778,999	18,468,094	16,596,208	6,701	\$55,292,281
1606	467	16	12,121	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1606	468	17	33,804	90	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1606	497	16	4,530	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1606	498	17	11,433	90	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1606	527	16	40	120	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1606	528	17	886	120	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1606	557	16	0	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1606	558	17	0	80	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1606	587	16	0	90	1,636,419	5,405,612	7,967,303	6,101	\$28,413,582
1606	588	17	1,011	90	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888

Table D3: Variables by Rural Municipality

RMDSSUB	RMNO	CEA	RMACRE25	RMAREA	RMB20	RMB25	RMB30	RMCF	RMCLVAL
1607	439	13	43,304	8.5	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1607	470	17	16,333	6.5	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1608	469	17	28,169	7.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1608	499	17	17,969	9.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1608	501	17	11,961	6.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1608	529	17	4,217	9.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1608	531	17	9,673	9.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1608	532	17	2,659	7.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1608	559	17	339	9.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1608	561	17	0	9.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1608	562	17	0	9.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1608	589	17	0	9.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1608	591	17	0	9.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1608	592	17	0	9.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1609	440	13	28,363	11.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1609	471	17	35,769	11.0	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1610	442	13	25,389	10.0	8,990,745	20,474,095	21,632,721	6,826	\$55,457,438
1610	472	17	41,069	10.5	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888
1610	502	17	20,090	9.5	2,111,185	4,048,919	9,828,720	3,651	\$18,080,888

Table D4: Variables by Rural Municipality

RMDSSUB	RMNO	RMCWF	RMDGDAY	RMF	RMFALO	RMFCROP	RMHD1	RMIMP	RMLAT
101	1	5,114	2,633	233	16,968	56,692	224	76,739	2.0
101	2	5,114	2,533	346	26,256	92,826	224	126,052	2.0
101	3	5,114	2,556	294	23,736	74,630	224	100,628	2.0
101	31	5,114	2,575	193	15,645	44,649	224	62,000	5.0
101	32	5,114	2,400	222	18,273	53,411	224	73,528	5.0
101	33	5,114	2,400	302	29,360	72,510	224	104,536	5.0
102	61	5,114	2,450	322	20,230	63,769	224	84,924	7.5
102	63	5,114	2,400	373	27,405	68,037	224	98,949	8.0
102	64	5,114	2,400	296	27,065	68,429	224	97,587	8.0
103	91	5,114	2,525	267	24,396	56,425	229.7069	82,111	11.5
103	92	5,114	2,400	363	24,054	57,964	229.7069	83,540	9.5
103	93	5,114	2,267	319	15,471	30,486	229.7069	55,951	11.0
104	4	5,114	2,622	226	15,922	56,660	224	75,358	2.0
104	34	5,114	2,444	335	38,009	85,386	224	125,145	5.0
104	35	5,114	2,556	314	33,425	78,454	224	112,882	5.0
105	94	5,114	2,311	281	17,116	37,448	229.7069	55,577	11.0
105	95	5,114	2,400	314	30,345	69,486	229.7069	101,071	11.0
105	96	5,870	2,400	300	40,153	93,128	224.2353	134,982	11.0
106	5	5,114	2,756	284	19,956	67,158	224	89,799	2.0
106	6	5,870	2,644	289	20,384	60,320	224	81,525	2.0
106	36	5,870	2,700	293	29,038	75,516	224.2353	106,777	5.0
107	65	5,114	2,400	334	39,170	84,557	224	127,660	8.0
107	66	5,870	2,467	249	30,701	72,909	224.2353	104,594	8.0
108	7	5,870	2,556	339	17,413	72,138	224.0588	90,502	2.0
108	8	5,870	2,400	282	9,566	37,291	224.0588	48,148	2.0
108	37	5,870	2,622	299	21,367	66,937	224.2353	90,748	5.0
108	38	5,870	2,556	345	19,386	45,825	224.0588	66,332	5.0
109	67	5,870	2,644	400	41,786	102,009	224.2353	147,654	8.0
109	68	5,870	2,600	228	19,117	42,702	224.2353	63,161	8.0
109	97	5,870	2,533	277	31,512	74,939	224.2353	109,253	11.0
110	98	5,870	2,600	359	52,624	107,398	224.2353	162,929	11.0
201	9	5,870	2,400	185	5,420	24,090	224.0588	29,525	2.0
201	10	5,870	2,400	177	8,072	21,306	224.0588	29,990	2.0
201	11	7,548	2,400	300	13,546	40,937	224.0588	55,333	2.0
201	39	5,870	2,467	352	24,352	56,549	224.0588	82,159	5.0
201	40	5,870	2,473	354	24,757	57,368	224.0588	84,517	5.0
202	69	5,870	2,600	380	34,800	74,180	224.2353	111,009	8.0
202	70	5,870	2,600	452	36,418	80,430	224.0588	117,941	8.0
203	99	5,870	2,600	263	35,344	71,601	224.2353	107,881	11.0
203	100	5,870	2,600	375	37,573	75,228	224.2353	113,711	11.0
204	12	7,548	2,400	286	16,673	53,304	224.0588	70,914	2.0
204	13	7,548	2,400	176	8,227	22,265	224.0588	30,889	2.0
204	14	7,548	2,400	147	7,769	18,585	224.0588	24,960	2.0
204	42	7,548	2,427	430	42,341	91,013	224.0588	134,583	5.0
204	43	7,548	2,511	229	13,771	32,161	224.0588	46,124	5.0
205	71	7,548	2,600	520	42,195	100,098	224.0588	143,935	8.0
205	101	7,548	2,600	351	24,021	53,186	225.1785	77,925	11.0
206	72	7,548	2,600	383	31,553	78,484	224.0588	112,098	8.0
206	102	7,548	2,600	295	26,385	99,430	225.1785	87,599	11.0
207	73	7,548	2,600	546	59,742	127,314	224.0588	189,697	8.0
208	44	7,548	2,489	377	29,058	55,676	224.0588	85,884	5.0

Table D4: Variables by Rural Municipality

RMDSUB	RMNO	RMCWF	RMDGDAY	RMF	RMFALO	RMFCROP	RMHD1	RMIMP	RMLAT
208	74	7,548	2,800	436	51,168	98,097	224,058	152,198	8.0
209	103	7,548	2,800	458	50,553	101,715	225,1765	155,089	11.0
210	104	7,548	2,644	418	54,244	104,554	225,1765	180,823	11.0
301	15	7,548	2,400	147	4,521	9,706	224,058	14,709	2.0
301	16	7,548	2,400	88	2,089	6,765	226,1765	9,079	2.0
301	17	5,000	2,556	283	7,441	20,535	226,1765	29,805	2.0
301	45	7,548	2,467	378	27,014	64,637	226,1765	93,121	5.0
301	47	5,000	2,422	77	4,796	10,594	226,1765	15,890	5.0
302	75	7,548	2,800	415	47,361	97,924	226,1765	147,086	8.0
302	105	7,548	2,800	441	49,532	99,754	226,1765	151,547	11.0
303	46	7,548	2,400	223	13,463	34,522	226,1765	48,717	5.0
303	76	7,548	2,578	349	33,834	78,010	226,1765	113,723	8.0
304	106	7,548	2,800	575	41,315	95,893	226,1765	139,393	11.0
304	107	5,000	2,800	541	26,919	74,576	226,1765	103,305	11.0
305	77	5,000	2,511	448	18,182	71,139	226,1765	90,261	8.0
305	78	5,000	2,511	313	22,275	57,449	226,1765	80,863	7.0
306	48	5,000	2,489	117	7,080	17,581	226,1765	24,796	5.0
306	49	5,000	2,467	318	24,413	57,086	227,7059	82,574	5.0
307	108	5,000	2,800	486	40,048	104,123	226,1765	146,343	10.0
308	79	5,000	2,489	364	31,285	70,222	227,7059	102,764	8.0
308	80	5,000	2,089	229	8,136	25,395	227,7059	34,657	8.0
309	18	5,000	2,800	229	10,659	33,116	226,1765	44,691	2.0
309	19	5,000	2,556	285	20,268	34,706	227,7059	55,535	2.0
309	20	5,000	2,467	110	6,998	13,589	227,7059	20,780	2.0
309	50	5,000	2,344	182	10,037	24,304	227,7059	35,189	5.0
310	21	5,000	2,644	115	8,071	16,270	227,7059	24,858	2.0
310	22	5,000	2,689	44	4,494	7,089	227,7059	11,985	2.0
310	51	5,000	2,256	189	12,769	30,942	227,7059	44,107	5.0
310	52	5,000	2,222	87	7,237	11,642	227,7059	19,082	5.0
310	81	5,000	1,978	80	2,521	6,151	227,7059	8,825	8.0
310	82	5,000	1,822	58	2,510	5,107	227,7059	7,780	8.0
401	135	7,750	2,800	458	42,890	93,476	226,5254	137,910	14.0
401	136	7,750	2,800	527	28,841	81,198	226,5294	111,447	14.0
401	166	7,750	2,615	694	41,812	100,369	226,5294	143,066	17.5
402	137	7,929	2,800	660	44,206	117,928	226,5294	164,484	14.0
403	167	7,929	2,667	360	29,807	60,838	226,5294	92,534	18.0
404	109	5,000	2,488	322	34,657	71,864	227,7059	107,212	11.0
404	138	7,929	2,800	492	41,335	107,697	226,5294	151,389	13.5
404	139	7,929	2,800	276	22,093	53,205	224,6471	76,775	14.0
405	168	7,929	2,650	650	55,033	126,404	226,5294	182,978	17.5
405	140	7,929	2,800	138	7,328	18,523	227,7059	26,462	14.0
406	169	7,929	2,800	451	34,972	82,983	224,6471	120,176	17.0
406	170	7,929	2,800	94	2,877	15,868	224,6471	18,844	17.0
407	229	7,929	2,754	537	50,737	97,099	224,6471	150,397	20.5
408	230	7,929	2,767	473	45,823	96,437	224,6471	144,559	21.0
409	110	5,000	2,433	210	10,217	34,194	227,7059	45,487	11.0
409	111	5,000	2,556	243	11,065	38,894	227,7059	50,738	11.0
409	112	5,000	2,529	188	6,455	22,753	227,7059	29,384	11.0
409	141	7,929	2,756	228	11,306	40,399	224,6471	52,416	14.0
409	142	7,929	2,800	170	9,974	24,462	224,6471	34,810	14.0
409	171	7,929	2,756	386	21,804	64,421	224,6471	87,527	17.0

Table D4: Variables by Rural Municipality

RMDSSUB	RMNO	RMCWF	RMDGDAY	RMF	RMFALO	RMFCROP	RMHD1	RMIMP	RMLAT
409	172	7,929	2,800	248	17,461	40,186	224.6471	58,401	17.0
410	231	7,929	2,800	636	57,582	141,488	224.6471	200,762	21.0
410	232	7,929	2,800	202	15,400	40,521	224.6471	56,672	20.5
501	131	7,750	2,600	433	43,432	83,891	228.0588	130,600	14.0
501	161	7,750	2,756	393	53,142	107,234	228.0588	163,921	17.0
502	132	7,750	2,680	157	8,403	16,142	225.1765	25,105	14.5
502	162	7,750	2,600	275	28,253	58,574	228.0588	87,481	17.0
502	163	7,750	2,600	288	23,951	48,675	225.1765	73,953	17.0
503	133	7,750	2,700	255	20,465	43,970	225.1765	65,484	14.0
503	134	7,750	2,622	350	30,835	63,986	225.1765	96,073	14.0
503	164	7,750	2,600	307	21,666	40,910	225.1765	64,246	17.0
504	190	7,653	2,620	436	39,988	80,793	227.7647	131,447	20.0
504	221	7,653	2,600	439	40,760	114,115	227.7647	156,964	23.0
505	191	7,750	2,600	400	56,029	105,480	228.0588	164,376	19.5
506	222	7,750	2,600	342	37,775	105,195	227.7647	145,618	22.5
507	185	7,750	2,600	415	36,634	69,489	226.5294	107,145	17.0
507	195	7,750	2,600	251	15,430	30,985	226.5294	47,360	19.5
508	194	7,750	2,600	440	41,836	84,586	225.1765	128,491	20.0
509	193	7,750	2,600	415	50,805	110,461	225.1765	166,791	20.0
509	223	7,750	2,600	317	31,619	80,703	227.4706	116,179	23.0
510	224	7,750	2,600	372	35,634	81,722	225.1765	119,617	23.0
601	121	6,763	2,600	384	20,983	56,515	229.7059	79,557	14.0
601	122	6,763	2,413	327	14,983	35,416	229.7059	51,659	14.0
601	151	6,763	2,578	422	19,832	60,395	229.7059	83,505	16.5
602	123	6,763	2,222	383	21,156	50,641	229.7059	76,275	14.0
602	124	6,763	2,244	402	25,149	62,338	229.7059	89,927	14.0
602	153	6,763	2,329	337	12,921	30,011	229.7059	45,023	16.5
602	154	6,763	2,400	407	25,823	55,224	229.7059	81,799	16.5
603	125	6,763	2,333	358	27,116	58,126	229.7059	86,572	14.0
603	126	7,653	2,378	400	39,032	90,051	228.0588	131,400	14.0
604	155	6,763	2,475	412	38,843	76,643	229.7059	117,453	17.0
604	156	7,653	2,422	383	49,798	86,518	228.0588	139,358	16.5
604	157	7,653	2,356	411	31,972	63,206	228.0588	96,920	17.0
605	127	7,653	2,382	458	58,669	140,713	228.0588	202,001	14.5
606	128	7,653	2,540	352	67,163	131,694	228.0588	203,318	14.0
607	158	7,653	2,400	516	41,555	91,703	228.0588	138,598	18.0
607	159	7,653	2,600	394	53,655	104,565	228.0588	164,053	17.0
608	129	7,653	2,600	336	66,216	122,025	228.0588	191,322	14.0
608	130	7,653	2,600	385	57,000	110,781	228.0588	170,289	14.0
609	160	7,653	2,678	400	60,629	112,875	228.0588	178,890	17.0
610	189	7,653	2,556	373	39,151	82,801	227.7647	124,704	19.5
701	152	6,763	2,600	296	10,836	30,760	230.4706	42,575	18.5
701	181	6,763	2,457	370	14,938	44,549	230.4706	60,822	20.5
701	183	6,763	2,420	671	29,754	71,375	230.4706	104,474	19.5
702	184	6,763	2,444	485	27,863	61,022	230.4706	91,505	20.0
702	185	6,763	2,467	500	29,228	73,257	230.4706	105,631	20.0
703	211	6,763	2,400	476	15,261	42,579	230.4706	60,670	23.0
703	241	7,259	2,400	589	16,661	52,375	230.4706	70,648	26.0
704	213	6,763	2,400	412	18,866	49,170	230.4706	69,906	23.0
704	243	7,259	2,400	445	28,370	72,481	230.4706	102,712	26.0
704	273	7,259	2,400	704	27,452	70,045	233.8824	99,086	29.0

Table D4: Variables by Rural Municipality

RMDSSUB	RMNO	RMCFW	RMDGDAY	RMF	RMFALO	RMFCROP	RMHD1	RMIMP	RMLAT
705	214	6,763	2,400	420	27,879	60,186	230.4706	89,054	23.0
705	244	7,259	2,400	463	25,986	62,707	230.4706	89,704	26.0
706	215	6,763	2,411	474	27,429	63,950	230.4706	93,545	23.0
706	245	7,259	2,366	449	13,455	36,397	230.4706	50,947	26.0
706	275	7,259	2,400	608	12,811	38,314	233.8824	52,467	29.0
707	271	7,259	2,366	536	18,175	59,704	233.8824	79,930	29.0
707	301	7,259	2,227	409	8,530	30,396	233.8824	40,233	32.0
707	331	7,259	2,200	367	7,489	25,926	233.8824	34,346	35.0
708	303	7,259	2,400	570	18,869	59,818	233.8824	80,689	32.0
708	333	7,259	2,211	556	3,179	34,953	233.8824	39,283	35.0
708	363	4,549	2,133	46	146	1,276	233.8824	1,495	38.0
709	274	7,259	2,400	577	16,929	49,846	233.8824	69,258	29.0
709	304	7,259	2,333	504	16,144	45,405	233.8824	63,326	32.0
710	305	7,259	2,320	447	6,806	24,443	233.8824	31,859	32.0
710	334	7,259	2,156	548	8,220	41,447	233.8824	51,254	35.0
710	335	7,259	2,078	337	1,615	12,749	233.8824	14,962	35.0
710	364	4,549	2,000	142	519	2,806	233.8824	3,441	38.0
710	365	4,549	2,000	80	396	987	233.8824	1,561	38.0
801	186	7,653	2,567	367	43,914	79,933	230.4706	126,512	20.0
801	216	7,653	2,422	235	9,486	26,709	230.4706	36,883	23.0
801	246	5,996	2,078	491	11,815	36,529	230.4706	49,313	26.0
802	187	7,653	2,571	272	19,870	42,225	230.4706	63,187	20.0
802	217	7,653	2,500	410	26,919	61,567	230.4706	89,798	23.0
803	218	7,653	2,500	485	48,793	112,988	230.4706	165,967	23.0
804	247	5,996	2,100	454	13,419	35,503	230.4706	50,649	26.0
804	248	5,996	2,284	354	15,584	36,966	230.4706	53,257	26.0
804	278	5,996	2,150	215	6,774	18,931	233.8824	26,305	28.5
805	219	7,653	2,511	548	35,182	84,184	227.7647	122,079	22.5
806	220	7,653	2,486	378	28,891	67,839	227.7647	98,801	23.0
807	249	5,996	2,400	445	37,502	99,055	227.7647	139,125	26.0
808	250	6,554	2,500	310	33,687	83,466	227.7647	118,839	26.0
809	279	5,996	2,400	457	38,803	103,365	227.7647	143,167	29.0
810	280	6,554	2,500	327	28,877	84,513	227.7647	115,922	29.0
901	251	6,554	2,533	324	34,039	94,806	227.7647	131,121	26.0
902	252	6,554	2,565	263	32,587	92,224	227.7647	126,761	26.0
903	253	6,554	2,467	310	37,192	92,037	227.4706	132,220	26.0
904	254	6,554	2,600	465	58,471	134,643	227.4706	198,167	26.5
905	281	6,554	2,411	407	26,495	87,869	227.7647	116,661	29.0
906	282	6,554	2,400	465	33,330	88,904	227.7647	123,332	29.0
907	283	6,554	2,520	311	38,137	114,772	227.4706	153,986	30.0
908	284	6,554	2,600	357	37,934	109,438	227.4706	152,449	29.5
909	312	6,554	2,400	444	31,101	94,834	227.7647	128,950	31.5
910	313	6,554	2,400	247	19,202	62,530	227.7647	83,126	32.0
1001	225	7,750	2,800	211	19,799	45,782	226.5294	66,538	22.0
1001	226	7,750	2,800	298	19,883	56,271	226.5294	76,997	21.5
1002	227	7,929	2,636	209	17,502	38,186	226.5294	56,278	21.5
1002	257	7,929	2,600	264	43,111	89,911	226.5294	115,094	25.5
1003	228	7,929	2,683	413	44,180	92,418	226.5294	139,070	22.5
1004	256	7,750	2,600	364	28,635	72,826	226.5294	103,370	25.0
1005	256	7,750	2,600	233	15,005	39,304	226.5294	54,547	25.0
1006	285	6,292	2,600	514	48,983	126,407	227.4708	177,741	28.5

Table D4: Variables by Rural Municipality

RMDSSUB	RMNO	RMCWF	RMDGDY	RMF	RMFALO	RMFCROP	RMHD1	RMIMP	RMLAT
1007	286	6,292	2,600	388	42,604	96,595	227.4706	142,007	28.5
1008	287	6,292	2,556	397	54,412	106,668	229.3529	162,325	29.0
1009	316	6,292	2,600	396	33,827	95,673	227.4706	134,924	32.0
1010	317	6,292	2,600	351	36,362	97,214	229.3529	136,006	32.0
1101	258	7,929	2,600	280	25,526	45,381	226.5294	72,160	26.0
1101	288	6,292	2,456	357	32,346	63,122	229.3529	104,662	29.0
1102	259	7,929	2,671	404	54,013	101,805	229.3529	158,426	25.0
1103	280	7,929	2,667	333	39,087	79,506	229.3529	123,376	25.5
1104	261	7,929	2,667	240	23,951	42,780	229.3529	67,915	25.5
1104	262	7,929	2,700	258	20,056	36,391	229.3529	59,049	25.0
1105	289	6,580	2,422	286	29,357	56,605	229.3529	86,440	29.0
1105	290	6,580	2,467	318	36,837	71,918	229.3529	109,600	29.0
1106	291	6,580	2,500	209	22,813	35,884	229.3529	60,217	29.0
1106	292	6,580	2,500	229	26,278	43,989	229.3529	72,373	29.0
1107	318	6,292	2,567	403	38,295	89,817	229.3529	129,829	32.0
1108	319	6,580	2,400	386	39,812	80,156	229.3529	121,830	32.0
1109	320	6,580	2,389	279	28,095	56,127	229.3529	87,884	32.0
1110	321	6,580	2,367	169	15,243	34,691	229.3529	50,709	32.0
1110	322	6,580	2,350	177	15,748	28,816	229.3529	45,264	32.0
1201	348	6,292	2,417	213	13,792	56,543	231.0588	72,072	35.0
1202	349	6,580	2,400	327	27,682	93,381	231.0588	123,143	35.0
1203	350	6,580	2,343	316	23,865	72,429	231.0588	97,228	35.0
1204	351	6,580	2,200	352	34,903	77,384	231.0588	113,904	35.0
1205	352	6,580	2,200	286	26,455	62,394	231.0588	90,500	35.0
1206	378	6,292	2,366	254	10,272	33,390	231.0588	44,303	38.0
1206	379	6,580	2,225	306	23,219	72,202	231.0588	96,433	38.0
1207	382	6,580	2,267	512	36,495	94,207	231.0588	133,286	38.0
1207	411	6,580	2,217	354	19,442	56,895	231.0588	77,148	41.0
1208	381	6,580	2,200	441	34,870	94,495	231.0588	130,627	38.0
1209	409	6,580	2,200	350	24,662	82,283	231.0588	109,990	41.0
1210	380	6,580	2,200	277	19,014	73,927	231.0588	94,199	38.0
1210	410	6,580	2,200	401	25,479	93,560	231.0588	121,283	41.0
1301	314	6,554	2,556	212	19,222	55,876	227.7647	75,838	33.0
1302	315	6,292	2,600	324	23,802	78,448	227.4706	106,334	32.0
1303	343	6,554	2,444	374	30,539	104,035	227.7647	137,514	35.0
1304	344	6,554	2,600	465	27,061	84,825	227.4706	114,778	36.0
1304	374	9,416	2,600	610	22,050	78,504	227.4706	102,370	39.0
1305	345	6,292	2,600	458	31,324	114,586	227.4706	150,095	35.0
1306	346	6,292	2,600	403	41,990	102,741	227.4706	149,542	35.0
1307	347	6,292	2,567	580	31,921	86,248	231.0588	122,178	35.5
1308	376	6,292	2,600	407	29,525	85,309	227.4706	116,373	38.0
1308	377	6,292	2,550	339	9,315	31,823	231.0588	41,928	39.0
1309	375	6,292	2,600	440	28,862	74,148	227.4706	103,733	38.0
1310	372	9,416	2,400	405	21,803	82,395	233.5882	86,040	38.5
1310	373	9,416	2,547	448	26,596	70,188	233.5882	98,404	38.5
1401	276	5,996	2,222	572	14,236	42,047	233.8824	57,379	29.0
1401	277	5,996	2,100	521	14,751	39,734	233.8824	55,381	29.0
1402	306	5,996	2,400	280	6,835	20,448	233.8824	27,576	31.5
1402	307	5,996	2,300	407	17,363	57,130	233.8824	75,827	32.0
1403	308	5,996	2,222	479	24,124	69,136	233.8824	94,575	31.0
1404	309	5,996	2,400	374	23,859	62,974	227.7647	88,863	32.0

Table D4: Variables by Rural Municipality

RMDSSUB	RMNO	RMCFW	RMDGDAY	RMF	RMFALO	RMFCROP	RMHD1	RMIMP	RMLAT
1404	338	5,986	2,400	253	11,200	40,210	233.8824	52,361	35.5
1404	339	5,986	2,300	356	11,816	39,578	227.7647	53,051	35.0
1405	339	5,986	2,172	513	7,128	42,510	233.8824	50,730	34.5
1405	337	5,986	2,300	354	7,013	30,297	233.8824	38,026	35.0
1405	386	4,549	2,022	370	4,982	25,606	233.8824	31,348	38.0
1405	367	4,549	2,200	482	1,251	21,458	233.8824	23,370	38.0
1405	386	4,549	2,000	128	554	4,491	238.1765	5,227	41.0
1405	387	4,549	2,167	262	1,080	12,002	238.1765	13,756	41.0
1406	388	4,549	2,200	431	4,890	32,896	233.8824	38,381	38.0
1406	389	9,416	2,200	375	12,225	50,533	233.5882	63,901	38.0
1406	388	4,549	2,200	378	4,999	29,880	238.1765	35,834	41.0
1406	389	9,416	2,200	417	6,279	33,653	233.5882	40,914	41.0
1407	310	6,554	2,400	387	28,882	74,895	227.7647	106,351	32.0
1408	340	6,554	2,333	345	22,077	52,810	227.7647	77,363	35.0
1408	370	9,416	2,333	414	17,411	67,206	233.5882	86,072	38.0
1409	341	6,554	2,400	429	31,945	87,343	227.7647	121,040	34.5
1409	371	9,416	2,400	482	21,579	65,222	233.5882	89,379	38.0
1410	342	6,554	2,400	363	25,119	71,108	227.7647	97,547	35.0
1501	426	4,549	2,022	90	797	4,508	238.1765	5,511	44.0
1501	427	4,549	2,200	510	8,456	52,495	238.1765	62,789	44.0
1501	456	4,549	2,111	213	899	11,277	238.1765	12,804	47.0
1501	457	4,549	2,278	555	7,379	54,337	238.1765	62,727	47.0
1502	428	4,549	2,278	480	17,556	75,561	238.1765	95,800	44.0
1503	458	4,549	2,389	663	11,547	57,678	238.1765	70,195	47.0
1504	429	9,416	2,400	532	15,138	82,084	233.5882	102,622	44.0
1504	459	9,416	2,480	556	13,942	46,222	233.5882	61,733	47.0
1505	400	9,416	2,333	385	6,501	38,315	233.5882	46,073	41.0
1505	430	9,416	2,484	457	6,356	29,462	233.5882	37,534	44.0
1505	480	9,416	2,528	364	9,476	35,926	233.5882	47,522	46.5
1506	401	9,416	2,425	619	16,208	62,067	233.5882	80,893	41.5
1506	402	9,416	2,500	489	11,944	38,760	233.5882	51,795	41.5
1506	431	9,416	2,586	520	16,960	54,684	233.5882	74,352	44.0
1507	403	9,416	2,586	636	25,850	90,510	227.4706	120,180	42.0
1507	404	9,416	2,571	521	17,137	68,910	227.4706	88,661	41.5
1507	463	9,416	2,300	334	10,076	34,839	235	47,569	46.0
1508	361	4,549	2,100	0	0	0	233.8824	0	38.0
1508	391	4,549	1,773	0	0	0	238.1765	0	41.0
1508	383	4,549	1,956	0	0	0	238.1765	0	41.0
1508	394	4,549	2,000	0	0	0	238.1765	0	41.0
1508	395	4,549	2,000	58	173	1,363	238.1765	1,688	41.0
1508	421	4,549	1,933	7	19	154	238.1765	218	44.0
1508	423	4,549	2,000	67	72	894	238.1765	967	44.0
1508	424	4,549	2,000	27	58	498	238.1765	630	44.0
1508	425	4,549	2,000	44	190	1,257	238.1765	1,583	44.0
1508	451	4,549	2,200	0	0	0	238.1765	0	47.0
1508	453	4,549	2,122	1	0	4	238.1765	5	47.0
1508	454	4,549	1,933	0	0	0	238.1765	0	47.0
1508	455	4,549	1,956	0	0	0	238.1765	0	47.0
1508	481	4,549	2,133	0	0	0	238.1765	0	50.0
1508	483	4,549	1,933	1	0	5	238.1765	6	50.0
1508	484	4,549	1,922	0	0	0	238.1765	0	50.0

Table D4: Variables by Rural Municipality

RMDSSUB	RMNO	RMCWF	RMDGDY	RMF	RMFALO	RMFCROP	RMHD1	RMIMP	RMLAT
1508	485	4,549	2,122	0	0	0	238.1765	0	50.0
1508	486	4,549	2,333	54	473	2,813	238.1765	3,398	50.0
1508	487	4,549	2,400	306	5,376	33,449	238.1765	39,647	49.5
1508	488	4,549	2,300	77	26	2,259	235	2,435	50.5
1508	489	9,416	2,311	27	22	283	235	326	50.0
1508	490	9,416	2,314	437	2,326	15,219	235	18,334	50.5
1508	511	4,549	2,200	0	0	0	238.1765	0	53.0
1508	513	4,549	2,167	0	0	0	238.1765	0	53.0
1508	514	4,549	2,255	1	5	14	238.1765	20	53.0
1508	515	4,549	2,389	0	0	0	238.1765	0	53.0
1508	516	4,549	2,389	0	0	0	238.1765	0	52.5
1508	517	4,549	2,233	58	50	1,906	235	2,035	53.0
1508	518	4,549	2,133	2	0	10	235	10	53.0
1508	519	9,416	2,133	2	0	15	235	16	53.0
1508	520	9,416	2,200	99	147	1,483	235	1,701	53.0
1509	461	9,416	2,380	514	15,051	41,436	235	57,717	48.0
1509	491	9,416	2,333	404	3,746	19,005	235	23,641	50.0
1509	493	5,490	2,257	524	10,484	48,602	235	61,208	49.5
1509	521	9,416	2,133	211	508	4,504	235	5,209	53.0
1509	523	5,490	2,067	70	931	4,998	235	6,012	53.0
1509	553	5,490	1,933	0	0	0	235	0	56.0
1510	464	5,490	2,189	414	12,872	50,510	235	65,384	47.0
1510	494	5,490	2,044	438	7,140	32,839	235	41,368	50.0
1510	524	5,490	2,000	168	980	4,754	235	6,110	53.0
1510	554	5,490	1,956	4	0	30	235	33	56.0
1601	405	5,490	2,533	382	18,521	71,975	235	91,901	40.5
1602	434	5,490	2,333	608	26,852	77,808	235	108,483	44.0
1603	435	5,490	2,109	557	21,491	63,964	235	88,611	43.5
1603	465	5,490	2,000	195	2,308	11,551	235	14,192	47.0
1603	495	5,490	2,000	242	4,443	13,179	235	18,017	50.0
1603	525	5,490	2,000	110	2,367	7,830	235	10,680	53.0
1603	555	5,490	2,000	61	182	1,377	234.7059	1,612	56.0
1604	406	5,490	2,513	375	23,571	84,089	235	109,767	41.5
1604	436	5,490	2,156	356	18,209	60,514	235	79,450	44.0
1604	466	5,490	1,933	293	2,628	12,386	235	15,397	47.0
1604	496	5,490	1,989	213	1,526	6,877	235	8,947	50.0
1604	526	5,490	2,000	106	655	4,820	235	5,668	53.0
1604	556	5,490	2,000	2	4	11	234.7059	15	56.0
1605	408	6,292	2,345	243	6,689	24,487	231.0588	31,820	41.0
1605	437	5,490	2,422	428	18,346	63,971	235	83,958	44.0
1605	438	6,292	2,400	221	8,425	29,376	234.7059	37,628	44.0
1606	467	5,490	2,000	315	4,884	19,309	235	24,836	47.0
1606	468	3,289	2,200	341	13,702	48,665	234.7059	63,580	47.0
1606	497	5,490	1,833	218	2,397	9,434	235	12,377	50.0
1606	498	3,289	1,922	274	4,152	20,432	234.7059	25,473	50.0
1606	527	5,490	1,917	11	44	204	234.7059	267	53.0
1606	528	3,289	1,800	76	264	2,397	234.7059	2,825	53.5
1606	557	5,490	2,000	0	0	0	234.7059	0	57.0
1606	558	3,289	1,922	0	0	0	234.7059	0	57.0
1606	587	5,490	2,000	1	0	0	234.7059	0	60.0
1606	588	3,289	2,000	98	270	3,555	234.7059	3,906	60.0

Table D4: Variables by Rural Municipality

RMDSSUB	RMNO	RMCFW	RMDGDAY	RMF	RMFALO	RMFCROP	RMHD1	RMIMP	RMLAT
1807	439	6,580	2,050	288	15,616	57,816	234.7059	75,008	44.0
1807	470	3,289	2,286	194	7,343	24,547	234.7059	32,808	46.5
1808	489	3,289	2,200	285	11,338	42,848	234.7059	55,598	48.5
1808	499	3,289	2,000	327	7,077	35,144	234.7059	42,727	51.0
1808	501	3,289	2,133	186	5,627	18,438	234.7059	24,693	51.5
1808	529	3,289	1,844	179	2,576	11,001	234.7059	13,828	54.0
1808	531	3,289	1,900	239	4,450	19,276	234.7059	24,294	54.0
1808	532	3,289	2,000	109	2,179	6,798	234.7059	9,284	54.0
1808	559	3,289	1,922	25	89	1,034	234.7059	1,143	57.0
1808	561	3,289	1,900	0	0	0	234.7059	0	57.0
1808	562	3,289	1,822	0	0	0	234.7059	0	57.0
1808	589	3,289	2,000	0	0	0	234.7059	0	60.0
1808	591	3,289	2,000	0	0	0	234.7059	0	60.0
1808	592	3,289	2,000	0	0	0	234.7059	0	60.0
1809	440	6,580	2,200	361	8,619	42,561	234.7059	51,746	44.5
1809	471	3,289	2,200	445	14,789	60,938	234.7059	77,498	48.5
1810	442	6,580	2,200	262	11,462	38,824	234.7059	50,855	44.5
1810	472	3,289	2,200	512	19,104	73,573	234.7059	93,866	47.5
1810	502	3,289	2,200	361	5,813	37,117	234.7059	43,769	51.5

Table D5: Variables by Rural Municipality

RMDSSUB	RMNO	RMPPOP	RM-PRMAP	RMR20	RMR25	RMR30	RMTVAL25	RMTW5	RMWTA5
101	1	1,086	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	22,902	0.125
101	2	1,511	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	39,122	0.213
101	3	1,392	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	36,362	0.209
101	31	1,118	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	23,661	0.129
101	32	1,177	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	21,587	0.118
101	33	1,498	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	37,892	0.206
102	61	1,471	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	31,527	0.267
102	63	1,588	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	34,188	0.311
102	64	1,367	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	44,107	0.402
103	91	1,332	4.8	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	25,497	0.322
103	92	1,775	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	29,835	0.377
103	93	1,437	4.6	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	23,799	0.301
104	4	1,672	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	30,918	0.206
104	34	1,952	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	58,690	0.392
104	35	1,843	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	60,248	0.402
105	94	1,480	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	28,302	0.213
105	95	1,483	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	47,804	0.359
105	96	1,440	5.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	57,019	0.428
106	5	1,929	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	40,484	0.285
106	6	1,490	5.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	48,366	0.340
106	36	1,259	5.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	53,390	0.375
107	65	1,483	5.0	\$23,581,172	\$29,267,942	\$4,822,497	\$73,407,989	70,901	0.560
107	66	1,372	5.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	49,204	0.410
108	7	1,711	5.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	54,488	0.318
108	8	1,077	5.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	32,025	0.187
108	37	1,333	5.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	44,663	0.260
108	38	1,300	5.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	40,375	0.236
109	67	1,894	5.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	90,181	0.477
109	68	1,106	4.9	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	37,990	0.201
109	97	1,582	5.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	60,623	0.322
110	98	2,121	4.1	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	119,234	1.000
201	9	667	5.5	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	20,918	0.123
201	10	586	6.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	14,273	0.084
201	11	1,219	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	34,148	0.201
201	39	1,425	5.2	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	49,895	0.293
201	40	1,660	6.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	50,705	0.299
202	69	1,776	5.0	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	70,570	0.480
202	70	2,481	5.6	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	73,305	0.510
203	99	1,459	4.7	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	72,651	0.489
203	100	2,182	5.9	\$9,114,801	\$17,586,962	\$4,986,783	\$85,795,383	75,923	0.511
204	12	1,419	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	40,895	0.218
204	13	613	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	15,575	0.083
204	14	488	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	13,523	0.072
204	42	3,090	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	90,508	0.482
204	43	1,150	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	27,347	0.146
205	71	2,888	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	95,102	0.650
205	101	1,785	5.7	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	51,178	0.360
206	72	1,738	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	74,596	0.551
206	102	1,384	5.9	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	60,849	0.449
207	73	2,959	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	134,914	1.000
208	44	1,407	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	53,623	0.334

Table D5: Variables by Rural Municipality

RMDSSUB	RMNO	RMPOP	RM-PRMAP	RMR20	RMR25	RMR30	RMTVAL25	RMTWS	RMWTAS
208	74	2,257	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	106,946	0.866
209	103	2,119	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	115,422	1.000
210	104	2,364	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	119,986	1.000
301	15	315	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	8,310	0.081
301	16	231	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	6,040	0.059
301	17	844	5.6	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	15,748	0.153
301	46	1,595	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	82,511	0.808
301	47	272	6.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	10,176	0.099
302	75	2,030	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	112,090	0.501
302	105	2,424	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	111,489	0.499
303	46	913	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	33,821	0.276
303	76	1,562	6.0	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	88,631	0.724
304	106	1,837	5.6	\$8,478,398	\$10,051,270	\$2,653,377	\$100,027,846	107,953	0.565
304	107	1,648	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	83,175	0.435
305	77	1,406	5.9	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	70,359	0.523
305	78	1,300	6.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	64,122	0.477
306	48	392	6.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	17,706	0.232
306	49	1,180	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	58,745	0.768
307	108	1,881	5.2	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	111,973	1.000
308	79	1,401	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	75,647	0.772
308	80	826	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	22,292	0.228
309	18	721	5.7	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	26,412	0.250
309	19	883	5.6	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	30,958	0.379
309	20	341	5.6	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	13,329	0.126
309	50	734	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	25,790	0.244
310	21	433	5.4	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	14,645	0.203
310	22	231	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	6,767	0.094
310	51	623	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	29,471	0.408
310	52	269	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	12,115	0.168
310	81	303	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	4,272	0.059
310	82	252	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	5,047	0.070
401	135	2,446	6.0	\$10,207,853	\$8,818,312	\$2,274,617	\$108,152,027	106,682	0.361
401	136	2,540	5.3	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	84,037	0.284
401	186	3,227	5.6	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	104,929	0.355
402	137	2,957	5.0	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	122,526	1.000
403	167	1,289	5.0	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	88,928	1.000
404	109	1,484	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	84,524	0.330
404	138	1,983	5.0	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	113,963	0.445
404	139	1,026	5.0	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	57,593	0.225
405	168	2,205	5.4	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	139,197	1.000
406	140	440	5.0	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	16,091	0.137
406	169	1,401	5.2	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	86,951	0.739
406	170	485	5.0	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	14,685	0.125
407	229	1,759	5.2	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	117,988	1.000
408	230	1,822	5.0	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	116,004	1.000
409	110	1,063	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	25,842	0.102
409	111	785	5.0	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	24,679	0.097
409	112	785	5.1	\$18,543,714	\$25,804,515	\$3,948,461	\$50,909,219	19,837	0.078
409	141	819	5.5	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	30,313	0.119
409	142	685	6.0	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	29,177	0.115

Table D5: Variables by Rural Municipality

RMDSSUB	RMNO	RMPOP	RM-PRMAP	RMR20	RMR25	RMR30	RMTVAL25	RMTW5	RMWTA5
409	171	1,733	5.3	\$14,179,284	\$25,863,401	\$3,627,805	\$93,481,454	73,467	0.289
409	172	1,131	6.0	\$14,179,284	\$25,863,401	\$3,627,805	\$93,481,454	50,477	0.199
410	231	3,587	5.2	\$14,179,284	\$25,863,401	\$3,627,805	\$93,481,454	170,025	0.776
410	232	1,083	5.3	\$14,179,284	\$25,863,401	\$3,627,805	\$93,481,454	49,116	0.224
501	131	1,776	5.2	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	80,832	0.424
501	161	2,186	4.5	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	109,856	0.576
502	132	551	5.8	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	14,908	0.129
502	182	1,284	5.0	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	58,738	0.510
502	183	1,180	5.7	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	41,540	0.361
503	133	1,002	5.8	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	40,166	0.277
503	134	1,663	6.0	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	67,541	0.467
503	164	1,225	5.3	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	37,055	0.256
504	190	2,049	5.0	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	81,377	0.448
504	221	2,385	5.0	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	100,316	0.552
505	191	1,748	5.0	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	108,731	1.000
506	222	1,718	5.0	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	85,770	1.000
507	185	1,982	5.8	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	74,270	0.701
507	195	1,233	6.0	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	31,630	0.299
508	194	1,759	6.0	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	87,761	1.000
509	193	1,942	5.3	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	115,196	0.618
509	223	1,307	5.0	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	71,335	0.382
510	224	1,499	5.6	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	75,537	1.000
601	121	1,563	4.5	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	31,874	0.380
601	122	1,118	4.0	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	20,740	0.247
601	151	1,938	4.0	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	31,259	0.373
602	123	1,697	4.0	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	33,946	0.264
602	124	2,058	4.9	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	39,834	0.310
602	153	1,455	4.0	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	18,377	0.143
602	154	1,954	4.9	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	36,333	0.283
603	125	1,671	5.0	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	45,221	0.370
603	126	2,325	5.0	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	76,972	0.630
604	155	1,848	5.0	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	53,461	0.283
604	156	1,849	4.8	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	79,104	0.419
604	157	2,248	5.0	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	58,071	0.297
605	127	2,748	5.0	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	139,299	1.000
606	128	2,503	4.4	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	147,781	1.000
607	158	2,618	4.9	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	80,454	0.453
607	159	3,120	4.7	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	97,025	0.547
608	129	1,938	4.1	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	142,634	0.549
608	130	1,844	5.5	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	117,405	0.451
609	160	2,115	4.5	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	113,218	1.000
610	189	1,884	5.0	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	74,554	1.000
701	152	1,581	4.4	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	14,655	0.207
701	181	1,765	4.3	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	18,335	0.230
701	183	3,097	4.7	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	39,916	0.583
702	184	2,701	5.0	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	39,864	0.506
702	185	2,903	4.8	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	38,997	0.494
703	211	2,352	4.0	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	20,538	0.482
703	241	2,970	4.0	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	23,873	0.538
704	213	1,751	4.0	\$12,356,896	\$26,440,867	\$3,313,725	\$81,808,086	12,091	0.138

Table D5: Variables by Rural Municipality

RMOSSUB	RMNO	RMPOP	RM-PRMAP	RMR20	RMR25	RMR30	RMTVAL25	RMTW5	RMTWAS
704	243	2,529	4.0	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	31,367	0.369
704	273	4,438	3.7	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	43,866	0.502
705	214	2,508	4.1	\$12,356,696	\$26,440,867	\$3,313,725	\$81,608,086	41,990	0.522
705	244	2,586	4.0	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	38,480	0.478
706	215	2,931	4.0	\$12,356,696	\$26,440,867	\$3,313,725	\$81,608,086	46,281	0.451
706	245	2,576	3.6	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	30,649	0.299
706	275	3,207	3.7	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	25,583	0.250
707	271	2,700	4.0	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	31,036	0.486
707	301	2,204	3.0	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	17,764	0.278
707	331	1,947	2.1	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	15,017	0.235
708	303	3,041	3.0	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	41,809	0.751
708	333	2,642	2.2	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	13,499	0.242
708	363	278	2.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	386	0.007
709	274	3,415	4.0	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	32,673	0.481
709	304	2,570	3.2	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	35,293	0.519
710	335	2,268	4.0	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	15,458	0.417
710	334	2,875	2.6	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	16,644	0.449
710	335	1,518	2.7	\$8,926,118	\$10,697,480	\$3,280,461	\$53,812,408	4,230	0.114
710	361	628	2.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	440	0.012
710	365	247	2.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	286	0.008
801	186	2,170	4.7	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	61,740	0.599
801	216	1,307	4.2	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	18,393	0.178
801	246	2,804	4.0	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	22,958	0.223
802	187	1,880	4.8	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	39,273	0.405
802	217	2,306	5.0	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	57,591	0.585
803	218	2,955	5.0	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	111,599	1.000
804	247	2,090	4.5	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	27,977	0.335
804	248	2,069	4.8	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	36,977	0.443
804	278	874	4.6	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	18,542	0.222
805	219	2,707	5.0	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	80,265	1.000
806	220	1,817	5.0	\$18,381,480	\$21,052,083	\$9,349,574	\$150,621,071	66,289	1.000
807	249	1,970	5.0	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	91,986	1.000
808	250	1,737	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	79,809	1.000
809	279	1,949	5.0	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	94,294	1.000
810	280	1,523	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	62,132	1.000
901	251	1,061	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	80,291	1.000
902	252	1,225	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	70,687	1.000
903	253	1,284	5.1	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	81,613	1.000
904	254	2,399	5.3	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	138,146	1.000
905	281	1,757	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	72,060	1.000
906	282	1,837	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	86,922	1.000
907	283	1,789	5.2	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	109,306	1.000
908	284	1,918	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	105,547	1.000
909	312	2,097	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	89,173	1.000
910	313	1,241	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	57,967	1.000
1001	225	958	6.0	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	42,611	0.493
1001	226	1,398	5.2	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	43,809	0.507
1002	227	943	5.2	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	34,351	0.286
1002	257	1,215	5.6	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	85,781	0.714
1003	228	1,824	6.0	\$14,179,284	\$25,863,401	\$3,627,805	\$83,481,454	85,954	1.000

Table D5: Variables by Rural Municipality

RMOSSUB	RMNO	RMPop	RM-PRMAP	RMR20	RMR25	RMR30	RMTVAL25	RMTW5	RMWTAS
1004	255	1,628	5.1	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	70,815	1.000
1005	256	915	5.1	\$10,209,653	\$8,818,312	\$2,274,617	\$108,152,027	37,290	1.000
1006	285	2,383	5.0	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	127,529	1.000
1007	286	1,597	5.0	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	105,991	1.000
1008	287	1,963	5.0	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	127,621	1.000
1009	316	1,517	4.9	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	98,678	1.000
1010	317	1,524	5.0	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	98,122	1.000
1101	258	1,044	5.7	\$14,179,284	\$25,863,401	\$3,627,805	\$93,481,454	51,012	0.424
1101	288	1,451	5.1	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	69,392	0.576
1102	259	1,700	5.0	\$14,179,284	\$25,863,401	\$3,627,805	\$93,481,454	117,135	1.000
1103	260	1,572	5.0	\$14,179,284	\$25,863,401	\$3,627,805	\$93,481,454	86,550	1.000
1104	261	1,082	5.1	\$14,179,284	\$25,863,401	\$3,627,805	\$93,481,454	48,217	0.541
1104	262	835	5.5	\$14,179,284	\$25,863,401	\$3,627,805	\$93,481,454	40,861	0.459
1105	289	1,171	5.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	58,713	0.445
1105	290	1,467	5.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	73,350	0.555
1106	291	814	5.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	38,674	0.428
1106	292	866	5.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	51,782	0.572
1107	318	1,576	5.0	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	93,135	1.000
1108	319	1,412	5.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	82,843	1.000
1109	320	1,191	5.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	60,854	1.000
1110	321	638	5.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	31,628	0.512
1110	322	744	5.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	30,121	0.488
1201	348	986	4.3	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	51,261	1.000
1202	349	1,549	5.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	91,188	1.000
1203	350	1,538	5.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	89,078	1.000
1204	351	1,560	5.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	82,745	1.000
1205	352	1,428	5.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	66,747	1.000
1206	378	1,034	3.2	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	28,924	0.290
1206	379	1,546	3.8	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	70,965	0.710
1207	382	2,628	4.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	98,684	0.654
1207	411	1,318	4.3	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	52,146	0.346
1208	381	2,293	4.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	98,343	1.000
1209	409	1,963	4.2	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	77,176	1.000
1210	380	1,778	4.0	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	68,814	0.438
1210	410	1,555	4.6	\$14,092,370	\$25,498,426	\$6,223,999	\$87,485,071	87,821	0.561
1301	314	1,244	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	52,931	1.000
1302	315	1,450	4.9	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	70,249	1.000
1303	343	1,985	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	93,400	1.000
1304	344	2,502	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	89,502	0.508
1304	374	4,477	4.0	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	67,363	0.482
1305	345	2,133	4.2	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	103,609	1.000
1306	346	1,833	4.9	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	109,130	1.000
1307	347	2,084	5.0	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	78,998	1.000
1308	376	1,984	3.9	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	82,837	0.743
1308	377	1,329	3.3	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	28,524	0.257
1309	375	2,156	5.0	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	73,405	1.000
1310	372	2,258	4.0	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	59,467	0.455
1310	373	2,642	4.0	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	71,268	0.545
1401	276	2,891	4.0	\$5,773,435	\$9,778,517	\$2,588,850	\$53,236,929	28,289	0.459
1401	277	2,525	4.0	\$5,773,435	\$9,778,517	\$2,588,850	\$53,236,929	33,371	0.541

Table D5: Variables by Rural Municipality

RMOSSUB	RMNO	RMPOP	RM-PRMAP	RMR20	RMR25	RMR30	RMTVAL25	RMTW5	RMWTAS
1402	306	1,011	4.0	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	11,050	0.205
1402	307	2,025	4.0	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	42,872	0.795
1403	308	2,508	4.8	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	88,799	1.000
1404	309	1,863	4.8	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	54,714	0.508
1404	338	1,329	3.3	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	22,378	0.208
1404	339	1,788	3.8	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	30,661	0.285
1405	336	2,461	3.4	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	17,518	0.292
1405	337	1,632	3.5	\$5,773,435	\$9,778,517	\$2,588,650	\$59,236,929	14,531	0.242
1405	386	1,504	2.3	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	11,327	0.189
1405	367	2,186	2.1	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	9,186	0.153
1405	366	471	1.8	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	1,502	0.025
1405	367	1,174	2.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	5,987	0.100
1406	368	1,741	2.3	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	17,229	0.180
1406	369	2,208	3.0	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	33,514	0.350
1406	368	1,734	2.2	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	19,424	0.203
1406	369	1,752	2.5	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	25,684	0.268
1407	310	2,068	4.3	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	62,020	1.000
1408	340	1,821	4.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	48,453	0.485
1408	370	2,706	3.9	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	51,370	0.515
1409	341	2,585	4.9	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	79,910	0.580
1409	371	2,921	4.5	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	62,860	0.440
1410	342	1,858	5.0	\$15,737,494	\$28,816,951	\$5,434,476	\$106,854,017	68,950	1.000
1501	426	686	1.1	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	2,124	0.026
1501	427	2,252	2.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	37,881	0.462
1501	456	832	1.3	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	5,819	0.071
1501	457	2,577	2.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	36,179	0.441
1502	428	2,465	2.2	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	57,329	1.000
1503	458	3,293	2.4	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	42,174	1.000
1504	429	2,752	1.5	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	57,249	0.586
1504	459	2,806	2.8	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	38,729	0.404
1505	400	1,879	3.0	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	28,108	0.342
1505	430	2,133	2.7	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	22,362	0.272
1505	480	1,833	3.1	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	31,607	0.385
1506	401	3,205	3.8	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	53,574	0.371
1506	402	2,713	4.8	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	37,536	0.280
1506	431	3,058	3.9	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	53,450	0.370
1507	403	3,970	4.5	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	82,727	0.479
1507	404	2,906	4.0	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	61,553	0.356
1507	463	1,586	3.8	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	28,566	0.185
1508	361	1	2.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	391	0	2.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	393	0	2.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	394	0	2.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	395	195	1.8	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	244	0.007
1508	421	48	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	1	0.000
1508	423	209	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	9	0.000
1508	424	202	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	21	0.001
1508	425	359	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	10	0.000
1508	451	0	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	453	77	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000

Table D5: Variables by Rural Municipality

RMDSSUB	RMNO	RMPOP	RM-PRMAP	RMR20	RMR25	RMR30	RMTVAL25	RMTW5	RMWTAS
1508	454	0	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	455	2	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	481	11	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	483	28	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	484	0	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	485	0	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	486	196	1.5	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	1,051	0.029
1508	487	1,890	2.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	22,238	0.623
1508	488	403	2.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	780	0.022
1508	489	139	2.0	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	30	0.001
1508	490	1,992	2.0	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	10,399	0.291
1508	511	3	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	513	3	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	514	49	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	515	0	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	516	0	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	517	278	1.0	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	530	0.015
1508	518	81	1.3	\$3,387,042	\$7,818,546	\$2,316,575	\$36,564,253	0	0.000
1508	519	31	1.2	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	0	0.000
1508	520	365	1.5	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	366	0.010
1509	461	2,454	3.1	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	31,916	0.364
1509	491	1,900	2.4	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	12,900	0.147
1509	493	2,187	3.0	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	36,744	0.420
1509	521	621	2.0	\$5,895,616	\$13,951,641	\$4,316,542	\$88,380,993	1,856	0.021
1509	523	258	1.7	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	4,158	0.047
1509	553	14	1.0	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	0	0.000
1510	464	2,114	3.3	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	38,792	0.559
1510	494	1,808	2.5	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	27,597	0.398
1510	524	805	1.1	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	3,025	0.044
1510	554	9	1.0	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	7	0.000
1601	405	2,096	4.4	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	66,921	1.000
1602	434	2,927	4.0	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	80,067	1.000
1603	435	3,366	4.0	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	66,193	0.703
1603	465	845	3.1	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	8,804	0.091
1603	495	971	2.4	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	12,062	0.128
1603	525	523	1.8	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	6,988	0.074
1603	555	303	1.0	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	327	0.013
1604	406	1,772	4.0	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	79,595	0.503
1604	436	1,830	4.0	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	63,597	0.402
1604	486	1,247	3.0	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	7,979	0.050
1604	496	708	2.7	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	4,242	0.027
1604	526	324	2.0	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	2,730	0.017
1604	556	4	1.8	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	0	0.000
1605	408	1,039	4.0	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	20,494	0.192
1605	437	1,843	4.4	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	61,073	0.572
1605	438	1,188	4.0	\$9,549,532	\$21,802,394	\$6,002,280	\$88,142,185	25,166	0.236
1606	467	1,381	3.4	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	15,187	0.190
1606	488	1,899	4.0	\$2,772,386	\$4,814,809	\$2,879,458	\$30,110,496	43,322	0.541
1606	497	732	2.7	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	5,881	0.071
1606	498	1,235	3.3	\$2,772,386	\$4,814,809	\$2,879,458	\$30,110,496	13,756	0.172

Table D5: Variables by Rural Municipality

RMDSSUB	RMNO	RMPOP	RM-PRMAP	RMR20	RMR25	RMR30	RMTVAL25	RMTWS	RMWTAS
1806	527	27	2.0	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	49	0.001
1806	528	282	2.1	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	984	0.012
1806	557	6	2.0	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	0	0.000
1806	558	6	2.0	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	0	0.000
1806	587	179	1.5	\$2,612,729	\$6,217,078	\$2,463,637	\$48,768,419	0	0.000
1806	588	761	2.0	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	1,088	0.014
1807	439	1,210	4.0	\$14,092,370	\$25,498,426	\$6,223,989	\$87,485,071	55,000	0.722
1807	470	853	4.0	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	21,219	0.278
1808	489	1,397	4.0	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	35,623	0.383
1808	499	1,462	3.6	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	21,227	0.228
1808	501	785	3.8	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	15,220	0.164
1808	529	770	2.3	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	5,204	0.166
1808	531	1,215	3.0	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	11,906	0.128
1808	532	430	3.0	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	3,511	0.038
1808	559	225	2.0	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	368	0.004
1808	561	10	2.3	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	0	0.000
1808	562	0	2.7	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	0	0.000
1808	589	7	2.0	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	0	0.000
1808	591	1	2.0	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	0	0.000
1808	592	16	2.0	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	0	0.000
1809	440	1,562	4.0	\$14,092,370	\$25,498,426	\$6,223,989	\$87,485,071	34,107	0.434
1809	471	1,780	4.0	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	44,450	0.586
1810	442	1,225	4.0	\$14,092,370	\$25,498,426	\$6,223,989	\$87,485,071	32,885	0.305
1810	472	1,874	4.0	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	51,733	0.480
1810	502	1,375	3.8	\$2,772,386	\$4,814,809	\$2,679,458	\$30,110,496	23,236	0.215

Table D6: Variables by Rural Municipality					
RMCSSUB	RMNO	RMWF5	RMCIVALI	RMPOPD6	RMPNM
101	1	212	\$17.80	1,086	1.186
101	2	315	\$17.80	1,511	1.186
101	3	288	\$17.80	1,382	1.186
101	31	176	\$17.80	1,672	1.186
101	32	202	\$17.80	1,929	1.186
101	33	275	\$17.80	1,118	1.186
102	61	293	\$17.80	1,177	1.186
102	63	340	\$17.80	1,488	1.186
102	64	269	\$17.80	1,952	1.186
103	91	243	\$17.80	1,843	1.186
103	92	331	\$17.80	1,471	1.186
103	93	290	\$17.80	1,588	1.186
104	4	206	\$17.80	1,367	1.186
104	34	305	\$17.80	1,483	1.186
104	35	286	\$17.80	1,499	1.186
105	94	256	\$17.80	1,997	1.186
105	95	286	\$17.80	1,437	1.186
105	96	286	\$17.36	1,460	1.185
106	5	259	\$17.80	1,483	1.186
106	6	276	\$17.36	1,490	1.185
103	36	280	\$17.36	1,711	1.185
107	65	304	\$17.80	1,077	1.186
107	66	238	\$17.36	867	1.185
108	7	324	\$17.36	586	1.185
108	8	289	\$17.36	1,259	1.185
108	37	257	\$17.36	1,333	1.185
108	38	329	\$17.36	1,300	1.185
109	67	382	\$17.36	1,425	1.185
109	68	218	\$17.36	1,299	1.185
109	97	204	\$17.36	1,372	1.185
110	98	343	\$17.36	1,894	1.195
201	9	177	\$17.36	1,108	1.185
201	10	169	\$17.36	1,776	1.185
201	11	286	\$17.32	2,491	0.879
201	39	336	\$17.36	1,440	1.185
201	40	338	\$17.36	1,592	1.185
202	69	344	\$17.36	2,121	1.185
202	70	432	\$17.36	1,459	1.185
203	99	251	\$17.36	2,182	1.185
203	100	358	\$17.36	1,219	1.185
204	12	272	\$17.32	1,419	0.879
204	13	188	\$17.32	813	0.879
204	14	140	\$17.32	488	0.879
204	42	409	\$17.32	315	0.879
204	43	216	\$17.32	231	0.879
205	71	495	\$17.32	1,918	0.879
205	101	334	\$17.32	1,110	0.879
206	72	346	\$17.32	1,407	0.879
206	102	281	\$17.32	1,595	0.879
207	73	520	\$17.32	913	0.879
208	44	359	\$17.32	2,688	0.879

Table D6: Variables by Rural Municipality					
RMDSSUB	RMNO	RMWFS	RMCIVALJ	RMPOPD6	RMPNM
208	74	415	\$17.32	1,955	0.879
209	103	436	\$17.32	2,959	0.879
210	104	398	\$17.32	2,257	0.879
301	15	140	\$17.32	2,030	0.879
301	16	85	\$17.32	1,582	0.879
301	17	258	\$17.47	1,672	0.862
301	45	380	\$17.32	1,916	0.879
301	47	70	\$17.47	2,119	0.862
302	75	395	\$17.32	2,364	0.879
302	105	420	\$17.32	2,424	0.879
303	46	212	\$17.32	1,837	0.879
303	76	332	\$17.32	844	0.879
304	106	547	\$17.32	721	0.879
304	107	494	\$17.47	883	0.862
305	77	409	\$17.47	341	0.862
305	78	286	\$17.47	433	0.862
306	48	107	\$17.47	231	0.862
306	49	290	\$17.47	272	0.862
307	108	425	\$17.47	588	0.862
308	79	332	\$17.47	1,180	0.862
308	80	209	\$17.47	734	0.862
309	18	209	\$17.47	623	0.862
309	19	280	\$17.47	289	0.862
309	20	100	\$17.47	1,406	0.862
309	50	148	\$17.47	1,300	0.862
310	21	105	\$17.47	1,401	0.862
310	22	40	\$17.47	826	0.862
310	51	173	\$17.47	303	0.862
310	52	79	\$17.47	284	0.862
310	81	73	\$17.47	1,648	0.862
310	82	53	\$17.47	1,881	0.862
401	135	433	\$16.45	1,484	0.207
401	136	498	\$16.45	1,063	0.207
401	186	656	\$16.45	785	0.207
402	137	622	\$15.04	1,009	0.174
403	167	339	\$15.04	2,345	0.174
404	109	294	\$17.47	1,677	0.862
404	138	464	\$15.04	1,897	0.174
404	139	260	\$15.04	2,058	0.174
405	168	613	\$15.04	1,671	0.174
406	140	130	\$15.04	2,180	0.174
406	189	425	\$15.04	1,779	0.174
406	170	89	\$15.04	2,015	0.174
407	229	506	\$15.04	1,954	0.174
408	230	448	\$15.04	1,957	0.174
409	110	192	\$17.47	2,289	0.862
409	111	222	\$17.47	2,855	0.862
409	112	172	\$17.47	2,701	0.862
409	141	215	\$15.04	2,903	0.174
409	142	180	\$15.04	2,117	0.174
409	171	373	\$15.04	1,751	0.174

Table D6: Variables by Rural Municipality					
RMDSSUB	RMNO	RMWFS	RMCIVALI	RMPOPD6	RMPNM
409	172	234	\$15.04	2,508	0.174
410	231	999	\$15.04	2,931	0.174
410	232	190	\$15.04	2,325	0.174
501	131	409	\$16.45	2,061	0.207
501	161	372	\$16.45	2,253	0.207
502	132	148	\$16.45	1,936	0.207
502	162	260	\$16.45	1,844	0.207
502	163	272	\$16.45	1,752	0.207
503	133	241	\$16.45	2,130	0.207
503	134	331	\$16.45	2,616	0.207
503	164	290	\$16.45	3,120	0.207
504	190	418	\$20.05	2,115	0.343
504	221	421	\$20.05	2,441	0.343
505	191	378	\$16.45	2,603	0.207
506	222	323	\$16.45	1,884	0.207
507	165	392	\$16.45	1,844	0.207
507	195	237	\$16.45	1,680	0.207
508	194	416	\$16.45	2,306	0.207
508	193	392	\$16.45	2,680	0.207
508	223	300	\$16.45	2,565	0.207
510	224	352	\$16.45	2,180	0.207
601	121	346	\$24.20	2,241	0.776
601	122	294	\$24.20	1,776	0.776
601	151	380	\$24.20	992	0.776
602	123	345	\$24.20	1,127	0.776
602	124	362	\$24.20	1,663	0.776
602	153	303	\$24.20	2,446	0.776
602	154	366	\$24.20	2,540	0.776
603	125	322	\$24.20	2,196	0.776
603	126	384	\$20.05	1,926	0.343
604	155	371	\$24.20	1,160	0.776
604	156	367	\$20.05	1,225	0.343
604	157	394	\$20.05	1,982	0.343
605	127	439	\$20.05	2,234	0.343
606	128	338	\$20.05	1,656	0.343
607	158	495	\$20.05	1,942	0.343
607	159	378	\$20.05	1,759	0.343
608	129	322	\$20.05	1,585	0.343
608	130	389	\$20.05	1,933	0.343
609	160	384	\$20.05	1,307	0.343
610	189	358	\$20.05	1,420	0.343
701	152	266	\$24.20	1,437	0.776
701	181	333	\$24.20	1,144	0.776
701	183	604	\$24.20	1,485	0.776
702	184	418	\$24.20	915	0.776
702	185	450	\$24.20	2,218	0.776
703	211	428	\$24.20	1,487	0.776
703	241	527	\$24.99	1,026	-0.117
704	213	371	\$24.20	440	0.776
704	243	398	\$24.99	819	-0.117
704	273	630	\$24.99	521	-0.117

Table D6: Variables by Rural Municipality					
RMDSSUB	RMNO	RMWFS	RMCVALJ	RMPOPD6	RMPNM
705	214	378	\$24.20	1,289	0.776
705	244	414	\$24.99	1,418	-0.117
706	215	427	\$24.20	1,401	0.776
706	245	402	\$24.99	485	-0.117
706	275	544	\$24.99	1,733	-0.117
707	271	480	\$24.99	1,887	-0.117
707	301	386	\$24.99	738	-0.117
707	331	328	\$24.99	1,385	-0.117
708	303	510	\$24.99	1,286	-0.117
708	333	489	\$24.99	1,083	-0.117
708	363	38	\$29.18	2,306	-0.573
709	274	516	\$24.99	1,218	-0.117
709	304	451	\$24.99	1,215	-0.117
710	305	400	\$24.99	1,044	-0.117
710	334	480	\$24.99	1,083	-0.117
710	335	302	\$24.99	1,179	-0.117
710	364	116	\$29.18	1,146	-0.573
710	365	49	\$29.18	826	-0.573
801	186	352	\$20.05	2,970	0.343
801	216	225	\$20.05	2,529	0.343
801	246	453	\$22.87	2,586	-0.202
802	187	261	\$20.05	2,576	0.343
802	217	383	\$20.05	2,700	0.343
803	218	465	\$20.05	4,438	0.343
804	247	418	\$22.87	3,415	-0.202
804	248	326	\$22.87	3,207	-0.202
804	278	198	\$22.87	2,204	-0.202
805	219	526	\$20.05	3,041	0.343
806	220	363	\$20.05	2,570	0.343
807	249	410	\$22.87	2,268	-0.202
808	250	299	\$17.02	1,947	-0.239
809	279	421	\$22.87	2,642	-0.202
810	280	315	\$17.02	2,875	-0.239
901	251	312	\$17.02	1,518	-0.239
902	252	253	\$17.02	2,804	-0.239
903	253	299	\$17.02	1,980	-0.239
904	254	448	\$17.02	2,328	-0.239
905	281	382	\$17.02	1,970	-0.239
906	282	448	\$17.02	2,891	-0.239
907	283	300	\$17.02	2,525	-0.239
908	284	344	\$17.02	1,311	-0.239
909	312	428	\$17.02	1,949	-0.239
910	313	238	\$17.02	1,517	-0.239
1001	225	200	\$16.45	2,804	0.207
1001	226	283	\$16.45	2,822	0.207
1002	227	187	\$15.04	1,883	0.174
1002	257	249	\$15.04	2,461	0.174
1003	228	389	\$15.04	1,836	0.174
1004	255	344	\$16.45	1,840	0.207
1005	256	220	\$16.45	1,788	0.207
1006	285	483	\$16.73	2,405	-0.287

Table D6: Variables by Rural Municipality					
RMDSSUB	RMNO	RMWFS	RMCVALI	RMPOPD6	RMPNM
1007	286	364	\$16.73	1,889	-0.287
1008	287	373	\$16.73	1,378	-0.287
1009	316	372	\$16.73	1,284	-0.287
1010	317	330	\$16.73	2,056	-0.287
1101	258	264	\$15.04	1,523	0.174
1101	288	335	\$16.73	1,757	-0.287
1102	259	381	\$15.04	1,575	0.174
1103	280	314	\$15.04	1,610	0.174
1104	261	226	\$15.04	1,918	0.174
1104	262	243	\$15.04	2,068	0.174
1105	289	256	\$16.02	2,087	-0.547
1105	290	307	\$16.02	1,862	-0.547
1106	291	201	\$16.02	1,244	-0.547
1106	292	221	\$16.02	1,821	-0.547
1107	318	378	\$16.73	2,585	-0.287
1108	319	353	\$16.02	2,787	-0.547
1109	320	269	\$16.02	1,965	-0.547
1110	321	163	\$16.02	2,502	-0.547
1110	322	171	\$16.02	1,716	-0.547
1201	348	200	\$16.73	1,797	-0.287
1202	349	315	\$16.02	1,863	-0.547
1203	350	305	\$16.02	1,451	-0.547
1204	351	339	\$16.02	1,374	-0.547
1205	352	276	\$16.02	1,517	-0.547
1206	378	238	\$16.73	1,524	-0.287
1206	379	295	\$16.02	1,576	-0.547
1207	382	494	\$16.02	2,021	-0.547
1207	411	341	\$16.02	1,833	-0.547
1208	381	425	\$16.02	1,563	-0.547
1209	409	337	\$16.02	1,494	-0.547
1210	380	267	\$16.02	2,282	-0.547
1210	410	387	\$16.02	1,984	-0.547
1301	314	204	\$17.02	1,259	-0.239
1302	315	304	\$16.73	1,551	-0.287
1303	343	380	\$17.02	895	-0.239
1304	344	448	\$17.02	1,188	-0.239
1304	374	561	\$25.01	1,171	-0.720
1305	345	430	\$16.73	1,467	-0.287
1306	346	378	\$16.73	1,221	-0.287
1307	347	557	\$16.73	1,039	-0.287
1308	376	382	\$16.73	1,412	-0.287
1308	377	318	\$16.73	1,191	-0.287
1309	375	413	\$16.73	957	-0.287
1310	372	373	\$25.01	957	-0.720
1310	373	412	\$25.01	1,840	-0.720
1401	276	527	\$22.87	1,977	-0.202
1401	277	480	\$22.87	1,580	-0.202
1402	306	240	\$22.87	1,428	-0.202
1402	307	375	\$22.87	1,739	-0.202
1403	308	442	\$22.87	2,286	-0.202
1404	309	345	\$22.87	2,293	-0.202

Table D6: Variables by Rural Municipality					
RMSSUB	RMNO	RMWFS	RMCVALI	RMPOPD6	RMPNM
1404	338	233	\$22.87	2,628	-0.202
1404	339	328	\$22.87	1,883	-0.202
1405	336	473	\$22.87	1,555	-0.202
1405	337	386	\$22.87	1,078	-0.202
1405	388	303	\$29.18	1,281	-0.573
1405	367	384	\$29.18	1,278	-0.573
1405	386	105	\$29.18	1,103	-0.573
1405	387	214	\$29.18	1	-0.573
1406	368	353	\$29.18	278	-0.573
1406	369	345	\$25.01	628	-0.720
1406	368	309	\$29.18	247	-0.573
1406	369	384	\$25.01	1,504	-0.720
1407	310	373	\$17.02	2,186	-0.239
1408	340	332	\$17.02	1,741	-0.239
1408	370	381	\$25.01	0	-0.720
1409	341	413	\$17.02	0	-0.239
1409	371	443	\$25.01	0	-0.720
1410	342	350	\$17.02	185	-0.239
1501	426	74	\$29.18	471	-0.573
1501	427	417	\$29.18	1,174	-0.573
1501	456	174	\$29.18	1,734	-0.573
1501	457	454	\$29.18	48	-0.573
1502	428	393	\$29.18	209	-0.573
1503	458	543	\$29.18	202	-0.573
1504	429	489	\$25.01	359	-0.720
1504	459	511	\$25.01	688	-0.720
1505	400	354	\$25.01	2,252	-0.720
1505	430	420	\$25.01	2	-0.720
1505	480	335	\$25.01	0	-0.720
1506	401	589	\$25.01	77	-0.720
1506	402	431	\$25.01	0	-0.720
1506	431	478	\$25.01	2	-0.720
1507	403	585	\$25.01	832	-0.720
1507	404	479	\$25.01	2,577	-0.720
1507	463	307	\$25.01	3,293	-0.720
1508	361	0	\$29.18	11	-0.573
1508	391	0	\$29.18	28	-0.573
1508	393	0	\$29.18	0	-0.573
1508	394	0	\$29.18	0	-0.573
1508	395	46	\$29.18	196	-0.573
1508	421	0	\$29.18	1,791	-0.573
1508	423	55	\$29.18	427	-0.573
1508	424	22	\$29.18	5	-0.573
1508	425	36	\$29.18	3	-0.573
1508	451	0	\$29.18	49	-0.573
1508	453	0	\$29.18	0	-0.573
1508	454	0	\$29.18	0	-0.573
1508	455	0	\$29.18	200	-0.573
1508	481	0	\$29.18	81	-0.573
1508	483	0	\$29.18	2,208	-0.573
1508	484	0	\$29.18	2,705	-0.573

Table D6: Variables by Rural Municipality					
RMDSSUB	RMNO	RMWFS	RMCIVALI	RMPOPD6	RMPPNM
1508	485	0	\$29.18	2,921	-0.573
1508	486	44	\$29.18	2,540	-0.573
1508	487	300	\$29.18	2,972	-0.573
1508	488	63	\$29.18	5,037	-0.573
1508	489	25	\$25.01	1,971	-0.720
1508	490	402	\$25.01	1,879	-0.720
1508	511	0	\$29.18	3,205	-0.573
1508	513	0	\$29.18	3,488	-0.573
1508	514	0	\$29.18	4,204	-0.573
1508	515	0	\$29.18	3,487	-0.573
1508	516	0	\$29.18	2,914	-0.573
1508	517	47	\$29.18	2,400	-0.573
1508	518	0	\$29.18	3,068	-0.573
1508	519	0	\$25.01	2,132	-0.720
1508	520	91	\$25.01	2,750	-0.720
1509	461	473	\$25.01	2,209	-0.720
1509	491	372	\$25.01	1,586	-0.720
1509	493	472	\$23.83	139	-1.001
1509	521	194	\$25.01	2,561	-0.720
1509	523	63	\$23.83	1,900	-1.001
1509	553	0	\$23.83	31	-1.001
1510	464	373	\$23.83	365	-1.001
1510	494	365	\$23.83	621	-1.001
1510	524	151	\$23.83	2,358	-1.001
1510	554	0	\$23.83	1,984	-1.001
1801	405	344	\$23.83	3,099	-1.001
1802	434	548	\$23.83	2,877	-1.001
1803	435	511	\$23.83	1,830	-1.001
1803	465	176	\$23.83	1,746	-1.001
1803	495	218	\$23.83	2,378	-1.001
1803	525	99	\$23.83	845	-1.001
1803	555	55	\$23.83	1,247	-1.001
1804	406	338	\$23.83	1,381	-1.001
1804	436	321	\$23.83	1,875	-1.001
1804	466	264	\$23.83	2,034	-1.001
1804	496	192	\$23.83	1,092	-1.001
1804	526	95	\$23.83	708	-1.001
1804	556	0	\$23.83	732	-1.001
1805	408	228	\$16.73	258	-0.287
1805	437	386	\$23.83	605	-1.001
1805	438	208	\$16.73	523	-0.287
1806	467	284	\$23.83	324	-1.001
1806	468	307	\$23.35	20	-1.924
1806	497	196	\$23.83	14	-1.001
1806	498	247	\$23.35	9	-1.924
1806	527	10	\$23.83	303	-1.001
1806	528	88	\$23.35	4	-1.924
1806	557	0	\$23.83	6	-1.001
1806	558	0	\$23.35	179	-1.924
1806	587	0	\$23.83	1,899	-1.001
1806	588	88	\$23.35	1,796	-1.924

Table D6: Variables by Rural Municipality					
RMDSSUB	RMNO	RMWFS	RMCVALJ	RMPOPD6	RMPNM
1807	439	258	\$16.02	1,181	-0.547
1807	470	175	\$23.35	1,456	-1.924
1808	489	257	\$23.35	1,808	-1.924
1808	489	295	\$23.35	1,235	-1.924
1808	501	188	\$23.35	1,482	-1.924
1808	529	161	\$23.35	1,178	-1.924
1808	531	215	\$23.35	1,303	-1.924
1808	532	98	\$23.35	212	-1.924
1808	559	23	\$23.35	770	-1.924
1808	561	0	\$23.35	1,215	-1.924
1808	562	0	\$23.35	553	-1.924
1808	589	0	\$23.35	6	-1.924
1808	591	0	\$23.35	225	-1.924
1808	592	0	\$23.35	10	-1.924
1809	440	348	\$16.02	0	-0.547
1809	471	401	\$23.35	761	-1.924
1810	442	253	\$16.02	7	-0.547
1810	472	461	\$23.35	1	-1.924
1810	502	325	\$23.35	16	-1.924

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Abbey	407	1	1	1	229	229	14.6	5	0.219479	
Aberdeen	1310	2	2	1	373	373	14.1	6	0.471508	
Aberfeldy	1610	2	2	1	472	472	13.0	1	0.03736	
Abarnethy	801	1	1	1	186	186	14.0	5	0.201977	
Adair	604	1	1	1	155	155	14.4	1	0.027233	
Adams	608	3	3	0.5	180	158	13.9	1	0.026874	
Adams	607	3	3	0.5	159	159	13.9	1	0.015915	
Adanac	1210	1	1	1	410	410	13.5	3	0.125387	
Admiral	305	1	1	1	77	77	15.0	5	0.211472	
Aikins	402	1	1	1	137	137	16.1	1	0.039936	
Aikow	510	1	1	1	224	224		1	0.061471	
Alameda	101	1	1	0.5	3	3	14.7	3	0.051843	
Alameda	101	1	1	0.5	33	3	14.7	3	0.051843	
Alida	101	1	1	1	32	32	14.0	2	0.063364	
Allen	1303	3	3	0.5	343	343	13.9	4	0.15444	
Allen	910	3	3	0.5	313	343	13.9	4	1	
Alaskan	1106	2	2	1	292	292	14.9	5	0.257598	
Amazon	905	1	1	1	281	281	13.7	3	0.229008	
Ambassador	810	1	1	1	280	280	14.1	2	0.190476	
Amsterdam	709	2	2	1	304	304	13.1	2	0.129474	
Amulet	202	1	1	1	69	69	14.9	2	0.090759	
Anarley	1006	2	2	1	285	285	14.7	2	0.099323	
Anarod	303	1	1	1	76	76	15.0	7	0.470232	
Angle	1101	1	1	1	288	288	14.0	3	0.138702	
Antelope	404	1	1	1	138	138	14.1	4	0.127844	
Antler	102	1	1	1	61	61	14.2	3	0.092968	
Archerhill	1405		1	1	307	307	11.0		0.057416	
Archive	501	1	1	1	131	131	14.5	1	0.041181	
Archydai	502	3	3	1	162	162	14.2	1	0.056444	
Arcole	102	1	1	1	64	64	14.3	5	0.139452	
Ardath	1006	2	2	0.5	285	285	14.1	4	0.097818	
Ardath	1302	2	2	0.5	315	285	14.1	4	0.156627	
Arddil	206	2	2	1	102	102	15.3	4	0.147404	
Argo	1307	3	3	1	347	347	13.6	2	0.247934	
Arma Siding	1507	2	2	1	403	403	14.0	1	0.036079	
Armley	1501		1	1	457	457	11.4		0.070922	
Arran	707	2	2	0.5	301	331	11.1	4	0.063882	
Arran	707	2	2	0.5	331	331	11.1	4	0.063882	
Artland	1610	3	3	1	442	442	13.0	2	0.03736	
Asquith (a)	1305	3	3	1	345	345	13.9	1	0.092827	
Asquith(a)	1305	1	1	0.5	345	345	13.9	2	0.04712	
Asquith(a)	1308	1	1	0.5	375	345	13.9	2	0.11811	
Assiniboia	206	1	1	0.5	72	72	15.2	6	0.142379	
Assiniboia	207	1	1	0.5	73	72	15.2	6	0.179136	
Astum	1108	1	1	1	319	319	14.3	1	0.078125	
Abrator	701	3	3	1	183	183	13.8	2	0.090214	
Ave	1108	3	3	1	319	319	13.8		0.078125	
Avonhurst	604	3	3	1	157	157	14.6		0.070806	
Avonlea	203	2	2	1	100	100	14.8	4	0.175171	
Adford	109	1	1	1	68	68	15.1	1	0.030468	
Aylesbury	506	2	2	1	222	222	14.5	5	0.417303	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Baldon	301	2	2	1	131	131	14.7	1	0.041181	
Balcarras (b)	801	8	8	1	186	186	14.0	5	0.247175	
Baldwinton (Baldwin)	1809		1	1	440	440	14.1		0.117647	Was Baldwin in 25-26, but 26-27 list had same elevator line for Baldwinto n
Balgownie	807	1	1	1	158	158	14.6	3	0.148802	
Baloi	1204	1	1	1	351	351	14.5	1	0.083799	
Bangor	701	3	3	1	183	183	14.2	3	0.120321	
Barbour	704	2	2	1	243	243	14.0	1	0.012833	
Barrig	803	1	1	1	125	125	14.1	1	0.052038	
Barnes	704	2	2	1	243	243	14.1	1	0.012833	
Bateman	210	2	2	1	104	104	15.3	3	0.165722	
Battleford	1805	2	2	1	438	438	13.9	1	0.050955	Bishop making a manufactu ring elevator? (see 25-26 list)
Batrum	405	1	1	1	168	168	14.6	4	0.337662	
Bayard Station	205	2	2	0.5	101	101	15.0	2	0.053144	
Bayard Station	203	2	2	0.5	100	101	15.0	2	0.045897	
Beadle	1105	2	2	1	290	290	14.3	3	0.152027	
Bear Creek	701	1	1	0.5	152	151	13.8	1	0.020053	
Bear Creek	801	1	1	0.5	151	151	13.8	1	0.027726	
Beatty	1504	2	2	1	429	429	12.5	5	0.175077	
Beaufield	1109	3	3	1	320	320	14.5	2	0.198675	
Beckard	806	3	3	0.5	128	128	14.0	3	0.089228	
Beckard	110	3	3	0.5	98	128	14.0	3	0.086964	
Beechy	1001	2	2	1	226	226	15.5	3	0.295082	
Belbeck	501	1	1	1	161	161	14.3	1	0.075468	
Belle Plaine	809	1	1	1	180	180	14.1	3	0.148219	
Bellwood (Dendron)	401		1	1	135	135	15.1		0.025779	Changed to Dendron, F eb. 15, 1926. "Designat ed numbers of Stations" via CP Rail
Bemanside	803		2	0.5	125	95	14.4		0.026019	
Bemanside	105		2	0.5	95	95	14.4		0.028571	
Bender	802	1	1	1	124	124	14.4	2	0.070064	
Bengough	201	2	2	1	40	40	15.2	4	0.327456	
Benson	104	3	3	1	35	35	14.0	2	0.089888	
Betelock	1008	1	1	1	285	285	14.0	1	0.045147	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSWT 25	NOTES
Bethune	504	2	2	1	190	190	14.6	4	0.171429	
Beverley	402	1	1	1	137	137	14.2	4	0.191693	
Biddleigh	1101		1	1	258	258	15.1		0.044743	
Bierleat	106	1	1	0.5	5	4	13.7	1	0.020644	
Bierleat	104	1	1	0.5	4	4	13.7	1	0.018727	
Bigger (a)	1307	3	3	1	347	347	13.9	2	0.247934	
Bigger(a)	1307	1	1	1	347	347	13.9	2	0.256198	
Birch Hills	1509	2	2	1	461	461	12.7	5	0.292208	
Birdnew (Donovan)	1302	2	2	1	315	315	13.3	4	0.366265	
Birmingham	706	3	3	1	215	215	13.9	2	0.084507	
Birsey	1004	2	2	1	255	255	14.5	2	0.29087	
Bladworth	906	2	2	0.5	282	282	14.7	5	0.39261	
Bladworth	903	2	2	0.5	253	282	14.7	5	0.425	
Blair Lake	1604	2	2	1	436	436	13.4	6	0.181818	
Blucher	1303	1	1	1	343	343	14.1	2	0.158301	
Blumenhof	304	1	1	1	107	107	14.5	5	0.250423	
Boham	501	1	1	0.5	161	161	14.2	2	0.065202	
Boham	502	1	1	0.5	162	161	14.2	2	0.08937	
Booth Siding	809		2	1	279	279	14.7		0.067114	Took as Booth, mod map & atlas
Borden	1601	2	2	1	405	405	13.4	5	0.563307	
Bourly	1006	1	1	1	285	285	14.4	3	0.186111	
Bracken	309		1	1	18	18	14.5		0.130435	
Brade	1605	2	2	1	437	437	14.3	1	0.076433	
Braddock	401	1	1	1	136	136	14.1	2	0.051557	
Bradwell	1303	3	3	1	343	343	13.9	4	0.23166	
Brancepeth	1505	2	2	1	480	480	12.5	3	0.77551	
Bratton	1006	2	2	1	285	285	13.8	2	0.287284	
Bredenbury	704	1	1	1	213	213	13.8	3	0.040637	
Breeze	104	3	3	1	34	34		1	0.044944	
Bremen	1409	3	3	1	371	371	13.7	2	0.086705	
Bresaylor	1605	2	2	0.5	438	439	13.4	1	0.038217	
Bresaylor	1607	2	2	0.5	439	439	13.4	1	0.034325	
Brewer	705	3	3	1	214	214	14.4	2	0.053715	
Bridgeford	509	1	1	0.5	223	224	14.2	3	0.056818	
Bridgeford	510	1	1	0.5	224	224	14.2	3	0.083304	
Briercrest	608	2	2	0.5	130	130	14.5	3	0.053239	
Briercrest	501	2	2	0.5	131	130	14.5	3	0.082361	
Brightmore	109	1	1	1	68	68	13.9	1	0.032644	
Brin Siding	1009	2	2	1	316	316	13.0	1	0.07109	
Broadacre	1203	1	1	1	350	350	14.3	3	0.35503	
Broadview	802	1	1	1	154	154	14.1	2	0.086242	
Brock	1105	2	2	1	289	289	14.6	3	0.143581	
Brodemick	908	1	1	1	284	284	14.1	5	0.53112	
Bronhead	108	1	1	1	7	7	13.9	3	0.18256	
Brooking	108	2	2	0.5	38	38	14.4	2	0.085646	
Brooking	201	2	2	0.5	38	38	14.4	2	0.075567	
Brooksbey	1503	2	2	1	458	458	11.8	6	0.745763	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Brona	607	1	1	0.5	159	189	14.8	1	0.015915	
Brona	610	1	1	0.5	189	189	14.8	1	0.067568	
Brough	107	3	3	1	86	86	12.7	1	0.051195	
Browning	104	2	2	1	34	34	13.4	3	0.134831	
Brownlee	505	1	1	0.5	191	193	14.9	4	0.127363	
Brownlee	508	1	1	0.5	193	193	14.9	4	0.076872	
Bruno	1409	2	2	1	371	371	13.6	4	0.251445	
Bryant	104	2	2	1	35	35	13.8	1	0.044944	
Buchanan	709	2	2	1	304	304	12.6	5	0.327494	
Bulyea	806	1	1	1	220	220	14.7	2	0.305512	
Burdick	501	3	3	1	161	161	14.0	1	0.041181	
Bures	202		1	0.5	89	70	14.7		0.024752	
Bures	202		1	0.5	70	70	14.7		0.024752	
Burges	709	3	3	0.5	274	274	13.1	2	0.041869	
Burges	704	3	3	0.5	273	274	13.1	2	0.011763	
Burrows	502	1	1	0.5	123	123	13.9	1	0.015287	
Burrows	602	1	1	0.5	153	123	13.9	1	0.015287	
Burstall	410	1	1	1	232	232	14.3	5	0.172612	
Buttress	501	1	1	1	131	131	15.1	1	0.041181	
Cabn	407	1	1	1	229	229	14.8	9	0.367627	
Cadillac	305	1	1	1	77	77	14.2	6	0.211472	
Calder	703	2	2	1	241	241	13.4	5	0.222222	
Cana	705	3	3	1	214	214	14.1	1	0.049230	
Candec	803	2	2	1	126	126	14.6	3	0.216026	
Cando	1206	3	3	1	378	378	13.4	2	0.050378	
Canora (b)	709	10	10	0.25	304	274	13.2	7	0.077304	
Canora (b)	709	10	10	0.25	274	274	13.2	7	0.077304	
Canora (b)	708	10	10	0.25	303	274	13.2	7	0.092147	
Canora (b)	704	10	10	0.25	273	274	13.2	7	0.021709	
Canuar	402	1	1	1	137	137	15.0	3	0.145367	
Canuck	309		1	1	18	18	15.0		0.123188	
Canwood	1510	2	2	1	494	494	11.2	4	0.287081	
Cardell	409	1	1	1	111	111	13.5	2	0.083391	
Canevale	101	1	1	0.5	1	2	13.4	3	0.038594	
Canevale	101	1	1	0.5	2	2	13.4	3	0.038594	
Carlton	1507	2	2	1	403	403	13.2	3	0.108238	
Carlyle (b)	102	6	6	1	83	83	14.4	4	0.108462	
Carmel	1408	2	2	1	370	370	13.4	4	0.265849	
Carmichael	404	1	1	0.5	109	139	14.0	5	0.080173	
Carmichael	404	1	1	0.5	139	139	14.0	5	0.080173	
Camduff	101	1	1	1	2	2	13.8	5	0.146313	
Caron	502	1	1	1	162	162	13.9	3	0.189332	
Caruthers	1809	3	3	1	440	440	13.4	2	0.117647	
Cavelier	1896	2	2	1	468	468	13.8	1	0.104895	
Cavell	1206	3	3	1	379	379	14.0	2	0.083963	
Ceciloux	109	3	3	1	97	97	14.4	2	0.095288	
Ceepee	1801	2	2	0.5	405	375	14.2	1	0.077519	
Ceepee	1309	2	2	0.5	375	375	14.2	1	0.15748	
Central Butte	508	3	3	1	194	194	14.7	4	1	
Ceylon	201	2	2	1	39	39	14.7	3	0.214106	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Chamberlain	504	2	2	1	221	221	14.8	1	0.117143	
Chambers	1302	2	2	1	315	315	13.2	3	0.072289	
Chaplin	503	1	1	1	164	164	15.1	4	0.194726	
Charlton	1605	2	3	1	408	408	13.4	1	0.076433	Falsely (no proof) listed as 2 in elev23-24
Chavot	1303	1	1	1	343	343	14.4	2	0.125483	
Chipperfield	1101		1	1	258	258	15.2		0.044743	
Chrysler	704	1	1	1	243	243	13.9	1	0.012833	
Churchbridge	703	1	1	1	211	211	13.8	3	0.153968	
Clair	1405	2	2	1	337	337	12.5	2	0.080909	
Clarkboro	1310	2	2	0.5	373	373	14.2	1	0.027933	
Clarkboro	1304	2	2	0.5	374	373	14.2	1	0.028281	
Clavet	1303	3	3	1	343	343	13.7	2	0.088456	
Claybank	608	2	2	0.5	130	120	15.4	1	0.01331	
Claybank	203	2	2	0.5	100	100	15.4	1	0.022848	
Claydon	309	1	1	1	20	20	14.4	1	0.043478	
Cleaves	1608	2	2	1	499	499	13.1	2	0.087977	
Clemens	1502	2	1	1	428	428	12.0	1	0.110429	Falsely listed as CN in 1923-24 list.
Climax	309	1	1	1	18	18	15.0	5	0.210145	
Cloan	1209	1	1	1	408	409	13.8	2	0.228571	
Clonmel	704	1	1	1	213	213	13.6	2	0.025666	
Coderre	503		1	1	133	133	14.9		0.194726	
Codette	1508		1	1	487	487	11.6		0.543478	
Coleville	1109	3	3	1	320	320	14.6	3	0.403974	
Colfax	109	3	3	1	97	97	14.1	3	0.097933	
Colgate	108	2	2	1	37	37	13.8	2	0.12035	
Colmer	706	3	3	1	215	215	14.4	1	0.042254	
Colonsay	1410	1	1	1	342	342	14.0	3	0.226867	
Conde	607	2	2	1	159	159	13.9	1	0.038196	
Congress	207	1	1	0.5	73	73	15.1	4	0.12118	
Congress	206	1	1	0.5	72	73	15.1	4	0.086315	
Conquest	1006	1	1	1	285	285	14.2	3	0.150489	
Consul	310	1	1	1	51	51	14.7	3	0.131067	
Coppen	210	2	2	1	104	104	15.2	4	0.235499	
Corinne	608	1	1	0.5	129	129	13.8	3	0.042147	
Corinne	203	1	1	0.5	99	129	13.8	3	0.072363	
Coming	105		2	1	95	95	14.4		0.114286	
Cory	1304	1	1	1	344	344	14.0	2	0.135747	
Cote	707	2	2	1	271	271	14.4	2	0.051993	
Court	1110	1	1	1	322	322	13.7	1	0.085934	
Craig	506	2	2	1	222	222	14.8	5	0.582697	
Crane Valley	205		1	1	71	71	14.6		0.053144	
Craven (b)	610		6	0.5	189	189	14.6	2	0.148398	
Craven (b)	605		6	0.5	219	189	14.6	2	0.08233	
Creelman	105	1	1	1	96	96	14.0	4	0.247619	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Creathwynd	502	1	1	0.5	132	131	14.8	1	0.056444	
Creathwynd	501	1	1	0.5	131	131	14.8	1	0.041181	
Crichlon	305	1	1	1	77	77	15.1	3	0.124395	
Crooked River	1501	2	2	0.5	427	426		1	0.01773	
Crooked River	1501	2	2	0.5	426	426		1	0.01773	
Cross	409	1	1	1	110	110	14.4	2	0.083391	
Crutwell	1509	2	2	1	493	493	12.6	1	0.038961	
Cudworth	1506	3	3	0.5	401	401	13.3	6	0.109756	
Cudworth	1506	3	3	0.5	402	401	13.3	6	0.109756	
Cupar	803	1	1	1	218	218	14.1	5	0.484041	
Cut Knife	1807	1	1	1	439	439	13.3	3	0.199085	
Cymric	808	1	1	1	250	250	14.2	3	0.238397	
Dafoe	1403	1	1	1	308	308	14.2	4	0.342857	
Dahinda	202		1	1	70	70	14.5		0.049505	
Dalmerly	1304	2	2	1	374	374	13.7	2	0.124434	
Dalzell	802	2	2	1	124	124	14.3	1	0.038217	
Dana	1409	2	2	1	371	371	14.3	1	0.036127	
Danion	1103		2	1	280	280	15.0		0.088235	
Daphne	1406	1	1	1	368	368	12.0	1	0.02451	
Darmody	509	3	3	1	193	193	14.3	3	0.120321	
Davidson	903	2	2	0.5	253	252	14.6	6	0.575	
Davidson	902	2	2	0.5	252	252	14.6	6	0.412186	
Devin	604	2	2	0.5	157	128	14.8	2	0.027233	
Devin	605	2	2	0.5	128	128	14.8	2	0.055127	
Davis	1509	2	2	1	461	461	12.3	1	0.025974	
Daylesford	1406	2	2	1	399	399	11.9	2	0.04902	
Debden	1510	2	2	0.5	524	524	10.8	3	0.07177	
Debden	1803	2	2	0.5	525	524	10.8	3	0.132353	
Deborah	104	3	3	0.5	34	4	14.0	1	0.022472	
Deborah	104	3	3	0.5	4	4	14.0	1	0.022472	
Deleale	1305	2	2	1	345	345	13.7	5	0.366492	
Delmas	1805	2	2	1	438	438	13.1	1	0.101911	
Demaine	1001	2	2	0.5	225	226	15.1	3	0.147541	
Demaine	1001	2	2	0.5	226	226	15.1	3	0.147541	
Denholtm	1804	2	2	0.5	406	406	13.8	3	0.0414	
Denholtm	1805	2	2	0.5	437	406	13.8	3	0.123567	
Denzil	1207	1	1	1	382	382	14.1	5	0.209064	
Demic	709	2	2	0.5	314	305	12.8	2	0.045697	
Demic	710	2	2	0.5	305	305	12.8	2	0.057471	
Deveron	803	1	1	1	125	125	14.7	1	0.052038	Was Deveron in 1923-24 list.
Dewar Lake	1106	3	3	0.5	291	321	14.5	3	0.085123	
Dewar Lake	1110	3	3	0.5	321	321	14.5	3	0.088901	
Diane Siding	808	1	1	1	129	129	13.6	2	0.053239	
Dike	504	1	1	1	221	221	14.8	3	0.121429	
Dismore	1007	2	2	1	286	286	14.7	6	0.37037	
Disley	504	2	2	0.5	190	189	13.9	2	0.085714	
Disley	610	2	2	0.5	189	189	13.9	2	0.207207	
Dixon Siding	1408	2	2	1	370	370	13.2	1	0.08135	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Doddsland	1108	3	3	1	319	319	14.4	1	0.239583	
Dollard	308	1	1	1	79	79	14.6	5	0.630435	
Domremy	1506	3	3	1	431	431	13.6	5	0.231707	
Donwell	704	2	2	1	273	273	13.8	2	0.044915	
Doonside	103	2	2	1	92	92	14.9	1	0.056764	
Downe	1107	3	3	1	318	318	14.3	1	0.098039	
Drake	1407	1	1	1	310	310	13.9	3	0.215463	
Drinkwater	809	1	1	0.5	160	130	14.1	4	0.102984	
Drinkwater	808	1	1	0.5	130	130	14.1	4	0.047471	
Driver	1109	3	3	1	320	320	14.2	2	0.126675	
Druid	1108	1	1	1	319	319	14.8	2	0.143229	
Dubuc	702	1	1	1	184	184	14.1	3	0.181677	
Duck Lake	1507	2	2	1	463	463	12.9	1	0.030066	
Duff	706	3	3	1	215	215	13.9	3	0.140845	
Dulwich	1606		2	0.5	469	469	13.3		0.043988	
Dulwich	1606		2	0.5	469	469	13.3		0.043988	
Dumas	103	1	1	1	93	93	13.8	1	0.056764	
Dummer	203	2	2	0.5	99	99	15.0	3	0.068545	
Dummer	203	2	2	0.5	100	99	15.0	3	0.068545	
Dunblane	1004	2	2	1	255	255	14.8	3	0.391304	
Dundum	1301	2	2	1	314	314	14.1	3	0.80241	
Dunelm	402	1	1	1	137	137	15.0	2	0.095847	
Dunfermline	1305	1	1	0.5	345	345	13.5	1	0.031414	
Dunfermline	1309	1	1	0.5	375	345	13.5	1	0.07874	
Dunkirk	206	1	1	0.25	102	102	15.2	2	0.025126	
Dunkirk	501		1	0.25	131	102	15.2	2	0.02059	
Dunkirk	502	1	1	0.25	132	102	15.2	2	0.028222	
Dunkirk	205	1	1	0.25	101	102	15.2	2	0.026572	
Duro	1304	3	3	1	344	344	13.6	1	0.083348	
Duval	806	1	1	1	250	250	14.4	5	0.394515	
Dysart	802	1	1	1	217	217	14.5	4	0.300546	
D'arcy	1105	2	2	0.5	289	289	14.6	3	0.067568	
D'arcy	1101	2	2	0.5	288	289	14.6	3	0.069657	
Earl Grey	805	1	1	1	219	219	14.7	4	0.383523	
Eastend	306	1	1	0.5	49	49	14.0	5	1	
Eastend	309	1	1	0.5	50	49	14.0	5	0.108606	
Eastview	609	3	3	0.5	160	160	13.6	1	0.028874	
Eastview	501	3	3	0.5	161	160	13.6	1	0.02059	
Eatonia	1104	2	2	1	261	261	14.5	3	0.333333	
Ebenezer	704	3	3	0.5	243	243	13.3	3	0.019249	
Ebenezer	705	3	3	0.5	244	244	13.3	3	0.040286	
Echo Lake (Layco)	1402		1	1	306	306	14.3		0.035462	Changed to Layco, Mar ch 1929. "Designati ng Numbers of Stations", v in CP Rail.

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Echo (Loomis)	309	1	1	1	19	19	15.2	2	0.086957	Changed to Loomis in March 1929, "Designati ng Numbers of Stations", v in CP rail.
Edam	1808	2	2	1	489	489	13.5	3	0.208211	
Ederwold	807	3	3	1	158	158	14.4	3	0.085491	
Edgeley	804	3	3	1	157	157	14.2	2	0.100218	
Edgeworth	202		1	1	70	70	14.3		0.049505	
Elbow	904	1	1	1	254	254	14.2	4	0.218579	
Elcott	101	3	3	1	3	3	13.4	1	0.034562	
Eldersley	1501	2	2	1	427	427	11.2	2	0.135934	
Eldred	1803	2	2	1	525	525	10.1	1	0.088235	
Elros	1402	1	1	1	307	307	13.5	4	0.230701	
Elrose	1002	2	2	1	257	257	14.7	6	0.230769	
Elstow	1303	1	1	1	343	343	14.2	5	0.23186	
Engen Siding	1304	1	1	1	344	344	14.9	1	0.056561	
Englefield	1406	2	2	0.5	389	389	12.6	3	0.046977	
Englefield	1404	2	2	0.5	339	389	12.6	3	0.088686	
Ens	1506	3	3	1	401	401	12.0	2	0.073171	
Ermine	1109	1	1	1	320	320	14.2	1	0.089338	
Ernfold	507	1	1	1	185	185	14.6	4	0.284024	
Esk	1404	1	1	1	309	309	13.7	2	0.082521	
Eskbank	509	3	3	1	193	193	14.9	2	0.120321	
Esterhazy	701	1	1	1	183	183	14.0	4	0.157754	
Estevan	106	1	1	1	5	5	11	5	0.236188	
Estlin	108	3	3	1	129	129		4	0.11535	
Eston	1102	2	2	1	259	259	14.7	5	0.256881	
Estuary	410	1	1	1	232	232	14.8	4	0.103567	
Etlington	209	2	2	1	103	103	15.2	2	0.115607	
Evesham	1207	1	1	1	382	382	13.8	4	0.175439	
Expanse	206	1	1	1	102	102	15.6	2	0.082127	
Eyebrow	509	1	1	1	193	193	14.7	5	0.195187	
Eyre	1104		2	1	282	282	14.0		0.111111	
Fairholme	1806		2	1	488	488	12.0		0.104895	
Fairlight (a)	103	2	2	0.5	92	91	14.3	1	0.023652	
Fairlight (a)	103	2	2	0.5	91	91	14.3	1	0.023652	
Fairlight(a)	103	1	1	0.5	92	91	14.3	2	0.056764	
Fairlight(a)	103	1	1	0.5	91	91	14.3	2	0.056764	
Farmount	1105	2	2	1	290	290	14.0	4	0.163851	
Fenton	1505	2	2	0.5	480	480	12.7	2	0.22449	
Fenton	1509	2	2	0.5	481	480	12.7	2	0.035714	
Fenwood	708	3	3	1	215	215	13.8	3	0.126761	
Ferlie	101	1	1	1	31	31	14.8	1	0.034562	
Fielding	1804	2	2	1	406	406	13.8	3	0.081336	
Filmore	105	1	1	1	98	98	14.3	5	0.28381	
Findlater	504	2	2	1	190	190	14.8	3	0.121429	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Finnie	706	3	3	0.5	215	185	14.6	2	0.042254	
Finnie	702	3	3	0.5	185	185	14.6	2	0.046584	
Fishing Lake	1402		1	1	306	306	13.6		0.035492	Based on modern map. Older maps show site as off rail.
Fiske	1101	2	2	1	288	288	14.3	2	0.085011	
Fleatcombe	1106	2	2	1	291	291	14.6	4	0.170767	
Fleming	103	1	1	0.5	91	121	14.1	3	0.085147	
Fleming	601	1	1	0.5	121	121	14.1	3	0.083179	
Floral	1304	1	1	1	344	344	14.2	1	0.067673	
Foam Lake	1401	1	1	0.5	276	276	13.9	7	0.764706	
Foam Lake	1402	1	1	0.5	306	276	13.9	7	0.173026	
Fonahill	705	2	2	1	244	244	14.3	2	0.102954	
Forgen	1002	2	2	1	257	257	14.6	4	0.172768	
Forget	107	1	1	1	65	65	13.6	3	0.192833	
Forslund	1410		1	1	342	342	14.1		0.08	
Fort Ou'Appelle	802	3	3	1	187	187	14.3	2	0.163934	
Fortune	1008	1	1	1	287	287	14.7	2	0.094915	
Fosston	1405		1	1	367	367	11.8		0.057416	
Francis	605	1	1	1	127	127	14.2	4	0.249448	
Franklake	607	3	3	1	158	158	14.2	1	0.03183	
Freemont	1809		1	1	440	440	13.1		0.058824	
Frobisher	101	1	1	0.5	3	3	14.5	3	0.050691	
Frobisher	104	1	1	0.5	4	3	14.5	3	0.065918	
Frontier	309	1	1	1	19	19	15.0	5	0.210145	
Froude	107	1	1	1	66	66	14.1	2	0.093857	
Frys	102	1	1	1	61	61	14.7	1	0.067936	
Fueller	1110	1	1	1	322	322	14.4	3	0.197802	
Gaines	1008	1	1	0.5	287	286	15.0	1	0.020339	
Gaines	1007	1	1	0.5	286	286	15.0	1	0.02924	
Gainsboro	101	1	1	1	1	1	14.5	4	0.120968	
Galilee	205	2	2	1	101	101	14.8	1	0.053144	
Gallivan	1807	3	3	1	439	439	13.6	2	0.1373	
Gascoigne	410	1	1	1	232	232	14.9	1	0.034522	
Gerald	701	3	3	1	152	152	14.1	2	0.080214	
Gibbs	805	1	1	1	219	219	14.8	2	0.142045	
Gillespie	801	3	3	1	186	186	14.3	1	0.042373	
Gilroy	510	3	3	1	224	224	15.0	4	0.25247	
Girvin	902	2	2	1	252	252	15.0	5	0.587814	
Glenis	1008	1	1	1	287	287	14.6	2	0.122034	
Glasnevin	202	1	1	1	70	70	14.9	2	0.08001	
Glen Ewen	101	1	1	0.5	3	3	14.1	4	0.077765	
Glen Ewen	101	1	1	0.5	2	3	14.1	4	0.077765	
Glenshon	803	2	2	1	125	125	15.4	3	0.142238	
Glenside	908	1	1	1	284	284	14.9	5	0.381743	
Glidden	1103	2	2	1	280	280	14.6	4	0.382363	
Golburn	1501		1	1	427	427	10.7		0.036461	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Goodeve	706	3	3	1	215	215	13.2	4	0.176056	
Goodwater	108	2	2	1	37	37	14.1	2	0.12035	
Goritz	709	3	3	0.5	274	274	13.5	2	0.041889	
Goritz	704	3	3	0.5	273	274	13.5	2	0.011763	
Gouverneur	303	1	1	0.5	76	76	14.9	4	0.126135	
Gouverneur	305	1	1	0.5	77	76	14.9	4	0.086386	
Goven	808	1	1	1	250	250	14.6	5	0.367089	
Goverlock	310	1	1	1	22	22	15.1	2	0.084034	
Grand Coulee	607	1	1	1	159	159	13.9	3	0.123077	
Grandora	1305	3	3	1	345	345	14.2	2	0.125854	
Gravelbourg	210	2	2	1	104	104	15.1	9	0.535543	
Gray	608	3	3	0.5	129	128	13.8	4	0.053239	
Gray	606	3	3	0.5	128	128	13.8	4	0.132304	
Grayburn	502	3	3	1	162	162	14.5	2	0.103481	
Grayson	702	1	1	1	184	184	14.6	3	0.197205	
Greenan	1101	2	2	1	258	258	15.0	2	0.089485	
Greene	1106	3	3	0.5	292	292	14.6	2	0.043415	
Greene	1110	3	3	0.5	322	292	14.6	2	0.065934	
Griffell	602	1	1	1	154	154	14.6	6	0.240764	
Griffin (b)	107	8	8	1	86	86	13.6	2	0.093857	
Guernsey	1408	1	1	0.5	340	310	13.6	4	0.105317	
Guernsey	1407	1	1	0.5	310	310	13.6	4	0.130545	
Gull Lake	404	1	1	0.5	138	139	14.4	8	0.136511	
Gull Lake	404	1	1	0.5	139	139	14.4	8	0.136511	
Gunworth	1101	1	1	1	258	258	14.9	2	0.086943	
Hafford	1803	2	2	1	435	435	13.2	3	0.338235	
Hague	1304	2	2	0.5	374	403	14.0	4	0.126897	
Hague	1507	2	2	0.5	403	403	14.0	4	0.067348	
Halbrite	106	1	1	1	36	36	13.9	2	0.099092	
Hallonquist	401	1	1	0.5	135	136	14.8	2	0.038688	
Hallonquist	401	1	1	0.5	136	136	14.8	2	0.038688	
Hammitt	1805	2	2	1	437	437	13.6	1	0.157962	
Hampton	704	2	2	1	273	273	13.7	3	0.059887	
Handel	1202	1	1	1	349	349	14.6	3	0.439024	
Handsworth	105		2	1	95	95	14.7		0.114286	
Hanley	907	2	2	1	283	283	14.2	6	0.588336	
Hardy	201	2	2	1	39	39	14.8	2	0.231738	
Harold (Edfield)	1402		1	1	306	306	13.3		0.035492	Edfield on 26-27 elevator list (acknowledged in brackets).
Harns	1009	2	2	1	316	316	14.2	5	0.809005	
Hartwell	1808		2	1	489	489	12.7		0.043988	Elev. Hartwell
Hassan	709	2	2	0.5	304	334	13.2	1	0.022848	
Hassan	710	2	2	0.5	334	334	13.2	1	0.028736	
Hatfield	810	1	1	1	280	280	14.4	1	0.111111	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Hallon	409	1	1	0.5	142	112	14.9	7	0.125087	Co-op listed as unlicensed . 1925
Hallon	409	1	1	0.5	112	112	14.9	7	0.125087	Co-op listed as unlicensed . 1925
Haultain	1301	2	2	0.5	314	314	13.1	1	0.108434	
Haultain	1304	2	2	0.5	344	314	13.1	1	0.050905	
Hawarden	904	1	1	1	254	254	15.2	6	0.311475	
Hawoods	1305	3	3	1	345	345	14.1	1	0.062827	
Hawthorne (Inchkeith)	802	2	2	1	124	124	14.9	1	0.098089	Wrigleys Saskatche wan Directory 1921-22. via Sask. Archives. May be Inchkeith?
Hazelcliff	701	1	1	1	152	152	14.0	1	0.033422	
Hazenmore	302	1	1	1	75	75	15.1	6	0.357245	
Heame	808	2	2	1	130	130	15.0	2	0.053239	
Hendon	1405		1	1	337	337	12.5		0.066986	
Hennibourg	1509		2	1	491	491	11.1		0.077922	
Hepburn	1507	2	2	1	404	404	13.7	3	0.102225	
Herbert	401	1	1	0.5	166	166	15.2	7	0.079484	
Herbert	507	1	1	0.5	165	165	15.2	7	0.218935	
Herschel	1107	1	1	1	318	318	14.3	4	0.428105	
Heward	107	1	1	1	85	85	14.7	3	0.133106	
Highgate	1805	2	2	0.5	437	438	13.2	1	0.040764	
Highgate	1805	2	2	0.5	438	438	13.2	1	0.040764	
Hirsch	104	1	1	1	4	4	13.2	1	0.052434	
Hitchcock	106	1	1	1	5	5	14.1	2	0.102305	
Hodgeville	401	2	2	1	135	135	14.7	4	0.107411	
Hoev	1506	3	3	1	431	431	13.6	4	0.152439	
Holbein	1509	2	2	1	493	493	11.8	2	0.077922	
Holdfast	504	1	1	1	221	221	14.6	5	0.164286	
Hoosier	1106	3	3	0.5	292	322	14.3	2	0.043415	
Hoosier	1110	3	3	0.5	322	322	14.3	2	0.085934	
Horizon	202	1	1	0.333	70	40	15.3	3	0.049505	
Horizon	204	1	1	0.333	42	40	15.3	3	0.294118	
Horizon	201	1	1	0.333	40	40	15.3	3	0.075567	
Hubbard	801	3	3	0.5	246	246	13.4	3	0.083559	
Hubbard	801	3	3	0.5	216	246	13.4	3	0.083559	
Hughton	1002	2	2	1	257	257	15.0	5	0.191279	
Humboldt	1408	2	2	1	370	370	13.3	4	0.224949	
Huntoon	107	3	3	0.5	85	86	13.5	2	0.051195	
Huntoon	107	3	3	0.5	86	86	13.5	2	0.051195	
Hys	708	2	2	0.5	333	333	11.7	4	0.127099	
Hys	708	2	2	0.5	303	333	11.7	4	0.127099	
Ilsen	110	1	1	1	98	98	13.9	2	0.089286	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Imperial	901	1	1	0.5	251	251	14.3	5	0.239404	
Imperial	905	1	1	0.5	261	251	14.3	5	0.187023	
Indi	1301	2	2	1	314	314	14.8	2	0.289157	
Indian Head	604	1	1	1	156	156	13.9	6	0.24183	
Innes	107	3	3	1	66	66	13.5	1	0.061196	
Ininger	706	1	1	1	275	275	13.1	2	0.084507	
Inetow	307	1	1	1	108	108	15.0	4	0.40678	
Invermay	710	2	2	1	305	305	12.6	2	0.114943	
Isham	1102		2	1	259	259	15.0		0.055046	
Iuna	801	3	3	1	246	246	13.7	4	0.169482	
Jamezon	607	2	2	1	158	158	14.3	1	0.026525	
Jansen	1404	1	1	1	309	309	13.5	3	0.131072	
Jasmin	801	3	3	1	246	246	13.9	2	0.084746	
Juniata	1306	3	3	1	346	346	13.5	2	0.109689	
Juniper	1006	2	2	1	285	285	14.4	1	0.083303	
Kamsack	707	2	2	1	271	271	13.4	6	0.292028	
Kandahar	1403	1	1	1	308	308	14.2	3	0.242857	
Keyville	202		1	1	70	70	15.3		0.049505	
Kedleston	504	1	1	0.5	190	190	14.3	2	0.039286	
Kedleston	504	1	1	0.5	221	190	14.3	2	0.039286	
Keeler	505	1	1	1	191	191	14.8	4	0.265781	
Kelfield	1202	1	1	1	349	349	14.2	3	0.414834	
Kellher	804	3	3	1	247	247	14.2	4	0.209091	
Kelso	103	2	2	1	92	92	14.5	1	0.047304	
Kelstern	401		1	0.5	135	134	15.4		0.038668	
Kelstern	503		1	0.5	134	134	15.4		0.073022	
Kelvington	1405	2	2	1	366	366	12.1	5	0.143541	
Kenaston	907	2	2	0.5	283	282	14.4	4	0.193505	
Kenaston	906	2	2	0.5	282	282	14.4	4	0.330254	
Kendal	803	2	2	1	126	126	14.5	3	0.194276	
Kennedy	103	1	1	1	93	93	13.9	2	0.0965	
Keppel	1306	1	1	0.5	346	346	13.8	1	0.027422	
Keppel	1307	1	1	0.5	347	346	13.8	1	0.061983	
Kerrobot	1204	1	1	0.5	351	351	14.6	3	0.129888	
Kerrobot	1203	1	1	0.5	350	351	14.6	3	0.183432	
Keesock	704	2	2	0.5	243	241	13.2	1	0.006416	
Keesock	703	2	2	0.5	241	241	13.2	1	0.02361	
Ketchen	710	2	2	1	334	334	11.6	2	0.105364	
Keystown	609	3	3	1	180	180	13.6	2	0.115486	
Khadive	202	1	1	1	69	69	14.4	2	0.09901	
Kilalee	702	1	1	0.5	184	184	14.6	3	0.061335	
Kilalee	702	1	1	0.5	185	184	14.6	3	0.061335	
Kilwinning	1510	2	2	1	464	464	11.8	1	0.047847	
Kincaid	302	1	1	1	75	75	14.8	7	0.404751	
Kincorth	409	1	1	1	112	112	14.4	2	0.083391	
Kindersley	1105	2	2	1	290	290	14.4	5	0.261824	
Kingsford	104	2	2	0.5	34	34	13.6	1	0.018727	
Kingsford	104	2	2	0.5	4	34	13.6	1	0.018727	
Kinhop	1009	2	2	1	316	316	14.3	2	0.177725	
Kniestino	1504	2	2	1	459	459	12.6	6	0.292616	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Kinley (a)	1306	1	1	1	346	346	13.8	2	0.18819	
Kinley(a)	1306	3	3	1	346	346	13.8	3	0.184534	
Kipling	602	2	2	1	124	124	14.1	2	0.095541	
Kesby	102	1	1	1	84	84	13.8	4	0.188248	
Kronau	606	1	1	0.5	128	128	14.2	4	0.126792	
Kronau	607	1	1	0.5	158	128	14.2	4	0.081008	
Krydor	1803	2	2	1	435	435	13.9	3	0.264708	
Kuroki	1405	2	2	1	336	336	12.7	1	0.033483	
Kyle	1002	1	1	1	227	227	15.0	1	0.148087	
Kylmore	1405	2	2	1	336	336	13.2	2	0.124402	
Lac Vert	1406	1	1	1	388	388	12.0	3	0.088038	
Lacadena	1003		2	1	228	228	14.9		0.138462	
LaFleche	208	1	1	1	74	74	15.4	6	0.357988	
Laird	1507	2	2	0.5	403	404	13.4	3	0.093205	
Laird	1507	2	2	0.5	404	404	13.4	3	0.093205	
Lajord	606	1	1	1	128	128	14.0	4	0.326351	
Lake Valley	509	3	3	1	193	193	14.9	2	0.080214	
Lampman	104	2	2	1	34	34	14.3	2	0.087378	
Lancor	407	1	1	1	229	229	14.4	5	0.203018	
Landis	1206	3	3	0.5	378	379	13.9	3	0.075567	
Lands	1206	3	3	0.5	379	379	13.9	3	0.075567	
Landscape	205	1	1	1	71	71	14.8	2	0.087431	
Lang	110	1	1	1	98	98	13.6	5	0.391389	
Langbank	602	2	2	0.5	123	123	13.7	1	0.028662	
Langbank	103	2	2	0.5	93	123	13.7	1	0.042573	
Langenburg	701	1	1	0.5	181	181	14.0	4	0.083583	
Langenburg	703	1	1	0.5	211	181	14.0	4	0.111111	
Lanham	1309	2	2	1	375	375	13.9	4	0.645889	
Lanigan	1407	1	1	1	310	310	13.8	3	0.248416	
Laporte	1104	2	2	1	261	261	14.4	2	0.333333	
Lashburn	1610	2	2	1	472	472	13.6	5	0.285255	
Laura	1009	2	2	0.5	316	315	14.4	4	0.14218	
Laura	1302	2	2	0.5	315	315	14.4	4	0.144578	
Lawson	510	3	3	1	224	224	15.1	4	0.263447	
Leacroes	1501		1	1	457	457	11.1		0.035461	
Leader	410	1	1	1	231	231	15.6	5	0.13809	
Leak	1510	2	2	1	464	464	12.5	4	0.287081	
Lebret	802	3	3	1	187	187	13.4	1	0.081967	
Leckford	1507	2	2	0.5	483	483	13.9	1	0.038079	
Leckford	1507	2	2	0.5	403	483	13.9	1	0.038079	
Leipzig	1206	1	1	1	379	379	14.6	3	0.238455	
Lemberg	702	1	1	1	185	185	14.2	5	0.253106	
Lensford	408	1	1	1	230	230	14.9	4	0.288884	
Leney	1306	3	3	1	346	346	14.0	4	0.23786	
Lenore Lake	1406	2	2	0.5	389	389	12.6	5	0.079857	Protein to ok Lake Lenore
Lenore Lake	1406	2	2	0.5	389	389	12.6	5	0.079857	Protein to ok Lake Lenore
Leofhard	1506	3	3	0.5	401	401	13.0	2	0.036585	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Leonard	1506	3	3	0.5	402	401	13.0	2	0.036585	
Lerosa	804	3	3	1	247	247	14.2	2	0.108091	
Leroy	1404	1	1	1	339	339	12.9	3	0.138782	
Leske	1402	1	1	0.5	306	307	13.7	4	0.11535	
Leslie	1402	1	1	0.5	307	307	13.7	4	0.11535	
Lestock	804	3	3	1	247	247	13.8	4	0.218182	
Lett	1206		3	1	378	378	13.6		0.050378	
Leurven	110	3	3	1	98	98	13.7	4	0.183452	
Liberty	901	1	1	1	251	251	14.3	4	0.388679	
Lilec	1804	2	2	0.5	406	406	13.4	1	0.034998	
Lilec	1804	2	2	0.5	436	406	13.4	1	0.034998	
Limerick	207	1	1	1	73	73	15.5	6	0.442571	
Lintlaw	710	2	2	1	335	335	11.2	3	0.201149	
Lipsett	1504	2	2	1	429	429	13.3	4	0.158629	
Lipton	802	1	1	1	217	217	14.1	4	0.303279	
Livelong	1806		2	1	499	499	12.2		0.043988	
Lloydminster	1610	2	2	1	472	472	13.0	5	0.174346	
Lockwood	1407	1	1	1	310	310	14.0	3	0.215463	
Loreburn	904	1	1	1	254	254	15.5	5	0.264117	
Loris	801	3	3	1	186	186	14.3	3	0.127119	
Lovett (Kegworth, Rig w.)	603	2	2	1	125	125	14.9	1	0.043385	Whigleys Saskatchewan Directory 1921-22, via Sask. Archives. Taken as Kegworth, misspelled as Rigworth in 1925-26 ed.
Loverna	1110	3	3	1	322	322	14.3	3	0.21978	
Lucky Lake	1001	2	2	1	225	225	15.1	4	0.408836	
Lumaden	610	2	2	1	189	189	14.2	2	0.247748	
Lurgan	1501		1	1	427	427	11.2		0.035461	
Luseland	1204	1	1	1	351	351	14.4	6	0.5	
Lydden (Duperow)	1201	3	3	1	348	348	14.2	2	0.3	
MacDowall	1507	2	2	0.5	463	463	11.9	1	0.015033	
MacDowall	1509	2	2	0.5	461	463	11.9	1	0.016234	
Macdon	1207	1	1	1	382	382	14.1	3	0.140351	
MacNutt	703	2	2	1	211	211	13.8	3	0.233333	
Macoun	106	1	1	1	36	36	13.8	3	0.14038	
Macrorie	1006	2	2	1	285	285	14.3	2	0.080293	
Madison	1103	2	2	1	280	280	14.2	6	0.529412	
Madstone	1809	2	2	1	471	471	13.4	4	0.343137	
Mar	103	2	2	1	82	82	14.3	1	0.056764	
Major	1110	1	1	0.5	321	321	14.6	3	0.083407	
Major	1205	1	1	0.5	352	321	14.6	3	1	
Mano?	102	1	1	1	83	83	14.2	4	0.133482	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Martario	1104	2	2	1	262	262	14.6	2	0.222222	
Maple Creek	409	1	1	1	111	111	13.8	5	0.250174	
Marcelin	1804	2	2	0.5	436	436	13.3	5	0.076825	
Marcelin	1510	2	2	0.5	464	436	13.3	5	0.143541	
March Well	701	1	1	1	181	181	13.8	2	0.080214	
Marango	1106	2	2	1	292	292	14.8	3	0.130246	
Margo	1405	2	2	1	336	336	13.1	2	0.057416	
Martinch	803	1	1	1	218	218	14.3	4	0.303359	
Marquis	505	1	1	1	191	191	14.5	4	0.305648	
Marsden	1610		1	1	442	442	13.4		0.14944	
Marshall	1610	2	2	1	472	472	13.5	4	0.180573	
Maryfield (b)	103	6	6	1	91	91	14.4	2	0.104068	
Masefield	301		1	1	17	17	14.2		0.25	
Matador	1002		1	1	227	227	14.5		0.080214	
Mawer	509	3	3	1	193	193	15.3	4	0.180428	
Maxim	108	1	1	1	37	37	14.6	2	0.115974	
Maymont	1604	2	2	1	406	406	13.3	4	0.136284	
Mazenod	209	2	2	1	103	103	14.7	5	0.364162	
McGee	1101	2	2	1	268	268	14.0	2	0.085485	
McKague	1405		1	1	397	397	11.0		0.057416	
McKim (Peoples)	705	3	3	1	214	214	13.8	2	0.063715	Was Peoples. '89 Gal.
McLean	604	1	1	1	157	157	14.3	1	0.023965	
McMahon	401	1	1	1	136	136	14.3	2	0.077336	
McMorrin	1102		1	1	250	250	14.9		0.065046	
McTeggart	109	1	1	1	67	67	13.9	3	0.082492	
Meecham	1410	3	3	1	342	342	14.2	4	0.386667	
Mehan	705	3	3	0.5	244	244	14.7	2	0.026858	
Mehan	704	3	3	0.5	243	244	14.7	2	0.012833	
Meleval	208	1	1	1	74	74	15.6	4	0.22929	
Melfort	1502	2	2	0.5	428	429	12.9	5	0.123926	
Melfort	1504	2	2	0.5	429	429	12.9	5	0.104016	
Melville	705	3	3	1	214	214	13.5	3	0.067144	
Mendham	410	1	1	1	231	231	14.4	6	0.172612	
Mennon	1507	2	2	1	404	404	13.4	2	0.072150	
Meota	1806	2	2	1	468	468	13.9	2	0.192308	
Mend	1106	2	2	1	292	292	14.5	2	0.079585	
Mervin	1808	2	2	1	498	498	13.5	3	0.197947	
Meyronne	208	1	1	0.5	74	75	15.2	6	0.131857	
Meyronne	302	1	1	0.5	75	75	15.2	6	0.169121	
Midele	106	1	1	1	38	38	13.6	3	0.14038	
Mikado	704	2	2	1	273	273	12.4	6	0.121912	
Milden	1007	1	1	1	286	286	14.4	4	0.230019	
Milestone	203	1	1	1	99	99	13.9	6	0.336834	
Milerdale	1108	3	3	0.5	319	319	15.2	2	0.078125	
Milerdale	1109	3	3	0.5	320	319	15.2	2	0.089338	
Mitchellton	205	2	2	0.5	101	102	15.0	3	0.076174	
Mitchellton	206	2	2	0.5	102	102	15.0	3	0.072027	
Mondou	1002	1	1	0.5	257	228	15.6	1	0.021586	
Mondou	1003	1	1	0.5	228	228	15.6	1	0.080789	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Montmarie	603	2	2	1	126	126	13.5	4	0.190807	
Moose Jaw	501	1	1	1	161	161	14.3	3	0.308854	
Moosemin	601	1	1	1	121	121	14.0	4	0.236590	
Moreland	202	2	2	1	69	69	14.8	1	0.086007	
Morse	507	1	1	1	175	165	15.1	7	0.467041	
Mortlack	502	1	1	1	163	163	14.4	5	0.331138	
Moseley	1408	2	2	1	370	370	12.6	3	0.194274	
Mosebank (b)	206	6	6	1	102	102	15.1	4	0.20268	
Mozart	1402	1	1	1	307	307	13.5	4	0.205456	
Muenster	1406	2	2	0.5	369	370	12.5	3	0.034722	
Muenster	1408	2	2	0.5	370	370	12.5	3	0.086912	
Muscow	602	3	3	1	167	167	13.9	1	0.081967	
Naicam	1406	1	1	0.5	368	368	12.0	5	0.0625	
Naicam	1406	1	1	0.5	368	368	12.0	5	0.0625	
Nasberry	1502	2	2	1	428	428	12.2	3	0.174233	
Neelby	602	1	1	1	124	124	14.3	2	0.076433	
Neely	1410	3	3	1	342	342	14.1	1	0.083333	
Nedpath	401		2	0.5	136	136	15.3		0.053706	
Nedpath	401		2	0.5	136	136	15.3		0.053706	
Neiburg	1609		1	0.5	440	442	13.2		0.127451	
Neiburg	1610		1	0.5	442	442	13.2		0.080946	
Neptune	108	1	1	1	38	38	13.9	1	0.061268	
Netherhi	1105	2	2	1	289	289	14.0	3	0.211149	
Nesdorf	702	1	1	1	185	185	14.0	3	0.128882	
Neville	304	1	1	0.5	106	106	14.5	5	0.124365	
Neville	304	1	1	0.5	107	106	14.5	5	0.124365	
Nipawin	1508		1	0.5	468	467	11.1		0.130435	
Nipawin	1508		1	0.5	467	467	11.1		0.130435	
Nokomis (b)	810	8	8	1	280	280	14.4	3	0.365079	
Nora	1405		1	1	367	367	11.2		0.028708	
Normanton	1306	3	3	1	346	345	14.2	1	0.054845	
Norquay	708	2	2	0.5	303	333	11.9	5	0.154335	
Norquay	708	2	2	0.5	333	333	11.9	5	0.154335	
North Battleford	1605	2	2	1	437	437	14.1	2	0.140127	
North Portal	104	1	1	1	4	4	14.4	1	0.052434	
Nottingham	101	1	1	1	32	32	13.6	1	0.034562	
Nut Mountain	1405	2	2	0.5	366	336	11.8	2	0.026708	
Nut Mountain	1405	2	2	0.5	336	336	11.8	2	0.026708	
Oakshels	602	1	1	1	154	154	15.1	2	0.070064	
Oban	1307	3	3	0.5	347	347	14.3	1	0.061983	
Oban	1201	3	3	0.5	348	347	14.3	1	0.075	
Odessa	605	2	2	1	127	127	14.6	4	0.302428	
Ogema	202	1	1	1	70	70	14.7	4	0.178218	
Onward	1274	1	1	1	351	351	14.4	2	0.167598	
Orcadia	705	1	1	1	244	244	13.8	2	0.053715	
Orlney	301		1	1	17	17	14.6		0.5	
Ormslon	205		1	1	71	71	15.3		0.053144	
Osege	105	1	1	1	96	96	14.2	4	0.211429	
Oster	1304	2	2	1	374	374	13.6	2	0.135747	
Othon	705	3	3	1	214	214	13.7	3	0.080573	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Outlook	1006	1	1	0.5	285	284	13.6	3	0.047404	
Outlook	908	1	1	0.5	284	284	13.6	3	0.087137	
Outram	106	1	1	1	6	6	14.8	1	0.041288	
Osbow	101	1	1	1	3	3	14.9	2	0.080645	
Paddockwood	1508		2	0.5	520	521	11.8		0.065217	
Paddockwood	1509		2	0.5	521	521	11.8		0.019481	
Palmer	209	2	2	1	103	103	15.1	5	0.285164	
Palo	1206	3	3	1	378	378	13.8	1	0.050378	
Pambrun	304	1	1	1	106	106	14.2	4	0.198662	
Pangman	202	1	1	1	69	69	14.4	3	0.136964	
Parkbeg	502	1	1	1	163	163	14.8	3	0.105589	
Parkman	103	2	2	0.5	92	61	13.9	1	0.028382	
Parkman	102	2	2	0.5	61	61	13.9	1	0.017878	
Parkside	1510	2	2	1	464	464	12.3	3	0.162679	
Perry	203	2	2	0.5	99	99	14.6	2	0.053313	
Perry	202	2	2	0.5	99	99	14.6	2	0.057756	
Pascal	1803	1	1	1	525	525	12.7	1	0.088235	
Pashwegun	1405	2	2	1	337	337	13.4	1	0.022323	
Pasqua	501	1	1	1	161	161	14.4	1	0.034317	
Pathlow	1504	2	2	1	429	429	12.7	5	0.159629	
Patrick	802	1	1	1	217	217	13.9	1	0.068306	
Pattie	809	3	3	1	180	180	13.7	1	0.057748	
Paynton	1807	2	2	1	439	439	13.4	2	0.263158	
Pelly	707	2	2	1	301	301	12.4	5	0.164645	
Penloll	1102		1	1	259	259	14.5		0.055046	
Pennant	405	1	1	1	168	168	15.0	5	0.454545	
Pense	609	1	1	1	180	180	14.0	4	0.27719	
Penzance	504	1	1	1	221	221	14.4	4	0.16	
Perceval	802	1	1	0.5	154	153	13.8	1	0.011485	
Perceval	802	1	1	0.5	153	153	13.8	1	0.011485	
Perdue	1306	1	1	1	346	346	14.3	4	0.23786	
Peterson	1409	3	3	1	371	371	13.9	4	0.15896	
Phppen	1209	1	1	1	409	409	13.8	3	0.262657	
Piepot	409	1	1	1	110	110	14.0	4	0.173732	
Pinkham	1106	2	2	1	291	291	14.5	3	0.144718	
Pinkie	607	1	1	1	159	159	14.4	1	0.037135	
Pitman	608	1	1	1	130	130	14.3	2	0.053239	
Plassey	906	1	1	1	312	312	14.4	1	0.05923	
Plato	1101	2	2	1	258	258	14.4	6	0.205817	
Plasent Dale	1406	1	1	1	398	398	11.5	3	0.073529	
Plenty	1108	1	1	1	319	319	14.7	4	0.304688	
Plunkett	1409	1	1	1	341	341	13.9	3	0.151734	
Pollock's Siding	705	3	3	0.5	244	244	14.1	1	0.013429	
Pollock's Siding	704	3	3	0.5	243	244	14.1	1	0.006416	
Porteik	303	1	1	1	76	76	14.8	6	0.403633	
Portiles	1508		1	1	487	487	11.1		0.130435	
Portneve	408	1	1	1	230	230	14.6	4	0.272517	
Poyser	1210	2	3	1	410	410	13.5	1	0.04644	Rail line uncertain

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Prescottville	710	2	2	1	334	334	12.4	4	0.214559	
Preble	410	1	1	1	231	231	14.8	9	0.283084	
Pringle	1207	1	1	1	382	382	14.2	4	0.188129	
Prince	1806	2	2	1	468	468	13.2	3	0.597902	
Prince Albert (b)	1508	10	10	1	461	461	12.0	3	0.142857	
Prongue	1805	3	3	1	438	438	13.5	2	0.152886	
Prudhomme (Howell)	1310	2	2	0.5	372	372	14.6	4	0.151855	
Prudhomme (Howell)	1409	2	2	0.5	371	372	14.6	4	0.098286	
Purnichy	804	3	3	0.5	248	278	13.9	3	0.081818	
Purnichy	804	3	3	0.5	278	278	13.9	3	0.081818	
Pym	1008	2	2	1	287	287	14.3	1	0.054237	
Quill Lake	1404	2	2	1	338	338	12.9	5	0.262143	
Quinton	804	3	3	1	278	278	14.3	2	0.163636	
Qu'Appelle	804	1	1	1	157	157	14.4	4	0.125272	
Radeson	1801	2	2	1	405	405	13.6	5	0.359173	
Radville	108	2	2	1	38	38	14.5	2	0.12035	
Ralph	109	1	1	1	67	67	14.3	2	0.048986	
Rama	710	2	2	1	305	305	12.2	2	0.057471	
Ravenscrag	309	1	1	1	50	50	14.0	2	0.086957	
Raymore	804	3	3	0.5	278	278	14.3	5	0.136364	
Raymore	809	3	3	0.5	279	278	14.3	5	0.167785	
Readlyn	205	1	1	0.5	71	71	15.0	3	0.075288	
Readlyn	206	1	1	0.5	72	71	15.0	3	0.071189	
Red Deer Hill	1509	3	3	1	461	461	12.7	1	0.038961	
Red Jacket	801	1	1	1	122	122	14.1	1	0.055453	
Redberry	1803	2	2	1	435	435	13.4	1	0.088235	
Redvers	102	1	1	1	61	61	14.2	2	0.097735	
Redford	1206	3	3	1	379	379	14.0	1	0.050378	Listed as Redford in 1925-26 list.
Regina (b)	807	6	6	1	159	159	14.7	4	0.161273	Made exception here and counted as one market since single location (e.g. could be more than one mile apart.)
Regate	1405		1	1	397	397	13.6		0.019139	
Ransom	909	1	1	0.5	312	312	14.1	3	0.083781	
Ransom	905	1	1	0.5	281	312	14.1	3	0.120885	
Revenue	1210	1	1	1	380	380	14.2	4	0.178019	
Rhein	704	2	2	1	243	243	13.8	6	0.112074	
Riceton	806	3	3	1	128	128	14.0	4	0.260198	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Richard	1804	2	2	1	436	436	13.0	4	0.116944	
Richardson	607	1	1	1	158	158	14.1	2	0.058355	
Richlea	1102	2	2	1	259	259	14.6	5	0.293578	
Richmond (Richmond)	409		1	1	172	172	15.1		0.044475	Ignore station named Richmond Richmond in 25-26 is Richmond d in 26-27.
Ridgedale	1501	2	2	1	457	457	11.6	5	0.183215	
Ridpath	1101	2	2	0.5	288	288	14.3	1	0.033557	
Ridpath	1008	2	2	0.5	287	288	14.3	1	0.030508	
Richie	201	2	2	1	40	40	15.4	1	0.075567	
Riverhurst	510	3	3	1	224	224	15.0	5	0.329308	
Robbart	310	1	1	1	51	51	14.4	4	0.327731	
Rocaville	601	1	1	1	151	151	13.8	4	0.212569	
Roche Perce	104	1	1	0.5	4	4	13.2	1	0.008989	
Roche Perce	106	1	1	0.5	5	4	13.2	1	0.009909	
Rockhaven	1807	1	1	0.5	439	439	14.3	3	0.091533	
Rockhaven	1209	1	1	0.5	409	439	14.3	3	0.152381	
Rokeby	704	1	1	0.5	213	243	14.4	2	0.019249	
Rokeby	704	1	1	0.5	243	243	14.4	2	0.019249	
Romance	1404	2	1	1	339	339	12.9	1	0.046261	Should have always been CP acc. to map. Error in elev. list?
Rose Valley	1405		1	1	367	367	11.6		0.066986	
Rosetown North	1008	1	1	1	287	287	14.4	1	0.040678	This one is the mill, although consoloda ted with Rosetown in the 1925 list, we kept it separate as it is more than one mile from Rosetown.

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Rosetown (b)	1008	6	6	1	287	287	14.4	6	0.257627	The actual listed capacity is an extra 30,000 in 1925, since Rosetown north was consolidated into this listing in 1925
Rosetham	1507	2	2	1	403	403	13.6	5	0.196031	
Rouleau	608	1	1	1	130	130	14.2	5	0.256433	
Rowat	607	3	3	1	159	159	13.6	3	0.095491	
Rowletta	505	3	3	1	191	191	14.7	2	0.13289	
Ruddell	1804	2	2	1	406	406	14.2	4	0.093043	
Runcimen	1501		1	1	457	457	11.1		0.035461	
Runnymede	707	2	2	1	271	271	13.7	4	0.168977	
Rush Lake	401	1	1	1	186	186	15.2	5	0.120301	
Rutan	1410	3	3	1	342	342	14.2	2	0.213333	
Ruthida	1202	3	3	0.5	349	349	14.0	2	0.148341	
Ruthida	1107	3	3	0.5	318	349	14.0	2	0.098039	
Rutland	1207	1	1	1	411	411	13.7	2	0.087719	
Ryerson	103	2	2	0.5	92	91	14.4	1	0.028362	
Ryerson	103	2	2	0.5	91	91	14.4	1	0.028362	
Saltcoats	704	1	1	1	213	213	13.5	5	0.074858	
Saller	1206		3	1	378	378	14.0		0.050378	
Salvador	1208	1	1	1	381	381	14.0	5	1	
Sanctuary	1003	1	1	0.5	228	257	14.9	2	0.219231	
Sanctuary	1002	1	1	0.5	257	257	14.9	2	0.058618	
Saskatoon	1304	1	1	1	344	344	15.2	2	0.085973	
Sceptre	408	1	1	1	230	230	14.8	6	0.438798	
Scotsguard	307	1	1	1	108	108	14.7	5	0.59322	
Scott	1210	3	3	0.5	380	380	14.6	2	0.04644	
Scott	1206	3	3	0.5	379	380	14.6	2	0.050378	
Scottsburg	401		2	1	135	135	14.5		0.051557	
Secretan	503	1	1	1	164	164	15.3	1	0.048682	
Sedley	805	1	1	1	127	127	14.4	4	0.271523	
Semans	809	3	3	1	279	279	14.4	6	0.496844	
Senale	310	1	1	0.5	52	52	14.7	2	0.084034	
Senale	310	1	1	0.5	22	52	14.7	2	0.084034	
Serlec	1207	1	1	1	411	411	13.8	3	0.131579	
Shackleton	407	1	1	1	229	229	15.2	5	0.209877	
Shamrock	503		1	1	134	134	14.9		0.148045	
Shaunavon	305	1	1	1	78	78	15.0	7	0.386275	
Sheho	708	1	1	1	275	275	13.1	3	0.126761	
Shellbrook	1509	2	2	1	483	483	12.0	5	0.233786	
Sidewood	406	1	1	0.5	140	110	14.4	2	1	
Sidewood	409	1	1	0.5	110	110	14.4	2	0.031272	
Sidmar	607	3	3	1	159	159	14.3	1	0.126525	
Ston	806	1	1	0.5	220	219	14.9	2	0.086614	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Siton	805	1	1	0.5	219	219	14.9	2	0.078125	
Silver Park	1406	1	1	0.5	398	428	11.2	1	0.036785	
Silver Park	1502	1	1	0.5	428	428	11.2	1	0.055215	
Simpson	905	1	1	1	281	281	14.3	5	0.463104	
Sinnett	1404	1	1	1	339	339	13.4	1	0.046261	
Sinkakuta	604	1	1	1	156	156	14.2	4	0.130719	
Smales (Holder)	906	2	2	1	282	282	15.2	2	0.277136	Was Holder in 1923 e.l but '80 Gazetteer lists change
Smiley	1110	3	3	0.5	321	321	14.4	3	0.089901	
Smiley	1106	3	3	0.5	291	321	14.4	3	0.065123	
Snipe Lake	1102	2	2	1	259	259	14.8	4	0.201835	
Souris River	101	3	3	1	3	3	14.6	1	0.034562	
Southey	803	1	1	0.5	218	218	14.6	5	0.2026	
Southey	805	1	1	0.5	219	218	14.6	5	0.265625	
Southfork	308	1	1	1	79	79	14.3	3	0.389585	
Sovereign	1008	1	1	1	287	287	14.6	5	0.244068	
Spalding	1406	1	1	1	368	368	11.9	3	0.073529	
Speers	1804	2	2	1	436	436	13.6	4	0.122066	
Spring Valley	205	2	2	1	101	101	15.0	3	0.207263	
Springside	705	1	1	1	244	244	13.8	4	0.113897	
Springwater	1201	3	3	1	348	348	13.9	4	0.625	
Spruce lake	1808	2	2	0.333	501	499	12.7	2	0.029326	
Spruce lake	1808	2	2	0.333	529	499	12.7	2	0.029326	
Spruce lake	1808	2	2	0.333	409	499	12.7	2	0.029326	
Spy Hill	701	3	3	1	152	152	13.7	2	0.080214	
Stalwart	901	1	1	1	251	251	14.1	4	0.391517	
Star City	1502	2	2	1	428	428	11.2	6	0.333742	
Steelman	104	3	3	1	34	34	14.7	2	0.089888	
Steicam	609	1	1	1	180	180	14.3	2	0.12512	
Stenen	708	2	2	0.5	333	333	12.8	5	0.172492	
Stenen	708	2	2	0.5	303	333	12.8	5	0.172492	
Steppes	102	1	1	1	83	83	13.2	1	0.035757	WIN plus atlas places between manor and earlyie
Stockholm	701	1	1	1	183	183	14.0	3	0.100267	
Stony Beach	809	3	3	1	180	180	13.9	2	0.115496	
Stomoway	704	2	2	1	243	243	13.2	5	0.070581	
Storhoken	101	1	1	1	31	31	14.1	2	0.083364	
Stoughton	107	1	1	1	85	85	13.8	4	0.230375	
Stranraer	1107	1	1	1	318	318	14.2	4	0.375817	
Strasbourg	806	1	1	1	220	220	14.5	6	0.607874	
Strong Siding	907	2	2	1	283	283	15.0	2	0.23816	
Strongfield	904	1	1	1	254	254	14.8	4	0.205829	
Sturdee	704	2	2	1	243	243	14.3	2	0.03836	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Sturge	710	2	2	1	334	334	12.3	3	0.220307	
St. Bowell	503	2	2	0.25	134	105	15.1	5	0.058824	
St. Bowell	401	2	2	0.25	135	105	15.1	5	0.031148	
St. Bowell	302	2	2	0.25	105	105	15.1	5	0.088884	
St. Bowell	210	2	2	0.25	104	105	15.1	5	0.063236	
St. Brieux	1406	2	2	1	389	389	11.7	4	0.151144	
St. Gregor	1406	2	2	1	389	389	12.6	3	0.073529	
St. Louis	1506	3	3	1	431	431	13.1	1	0.036585	Note: divided from 461 by ferry.
St. Walburg	1808	2	2	1	531	531	12.4	1	0.043988	
Success	403	1	1	0.5	167	168	14.7	5	1	
Success	405	1	1	0.5	168	168	14.7	5	0.207792	
Summerberry	604	1	1	1	155	155	14.3	3	0.107843	
Superb	1110	1	1	0.5	321	321	14.1	3	0.093407	
Superb	1204	1	1	0.5	351	321	14.1	3	0.118715	
Surblon	1006	2	2	1	285	285	14.9	1	0.100628	
Sutherland	1304	1	1	1	344	344	14.0	2	0.124434	
Swanson	1302	2	2	1	315	315	13.2	3	0.280241	
Swift Current	402	1	1	1	137	137	14.5	6	0.28754	
Swinburne	1210		1	1	410	410	14.2		0.082879	
Sylvana	1501	1	1	1	427	427	11.0	2	0.106383	
Tadmor	709	2	2	1	304	304	13.0	2	0.152323	
Tako	1210	3	3	0.333	380	380	14.2	2	0.03096	
Tako	1209	3	3	0.333	409	380	14.2	2	0.07619	
Tako	1210	3	3	0.333	410	380	14.2	2	0.03096	
Tallman	1804	2	2	1	436	436	13.9	2	0.088289	
Talmage	109	3	3	0.5	97	67	14.2	2	0.032644	
Talmage	109	3	3	0.5	67	67	14.2	2	0.032644	
Tartallan	801	1	1	0.5	151	152	13.8	2	0.046211	
Tartallan	701	1	1	0.5	152	152	13.8	2	0.033422	
Tatagwa	109	1	1	1	67	67	13.3	1	0.032644	
Tate	809	3	3	1	279	279	14.2	4	0.268456	
Tatefield	1807	3	3	1	439	439	13.3	2	0.1373	
Tessier	1010	2	2	1	317	317	14.4	5	0.685185	
Thackeray	1209	1	1	1	409	409	13.9	1	0.114286	
Theodore	706	1	1	1	275	275	13.3	5	0.176056	
Thrasher	1008	1	1	0.5	287	287	15.0	1	0.020338	
Thrasher	1002	1	1	0.5	257	287	15.0	1	0.018511	
Tichfield	1004	2	2	1	255	255	14.7	2	0.173913	
Tiney	501	2	2	1	131	131	14.6	2	0.082361	
Tiny	709	2	2	1	304	304	13.0	2	0.083778	
Tiedale	1501	2	2	1	427	427	11.1	6	0.219858	
Togo	707	2	2	1	271	271	13.4	5	0.194974	
Tompkins	404	1	1	1	139	139	14.1	7	0.216885	
Tonkin	704	2	2	1	243	243	13.9	2	0.034221	
Torquay	106	1	1	1	6	6	14.4	3	0.209744	
Totnes	1102		1	0.5	259	258	14.2		0.027523	
Totnes	1101		1	0.5	258	258	14.2		0.022371	
Tramping Lake	1210	1	1	0.5	380	360	14.3	4	0.085139	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
TrampingLake	1203	1	1	0.5	350	350	14.3	4	0.216963	
Trayner	1206	1	1	1	378	378	14.2	2	0.100756	
Tregarva	610	1	1	1	189	189	14.3	2	0.27027	
Trewdale	503		1	1	134	134	14.5		0.146045	
Tribune	108	1	1	0.5	37	7	14.4	3	0.101751	
Tribune	108	1	1	0.5	7	7	14.4	3	0.101751	
Troeschke	109	1	1	1	68	68	14.0	1	0.032644	
Truett	203	2	2	1	100	100	15.1	3	0.156893	
Tuberoae	1003	1	1	0.333	228	228	15.2	3	0.146154	
Tuberoae	1002	1	1	0.333	257	228	15.2	3	0.039079	
Tuberoae	1002	1	1	0.333	227	228	15.2	3	0.039079	
Tuffnel	1401	1	1	0.5	276	276	13.5	2	0.235294	
Tuffnel	1402	1	1	0.5	306	276	13.5	2	0.053239	
Tugaste	509	1	1	1	223	223	14.8	5	0.18984	
Tullis	1004	2	2	1	255	255	15.0	2	0.173913	
Turtelford	1808	2	2	1	499	439	13.2	2	0.080645	
Tuxford	505	1	1	0.5	191	191	14.3	4	0.168328	
Tuxford	501	1	1	0.5	191	191	14.3	4	0.104324	
Tyner	1003		2	1	228	228	14.7		0.136462	
Tyvan	108	1	1	1	97	97	14.3	5	0.161045	
Undora	810	3	3	1	280	280	13.6	1	0.095238	
Unity (a)	1210	3	3	1	410	410	14.3	4	0.178019	
Unity(a)	1210	1	1	1	410	410	14.3	3	0.092879	
Unwin	1610		1	0.5	472	442	13.2		0.03736	
Unwin	1610		1	0.5	442	442	13.2		0.03736	
Uren	503	1	1	1	164	164	14.2	2	0.089248	
Val Marie	301		1	1	17	17	14.7		0.25	
Valeport	805	1	1	0.5	219	219	14.3	1	0.036352	
Valeport	610	1	1	0.5	189	219	14.3	1	0.060611	
Valjean	503	1	1	1	164	164	15.4	1	0.046682	
Valor	207	1	1	1	73	73	15.7	3	0.257113	
Valperasso	1502	2	2	0.5	428	428	11.2	4	0.110429	
Valperasso	1501	2	2	0.5	427	428	11.2	4	0.106383	
Vance	1307	1	1	1	347	347	13.7	1	0.123967	
Vandura	103	2	2	1	93	93	13.7	1	0.047304	
Vanguard	304	1	1	1	106	106	15.0	6	0.301184	
Vanscoy	1305	2	2	1	345	345	13.4	4	0.303865	
Vantage	209	1	1	1	103	103	15.2	3	0.235067	
Vaun	1808	2	2	1	489	489	13.5	2	0.117302	
Venn	1407	3	3	0.5	310	280	13.9	3	0.114088	
Venn	810	3	3	0.5	280	280	13.9	3	0.142857	
Vera	1210	3	3	1	410	410	13.6	1	0.092879	
Veregin	704	2	2	1	273	273	12.8	6	0.198909	
Venulam	1203	1	1	1	350	350	14.4	2	0.244576	
Verwood	204	1	1	0.5	42	71	15.5	5	0.705882	
Verwood	205	1	1	0.5	71	71	15.5	5	0.127547	
Vibank	605	2	2	1	127	127	14.0	2	0.1786	
Viceroy	205	1	1	1	71	71	15.5	3	0.150576	
Vidors	310	1	1	1	51	51	14.7	3	0.252101	
Viewfield	107	3	3	0.5	65	35	13.4	2	0.051195	

Table D7: Variables by Shipping Point

NAME	PTSUB	R23	R25	RECWT	MUNREC	MUN1	PROTEIN	ELEV23	ELSBWT 25	NOTES
Viewfield	104	3	3	0.5	36	36	13.4	2	0.044944	
Viola	810		3	1	280	280	15.5		0.095238	Source: Wt N
Vincourt	1409	1	1	1	341	341	14.1	5	0.216763	
Vogel	401		1	1	135	135	15.0		0.077336	
Vonda	1310	2	2	1	372	372	14.4	5	0.348803	
Wadena (b)	1405	4	6	1	337	337	13.1	2	0.114833	
Wakarusa	1506	3	3	0.5	402	401	13.8	6	0.106707	
Wakarusa	1506	3	3	0.5	401	401	13.6	6	0.106707	
Waldeck	401	1	1	1	186	186	14.6	5	0.154672	
Waldheim	1507	2	2	1	404	404	13.3	2	0.114251	
Waldron	702	3	3	0.5	184	184	14.0	3	0.089876	
Waldron	705	3	3	0.5	214	184	14.0	3	0.040286	
Walleriaville	1108		2	1	319	319	14.1		0.078125	
Walpole	103	1	1	1	92	92	13.9	1	0.047304	
Wapella	801	1	1	1	122	122	13.7	5	0.180388	
Warrens	1101	2	2	1	258	258	15.0	2	0.089485	
Waseca	1809	2	2	1	471	471	13.2	3	0.236294	
Watrous	909	3	3	1	312	312	14.3	3	0.240889	
Watson	1404	2	2	0.5	338	338	12.7	4	0.101773	
Watson	1406	2	2	0.5	368	338	12.7	4	0.053922	
Wauchope	102	1	1	1	61	61	14.2	3	0.065554	
Wawota	103	1	1	0.5	92	93	14.2	2	0.056764	
Wawota	103	1	1	0.5	93	93	14.2	2	0.056764	
Webb	404	1	1	1	138	138	13.9	7	0.222102	
Weldon	1504	2	2	1	459	459	12.3	4	0.139032	
Welmyn	801	1	1	0.5	121	121	14.2	3	0.073937	
Welmyn	801	1	1	0.5	151	121	14.2	3	0.073937	
Westham	410	1	1	1	231	231	15.3	3	0.065512	
Weyburn	109	1	1	1	67	67	13.9	6	0.244831	
Wheatstone	205		1	0.5	71	70	15.0		0.026572	
Wheatstone	202		1	0.5	70	70	15.0		0.024752	
White Bear	1003		2	1	228	228	14.9		0.276923	
Whitewood	802	1	1	1	153	153	13.7	3	0.101911	
Whitome	1502	2	2	0.5	428	428	13.1	3	0.082025	
Whitome	1503	2	2	0.5	458	428	13.1	3	0.254237	
Wilbert (Path)	1807	1	1	1	439	439	14.1	1	0.1373	
Wilcox	808	1	1	1	129	129	14.2	6	0.259085	
Willie	1208	1	1	0.5	379	409	13.6	2	0.073048	
Willie	1209	1	1	0.5	409	409	13.6	2	0.185714	
Willmar	104	2	2	1	34	34	13.8	2	0.127341	
Willowbrook	705	2	2	1	244	244	13.7	5	0.134288	
Willows	206	1	1	1	72	72	15.4	3	0.150754	
Wimmer	1404	2	2	1	338	338	12.0	2	0.082521	
Windthorst	802	1	1	0.5	124	125	14.4	3	0.08051	
Windthorst	803	1	1	0.5	125	125	14.4	3	0.082384	
Winro	804	1	1	1	156	156	14.4	1	0.038126	
Winter	1207	3	3	1	411	411	13.6	1	0.04386	
Winton	1007	2	2	1	286	286	14.9	6	0.37037	
Wiley	1102		2	1	259	259	14.9		0.055046	
Wille	1208	1	1	1	379	379	14.0	1	0.050378	

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Abbey		1		5	1				180
Aberdeen		1		6	1				211
Aberfeldy				1					30
Abernethy		1		5	1				143
Adair				1					25
Adams				1					30
Adams				1					30
Adenac	1	1		3	1				81
Admiral		1		5	1				153
Aikine				1					25
Aikow				1					28
Alameda				3					90
Alameda				3					90
Alida				2					55
Allen				5		1			180
Allen				5		1			180
Alzak		1		5	1				178
Amazon		1		3	1				90
Ambassador				2		1			60
Amsterdam				2					85
Amulet				2					55
Anarley				2					66
Anaroid		1		6	1	1			233
Angia		1		3	1				93
Antelope		1		4	1				118
Artler				3					78
Archerhill				2	1		1		60
Archive		1		1	1				30
Archydai				1					30
Arcole				5					117
Ardath		1		4	1				130
Ardath		1		4	1				130
Ardill		1		3	1				88
Argo		1		2	1				60
Arma Siding				1					30
Armley				2	1				60
Arran				4					147
Arran				4					147
Artland				1					30
Asquith (a)				1					30
Asquith(a)				2					45
Asquith(a)				2					45
Assinibois		1		6	1				170
Assinibois		1		6	1				170
Aslum				1					30
Atwater				2					60

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Ava				1					30
Avonhurst				2					85
Avonlea		1		4	1				115
Axford				1					28
Aylesbury				5		1			184
Baldon		1		1	1				30
Belcemes (b)	0	0	0	6	1	0	0	0	175
Baldwinton (Baldwin)				2	1				80
Belgonie				4		1			141
Beloi				1					30
Bengor		1		3	1				90
Barbour				1					30
Baring				1					30
Barnes				1					30
Bateman		1		3	1				95
Battleford			1	1					20
Bellrum		1		4	1				130
Bayard Station				2					80
Bayard Station				2					80
Beadle		1		3	1				90
Bear Creek				1					30
Bear Creek				1					30
Beatty				5	1				170
Beaufield	1			2			1		80
Bechard		1		3	1				90
Bechard		1		3	1				90
Beechy		1		3	1				90
Belbeck				1					55
Belle Plains				3					77
Bellwood (Dendron)				1					30
Bemersyde				1			1		30
Bemersyde				1			1		30
Bender				2					55
Bengough		1		4	1				130
Benson		1		2	1				80
Betalock				1					30
Bethune		1		4	1				120
Beverley		1		4	1				120
Bickeligh				1			1		30
Bienfait				1					25
Bienfait				1					25
Bigger (a)		1		2	1				80
Bigger(a)				2		1			82
Birch Hills		1		5	1				225
Birdview (Donovan)				4		1			152
Birmingham				2					80
Bisay		1		3	1				90
Bladworth		1		5	1				170
Bladworth		1		5	1				170
Blain Lake		1		6	1				213
Blucher				3		1			92

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Blumenhof		1		5	1				148
Boham				2		1			95
Boham				2		1			95
Booth Siding				1	1				30
Borden		1		6	1	1			218
Bounty				4		1			125
Bracken				3	1				90
Brade				1					30
Braddock		1		2	1				60
Bradwell		1		4	1				120
Brancopeth				3			1		95
Brafton		1		2	1				58
Bredenbury	1			3			1		95
Breeze				1					30
Bremen				2					60
Bresaylor				1					30
Bresaylor				1					30
Brewer				2					60
Bridgford				3					85
Bridgford				3					85
Briercrest		1		3	1				120
Briercrest		1		3	1				120
Brightmore				1					30
Briarlin Siding				1					30
Broadacres		1		3	1				90
Broadview		1		2	1				52
Brock		1		3	1				85
Brodemick				6		1			192
Bromhead				3					68
Brooking		1		2	1				60
Brooking		1		2	1				60
Brooksby		1		5	1				220
Brora				1					30
Brora				1					30
Brough		1		1	1				30
Browning		1		3	1				90
Brownlee		1		4	1				115
Brownlee		1		4	1				115
Bruno				5		1			174
Bryant				1					30
Buchanan				5		1			215
Buylee				3		1			97
Burdick		1		1	1				30
Bures				1	1				30
Bures				1	1				30
Burges				2					55
Burges				2					55
Burrows				1					24
Burrows				1					24
Burstall				5		1		1	150
Butress				1	1				30

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Cabri		1		9	1	1			298
Cadillac		1		5	1				153
Calder		1		4	1				140
Cana				2					55
Candiac				3			1		125
Cando				2					30
Canora (b)	0	0	0	7	0	1	0	0	203
Canora (b)	0	0	0	7	0	1	0	0	203
Canora (b)	0	0	0	7	0	1	0	0	203
Canora (b)	0	0	0	7	0	1	0	0	203
Canuar		1		3	1				91
Canuck				3	1				85
Canwood		1		4	1				180
Cardell				2				2	60
Canevale				3					67
Canevale				3					67
Carlton		1		3	1				90
Carlyle (b)	0	1	0	3	1	0	0	0	91
Carmel		1		4	1				130
Carmichael		1		5	1				148
Carmichael		1		5	1				148
Carmuff			1	4					127
Caron				3					90
Carruthers	1			2			1	1	60
Cavaler		1		1	1				30
Cavell				2					50
Cedoux		1		2	1				60
Cespee				2	1				60
Cespee				2	1				60
Central Butte		1		4	1				120
Ceylon		1		3	1				65
Chamberlain				3	1				82
Chambers		1		1		1			30
Chaplin				4					120
Charlton	1			1			1		30
Cheviot				2					65
Chippierfield				1			1		30
Chrysler				1					30
Churchbridge				3					97
Claire				3	1				95
Clarkboro				1					25
Clarkboro				1					25
Cleavel				2					51
Claybank				1					30
Claybank				1					30
Claydon				1					30
Cleaves		1		2	1				60
Clemens		1		3	1				90
Climax		1		5	1				145
Clean				2					60
Clonmel	1			2			1		60

Table D8: Variables by Shipping Point

NAME	UGQ25	COOP25	UNL25	ELEV25	COOP25	POOL25	UGQ25	UNL25	ELCAP25
Codomo				4	1				120
Codette				4	1				125
Coleville				4		1			122
Collax		1		3	1				90
Colgate		1		2					55
Colmar				1					30
Colony		1		3	1				85
Condie				1					36
Congress		1		4	1				115
Congress		1		4	1				115
Conquest		1		3	1				100
Consul				2					80
Coppen				4		1			135
Corinne				3					95
Corinne				3					95
Corning				2			1		80
Cory	1			2			1		80
Cole				2					80
Court				1					30
Craig		1		6		1			229
Crane Alley				1	1				30
Craven (b)	0	0	0	2	1	0	0	0	65
Craven (b)	0	0	0	2	1	0	0	0	65
Creechman		1		4	1				130
Crestwynd				2					80
Crestwynd				2					80
Crichton				3					90
Crooked River				1					30
Crooked River				1					30
Cross				2				1	80
Cruwell				1					30
Cudworth		1		6	1				180
Cudworth		1		6	1				180
Cuper		1		5	1				228
Cut Knife		1		3	1				87
Cynric		1		4	1				113
Dalfoe		1		4	1				120
Dalhousie				1	1				30
Dalmeny	1			2			1		95
Dalzell				1					30
Dana				1					25
Danlon				1			1		30
Daphne				1					30
Darmody		1		3	1				90
Dawson		1		6	1	1			230
Davidson		1		6	1	1			230
Dawn				2					50
Davin				2					50
Davis				1					20
Daylesford				2					40
Debden				3					90

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Debden				3					90
Deborah				1					30
Deborah				1					30
Delele	1			5			1		175
Delmas				1					40
Demaine		1		3	1				90
Demaine		1		3	1				90
Denholm		1		3	1				97
Denholm		1		3	1				97
Denzil	1			5			1		143
Demic				2					60
Demic				2					60
Deveron				1					30
Dewar Lake		1		3	1				90
Dewar Lake		1		3	1				90
Diana Siding				2					60
Dilke	1			3			1		85
Dinsmore		1		6	1				130
Disley				3		1			92
Disley				3		1			92
Dixon Siding				1					30
Doddsland				3		1			92
Dollard		1		5	1				145
Domremy		1		5	1				190
Donwell				2					105
Doonside		1		1	1				30
Downe				1					30
Drake		1		3	1				85
Drinkwater				4					107
Drinkwater				4					107
Driver				2					60
Druid		1		2	1				55
Dubuc				4		1			117
Duck Lake				1					25
Duff				3					100
Dulwich				2			1		60
Dulwich				2			1		60
Dumas				1					30
Dummer		1		3	1				90
Dummer		1		3	1				90
Dunblane				4		1			135
Dundum		1		3	1				125
Dunelm				2					60
Dunfermline				1					30
Dunfermline				1					30
Dunkirk		1		2	1				60
Dunkirk		1		2	1				60
Dunkirk		1		2	1				60
Dunkirk		1		2	1				60
Duro				1					28
Duvai		1		6	1	1			167

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Dysart		1		4	1				110
D'arcy				3		1			80
D'arcy				3		1			80
Earl Grey		1		4	1				135
Eastend		1		5	1				150
Eastend		1		5	1				150
Eastview		1		1	1				30
Eastview		1		1	1				30
Estonia		1		3	1				90
Ebenezer				3					90
Ebenezer				3					90
Echo Lake (Layco)				1	1				20
Echo (Loomis)				2					60
Edam		1		3	1				142
Edenwold		1		3	1				90
Edgeley				3		1			92
Edgeworth				1	1				30
Elbow		1		4	1				120
Elcott				1					30
Eldersley				3			1		115
Eldred				1					30
Elfrs		1		4	1				130
Elrose		1		5	1			1	187
Elstow		1		4	1				120
Engen Siding				1					25
Englefield				3					115
Englefield				3					115
Enn				2					60
Ermine				1					30
Emfold		1		4	1				120
Esk				2					60
Eskbank				3	1				90
Esterhazy				4				1	118
Estevan		1		5	1				143
Estlin		1		4	1				130
Eston		1		5	1				140
Estuary		1		3	1				90
Etlington				2					60
Evesham	1			4			1		120
Expense		1		2	1				55
Eyrle		1		5	1				146
Eyre				1					30
Farholme				1	1				30
Fairlight (a)				1					25
Fairlight (a)				1					25
Fairlight(a)		1		2	1				60
Fairlight(a)		1		2	1				60
Farmount		1		3	1				97
Fenton				2			1		55
Fenton				2			1		55
Fenwood				3					90

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Fertile				1					30
Felding		1		3	1				107
Filmore		1		5	1				149
Findlater	1			3			1		85
Finnie				2					80
Finnie				2					80
Fishing Lake				1	1				20
Fiske		1		2	1				57
Flecombe		1	1	4	1			1	118
Fleming				3					90
Fleming									90
Floral		1		1	1				30
Foam Lake		1	1	7	1			1	195
Foam Lake		1	1	7	1			1	195
Fonahill				2				1	115
Forgan				4					140
Forget				4		1			113
Forslund				1					30
Fort Qu'Appelle				2		1			60
Fortune		1		2	1				70
Foston				2			1		80
Francis		1		4	1				113
Franklake				1					30
Freemont				1			1		30
Frobisher				3					88
Frobisher				3					88
Frontier		1		5	1				145
Froude				2					55
Frys				2			1		57
Fueller	1			3			1		90
Games				1	1				30
Games				1	1				30
Gainsboro				4					105
Galilee				2			1		30
Gallivan	1			2			1		60
Gascoigne				1					30
Gerald		1		2	1				60
Gibbs				2	1				50
Gillespie				1					30
Gilroy				4					115
Girvin		1		5	1				164
Glenie		1		3	1				90
Glenavon				2					60
Glen Ewen				4					135
Glen Ewen				4					135
Glenavon	1			3			1		82
Glenaside		1		5	1				138
Glidden		1		4	1				130
Golburn				1	1				30
Goodeve				4					125
Goodwater				2	1				55

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Gorliz				2					55
Gorliz				2					55
Gouverneur				4					125
Gouverneur				4					125
Govan		1		5	1	1			174
Goverlock				1					30
Grand Coulee				3					116
Grandora				2					60
Gravelbourg		1	1	9	1	1			307
Gray		1		4	1				120
Gray		1		4	1				120
Grayburn				2					55
Grayson				4		1			127
Greenan				2					60
Greene		1		2	1				60
Greene		1		2	1				60
Grenfell			1	6		1		1	189
Griffin (b)	0	1	0	2	1	0	0	0	55
Guemsey		1		4	1				103
Guemsey		1		4	1				103
Gull Lake		1		8	1	1			252
Gull Lake		1		8	1	1			252
Gumworth	1			2			1		65
Hafford		1		3	1				115
Hague				4					112
Hague				4					112
Halbrite		1		2	1				60
Hallonquist		1		3	1				90
Hallonquist		1		3	1				90
Hamin				2		1			62
Hamton				3					140
Handel	1			3			1		90
Handsworth				2	1		1		60
Hanley		1		7	1	1			210
Hardy				3		1			92
Harold (Edfield)				1	1				20
Harris		1		6	1	1			257
Hartwell				1	1				30
Hassan				1					30
Hassan				1					30
Helfield				1					35
Helton		1		5	1			2	180
Helton		1		5	1			2	180
Haultain				1					45
Haultain				1					45
Hawarden		1		6	1				171
Hawoods				1					30
Hawthorne (Inchkeith)				2			1		77
Hazelcliff		1		1	1				25
Hazenmore		1		6	1				188
Heame		1		2	1				60

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Hendon				2			1		70
Henribourg				2	1		1		80
Hepburn	1			3			1		85
Herbert		1		6	1				185
Herbert		1		6	1				185
Herschel		1		4	1				131
Heward				3					78
Highgate				1					32
Highgate				1					32
Hirsch				1					35
Hitchcock				2					62
Hodgeville		1		4	1				125
Hoey		1		4	1				125
Holbein				2					80
Holdfast	1			4			1		115
Hoosier				2					80
Hoosier				2					80
Horizon				3					90
Horizon				3					90
Horizon				3					90
Hubbard				3					90
Hubbard				3					90
Hughton				5					155
Humboldt		1		4	1				110
Huntoon		1		2	1				80
Huntoon		1		2	1				80
Hyas	1			4			1		140
Hyas	1			4			1		140
Ibeen				2					80
Imperial		1		5	1				147
Imperial		1		5	1				147
Indi		1		2	1				80
Indian Head				7		1			222
Innes				1					30
Insinger				2					80
Inetow		1		4	1				120
Invermay				2					80
Isham				1	1				30
Ituna		1		4	1				120
Jameson				1					25
Jensen		1		3	1				85
Jesman				2					80
Juniata		1		2	1				60
Juniper				2	1				62
Kamsack				6					337
Kandahar		1		3	1				85
Kayville				1	1				30
Kedleston		1		2	1				55
Kedleston		1		2	1				55
Keeler		1		4	1				120
Kelfield		1		3	1				85

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Kellher		1		4	1				115
Kelso		1		1	1				25
Kelstern				3	1				90
Kelstern				3	1				90
Kelvington		1		5	1				150
Kenaston		1		5	1				143
Kenaston		1		5	1				143
Kendal	1			3			1		112
Kennedy		1		2	1				51
Keppel				1					30
Keppel				1					30
Kerobert				3		1			93
Kerobert				3		1			93
Kessock				1					30
Kessock				1					30
Ketchen				2					55
Keystown		1		2	1				80
Khadive				2					60
Kilaley				3					79
Kilaley				3					79
Kilwinning				1					30
Kircaid		1		7	1				213
Kincorth		1		2	1			1	80
Kindersley		1		5	1				155
Kingsford				1					25
Kingsford				1					25
Kinhop				2		1			75
Kinistrino		1		6	1				255
Kinley (a)				3		1		1	92
Kinley (b)		1		3	1				90
Kipling				2					75
Ksby				5		1			142
Kronau		1		4	1				115
Kronau		1		4	1				115
Krydor				3					90
Kuroki				1					35
Kyle				4	1				120
Kylemore		1		2	1				130
Lac Vert		1		4	1				120
Lacadena				1	1				30
LaFleche		1		7	1	1			242
Laird	1			3			1		155
Laird	1			3			1		155
Lagord				5		1			148
Lake Valley				2					60
Lampman		1		2	1				85
Lancor		1		5	1				148
Landis		1		3	1				90
Landis		1		3	1				90
Landscape		1		2	1				55
Lang				6		1			283

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Langbank				1					45
Langbank				1					45
Langenburg	1			4			1		140
Langenburg	1			4			1		140
Langham		1		4	1				123
Langlan				3					98
Laporte		1		3	1				90
Lashburn		1		5	1				213
Laura		1		4	1				120
Laura		1		4	1				120
Lawson		1		4	1				120
Leacross				1	1				30
Leader				4					120
Leask		1		4	1				180
Lebret				1					30
Leckford				2	1				80
Leckford				2	1				80
Leipzig		1		4	1	1			142
Lemberg				5					163
Lemsford		1		4	1				125
Leney		1		4	1				130
Lenore Lake		1		5	1				195
Lenore Lake		1		5	1				155
Leoherd				2					80
Leoherd				2					80
Lerose				2					80
Leroy		1		3	1				90
Leslie		1		4	1				130
Leslie		1		4	1				130
Lestock		1		4	1				120
Leff				1			1		30
Leurvan		1		4	1				130
Liberty		1		4	1				113
Lilac				2	1				82
Lilac				2	1				82
Limerick				6		1			210
Lintlaw				3					105
Lipsitt		1		4	1				155
Lipton		1		4	1				111
Livelong				1	1				30
Lloydminster		1		5	1				140
Lockwood		1		3	1				85
Loreburn		1		5	1				145
Lorlie				3					90
Lovett (Kegworth, Rgw.)				1					25
Lovema		1		3	1				100
Lucky Lake		1		4	1				125
Lumsden				2					55
Lurgan				1	1				30
Luseland		1		6	1	1			179
Lydden (Duperow)		1		2	1				80

Table D8: Variables by Shipping Point

NAME	UGG25	COOP25	UNL25	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
MacDowall				1					25
MacDowall				1					25
Macklin		1		3			1		98
MacNutt				3					147
Macoun				3					85
Macorie		1		2	1				80
Madison		1		6	1				180
Maidstone		1		4	1				175
Meir				1					30
Mejor				3					85
Mejor				3					85
Menor				4					112
Mentario		1		2	1				80
Maple Creek		1		5	1				180
Marcelin		1		5	1				180
Marcelin		1		5	1				180
March Well				2					80
Marengo				3					90
Margo				2					80
Markinch		1		4	1				140
Marquis				5	1				138
Marsden				4			1		120
Marshall		1		4	1				145
Maryfield (b)	0	1	0	2	1	0	0	0	55
Masefield				1	1				30
Matador				2					85
Mawer		1		4	1				120
Maxim				2					53
Maymont		1		4	1				162
McLeod				5		1			189
McGee		1		2	1				80
McKague				2	1		1		80
McKim (Peoples)				2					80
McLean				1					22
McMahon		1		3	1				90
McMorrison				1	1				30
McTaggart				3					85
Meecham				5	1				145
Mehan				2				1	80
Mehan				2				1	80
Melval				5		1			155
Mellort		1		5	1				202
Mellort		1		5	1				202
Melville				3					75
Mendham		1		5	1				150
Mennon				2					80
Meola		1		2	1				55
Merd				2					55
Mervin				3					135
Meyronne		1		6	1				178
Meyronne		1		6	1				178

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Midele				3					85
Mikado				6					285
Miden		1		4	1				118
Milestone				7		1			221
Millersdale				2					80
Millersdale				2					80
Mitchellton		1		3	1				86
Mitchellton		1		3	1				86
Mondou				1					35
Mondou				1					35
Montmartre	1			4			1		110
Moose Jaw				3				1	225
Moosomin		1	1	4	1				128
Moreland				1					40
Morse		1		8	1				210
Mortlack		1		5	1				176
Moseley				3					95
Mossbank (b)	0	0	0	4	0	1	0	0	121
Mozart		1		4	1				116
Muenster		1		3	1				85
Muenster		1		3	1				85
Muscow				1					30
Naicam		1		5	1				153
Naicam		1		5	1				153
Naisberry				3					142
Neelby				2					80
Neely				1					35
Neidpath				4	1				125
Neidpath				4	1				125
Neilburg				4			1		130
Neilburg				4			1		130
Neptune				1					28
Neithal		1		3	1				125
Neudorf				3					83
Neville		1		5	1				147
Neville		1		5	1				147
Nipawin				2	1				80
Nipawin				2	1				80
Nokomis (b)	0	0	0	4	1	0	0	0	115
Nora				1	1				30
Normanton		1		1	1				30
Norquay	1			5			1		170
Norquay	1			5			1		170
North Battleford				2					55
North Portal				1					35
Nottingham				1					30
Nul Mountain				2					80
Nul Mountain				2					80
Oakshale				2					55
Oban		1		1	1				30
Oban		1		1	1				30

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Odessa				5		1			137
Ogema		1		4	1				108
Onward	1			2			1		80
Orcadia				2					80
Orlney				2	1				80
Orriston				1	1				30
Osege		1		4	1				111
Oster				2					80
Otthon		1		3	1				90
Outlook			1	2					63
Outlook			1	2					63
Outram				1					25
Oxbow				2					70
Paddockwood				1	1				30
Paddockwood				1	1				30
Palmer		1		5	1				148
Palo				1		1			30
Pambrun		1		4	1				118
Pangman				3					83
Parlbeg		1		3	1				88
Parlman				1					30
Parlman				1					30
Partside		1		3	1				102
Pary		1		2	1				70
Pary		1		2	1				70
Pascal				1					30
Pashvegin				1					25
Pasqua				1					25
Pathlow		1		5	1				155
Patrick				1					25
Pattee				1					30
Paynton		1		2	1				115
Pelly	1			5			1		190
Penolt				1	1				30
Pennart		1		5	1				175
Pense				5	1				144
Penzance		1		4	1				112
Percival		1		1	1				18
Percival		1		1	1				18
Perdue		1		4	1				130
Peterson				4				1	110
Phappen	1			3			1		89
Piapot		1		4	1				125
Perkham		1		3	1				100
Pinkie				1					35
Pitman				2					80
Plasey		1		1	1				30
Plato		1		5	1				138
Pleasant Dale				3	1				90
Plenty		1		4	1				117
Plunkett		1		3	1				105

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Pollock's Siding				1					30
Pollock's Siding				1					30
Porteix		1		6	1				200
Portlines				1	1				30
Portneve		1		4	1				118
Poyser				1					30
Preecsville		1		4	1				112
Prelate				8		1			246
Primate		1		4	1				115
Prince		1		3	1				171
Prince Albert (b)	0	0	1	3	0	1	0	1	110
Prongus	1			2			1		60
Prudhomme (Howell)		1		4	1				136
Prudhomme (Howell)		1		4	1				136
Punnichy		1		3	1				90
Punnichy		1		3	1				90
Pym				1					40
Quill Lake				5	1				170
Quntion				3		1			90
Qu'Appelle				4					115
Radeson		1	1	5	1				139
Radville		1		2	1				55
Ralph			1	2					45
Rama				1					30
Ravenecrag				2					60
Raymore		1		5	1				150
Raymore		1		5	1				150
Reedlyn		1		4	1				85
Reedlyn		1		4	1				85
Red Deer Hill				1					30
Red Jacket				1					30
Redberry				1					30
Redvers				3			1		82
Reford				1					30
Regna (b)	0	0	1	5	0	0	0	1	152
Reigale				1	1				20
Renown				3		1			95
Renown				3		1			95
Revenue		1		4	1				115
Rhein				6					262
Ricston		1		4	1				118
Richard		1		4	1				137
Richardson				2					55
Richies		1		5	1				160
Richmond (Richmond)				1		1			32
Ridgedale		1		5	1				155
Ridpath				1					45
Ridpath				1					45
Rilche				1					30
Riverhurst		1		4	1				150
Robart				4		1			117

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Rocaville		1		4	1				115
Roche Perce				1					12
Roche Perce				1					12
Rockhaven		1		3	1				80
Rockhaven		1		3	1				80
Rokeby				2					90
Rokeby				2					90
Romance				1	1				30
Rose Valley				2			1		70
Rosetown North		1		1	1				30
Rosetown (b)	0	1	0	6	1	0	0	0	190
Rosthem		1		5	1				163
Rouleau				6		1			289
Rowat				3	1				90
Rowlette		1		2	1				60
Ruddell		1	1	4	1			1	109
Runciman				1	1				30
Runnymede				4					195
Rush Lake		1		5	1				140
Rutan		1		2	1				80
Ruthilda				2					60
Ruthilda				2					60
Rutland	1			2			1		60
Ryerson		1		1	1				30
Ryerson		1		1	1				30
Sailcoats	1			5			1		175
Saller				1			1		30
Salvador		1		5	1				140
Sanctuary		1		3	1				95
Sanctuary		1		3	1				95
Saskatoon				2					38
Sceptre		1		3	1				190
Scotsguard				6	1				175
Scott		1		2	1				60
Scott		1		2	1				60
Scottsburg				2	1				60
Secretan				1					30
Sedley		1		4	1				123
Semans		1		7	1	1			222
Senale		1		2	1			1	60
Senale		1		2	1			1	60
Seriac		1		3	1				90
Shackleton		1		5	1				153
Shamrock				3	1				90
Shaunavon		1		8	1	1			265
Shoho				3					90
Shellbrook		1		5	1				180
Sidewood				2					45
Sidewood				2					45
Sidmer				1					25
Silton		1		2	1				55

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Siton		1		2	1				55
Silver Park				3	1				90
Silver Park				3	1				90
Simpson		1		6	1	1			182
Sinnett				1					30
Sokolus				4					120
Smiles (holder)				2	1				60
Smiley		1		3	1				90
Smiley		1		3	1				90
Sripe Lake		1		4	1				110
Souris River				1					30
Southey		1		6	1	1			187
Southey		1		6	1	1			187
Southfork		1		3	1				85
Sovereign		1		4	1				180
Spalding		1		3	1				90
Speers		1		4	1				143
Spring Valley				4		1			117
Springside		1		4	1				127
Springwater		1		4	1				125
Spruce lake				2					60
Spruce lake				2					60
Spruce lake				2					60
Spy Hill		1		2	1				60
Stalwart		1		4	1				120
Star City		1		6	1				272
Steelman				2					60
Stelcam				2					65
Stenen	1			5			1		190
Stenen	1			5			1		190
Steppes				1					30
Stockholm		1		3	1				75
Stony Beach				2	1				60
Stormway	1		1	4			1		165
Storhols				2					55
Stoughton				5		1			135
Stranraer				4		1			115
Strasbourg		1		6	1	1			193
Strong Siding				3	1				88
Strongfield		1		4	1				113
Sturdee				2				1	65
Sturgis	1			3			1		115
St. Bowell		1		5	1				145
St. Bowell		1		5	1				145
St. Bowell		1		5	1				145
St. Bowell		1		5	1				145
St. Breaux				4					185
St. Gregor		1		3	1				90
St. Louis				1					30
St. Walburg				1					30
Success		1		5	1	1			160

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Success		1		5	1	1			180
Summerberry				3					99
Superb		1		3	1				85
Superb		1		3	1				85
Surblon		1		1	1				87
Sutherland		1		2	1				55
Swanson		1		3	1				108
Swift Current				4		1			180
Swinburne				2			1		80
Sylvania		1		3	1				90
Tadmor				2					100
Tako		1		2	1				80
Tako		1		2	1				80
Tako		1		2	1				80
Tallman				2					80
Talmage		1		2	1				80
Talmage		1		2	1				80
Tantalion		1		2	1				50
Tantalion		1		2	1				50
Tatagwa				1					30
Tate		1		4	1				120
Tatefield				2				1	80
Tesler		1		5	1				185
Thackeray		1		1	1				30
Theodore		1		4	1				125
Thrasher		1		1	1				30
Thrasher		1		1	1				30
Tichfield				2					80
Tilney		1		2	1				80
Tiny				2					55
Tisdale		1		6	1			1	186
Togo				5					225
Tomplins		1		7	1				200
Tonkun				2					80
Torquay				4		1			127
Totnes				1	1				30
Totnes				1	1				30
TrampingLake		1		1	1				110
TrampingLake		1		1	1				110
Trayner	1			4	1				80
Tregarva		1		2	1				80
Treardale				3	1				90
Tribune				3					93
Tribune				3					93
Trossachs				1					30
Trux		1		3	1				103
Tuberosa		1		3	1				95
Tuberosa		1		3	1				95
Tuberosa		1		3	1				95
Tuffnel				2					80
Tuffnel				2					80

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Tugnots		1		5	1				142
Tullis				2					80
Turtelford		1		2	1				55
Tusford				4					152
Tusford				4					152
Tyner				1	1				30
Tyven		1		5	1				148
Undora				4	1				30
Unuly (a)		1		4	1				115
Unuly(a)				2					80
Unwin				2			1		80
Unwin				2			1		80
Uron				2		1			55
Val Marie				1	1				30
Valeport				1					27
Valeport				1					27
Valjean		1		1	1				30
Valor				4		1			122
Valparaiso				5			1		180
Valparaiso				5			1		180
Vance				1					30
Vandura				1					25
Vanguard		1		6	1				178
Vancovy		1		4	1				145
Vantage				4		1			122
Vawn		1		2	1				80
Venn		1		3	1				90
Venn		1		3	1				90
Vera				2	1				80
Veregen				6		1			465
Verulam		1		2	1				82
Venwood		1		5	1				144
Venwood		1		5	1				144
Vibank				5	1				80
Viceroy		1		3	1				85
Vidors		1		3	1				90
Viewfield				2					80
Viewfield				2					80
Viola				1	1				30
Viscount		1		5	1				150
Vogel				3	1				90
Vonda		1		5	1				156
Wadens (b)	0	0	0	4	1	0	0	1	120
Wakaw		1		6	1				175
Wakaw		1		6	1				175
Waldeck		1		5	1				180
Waldhorn		1		3	1				95
Waldron		1		3	1				90
Waldror		1		3	1				90
Wallsville				1	1				30
Walpole				1					25

Table D8: Variables by Shipping Point

NAME	UGG23	COOP23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Wapelle				4					103
Warline				2					80
Waseca		1		4	1				120
Watrous				4		1			122
Watson		1		4	1				132
Watson		1		4	1				132
Wauchoy 3			1	2					55
Wawota		1		2	1				80
Wawota		1		2	1				80
Webb		1		7	1				205
Weldon		1		4	1				135
Welwyn				3					80
Welwyn				3					80
Westerham				3				1	83
Weyburn				7		1			225
Wheatstone				1	1				30
Wheatstone				1	1				30
White Bear				2	1				80
Whitewood				3					80
Whitome		1		3	1				150
Whitome		1		3	1				150
Wilbert (Path)		1		2	1				80
Wilcox				7		1			292
Wilke	1			2			1		87
Wilke	1			2			1		87
Wilmar		1		2	1				85
Willowbrook		1		5	1				150
Willows		1		3	1				90
Wimmer				2					80
Windhorst	1			3			1		95
Windhorst	1			3			1		95
Winro				1					35
Winter				1					30
Wiseton		1		6	1				190
Witley				1	1				30
Wolfe	1			1			1		30
Wolsley				4					98
Wolverine		1		2	1				80
Wolverne		1		2	1				80
Woodley (Sander)				1					30
Woodrow		1		6	1				190
Worcester (Ranton)		1		2	1				80
Wordsworth		1		2	1				80
Wroxton		1		4	1				161
Wymerk		1		5	1				150
Wynyard		1		5	1				145
Xena				1					35
Yarbo				2	1				80
Yellow Grass				5		1			174
Yeoman				1					28
Yonker				1					30

Table D8: Variables by Shipping Point

NAME	UGG23	COOF23	UNL23	ELEV25	COOP25	POOL25	UGG25	UNL25	ELCAP25
Yorlon			1	6				1	180
Young (b)	0	1	0	5	1	1	0	0	152
Young's Siding				2				1	60
Young's Siding				2				1	60
Zaelandia		1		5	1				170
Zaelandia		1		5	1				170
Zehner		1		2	1				60
Zelma		1		4	1				120
Zeneta				1					30
Douei									
Factoria Siding				1					40

Volume II

ESTIMATION OF AGRICULTURAL SUPPLY PRICE FROM PRICE OF TRADED QUOTAS; IMPLICATIONS FOR WELFARE IMPACT OF MARKETING BOARDS AND COMPETITIVENESS UNDER TRADE LIBERALISATION

Abstract

Canadian agricultural marketing boards often limit production through producer quota. The estimation of agricultural supply price under these output restrictions is important for estimating the welfare impact of supply restrictions, and for assessing the viability of agricultural sectors in the event of trade liberalization. This paper addresses the issue of estimating supply price using the example of Ontario milk production. The paper reviews and refines the theoretical relationship between supply price and the observed market value of production quota. Past estimates of supply price derived from quota are then examined and compared to the theoretical model. It is found that past studies have not correctly accounted for undiversifiable risk to holding quota, including risk of changes in the political regime, or tax benefits. As a result, some of the principal estimates of the welfare losses from Canadian marketing boards are inaccurate. A review of casual empirical evidence indicates that these studies have led to an over-estimate of supply price and an under-estimate of welfare losses. An alternative approach to estimation of supply price is suggested for regimes where both "used" and "unused" quota are traded. This approach is developed into an empirical model and applied to the case of Ontario industrial milk. Supply price in this case is estimated to be only 58.4% of farm price, supporting the suggestion that past estimates of supply price have been too high. The estimated supply price is also found to be less than comparable U.S. milk prices over the same time period, suggesting that Ontario milk production would be a viable sector under liberalised trade in agricultural products.

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ESTIMATION OF AGRICULTURAL SUPPLY PRICE FROM PRICE OF TRADED QUOTAS; IMPLICATIONS FOR WELFARE IMPACT OF MARKETING BOARDS COMPETITIVENESS UNDER TRADE LIBERALISATION

Marketing boards have been an enduring feature of agricultural policy in Canada. Their contribution to economic welfare has been subject to continuing debate.

Marketing boards stabilize price and restrict farm output through the use of quotas. The restriction of farm output is usually thought to impose a welfare cost. A typical method for estimating this welfare cost has been to impute a Marshallian deadweight loss from an observed farm price, an

Figure 1: Marshallian Welfare Impact of Supply Restriction

an observed farm price, an estimated supply price, and estimates of the elasticity of the demand and supply curves.¹

Figure 1 illustrates this approach. (P_e, Q_e) are the welfare maximizing price and quantity.

The shaded area is the Marshallian deadweight loss from a quota restriction to Q_r . The

¹ For example, Veeman (1982). Veeman estimates short run costs of poultry marketing board by deriving a supply price from quota values, and assuming linear demand and supply curves (i.e. as in Figure 1). A range of estimates are developed based on assumed elasticities. Veeman's long run impacts incorporate shifts in the short-run supply curves, but still employ the same basic methodology. She also develops alternative estimates by comparison with U.S. prices.

bigger the gap between farm price and supply price, the larger is the welfare loss. Since farm price is directly observable, the issue is the measurement of the supply price. The supply price may also be termed the marginal cost to the industry at the quota level of output.

One source of data for estimating supply price is the observed market price of quota. Some regulatory regimes permit farmers to buy and sell their quota rights in an open market.² The greater the gap between the supply price and farm price of the product, the more farmers are willing to pay for the right to produce.

International trade negotiations have raised additional reasons for wanting reliable estimates of agricultural supply price. General Agreement on Tariffs and Trade (GATT) negotiations, and continuing trade negotiations surrounding the North American Free Trade Agreement, all raise the possibility of opening Canadian agricultural markets to foreign competition. At present, Canadian dairy and poultry producers are protected from imports by import quota, freeing the marketing boards to pursue independent domestic pricing policies. An important policy question in the event of open agriculture trade is: Can Canadian agricultural producers produce at a price that would be competitive with unrestricted imports? The domestic supply price is an important indicator for this question. Clearly, if the domestic supply price is below potential import prices, then the viability of current domestic agricultural production would be assured. Concern for the

² The Ontario Milk Marketing Board (OMMB) is the example used in this paper.

loss of domestic production arises to the extent that domestic supply price exceeds potential import prices.

This paper examines the estimation of supply price from quota value data. Section one reviews and refines the theoretical relationship between the capitalized price of a quota and the supply price of the product. It is found that there are significant difficulties in applying the standard approach. In particular, one must account for the presence of "policy risk", non-diversifiable risk, and tax benefits. If these factors are significant, then estimation problems ensue. Section two examines past estimates of agricultural supply price and welfare impacts of Canadian marketing boards for dairy and poultry. It is found that some past studies, particularly of poultry, have neglected one or more of these factors and are potentially inaccurate. Examination of casual empirical evidence in section three suggests that the net inaccuracy has been to overestimate supply price and underestimate the welfare costs of output restrictions.

Section four seeks a solution to the problem of deriving supply price from observed quota values. A method of estimation is proposed based on price differences between "used" and "unused" quota. Section five applies this method to the case of the Ontario Milk Marketing Board (OMMB). Ontario accounts for approximately one third of Canada's milk production.³ The model is estimated in section six for the sample period 1982/83 to 1989/90. Mean estimates and confidence intervals are reported for supply price in each

³ In 1988/89, Ontario farm milk sales accounted for 25.1 million hectolitres out of a national total of 74.9 million hectolitres. *Facts and Figures at a Glance; 1989*, Dairy Farmers of Canada.

year of the sample, and a supply price ex ante of year to year transitory factors. These estimates are then examined for their implications for previous estimates of supply price and welfare impacts of supply restrictions by Canadian Marketing Boards. Section seven compares the estimated supply price for Ontario milk to U.S. prices, and analyzes the implications for the viability of Ontario and Canadian milk production under liberalized trade in agricultural products. Findings are summarized in section eight.

1.0 ESTIMATING SUPPLY PRICE FROM THE CAPITALIZED PRICE OF QUOTA

1.1 Cost function estimates vs. quota value estimates

There are two approaches to estimating supply price. One is to estimate a farm cost function from available cost data. The other is to estimate the supply price implied by the price of quota rights.

A significant disadvantage of the cost function approach is the interpretation of cost data. In addition to the usual problems in using accounts data, such as adjusting historical costs to reflect opportunity cost, there may also be potential bias in the data. The most extensive sources of data may be those which are developed by marketing boards themselves to govern their price setting. For example, the Ontario Milk Marketing Board (OMMB) sponsors the Ontario Dairy Farm Accounting Project (ODFAP). Pricing policy

for "fluid" milk is guided by cost estimates based on the 75% most efficient producers reported through ODFAP.⁴ Since pricing policy is intended to give farmers a "fair" return, there is the concern that the cost data may eliminate gaps between farm price and supply price by the assumptions employed in calculation.

This paper uses the alternative approach, imputing a supply price from the observed market value of quota rights.

The market value of quota is a convenient data source, since a positive value is *a priori* evidence that returns to farm production under the marketing board are above normal. If quota output were set at a welfare maximizing level (Q_c in Figure 1), and if farmers were permitted to freely trade quota among themselves, then the farm price would equal supply price and farmers would not be willing to pay for acquiring additional quota.⁵ The market value of quota would be zero. If quota production is restricted to less than Q_c , then a gap opens between farm price and supply price, representing the above normal profit that the average farmer will receive from acquiring an additional unit of quota.

Estimates of supply price developed from quota market values are useful both as independent estimates, and as a check upon cost function based estimates.

⁴ Ontario milk is sold on a price discriminated basis. "Fluid" milk refers to milk sold for direct table consumption and is regulated by the province. The pricing of "industrial milk" is affected by federally sponsored inter-provincial agreements.

⁵ Also assuming that the marketing board sets price at a market clearing level consistent with the quota it has set.

1.2 What do we wish to measure? Seeking a supply price independent of transitory factors.

Agricultural costs are heavily influenced by transitory factors such as weather, length of growing season, conditions of harvest, etc. When evaluating the welfare cost of supply restrictions, or the viability of an agricultural sector, we do not wish our estimates to be overly influenced by the transitory factors of a particular year. For example, if harvest conditions are good for feed crops in a particular year, then dairy feed quality will be higher, and milk production costs will be lower. An estimate of supply price based on data from that year would overestimate the longer run welfare impact of supply restrictions.

Therefore, we define two supply prices. Let MC be the supply price in a particular year, ex post of the revelation of transitory factors governing a given crop year's cost conditions. Let (MCX) represent the expected supply price ex ante of transitory cost factors. We are most interested in estimating (MCX) .

To narrow the focus of enquiry, we will also define our objective as the supply price given the current institutional framework of supply management. The issue of whether the supply curve would be lower (or higher) without marketing boards will not be addressed in this paper. In this context, the elimination of supply restrictions does not necessarily mean the elimination of supply management. A supply management regime

might relax output restrictions to average market clearing levels (Q_c in Figure 1), but maintain its price stabilization and management activities. If it is believed that elimination of supply management would lower farm costs, then the methodologies explored in this paper will over-estimate supply price, and lead to a conservative estimate of welfare losses and viability in the face of import competition. We regard the question of supply restriction and the question of supply management as separate.

For convenience, unless otherwise specified, it will also be assumed that one unit of quota is the right to produce one unit of output per year.

1.3 Using the Capital Asset Pricing Model to Estimate Supply Price

Although quota rights are nominally the property of the state, some marketing boards permit the purchase and sale of these rights. For example, an Ontario milk producer may buy or sell the right to produce "x" litres of milk annually. "x" may be any number, provided the buyer is qualified and does not exceed the total size limit that the OMMB places on farms. Monthly computer auctions are organized by the OMMB to facilitate trade in these rights. The policy of other marketing boards in Canada varies by jurisdiction, but the OMMB is not alone in allowing explicit sale and purchase.⁶

⁶ See Barichello (1987) for a compendium of Canadian practices.

Out of such auctions, we may observe market determined prices of quota rights. In a competitive market for quota, the price of the quota will be determined by its value to farmers at the margin. The annual return to the farmer from acquiring an additional unit of quota will be difference between farm price and supply price (see Figure 1). The capitalized value of this return over future years is the price farmers are willing to pay for quota.

To extract an estimate of supply price from the price of a quota, capital asset pricing theory may be used. Quota rights are similar to stocks and other securities. Ownership provides a variable income stream over time. An investor's willingness to pay for stock is governed by its current dividend, expected dividend growth, and the riskiness of the dividend. In the standard case, risk is the covariance of the dividend with the average rate of return to the market portfolio. The mean-variance approach to capital asset pricing defines this relationship as

$$\text{Price} = \text{Dividend} / (r + \pi - g) \quad (1.)$$

where *dividend* is the current dividend paid by the asset, *r* is the nominal risk free rate of return available in the market, π is a risk premium, and *g* is the expected rate of growth in the dividend in future years. (1.1) is an extension of the formula for the net present value of a perpetuity. Rate of growth (*g*) will include the expected rate of inflation plus any other anticipated changes in the nominal value of the dividend. Since

nominal interest rate and growth rates will both include inflation, real interest rates and growth rates can also be used for r and g . Risk premium (π) is an allowance for undiversifiable risk only. Where possible, investors will reduce their exposure to riskiness in individual stock returns by diversifying their portfolios. When holdings may be diversified, the impact of stock-specific risks on stock price is reduced, and the risk premium is a function of the covariance of dividends with the average rate of return to the market portfolio (often termed the "beta coefficient" in financial literature).

In the case of quota, the price is observable, but the current "dividends" are not. Instead, the return per year is the difference between observed farm price (P) and unobserved supply price (MCX). Let QV be the market value of the quota right to produce one unit of output per year. Then (1.1) may be written as

$$(P-MCX) = QV(r+\pi+g)$$

or

$$MCX = P - QV(r+\pi+g) \quad (1.2)$$

4

PM-1 3½"x4" PHOTOGRAPHIC MICROCOPY TARGET
NBS 1010a ANSI/ISO #2 EQUIVALENT

PRECISIONSM RESOLUTION TARGETS

Thus, MCX may be estimated by determining the rate of return that farmers require to persuade them to hold quota ($r+\pi-g$), multiply it by the current quota value, and subtract from price. This is a common approach to estimating a supply price.⁷

Estimation of a rate of return for (1.2) presents several problems. Farm price, quota market values, and nominal risk free interest rates are observable. However, the discount rate must account for risk and expected growth ($\pi - g$). In addition, there are also tax considerations. If quota is depreciable on a tax basis, as in Canada, then this will further complicate the relationship between supply price and quota value.

The remainder of this section explores some of the difficulties and adjustments that must be made to (1.2) if it is to provide an accurate estimate of supply price.

1.4 Risk Premium (π)

For tradeable stocks and similar assets, the risk premium is not related to variation in the expected returns paid by the asset, since investors may protect themselves from this form of risk through diversified portfolios.⁸ Instead, the risk premium on such assets is driven

⁷ Arcus (1981), Veeman (1982), and Lerner & Stanbury (1983), are reviewed in the next section.

⁸ Diversification one's portfolio over different asset holdings will even out variation in income from individual sources. However, investors cannot collectively escape the average variation in returns to the market as a whole.

by the portion of risk that cannot be escaped through diversification, the covariance of the rate of return on the asset with average returns to all capital assets. For example, the "beta coefficient" in measurement of stock risk refers to the covariance of an individual stock's returns with average returns to all stocks in the market. Stocks which have a high "beta" will require a high risk premium and command a lower price.

Obtaining an estimate of the covariance of quota ownership returns with average returns to the market is difficult because we do not have direct observation of the annual return to quota ownership. If we had such observations, we would be able to calculate supply price directly.

It has been suggested that the average risk premium of traded stocks be used as a proxy for the risk premium of quota.⁹ There are reasons to expect that risk premium demanded from quota be either higher or lower than this standard.

The risk premium to quota may be lower than the average risk premium to stocks because marketing board efforts to stabilize price may reduce covariance of quota returns with return to other assets in the economy. With an administered product price and the income inelasticity of demand typical of agricultural commodities, revenues to quota may be more stable than revenues to stock. If farm costs vary with market returns, they are likely to

⁹ Lerner & Stanbury (1985) employ average risk premium of U.S. stocks to calculate a discount rate for poultry quota.

vary inversely, with lower real costs during recessionary periods.¹⁹ It is conceivable that quota returns have a negative covariance with market returns, leading to a negative risk premium on quota.

The risk premium to quota may be higher than the average risk premium to stocks if the ability of quota holders to diversify their risk is limited. Farmers' ability to diversify ownership may be limited both by the agency costs of farm ownership, and marketing board regulation. Marketing boards may limit diversification in order to preserve the "family farm". Limited diversification means that the risk premium (π) may incorporate an allowance for the variance in individual farm income. Since farm returns are subject to significant variation according to weather, the impact of limits to diversification on the risk premium may be significant.

Direct estimates of a risk premium for farmers are difficult to obtain, and it is not clear that average risk premiums to other capital assets are an accurate proxy.

There is also an additional source of risk for quota that does not exist for stocks. That is the risk that the quota regime itself may end. If marketing boards are eliminated by government, or change their policy to restrict supply, then quotas may disappear or lose their effective value. This risk will be incorporated in the market value of the quota.

¹⁹ If the recessionary period is a result of deliberate monetary restraint, as has been the case recently, this may not hold. Higher interest rates will have a strong impact on farm costs.

Barichello (1984) terms this source of income uncertainty "policy risk".¹¹ This issue is discussed below.

1.5 Expected Growth (g): Does Policy Risk Matter?

The expected growth rate to quota returns will incorporate concerns unique to quotas. The creation of rents to quota holders is not an explicit goal of marketing board policy. Official pricing policy usually guarantees only a "fair" rate of return to farm operation.

There is always the risk that a change in the political regime will change the level of rents earned by quota. For example, government might find the rents indicated by quota value objectionable and eliminate quota or increase quota controlled output to an efficient level where quota values are negligible. Alternatively, a pro-farmer regime might undertake more restrictive output policies, increasing quota returns. This is "policy risk".

In principle, the impact of policy risk on quota rate of return is no different than the impact of the risk of bankruptcy or low profit on rate of return to share-holding. The impact of these risks on expected rate of return may be incorporated in expected growth rate g , which may be negative if policy risk is high.

¹¹Barichello (1984) is an unpublished conference paper, with extensive analysis of some of the issues treated in this paper. This author is indebted to Barichello (1984) for raising the issues of policy risk and taxation, and for providing empirical evidence acknowledged at other points in this paper.

The significance of policy risk is that observed past rates of growth may not represent expected future growth. Past rates of income growth (or asset value growth) represent the current policy regime. If there is a discrete risk of a change to a more/less favourable regime, then expected growth rate will be more/less than observed growth rates.

To illustrate this point, assume that there is a fixed probability λ in each future period ($t=2, N$) that marketing board program will be terminated outright.¹² Assume that termination of the marketing board means the elimination of quota returns from that period on (i.e. quota becomes worthless). Let the expected income growth rate *conditional on the current policy regime continuing* be g_r . The present value of expected future income from the quota is ¹³

$$QV = (P-MCX) \sum_{t=1}^N (1-\lambda)^{t-1} (1+r+\pi-g_r)^{-t} \quad (1.3)$$

or, for an infinite lifespan

¹²The likelihood of marketing board termination in the current period will usually be known as 1 or 0, since marketing boards would normally announce termination of their program effective the end of their regulatory period or fiscal year.

¹³ Barichello (1984) obtains a different result. Using the notation of this paper and assuming an intention to hold the quota for N periods, Barichello proposes

$$QV = (1-\lambda)(P-MCX) \sum_{t=1}^N (1+r+\pi-g)^{-t} + \lambda QV \sum_{t=1}^N (1+r+\pi-g)^{-t} \quad (A)$$

(A) assumes that after a regime is terminated, it has a $(1-\lambda)$ probability of being reinstated up until period N , and that the original quota holders will retain their previous rights in the reinstated regime, and that farmers recover their current period purchase price in period N . We have difficulty with the last two assumptions. Accepting (A) for an infinite time horizon yields Barichello's

$$QV = [(1-\lambda)(P-MCX)]/[r+\pi+\lambda \cdot g] \quad (B)$$

$$QV = (P-MCX)/[r+\pi+\lambda-g_r] \quad (1.4)$$

Combining (1.1) and (1.4) yields

$$g = g_r - \lambda \quad (1.5)$$

The expected growth rate includes consideration of probability of the termination of the marketing board regime. However, past income growth rates will represent g_r and will overestimate g by λ in this example.

In most cases the probability of termination of a marketing board regime may be negligible (λ approaches zero). Once established, marketing board regimes become firmly entrenched. Policy risk takes the form of upward or downward pressure on quota rents through price and quota policy, or indirectly by requiring farmers to pay a larger/smaller proportion of the cost of supply management programs. The probability of such changes in policy regime introduce the same bias illustrated in (1.5). In general, the value of λ can be either positive or negative.

The probability of any change in policy regime will be incorporated in farmers expected growth rate, but will not necessarily be reflected in past income growth rates of the current regime. Use of past income growth as a proxy for expected income growth can be biased.

It is also possible that the degree of bias is correlated with the level of rents on quota themselves. If we view the rates of return to quota as a political game where the maximum return is equivalent to monopoly rent and the lowest return is zero, then as rents approach maximum under a regime, the down side risk increases relative to the upside risk. In the limit, with quota rents at maximum, rents to the current regime would overstate future expected rents by failing to incorporate the expected future risk. Thus, it is possible that higher rents earned by quota holders may lead to a higher political risk of a negative change in the marketing board regime. If true, it would suggest that farmers apply higher discount rates to quota where the proportionate gap of farm price over supply price is higher.

1.6 Impact of Taxation

Depreciation policy under the tax system can create an added incentive for the purchase of quota. For example, Canadian tax regulations permit a depreciation deduction of a portion of farmer quota holdings.¹⁴

Tax eligibility of quota depreciation has two benefits. First, if the quota regime is maintained, there is the net gain from the ongoing tax deduction. These benefits will be

¹⁴Under Canadian tax law, farm quotas are not a capital cost but are an "eligible capital expenditure". A portion of the purchase price (50% prior to Dec.31 1988, 75% afterwards) is eligible for depreciation. Arthur Andersen & Co. (1991), pg. 209.

reclaimed through capital gains tax if the quota is sold, but the net effect is an interest free loan for the holding period. The second benefit occurs if the marketing board quota program is terminated.¹⁵ The balance of the book value of the quota may be written off. In effect, depreciation allowance provides partial insurance on the continuity of the quota regime.

The tax deduction in the first year will be $(QV\rho/f\theta)$ where ρ is the portion of quota value that may be subject to depreciation allowance, f is the annual percent depreciation allowed, and θ is the marginal tax rate.

The present value of expected tax benefits (T) for holding a unit of quota n periods is the present value of expected savings from deductions, less expected repayment of tax saved in period n , plus expected tax savings in the event quota are terminated before period n .^{16,17}

¹⁵For simplicity, we assume without compensation.

¹⁶Extending Barichello (1984) to account for the proportion of quota eligible for deduction (ρ), the impact of policy risk (δ) on the tax benefit and the unique risk premium (π_k).

¹⁷ It is possible to argue that a risk premium should be included to account for potential future variations in taxation policy. However, the tax system is fairly stable with respect to depreciation. Changes made to the depreciation table are usually neutral in their net impact on holders of previously purchased capital assets. For example, the increase in the proportion of quota that could be depreciated in 1988 was accompanied by a reduction in the rate of depreciation permitted, and a special "gross-up" of current undepreciated balances by existing quota holders. The net result was that the change in rules had no impact on current quota holders. Arthur Anderson & Co. (1991), Pg. 210.

$$\begin{aligned}
T = & QV\rho f\theta [\sum_{t=1}^n (1-\lambda)^{t-1} (1-f)^{t-1} (1+r)^{-t}] \\
& + QV\rho\theta (1-\lambda)^n (1-(1-f)^n) (1+r)^{-n} \\
& + QV\rho\theta\lambda [\sum_{t=1}^n (1-\lambda)^{t-1} (1-f)^{t-1} (1+r)^{-t}]
\end{aligned} \tag{1.6}$$

For estimation purposes, it may be reasonable to assume that farmers purchasing quota intend an infinite quota holding period. The penalty of capital gains and marketing board quota transfer taxes mean that farmers who acquire quota for the long run will do better. The nature of farming also rewards those who stay with their land longer. Farmers who stay with their land longer acquire a knowledge of the specific characteristics of their land and the surrounding micro-climate. They may also internalize externalities related to preservation of the quality of the soil and the farm infrastructure. Farmers who stay in farming for extended periods have a competitive advantage in farming and bidding for quota. They will tend to squeeze out those with only a short term commitment. In addition, the tax system may permit farm families to pass farm operations to succeeding generations without paying capital gains on the quota. As n approaches infinity, (1.6) becomes

$$T = QV\rho\theta(f+\lambda(1-f))(r+\lambda+f-\lambda f)^{-1} \tag{1.7}$$

As discussed previously, the likelihood of a quota regime being terminated outright in any given period (λ) is usually negligible. If we set λ equal to zero, the income stream

represented by the tax deduction becomes become certain, regardless of the state of the economy or the variation in other returns to quota ownership. (1.7) reduces to

$$T = QV\rho\theta f(r+f)^{-1} \quad (1.8)$$

Note that (1.8) can be calculated from observed values. To the extent that the expected holding period is less than infinite, (1.8) will be an overestimate of T .

Adjusting the market value of quota for tax benefits yields

$$QV = (P-MCX) \cdot (r+\pi-g) + T \quad (1.9)$$

or, alternatively

$$QV = (P-MCX) \cdot [x(r+\pi-g)] \quad (1.10)$$

where x is the proportion of quota value generated by returns to farm production.

$$x = (QV-T)/QV \quad (1.11)$$

x is a measure of the tax impact, rising to a value of 1 when the tax impact declines to zero.

Incorporating a tax adjustment into (1.2)

$$MCX = P - QV[x(r+\pi-g)] \quad (1.12)$$

The expression $[x(r+\pi-g)]$ will be referred to as the *tax adjusted rate of return*. That is, the rate of return to quota holding exclusive of tax benefits.

Since x is less than one, the impact of tax deductibility is to increase the supply price (MCX) associated with any given quota value. A less than infinite holding period would reduce the tax benefit, reducing the value of x , causing (1.12) to over estimate MCX . Therefore (1.12) is a conservative estimate of MCX if planned holding periods are finite.

1.7 Assessing the Feasibility of Using the Capital Asset Pricing Model to Estimate Supply Price

Estimation of supply price through (1.12) presents significant problems. The estimate depends on the tax adjusted rate of return $[x(r+\pi-g)]$. As discussed above, tax impacts (x) and the risk free rate of interest (r) may be estimated under reasonable assumptions.

Problems arise estimating the risk premium and the growth rate. The value of $(\pi-g)$ must account for the covariance of quota returns with market returns, the potential impact of limits on farmer ability to diversify, and policy risk. If any of these factors are significant, then the true rate of return will differ from an estimate derived from market rates of interest alone. If undiversifiable risk is significant, or if policy risk is negative, the consequent supply price associated with any given quota market value will be lower.

Since we lack a methodology to estimate policy risk and to measure limits to diversification by farms, obtaining an accurate estimate of supply price from the market value of quota may not be feasible. The next section reviews past estimates of supply price in this light. The subsequent section suggests an alternative approach to deriving estimates from quota value information.

2.0 PAST ESTIMATES OF FARM MARGINAL COST UNDER MARKETING BOARDS

This section reviews past empirical estimates of supply price under Canadian chicken turkey, and dairy marketing boards (based on quota values). The estimates are compared to the requirements for an accurate estimate established above. In the case of poultry, it is found that published estimates have neglected the question of policy risk and one or more of the other factors. The consequence is potential inaccuracy for both the supply

price estimates, and consequent estimates of welfare costs. Dairy estimates using the capital asset pricing model share the same weaknesses. The dairy literature also employs an alternative technique for deriving a supply price based on assumption of a fixed life-span of the quota. This technique produces lower estimates of supply price, but is subject to challenge on the arbitrariness of the selected amortization period.

Each study is evaluated in terms of the rate of return it employs, compared with the tax adjusted rate of return $\{ \lambda(r+\pi-g) \}$ of (1.12).

2.1 Poultry Estimates

Different approaches to estimating (1.12) for poultry marketing boards are represented by Arcus (1981), Veeman (1982), and Lerner & Stanbury (1984). These estimates use variations of (1.12). Each estimate omits considerations for one or more of the risk free rate of interest (r), the growth rate (g), the risk premium (π), or tax effects (λ).

Arcus (1981) examines broilers (chickens) and egg marketing boards.¹⁸ The study was part of a review of the welfare impact of regulation undertaken by the Economic Council of Canada. Arcus (1981) makes the straight forward assumption that the rate of return

¹⁸ Broilers are chickens raised for eating (e.g. roasting). Their production is controlled. "Stewing hens", old egg laying chickens, are marketed separately.

farmers require to persuade them to own quota is equal to the rate of interest at which they can borrow (i.e. rate of return = r). Arcus' method may be represented as

$$MCX = P - QV[r] \quad (2.1)$$

Arcus uses a nominal rate interest rate equal to the chartered banks' prime rate plus 1%, a value of 16% during the study period. This method neglects the impact of inflation on the growth rate of returns and does not allow for either policy risk or undiversifiable risk.¹⁹ These omissions would bias the estimate of supply price upwards. However, the omission of tax benefits has the opposite effect. The net bias in the estimates of welfare losses depend on the relative importance of the risk premium versus the tax impacts. Evidence reviewed in the next section suggests that supply price was over-estimated, and welfare costs underestimated.

Veeman (1982) improves on Arcus' approach by using the real rate of interest as an expected rate of return instead of the nominal rate of interest. Use of the real rate accounts for growth in quota returns due to inflation. Veeman's seminal work on the welfare impact of supply management in eggs, broilers, and turkey offers two sets of estimates for domestic welfare cost.²⁰ One is based on a rate of return to quota equal to

¹⁹ A simple approach would be to use the real rate of interest, or the nominal rate of interest minus inflation. Using the nominal rate of interest alone has the unlikely implication that dividends will be falling at the rate that inflation is rising.

²⁰ Subsequent work improving Veeman's estimates (e.g. Van Kooten & Spriggs (1984)) utilize the same discount factors as Veeman (1982).

the subsidized nominal rate of interest for farm credit, a value of 14% at the time in question. A lower set of estimates is based on rate of return to quota equal to an estimated real rate of interest on farm credit of 8%.²¹ Veeman notes that the 8% is the more appropriate rate. In terms of (1.12), g is set to the rate of inflation while π and x are still omitted (i.e. rate of return is $(r - g)$).

$$MCX = P - QV[r - g] \quad (2.2)$$

By setting an implied value of g equal to inflation, the use of a real rate of interest is theoretically preferable to a nominal rate of interest. However, the continued exclusion of a risk premium (π) leads to too low a rate of return and too high an estimate of supply price. Again the additional omission of tax benefits has the opposite effect, leaving the net result ambiguous.

Lerner & Stanbury (1985) question the absence of a risk premium from earlier studies, principally Veeman (1982).²² Relying on past estimates of returns to United States common stock, they apply an 8% risk premium to quota returns. The 8% is added to a 12% risk free real rate of interest for a total rate of return to quota of 20%. The 12% risk free rate was taken from the nominal return to 3 month treasury bills and an assumption

²¹These estimates assume continued restrictions on imported poultry products. Veeman also offers estimates of the welfare impact if the alternative regime would allow imports at available U.S. prices.

²²Lerner & Stanbury suggest that differences in the discount rate of farmers and taxpayers creates the opportunity for a Pareto improvement if taxpayers buy out farmers quotas and restore competitive agricultural pricing. This topic is outside the scope of discussion here.

of zero expected inflation. In terms of (1.12), π is set at 8% and $(r-g)$ is set at 12%. The tax benefit impact is still omitted. The form of Lerner & Stanbury's estimate may be represented as

$$MCX = P - QV(r+\pi-g) \quad (2.3)$$

Lerner & Stanbury's choice of the risk premium to common stocks as an estimator of the risk premium to quota is somewhat arbitrary. As discussed previously, the risk premium earned by quota may vary from common stock because of price stabilization, limits to portfolio diversification by quota holders, and policy risk.

In general, studies of the welfare impacts of Canadian poultry marketing boards have omitted consideration of policy risk and other forms of risk, resulting in too low an estimated rate of return to quota. The additional omission of tax impacts makes the net result uncertain. There is no study to date providing an estimate which accounts for the impacts of policy risk and tax benefits.

These studies illustrate the difficulty of using the capital asset pricing model to estimate supply price from the market value of a quota. The risk premium is not directly observable, is variable according to political circumstances, and may not be comparable to other securities. The expected growth rate is not necessarily related to past observed earnings growth rates or to the average rate of inflation, since there exists the discrete

future possibility of a shift in policy regime which may not be revealed in the past growth rate under the current marketing board regime.

2.2 Milk Estimates

Estimates of the welfare impact of Canadian milk supply management are fewer, possibly due to the complexity of supply management programs for dairy. In addition to milk quotas, there is a federal subsidy and a levy which finances a variety of surplus disposal programs.

The two principal estimates for dairy are Arcus (1978) and Barichello (1981). Both studies include estimates based on a fixed amortization period, such as five years. The result is a much higher estimate of rate of return to holding quota, with consequently lower estimates of supply price.

Arcus (1978) estimates the rate of return to milk quota in British Columbia in May, 1977, using an aggregate method. He assumes that the farmer requires a rate of return sufficient to amortize the cost of the quota over a fixed period. In his study, Arcus takes the nominal rate of farm credit (9%) and calculates the annual payment necessary to finance the purchase of a unit quota if amortized over 4 and one half years, the maximum amortization period permitted by chartered banks for the financing of quota purchase.

Arcus subtracts this payment from the price of fluid milk to arrive at the marginal cost of milk production. Taking the ratio of the annual payment to the price of the quota, the implied rate of return is 27% annually over 4.5 years. It is assumed that the farmer expects the quota to be worth zero at the end of 4.5 years.

The fixed amortization period method is also applied in Barichello (1981), another of the Economic Council of Canada sponsored works. Barichello examines the welfare cost of dairy regulation, using 1980 quota value data for Ontario and Quebec as a proxy for Canada as a whole. Barichello provides three sets of estimates. One assumes a rate of return to quota equal to the nominal farm credit rate of 12%. The other is based on the required rate of return to amortize the purchase price of quota over 4 years. The rate of return implied by this calculation is 32.9%. The third estimate was based on the mean of the first two (rate of return = $(12+32.9)/2 = 22.5\%$).

Application of the "fixed lifetime" approach bypasses the necessity of identifying the individual components of (1.12), (r, π, g, x) to arrive at an estimate of a rate of return. However, the choice of the length of lifetime is subjective on the part of the researcher. Economic decision makers will develop convenient proxies for profit maximizing conditions, and farmers may indeed use an amortization period as a proxy for determining an acceptable rate of return. However, there is no way of verifying that selected periods, such as bank amortization periods, are the amortization period used by the marginal purchaser of quota.

The short dairy amortization periods employed by Arcus (1978) and Barichello (1981) lead to higher estimates of quota rate of return than those for poultry. We may compare their respective estimated rates of return of 27% and 32.9% to Veeman's 8% and Lerner & Stanbury's 20%. The use of short amortization periods may have been driven by an awareness of the data in the next section, which suggests high rates of return to quota ownership, particularly in the dairy sector.

3.0 EMPIRICAL EVIDENCE ON HIGH RATES OF RETURN TO QUOTA OWNERSHIP

The above literature review found that past estimates of supply price derived from application of capital asset pricing theory to quota value were likely inaccurate. The direction of inaccuracy was ambiguous. Neglecting policy risk and other risk elements leads to an underestimate of rates of return to quota and overestimates of supply price. Neglecting tax benefits has the opposite effect: overestimates of rate of return and underestimates of supply price.

Is the net effect of these omissions significant? This section examines available empirical evidence of the tax adjusted rates of return earned by quota. The evidence suggests that rates of return to quota holding are often quite high. This in turn suggests that some of the supply price estimates in the literature are too high, and welfare loss estimates too

low. It also suggests that estimates of supply price based on fixed amortization periods may be closer to the truth despite their arbitrary nature.

Two sources of data are offered in this section, a set of data reported in Barichello (1984), and more recent examples from the Ontario and Quebec milk marketing boards.

3.1 Evidence from Barichello (1984).

Evidence offered in Barichello (1984) is drawn from the British Columbia milk quota, Ontario egg and poultry quota, and Ontario milk quota.

Barichello (1984) takes advantage of a unique period in the history of British Columbia milk regulation. Between 1971 and 1975, the sale of milk for fluid purposes was subject to quota restrictions, but the sale of milk for industrial purposes was effectively unconstrained. Although separate quota rights were issued for "fluid" and "industrial milk", the commodity was the same from the point of view of production.²³ Allocated quota for industrial milk also exceeded demand for most of this period and milk price for industrial milk was set to clear the market. As a result, the farm price for milk sold for industrial purposes was the same as the supply price (MC), and milk sold for fluid

²³Fluid milk, such as milk sold in cartons, must meet higher health standards than milk used for industrial purposes such as butter and cheese. However, modern milk management and bulk milk collection methods have lead to a preference to produce all milk to meet fluid standards.

markets under fluid quota was sold at a higher price. The difference between the two prices ($P-MC$) was the net annual return for holding a unit of fluid quota. Given these conditions, the tax adjusted rate of return on quota may be stated as:

$$[x(r+\pi-g)] = (P-MC)/QV = (\text{Fluid Price} - \text{Industrial Price})/QV \quad (3.1)$$

Applying (3.1) to Barichello's data yields an average tax adjusted annual rate of return of 28.3% over the five year period.²⁴ This number is large, but conservative. An adjustment is necessary to account for the fact that farmers received one unit of industrial milk quota for every ten units of fluid milk quota held. While industrial milk quota should have no significant value if it does not constrain production, there may be some value to it as an option in the event of changes in demand or changes in supply management policy. The higher the option value of the extra industrial milk quota, the less the true market value of the fluid quota it is bundled with. Barichello estimates a rate of return to fluid quota exclusive of tax benefits as

$$(r+\pi-g) = (\text{Fluid Price} - \text{Industrial Price})/QV^* \quad (3.2)$$

Where QV^* is the quota value reduced for the capitalized value of tax benefits and the value of the industrial milk quota bundled with the fluid quota. Barichello estimates that tax benefits raise the value of quota by 1.765%, and treats industrial milk quota as equal

²⁴ This not Barichello's estimate.

in value to fluid milk quota.²⁵ The result is $[QV^* = QV/(1.10(1.01765))]$, an estimated rate of return exclusive of tax benefits of 31.7%.²⁶ The tax adjusted rate of return on this basis would be 31.1%.²⁷ Whether we consider the 31.1% or the more conservative 28.3%, either real rates of return are larger than the 20% employed by Lermer and Stanbury (1985), or the nominal rates of interest employed by other authors.

Barichello provides corroborating evidence of high rates of return from Ontario egg quota, broiler quota and industrial milk quota. Ontario egg and broiler quota are unique in that their respective marketing boards permit rental of quota. The rental price of quota will equal the difference between farm price and supply price (disregarding transaction costs). The tax adjusted rate of return will be

$$[x(r+\pi-g)] = (P-MC)/QV = (\text{Rental})/QV \quad (3.3)$$

²⁵ Barichello notes that this overvalues industrial milk quota: "If we assume that MSQ is as valuable as fluid quota (likely an upward biased estimate because the corresponding milk price is only seventy percent of the fluid milk price), then this benefit is worth one-tenth the value of fluid quota. To the extent that this overstates the value of the benefit it will also cause a small overstatement of the supply price." Barichello (1984), pg. 17.

²⁶ Note that $[31.7\%/(1.10 \cdot 1.01765)] = 28.3\%$, our estimate from (3.1).

²⁷ Barichello (1984) goes on to decompose the estimated rate of return $(r+\pi-g)$ to derive an estimate farmer expectation of the probability that the marketing board regime will come to an end (0). He assumes an average real rate of return to Canadian farm capital of 6% based on work by Jenkins (1972), adds a 2% allowance for undiversifiable risk, and assumes expected growth in real earnings of 3.2% based on a geometric weighting of past earnings. Based on his formulations, farmer expectations of marketing board default are 20.4% in any given year.

For egg quota in the period 1978-1981, Barichello reports the average ratio of rental to quota price was 18%. Similarly, for broilers from 1976 to 1983, the average ratio was 14%. These rates of return are less than for B.C. milk quota, but are still significantly above both real and nominal interest rates. By comparison, average nominal prime rates for these periods was significantly lower at 12.5% and 12.7% respectively.

In the case of Ontario industrial milk quota, rental is not permitted, but there exist separate markets for "used" and "unused quota". A unit of quota permits the production of a litre of milk each dairy year. After the right has been used for the current year, the farmer is permitted to sell it on the "used" market. The purchaser may begin exercising his/her rights the following year. The difference in price between used and unused quota represents the expected revenue from quota holding this year ($P-MC$) adjusted for the consequent lower tax benefits. Define the *premium* for unused quota as

$$\text{Premium} = (QV_{\text{unused}} - QV_{\text{used}}) = (P-MC)/x \quad (3.4)$$

From (3.4), the tax adjusted rate of return will be

$$[x(r+\pi-g)] = (P-MC)/QV = x(\text{Premium})/QV \quad (3.5)$$

Similarly, the rate of return exclusive of tax benefits will be

$$(r+\pi-g) = (P-MC)/QV = (\text{Premium})/QV \quad (3.6)$$

In 1980, Ontario established an official exchange for industrial milk quota, held once a month. Using the most recent four months of data available at the time, (October 1980 to January 1981), Barichello finds the average price difference between used and unused quota to be 10.25 cents per litre. Taking the ratio of this figure to the average price of unused quota, and adjusting for tax benefits, he estimates an average rate of return of 29% for Ontario industrial milk quota.

3.2 Further Evidence from Ontario & Quebec Dairy Quota

More recent data for Ontario and Quebec industrial dairy quota provides further evidence of high rates of return to dairy quota. Figure 2 illustrates the rate of return exclusive of tax benefits, for Ontario over the years 1982/83 to 1989/90. This period is a natural period for examination. The two years prior to 1982/83 were characterized by rapidly expanding milk demand. Quota during this period was expanded to accommodate demand, and was not a constraining factor on output. After 1989/90 there was a major change in the regulatory regime affecting the value of quota, including off-season production incentives and a change in the quota unit from fluid volume (hectolitres) to kilograms of butterfat. The period of 1982/83 to 1989/90 was relatively stable for both regulatory regime and demand conditions.

Figure 2

Figure 2 shows the annual average of monthly ratios, calculated from data in Appendix B.²⁸ The ratio is the rate of return exclusive of tax benefits (by (3.6)). While it is quite volatile between years, the average return over the period for Ontario is 30.7%. The mean rate of return adjusted for tax benefits using (1.8) and (1.12) is 26.9%²⁹

²⁸ Sources listed in Appendix B.

²⁹ Note that the observed ratios in Figure (2) are only approximations of the ratios implied by (3.5). The geometric formula applied to convert an infinite series to a net present value assumes that the quota is purchased at the beginning of the period, and the revenue is received at the end of each period. The monthly values employed to calculate (3.5) will not conform to this timing. The market value of the premium observed at the beginning of the period will understate the future value of the same earnings expectations evaluated at the end of the period. Similarly, the present value of the unused quota will rise as the months elapse.

Also shown is the rate of return exclusive of tax benefits for Quebec over the period 1985/86 to 1989/90. The Quebec dairy regulatory regime is similar to Ontario's. The mean rate of return over these four years is comparable to Ontario's at 25.5%.

The volatility in the rate of return for both provinces is a reflection of the year to year variations in annual return due to weather conditions; and year to year variations in expected growth in returns, including changing levels of confidence in the political strength of the supply management regime (policy risk).

3.3 Comparing Empirical Evidence to Past Estimates

Estimates of supply price reviewed in the previous section fell into two types. One type estimated a rate of return to quota by estimating values for individual components of $[x(r+\pi-g)]$. Estimated rates of return ranged from an 8% real rate of return by Veeman (1982) to a 20% risk adjusted rate by Lerner & Stanbury (1985). The second type imposed an aggregate rate of return by assuming a fixed amortization period. Because of the short periods selected, rates of return were higher than the identification by components method. Arcus (1978) employed 27% and Barichello (1981) employed 32.9%. Note that all these estimates failed to adjust their rates of return to account for tax benefits. Correction would result in lower estimated rates of return.

In comparison, the cases examined in this section found tax adjusted rates of return of 14% for Ontario broiler quota, 18% for Ontario eggs, 26.9% for Ontario industrial milk, and 28.3% for B.C. milk, over assorted periods. In addition, the rate of return exclusive of tax benefits for Quebec industrial milk quota was 25.5% during the period examined.

The empirical evidence in this section supports the higher estimates of the second approach. There is evidence from a number of jurisdictions that the rate of return earned by quota can be significantly higher than risk free rates of interest, and higher than the average rate of return to other risky assets such as stock. This in turn gives strong support to the presence of either undiversifiable risk, or policy risk, or both.

If rates of return to quota holding are high, this means farm supply prices must be correspondingly lower. For example, consider Ontario industrial milk quota from 1982/83 to 1989/90. During this period, the average farm price per hectolitre was \$40.47, or \$44.69 after adjusting for butterfat content, federal levies, and subsidies.³⁰ The average premium for unused quota during the same period was \$26.02, or \$22.75 after adjusting for taxes using (1.8) and (3.4). The average ratio of premium net of tax to mean price net of levies is 51.8%. **The simple average suggests that the supply price averages only 48.2% of net farm price for Ontario milk! The balance represents a return to quota holders.** Subsequent sections of this paper show that estimates using annual

³⁰ Price is reported on the basis of milk of 3.6 kg. butterfat content per hectolitre. A differential is paid for different butterfat content. Mean butterfat for the province is usually higher. Averages are calculated from data and sources provided in Appendix B.

averages overestimate returns to quota holders and underestimate supply price, but the proportion of farm price accounted for by returns to quota remains surprisingly high.

3.4 Comparison to Cost Function Based Estimates

The alternative to using quota data to estimate supply price is to use farm cost data to develop a farm cost function. Supply price is then the cost of producing milk derived from the cost function. A review of estimates of supply price using farm cost data is outside the scope of this paper.³¹ However, Moschini & Meilke (1988) occupy a unique position in the literature. Moschini & Meilke estimate the rates of return earned by Ontario milk quota using results from an earlier paper estimating farm supply price by means of a cost functions.

Moschini (1987) provided an econometric estimate of a cost function for Ontario dairy farms.³² At efficient scale, average and marginal costs were estimated to be 15% below the farm price of industrial milk. Moschini & Meilke (1988) build upon this result by assuming that the annual return to a unit of quota will remain at 15% of price over future years. Since the quota value is the capitalized value of this stream of income, it is possible to impute an effective rate of return to quota.

³¹ For a recent example of an accounting based approach, see *National Dairy Policy Task Force: A Comparison of Canadian and U.S. Dairy Industries.*, February, 1991.

³²The data was drawn from the Ontario Dairy Farm Accounting Project, ODFAP.

Moschini and Meilke (1988) assume an expected rate of growth in earnings (g) equal to the average growth in industrial milk price in the past six years (3%). They estimate a risk adjusted discount rate ($r+\pi$) for unused industrial milk quota to begin at 20.1% in 1980/81 and fall to 9.8% in 1985/86. They observe that the estimated rate of return moves in the same direction as nominal rates of interest over this period. Combining the components ($r+\pi+g$) we have an implied estimate of the rate of return falling from 17.1% to 6.8% during this period. Similar results are obtained by applying the formula to unused industrial milk quota. The authors do not account for tax benefits.

Moschini & Meilke's estimates of quota rates of return are significantly less than those indicated by the difference between used and unused quota in this same market. As noted above, we find premia for unused quota suggest an average rate of return ($r+\pi+g$) of 30.1% for the overlapping period 1982/83 to 1989/90, and Barichello finds 29% during the early months of 1981.

The difference is accounted for by Moschini's estimate of an annual return of 15% of milk price derived from cost estimates, as compared to the much higher return implied by the premium for unused quota. Moschini & Meilke show data for both used and

unused quota value, but do not reconcile their results with the difference in the value.³³

Moschini & Meilke's findings illustrate the importance of quota values in providing an independent check on models of farm costs. The finding of marginal cost at 15% less than milk price is clearly contradicted by the much higher gap implied by quota values for the same commodity. Since the quota value estimates are based on the straightforward difference between two arm's length market determined values, used and unused quota prices, it is likely that the econometric estimate is incorrect.³⁴

4.0 AN ALTERNATIVE METHOD FOR ESTIMATING SUPPLY PRICE FROM QUOTA VALUES

Previous sections have established that

³³ There is an additional inconsistency in their approach, but correction would not appreciably alter their findings. In addition to omitting tax benefits, Moschini & Meilke use inconsistent definitions for the capital value of used and unused quota. Used quota is defined as $[V = R/(r-g)]$ where R is the income to holding the quota in the current period and r is the discount rate including risk premium. Unused quota is defined as $[V = R(1+r)/(r-g)]$. While either of these is acceptable given the approximate nature of the formula (see previous footnote), they are inconsistent. The income stream from an unused quota is equivalent to the income stream from a used quota reduced by one years growth and advanced one year $[V_{un} = V_u(1+r)/(1+g)]$. For example, a consistent definition of unused quota value would be $[V = (R/(1+g))(1+r)/(r-g)]$.

³⁴ A possible reason for Moschini (1987)'s high estimate of marginal cost is the underlying data it employs. The Ontario Dairy Farm Accounting Project is also used to generate cost estimates which guide the Ontario Milk Marketing Board's pricing policies.

- **Market value of quota is an important independent source of data for the estimation of farm price.** Estimates based on farm cost data, such as Moschini & Meilke (1988) are vulnerable to biases in data. Quota values can provide both an independent estimate and a check upon cost-function based estimates.
- **Current methods of estimating supply price from quota values have significant drawbacks.** Estimating a rate of return to quota by estimating the components of $[x(r+\pi-g)]$ face significant data problems in accounting for the effects of undiversifiable risk and policy risk. The alternative is based on an arbitrary choice of a fixed amortization period, which may or may not be accurate.

This section will explore another alternative: estimation of supply price from the difference in market value of used and unused quota, termed the *premium for unused quota*.

4.1 Estimating Supply Price from the Premium for Unused Quota

The review of empirical data in Section 3 revealed two additional methods of estimating farm supply price from quota information. The most convenient is the rental price of

quota. If quota can be rented, and if the rent is set competitively, then the rental price represents the immediate return to quota holding that period ($P-MC$), and deduction of rent from the farm price per unit of output provides an estimate of supply price. However, few marketing boards permit explicit quota rental. There is the general preference by marketing boards to have quota owned by the users.³⁵

The second method is to derive an estimate from the price difference between used and unused quota. In principal, a market for used and unused quota is possible in any regime which permits trade in quota. Quota is normally set in output units per period. Within any given period, quota can potentially be exchanged with or without its current period rights used. Simultaneous trade in used and unused quota will tend to occur when the production cycle is shorter than the regulatory period. Milk, for example, is produced daily, while a unit of Ontario & Quebec industrial milk quota entitles the holder to produce a hectolitre of milk at any time during the dairy year (August to July).

Intuitively, the proposition is straightforward. The difference between used and unused quota is the right to produce a unit in the current period. Therefore, the difference in value between used and unused quota must equal the profit to be made from producing a unit in the current period. Subtracting this value from the farm price should provide an estimate of the supply price.

³⁵ Perhaps to avoid the uncomfortable explicitness of rents being collected by quota holders who do no farming.

Two considerations make this a non-trivial exercise, seasonal variation and volatility in the premium paid for unused quota. To simplify discussion, we will assume the Ontario & Quebec case, where quota is issued in terms of annual production, and market value of quota is observed monthly.

4.2 Volatility

As discussed in section 1.2, we wish an estimate of supply price *ex ante* of the revelation of transitory factors (defined as MCX). Observed premia for unused quota in any given period will reflect the actual farm cost conditions in that month, including transitory factors. Thus, single observed premia will reflect $[(P-MC)/x]$ rather than $[(P-MCX)/x]$. Volatility will occur from year to year as key transitory factors, such as harvest conditions and feed quality, are specific to an entire year. Figure 2 illustrates this year to year volatility.

The intuitive response to volatility is to derive an estimate of supply price based on averages over several years. However, a second problem may prevent this simple solution: seasonality in the market value of quota. Institutional constraints in the allocation of production between months may produce a seasonal variation in the market value of the quota. The seasonal variation will introduce potential bias in the calculation of averages, as discussed in the next section.

4.3 Seasonal Variation in Premia for Unused Quota

In principle, there should be very little seasonality in the market value of quota when it is freely traded. Although cost functions for farmers will vary seasonally, inter-temporal allocation of production should prevent quota value from moving up and down in a regular seasonal pattern.³⁶

However, seasonality in unused premium may occur. Figure 3 shows monthly values for rate of return implied by premia for unused industrial milk quota in Ontario, averaged over eight years. Quebec averages are shown over four years. Both series show a seasonal variation.

Seasonality in market value of quota may occur if there are additional marketing board regulations which affect the value of quota. For example, quota holders may be required to maintain minimum production levels during high cost months, lowering the value of quota during these months. In general, marketing boards are rarely as simple as illustrated in Figure 1. The necessity of enforcing quota rules and the pursuit of other policy objectives often result in complex regulations concerning methods of production, delivery, etc. The result may introduce seasonality into observed quota market values.

³⁶ With one exception: The market value of quota will rise slightly as the end of the regulatory period approaches. The net present value of future income from the quota increases as the start of the next period approaches.

Figure 3

When seasonality occurs, a simple annual average of quota values may produce a biased estimate of supply price. For example, compare Figure 3 with Figure 4 showing average monthly production of milk in Ontario. In Figure 3, rates of return start low in October, rise to a peak in the spring, and fall in the summer. It is reasonable to suppose that this cycle is related to the "spring flush" of dairy cows. Cows tend to produce more milk in the spring months, lowering production costs during these periods.

Figure 4

If seasonal variation in quota values is related to seasonal variation in costs, then taking an annual average of premium values, as in Barichello (1984), will be inaccurate.³⁷ Monthly values will bias annual averages in favour of the cost conditions in the final months of the year. Quota values in each month of the year will incorporate expected cost conditions over the remaining months of the year. In our example, October's premium for unused quota would incorporate expectations of lower cost conditions in March, but March's figures would not incorporate past cost conditions in October. Therefore, the cost conditions in the later months are over-represented in a simple average

³⁷The year is used for convenience. Quota for some products, such as broilers or eggs, may use a shorter production period.

of all months. This bias is enhanced if data is not available for early months of the year and are excluded from calculation of an annual average. In our example, an annual average of premia for unused quota likely overstates the rate of return to quota by overweighting the low cost conditions in the spring (April, May, June). These months comprise three of the last four months of the dairy year ending in July.

In general, annual averages of quota values may give too much weight to seasonal cost conditions at the end of the year.

An alternative to taking an annual average would be to take the premium for unused quota from only the first month of the regulatory period. This premium would incorporate expectations for the remainder of the period. Unfortunately, by their nature, used quota tend to be in short supply at the beginning of the regulatory period. Quantities may not be sufficient to support a market exchange. In the case of Ontario and Quebec industrial milk quota, exchanges of used quota do not take place until the third month of the dairy year. As a result premia for unused quota cannot be observed for the first two months.

4.4 The Proposed Alternative

To estimate supply price, it is proposed that a seasonal model of the level of marginal cost be developed which has observed premium for unused quota as the dependent variable, and which incorporates known institutional information.

The next section develops such a model for the case of the Ontario Milk Marketing Board during the period 1982/83 to 1989/90. Empirical estimates of the model will incorporate implicit estimates of annual supply price both ex post and ex ante of the revelation of transitory annual factors.

5.0 MODELLING EX POST SUPPLY PRICE FOR ONTARIO MILK

5.1 Background on Regulation of Ontario Milk

Some background will be helpful in the development of the model.

Ontario milk is collected from farmers and sold to processors by the Ontario Milk Marketing Board. Out-of-province imports of raw milk are controlled, isolating the provincial market. Milk is sold on a price discriminated basis according to end use. Milk sold for milk or cream is termed "fluid milk" and commands the highest price. Milk sold for other products is divided into a number of classes and may be termed "industrial

milk".³⁸ Milk sold in each class is of the same quality, due to the demands of modern bulk transportation. Prices for each class of milk are set by the marketing board, and do not vary seasonally.

Production of milk is controlled through two sets of quotas, fluid and industrial.³⁹ Revenues from the sales of fluid milk are averaged each month, and a pooled price is paid to farmers holding fluid quota based on the volume of their deliveries with an allowance for differences in butterfat content. Industrial milk is managed in the same way. Milk which is delivered in excess of combined quota over the dairy year is deemed to be excess "industrial milk" and may be accepted by the OMMB at the industrial milk price, less a severe "over-quota levy". The dairy year is from August to July.

The farm pool price of industrial milk is less than fluid milk due to the higher prices set for fluid use. The industrial pool price varies slightly on a seasonal basis, despite the fixed prices by milk class, because of larger sales of milk in the lower priced industrial classes during portions of the year.

³⁸Differences between federal and provincial definitions of industrial milk actually result in a third classification of milk called the "exclusion factor". Industrial milk licensed under industrial quota excludes this classification of milk.

³⁹Fluid milk quota is termed "Group 1" quota. Industrial quota is termed "Market Sharing Quota" (MSQ), and is part of federally sponsored cooperative marketing scheme with other provinces.

Fluid milk quota is specified in terms of litres of output per day. Industrial quota is specified in terms of hectolitres per dairy year.⁴⁰

Ontario permits the transfer of both used and unused quota. Quota is exchanged in a monthly double auction conducted by the OMMB. Farmers submit their offers to buy and sell quota at fixed prices to the OMMB. The OMMB calculates a price (currently with a computer program) where supply equals demand. The monthly market may be cancelled if there are insufficient offers to determine a competitive price. There are separate auctions for fluid quota, used industrial quota, and unused industrial quota. Industrial quota purchased at the exchange may be used in the same month it is purchased. The price quoted on the exchange is the price paid by the purchaser. Sellers of quota must give 15% of the quota units sold back to the OMMB, who places them in reserve.

⁴⁰There is a complication in the relationship between industrial quota and fluid quota which does not affect the experiment, but is worthy of mention. To benefit fully from fluid quota, a farmer must own a minimum amount of industrial quota. Because the total amount of fluid quota outstanding is greater than the sales of milk for fluid purposes, a farmer is given credit only for a portion of their fluid quota. For example, in 1988/89 fluid sales were 80.2% of fluid quota (including exclusion factor allowance). In 1988/89 farmers were credited with fluid deliveries for the lesser of 80.2% of their actual deliveries or 80.2% of their fluid quota entitlement. To receive the fullest benefit from the fluid quota, a farmer was required to deliver 19.8% of their fluid quota as industrial milk. Therefore farmers holding fluid quota required industrial quota of at least this amount. However, since more than half of Ontario milk production is industrial milk, the farmers' marginal evaluation of the value of industrial quota is unaffected.

Figure 5: Ontario Industrial Milk

Figure 5 illustrates the principal data for the sample period 1982/83 to 1989/90.⁴¹ Price is the industrial pool price paid each month for a hectolitre of milk of average butterfat content, less federal levies plus federal subsidies.⁴² The premium for unused quota is the difference between the price of used and unused quota each month. Volumes of used quota are insufficient to conduct auctions in August and September of each year, so each dairy year appears as a separate series. The tax-adjusted premium is also shown, based on the assumption of an infinite holding period as per (1.8). The over-quota penalty rate is also shown. It has changed from time to time during the sample period.

Several points about the data are striking.

1. **The premium paid for unused quota is surprisingly large.** A farmer will not be willing to pay more than the price of milk for the right to produce milk. In some months the value of the premium (after tax benefits) approaches this limit. Its average value is a significant portion of the price of milk, indicating that the marginal cost of milk production is significantly lower than the price of milk.
2. **The premium consistently exceeds the over-quota penalty.** In theory, a farmer with excess milk may choose between purchasing unused quota or

⁴¹ See Appendix B for data and sources.

⁴²OMMB levies have not been subtracted from the price. Depending on one's sympathies for marketing boards, OMMB levies may be viewed as part of farm costs of operation.

paying the over-quota penalty. Premiums above the over-quota penalty suggests that there are administrative penalties or constraints to excessive deliveries of over-quota production.

3. **The tax benefit estimate appears to be supported by the raw data.** The unadjusted premium exceeds the price of milk in 1985/86. Excluding tax benefits brings the premium below the price, as we would expect. In the early months of 1988/89, the tax-adjusted premium is approximately equal to the over-quota penalty for 3 months in a row.
4. **The premium is quite volatile.** Although the seasonal tendency to higher premiums in the spring is evident, the year to year pattern varies considerably, suggesting other factors at work.

5.2 Model Development

We are seeking an estimate for both annual supply price ex post of the revelation of transitory factors (MC) and the ex ante supply price (MCX).

We will first develop a hypothesis relating the unused quota premium to annual supply price MC , and then estimate the model for the period 1982/83 to 1989/90. The model estimates will then be used to develop an estimate for MCX .

Consider an increase in output in a given year. To produce an additional unit of output during this year, the farmer must acquire an additional unit of quota. The farmer will plan to distribute use of this quota unit among the remaining months of the dairy year. The expected marginal cost of producing another hectolitre of milk (excluding the cost of quota) will be the average of expected marginal cost of milk production in each month, weighted by the proportion of additional unit of production that the farmer intends to allocate to that month.

$$MC = \sum_{j=1,12} w_{ij} MC_{ij} \quad (5.1)$$

where

w_{ij} = The proportion of additional quota acquired in month i that the farmer intends to use in month j .⁴³

MC_{ij} = Farmers expectation in month i of the level of marginal cost in month j .

⁴³ w_{ij} is treated here as a decision variable of the farmers, without uncertainty. The implications of stochasticism in w_{ij} is considered separately in Appendix C.

Marginal cost is not directly observable, but it is implicitly present in the premium paid for unused quota. Let M_i be the market premium paid for unused quota in month i (exclusive of tax benefits). Farmers will be willing to pay their expected net present value of incremental production permitted by the quota in each of the remaining months of the dairy year. Therefore

$$M_i = [\sum_{j=i+1}^{12} w_{ij}(P_{ij} - MC_{ij})(1+r_i)^{(i-j)}] \quad (5.2)$$

where

P_{ij} = Farmers' expectation in month i of the price of milk (P_j) in month j . This price is calculated inclusive of federal subsidies and levies for milk production, and net of levies to finance marketing board surplus disposal programs. Levies for transportation and administration have not been subtracted from P_j , as they reflect costs of production.

r_i = a discount rate of interest, expressed on a monthly compound basis.

The premium (M) is a weighted average of the profit from incremental production in each month of the remaining dairy year, discounted to present value.

If the level of marginal cost does not vary seasonally, then estimation of (5.2) is trivial. The premium would represent the difference between marginal cost and the weighted average of expected prices over the period. Since prices are relatively stable under supply management, actual prices may be treated as expected prices, and an estimate of MC may be calculated.

The level of marginal cost need not vary seasonally, even if cost conditions change seasonally. If farmers are free to allocate the use of their quota within the regulatory period, then they will maximize profit by allocating quota use between months such that the net present value of marginal profit generated in month is the same. They will plan allocation of quota use such that

$$(P_u - MC_u) = (P_y - MC_y)(1+r)^{(t-y)} \quad (5.3)$$

or

$$MC_y = MC_u(1+r)^{(t-y)} + P_y - P_u(1+r)^{(t-y)} \quad (5.4)$$

If prices are relatively stable, we expect the level of marginal cost to be stable, rising or falling slightly over the course of the year in response to the discount rate. This rise would reflect farmers' preference for claiming the rents to quota earlier rather than later within

a given regulatory period. In seasons where the cost of producing milk is low, the farmer will allocate a greater proportion of quota use to that period, increasing the level of marginal cost to meet (5.4). Thus the level of marginal cost would remain consistent, even though the marginal cost curve may be shifting with seasonal cost conditions.

If we observe large seasonal variations in the unused quota premium M_i beyond that expected from the discount rate, then the level of marginal cost must also be varying seasonally beyond that to be expected from the discount rate and seasonal price variations. Such seasonal variation in marginal cost means, à priori, that there are restrictions to the allocation of quota use within periods. For example, constraints could take the form of either a required minimum monthly production, a maximum output permitted in a given month, or both. Another possibility would be that farmers are unable to reallocate production between months.

In the case of the OMMB, we do observe seasonal variation in the unused quota premium. Therefore the monthly levels of marginal cost (MC_i) also vary, and an estimate of MC based on an average premium would be biased. To estimate MC_i it is necessary to further develop (5.2) into a form suitable for estimation.

Ideally, we would know the precise nature of the constraints to monthly production that cause the variation in levels of marginal cost, and construct a model accordingly. However, institutional arrangements by marketing boards can become very complex, and

the resulting constraints on production may not be obvious.⁴⁴ In the case of the OMMB, there is no explicit regulation limiting the allocation of industrial milk quota to specific months of the year.⁴⁵

Lacking an explicit structure of production constraints, we turn to a model of seasonal adjustment factors to estimate MC . Hypotheses concerning monthly production constraints will be discussed and tested later in light of empirical results.

Observations of the premium for unused quota begin in October, the third month of each dairy year. Let β_{sj} be an additive seasonal adjustment factor relating the expected level of marginal cost in month k to the level of marginal cost in October.

$$MC_{ij} = MC_3 + \beta_{sj} \quad (5.5)$$

MC_3 , the level of marginal cost in October, is taken as an arbitrary reference point for the expected seasonal variation in other months. For estimation purposes, it will be convenient to write (5.5) as

⁴⁴ Complexity may result from efforts to prevent illegal production, or the pursuit of other policy goals in concert with restricting supply.

⁴⁵ There is a regulation limiting the amount of quota that can be used in the first eight months to 80% of total quota. However, this limit is for "payment purposes" only. (*Quota Policies*, pg. 12. OMMB, 1989). Farmers, delivering over 80% have payment delayed until the end of the year, and are only charged the over-quota levy if they have exceeded 100% of their quota over the entire year. The delay of payment does not seem to be very binding constraint.

$$MC_{ij} = MC_3 + \sum_{k=4,12} \beta_{Sk} S_{kj} \quad (5.6)$$

where S_{kj} 's are monthly dummies equal to one when ($j=k$), and equal to zero otherwise.

In addition to seasonal variation, the level of marginal cost may also change if the marketing board decides to expand or reduce quota during the course of the dairy year. Under normal circumstances, the OMMB sets production quota at the beginning of the dairy year, but on occasion the Board adjusts the quota by reducing or expanding all farm quota rights proportionately. We hypothesize that the occasional within year adjustments are not anticipated in advance by farmers, and that the proportion of quota used in each month is independent of scale (i.e. the percentage increase in each month is the same, and the relative production weights w_{ij} 's used in (5.2) are constant). As a result, we modify (5.6) to

$$MC_{ij} = (MC_3 + \sum_{k=4,12} \beta_{Sk} S_{kj})(1 + \beta_V V_i) \quad (5.7)$$

where V_i is the percent increase in production expected in month i for any month j as a result of within year adjustments in the amount of quota. If an adjustment to quota takes place in month t , then

$$V_i = 0 \quad (\text{for } i < t).$$

$$V_i = \text{The percentage change in total milk production in the remainder of the dairy year necessary to accommodate the adjustment in quota. (for } i \geq t).$$

β_v is the percentage increase in marginal cost from a 1% increase in monthly production. Note that β_v is the inverse of the short-run elasticity of milk supply.⁴⁶

For the monthly price of milk (P_j), we want the effective price received by farmers. This will be the monthly pool price for industrial milk, plus federal subsidy, less federal levies. OMMB provincial levies for administration and transportation are not deducted from the price. Instead they are defined as part of marginal cost. This choice should be remembered when interpreting empirical results. The estimated supply price presumes the continued existence of the supply management system. As noted earlier, this approach permits the separation of the issues of supply management from the impact of supply restrictions.

Farmers have reasonably complete foreknowledge of price. Prices are fixed by regulation on a semi-annual basis based on formula guidelines. Because milk is sold on a price

⁴⁶ Short-run may be defined here as supply response within the regulatory period of one year. This length of time coincides approximately with a natural definition of short run: the gestation period of a cow. The period of time between heat detection by the farmer, insemination, and gestation, is approximately 12 to 14 months. The elasticity is stated from the perspective of the individual farmer, but as a proportion, it may also be interpreted as the collective response of all farmers.

discriminated basis, there is some seasonal variation in the average price paid to farmers, based on seasonal variation of demand for different classes of milk.⁴⁷ This variation is slight and may also be anticipated (See Figure 5). However, P_j is computed net of marketing board levies for surplus disposal. These levy rates are usually set annually, but occasionally adjustments are made. These regulatory decisions introduce an element of uncertainty into the net price farmers receive. We hypothesize that the monthly pool price is accurately anticipated by farmers, but that occasional adjustments of levies comes as a surprise. Therefore, the price expected in month i for production in month j is

$$P_{ij} = P_j + (L_j - L_i) \quad (5.8)$$

where P_j is net of levies L_j month j , and the expression $(L_j - L_i)$ adjusts for the changes in levies which are not anticipated in month i .

We may now define the willingness of farmers to pay a premium for unused quota (from (5.2) and (5.7)) as

⁴⁷ The OMMB's usual method of reconciling demand with supply at a fixed price is through a system of price discrimination. Milk is sold at varying price according to its "class". The class is not based on the quality of milk, which is uniform, but according to the end-use. Demand for high price end-uses is fully supplied, while the remaining supply of milk is sold as the lowest class (primarily for butter and skim-milk powder). Therefore, any excess demand arises only for the lowest class use. The allocation problem among lowest class purchasers is solved by a separate quota system for food processors. In the event of a shortage, milk for the lowest class use is allocated in proportion to processor quota. The OMMB maintains a slight condition of excess demand in order to absorb fluctuations in supply and demand, eliminating the need for fine-tuning quota within the year. Note that the additional welfare cost of this procedure has never been included in quantitative estimates of welfare impacts of marketing boards.

$$M_i = \sum_{j=1,12} [w_{ij}(P_{ij} - (MC_3 + \sum_{k=4,12} \beta_{sk} S_{kj})(1 + \beta_v V_j)(1 + r_j)^{(i-j)})] \quad (5.9)$$

This expression may be rearranged into a form suitable for estimation:

$$M_i = WP_i - (MC_3 + \sum_{k=4,12} \beta_{sk} WS_k)WK_i(1 + \beta_v V_i) \quad (5.10)$$

where:

$$WP_i = \sum_{j=1,12} w_{ij}(P_{ij})(1 + r_j)^{(i-j)}$$

$$WK_i = \sum_{j=1,12} w_{ij}(1 + r_j)^{(i-j)}$$

$$WS_k = \sum_{j=1,12} w_{ij}(S_{kj})(1 + r_j)^{(i-j)}$$

The parameters to be estimated in (5.10) are the marginal cost in October (MC_3), the monthly seasonal adjustments in marginal cost relative to October (β_{sk} 's), and the inverse of the short run elasticity of supply β_v . Independent variables are average price (WP_i), the seasonal dummies for each month (S_{ki} 's), and within-year adjustments to quota amounts (V_i).

Not yet defined is the proportion of increased production that farmers intend to allocate to each future month (w_{ij}). As noted earlier, we hypothesize that expansion in scale of

production does not alter the optimal seasonal shares of production in each month. Under this assumption, w_{ij} will be equal to the planned current proportions of production in each month. This is consistent with our treatment of within-year adjustments in quota by the regulator (V_j), and means that the weights (w_{ij}) are independent of the value of V_j . Since the planned proportions of production are not directly observable, we will use the average monthly shares of production over the 8 year sample period.

$$w_{ij} = W_j / (\sum_{j=1}^{12} W_j) \quad (5.11)$$

where W_j is the mean proportion of annual production of month j over the 8 year sample period. w_{ij} rises the fewer months remain in the dairy year.

Using a mean value for the proportions of output planned by farmers raises the issue of measurement error and stochasticism in w_{ij} , which in turn has implications for estimation procedures. The likelihood and significance of stochasticism in w_{ij} is discussed in Appendix C. Appendix C concludes that if stochasticity exists in w_{ij} it is very small and will not introduce significant bias into the regression. Reasons for this conclusion are the observed stability in W_j , and that w_{ij} 's will only enter the regression indirectly through their use as weights in calculation of independent variables.

5.3 Accounting for Changes in Supply Price Between Years

To account for the impact of year to year transitory factors on the level of marginal cost, we introduce a set of annual dummy variables. Selecting 1989/90 as an arbitrary reference year, let β_{Dy} be the dollar difference between the level of marginal cost in October 1989/90 and year y . Incorporating this provision into (5.10) yields

$$M_{yt} = WP_{yt} - ((MC_{s3} + \sum_{i=1,7} \beta_{Di} D_{iy}) WK_{yt} + \sum_{k=4,12} \beta_{Sk} WS_{kt})(1 + \beta_V V_{yt}) \quad (5.12)$$

Where D_i is a set of dummy variables equal to one when y equals i , and zero otherwise.

5.4 Accounting for the Right to Deliver Over Quota

Before estimating (5.12), we must account for the right to deliver over-quota milk.

Farmers who produce more milk than their quota are not required to destroy it. OMMB policy is to accept over-quota milk but at a price reduced by an "over-quota levy". For example, in 1989/90 the over-quota levy was \$36.00 per hectolitre compared to an average annual price of \$48.23 per hectolitre.

On first glance, it would appear that there is no reason for a farmer to pay a premium for unused quota in excess of the levy for delivering over-quota milk. The alternative is to

buy used quota and deliver this year's milk under the over-quota levy. However, in some years farmers have consistently paid a premium for unused quota that exceeds the over-quota levy (see Figure 5). There are a number of potential explanations. One is the risk that the over-quota levy may be changed retroactively. The OMMB has on occasion made retroactive changes to the levy structure. Another possibility is the unknown constraints on milk delivery which create the seasonal variation in premium structure in the first place. Whatever their form, they could create a value to quota in excess of the over-quota levy. For example, if peak-load trucking capacity were less than peak volumes in the spring, administrative allocation of capacity might be allocated according to quota holdings in some districts. In this event, it would not be possible to deliver over-quota milk even if one were willing to pay the over-quota levy. We observe premium prices in excess of the over-quota levy in 17 of 80 months of data.

We hypothesize that there is a discontinuity in the demand for unused quota when the premium above used quota exceeds the over-quota levy. The farmer will be less willing to pay for quota when a cheaper alternative method for delivering milk to market exists. To facilitate estimation, we impose a linear form on the discontinuity. We assume that the reduction in the farmers' willingness to pay is a fixed proportion of the excess of the premium above the over-quota levy. If m_{yt} is the premium consistent with (5.12), then

$$M_{yt} = m_{yt} - \beta_Q D_{Qyt}(m_{yt} - OQ_{yt}) = (1 - \beta_Q D_{Qyt})m_{yt} + \beta_Q D_{Qyt} OQ_{yt} \quad (5.13)$$

where OQ_{yi} is the over-quota levy in year y and month i , D_{Qyi} is a dummy equal to one when $(M_{yi} > OQ_{yi})$, and β_Q is the proportionate reduction of the excess with a value between 0 and 1.

Incorporating (5.12) into (5.13) yields the form of the model to be estimated:

$$M_{yi} = (1 - \beta_Q D_{Qyi}) [WP_{yi} - ((MC_{s3} + \sum_{y=1.7} \beta_D D_{yi})(WK_{yi} + \sum_{k=4.12} \beta_{Sk} WS_{ki})(1 + \beta_V V_{yi})] + \beta_Q D_{Qyi} OQ_{yi} + u_{yi} \quad (5.14)$$

where u_{yi} is a disturbance term assumed to be normally distributed with mean of zero.

This model may be estimated by non-linear least squares. It may be employed to

- Test the hypothesis that marginal cost varies seasonally (t-test on β_{Sk} 's).
- Estimate monthly marginal cost levels over the sample period.
- Estimate annual ex post supply price (MC) (using a weighted average of monthly MC_{yi}).
- Estimate an ex ante supply price (MCX) (using the estimated mean of MC over the sample period).

- Provide an estimate of the short run elasticity of milk supply ($1/\beta_v$).
- Test for the relevance of the over-quota levy on quota values (t-test on β_q).

5.5 Accounting for Transfer Tax on Quota

A final feature of the OMMB quota system is a 15% tax on the transfer of quota traded through the quota auction. The tax is paid in the form of a 15% of the volume of quota rights taken from the successful seller (e.g. selling 100 units of quota results in a net sale of 85 units.) The price quoted from the auctions is the after tax price.

If the burden of the tax falls on the seller of quota, then the results of from estimation of (5.14) do not need to be adjusted for the tax, since they are derived from after-tax prices.

This paper has assumed that marginal buyers of quota do so with a long holding period in mind, so that the discounted value of end of holding period considerations are negligible. A view of the quota market which is consistent with this assumption would be that sellers of quota do so at the end of a long holding period, perhaps at the end of a working life of farming and with the absence of willing heirs. In this case the burden of taxation would fall on the seller.

If the burden of taxation is shared between buyers and sellers, then (5.14) is still not in need of adjustment for the tax, because it is derived from the difference between two

quota prices. Under this assumption, the impact of the tax on estimation of (5.14) is to introduce stochasticism into the dependent variable M_{yi} . Because of the tax, it is possible that the after-tax price of quota will over-state its value to the marginal producer(s) by up to 15%. Depending on the random events determining the need to buy or sell quota among farmers in a particular month, the settlement price could be above the value at which the marginal producer would buy, but below the additional 15% required to persuade them to sell.

Since the observed dependent variable is the difference between two quota prices (used and unused), the observed difference may either over-state or under-state the difference in the value of the two types of quota to the marginal producer(s). The degree of overstatement/understatement is limited by the 15% range. The degree of overstatement/understatement will vary for each observed month.

Thus, in estimation, the disturbance term u_{yi} would incorporate disturbances in the dependent variable as well as other sources of disturbance. Estimates remain unbiased, but the additional disturbance in the data will make itself felt in lower t and F statistics and wider confidence intervals. An explicit adjustment for the tax is not necessary.

a consequence, no adjustment to (5.14) was found to be necessary to account for the transfer tax.

6.0 ESTIMATION OF SUPPLY PRICE FOR ONTARIO

6.1 Sample Period

The sample is 8 year sample (1982/83 to 1989/90). The sample is complete, with 10 months of data for each year or 80 total observations. The sample is discontinuous in that auctions for used quota are not held in August or September of each year. The sample period was chosen because, there were changes in the regulatory regime before and after the period which would alter model parameters substantially. Prior to 1982/83, there was a two year period when milk demand was expanding so fast that all milk produced was accepted without penalty, and the quota regime was effectively non-constraining. After 1989/90, there was a major revision in the regulations, including off-season production incentives and a change in quota units from volume (hectolitres) to kilograms of butterfat.

6.2 Adjustments to Dependent Variable M_{yi}

The dependent variable is the premium for unused quota over used quota, net of tax benefits assuming an infinite planned holding period as per (1.8). Appendix B provides data and sources for the calculation of M_{yi} . In addition to the tax adjustment, the dependent variable was adjusted for a change in the provincial levy structure during 1985/86, and 1988/89. During this period, quota production for industrial milk was

divided in two. Effective August 1st, 1985, the first 96% of within quota production was accepted at the usual levies, and the last 4% of each farmer's within quota production was subject to a "special export rate" levy.⁴⁸ The levy was substantial. At \$29.73 per hectolitre it is comparable to the over-quota levy, which was \$38.00 in August, 1985.

A unit of quota as sold at auction, effectively represented the right to produce .96 of a unit of production. To account for this arrangement, the reported premia for unused quota are divided by this proportion. The proportion was changed twice during this period, first to 98.5%, and then back up to 100%. Announcements were dated Nov.27 1986, and Oct 16, 1987 for the respective dairy years, but were retroactive to the beginning of each dairy year.⁴⁹ The proportion used for adjusting the premium is the proportion known to farmers at the time of the monthly auction (e.g. retroactivity ignored).

6.3 Development of Within Year quota adjustments V_{yi}

The OMMB irregularly announces changes in industrial milk quota within the dairy year. Adjustments to each farmers quota holdings are made proportionally. For example, a 2%

⁴⁸ The levy was designed to finance the disposal of excess production by Canadian milk marketing boards through subsidized exports. Later, the burden of export disposal was folded into the general levy on all quota production.

⁴⁹ Table 42, *Dairy Statistical Handbook 1988/89*. OMMB, 1989.

increase in total industrial milk quota would mean each farmers quota holdings would increase by 2%. V_{yi} is the percent change in milk production for the remainder of the dairy year necessary to accommodate the change in industrial milk production.

Note that the size of V_{yi} is affected by the proportion of total milk production accounted for by industrial milk, and the time of year of the announcement. If industrial milk is half of total milk production, then a 4% increase in quota becomes a 2% increase in total production. If the announcement is made three quarters of the way into the year, then the rate of increase must quadruple for the remaining quarter (e.g. a 2% increase becomes 8% for the remainder of the year). We may define V_{yi} for a given year as

$$V_{yi} = (\% \text{ change in quota})(\% \text{ indust. milk production in year } y)[\sum_{j=a,12} W_{aj}]^{-1}$$

(for $i \geq a$) (6.1)

where month a is the month of the announcement, and W_j is the mean proportion of annual production of month j over the 8 year sample period.

Initial examination of the data revealed some inconsistencies between the official timing of the announcement and its apparent impact on the series. To resolve this inconsistency, the timing was investigated by reviewing the *Ontario Milk Producer*, a monthly publication by the OMMB, over the sample period. In constructing V_{yi} , farmers were

Table 1
Within-Year Adjustments to Industrial Milk Quota by OMMB
As Reported in *Ontario Milk Producer*

Dairy Year (Aug-Jul)	Event	Industrial Milk % of Total Production	Effective Month	Effective % Increase in Output V_{y1}
1982/83	Reduction of 2% reported in January '83 issue.	60.95%	Feb	-2.3682%
1983/84	Increase of 1% reported October issue, effective Dec.	54.76%	Nov	0.7283%
1984/85	Reduction of 1.5%, reported Feb. issue, effective Feb. 1.	54.35%	Mar	-1.8540%
1985/86	Increase of 1%, reported in March issue.	55.85%	Apr	1.5761%
1986/87	Increase of proportion of quota exempt from special within quota export levy from 96% to 98.5% (i.e. $.025/.96 = 2.6041\%$ increase) reported in January issue, but direct mail notice sent on Dec. 1st. Retroactive to Aug. 1st.	56.07%	Dec	2.1599%
1987/88	Increase in proportion of quota exempt from special within quota export levy from 98.5% to 100% (i.e. a 1.5228% increase) reported in November issue.	57.67%	Dec	1.2973%
1988/89	Reduction of 3% announced on January 31st, reported in March issue as "all producers should know by now that..."	58.48%	Feb	-3.4087%

Sources: The Ontario Milk Producer, OMMB annual. Dairy Market Review, Agriculture Canada Annual.

assumed to become aware of changes in their quota when reported in the *Ontario Milk Producer*, except where it was explicitly reported that earlier notice had been sent. This happened in two cases. The history of within year adjustments is given in Table 1.

6.4 Calculation of Weights (w_{ij})

w_{ij} is the proportion of quota acquired in month i which the farmer plans to use in month j . (5.11) defined w_{ij} in terms of each month's average share of annual production over the sample period (W_j). To calculate W_j we must account for the impact of leap years on the number of days in February. The OMMB maintains an index of seasonal production for each month, where a value of 1.000 means that daily production in that month equalled the average daily production over the year. Let $AVPROD_j$ be the average of this index for the month j over the 8 year period, and $DAYS_{yj}$ be the days in month j for year y . We may define the average share of production of month j in year y as

$$W_{yj} = DAYS_{yj} AVPROD_j / (\sum_{y=1,12} DAYS_{yj} AVPROD_j) \quad (6.2)$$

This produces two slightly different sets of weights, one for data in leap years and one for non-leap years. From (5.11) and (6.2)

$$w_{ji} = \text{DAYS}_{yj} \text{AVPROD}_j / (\sum_{j=i,12} \text{DAYS}_{yj} \text{AVPROD}_j) \quad (6.3)$$

Independent variables were calculated using this definition of w_{ji} .

6.5 Rate of Interest (r_i) and Inflation

All prices were adjusted to \$1989 dollars (June) using the Consumer Price Index.⁵⁰ The real interest rate (r_i) was set equal to the prime rate of interest, reduced by the rate of inflation in the consumer price index for the previous 12 months, inclusive of month i . No risk premium was allowed. The risk premium on the return to quota within the dairy year is likely to be small. As discussed earlier in this paper, the major source of risk is likely the risk of a change of political regime, combined with limits on the ability to diversify. Major changes in regulatory regime are likely to be announced in advance, effective in the subsequent dairy year(s). Thus the risk premium for short term discounting is likely to be small.

⁵⁰ *Bank of Canada Review*. Serial, Bank of Canada. The 1981 price index was used as a basis.

6.6 Serial Correlation

Preliminary tests suggested first order serial correlation, as is common with monthly data.

First order correlation was hypothesized to be of the form

$$u_{yi} = \beta_u u_{yi-1} + \gamma_{yi} \quad (6.4)$$

where γ_{yi} is a disturbance term of mean zero and β_u is a parameter to be estimated. In addition. Since only 10 months out of 12 are present in each years sample, it was also necessary to make an assumption about how the disturbance term behaved over the months when unused quota auctions are not held (August and September).

It is hypothesized that the serial correlation is discontinuous over the August-September break at the beginning of dairy years. If serial correlation comes from disturbances in the production function, then the conditions of the autumn harvest are a natural point of discontinuity. Timing, rain conditions, and the quality of the fall harvest are key factors in determining the quality of feed available for dairy cattle in the fall and winter. If serial correlation arises from disturbances in farmers bidding behaviour, such as the influence of one month's auction results on bids placed the next month, then the two month break is also significant. Thus the observation period beginning in October (the third month of each dairy year) is based on substantially different conditions than the previous

observation in the preceding July. To achieve this discontinuity, the disturbance term for each September is set equal to zero.

$$u_{y2} = 0 \quad (6.5)$$

To achieve this constraint, a set of false observations was entered for September of each year, consisting of zero for all variables. Thus the estimated value for u_{y2} was always zero. While September was not included in the sample for estimation, the NLS procedure implicitly calculated u_{y2} as the lagged error term when calculating estimates for October.

In its lagged form, the regression equation is specified as

$$M_{yi} = X_{yi} + \beta_u X_{yi-1} + \gamma_{yi} \quad (i \in 3 \text{ to } 12) \quad (6.6)$$

where X_{yi} is the model as specified by (5.14).

$$X_{yi} = (1 - \beta_Q D_{Qyi}) [WP_{yi} - ((MC_{s,3} + \sum_{y=1.7} \beta_D D_{yi}) WK_{yi} + \sum_{k=4.12} \beta_{Sk} WS_{ki})(1 + \beta_V V_{yi})] + \beta_Q D_{Qyi} OQ_{yi} \quad (6.7)$$

6.7 Heteroscedasticity

A problem of heteroscedasticity may be anticipated from the functional form of (5.14).

In months where the premium for unused quota exceeds the over-quota levy, the excess

Table 2: RESULTS OF ESTIMATION

Coefficient Description	Name	# in Regr.	Coefficient Estimate	Standard Error	T-Stat	2-Tailed Signif.
OQ Levy % Reduction	β_Q	C(5)	0.7418809	0.1023971	7.2451329	0.0000
MC Oct. 1989	MC_{83}	C(1)	44.561068	4.0524273	10.996143	0.0000
\$ Relative Difference Between MC Oct. in 1989 and Oct. in Other Years	β_{D1}	C(22)	-3.3663996	4.7470541	-0.7091555	0.4810
	β_{D2}	C(23)	-20.322239	4.8581412	-4.1831409	0.0001
	β_{D3}	C(24)	9.5801171	5.7495150	1.6662479	0.1009
	β_{D4}	C(25)	-18.785115	4.8030459	-3.9110838	0.0002
	β_{D5}	C(26)	-16.151394	5.6978468	-2.8346486	0.0062
	β_{D6}	C(27)	0.5417977	4.8319462	0.1121282	0.9111
	β_{D7}	C(28)	-8.0404367	4.8679426	-1.6517115	0.1038
Seasonal Adjustment Factors (\$ Difference Relative to Oct. MC)	β_{S4}	C(34)	-5.4264303	1.3174691	-4.1188292	0.0001
	β_{S5}	C(35)	-6.5535147	1.8207555	-3.5993380	0.0006
	β_{S6}	C(36)	-8.8227744	1.9464718	-4.5327008	0.0000
	β_{S7}	C(37)	-12.375735	2.1696320	-5.7040709	0.0000
	β_{S8}	C(38)	-14.892387	2.4597344	-6.0544693	0.0000
	β_{S9}	C(39)	-11.449876	2.3404626	-4.8921422	0.0000
	β_{S10}	C(40)	-13.122641	2.8233432	-4.6479086	0.0000
	β_{S11}	C(41)	-13.793898	2.8641817	-4.8159997	0.0000
	β_{S12}	C(42)	-7.9874487	3.1053063	-2.5721935	0.0126
Short Run η_{1s}	β_V	C(3)	8.7291496	2.6977748	3.2356851	0.0020
Serial Corr.	β_u	C(6)	0.9962135	0.0460117	21.651285	0.0000
SUMMARY STATISTICS						
R-squared			0.973634	Mean of dependent var		28.35759
Adjusted R-squared			0.965284	S.D. of dependent var		20.18437
S.E. of regression			3.760774	Sum of squared resid		848.6052
Log likelihood			-207.9778	F-statistic		116.6124
Durbin-Watson stat			1.844435	Prob(F-statistic)		0.000000

value of the premium is reduced by the proportion β_q . One might suspect that the variance in M_i is lower for these observations as a result.

To test for heteroscedasticity, (6.6) was estimated. Examination of residuals yielded a variance of 3.77 for the 17 observations where $M_i > OQ$, and a variance of 16.95 for the remaining 63 observations. The Bartlett statistic testing for significance between these two variances was 10.87, compared to a 5% critical Chi statistic of 3.84.⁵¹ Therefore we accepted the hypothesis that heteroscedasticity exists.

To correct for heteroscedasticity, (6.6) was re-estimated by weighted non-linear least squares. Observations in were pre-multiplied by weights based on the estimated standard deviations of the two groups of observations, normalized to a mean value of one. The specification took the form of

$$MWT_{it} = WT_{it}[X_{it} + \beta_q X_{it+1}] + \gamma_{it} \quad (i \in 3 \text{ to } 12) \quad (6.8)$$

Where WT_{it} is the weights and MWT_{it} is the weighted dependent variable.

6.8 Results

⁵¹ Bartlett test as per Johnston *Econometric Methods* 3rd Edition. McGraw Hill. Pg. 298.

Table 2 reports the principal results for estimation of (6.8). Full results are reported in Appendix A.

The estimated residuals give reasonable assurance of normality. To test for serial correlation, a Box-Pierce Q statistic was calculated for up to a 12 month lag (see Appendix A). A Q-statistic of 4.56 was found, indicating no serial correlation at a 95% level of confidence. Autocorrelation for individual lags was also not of significance. The Jarque-Bera normality test statistic was 1.09, passing a 5% test for normality.⁵²

With acceptable residuals, we may treat the statistics produced by non-linear least squares as asymptotically approaching t and F distributions, and may use the variance and covariance estimates for hypothesis testing.

Results support the hypotheses underlying the model:

- Seasonal variation in *MC*: The β_{sk} 's are the expected differences between the level of marginal cost in October and other months. They are expected to be negative and larger in the latter months of the dairy year (the spring flush).

⁵² Probability of normal distribution of 57.9%.

They should not be so large as to produce a negative marginal cost. Estimated values fit expectations of the model, with lower marginal costs in the spring months. The estimates are all significantly different from zero at the 5% level or better. Therefore we accept the hypothesis that the level of marginal cost does vary seasonally.

- Discontinuity for $M_1 > OQ$: β_q is the reduction factor for values of the quota premium when they exceed the penalty for delivering unlicensed milk. Its value should be between zero and one. If it is not significantly different from zero, then we reject the hypothesis of discontinuity. The t-test for β_q is significant to the .001% level. β_q is positive and less than one as predicted by the model. Therefore we accept the hypothesis of discontinuity.
- Serial correlation. β_s is the coefficient for serial correlation. It is significant to the .001% level, and close to one. We accept the hypothesis of serial correlation. Remaining residuals show no significant autocorrelation at the 5% level, either individually, or collectively over 12 months as determined by the Q-test. We accept the first order structure of serial correlation.
- Estimate of short run elasticity of milk supply: β_v is the inverse of elasticity of supply. At an estimated 8.73, it implies a highly inelastic supply. An

inelastic supply is to be expected because of the very short run (within a dairy year) under consideration. β_Y is significant to the 1% level.

- Year to year variation in marginal cost: β_Y 's represent the difference between October marginal cost in 1989/90 and other years. We expect the level of marginal cost to be vary from year to year with changes in productivity, input costs, and output levels. We expect the level of marginal cost to be volatile from year to year because of transitory factors such as weather, harvest, and feed quality. The estimated values for the annual dummies reflect this expectation.

Some of the t-statistics for the β_D 's do not pass a 5% level t-test, indicating they are not significantly different from zero. This does indicate they should be dropped from the regression. It is quite possible that marginal cost in one year may be close to, but not equal to, marginal cost in another year. The t-statistics for individual years will vary arbitrarily depending on which year is chosen as the reference year. Had a year other than 1989/90 been chosen, different β_D 's would appear to be insignificant. The correct test for the significance of annual dummies is to test them as a class. Either marginal cost varies from year to year, or it does not. If annual dummies are significant as a class, then they should all be included. An F-test was run comparing the sum of squared residuals of (6.8) to the sum of squared residuals after

dropping the annual dummies. The unrestricted sum of squared residuals was 848.6, compared to a restricted sum of squares of 1572.7. The resulting F-statistic was 7.31, well in excess of the critical one percent value ($F_{7,60} = 3.65$).

Therefore we accept that marginal cost varies between years.

- General validity of model: The model and its estimated parameters are acceptable.
 - The F-test shows the total relationship to be significant to .00001%
 - Individual coefficients are significant according to the relevant t and F statistics.
 - Estimated parameter values are within theoretical bounds and consistent with expectations.
 - Error terms indicate normally distributed disturbance term and an absence of serial correlation.
 - The explained variance is high, at 97%.
 - The visual fit is good, with turning points of the fit matching well with turning points of the dependent variable.

Figure 6: Fitted Values

The visual fit is illustrated in Figure 6, where dollar values have been converted to constant 1989 dollars.

6.9 Testing Hypotheses on Seasonal Production Constraints

As discussed in the previous section, significant seasonal variation in marginal cost levels may not occur without either wide seasonal variation in prices, or constraints on the allocation of quota use within the regulatory period. In the case of the OMMB, there must be some form of constraint to the allocation of quota use within months of the year, since we witness significant seasonal variation in marginal cost levels and relatively stable prices.

The lack of an explicit regulation limiting within period quota use forced the use of a seasonal adjustment model to estimate supply price. We may now use this model to test hypotheses for the nature of the constraint.

One hypothesis is that farmers perceive that the rule limiting when payment is made in the last four months of the year as an actual limit on the use of quota. The regulation reads as follows (MSQ refers to "market sharing quota", the name for industrial milk quota):

"4. Monthly MSQ's In Effect, April to July

In the first eight months of the dairy year, each producer may use up to 80 per cent of the MSQ available to him. For payment purposes the remaining 20 per cent will be available for use at the rate of five percent per month during April, May, June, and July, plus any unused MSQ carried forward." (*Quota Policies*. Pg. 12. OMMB 1989)

The phrase "for payment purposes" means that the actual penalty for exceeding the monthly limits is a delay in payment until the end of the year. The over-quota levy is actually charged only on excess production over the entire year.

If farmers believe this regulation to be binding, then we would expect to see a seasonal pattern to premium values similar to the one that exists. Un-used quota purchased later in the year would be worth more since a greater proportion of it could be used in the cheaper production months of the spring and summer.

If this regulation were also the sole constraint to monthly production, then we would expect the seasonal level of marginal cost in the first eight months to be roughly the same. Differences would occur only because of the discount rate and seasonal variation in farm price. From (5.4) we would expect that the level of marginal cost in month j would be approximately

$$MC_j = MC_i(1+r_j)^{(j-i)} + P_{ij} - P_{ii}(1+r_j)^{(j-i)} \quad (6.9)$$

We may use (6.9) to develop the hypothesis in terms of the value of β_{s4} , the seasonal adjustment factor for November. Let $E\{.. \}$ be an expectations operator, and $\text{Cov}\{a,b\}$ be the covariance between a and b . If allocation of quota use between the months of October and November is unconstrained, then we expect

$$\begin{aligned} E\{\beta_{s4}\} &= E\{MC_{y4} - MC_{y3}\} = E\{MC_{y3}r_{y4}\} + E\{(P_{y4} - P_{y3})(1+r_{y4})\} \\ &= E\{MC_{y3}\}E\{r_{y4}\} + E\{(P_{y4} - P_{y3})(1+r_{y4})\} + \text{Cov}\{r_{y4}, MC_{y3}\} \end{aligned} \quad (6.10)$$

We expect the covariance term to be positive. The higher the rate of interest, the earlier farmers will allocate production, and the higher the marginal cost in October. Therefore, we may say that

$$E\{\beta_{s4}\} \geq E\{MC_{y3}\}E\{r_{y4}\} + E\{(P_{y4} - P_{y3})(1+r_{y4})\} \quad (6.11)$$

Using observed means from the eight year sample, let

$$E\{r_4\} \approx .0050 \quad \text{and} \quad E\{(P_4 - P_3)(1+r_4)\} \approx -.0193 \quad (6.12)$$

Using the estimated parameters for MC_3 and the β_{Dy} 's, we may calculate the mean of estimated MC_3 to be \$37.49. Thus, if the 8 month limit is the only within year production constraint, we expect

$$E\{\beta_{s4}\} \geq .0050(\$37.49) - .0193 = \$.1656 \quad (6.13)$$

That is, we expect the difference between the levels of marginal cost in October and November to be greater than approximately seventeen cents. Since the estimated value of β_{s4} is less than this critical value at (-\$.43), we may conduct a t-test as if β_{s4} was expected to equal (.1656). Let

$$t = (\beta_{s4} - .0532) / (\text{Standard Deviation of } \beta_{s4}) = -4.13 \quad (6.14)$$

This t statistic is well outside the critical 5% value of -2.00. Therefore we reject the hypothesis that farmers are free to allocate quota use between October and November. By extension, we reject the hypothesis that the sole reason for seasonal variation in premium values is farmers' misinterpretation of the limitation of payments to 80% of quota in the first eight months of the year.

Examination of the estimates and t-statistics for the other seasonal adjustment factors indicate a similar conclusion.

It is still possible that farmers interpretation of quota limitations in the last four months operates in conjunction with other unknown institutional constraints. Additional possibilities are:

- The quota maintenance requirement. Industrial milk producers are required to produce at least 85% of quota over the course of the year. If farmers interpret this requirement as a monthly requirement, then monthly quota use would be constrained during high cost winter months. A potential reason for farmers misinterpretation of the rule may be the separate daily production maintenance requirement for fluid milk quota.
- Administrative pressure. Monthly regularity in milk deliveries is a concept regularly endorsed by the OMMB's *Ontario Milk Producer*.
- Transportation system. The milk transport system is centrally managed by the OMMB. Administrative allocation of milk transport capacity may depend upon regular delivery, or performance in relation to quota.

The actual institutional constraints remain unknown, but the strong seasonal variation in observed premium for unused quota indicate that they must exist. In the absence of further institutional information, the seasonal adjustment model estimated in this section provides the best estimate of monthly levels of marginal cost, and supply price.

6.10 Estimates of Supply Price

We may estimate supply price for each year ex post of the revelation of transitory factors (MC_y), from the estimated coefficients of (6.8).

From (5.1), the supply price for any given year, ex post of the revelation of transitory factors, is the weighted average of marginal cost levels for each month⁵³

$$MC_y = \sum_{j=1}^{12} w_{yj} MC_{yj} \quad (6.15)$$

(6.8) provides us with estimates of the level of marginal cost for 10 months of the year. Estimates for August and September are absent because data on over-quota premia does not exist for these months. We will use the 10 month average as an estimate of the 12 month average. Let the superscript (*) denote an estimator.

$$\begin{aligned} MC_y^* &= \sum_{j=3,12} w_{yj} MC_{yj}^* = MC_{s,3}^* + \beta_{Dy}^* + \sum_{j=4}^{12} \beta_{Sj}^* w_{yj} \\ &= MC_{s,3}^* + \sum_{y=1,7} \beta_{Dy}^* D_y + \sum_{j=4}^{12} \beta_{Sj}^* w_{s,j} \end{aligned} \quad (6.16)$$

⁵³ Disregarding the discount rate places the estimate approximately mid-year, appropriate for an annual estimate.

A 10 month average will be close to the 12 month average by virtue of the number of months alone. If the missing two months represent average conditions, then the 10 month average will be a good estimator for the 12 month average. Cost conditions during September and August are very close to annual averages. It is after the spring flush, but before the winter "dry" months. Production statistics, illustrated in Figure 4, support this. The average daily production index for the sample period was 1.026 in August and .993 in September, relatively close to the average daily production for the whole year (1.000). While average cost conditions do not necessarily represent the level of marginal cost, it is reasonable to assume that institutional constraints on farmer milk deliveries between months are likely to be those which moderate extremes of high and low volume months. As a result, intermediate production months are likely to be unconstrained production, and marginal cost in those months is more likely to approach average conditions. This is supported by the estimated values for the seasonal adjustment factors (the β_{Dy} 's), which indicate higher levels of marginal cost during the high cost winter months, and lower levels of marginal cost during the low cost spring and summer months.

(6.16) is a linear function of the weights and the dummy variables, where the variance and covariance of the coefficients is known (asymptotically) from the regression results. Therefore, it is possible to calculate both a mean value and an approximate confidence interval using standard approach (t-statistic).

Similarly, we may define the an estimator for MCX , the supply price ex ante of transitory annual conditions, as the average of the annual supply price over the eight year sample period. Let

$$\begin{aligned}
 MCX' &= .125(\sum_{y=1}^8 \sum_{j=3,12} w_{y3j} MC_{y3j}') \\
 &= MC_{8,3}' + \sum_{y=1}^7 \beta_{Dy}'(.125) + \sum_{j=4,12} \beta_{Sj}'(.25w_{leap,3j} + .75w_{nonleap,3j})
 \end{aligned} \tag{6.17}$$

where $w_{leap,3j}$ are the mean proportions of production for each month in leap years, and $w_{nonleap,3j}$ are the mean proportions for non-leap years, as per (6.3). Again, (6.17) is linear and the estimated variance-covariance matrix of coefficients available from the regression of (6.8).

The annual mean of past ex-post supply prices (MCX') is a conservatively biased estimator of ex ante supply price in 1989/90. It does not include the impact of advancing productivity in the dairy industry. In addition, it should be noted that the confidence interval that is estimated is actually for the mean of 10 month average marginal costs over the sample period. The extent to which this interval can be relied on to represent the variance of the estimator from current values is a matter of judgement. It is clear from the estimates in individual years that year to year conditions are quite volatile, leading to a wide confidence interval even when averaging over eight years.

Table 3 ESTIMATED SUPPLY PRICES USING 10 MONTH AVERAGE LEVELS OF MARGINAL COST (OCT-JUL) (Constant \$1989/Hectolitre)			
Year	95% Confidence Interval		
	Lower Bound	Mean	Upper Bound
Mean For 1982/83 - 88/89	\$24.75	\$27.91	\$31.07
1982/83	\$26.07	\$31.61	\$37.16
1983/84	\$10.23	\$14.65	\$19.06
1984/85	\$35.69	\$44.56	\$53.43
1985/86	\$11.44	\$16.19	\$20.95
1986/87	\$10.19	\$18.83	\$27.46
1987/88	\$29.98	\$35.51	\$41.04
1988/89	\$21.48	\$26.94	\$32.39
1989/90	\$26.19	\$34.98	\$43.77

Mean estimates and confidence intervals are reported in Table 3.⁵⁴ The mean estimate of 10 month average marginal cost over the sample period is \$27.91 per hectolitre in constant \$1989. If we are willing to accept this is average as representative of future expectations of a 12 month average, then the supply price for milk in Ontario in 1989/90, prior to transitory annual factors, is estimated at \$27.49 per hectolitre. The supply price may be compared to the effective price received by farmers during the same period. The average price in 1989/90, inclusive of federal subsidies and net of the federal levy, was

⁵⁴ Calculated using a Lotus 1-2-3 matrix macro.

\$47.83 per hectolitre.⁵⁵ Thus, the mean estimate of supply price for 1989/90 is 58.4% of the farm price inclusive of subsidies and levies. Applying the confidence interval from Table 3 suggests a 95% confidence interval for supply price from 51.7% of the price received to 65.0% of price received.

While a supply price only 58.4% of farm price is a substantial discount, it should be recalled that this is a *conservative* estimate. As noted earlier:

- The use of a historical average for an estimator does not account for increases in farm productivity, which would lower supply price at the end of the period.
- The estimation process is designed to remove the bias present in simple averages of monthly quota premia, which give too much weight to cost conditions in the low cost spring months.
- The simple average of the ratio of unused quota premium to farm price over the sample period implied a supply price of only 48.2% of farm price after adjusting for tax benefits (see Section 3.3). The mean estimated supply price is higher because it corrects for overweighting given to low cost conditions at the end of the year.

⁵⁵ The price is for a hectolitre of average butterfat content, where monthly prices are weighted according to the seasonal volume weights used in developing the supply price estimates (W_j). The number is calculated from price and weight data in Appendix B.

In addition, it should be recalled that this estimate of supply price is not for a hypothetical free market. It is an estimate of supply price *inclusive of institutional constraints and benefits associated with supply management and marketing boards*. The estimated cost level includes administrative levies by the provincial boards, and any other institutional restrictions on output, transport of milk, or technology employed. Thus, the estimate can be used as a suitable point of departure for analyzing the welfare impacts of expanding quota restrictions within the context of a continued supply management regime.

The estimated supply price of 58.4% of farm price contrasts sharply with Moschini (1987)'s estimate of supply price as 85% of farm price. Moschini's estimate was based on cost function estimates, based on data gathered through the Ontario Dairy Farm Accounting Project (ODFAP). The contrast illustrates the importance of having an method of estimating supply price independent of the potential biases of accounting data. Despite the width of our confidence interval (51.7% to 65.0%), it is clear that Moschini's 1987 estimate is strongly contradicted by farmers' willingness to pay for dairy quota.

6.11 Examining the Rate of Return on Quota ($r+\pi+g$)

Early sections of this paper demonstrated that estimates of the rate of return to quota should include allowance for policy risk and undiversifiable risk by farmers. It was also

found that many past estimates of the welfare impact of supply restrictions had not made these allowances. As a result, rates of return embodied in quota values were likely underestimated, significantly overestimating supply price and underestimating welfare impacts.

The regression estimates for Ontario industrial milk provide additional support to the suggestion that supply prices have been underestimated in past studies of marketing boards.

We may compare the rate of return on quota implied by our estimate with the other authors cited. From (1.12) we define the expected rate of return net of tax benefits as

$$(r+\pi-g) = (P-MCX)/(xQV) \quad (6.19)$$

where x is the proportion of quota value not a tax benefit, and QV is quota value ex ante of transitory factors. We cannot use the observed values of unused quota for QV because they would include transitory factors. For this purpose, we define (QV) as the value of used quota for the year in question, plus the ex ante expected return to quota for the current period.

$$QV = (\text{Average market value of used quota} + (P-MCX)) \quad (6.20)$$

Table 4 provides estimates of (6.19) based on the 95% confidence intervals for ($P-MCX$) provided in Table 3. The value of x employed is a simple average of the monthly values for x employed in the regression, based on (1.8).⁵⁶

Table 4 EXPECTED RATES OF RETURN EARNED BY QUOTA Based on 95% Confidence Interval of 10 month Average Returns per Hectolitre of Quota						
Year	Average Value of Used Quota Traded on Exchange (\$/hl.)	Real Average Value of Used Quota Traded on Exchange (\$1989)	Estimated % of Quota Value Not a Tax Benefit	Estimated Rate of Return ($r+\pi-g$)		
				Low	Mean	High
1982/83	\$47.30	\$61.80	88.3%	31.4%	34.0%	36.5%
1983/84	\$57.20	\$71.36	88.3%	28.3%	30.8%	33.2%
1984/85	\$65.60	\$78.85	87.9%	26.4%	28.8%	31.1%
1985/86	\$70.10	\$80.93	86.9%	26.2%	28.5%	30.8%
1986/87	\$60.10	\$66.48	86.3%	30.3%	32.9%	35.3%
1987/88	\$63.50	\$67.48	86.1%	30.0%	32.6%	35.0%
1988/89	\$54.70	\$55.72	87.6%	33.8%	36.6%	39.1%
1989/90	\$46.40	\$45.09	88.4%	38.6%	41.4%	44.1%
Average				30.6%	33.2%	35.6%

Average expected rate of return for the sample period is estimated at 33.2% with an a high and low estimate ranging from 30.6% to 35.6%. The high and low estimate may be interpreted as a 95% confidence interval if one is willing to accept the 10 month average estimates as a close approximation of the 12 month averages.

⁵⁶ Assumes an infinite intended holding period. For calculation of x series see Appendix C.

It is interesting to note the increasing rates of return in later years. This may be caused by increasing perception of policy risk as the prospects for liberalized trade in agricultural products grew under GATT negotiations and under the Canada-U.S. free-trade pact.

The estimated rates of return are substantially above the 8% employed by Veeman (1982) or the risk adjusted 20% employed by Lermer and Stanbury (1985). This suggests that there can be, indeed, significant non-diversifiable risk and policy risk in the holding of farm quota. This certainly appears to be the case with Ontario industrial milk quota. The arbitrary amortization periods employed by Arcus (1978) and Barichello (1981) produce levels more consistent with farmers willingness to pay for unused quota at 27% and 32.9% respectively.

We may not, however, mechanically transfer Arcus' or Barichello's amortization periods over to other jurisdictions, as the levels of risk may be different. For each jurisdiction, it is preferable to make an specific estimate, such as undertaken in this paper.

The evidence from Ontario industrial milk demonstrates the possibility for substantial policy risk and undiversifiable risk embodied in market value for quota. Estimates of supply price derived from quota values which do not account for these factors are likely to be overestimates.

6.12 Application of the Empirical Model to Other Jurisdictions

The empirical model employed for Ontario industrial milk may be generalized to other jurisdictions where data is available on used and unused quota.

Recall that the model is only necessary when seasonal variation in the premium for unused quota exhibits significant seasonal variation, indicating that quota use is controlled within the regulatory period. If the nature of the institutional constraints on production within the production period is not known, then seasonal adjustment factors for each month (or other time unit) may be employed, as in this paper. If the nature of the constraint is known, then the seasonal adjustment factors may be constrained to reflect the constraint. For example, if it had been found that Ontario farmers were free to allocate 80% of quota use within the first 8 months of the year, then only one seasonal adjustment factor would be shared by all those months.⁵⁷

7.0 COMPARISON OF ONTARIO SUPPLY PRICE TO \$U.S. PRICE

Concern over liberalized trade in dairy products focuses on the significant price differences between United States and Canadian milk prices. Table 5 shows U.S. prices

⁵⁷ Farmers will tend to allocate production between those months to equalize levels of marginal cost, subject to the effects of the discount rate and seasonal variations in price. Adjustment of the seasonal dummy variables could account for these differences. The same seasonal adjustment factor β_s would then be shared by all eight months.

of industrial milk, converted to Canadian \$ per hectolitre, over the sample period. The basis for comparison are prices for Minnesota-Wisconsin 3.5% butterfat.

Table 5 U.S. FARM PRICE OF INDUSTRIAL MILK Basis Minnesota-Wisconsin 3.5% Butterfat					
Calendar Year	U.S. Price (\$/cwt.)^a	Equivalent \$U.S./Hl.^b	Average Closing Spot Exchange Rate^c (\$US/Can)	Can \$ Price	Real Canadian Price^d (\$1989)
1982	\$12.49	\$28.35	\$0.81	\$34.84	\$47.75
1983	\$12.49	\$28.35	\$0.80	\$35.28	\$45.56
1984	\$12.29	\$27.90	\$0.76	\$36.88	\$45.58
1985	\$11.48	\$26.06	\$0.72	\$36.44	\$43.35
1986	\$11.30	\$25.65	\$0.72	\$35.41	\$40.46
1987	\$11.23	\$25.49	\$0.77	\$33.12	\$36.24
1988	\$11.03	\$25.04	\$0.84	\$29.86	\$31.40
1989	\$12.37	\$28.08	\$0.86	\$32.53	\$32.62
Average					\$40.37

Notes: ^a Dairy Situation Outlook and Report. *United States Dept. of Agriculture. Serial.*

^b Conversion factor of .4405 hectolitres/cwt. of milk, employed by Statistics Canada, *Farm Livestock and Animal Products Division.*

^c Bank of Canada Review. *January 1991, Table 11. Bank of Canada.*

^d Using Consumer Price Index, basis 1981.

The Minnesota-Wisconsin area is the major exporter of milk to the balance of the United States. Regulatory programs for milk in other areas of the United States use the Minnesota-Wisconsin price, plus transport costs, as a reference price.

The table shows an average price for U.S. milk during this period as \$40.37 per hectolitre, significantly above our mean estimate for Canadian supply price of \$27.91, and also above the upper bound of our 95% confidence interval of \$31.07. This suggests that the Canadian dairy industry, at least in Ontario, is cost competitive with U.S. dairy production and very viable under liberalized trade in agricultural products.

Care should be taken in the interpretation of this result. The series on U.S. prices may be biased by two elements. fluctuations in the exchange rate and U.S. regulatory programs. The exchange rates during the period appear to be volatile but representative. However, the presence of U.S. regulatory programs may have a strong impact on the observed U.S. price.

The U.S. has regulatory programs for both industrial and fluid milk. in a manner similar to Canada. The primary difference is the absence of production quotas.⁵⁸ The net impact of the programs on the price of industrial milk is mixed.⁵⁹ Briefly, U.S. dairy farmers are paid a blend price for both fluid and industrial milk, but only the price of fluid milk is regulated.⁶⁰ The blend price is determined on total sales by all farms, and may be treated

⁵⁸ The U.S. government has tried to deal with over-production with temporary programs. For example, the Dairy Termination Program paid farmers to destroy their herds and withdraw from the industry.

⁵⁹ For a complete discussion of U.S. dairy programs, see Ippolito & Masson (1978).

⁶⁰ For ease of exposition, we have neglected the distinction between Grade A and Grade B milk in the United States. Grade A is used for both fluid and industrial purposes. Producers of Grade A are paid a pool price of both fluid and industrial sales, with industrial price the lower price. Regulation for this purposes is divided into regional "milk sheds" consisting of all or parts of states. The industrial milk price of Grade A is competitively determined by the price of Grade B milk, which can also be

as constant with respect to individual farm production. The blend price is, by definition, higher than the price of industrial milk alone. Since farmers are free to expand production until marginal cost equals the blend price, the price of industrial milk is forced below the level of marginal cost. At the same time, the U.S. federal Commodity Credit Corporation supports a target price for butter, skim milk powder, and other dairy products through a purchase program. This has the impact of supporting industrial milk prices.

Past estimates of the net impact of U.S. programs suggest that, on the whole, their net impact is to depress the price of industrial milk. Ippolito & Masson (1978) estimated that the price of industrial milk is depressed by 5.0% to 6.3% relative to an unregulated market. More recently, LaFrance & DeGorter (1985) estimated that prices of industrial milk were depressed by about 5%. However, U.S. dairy policy has undergone continual evolution since the data under which these estimates are based.

Therefore, it is difficult to make a conclusive comparison to the underlying cost-competitiveness of U.S. and Ontario dairy farms without a separate analysis of current U.S. dairy policy. It may be possible that the overproduction encouraged by U.S. policies, in combination with the underproduction caused by Ontario quotas, means that Ontario is relatively lower on its supply curve than the U.S. In this case, Ontario supply price at present may be genuinely lower than U.S. supply price, and unregulated markets

used for industrial purposes. Grade B is milk produced and collected under older "milk-can" technology, or Grade A milk from out of the area (such as from Minnesota-Wisconsin) which is sold as Grade B. In reality, most Grade B milk meets Grade A standards.

under free trade might produce a shift in milk production to Ontario. While this is a possibility, no conclusion can be drawn without a concurrent examination of the net impact of U.S. regulation, a subject beyond the scope of this paper.

It is possible to make a more limited comparison on the assumption that liberalized trade in agricultural goods would involve export of milk and milk products based on current U.S. price levels. This would be the case if the U.S. retained its current domestic policies, but was not permitted to specially subsidize its milk exports, as both Canada and the U.S. do at present under their respective milk surplus disposal programs.

If we examine the column of U.S. prices in real Canadian \$, we see a clear downward trend. Taking the domestic price in the last year of the sample period (1989), we have a potential U.S. import cost (before transport costs) of \$32.62 per hectolitre. This much more competitive than the sample mean price for U.S. milk of \$40.37. However, a U.S. price of \$32.62 is still above the upper bound estimate for the supply price of Ontario milk, at \$31.07 (constant \$1989).

Therefore, we may conclude there is a strong likelihood that the Ontario dairy industry is cost competitive with U.S. dairy production and, assuming unchanged domestic U.S. dairy policy, could potentially increase its output levels under liberalized trade in agricultural products.

8.0 CONCLUSION

This paper has examined the issue of determining agricultural supply price when marketing boards restrict output through quota. The issue is important for both determining the welfare impact of supply restrictions and the viability of agricultural industries under the prospect of liberalized trade.

A model of the relationship between supply price and the market value of farm quota was developed. The model showed that estimates of supply price from quota values must account for policy risk, undiversifiable risk, and tax benefits. The model also defined the theoretical relationship between these factors, and provided a means of calculating tax benefits. Analysis of the model suggested that deriving an accurate supply price from gross quota values is difficult because of lack of quantitative information on policy risk and the degree to which risk is undiversifiable.

Past empirical estimates of supply price under Canadian poultry and dairy marketing boards were reviewed. It was found that past studies had omitted consideration of policy risk and undiversifiable risk, as well as tax considerations. These omissions suggested inaccuracy. The omission of risk factors suggested too high a supply price, while the omission of tax considerations suggested too low a supply price.

A review of casual empirical evidence from selected jurisdictions suggested that the net effect was to significantly underestimate supply price, except for studies where arbitrary amortization periods were employed to determine annual quota returns.

An alternative method for deriving estimates of supply price from quota data was suggested. The approach bypasses the difficulties in assessing risk factors by examining the difference between the market value of "used" and "unused" quota (termed the "premium"). This approach is found to be simple if premia do not have significant seasonal variation. However, if seasonal variation in the value of the premium exists, it is indicative of constraints to the allocation of quota use within the regulatory period. In this case, estimates of supply price derived from simple averages of premia will be biased by over-weighting cost conditions at the end of the regulatory period. A specific modelling effort is required.

A model containing seasonal adjustment factors was suggested for the case where the nature of institutional constraints is not known. A specific model was developed for the case of Ontario industrial milk during the period 1982/83 to 1989/90. The model accounted for seasonal variation in marginal cost levels, changes in regulatory fee structures, changes in quota levels, and the ability to deliver milk in excess of quota at a lower price.

Estimates derived from the model suggested that in 1989/90, the supply price of milk in Ontario, ex ante of annual transitory factors, was \$27.91 per hectolitre, or only 58.4%% of an average farm price in 1989/90 of \$47.83 per hectolitre (after federal subsidies and levies). This estimate is conservative in that it does not allow for reductions in supply price due to increased productivity over the sample period. The estimate also represents real costs as they exist under the current supply management regime, inclusive of whatever inefficiencies or benefits result from that regime. A 95% confidence interval for this estimator of supply price was found to be from \$24.75 to \$31.07. This confidence interval implied an average rate of return embodied in quota values, of between 30.6% to 35.6%.

The results:

- confirm the hypothesis that there can be significant premia for undiversifiable risk and policy risk incorporated in the market value for quota.
- support the suggestion that estimates of supply price under marketing boards should employ methodologies which account for risk and policy risk.

- support the likelihood that the welfare cost estimates of Canadian marketing boards have been underestimated (Arcus(1981), Veeman (1982), Lerner & Stanbury (1984))
- demonstrate a workable methodology for deriving supply price estimates under quota restrictions by other jurisdictions, when data on the market value of used and unused quota are available.
- suggest that significant welfare gains may be available from the expansion of quota limits for Canadian industrial milk, at least in the case of Ontario.

In addition, estimated supply price was compared to U.S. milk prices. The average price of U.S. industrial milk for the sample period was \$40.37 per hectolitre (constant Canadian \$1989). This is above both the mean estimated supply price for Ontario of \$27.91, and the upper bound estimate of \$31.07.

Caution was urged in the interpretation of this data, since U.S. prices are themselves influenced by U.S. domestic dairy programs. On a more limited basis, the estimate of Ontario supply price was compared to U.S. prices in the final year of the sample (1989). The converted U.S. price of \$32.62 per hectolitre was still above the upper bound of our estimate for Ontario supply price.

Therefore, we conclude that there is a likelihood that the Ontario dairy industry is cost competitive with U.S. dairy production and, assuming unchanged domestic U.S. dairy policy, could potentially increase its output levels under liberalized trade in agricultural products. A potential reason for this result is that U.S. policies have the net effect of encouraging overproduction of milk, and Canadian policies restrict production. Current levels of production may place Ontario output relatively lower on its supply curve than U.S. output.

While volatility of exchange rates and the presence of U.S. dairy regulation make the \$U.S. price difficult to interpret, the balance of evidence suggests that the Ontario dairy industry is cost competitive with U.S. producers, and would remain viable under liberalized trade in agricultural products with the United States.

5 OF 5

PM-1 3½"x4" PHOTOGRAPHIC MICROCOPY TARGET
NBS 1010a ANSI/ISO #2 EQUIVALENT

PRECISIONSM RESOLUTION TARGETS

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APPENDIX A: DETAILED RESULTS

This appendix reports the summary statistics, variance-covariance matrix, residuals, and analysis of residuals from the estimation of (6.8).

$$MWT_{y_i} = WT_{y_i}[X_{y_i} + \beta_u X_{y_i-1}] + \gamma_{y_i} \quad (i \in 3 \text{ to } 12) \quad (6.8)$$

Where WT_{y_i} are weights to adjust for heteroscedasticity, MWT_{y_i} is the weighted dependent variable M_{y_i} , and

$$\begin{aligned} X_{y_i} = & (1 - \beta_Q D_{Qy_i}) [WP_{y_i} - ((MC_{8,3} + \sum_{j=1,7} \beta_D D_{y_i}) WK_{y_i} + \sum_{k=4,12} \beta_{Sk} WS_{ki}) (1 + \beta_V V_{y_i})] \\ & + \beta_Q D_{Qy_i} OQ_{y_i} \end{aligned} \quad (6.7)$$

The model was estimated by iterative non-linear least squares using Time Series Processor Version 7.0.

RESULTS OF ESTIMATION						
Coefficient Description	Name	# in Regr.	Coefficient Estimate	Standard Error	T-Stat	2-Tailed Signif.
OQ Levy % Reduction	β_0	C(5)	0.7418809	0.1023971	7.2451329	0.0000
MC Oct. 1989	MC_{83}	C(1)	44.561068	4.0524273	10.996143	0.0000
\$ Relative Difference Between MC Oct. in 1989 and Oct. in Other Years	β_{D1}	C(22)	-3.3663996	4.7470541	-0.7091555	0.4810
	β_{D2}	C(23)	-20.322289	4.8581412	-4.1831409	0.0001
	β_{D3}	C(24)	9.5801171	5.7495150	1.6662479	0.1009
	β_{D4}	C(25)	-18.785115	4.8030459	-3.9110838	0.0002
	β_{D5}	C(26)	-16.151394	5.3978468	-2.8346486	0.0062
	β_{D6}	C(27)	0.5417977	4.8319462	0.1121282	0.9111
	β_{D7}	C(28)	-8.0404367	4.8679426	-1.6517115	0.1038
Seasonal Adjustment Factors (\$ Difference Relative to Oct. MC)	β_{S4}	C(34)	-5.4264303	1.3174691	-4.1188292	0.0001
	β_{S5}	C(35)	-6.5535147	1.8207555	-3.5993380	0.0006
	β_{S6}	C(36)	-8.8227744	1.9464718	-4.5327008	0.0000
	β_{S7}	C(37)	-12.375735	2.1696320	-5.7040709	0.0000
	β_{S8}	C(38)	-14.892387	2.4597344	-6.0544693	0.0000
	β_{S9}	C(39)	-11.449876	2.3404626	-4.8921422	0.0000
	β_{S10}	C(40)	-13.122641	2.8233432	-4.6479086	0.0000
	β_{S11}	C(41)	-13.793898	2.8641817	-4.8159997	0.0000
	β_{S12}	C(42)	-7.9874487	3.1053063	-2.5721935	0.0126
Short Run η_S	β_V	C(3)	8.7291496	2.6977748	3.2356851	0.0020
Serial Corr.	β_u	C(6)	0.9962135	0.0460117	21.651285	0.0000
SUMMARY STATISTICS						
R-squared			0.973634	Mean of dependent var		28.35759
Adjusted R-squared			0.965284	S.D. of dependent var		20.18437
S.E. of regression			3.760774	Sum of squared resid		848.6052
Log likelihood			-207.9778	F-statistic		116.6124
Durbin-Watson stat			1.844435	Prob(F-statistic)		0.000000

SYS - Iterative Weighted LS

Date: 11-25-1992 / Time: 21:36

SMPL range: 27 - 36 39 - 48 51 - 60 63 - 72
75 - 84 87 - 96 99 - 108 111 - 120

Number of observations: 80

System: FINLIN.SYS - 1 Equations

Convergence achieved after 10 iterations

=====

Coefficients

=====

C(5)	0.741881	C(1)	44.56107	C(22)	-3.366400	C(23)	-20.32229
C(24)	9.580117	C(25)	-18.78511	C(26)	-16.15139	C(27)	0.541798
C(28)	-8.040437	C(34)	-5.426430	C(35)	-6.553515	C(36)	-8.822774
C(37)	-12.37573	C(38)	-14.89239	C(39)	-11.44988	C(40)	-13.12264
C(41)	-13.79390	C(42)	-7.987449	C(3)	8.729150	C(6)	0.996213

=====

Residual Covariance Matrix

=====

1,1 10.60756

=====

Residual Correlation Matrix

=====

1,1 1.000000

=====

Determinant(Residual Covariance Matrix) 10.607565

=====

SYS - Iterative Weighted LS // Dependent Variable is MWT

Date: 11-25-1992 / Time: 21:37

SMPL range: 27 - 36 39 - 48 51 - 60 63 -
72 75 - 84 87 - 96 99 - 108 111 - 120

Number of observations: 80

System: FINLIN.SYS - Equation 1 of 1

MWT = WT*(((1-C(5)*DQ)*(WP-((C(1)+C(22)*D2+C(23)*D3+C(24)*D4+C(25)*D5+C(26)*D6+C(27)*D7+C(28)*D8)*WK+C(34)*WS4+C(35)*WS5+C(36)*WS6+C(37)*WS7+C(38)*WS8+C(39)*WS9+C(40)*WS10+C(41)*WS11+C(42)*WS12)*(1+C(3)*V))+C(5)*DQ*OQ)+C(6)*(M(-1)-((1-C(5)*DQ(-1))*(WP(-1)-((C(1)+C(22)*D2(-1)+C(23)*D3(-1)+C(24)*D4(-1)+C(25)*D5(-1)+C(26)*D6(-1)+C(27)*D7(-1)+C(28)*D8(-1))*WK(-1)+C(34)*WS4(-1)+C(35)*WS5(-1)+C(36)*WS6(-1)+C(37)*WS7(-1)+C(38)*WS8(-1)+C(39)*WS9(-1)+C(40)*WS10(-1)+C(41)*WS11(-1)+C(42)*WS12(-1))*(1+C(3)*V(-1)))))+C(5)*DQ(-1)*OQ(-1))))

Convergence achieved after 10 iterations

	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C(5)	0.7418809	0.1023971	7.2451329	0.0000
C(1)	44.561068	4.0524273	10.996143	0.0000
C(22)	-3.3663996	4.7470541	-0.7091555	0.4810
C(23)	-20.322289	4.8581412	-4.1831409	0.0001
C(24)	9.5801171	5.7495150	1.6662479	0.1009
C(25)	-18.785115	4.8030459	-3.9110838	0.0002
C(26)	-16.151394	5.6978468	-2.8346486	0.0062
C(27)	0.5417977	4.8319462	0.1121282	0.9111
C(28)	-8.0404367	4.8679426	-1.6517115	0.1038
C(34)	-5.4264303	1.3174691	-4.1188292	0.0001
C(35)	-6.5535147	1.8207555	-3.5993380	0.0006
C(36)	-8.8227744	1.9464718	-4.5327008	0.0000
C(37)	-12.375735	2.1696320	-5.7040709	0.0000
C(38)	-14.892387	2.4597344	-6.0544693	0.0000
C(39)	-11.449876	2.3404626	-4.8921422	0.0000
C(40)	-13.122641	2.8233432	-4.6479086	0.0000
C(41)	-13.793898	2.8641817	-4.8159997	0.0000
C(42)	-7.9874487	3.1053063	-2.5721935	0.0126
C(3)	8.7291496	2.6977748	3.2356851	0.0020
C(6)	0.9962135	0.0460117	21.651285	0.0000

Unweighted Statistics

R-squared	0.973634	Mean of dependent var	28.35759
Adjusted R-squared	0.965284	S.D. of dependent var	20.18437
S.E. of regression	3.760774	Sum of squared resid	848.6052
Log likelihood	-207.9778	F-statistic	116.6124
Durbin-Watson stat	1.844435	Prob(F-statistic)	0.000000

Residual Plot	obs	RESIDUAL	ACTUAL	FITTED
:	27	2.87476	11.9987	9.12398
:	28	2.11764	18.4197	16.3021
:	29	1.32216	53.2290	51.9069
:	30	0.76116	69.2860	68.5249
:	31	0.00609	73.1205	73.1144
:	32	-2.97613	70.4070	73.3831
:	33	2.00757	71.1555	69.1479
:	34	1.45987	72.9160	71.4562
:	35	-0.46016	71.9163	72.3765
:	36	-1.38930	23.2807	24.6700
:	39	1.55911	23.9263	22.3672
:	40	-4.93078	22.3072	27.2380
:	41	-0.85369	22.4119	23.2656
:	42	0.62832	25.0313	24.4030
:	43	-1.35924	26.6640	28.0232
:	44	1.90665	30.6845	28.7778
:	45	4.12770	31.9395	27.8118
:	46	-2.12095	67.5273	69.6482
:	47	-6.01770	26.5310	32.5487
:	48	5.16267	26.5212	21.3585
:	51	-0.09354	-1.76024	-1.66670
:	52	10.6981	13.0791	2.38100
:	53	5.31887	19.0799	13.7610
:	54	-0.82854	19.8300	20.6585
:	55	3.56594	25.7586	22.1927
:	56	0.69511	33.3480	32.6529
:	57	-4.66536	26.1449	30.8103
:	58	2.20535	29.2393	27.0339
:	59	0.17479	29.5812	29.4064
:	60	8.08493	33.4982	25.4133
:	63	-2.67075	17.3184	19.9891
:	64	-1.78112	19.7402	21.5213
:	65	2.40975	22.9805	20.5707
:	66	2.27758	26.8972	24.6196
:	67	-0.74790	28.7756	29.5235
:	68	2.24016	33.0313	30.7912
:	69	3.42262	31.9697	28.5470
:	70	-1.36287	79.8460	81.2088
:	71	-0.28813	32.8720	33.1601
:	72	-7.57395	19.7430	27.3169
:	75	1.06868	18.0308	16.9621
:	76	0.16858	22.4011	22.2325
:	77	-5.28929	15.0073	20.2966
:	78	-1.22812	15.8330	17.0611
:	79	-2.54941	16.5511	19.1006
:	80	-3.23816	15.6275	18.8657
:	81	-0.02110	12.1093	12.1304
:	82	-0.81202	12.6860	13.4981
:	83	2.41433	15.5206	13.1063
:	84	0.50407	10.1700	9.66595
:	87	2.55175	5.38063	2.82888
:	88	2.06831	12.2885	10.2202
:	89	0.27649	9.86901	9.59252
:	90	-0.29101	11.4959	11.7869
:	91	4.30883	19.2152	14.9064
:	92	2.97396	66.5805	63.6066
:	93	-5.63680	58.9195	64.5563
:	94	3.07519	20.9292	17.8540
:	95	0.28579	21.4367	21.1510
:	96	-0.97968	14.8831	15.8628
:	99	2.53856	12.4771	9.93850
:	100	4.72053	21.9024	17.1819
:	101	-0.76228	21.9138	22.6760
:	102	-1.79550	21.8162	23.6117
:	103	1.63037	56.5069	54.8766
:	104	-2.29270	54.9726	57.2653

	*	:	:	105	-4.50968	48.7342	53.2439
	:	:	*	106	3.92844	52.8912	48.9627
	:	:	:	107	2.51258	55.3117	52.7991
	:	*	:	108	-0.89113	51.3994	52.2905
	:	*	:	111	-0.80055	1.75829	2.55883
*	:	:	:	112	-5.91553	0.00000	5.91553
:	:	*	:	113	3.06088	3.85822	0.79734
:	:	:	*	114	4.90360	10.4464	5.54282
:	*	:	:	115	-2.69758	18.0858	20.7834
*	:	:	:	116	-4.87040	14.4890	19.3654
:	*	:	:	117	-2.94049	9.52603	12.4665
:	:	*	:	118	1.10773	11.4150	10.3072
:	:	:	*	119	4.32707	15.8450	11.5180
:	*	:	:	120	-2.23984	10.0763	12.3162

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Coefficient Covariance Matrix

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C(5),C(5)	0.010485	C(5),C(1)	-0.009076
C(5),C(22)	-0.057037	C(5),C(23)	0.057121
C(5),C(24)	0.009037	C(5),C(25)	-0.031315
C(5),C(26)	0.010959	C(5),C(27)	-0.100241
C(5),C(28)	0.002261	C(5),C(34)	-0.024241
C(5),C(35)	-0.034278	C(5),C(36)	-0.032337
C(5),C(37)	-0.063071	C(5),C(38)	-0.075961
C(5),C(39)	-0.061382	C(5),C(40)	-0.080599
C(5),C(41)	-0.079206	C(5),C(42)	-0.070803
C(5),C(3)	0.021610	C(5),C(6)	-0.000750
C(1),C(1)	16.42217	C(1),C(22)	-16.50931
C(1),C(23)	-16.40477	C(1),C(24)	-16.26037
C(1),C(25)	-16.16648	C(1),C(26)	-16.29213
C(1),C(27)	-16.00786	C(1),C(28)	-16.41948
C(1),C(34)	0.036100	C(1),C(35)	0.193874
C(1),C(36)	0.082059	C(1),C(37)	0.335124
C(1),C(38)	0.119021	C(1),C(39)	0.154303
C(1),C(40)	0.135961	C(1),C(41)	0.057401
C(1),C(42)	-0.023105	C(1),C(3)	-1.873492
C(1),C(6)	0.004523	C(22),C(22)	22.53452
C(22),C(23)	16.73468	C(22),C(24)	16.31858
C(22),C(25)	17.01366	C(22),C(26)	16.25703
C(22),C(27)	17.14985	C(22),C(28)	17.16115
C(22),C(34)	-1.106855	C(22),C(35)	-0.756025
C(22),C(36)	-0.609207	C(22),C(37)	-0.565311
C(22),C(38)	-0.264312	C(22),C(39)	-0.183311
C(22),C(40)	-0.529398	C(22),C(41)	-0.601891
C(22),C(42)	-0.866403	C(22),C(3)	2.530934
C(22),C(6)	-0.011603	C(23),C(23)	23.60154
C(23),C(24)	16.22898	C(23),C(25)	19.32741
C(23),C(26)	16.44043	C(23),C(27)	17.17768
C(23),C(28)	17.13821	C(23),C(34)	-0.626895
C(23),C(35)	-1.215051	C(23),C(36)	-1.519796
C(23),C(37)	-2.686864	C(23),C(38)	-3.563634
C(23),C(39)	-4.361557	C(23),C(40)	-3.755631
C(23),C(41)	-4.036354	C(23),C(42)	-3.751505
C(23),C(3)	1.690715	C(23),C(6)	-0.015531
C(24),C(24)	33.05692	C(24),C(25)	16.05914
C(24),C(26)	16.17519	C(24),C(27)	16.19942
C(24),C(28)	16.21576	C(24),C(34)	-0.023980
C(24),C(35)	-0.128561	C(24),C(36)	-0.049324
C(24),C(37)	-0.448083	C(24),C(38)	0.024464
C(24),C(39)	-0.071549	C(24),C(40)	-0.128882
C(24),C(41)	-0.091905	C(24),C(42)	-0.059665
C(24),C(3)	1.241972	C(24),C(6)	-0.007709
C(25),C(25)	23.06925	C(25),C(26)	15.22262
C(25),C(27)	18.03903	C(25),C(28)	16.84576
C(25),C(34)	-0.351157	C(25),C(35)	-0.764245
C(25),C(36)	-1.086982	C(25),C(37)	-2.085288
C(25),C(38)	-2.957150	C(25),C(39)	-3.973409
C(25),C(40)	-3.206518	C(25),C(41)	-3.551550
C(25),C(42)	-3.368534	C(25),C(3)	0.882031
C(25),C(6)	-0.013654	C(26),C(26)	32.46546
C(26),C(27)	16.14119	C(26),C(28)	16.42595
C(26),C(34)	-0.008416	C(26),C(35)	-0.489313
C(26),C(36)	-0.291432	C(26),C(37)	-0.556306
C(26),C(38)	-0.363644	C(26),C(39)	-0.336617
C(26),C(40)	-0.343967	C(26),C(41)	-0.267381
C(26),C(42)	-0.197795	C(26),C(3)	1.493261
C(26),C(6)	-0.003682	C(27),C(27)	23.347
C(27),C(28)	17.03702	C(27),C(34)	-0.340450
C(27),C(35)	-0.945799	C(27),C(36)	-1.508135
C(27),C(37)	-2.765789	C(27),C(38)	-1.823490
C(27),C(39)	-1.702742	C(27),C(40)	-2.211533
C(27),C(41)	-1.794420	C(27),C(42)	-1.746203
C(27),C(3)	0.263407	C(27),C(6)	-0.003387

C(28),C(28)	23.69687	C(28),C(34)	-0.891603
C(28),C(35)	-2.127562	C(28),C(36)	-2.860651
C(28),C(37)	-2.002867	C(28),C(38)	-1.421384
C(28),C(39)	-1.248509	C(28),C(40)	-1.267171
C(28),C(41)	-1.054879	C(28),C(42)	-0.914020
C(28),C(3)	3.403321	C(28),C(6)	-0.014170
C(34),C(34)	1.735725	C(34),C(35)	1.536126
C(34),C(36)	1.245858	C(34),C(37)	1.094103
C(34),C(38)	0.970786	C(34),C(39)	0.798958
C(34),C(40)	0.874081	C(34),C(41)	0.808292
C(34),C(42)	0.789706	C(34),C(3)	-0.570946
C(34),C(6)	-0.001382	C(35),C(35)	3.315151
C(35),C(36)	2.685090	C(35),C(37)	2.236591
C(35),C(38)	1.846699	C(35),C(39)	1.489824
C(35),C(40)	1.575857	C(35),C(41)	1.367792
C(35),C(42)	1.229220	C(35),C(3)	-1.693352
C(35),C(6)	-0.000215	C(36),C(36)	3.788753
C(36),C(37)	3.122083	C(36),C(38)	2.595962
C(36),C(39)	2.060277	C(36),C(40)	2.160678
C(36),C(41)	1.877449	C(36),C(42)	1.698130
C(36),C(3)	-1.788781	C(36),C(6)	-0.000153
C(37),C(37)	4.707303	C(37),C(38)	4.112542
C(37),C(39)	3.192608	C(37),C(40)	3.399745
C(37),C(41)	3.022514	C(37),C(42)	2.784663
C(37),C(3)	-0.982594	C(37),C(6)	0.000212
C(38),C(38)	6.050293	C(38),C(39)	4.495787
C(38),C(40)	4.454241	C(38),C(41)	4.090919
C(38),C(42)	3.826436	C(38),C(3)	-0.187078
C(38),C(6)	0.004419	C(39),C(39)	5.477765
C(39),C(40)	5.222653	C(39),C(41)	4.851011
C(39),C(42)	4.561255	C(39),C(3)	-0.427254
C(39),C(6)	0.011561	C(40),C(40)	7.971267
C(40),C(41)	6.671218	C(40),C(42)	6.284849
C(40),C(3)	-0.361134	C(40),C(6)	0.018660
C(41),C(41)	8.203537	C(41),C(42)	7.756792
C(41),C(3)	-0.118960	C(41),C(6)	0.025836
C(42),C(42)	9.642927	C(42),C(3)	0.122823
C(42),C(6)	0.031299	C(3),C(3)	7.277989
C(3),C(6)	-0.020170	C(6),C(6)	0.002117

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IDENT RESID

Date: 11-25-1992 / Time: 21:37

SMPL range: 27 - 36 39 - 48 51 - 60 63 - 72
75 - 84 87 - 96 99 - 108 111 - 120

Number of observations: 80

Autocorrelations			Partial Autocorrelations			ac	pac	
.	*	.	.	*	.	1	0.040	0.040
***	.	.	***	.	.	2	-0.199	-0.201
.	*	.	.	*	.	3	0.049	0.070
.	.	.	.	*	.	4	0.000	-0.049
.	*	.	.	.	.	5	-0.056	-0.031
.	.	.	.	.	.	6	0.005	-0.002
.	*	.	.	.	.	7	0.049	0.035
.	*	.	.	*	.	8	0.084	0.090
.	.	.	.	.	.	9	0.023	0.029
.	.	.	.	.	.	10	0.000	0.028
.	.	.	.	.	.	11	0.000	0.002
.	.	.	.	.	.	12	0.000	0.010
Box-Pierce Q-Stat			4.56	Prob	0.9710	SE of Correlations		0.112
Ljung-Box Q-Stat			4.88	Prob	0.9619			

Date: 11-25-1992 / Time: 21:38

SMPL range: 27 - 36 39 - 48 51 - 60 63 - 72
75 - 84 87 - 96 99 - 108 111 - 120

Number of observations: 80

Variable	Mean	S.D.	Maximum	Minimum
RESID	0.2945662	3.2640420	10.698110	-7.5739480

INTERVAL	COUNT	HISTOGRAM
-8 >= RESID < -7	1	***
-7 >= RESID < -6	1	***
-6 >= RESID < -5	3	*****
-5 >= RESID < -4	4	*****
-4 >= RESID < -3	1	***
-3 >= RESID < -2	8	*****
-2 >= RESID < -1	6	*****
-1 >= RESID < 0	13	*****
0 >= RESID < 1	9	*****
1 >= RESID < 2	7	*****
2 >= RESID < 3	13	*****
3 >= RESID < 4	5	*****
4 >= RESID < 5	5	*****
5 >= RESID < 6	2	*****
6 >= RESID < 7	0	
7 >= RESID < 8	0	
8 >= RESID < 9	1	***
9 >= RESID < 10	0	
10 >= RESID < 11	1	***

Skewness 0.127231

Jarque-Bera normality test stat. 1.090438

Kurtosis 3.512230

Probability 0.579715

APPENDIX B: DATA TABLES

This Appendix provides the underlying data for the calculation of dependent and independent variables. For convenience, some of the key variable definitions are reviewed prior to each table. Data sources are provided at the end of each table. Tables in Appendix B are:

TABLE B-1: THE DEPENDENT VARIABLE M_{yi}

TABLE B-2: ADJUSTMENT OF DEPENDENT VARIABLE M_{yi} FOR INFLATION AND SPECIAL EXPORT LEVY

TABLE B-3: INDEPENDENT VARIABLES WK_{yi} , WS_{yi} , and V_{yi}

TABLE B-4: INDEPENDENT VARIABLE WP_{yi}

TABLE B-5: INDEPENDENT VARIABLES OQ_{yi} & $D_{Q,i}$

TABLE B-1: THE DEPENDENT VARIABLE M_{yi}

The dependent variable M_{yi} is the difference in price between the market value of unused quota ($QV_{unused,yi}$) and used quota ($QV_{used,yi}$) for month i of year y , adjusted to real 1989 dollars using the consumer price index, and adjusted for the special export levy.

$$M_{yi} = x_{yi}(QV_{unused,yi} - QV_{used,yi})(\text{CPI conversion factor})_{yi}(\text{adjustment\% for special export levy})_{yi} \quad (\text{B.1})$$

where x is the percentage of premium value not a tax benefits. From (1.8) and (1.11) of the text, assuming an infinite intended holding period,

$$x = 1 - \rho\theta f(r_{nominal} + f)^{-1} \quad (\text{B.2})$$

where ρ is the portion of quota value that may be subject to depreciation allowance, f is the annual percent depreciation allowed, and θ is the marginal tax rate. $r_{nominal}$ is the nominal interest rate expressed on an annual basis. Note that other variables in the model use a real monthly rate of interest r . is defined on a real monthly basis for the calculation of other variables in the model.

The special export levy was a very large levy imposed on the last few percent of within quota production during some periods. For example, in 1985/86 the last 4% of quota production was subject to this special levy, making the price of unit of quota effectively the price of (.96) of a unit of quota. The adjustment factor in this case would be (1/.96).

Table B-1: DEPENDENT VARIABLE M_y

Year	Month	$QV_{unmed,y}$ (\$/hl.) ^a	$QV_{med,y}$ (\$/hl.) ^a	Premium for Unused Quota	ρ Deprec- iable % ^b	θ Marginal Tax Rate ^b	f % Deprec- iation ^b	$r_{nominal}$ Prime Rate of Interest ^c	x % Not a Tax Benefit	Premium Net of Tax Benefits
1982/83	Aug				50.00%	50.73%	10.00%	16.00%	90.24%	
	Sep				50.00%	50.73%	10.00%	15.00%	89.85%	
	Oct	\$43.00	\$30.50	\$12.50	50.00%	50.73%	10.00%	13.75%	89.32%	\$11.16505
	Nov	\$51.00	\$31.60	\$19.40	50.00%	50.73%	10.00%	13.00%	88.97%	\$17.26060
	Dec	\$64.70	\$38.00	\$26.70	50.00%	50.73%	10.00%	12.50%	88.73%	\$23.69014
	Jan	\$84.90	\$50.10	\$34.80	50.00%	51.14%	10.00%	12.00%	88.38%	\$30.75561
	Feb	\$85.00	\$48.00	\$37.00	50.00%	51.14%	10.00%	11.50%	88.11%	\$32.59993
	Mar	\$75.00	\$39.00	\$36.00	50.00%	51.14%	10.00%	11.50%	88.11%	\$31.71885
	Apr	\$76.50	\$40.00	\$36.50	50.00%	51.14%	10.00%	11.00%	87.82%	\$32.05604
	May	\$87.60	\$50.10	\$37.50	50.00%	51.14%	10.00%	11.00%	87.82%	\$32.93429
	Jun	\$100.00	\$62.60	\$37.40	50.00%	51.14%	10.00%	11.00%	87.82%	\$32.84646
	Jul	\$84.50	\$58.90	\$25.60	50.00%	51.14%	10.00%	11.00%	87.82%	\$22.48314
1983/84	Aug				50.00%	51.14%	10.00%	11.00%	87.82%	
	Sep				50.00%	51.14%	10.00%	11.00%	87.82%	
	Oct	\$80.10	\$53.50	\$26.60	50.00%	51.14%	10.00%	11.00%	87.82%	\$23.36139
	Nov	\$79.80	\$55.00	\$24.80	50.00%	51.14%	10.00%	11.00%	87.82%	\$21.78054
	Dec	\$75.00	\$50.00	\$25.00	50.00%	51.14%	10.00%	11.00%	87.82%	\$21.95619
	Jan	\$73.00	\$45.00	\$28.00	50.00%	50.32%	10.00%	11.00%	88.02%	\$24.64533
	Feb	\$80.00	\$50.00	\$30.00	50.00%	50.32%	10.00%	11.00%	88.02%	\$26.40571
	Mar	\$94.50	\$60.00	\$34.50	50.00%	50.32%	10.00%	11.50%	88.30%	\$30.46270
	Apr	\$95.00	\$59.00	\$36.00	50.00%	50.32%	10.00%	11.50%	88.30%	\$31.78716
	May	\$91.10	\$55.00	\$36.10	50.00%	50.32%	10.00%	12.00%	88.56%	\$31.97147
	Jun	\$90.00	\$60.10	\$29.90	50.00%	50.32%	10.00%	12.50%	88.82%	\$26.55652
	Jul	\$100.00	\$70.10	\$29.90	50.00%	50.32%	10.00%	13.50%	89.29%	\$26.69879
1984/85	Aug				50.00%	50.32%	10.00%	13.00%	89.06%	
	Sep				50.00%	50.32%	10.00%	13.00%	89.06%	
	Oct	\$73.00	\$75.00	(\$2.00)	50.00%	50.32%	10.00%	12.50%	88.82%	(\$1.77636)
	Nov	\$70.00	\$55.00	\$15.00	50.00%	50.32%	10.00%	12.00%	88.56%	\$13.28455
	Dec	\$72.00	\$50.00	\$22.00	50.00%	50.32%	10.00%	11.25%	88.16%	\$19.39520
	Jan	\$80.10	\$57.00	\$23.10	50.00%	52.02%	10.00%	11.00%	87.61%	\$20.23890

Table B-1: DEPENDENT VARIABLE M_p

Year	Month	$QV_{mod,yt}$ (\$/hl.) ^a	$QV_{mod,yt}$ (\$/hl.) ^a	Premium for Unused Quota	ρ Deprec- iable % ^b	θ Marginal Tax Rate ^c	f % Deprec- iation ^d	$r_{nominal}$ Prime Rate of Interest ^e	x % Not a Tax Benefit	Premium Net of Tax Benefits
	Feb	\$95.10	\$65.00	\$30.10	50.00%	52.02%	10.00%	11.50%	87.90%	\$26.45860
	Mar	\$100.00	\$61.00	\$39.00	50.00%	52.02%	10.00%	11.75%	88.04%	\$34.33614
	Apr	\$95.10	\$64.20	\$30.90	50.00%	52.02%	10.00%	10.75%	87.47%	\$27.02670
	May	\$98.60	\$63.90	\$34.70	50.00%	52.02%	10.00%	10.50%	87.31%	\$30.29733
	Jun	\$105.10	\$69.80	\$35.30	50.00%	52.02%	10.00%	10.50%	87.31%	\$30.82120
	Jul	\$115.10	\$75.00	\$40.10	50.00%	52.02%	10.00%	10.50%	87.31%	\$35.01219
1985/86	Aug				50.00%	52.02%	10.00%	10.25%	87.16%	
	Sep				50.00%	52.02%	10.00%	10.25%	87.16%	
	Oct	\$80.00	\$59.90	\$20.10	50.00%	52.02%	10.00%	10.00%	87.00%	\$17.48600
	Nov	\$83.00	\$60.00	\$23.00	50.00%	52.02%	10.00%	10.00%	87.00%	\$20.00885
	Dec	\$86.90	\$60.00	\$26.90	50.00%	52.02%	10.00%	10.00%	87.00%	\$23.40166
	Jan	\$90.50	\$58.80	\$31.70	50.00%	55.42%	10.00%	11.00%	86.80%	\$27.51711
	Feb	\$98.60	\$65.00	\$33.60	50.00%	55.42%	10.00%	13.00%	87.95%	\$29.55193
	Mar	\$105.00	\$66.10	\$38.90	50.00%	55.42%	10.00%	12.00%	87.40%	\$34.00037
	Apr	\$108.00	\$70.10	\$37.90	50.00%	55.42%	10.00%	11.25%	86.96%	\$32.95784
	May	\$115.00	\$69.50	\$45.50	50.00%	55.42%	10.00%	10.25%	86.32%	\$39.27380
	Jun	\$114.00	\$74.50	\$39.50	50.00%	55.42%	10.00%	10.25%	86.32%	\$34.09484
	Jul	\$100.00	\$76.00	\$24.00	50.00%	55.42%	10.00%	9.75%	85.97%	\$20.63271
1986/87	Aug				50.00%	55.42%	10.00%	9.75%	85.97%	
	Sep				50.00%	55.42%	10.00%	9.75%	85.97%	
	Oct	\$85.10	\$63.00	\$22.10	50.00%	55.42%	10.00%	9.75%	85.97%	\$18.99929
	Nov	\$89.00	\$61.40	\$27.60	50.00%	55.42%	10.00%	9.75%	85.97%	\$23.72762
	Dec	\$80.00	\$61.00	\$19.00	50.00%	55.42%	10.00%	9.75%	85.97%	\$16.33423
	Jan	\$80.00	\$60.00	\$20.00	50.00%	52.53%	10.00%	9.25%	86.36%	\$17.27117
	Feb	\$80.00	\$59.00	\$21.00	50.00%	52.53%	10.00%	9.25%	86.36%	\$18.13473
	Mar	\$80.00	\$60.00	\$20.00	50.00%	52.53%	10.00%	8.75%	85.99%	\$17.19840
	Apr	\$77.50	\$62.00	\$15.50	50.00%	52.53%	10.00%	9.25%	86.36%	\$13.38516
	May	\$75.30	\$59.00	\$16.30	50.00%	52.53%	10.00%	9.50%	86.53%	\$14.10452
	Jun	\$76.00	\$56.00	\$20.00	50.00%	52.53%	10.00%	9.50%	86.53%	\$17.30615
	Jul	\$81.20	\$68.00	\$13.20	50.00%	52.53%	10.00%	9.50%	86.53%	\$11.42206
1987/88	Aug				50.00%	52.53%	10.00%	10.00%	86.87%	

Table B-1: DEPENDENT VARIABLE M_{μ}

Year	Month	QV_{market}^a (\$/hl.) ^a	QV_{used}^a (\$/hl.) ^a	Premium for Unused Quota	ρ Deprec- iable % ^b	θ Marginal Tax Rate ^b	f % Deprec- iation ^b	r_{nominal} Prime Rate of Interest ^c	x % Not a Tax Benefit	Premium Net of Tax Benefits
	Sep				50.00%	52.53%	10.00%	10.00%	86.87%	
	Oct	\$60.00	\$53.00	\$7.00	50.00%	52.53%	10.00%	9.75%	86.70%	\$6.06909
	Nov	\$56.30	\$40.00	\$16.30	50.00%	52.53%	10.00%	9.75%	86.70%	\$14.13231
	Dec	\$60.10	\$47.00	\$13.10	50.00%	52.53%	10.00%	9.75%	86.70%	\$11.35787
	Jan	\$71.40	\$55.90	\$15.50	75.00%	46.14%	7.00%	9.75%	85.54%	\$13.25842
	Feb	\$96.00	\$70.00	\$26.00	75.00%	46.14%	7.00%	9.75%	85.54%	\$22.23993
	Mar	\$103.00	\$60.00	\$43.00	75.00%	46.14%	7.00%	9.75%	85.54%	\$36.78143
	Apr	\$99.90	\$61.90	\$38.00	75.00%	46.14%	7.00%	10.25%	85.96%	\$32.66381
	May	\$94.00	\$65.40	\$28.60	75.00%	46.14%	7.00%	10.25%	85.96%	\$24.58381
	Jun	\$96.50	\$67.30	\$29.20	75.00%	46.14%	7.00%	10.75%	86.35%	\$25.21506
	Jul	\$90.00	\$69.60	\$20.40	75.00%	46.14%	7.00%	10.75%	86.35%	\$17.61600
1988/89	Aug				75.00%	46.14%	7.00%	11.25%	86.73%	
	Sep				75.00%	46.14%	7.00%	11.75%	87.08%	
	Oct	\$72.10	\$55.00	\$17.10	75.00%	46.14%	7.00%	11.75%	87.08%	\$14.89082
	Nov	\$80.10	\$50.00	\$30.10	75.00%	46.14%	7.00%	11.75%	87.08%	\$26.21132
	Dec	\$80.00	\$50.00	\$30.00	75.00%	46.14%	7.00%	12.25%	87.42%	\$26.22491
	Jan	\$85.00	\$55.00	\$30.00	75.00%	47.18%	7.00%	12.25%	87.13%	\$26.13982
	Feb	\$92.00	\$55.00	\$37.00	75.00%	47.18%	7.00%	12.75%	87.46%	\$32.35964
	Mar	\$92.00	\$56.00	\$36.00	75.00%	47.18%	7.00%	13.50%	87.92%	\$31.65023
	Apr	\$85.00	\$53.00	\$32.00	75.00%	47.18%	7.00%	13.50%	87.92%	\$28.13354
	May	\$85.10	\$50.00	\$35.10	75.00%	47.18%	7.00%	13.50%	87.92%	\$30.85898
	Jun	\$92.00	\$55.10	\$36.90	75.00%	47.18%	7.00%	13.50%	87.92%	\$32.44149
	Jul	\$98.00	\$63.50	\$34.50	75.00%	47.18%	7.00%	13.50%	87.92%	\$30.33147
1989/90	Aug				75.00%	47.18%	7.00%	13.50%	87.92%	
	Sep				75.00%	47.18%	7.00%	13.50%	87.92%	
	Oct	\$52.90	\$50.40	\$2.50	75.00%	47.18%	7.00%	13.50%	87.92%	\$2.19793
	Nov	\$40.00	\$40.00	\$0.00	75.00%	47.18%	7.00%	13.50%	87.92%	\$0.00000
	Dec	\$46.00	\$40.50	\$5.50	75.00%	47.18%	7.00%	13.50%	87.92%	\$4.83545
	Jan	\$60.00	\$45.00	\$15.00	75.00%	46.72%	7.00%	13.50%	88.03%	\$13.20521
	Feb	\$68.00	\$42.00	\$26.00	75.00%	46.72%	7.00%	14.25%	88.46%	\$22.99882
	Mar	\$64.90	\$44.00	\$20.90	75.00%	46.72%	7.00%	14.25%	88.46%	\$18.48752

Table B-1: DEPENDENT VARIABLE M_{jt}

TABLE B-2: ADJUSTMENT OF DEPENDENT VARIABLE M_t FOR INFLATION AND SPECIAL EXPORT LEVY

See introduction to Table 1.

Table B-2: ADJUSTMENT OF DEPENDENT VARIABLE M_t FOR EXPORT LEVY AND INFLATION						
Year	Month	Proportion of Quota Not Subject to Special Export Levy Quota*	Premium Adjusted for Special Export Levy	CPI Basis June 1981^b	CPI Adjustment Factor	M_t Real After Tax Premium
1982/83	Aug	1		112.3	1.342	
	Sep	1		112.9	1.335	
	Oct	1	\$11.17	113.6	1.327	\$14.82
	Nov	1	\$17.26	114.4	1.318	\$22.75
	Dec	1	\$23.69	114.4	1.318	\$31.22
	Jan	1	\$30.76	114.1	1.321	\$40.64
	Feb	1	\$32.60	114.6	1.316	\$42.89
	Mar	1	\$31.72	115.8	1.302	\$41.30
	Apr	1	\$32.06	115.8	1.302	\$41.73
	May	1	\$32.93	116.1	1.299	\$42.77
	Jun	1	\$32.85	117.4	1.284	\$42.18
	Jul	1	\$22.48	117.9	1.279	\$28.75
1983/84	Aug	1		118.5	1.272	
	Sep	1		118.5	1.272	
	Oct	1	\$23.36	119.2	1.265	\$29.55
	Nov	1	\$21.78	119.2	1.265	\$27.55
	Dec	1	\$21.96	119.6	1.261	\$27.68
	Jan	1	\$24.65	120.2	1.254	\$30.91
	Feb	1	\$26.41	120.9	1.247	\$32.93
	Mar	1	\$30.46	121.2	1.244	\$37.89
	Apr	1	\$31.79	121.5	1.241	\$39.44
	May	1	\$31.97	121.7	1.239	\$39.61
	Jun	1	\$26.56	122.2	1.234	\$32.76
	Jul	1	\$26.70	122.9	1.227	\$32.75
1984/85	Aug	1		122.9	1.227	

Table B-2: ADJUSTMENT OF DEPENDENT VARIABLE M_{ji} FOR EXPORT LEVY AND INFLATION						
Year	Month	Proportion of Quota Not Subject to Special Export Levy Quota ^a	Premium Adjusted for Special Export Levy	CPI Basis June 1981 ^b	CPI Adjustment Factor	M_{ji} Real After Tax Premium
	Sep	1		123.0	1.226	
	Oct	1	(\$1.78)	123.2	1.224	(\$2.17)
	Nov	1	\$13.28	124.0	1.216	\$16.15
	Dec	1	\$19.40	124.1	1.215	\$23.56
	Jan	1	\$20.24	124.6	1.210	\$24.49
	Feb	1	\$26.46	125.4	1.202	\$31.81
	Mar	1	\$34.34	125.7	1.199	\$41.18
	Apr	1	\$27.03	126.2	1.195	\$32.29
	May	1	\$30.30	126.5	1.192	\$36.11
	Jun	1	\$30.82	127.2	1.185	\$36.53
	Jul	1	\$35.01	127.6	1.182	\$41.37
1985/86	Aug	0.96		127.8	1.180	
	Sep	0.96		128.0	1.178	
	Oct	0.96	\$18.21	128.4	1.174	\$21.39
	Nov	0.96	\$20.84	128.9	1.170	\$24.38
	Dec	0.96	\$24.38	129.5	1.164	\$28.38
	Jan	0.96	\$28.66	130.1	1.159	\$33.22
	Feb	0.96	\$30.78	130.6	1.154	\$35.54
	Mar	0.96	\$35.42	130.9	1.152	\$40.79
	Apr	0.96	\$34.33	131.1	1.150	\$39.48
	May	0.96	\$40.91	131.7	1.145	\$46.83
	Jun	0.96	\$35.52	131.9	1.143	\$40.59
	Jul	0.96	\$21.49	132.9	1.134	\$24.38
1986/87	Aug	0.96		133.3	1.131	
	Sep	0.96		133.3	1.131	
	Oct	0.96	\$19.79	134.0	1.125	\$22.27
	Nov	0.96	\$24.72	134.7	1.119	\$27.66
	Dec	0.985	\$16.58	134.9	1.118	\$18.53
	Jan	0.985	\$17.53	135.2	1.115	\$19.55

Table B-2: ADJUSTMENT OF DEPENDENT VARIABLE M_{jt} FOR EXPORT LEVY AND INFLATION						
Year	Month	Proportion of Quota Not Subject to Special Export Levy Quota ^a	Premium Adjusted for Special Export Levy	CPI Basis June 1981 ^b	CPI Adjustment Factor	M_{jt} Real After Tax Premium
	Feb	0.985	\$18.41	135.8	1.110	\$20.44
	Mar	0.985	\$17.46	136.4	1.105	\$19.30
	Apr	0.985	\$13.59	137.0	1.100	\$14.95
	May	0.985	\$14.32	137.8	1.094	\$15.67
	Jun	0.985	\$17.57	138.2	1.091	\$19.17
	Jul	0.985	\$11.60	139.2	1.083	\$12.56
1987/88	Aug	0.985		139.3	1.082	
	Sep	0.985		139.3	1.082	
	Oct	0.985	\$6.16	139.8	1.078	\$6.64
	Nov	1	\$14.13	140.4	1.074	\$15.18
	Dec	1	\$11.36	140.5	1.073	\$12.19
	Jan	1	\$13.26	140.8	1.071	\$14.20
	Feb	1	\$22.24	141.3	1.067	\$23.73
	Mar	1	\$36.78	142.0	1.052	\$39.05
	Apr	1	\$32.66	142.5	1.058	\$34.56
	May	1	\$24.58	143.4	1.051	\$25.85
	Jun	1	\$25.22	143.6	1.050	\$26.47
	Jul	1	\$17.62	144.5	1.043	\$18.38
1988/89	Aug	1		144.9	1.040	
	Sep	1		145.0	1.040	
	Oct	1	\$14.89	145.7	1.035	\$15.41
	Nov	1	\$26.21	146.1	1.032	\$27.05
	Dec	1	\$26.22	146.1	1.032	\$27.06
	Jan	1	\$26.14	146.3	1.031	\$26.94
	Feb	1	\$32.36	147.2	1.024	\$33.14
	Mar	1	\$31.65	148.0	1.019	\$32.24
	Apr	1	\$28.13	148.4	1.016	\$28.58
	May	1	\$30.86	150.0	1.005	\$31.02
	Jun	1	\$32.44	150.8	1.000	\$32.44

Table B-2: ADJUSTMENT OF DEPENDENT VARIABLE M_{it} FOR EXPORT LEVY AND INFLATION

Year	Month	Proportion of Quota Not Subject to Special Export Levy Quota*	Premium Adjusted for Special Export Levy	CPI Basis June 1981*	CPI Adjustment Factor	M_i Real After Tax Premium
	Jul	1	\$30.33	151.7	0.994	\$30.15
1989/90	Aug	1		151.8	0.993	
	Sep	1		152.1	0.991	
	Oct	1	\$2.20	152.6	0.988	\$2.17
	Nov	1	\$0.00	153.1	0.984	\$0.00
	Dec	1	\$4.84	153.0	0.985	\$4.76
	Jan	1	\$13.21	154.3	0.977	\$12.90
	Feb	1	\$23.00	155.2	0.971	\$22.33
	Mar	1	\$18.49	155.8	0.968	\$17.89
	Apr	1	\$12.15	155.8	0.968	\$11.76
	May	1	\$14.64	156.6	0.963	\$14.10
	Jun	1	\$20.41	157.2	0.959	\$19.57
	Jul	1	\$13.04	158.0	0.954	\$12.44

Sources: * *Dairy Statistical Handbook*. Annual. Ontario Milk Marketing Board. Note that entries for each month are based on the special export levy in effect at that time. Retroactivity of announcements is ignored.

^b *Bank of Canada Review*. Monthly. Bank of Canada. Assorted issues.

TABLE B-3: INDEPENDENT VARIABLES WK_{yi} , WS_{yi} , and V_{yi}

V_{yi} is the effective percent change in quota production as a result of within year adjustments to quota by the OMMB. Details of its calculation are given in Section 6.3, Table 1, of the text.

From (5.10), WK_{yi} and WS_{yi} are defined as

$$WK_{yi} = \sum_{j=k,12} w_{yj}(1+r_{yi})^{(i-j)}$$

$$WS_{yki} = \sum_{j=k,12} w_{yj}(S_{kj})(1+r_{yi})^{(i-j)}$$

where S_{kj} 's are monthly dummies equal to one when ($j=k$), and equal to zero otherwise. r_i is the real rate of interest in month i expressed on a monthly basis. r_{yi} was set equal to the prime rate of interest, reduced by the rate of inflation in the consumer price index for the previous 12 months, inclusive of month i .

w_{yj} is the proportion of quota acquired in month i which the farmer plans to use in month j . (5.11) defined w_{yj} in terms of each month's average share of annual production over the sample period (W_{yj}). To calculate W_{yj} we must account for the impact of leap years on the number of days in February. The OMMB maintains an index of seasonal production for each month, where a value of 1.000 means that daily production in that month equalled the average daily production over the year. Let $AVPROD_j$ be the average of this index for the month j over the 8 year period, and $DAYS_{yj}$ be the days in month j for year y . We may define the average share of production of month j in year y as

$$w_{yj} = DAYS_{yj}AVPROD_j / (\sum_{j=k,12} DAYS_{yj}AVPROD_j) \quad (6.3)$$

The variables WS_{yki} are products of the monthly dummies, and reduce to

$$WS_{yki} = WK_{yi} \quad \text{when} \quad k=i$$

Table B-3: INDEPENDENT VARIABLES WK_{jt} , WS_{jt} & V_{jt}									
Year	Month	$DAYS_{jt}$ Days of the Month	Prime Rate of Interest, plus one (monthly) ^a	$(1+r_{jt})$ Real rate of interest (monthly) ^b	OMMB Index of Daily Production ^c	$AVPROD_{jt}$ Average Index For Month.	w_{jt} Example Weights for October	V_{jt} Effective Increase in Production due to Quota Adjustments ^d	WK_{jt}
1982/83	Aug	31	1.0124	1.0040	1.0731	1.0266			
	Sep	30	1.0117	1.0034	1.0272	0.9931			
	Oct	31	1.0108	1.0028	0.9686	0.9415	9.62%		0.987
	Nov	30	1.0102	1.0024	0.9214	0.9149	9.05%		0.990
	Dec	31	1.0099	1.0024	0.933	0.9378	9.58%		0.991
	Jan	31	1.0095	1.0028	0.9418	0.9615	9.82%		0.991
	Feb	28	1.0091	1.0031	0.9433	0.9780	9.03%	-2.37%	0.992
	Mar	31	1.0091	1.0033	0.9701	1.0046	10.26%	-2.37%	0.993
	Apr	30	1.0087	1.0034	1.0245	1.0483	10.37%	-2.37%	0.995
	May	31	1.0087	1.0043	1.056	1.0759	10.99%	-2.37%	0.996
	Jun	30	1.0087	1.0042	1.092	1.0838	10.72%	-2.37%	0.998
	Jul	31	1.0087	1.0043	1.0457	1.0334	10.56%	-2.37%	1.000
1983/84	Aug	31	1.0087	1.0042	1.0356	1.0266			
	Sep	30	1.0087	1.0047	1.0017	0.9931			
	Oct	31	1.0087	1.0047	0.9452	0.9415	9.59%		0.979
	Nov	30	1.0087	1.0053	0.9103	0.9149	9.02%	0.73%	0.978
	Dec	31	1.0087	1.0050	0.9329	0.9378	9.55%	0.73%	0.982
	Jan	31	1.0087	1.0044	0.9543	0.9615	9.79%	0.73%	0.987
	Feb	29	1.0087	1.0042	0.978	0.9780	9.32%	0.73%	0.989
	Mar	31	1.0091	1.0053	0.9975	1.0046	10.23%	0.73%	0.989
	Apr	30	1.0091	1.0051	1.0407	1.0483	10.33%	0.73%	0.992
	May	31	1.0095	1.0055	1.0705	1.0759	10.96%	0.73%	0.995
	Jun	30	1.0099	1.0065	1.0941	1.0838	10.68%	0.73%	0.997
	Jul	31	1.0106	1.0071	1.0392	1.0334	10.53%	0.73%	1.000
1984/85	Aug	31	1.0102	1.0072	1.0264	1.0266			
	Sep	30	1.0102	1.0071	1.0009	0.9931			
	Oct	31	1.0099	1.0071	0.9455	0.9415	9.62%		0.968

Table B-3: INDEPENDENT VARIABLES WK_{jt} , WS_{jt} , & V_{jt}

Year	Month	DAYS _{jt} Days of the Month	Prime Rate of Interest, plus one (monthly) ^a	(1+r _{jt}) Real rate of interest (monthly) ^b	OMMB Index of Daily Production ^c	AVPROD Average Index For Month.	W _{jt} Example Weights for October	V _{jt} Effective Increase in Production due to Quota Adjustments ^d	WK _{jt}
	Nov	30	1.0095	1.0062	0.909	0.9149	9.05%		0.975
	Dec	31	1.0089	1.0058	0.9375	0.9378	9.58%		0.979
	Jan	31	1.0087	1.0057	0.9613	0.9615	9.82%		0.983
	Feb	28	1.0091	1.0060	0.9744	0.9780	9.03%		0.985
	Mar	31	1.0093	1.0062	0.9971	1.0046	10.26%	-1.85%	0.988
	Apr	30	1.0085	1.0054	1.0408	1.0483	10.37%	-1.85%	0.992
	May	31	1.0084	1.0051	1.081	1.0759	10.99%	-1.85%	0.995
	Jun	30	1.0084	1.0050	1.0899	1.0838	10.72%	-1.85%	0.998
	Jul	31	1.0084	1.0052	1.0352	1.0334	10.56%	-1.85%	1.000
1985:86	Aug	31	1.0082	1.0049	1.0294	1.0266			
	Sep	30	1.0082	1.0048	0.9971	0.9931			
	Oct	31	1.0080	1.0045	0.9529	0.9415	9.62%		0.979
	Nov	30	1.0080	1.0047	0.9161	0.9149	9.05%		0.981
	Dec	31	1.0080	1.0044	0.9334	0.9378	9.58%		0.984
	Jan	31	1.0087	1.0051	0.9555	0.9615	9.82%		0.984
	Feb	28	1.0102	1.0068	0.9713	0.9780	9.03%		0.983
	Mar	31	1.0095	1.0061	1.0054	1.0046	10.26%		0.988
	Apr	30	1.0089	1.0057	1.059	1.0483	10.37%	1.58%	0.991
	May	31	1.0082	1.0048	1.0855	1.0759	10.99%	1.58%	0.995
	Jun	30	1.0082	1.0051	1.0738	1.0838	10.72%	1.58%	0.997
	Jul	31	1.0078	1.0044	1.0192	1.0334	10.56%	1.58%	1.000
1986:87	Aug	31	1.0078	1.0043	1.0219	1.0266			
	Sep	30	1.0078	1.0044	0.9804	0.9931			
	Oct	31	1.0078	1.0042	0.9171	0.9415	9.62%		0.981
	Nov	30	1.0078	1.0041	0.8935	0.9149	9.05%		0.983
	Dec	31	1.0078	1.0044	0.9157	0.9378	9.58%	2.16%	0.984
	Jan	31	1.0074	1.0042	0.9432	0.9615	9.82%	2.16%	0.987
	Feb	28	1.0074	1.0041	0.9648	0.9780	9.03%	2.16%	0.989
	Mar	31	1.0070	1.0036	1.0053	1.0046	10.26%	2.16%	0.993

Table B-3: INDEPENDENT VARIABLES WK_{jt} , WS_{jt} , & V_{jt}

Year	Month	DAYS _{jt} Days of the Month	Prime Rate of Interest, plus one (monthly) ^a	(1+r _{jt}) Real rate of interest (monthly) ^b	OMMB Index of Daily Production ^c	AVPROD Average Index For Month.	W _{jt} Example Weights for October	V _{jt} Effective Increase in Production due to Quota Adjustments ^d	WK _{jt}
	Apr	30	1.0074	1.0037	1.0656	1.0483	10.37%	2.16%	0.994
	May	31	1.0076	1.0038	1.1127	1.0759	10.99%	2.16%	0.996
	Jun	30	1.0076	1.0037	1.1139	1.0838	10.72%	2.16%	0.998
	Jul	31	1.0076	1.0037	1.0642	1.0334	10.56%	2.16%	1.000
1987-88	Aug	31	1.0080	1.0043	1.0252	1.0266			
	Sep	30	1.0080	1.0043	0.9777	0.9931			
	Oct	31	1.0078	1.0042	0.931	0.9415	9.59%		0.981
	Nov	30	1.0078	1.0043	0.9139	0.9149	9.02%		0.982
	Dec	31	1.0078	1.0044	0.9456	0.9378	9.55%	1.30%	0.984
	Jan	31	1.0078	1.0044	0.9715	0.9615	9.79%	1.30%	0.987
	Feb	29	1.0078	1.0045	0.9864	0.9780	9.32%	1.30%	0.989
	Mar	31	1.0078	1.0044	1.012	1.0046	10.23%	1.30%	0.991
	Apr	30	1.0082	1.0049	1.0436	1.0483	10.33%	1.30%	0.993
	May	31	1.0082	1.0048	1.0622	1.0759	10.96%	1.30%	0.995
	Jun	30	1.0085	1.0053	1.0841	1.0838	10.68%	1.30%	0.997
	Jul	31	1.0085	1.0054	1.0464	1.0334	10.53%	1.30%	1.000
1988-89	Aug	31	1.0089	1.0056	1.0192	1.0266			
	Sep	30	1.0093	1.0059	1.0036	0.9931			
	Oct	31	1.0093	1.0058	0.9528	0.9415	9.62%		0.973
	Nov	30	1.0093	1.0060	0.9405	0.9149	9.05%		0.976
	Dec	31	1.0097	1.0064	0.9671	0.9378	9.58%		0.977
	Jan	31	1.0097	1.0065	0.9914	0.9615	9.82%		0.980
	Feb	28	1.0101	1.0066	1.0042	0.9780	9.03%		0.983
	Mar	31	1.0106	1.0071	1.0215	1.0046	10.26%		0.986
	Apr	30	1.0106	1.0072	1.0494	1.0483	10.37%		0.989
	May	31	1.0106	1.0068	1.0538	1.0759	10.99%		0.993
	Jun	30	1.0106	1.0065	1.027	1.0838	10.72%		0.997
	Jul	31	1.0106	1.0065	0.9706	1.0334	10.56%		1.000
1989-90	Aug	31	1.0106	1.0067	0.9822	1.0266			

Table B-3: INDEPENDENT VARIABLES WK_{jt} , WS_{jt} , & V_{jt}

Year	Month	DAYS _{jt} Days of the Month	Prime Rate of Interest, plus one (monthly) ^a	(1+r _{jt}) Real rate of interest (monthly) ^b	OMMB Index of Daily Production ^c	AVPROD Average Index For Month.	w _{jt} Example Weights for October	V _{jt} Effective Increase in Production due to Quota Adjustments ^d	WK _{jt}
	Sep	30	1.0106	1.0066	0.9563	0.9931			
	Oct	31	1.0106	1.0067	0.9186	0.9415	9.62%		0.970
	Nov	30	1.0106	1.0067	0.9144	0.9149	9.05%		0.973
	Dec	31	1.0106	1.0067	0.9372	0.9378	9.58%		0.976
	Jan	31	1.0106	1.0061	0.9729	0.9615	9.82%		0.981
	Feb	28	1.0112	1.0067	1.0014	0.9780	9.03%	-3.41%	0.983
	Mar	31	1.0112	1.0069	1.0275	1.0046	10.26%	-3.41%	0.986
	Apr	30	1.0115	1.0074	1.0627	1.0483	10.37%	-3.41%	0.989
	May	31	1.0115	1.0079	1.0855	1.0759	10.99%	-3.41%	0.992
	Jun	30	1.0115	1.0080	1.0958	1.0838	10.72%	-3.41%	0.996
	Jul	31	1.0115	1.0081	1.0466	1.0334	10.56%	-3.41%	1.000

Sources: ^a Calculated from nominal prime rate of interest, Table B-1.^b Calculated from Consumer Price Index, Table B-2.^c Dairy Statistical Handbook. Annual. OMMB.^d Table 1 of main text.

TABLE B-4: INDEPENDENT VARIABLE WP_{yi}

Weighted expected price is defined by (5.10) as

$$WP_{yi} = \sum_{j=i,12} w_{yij}(P_{yij})(1+r_{yi})^{(i-j)} \quad (B.3)$$

where expected price is actual price of milk, adjusted for unanticipated changes in the levy structure.¹

P_{yj} is computed net of marketing board levies for surplus disposal. These levy rates are usually set annually, but occasionally adjustments are made. These regulatory decisions introduce an element of uncertainty into the net price farmers receive. We hypothesize that the monthly pool price is accurately anticipated by farmers, but that occasional regulator adjustments of levies comes as a surprise. Therefore, the price expected in month i for production in month j is

$$P_{yij} = P_{yj} + (L_j - L_{yi}) \quad (5.8)$$

where P_j is net of levies L_j month j, and the expression $(L_j - L_{yi})$ adjusts for the changes in levies which are not anticipated in month i. For calculation purposes, (B.3) and (5.8) may be expressed as

$$\begin{aligned} WP_{yi} = & \sum_{j=i,12} w_{yij}(MEANP_{yj})(CPI \text{ conversion factor}_j)(1+r_{yi})^{(i-j)} \\ & - \sum_{j=i,12} w_{ij}(LEVY_{yi})(CPI \text{ Conversion Factor}_j)(1+r_{yi})^{(i-j)} \end{aligned} \quad (B.4)$$

where $MEANP_{yj}$ is the mean nominal price per hectolitre before levies in future month j, and $LEVY_{yi}$ is the nominal levy per hectolitre in the current month i. $MEANP_{yj}$ is the average price received per hectolitre. Published monthly pool prices for industrial milk are based upon a standard 3.6 kilograms of butterfat per hectolitre. The actual mean butterfat is higher, and changes over time. Dairy farmers are paid the pool price, plus an adjustment for butterfat content, plus a federal subsidy per kilogram of butterfat. Thus, the actual mean price is given by

¹ The subsidy structure remains unchanged throughout the sample period.

$$\begin{aligned}
 MEANP_{jt} = & (\text{Pool price for 3.6 kg. bf.}) + ((\text{mean kg. butterfat}) - 3.6)(\$ \text{butterfat differential}) \\
 & + (\text{mean kg. butterfat})(\$ \text{fed. subsidy})
 \end{aligned}
 \tag{B.5}$$

Adjustment for butterfat is significant because the butterfat content of milk has been rising consistently over the sample period.

The table below records changes in Levy in the month they are announced. Retroactivity of announcements is disregarded.

Table B-4: INDEPENDENT VARIABLE WP_{jt}

Year	Month	Pool Price Industrial Milk* (3.6 kg. bf.) (\$/hl.)	Butterfat Differential* (\$/kg/hl)	Mean Butterfat* (kg/hl)	Federal Subsidy* (\$/kg. of bf.)	MEANPJ, Mean Price Before Levies (\$/hl.)	LEVY, Within Quota Levy (\$/hl.)	WP_{jt} , Weighted Mean Price	Real Mean Price Net of Within Quota Levy
1982/83	Aug	\$34.75	\$5.514	3.64	\$1.675	\$41.07	\$3.58		\$50.33
	Sep	\$36.44	\$5.514	3.75	\$1.675	\$43.55	\$3.58		\$53.37
	Oct	\$35.88	\$5.511	3.86	\$1.675	\$43.78	\$3.58	\$51.93	\$53.35
	Nov	\$36.00	\$5.511	3.87	\$1.675	\$43.97	\$3.58	\$52.01	\$53.22
	Dec	\$35.97	\$5.511	3.85	\$1.675	\$43.80	\$3.58	\$51.99	\$53.00
	Jan	\$36.23	\$5.578	3.84	\$1.675	\$44.00	\$4.28	\$51.02	\$52.48
	Feb	\$36.33	\$5.578	3.84	\$1.675	\$44.10	\$4.28	\$50.90	\$52.38
	Mar	\$36.27	\$5.578	3.82	\$1.675	\$43.89	\$4.28	\$50.79	\$51.57
	Apr	\$36.36	\$5.608	3.84	\$1.675	\$44.13	\$4.28	\$50.75	\$51.89
	May	\$36.47	\$5.608	3.82	\$1.675	\$44.10	\$4.28	\$50.51	\$51.71
	Jun	\$36.43	\$5.608	3.79	\$1.675	\$43.84	\$4.28	\$50.11	\$50.80
	Jul	\$36.47	\$5.608	3.68	\$1.675	\$43.08	\$4.28	\$49.62	\$49.62
1983/84	Aug	\$37.29	\$5.794	3.63	\$1.675	\$43.54	\$4.27		\$49.96
	Sep	\$37.88	\$5.794	3.71	\$1.675	\$44.73	\$4.27		\$51.47
	Oct	\$37.95	\$5.794	3.88	\$1.675	\$46.07	\$4.27	\$51.34	\$52.86
	Nov	\$38.01	\$5.794	3.95	\$1.675	\$46.65	\$4.27	\$51.30	\$53.60
	Dec	\$37.80	\$5.794	3.93	\$1.675	\$46.29	\$4.27	\$51.36	\$52.97
	Jan	\$38.12	\$5.862	3.93	\$1.675	\$46.64	\$4.27	\$51.50	\$53.14
	Feb	\$38.11	\$5.862	3.89	\$1.675	\$46.33	\$4.27	\$51.48	\$52.44
	Mar	\$38.17	\$5.862	3.87	\$1.675	\$46.23	\$4.27	\$51.43	\$52.19
	Apr	\$38.60	\$5.977	3.88	\$1.675	\$46.77	\$4.27	\$51.53	\$52.74
	May	\$38.78	\$5.977	3.83	\$1.675	\$46.57	\$4.27	\$51.38	\$52.40
	Jun	\$38.71	\$5.977	3.78	\$1.675	\$46.12	\$4.27	\$51.10	\$51.63
	Jul	\$38.82	\$5.977	3.72	\$1.675	\$45.76	\$4.27	\$50.90	\$50.90
1984/85	Aug	\$39.41	\$6.096	3.65	\$1.675	\$45.83	\$4.51		\$50.69
	Sep	\$39.82	\$6.096	3.77	\$1.675	\$47.17	\$4.51		\$52.29
	Oct	\$39.94	\$6.096	3.89	\$1.675	\$48.22	\$4.51	\$50.34	\$53.49

Table B-4: INDEPENDENT VARIABLE WP_{jt}

Year	Month	Pool Price Industrial Milk* (3.6 kg. bf.) (\$/hl.)	Butterfat Differential* (\$/kg/hl)	Mean Butterfat* (kg/hl)	Federal Subsidy* (\$/kg. of bf.)	MEANPJ, Mean Price Before Levies (\$/hl.)	LEVY, Within Quota Levy (\$/hl.)	WP_{jt} , Weighted Mean Price	Real Mean Price Net of Within Quota Levy
	Nov	\$40.06	\$6.096	3.95	\$1.675	\$48.81	\$4.51	\$50.55	\$53.86
	Dec	\$39.82	\$6.096	3.92	\$1.675	\$48.34	\$4.51	\$50.55	\$53.25
	Jan	\$39.89	\$6.096	3.89	\$1.675	\$48.18	\$4.51	\$50.50	\$52.84
	Feb	\$39.76	\$6.096	3.88	\$1.675	\$47.96	\$4.76	\$50.08	\$51.94
	Mar	\$39.78	\$6.096	3.87	\$1.675	\$47.91	\$4.76	\$50.05	\$51.75
	Apr	\$39.70	\$6.096	3.85	\$1.675	\$47.67	\$4.76	\$50.01	\$51.26
	May	\$39.76	\$6.096	3.80	\$1.675	\$47.34	\$4.76	\$49.89	\$50.75
	Jun	\$39.72	\$6.096	3.76	\$1.675	\$46.99	\$4.76	\$49.70	\$50.06
	Jul	\$39.84	\$6.096	3.71	\$1.675	\$46.72	\$4.76	\$49.58	\$49.58
1985/86	Aug	\$39.91	\$6.186	3.71	\$1.675	\$46.80	\$5.14		\$49.15
	Sep	\$40.97	\$6.275	3.83	\$1.675	\$48.83	\$5.14		\$51.45
	Oct	\$41.09	\$6.275	3.96	\$1.675	\$49.98	\$5.14	\$49.93	\$52.65
	Nov	\$41.15	\$6.275	3.98	\$1.675	\$50.21	\$5.14	\$49.82	\$52.71
	Dec	\$41.13	\$6.275	3.96	\$1.675	\$50.02	\$5.14	\$49.79	\$52.25
	Jan	\$40.98	\$6.275	3.93	\$1.675	\$49.63	\$5.14	\$49.57	\$51.56
	Feb	\$40.89	\$6.275	3.93	\$1.675	\$49.55	\$5.14	\$49.30	\$51.26
	Mar	\$40.96	\$6.275	3.93	\$1.675	\$49.61	\$5.14	\$49.37	\$51.22
	Apr	\$40.92	\$6.275	3.87	\$1.675	\$49.10	\$5.14	\$49.24	\$50.55
	May	\$40.77	\$6.275	3.84	\$1.675	\$48.71	\$5.14	\$49.15	\$49.87
	Jun	\$40.85	\$6.275	3.79	\$1.675	\$48.39	\$5.14	\$49.00	\$49.44
	Jul	\$40.93	\$6.275	3.75	\$1.675	\$48.15	\$5.14	\$48.79	\$48.79
1986/87	Aug	\$41.32	\$6.408	3.74	\$1.675	\$48.48	\$5.13		\$49.03
	Sep	\$41.85	\$6.408	3.91	\$1.675	\$50.38	\$5.13		\$51.18
	Oct	\$41.89	\$6.408	3.98	\$1.675	\$50.99	\$5.13	\$48.81	\$51.59
	Nov	\$41.92	\$6.408	3.98	\$1.675	\$51.02	\$5.13	\$48.74	\$51.36
	Dec	\$41.76	\$6.408	3.96	\$1.675	\$50.70	\$4.65	\$49.12	\$51.47
	Jan	\$41.78	\$6.408	3.93	\$1.675	\$50.48	\$4.65	\$49.05	\$51.10
	Feb	\$41.73	\$6.408	3.94	\$1.675	\$50.51	\$4.65	\$48.93	\$50.91

Table B-4: INDEPENDENT VARIABLE WP_j

Year	Month	Pool Price Industrial Milk* (3.6 kg. bf.) (\$/hl.)	Butterfat Differential* (\$/kg/hl)	Mean Butterfat* (kg/hl)	Federal Subsidy* (\$/kg. of bf.)	MEANPJ, j Mean Price Before Levies (\$/hl.)	LEVY _j , Within Quota Levy (\$/hl.)	WP _j , Weighted Mean Price	Real Mean Price Net of Within Quota Levy
	Mar	\$41.79	\$6.408	3.93	\$1.675	\$50.49	\$4.65	\$48.85	\$50.67
	Apr	\$41.70	\$6.408	3.89	\$1.675	\$50.08	\$4.65	\$48.57	\$49.99
	May	\$41.59	\$6.408	3.85	\$1.675	\$49.64	\$4.65	\$48.29	\$49.22
	Jun	\$41.63	\$6.408	3.78	\$1.675	\$49.11	\$4.65	\$47.99	\$48.50
	Jul	\$41.73	\$6.408	3.71	\$1.675	\$48.65	\$4.65	\$47.65	\$47.65
1987/88	Aug	\$41.64	\$6.408	3.71	\$1.675	\$48.56	\$4.90		\$47.25
	Sep	\$41.75	\$6.408	3.88	\$1.675	\$50.04	\$4.90		\$48.85
	Oct	\$41.65	\$6.408	4.02	\$1.675	\$51.07	\$4.90	\$47.72	\$49.79
	Nov	\$41.92	\$6.408	4.01	\$1.675	\$51.27	\$4.16	\$48.46	\$50.58
	Dec	\$41.78	\$6.408	3.97	\$1.675	\$50.80	\$4.16	\$48.42	\$50.05
	Jan	\$41.77	\$6.408	3.96	\$1.675	\$50.71	\$4.16	\$48.42	\$49.85
	Feb	\$42.28	\$6.504	3.96	\$1.675	\$51.25	\$3.75	\$48.82	\$50.68
	Mar	\$42.27	\$6.504	3.97	\$1.675	\$51.32	\$3.75	\$48.71	\$50.51
	Apr	\$42.09	\$6.504	3.94	\$1.675	\$50.90	\$3.75	\$48.46	\$49.88
	May	\$42.19	\$6.504	3.90	\$1.675	\$50.67	\$3.75	\$48.24	\$49.33
	Jun	\$42.11	\$6.504	3.81	\$1.675	\$49.86	\$3.75	\$47.89	\$48.41
	Jul	\$42.13	\$6.504	3.75	\$1.675	\$49.38	\$3.75	\$47.61	\$47.61
1988/89	Aug	\$42.90	\$6.504	3.73	\$1.675	\$49.99	\$3.00		\$48.89
	Sep	\$42.22	\$6.504	3.89	\$1.675	\$50.62	\$3.00		\$49.51
	Oct	\$42.35	\$6.504	4.02	\$1.675	\$51.81	\$3.00	\$47.82	\$50.51
	Nov	\$42.39	\$6.504	4.00	\$1.675	\$51.69	\$2.35	\$48.44	\$50.92
	Dec	\$42.22	\$6.504	3.99	\$1.675	\$51.44	\$2.35	\$48.37	\$50.65
	Jan	\$42.26	\$6.504	3.98	\$1.675	\$51.40	\$2.35	\$48.37	\$50.55
	Feb	\$42.86	\$6.504	3.99	\$1.675	\$52.08	\$2.35	\$48.31	\$50.93
	Mar	\$42.17	\$6.479	4.02	\$1.675	\$51.63	\$2.35	\$48.13	\$50.20
	Apr	\$42.11	\$6.479	3.98	\$1.675	\$51.23	\$2.35	\$47.97	\$49.67
	May	\$42.18	\$6.474	3.96	\$1.675	\$51.14	\$2.35	\$47.78	\$49.05
	Jun	\$42.14	\$6.469	3.89	\$1.675	\$50.53	\$2.35	\$47.46	\$48.18

Table B-4: INDEPENDENT VARIABLE WP_{jt}

Year	Month	Pool Price Industrial Milk* (3.6 kg. bf.) (\$/hl.)	Butterfat Differential* (\$/kg/hl)	Mean Butterfat* (kg/hl)	Federal Subsidy* (\$/kg. of bf.)	$MEANPJ_{jt}$ Mean Price Before Levies (\$/hl.)	$LEVY_{jt}$ Within Quota Levy (\$/hl.)	WP_{jt} Weighted Mean Price	Real Mean Price Net of Within Quota Levy
	Jul	\$42.26	\$6.469	3.77	\$1.675	\$49.67	\$2.35	\$47.03	\$47.03
1989/90	Aug	\$43.29	\$6.514	3.76	\$1.675	\$50.63	\$2.35		\$47.94
	Sep	\$42.75	\$6.514	3.86	\$1.675	\$50.91	\$2.35		\$48.14
	Oct	\$42.89	\$6.514	4.01	\$1.675	\$52.28	\$2.35	\$46.36	\$49.32
	Nov	\$42.87	\$6.514	4.02	\$1.675	\$52.34	\$2.35	\$46.37	\$49.21
	Dec	\$42.66	\$6.514	4.02	\$1.675	\$52.13	\$2.35	\$46.35	\$49.05
	Jan	\$42.66	\$6.514	3.97	\$1.675	\$51.72	\$2.35	\$46.38	\$48.23
	Feb	\$43.39	\$6.514	3.96	\$1.675	\$52.37	\$2.35	\$46.30	\$48.57
	Mar	\$42.48	\$6.514	3.98	\$1.675	\$51.62	\$2.35	\$46.21	\$47.69
	Apr	\$42.60	\$6.514	3.96	\$1.675	\$51.57	\$2.35	\$46.13	\$47.64
	May	\$42.74	\$6.514	3.92	\$1.675	\$51.39	\$2.35	\$45.96	\$47.22
	Jun	\$42.65	\$6.514	3.83	\$1.675	\$50.56	\$2.35	\$45.66	\$46.23
	Jul	\$42.49	\$6.514	3.78	\$1.675	\$49.99	\$2.35	\$45.45	\$45.45

Sources: *Dairy Statistical Handbook. Annual. Ontario Milk Marketing Board.

TABLE B-5: INDEPENDENT VARIABLES OQ_{yi} & D_{Qyi}

OQ_{yi} is the over-quota levy in year y and month i, expressed in \$1989. D_{Qyi} is a dummy equal to one when $(M_{yi} > OQ_{yi})$.

Table B-5: INDEPENDENT VARIABLES OQ_{yi} & D_{Qyi}				
Year	Month	Over Quota Levy (\$/hl.)	OQ_{yi} Real Over Quota Levy (\$1989)	D_{yi} Dummy for $(M_{yi} > OQ_{yi})$
1982/83	Aug	20.21	27.13174	0
	Sep	20.21	26.98755	0
	Oct	20.21	26.82125	0
	Nov	20.21	26.63369	0
	Dec	20.21	26.63369	1
	Jan	29	38.31805	1
	Feb	29	38.15087	1
	Mar	29	37.75552	1
	Apr	29	37.75552	1
	May	29	37.65796	1
	Jun	29	37.24097	1
	Jul	29	37.08303	0
1983/84	Aug	31.79	40.44485	0
	Sep	31.79	40.44485	0
	Oct	31.79	40.20734	0
	Nov	31.79	40.20734	0
	Dec	31.79	40.07286	0
	Jan	31.79	39.87283	0
	Feb	31.79	39.64197	0
	Mar	31.79	39.54385	0
	Apr	31.79	39.44621	0
	May	31.79	39.38138	1
	Jun	31.79	39.22025	0
	Jul	31.79	38.99686	0
1984/85	Aug	34.38	42.17402	0
	Sep	34.38	42.13973	0

Table B-5: INDEPENDENT VARIABLES OQ_{it} & D_{it}				
Year	Month	Over Quota Levy (\$/hl.)	OQ_{it} Real Over Quota Levy (\$1989)	D_{it} Dummy for ($M_{it} > OQ_{it}$)
	Oct	34.38	42.07133	0
	Nov	34.38	41.7999	0
	Dec	34.38	41.76621	0
	Jan	34.38	41.59861	0
	Feb	36	43.28087	0
	Mar	36	43.17758	0
	Apr	36	43.00651	0
	May	36	42.90452	0
	Jun	36	42.66841	0
	Jul	36	42.53465	0
1985/86	Aug	38	44.82742	0
	Sep	38	44.75738	0
	Oct	38	44.61795	0
	Nov	38	44.44488	0
	Dec	38	44.23895	0
	Jan	38	44.03493	0
	Feb	38	43.86634	0
	Mar	38	43.76581	0
	Apr	38	43.69904	0
	May	38	43.49996	1
	Jun	38	43.434	0
	Jul	38	43.10718	0
1986/87	Aug	38	42.97783	0
	Sep	38	42.97783	0
	Oct	38	42.75332	0
	Nov	38	42.53114	0
	Dec	38	42.46808	0
	Jan	38	42.37385	0
	Feb	38	42.18663	0
	Mar	38	42.00106	0

Table B-5: INDEPENDENT VARIABLES OQ_{it} & D_{it}				
Year	Month	Over Quota Levy (\$/hl.)	OQ_{it} Real Over Quota Levy (\$1989)	D_{it} Dummy for ($M_{it} > OQ_{it}$)
	Apr	38	41.81711	0
	May	38	41.57434	0
	Jun	38	41.45401	0
	Jul	38	41.15621	0
1987/88	Aug	37.66	40.75869	0
	Sep	37.66	40.75869	0
	Oct	37.66	40.61292	0
	Nov	28.5	30.60334	0
	Dec	28.5	30.58155	0
	Jan	28.5	30.5164	0
	Feb	28.5	30.40841	0
	Mar	28.5	30.25851	1
	Apr	28.5	30.15234	1
	May	28.5	29.9631	0
	Jun	28.5	29.92137	0
	Jul	28.5	29.73501	0
1988/89	Aug	26.5	27.57202	0
	Sep	26.5	27.553	0
	Oct	26.5	27.42062	0
	Nov	26.5	27.34555	0
	Dec	26.5	27.34555	0
	Jan	26.5	27.31244	0
	Feb	26.5	27.14113	1
	Mar	26.5	26.99599	1
	Apr	26.5	26.924	1
	May	26.5	26.63984	1
	Jun	26.5	26.5	1
	Jul	26.5	26.3387	1
1989/90	Aug	30	29.79149	0
	Sep	30	29.73981	0

Table B-5: INDEPENDENT VARIABLES OQ_{it} & D_{Qit}				
Year	Month	Over Quota Levy (\$/hl.)	OQ_{it} Real Over Quota Levy (\$1989)	D_{it} Dummy for ($M_{it} > OQ_{it}$)
	Oct	30	29.63699	0
	Nov	30	29.53488	0
	Dec	30	29.56034	0
	Jan	30	29.30769	0
	Feb	30	29.13339	0
	Mar	30	29.03472	0
	Apr	30	29.03472	0
	May	30	28.88795	0
	Jun	30	28.76678	0
	Jul	30	28.6227	0

APPENDIX C: LIKELIHOOD AND IMPACT OF STOCHASTICITY IN w_{ij}

The basic form in which the model is estimated is given by (5.10).

$$M_i = WP_i - (MC_3 + \sum_{k=4,12} \beta_{sk} WS_{ki}) WK_i (1 + \beta_v V_i) \quad (5.10)$$

where:

$$WP_i = \sum_{j=1,12} w_{ij}(P_{ij})(1+r_i)^{(i-j)}$$

$$WK_i = \sum_{j=1,12} w_{ij}(1+r_i)^{(i-j)}$$

$$WS_{ki} = \sum_{j=1,12} w_{ij}(S_{kj})(1+r_i)^{(i-j)}$$

The parameters to be estimated in (5.10) are the marginal cost in October (MC_3), the monthly seasonal adjustments in marginal cost relative to October (β_{sk} 's), and the inverse of the short run elasticity of supply β_v . Independent variables are average price (WP), the seasonal dummies for each month (S_{ki} 's), and within-year adjustments to quota amounts (V_i).

A potential concern in any estimating any model is stochasticity in the independent variables. In the case of estimating (5.10) or its variants, this concern is most likely to

occur through stochasticity in w_{ij} , the proportion of incremental output planned for month j .

Stochasticity is a concern because farmer plans for w_{ij} are not directly observable. As a result, estimation of (5.10) substitutes a value based on the mean share of production observed for each month over the sample period (see 6.3). If farmer plans deviate significantly from the mean, then there will be stochasticity in the dependent variables.

The consequences of stochasticity would be potential bias in the estimates. Bias would emerge through covariance of the w_{ij} 's with the disturbance term.

The likelihood of stochasticism in w_{ij} significantly biasing the estimates is low for these reasons:

- w_{ij} does not enter directly into the regression. It is a weight which sums to one and is used to calculate independent variables. Positive disturbances in the weight are necessarily at least partially offset by complementary negative disturbances in calculating the weighted averages.
- w_{ij} is relatively stable. Consider the variance in the underlying series, the actual proportion of annual production occurring in each month. The average shares of each month range from 7.52% for November to 9.14%

for May. The standard deviation of actual monthly shares from their respective means (e.g. May from the mean for May, etc.) is .0017 or 0.17% points.¹ It can be shown (see below) that the variance of farmer expectations cannot exceed twice the variance of the underlying series itself. In the limit, the standard deviation of farmer expectations from the mean cannot exceed $[(2(.0017)^2)^{.5}]$, or approximately .0024. As a percent of the mean of the lowest value weight, this is $(.0024/.0752 = 3.20\%)$. In addition, in order for the outer bound to apply, farmer estimates of w_j would have to be as inefficient as the mean itself. As the efficiency of farmer expectations increases, the stochasticity of w_j approaches the variance of the observed values from the mean.

- The absolute value of any bias caused by stochasticity in w_{ij} would be small. As noted above, the limit to stochasticity in w_{ij} is twice the variance in the actual underlying series at a standard deviation of roughly .0024 in absolute value. Since the impact of w_j comes from multiplying it by other variables as a weight, and since disturbances in the weights are necessarily offsetting, the net disturbance in the weighted averages variables used in the regression would be very small.

¹ Calculated from data in Appendix B.

In summary, if stochasticity exists in w_{ij} it is very small and its effects on the regression will be further reduced by its limited application as weights used in the calculation of independent variables. The weights do not enter directly into the regression (they are not weights as in weighted least squares), and disturbances of weights are necessarily offsetting.

The following proof demonstrates the proposition that, under reasonable assumptions, the stochasticity arising from the use of a mean of series as a proxy for expectations cannot exceed twice the variance of the series itself.

PROOF ON LIMITS TO STOCHASTICITY WHEN USING A MEAN AS A PROXY FOR EXPECTATIONS

Assume there exists a class of agents, called farmers, who wish to anticipate the value of a variable X . X varies randomly around its mean $\bar{X}$ such that

$$X_i = \bar{X} + u_{Xi} \text{ and } E\{(X_i - \bar{X})^2\} = \sigma_X^2 \quad (\text{A.1})$$

where the subscript i denotes a single trial, $E\{\dots\}$ is a mathematical expectations operator and the values of $\bar{X}$ and σ_X^2 is known to farmers. Let farmer expectations of X in a given trial i be Y_i . Over repeat trials, the estimator Y_i will be unbiased, since farmers will eliminate bias in their estimator through observation. Therefore

$$E\{Y_i\} = X_i \quad (A.2)$$

Finally, assume that farmers prefer a lower variance unbiased estimator over a higher variance unbiased estimator, and that farmers have information for each trial i in addition to the known mean $\bar{X}$. Then

$$E\{(Y_i - X_i)^2\} = \sigma_Y^2 \leq \sigma_X^2 \quad (A.3)$$

Now an impartial observer, who is not party to the special information of farmers, wishes to use $\bar{X}$ as a proxy for farmer expectations. The observer is interested in the stochasticity of their proxy, defined as the variance of farmer expectations from $\bar{X}$.

$$E\{(Y_i - \bar{X})^2\} = E\{(u_{Yi} + (X_i - \bar{X}))^2\} = \sigma_X^2 + \sigma_Y^2 + 2E\{u_X u_Y\} \quad (A.4)$$

where $E\{u_X u_Y\}$ is the covariance between X_i and Y_i . Now, the covariance between X_i and Y_i must be zero if Y_i is an unbiased estimator of X_i . Farmers would use any covariance between their estimator and the target of estimation to improve the accuracy of their estimator. We may show this as follows. By definition, the covariance gives the linear relationship between the two variables with zero mean such that

$$u_{Yi} = (\rho\sigma_Y/\sigma_X)u_{Xi} + \gamma = (E\{u_X u_Y\}/\sigma_X^2)u_{Xi} + \gamma \quad (A.5)$$

where γ is the unsystematic disturbance term with mean of zero and ρ is the correlation coefficient ($\rho = E\{u_X u_Y\} / (\sigma_X \sigma_Y)$).² By (A.2) farmer expectations are unbiased and $E\{u_Y\}$ is zero. Taking the expectation of both sides of (A.5) yields

$$E\{u_{Yi}\} = (E\{u_X u_Y\} / \sigma_X^2) E\{u_{Xi}\} = 0 \quad (A.6)$$

From (A.4), it is clear that if farmers have a non zero expectation of u_{Xi} , then the covariance of u_{Xi} and u_{Yi} must be zero. Farmer expectation of u_{Xi} is

$$E\{u_{Xi}\} = E\{X_i - \bar{X}\} = E\{(Y_i - u_{Yi}) - \bar{X}\} = Y - \bar{X} \neq 0 \quad (Y \neq \bar{X}) \quad (A.7)$$

Therefore, if farmers are using an estimator for X_i other than $\bar{X}$ itself, the covariance of X and Y is zero. Intuitively, since farmers know Y , $\bar{X}$, and X , they are also able to observe u_X and u_Y . If u_X and u_Y covary, farmers will incorporate this information into their estimate of Y until the covariance no longer exists. For example, if u_Y and u_X covary positively, this would mean that whenever farmer expectation Y was larger than the known mean $\bar{X}$, expected u_X and u_Y would be positive, and Y would be underestimated. Farmers would then revise their predictor of Y upwards. The revised estimator would have no covariance with X .

From (A.7) and (A.3) we may simplify (A.4) as

² The proof for this is the same as for proving Ordinary Least Squares an unbiased estimator. The expression $(\rho\sigma_Y/\sigma_X)$ is the OLS β (Johnston, Econometric Methods, 3rd. Ed. pg. 24).

$$E\{(Y-\bar{X})^2\} = \sigma_X^2 + \sigma_Y^2 \leq 2\sigma_X^2 \quad (\text{A.8})$$

Q.E.D. Note that as the accuracy of farmer expectations improve, variance of farmer expectations from the observed mean of the series declines. In the limit, when farmer expectations are perfectly accurate, the variance of their expectations from $\bar{X}$ is σ_X^2 . Of course, if farmers use $\bar{X}$ itself as an estimator of X , then there is no stochasticity.

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