Income Stabilization for Grain Farms

by

Mark Kovacs

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A thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

MASTER OF SCIENCE

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ABSTRACT

This study addresses the varition in income of Western Canadian grain producers. The income of grain producers on the prairies is subject to various sources of risk and uncertainty. Consequently, producers have experienced relatively high and low levels of income. The income problem can be divided into income stabilization and income support. Income stabilization is used to reduce the variation in income. Income support is used to increase the level of income. The logical starting point is income stabilization.

Currently, The Western Grain Stabilization (WGSP) and Crop Insurance Programs are two instruments used to stabilize and support the income of grain producers. The Western Grain Stabilization Program and to a lessor extent crop insurance use aggregate measures in determining indemnities. Conversely, the alternative proposed enables producers to stabilize their income based soley on their own financial position.

The objectives of the research are as follows. Firstly to determine if a self sustaining income stabilization program is feasible under different experiments. The self sustaining program will consist of tax credits and rebates which the producer pays back upon termination of the enterprise. Thus the income support is limited to the time value of the credits and rebates between the time they are taken and paid back. Secondly, to determine the effect the WGSP has on the income position of producers relative to the proposed stabilization program.

The WGSP is a combination of income support and stabilization. The Federal Government contributes an additional 2% levy to the fund balance and pays for the administration of the program. In addition the fund balance has been increased ad hoc by the Federal Government in order to make payouts when funds are not available as in 1987 (750 million dollars).[1] These are the sources of income support. Since producers contribute a levy they are also paying in part for the money they receive. This is the source of the stabilization aspect of the program. The proposed stabilization program will be self-sustaining in that producers are able to use fiscal policy to stabilize their income. The use of fiscal policy is not without income support in that the government either forgoes tax revenues (tax credit) or pays a tax rebate (transfer). In contrast to the WGSP the tax credits and rebates are a liability to the producer and payable upon termination of the business. Therefore the element of income support is limited to the time value of the credits and rebates used over time. In order to make a comparison between the WGSP and the proposed stabilization program one must keep in mind the different levels of income support.

In each experiment the fiscal policy is at least as effective and more effecient. The results indicate that a individualized stabilization program has merit.

[1] Barry Wilson,"Federal Farm aid adds to the deficit mountain", Western Producer, Dec.24, 1984, p.5.

CONTENTS

Chapter I

INTRODUCTION

Annual returns to Canadian grain producers are subjected to various sources of risk. Incomes are adversely affected by weather conditions (temperature, hail, moisture), boilogical (disease) and market relationships (institutional risk). The availability of world markets(which are important due to the percentage of production exported) for Canadian grain is also uncertain because of the actions of competitors such as the United States and the European Economic Community subsidizing exports. The grain handling system can also constrain export sales. The combination of production risk and market uncertainty can often lead to a large variation in income. The need for stabilization is seen as a result of the inherent risk and uncertainty in agricultural production and marketing. The interested reader is referred to Dzisiak (1987)[2] and Snitynsky (1983)[3] for a further explanation of risk in agricultural production.

[2] R. Dzisiak, "An Evaluation Of The Risk Associated With High Debt Enterprises" (M.Sc. Thesis, University Of Manitoba, 1987)

[3] R. Snitynsky, "Risk Analysis Of Farm Land Investment Model" (M.Sc. Thesis, University Of Manitoba, 1983)

1.1 WESTERN GRAIN STABILIZATION PROGRAM

The Western Grain Stabilization Program(WGSP) came into effect on April 1, 1976 with the objective of stabilizing the cash flow of western grain producers.Cash flow ,as defined by the program

> is the difference between the overall cash receipts for western grain and the overall related cost of producing it. Reduced cash flow can result from a fall in prices, low sales resulting from poor yields, a slump in world demand, inability to move grain through the elevator system, rising production costs or a combination of these factors.[4]

The WGSP uses a comparison of current cash flow with the previous 5 year average in determining payments. The procedures are explained below.[5]

1. The total gross cash receipts for wheat, barley, oats, rye, flax, rapeseed and mustard seed in the Wheat Board area is determined.
2. From 1) above the elegible costs of production are subtracted. These costs include fuel, fertilizer, seed, pesticides, repairs, hydro, telephone and interst on loans other than mortages. The eligible costs of production is equal to the total cost of production multiplied by a marketing to production ratio to separate costs for grain marketed.
3. The subtraction of eligible costs of production from total gross cash receipts yields net cash receipts. The program is designed to stabilize sales up to $60,000 per participant. Therefore an eligibility ratio is multiplied by the net cash receipts to remove the value of grain above the $60,000 limit.

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[4] Western Grain Stabilization Administration, Western Grain Stabilization Handbook (Winnipeg,Manitoba:1979), p.3.

[5] Ibid., p.10.

4. The resulting calculation from 3) is called current eligible net cash flow. The current eligible net cash flow is compared with the previous 5 year average.

5. In addition a per tonne cash flow calculation was introduced in order to make the program more responsive to price changes and to recognize the general increase in volume produced and marketed. The per tonne calculation is identical except that the curret net cash flow is divided by the total tonnes and compared with the previous 5 year average on a per tonne basis.

6. The potential payout is defined as the maximum of the following differences ;

   a) The current cash flow and the previous 5 year average.

   b) The current cash flow per tonne and the previous 5 year average on a per tonne basis.

7. The potential payout is then multiplied by a participation ratio so as only to stabilize income to the extent of actual participation in the program.

8. An individuals payment is calculated by dividing the individuals' levies paid in the last three years by all producers levies for the last three years and multiplying the result by the total payment.

9. Levies collected from producers vary from 1% to 2.5% of grain sales up to $60,000. The current levy rate is 2%.

10. The Federal Government contributes an additional 2% premium to the stabilization fund.

1.2 PROBLEM STATEMENT

In June of 1986 the Standing Committee on Agriculture conducted a review of the WGSP entitled "Improving the WGSA". Two recommendations that came from the review are,

1. That an income insurance scheme is an innovative approach to agricultural assistance and is worthy of consideration.[6]
2. That the minister, in co-operation with interested agencies, explore and report back on the feasibility of a regional or farm specific approach to suit more specific producer needs.[7]

These two recommendations indicate that the WGSP is not meeting all the needs of individual producers. The report continues to state,

> favorable financial or market conditions in one region or for one crop may overshadow poor returns in another area so that a payment is not triggered. A predominant crop such as wheat,can exert a bias against zones of more diversified crops. Each farmers financial situation is unique.[8]

The problem is defined as the relationship between the individual and the aggregates used in the WGSP. The hypothesis is that a stabilization program based on aggregates such as the WGSP does not reflect the individuals situation adequately and therefore will not stabilize the individual to the extent of a individualized program. If this is true then a producer could receive a payout from the WGSP when it is not required and conversely not recieve a payout when the producer experiences relatively low levels of income. For example in 1980 Manitoba suffered a

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[6] The Response to the Fourth Report of the House of Commons Standing Committee on Agriculture, Improving The Western Grain Stabilization Act (Ottawa,Canada:Government of Canada, 1986), p.8.

[7] Ibid., p.8

[8] Government of Canada: House of Commons, Minutes of Procedures and Evidence of the Sanding Committee on Agriculture (Ottawa,Canada:Government of Canada,1986), p.20.

drought and on the most part average wheat yields were quite low (21.2 bu./acre).[9] The income of Manitoba producers in 1980 fell by approximately 80% and there was no payout from the program (see table 1). For example the income of Manitoba producers in 1985 was the highest in the ten year history and the WGSP paid out the highest amount in the ten year history. Table 1 shows the income per farm with and without the WGSP payouts. Four WGSP payouts have occured in years when the income of Manitoba producers was above average. Conversely of the 6 years when the income of Manitoba producers was below average only once did the WGSP make a payout. Table 1 illustrates a number of interesting points

1. Based on the historical data the probability of a payout when the income of Manitoba producers falls below average is .167.
2. The probability of a payout when the income of Manitoba producers is above average is .75.
3. The major effect of the WGSP on the income of Manitoba producers has been to increase the mean while providing little reduction in the variance of income below the mean.

One must be careful in interperting the income figures in table 1 because they include all types of farmers not just grain farmers. However crop sales account for at least 50% of the cash income.

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[9] Manitoba Department of Agriculture, Manitoba Agriculture Yearbook 1985 (Winnipeg,Manitoba:1985), p.52.

TABLE 1

Farm Cash Income

year	Total Net Income ($/farm) (production-cost)	Payout From WGSP ($/farm)	Net Income with WGSP ($/farm)
1976	8795	0	8795
1977	9145	2196.76	11341.76
1978	11304	4698.90	16002.9
1979	8052	0	8052
1980	1543	0	1543
1981	14207	0	14207
1982	9162	0	9162
1983	1889	0	1889
1984	11188	3852.97	15040.97
1985	23057	9527.30	32584.3
mean	9834.2		11861.79
standard deviation	18303.28		26,449.79

Source: Manitoba Department of Agriculture, Manitoba Agriculture Yearbook 1985 (Winnipeg, Manitoba:1985), p.109.

Agriculture Canada,Western Grain Stabiization Annual Report 1984-1985, p.5.

1.3 OBJECTIVES

The objectives of the research are as follows. Firstly to determine if a self sustaining income stabilization program is feasible under different experiments. The self sustaining program will consist of tax credits and rebates which the producer pays back upon termination of the enterprise. Thus the income support is limited to the time value of the credits and rebates between the time they are taken and paid back. Secondly, to determine the effect the WGSP has on the income position of producers relative to the proposed stabilization program.

1.4 METHODOLOGY

In order to test the hypothesis the following methodology is employed. The WGSP is a combination of income support and stabilization. The Federal Government contributes an additional 2% levy to the fund balance and pays for the administration of the program. In addition the fund balance has been increased ad hoc by the Federal Government in order to make payouts when funds are not available as in 1987 (750 million dollars).[10] These are the sources of income support. Since producers contribute a levy they are also paying in part for the money they receive. This is the source of the stabilization aspect of the program. The proposed stabilization program will be self-sustaining in that producers are able to use fiscal policy to stabilize their income. The use of fiscal policy is not without income support in that the government either forgoes tax revenues (tax credit) or pays a tax rebate (transfer). In contrast to the WGSP the tax credits and rebates are a

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[10] Barry Wilson,"Federal Farm aid adds to the deficit mountain", Western Producer, Dec.24, 1984, p.5.

liability to the producer and payable upon termination of the business. Therefore the element of income support is limited to the time value of the credits and rebates used over time. In order to make a comparison between the WGSP and the proposed stabilization program one must keep in mind the different levels of income support.

The benchmark situation is a financial model of an individual farm with no stabilization. The starting point of the enterprise is taken from the 1984 Farm Credit Corporation Survey. In the survey a balance sheet is given for the average Manitoba cash crop farm. The only changes made to the balance sheet are, one additional year of depreciation to extend the time period to the end of 1985 and adjusting acreage levels to 640 acres because of the limit imposed by the WGSP on eligible sales. The model consists of inputs such as operating expenses (variable costs of production) and machinery (fixed costs of production). The crop produced is wheat. In order to use fiscal policy one needs to calculate taxable income and taxes payable. To do this many other components of the farm enterprise are incorporated such as operating loans and machinery investment. The definition of cash flow from grain sales in the benchmark model is equivelant to the definition of cash flow used by the WGSP. Given the marketing system of Canadian grain(ie The Canadian Wheat Board, where producers receive the same price for similiar quality grain), the competitive structure of the input industry, the only parameters which differentiate producers are yields, management practices and financial structure of the farm. The experiments will determine the effect of different locations and financial characteristics.

The case 1 situation is the identical farm model with the addition of the WGSP. Thus case 1 represents the current situation. In the case 1 model the cash flow from grain sales includes the levy paid by producers and the payouts received.

The case 2 situation is the identical farm model from the benchmark with the addition of a self administered plan utilizing a system of tax credits and rebates. The case 2 model cash flow from grain sales includes the use of tax credits and rebates.

A monte carlo simulation using the Interactive Financial Planning System(IFPS) is performed on all models.[11] The probability distributions of cash flow from grain sales are compared to see the effect of the WGSP and fiscal policy relative to the benchmark model.

To determine how fiscal policy should be applied one needs to consider the objectives of stabilization. The WGSP stabilizes cash flow from grain sales above the previous five year average based on aggregate measures but offers no statement on the objectives of stabilization. For the purposes of this research the primary objective is to provide producers with the incentive to engage in short run production. The long run decision to produce agricultural commodities is beyond the scope of this research. Thus it is assumed that the returns to agricultural investments (yearly income streams and capital appreciation) justify the resources employed. Assuming farmers sell crops at fixed prices then revenue and profit are a function of the level of output. Stated mathematicaly as 'follows[12]

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[11] Execucom Systems Corporation, <u>IFPS User's Manual Release 10.0</u> (Austin,Texas:1984)

1.1 profit = p * q - c(q) - b

where ; p = price of wheat

q = quantity of wheat

c(q) = variable cost function (short run)

b = fixed costs of production

Since the price of wheat is determined in the world market producers sell output at fixed prices. Differentiating 1.1 with respect to q one obtains the first order condition that equates price and marginal cost. Fixed costs generally have no effect on short run production decisions except in the case where production of a positive output results in a greater loss than that of no output (-b). Equation 1.1 provides the means of stabilization for this research. If variable costs of production ($/acre) is less than the product of yield (bu/acre) and price ($/bu) then short run production will take place. The cash flow from grain sales is defined on that basis for each model. Therefore as long as the cash flow from grain sales is greater than or equal to zero a positive output is produced. The modeling of the tax credits and rebates ensures that the cash flow from grain sales is at least zero.

[12] James M. Henderson and Richard E. Quandt, Microeconomic Theory: A Mathematical Approach (New York:Mc Graw-Hill Book Company, 1980), p.86.

1.5 OUTLINE

Chapter 2 provides definitions and explanations of simulation, model and monte carlo methods. The equations of the model are presented and discused in chapter 2 along with all assumptions. Chapter 3 documents experiments and scenarios. Chapter 4 provides an analysis of the results and conclusions.

Chapter II

MODEL AND METHODOLOGY

The purpose of this section is to provide definitions for model, simulation and monte carlo methods. These three terms have come to mean different things to different people.Only basic definitions are given and the interested reader is referred to the literature for more details. For the purposes of the study a model is defined as follows;

> A model is a representation of an object,system, or idea in some form other than that of the entity itself.[13]

The farm financial model presentated in this chapter is a representation of the annual transactions and investments for a cereal grain farm in Manitoba. The form of the model is not an exact replica of the financial statements for the farm but a reasonable representation.

Simulation for the purposes of this research is defined as follows;

> Simulation is a model of some situation in which the elements of the situation are represented by arithmetic and logical processes that can be executed on a computer to predict the dynamic properties of the situation.[14]

The input and output variables along with the relationship between variables are expressed as mathematical functions and the unknown variables solved for on a computer. Thus the model presented in this chapter fits the definition of simulation. The definition of monte carlo

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[13] Robert E. Shannon, <u>System Simulation, The Art and Science</u> (Englewood Cliffs, N.J.: Prentice-Hall Inc., 1975), p.4.

[14] James R. Emshoff and Roger L. Sission, <u>Design and Use of Computer Simulation Models</u> (New York: Macmillan Company, 1970), p.8.

simulation is not as precise and concise as those for a model and simulation. Lusztig and Schwab provide a basic definition as follows;

> Monte Carlo simulation is a computer-based technique offering solutions based on sampling, for problems of practically any degree of complexity. This technique calls for (i) the identification of key variables which are expected to affect the investment project's cash flow and (ii) the assignment of probability distributions to each factor. Then, giving due recognition to the likelihood of particular outcomes the computer is programmed to randomly select values for each variable and to combine them to generate estimated cash flows and net present values or internal rates of return.[15]

Lusztig and Schwab are defining Monte Carlo methods in a financial setting but the definition can easily be extended to incorporate this research.

2.1 STARTING BALANCE SHEET

The opening balance sheet of the farm business was based upon the the 1984 Farm Credit Corporation Survey and modified to reflect the case farm specified in the model. The modifications are shown in tables 2 and 3. The term liabilities are assumed to be amortized over a twenty year period at an interest rate of 10% because the balance sheet gives no indication of the terms of financing. The intermediate term assets (machinery) have been standardized on a per cropped acre basis.Machinery investment was reduced to reflect a farm of a size of equal to 640 acres. The area cropped was assumed to be 640 acres because of the limit on eligible sales of grain in the WGSP. The approximate size of a Manitoba grains and oilseeds farm to contribute to the maximum extent possible in the WGSP is 640 acres. Similarily the long term assets (land) were standardized on a per acre basis and reduced to reflect a

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[15] Peter Lusztig and Bernhard Schwab, Managerial Finance in a Canadian Setting (Toronto,Canada: Butterworths,1977), p.165.

farm of size equal to 640 acres.

TABLE 2

Initial Balance Sheet For
Cash Crop Farm in Manitoba 1985

	unadjusted	adjusted
Assets		
short term	63900	63900
intermediate term	115693	94523.64
long term	290113	362641.25
total	469706	521064.89
Liabilities		
short term	17525	0
intermediate term	19793	0
long term	35374	72692
total	72692	72692
average off farm income	$ 6,555	$ 6,655
cultivated acres owned	512	640
cultivated acres rented	193	0
total acres farmed	705	640

source: Farm Credit Corporation, Farm Survey 1984, p.28.

TABLE 3

Adjustments to Balance Sheet from
The Farm Credit Corporation

1) intermediate term assets, 115693 x .90 = 104123.7
To bring the book value of assets to the end of 1985.

2) 104123.7 / 705 = 147.69
To standardize the machinery investment per acre.

3) 147.69 * 640 = 94523.64
To determine the book value of machinery at the end of 1985 of a 640 acre farm.

4) 290113 / 512 = 566.63
To determine the approximate book value of land per acre.

5) 566.63 * 640 = 362641.25
To determine the book value of land of 640 acres.

6) The yearly debt payment to amortize 72692 over 20 years at 10% is 8537.94.

7) The debt / equity of the farm is 72692.02/448372.87 = 16%.

8) The long term debt associated with a debt / equiy ratio of 30 % is $120,245.78.

9) The yearly loan payment to amortize $120,245.78 over 20 years at 10% is $14,123.3.

2.2 BENCHMARK MODEL

Many of the variables in the benchmark model are taken from Snitinsky (1983). Specificaly the calculation of grain production and the method of treating variable inputs and expenses. The objective of the model is to provide a reasonable estimate of the variation in income one can expect from agricultural production.

2.2.1 Price of Wheat

The purpose of this section is to generate real and nominal prices of wheat. The real price of wheat (pd) is generated from a cummulative probability distribution of historical nominal prices. The simulated real annual price of wheat is indexed by the inflation rate resulting in the nominal price (pw). Determining future prices of wheat is a difficult task due to the factors affecting the world market. Traditional economic theory uses the concepts of supply and demand however one cannot ignore the influences of agricultural policies. In order to provide a reasonable estimate of price variation the price of wheat is based on the historic nominal prices from 1975 - 1985. The real price of wheat is computed by the following equations.

2.1 $pd_t = \text{cumrandr}\ (2.67, 2.80, 3.53, 3.61, 4.03, 4.48, 4.62, 4.68, 4.74, 4.75, 5.52,)$

where; pd_t = price from distribution cumrandr.

cumrandr = IFPS cummulative probability function.

2.2 $pw_t = pd_t\ (1 + inf\ )^{counter}$

where; pw_t = nominal price of wheat ($/bu.) in year t.

inf = annual inflation rate.

counter = simualtion year.

The price from the distribution (pd) is based on the historic prices of wheat from 1975-1985 (see table 4). In any year the probability that the price from the distribution is greater than $5.52 or less than $2.67 is equal to zero. The probabiity that the price from the distribution is between any two adjacent arguments is ten percent. Equation 2.1 generates an annual price of wheat from a cummulative probability distribution over the interval between $2.67 per bushel and $5.52 per bushel. Cumrandr is an IFPS probability function which forms a cummalative distribution from the values in parenthesis. Equation 2.2 converts the real price into a nominal price. In equation 2.2 inflation is set at 4% per year for the entire simulation. The real prices are indexed exponentialy using the inflation rate and the current simulation period. This method of modeling prices will provide a reasonable estimate of the historic price variation experienced from 1975 - 1985 with annual inflation of 4%.

TABLE 4

Historical Wheat Prices Received by Manitoba Farmers

year	price ($/bu.)
1975	3.53
1976	2.80
1977	2.67
1978	3.61
1979	4.62
1980	5.52
1981	4.75
1982	4.48
1983	4.74
1984	4.68
1985	4.03

source: Manitoba Department of Agriculture, Manitoba Agriculture Yearbook 1985(Winnipeg, Manitoba:1985), p.52.

2.2.2 Production and Sales

The purpose of this section is to generate annual crop production and grain revenue. Production and sales are basic components of farm income. Wheat production is a function of area seeded and yield per acre. Sales are a function of production and the price of wheat. Wheat yields at the farm level are modeled using a cummulative probability distribution. Farm production of wheat is computed from the simulated yield and a and a designated area seeded. Grain revenue is computed from the farm production and the price of wheat.

2.3 $yield_t$ = cumrandr (18.52, 21.03, 21.46, 23.18, 23.66, 24.54 26.01, 29.33, 29.72, 32.37, 33.67)

where; $yield_t$ (bu./acre) in year t.

Cumrandr is an IFPS cummulative probability function and the arugments of the distribution are from risk area 3 of the Manitoba Crop Insurance Corporation records.

2.4 a = 640

where; a = acreage (acres)

2.5 $prod_t = a * yield_t$

where; $prod_t$ = production (bu.) in year t.

2.6 $gr_t = prod_t * pw_t$

where gr_t = grain revenue ($) in year t.

The wheat yields will depend on the location of the producer (soil characteristics and weather patterns), and management practices. The cummulative probability distribution of wheat yields is taken directly from the Manitoba Crop Insurance Corporation (MCIC) records from 1975-1985 for risk area 3. Equation 2.3 generates wheat yields using the cummulative probability function based upon historical data taken from risk 3 area. There is a probability of ten percent that the yield generated will fall between any two adjacent arguments. The probability that the yield will be greater than 33.67 bushels per acre or less than 18.52 bushels per acre is equal to zero. Seeded area is set at a level of 640 acres (equation 2.4). Farm production (prod) is simply the product of acreage and yield per acre. Equation 2.5 computes the production of wheat. Grain revenue (gr) is simply the product of production and the price of wheat (pw). Equation 2.6 computes the grain revenue of the enterprise.

2.2.3 Inputs

Inputs are grouped into two main categories; operating expenses and capital expenditures. Operating expenses include fertilizer, chemicals, fuel, machinery operating costs, insurance, seed and treatment. Capital expenditures are restricted to replacing machinery. The purpose of this section is to generate operating expenses per acre and model the replacement of machinery.

2.7 $oe_t = oe_{(t-1)} * (1+inf)$

where; oe_t = operating expenses ($/acre) in year t.

2.8 $toe_t = oe_t * a$

where; toe_t = total operating expenses ($) in year t.

2.9 $rmi_t = rmi_{(t-1)} * (1+inf)$

where ; rmi_t = is the required machinery investment($/acre)

and was assumed to equal $149/acre in 1985.

2.10 $bv_t = bv_{(t-1)} + amacrep_{(t-1)} - dep_{(t-1)}$

where; bv_t = book value of machinery($) in year t.

$amacrep_t$ = actual machinery replacement ($) in

year t.

dep_t = depreciation ($) in year t.

2.11 $dep_t = ccar * bv_t$

where ; dep_t = depreciation ($) in year t.

ccar = capital consumption allowance rate

2.12 ccar = .10

2.13 $macdef_t = macdef_{(t-1)} * (1 + inf) + dep_t - amacrep_t$

where ; $macdef_t$ = machinery defecit pool ($) in year t.

$amacrep_t$ = actual machinery replaced ($)

in year t.

2.14 $macrep_t$ = if $bv_t > rmi_{(t-1)} * a$

then 0

else $macdef_{(t-1)}$

where; $macrep_t$ = machinery replacement ($) in year t.

2.15 $amacrep_t = maximum(0, macrep_t)$

where; $amacrep_t$ = actual machinery replacement ($) in year t.

Operating expenses are a function of seeded area, management practices and input prices. Therefore the operating expenses are standadized per acre and are increased by the inflation rate. Operating expenses per acre are based on the Manitoba Department of Agriculture estimates of operating expenses.[16] In year one (1985) the operating expenses are initialized to $83.85 per acre. Each subsequent year the operating expenses per acre are adjusted to increase at the designated inflation rate. Equation 2.7 generates operating expenses per acre. Total operating expenses is simply the product of operating expenses per acre and acreage. Equation 2.8 computes total operating expenses.

In general machinery investment is a function of seeded area and management practices. The replacement of machinery is governed by the difference between the book value of machinery and the average investment per acre in Manitoba. The result of this method will limit the deviation of machinery investment from the Provincial average. At the end of

[16] Manitoba Department of Agriculture, Farm Buisness Management Information Update (Winnipeg,Manitoba:1984)

1985, on average Manitoba farms had capital investment of $149 per acre. The $149 is equal to the total capital invested in machinery and equipment in 1981 divided by the total area cropped in 1981 and adjusted for input index increases to the end of 1985.[17] The level of average machinery investment on average will increase as the price level rises over time. Thus required machinery investment (rmi) in equation 2.9 is initialized to $149 per acre and increased yearly by the inflation rate.

In year one the book value of machinery is initialized at $94523.64. (see table 2). The book value of an asset changes over time as the asset is used (depeciation) and replacements made. In equation 2.10 the book value is increased as replacements are made (amacrep) and reduced as the asset is used (dep). The book value is the value at the start of the year. Economic depreciation and depreciation for tax purposes are assumed to be equal. Equation 2.11 calculates the depreciation (dep) based on the book value (bv) and the depreciation rate (ccar). Most farm machinery falls into class 10 of the Income Tax Act which has a maximum capital consumption rate of 15%. The model uses a capital consumption rate of 10% (equation 2.12).

The replacment of machinery is calculated in equations 2.13-2.15. Machinery deficit (macdef) is one variable used to calculate the amount of machinery replaced (amacrep). For every year macdef (2.13) calculates the difference between the book value of equipment (bv) and the required investment (a * rmi) to determine if the producer is over or under capitalized. The subtraction of the initial book value from the product of the acreage and required investment per acre is the initial-

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[17] Manitoba Department of Agriculture, <u>Manitoba Agricultuure Yearbook 1985</u> (Winnipeg,Maitoba:1985), p.99.

ized value of machinery deficit in year 1. The machinery deficit pool increases over time by the amount of depreciation (dep) and is reduced by replacements (amacrep). In addition the machinery deficit (macdef) is increased by the inflation rate because future replacements are made at prevailing market prices. Viewed in this way machinery deficit (macdef) is the mirror image of the book value of machiney investment (bv) adjusted for inflation. Machiney replacement (amacrep) is a function of the book value (bv), requied investment (rmi)and machinery deficit (macdef). The decision to replace machinery is determined by the difference between the book value (bv) and required investment (rmi). If the book value (bv) at the start of any year is greater than the required investment then no repacement is required. The assumption that purchases can be postponed until the value of machinery falls below 65% of the desired level (rmi) is an attempt to model the behaviour known as living off of depreciation. Thus the model postpones machinery investment until the book value of machinery is less than 65% of the required investment. The amount of replacements (amacrep) is a function of the machinery deficit (macdef). Machinery replacement is assumed to take place at the beginning of the year. Equation 2.15 is used to avoid the computation of negative machinery replacements. Viewed in this way machinery replacement is a decision made at the start of the year based on last years deficit, required investment, and the beginning years book value.

2.2.4 Financing and Income Taxes

The purpose of this section is model the demand for operating loans, calculate the interest payable associated with the operating loan, compute taxable income, income taxes payable, cash flow, cash flow from grain sales and net current assets. The demand for a operating loan is a function of the financial resources of the enterprise and the level of operating expenses. The computation of taxes and cash flow variables is straightforward.

2.16 $opln_t$ = if $nca_{(t-1)} - amacrep_t < 0$

and $nca_{(t-1)} \geq 0$

then $toe_t + amacrep_t - nca_{(t-1)}$

else if $nca_{(t-1)} - amacrep_t < 0$

and $nca_{(t-1)} < 0$

then $toe_t + amacrep_t + absnca_{(t-1)}$

else if $nca_{(t-1)} - amacrep_t \geq 0$

and $nca_{(t-1)} - amacrep_t < toe_t$

then $toe_t - (nca_{(t-1)} - amacrep_t)$

else 0

where; $opln_t$ = operating loan ($) in year t.

nca_t = net current assets ($) in year t.

$absnca_t$ = absolute value of net current assets ($) in year t.

2.17 $int_t = opln_{(t-1)} * (.10)^{.75}$

where; int_t = interest repayment of operating loan ($) in year t.

2.18 $taxinc_t = gr_t - toe_t - int_t - dep_t + ofi_t$

where; $taxinc_t$ = taxable income ($) in year t.

ofi_t = off farm income ($) in year t.

2.19 $ofi_t = ofi_{(t-1)} * (1+inf)$

where; ofi_t = off farm income ($) in year t.

2.20 $taxpay_t$ = if $taxinc_t > 0$ then $ptaxpay_t$

else 0

where; $taxpay_t$ = tax payable ($) in year t.

2.21 $ptaxpay_t = mtr * taxinc_t$

where; $ptaxpay_t$ = positive tax payable ($) in year t.

2.22 mtr = .35

where; mtr = marginal tax rate

2.23 $cfgs_t = gr_t - toe_t - int_t - taxpay_t$

where; $cfgs_t$ = cash flow from grain sales ($) in year t.

2.24 $cf_t = cfgs_t - amacrep_t - ltd + opln_t + ofi_t - opln_{(t-1)}$

where; cf_t = cash flow ($) in year t.

ltd = annual long term debt payment ($) in year t.

2.25 ltd = 8537.94 with a debt / equity ratio of 16%

14123.3 with a debt / equity ratio of 30%

where; ltd = long term debt payments ($)

2.26 $nca_t = nca_{(t-1)} + cf_t$

where; nca_t = net current assets ($) in year t.

2.27 $absnca_t = abs(nca)$

where; abs = IFPS absolute value function

$absnca_t$ = absolute value of nca in year t.

The need for a operating loan is determined by the difference between the net current assets which are assumed to be cash and the operating expenses. The decision to take a operating loan is made at the start of the year after the decision to replace machinery is made. The residual financial resources of the enterprise at the start of any year is equal to last years net current assets minus the amount of machinery replacement at the start of the year. If this difference is less than 0 then a operating loan is required. When the difference is less than 0 the amount of the loan depends on the whether last years net current assets are greater than 0. If last years net current assets are greater than 0 then the operating loan is equal to total operating expenses (toe) plus machinery replacement (amacrep) minus last years net current assets. If last years net current assets are less than 0 then the operating loan is equal to total operating expenses (toe) plus machinery replacement (amacrep) plus the absolute value of last years net current assets. If the residual financial resources is greater than 0 but less than total operating expenses then a loan equal to the difference is required. Under all other circumstances no loan is required. Equation 2.16 models the demand for an operating loan.

The two components for calculating the interest on the operating loan (opln) are the interest rate and the term of the loan. The model assumes a interest rate of 10% for the simulation period and a term of 9 months or 3/4 of a year. Nine months is the approximate time from seeding to the sale of output. The principal and interest is paid in the year after the loan is made. In any year the interest on the previous years operating loan is equal to the product of the annual interest rate (10%) raised to the power of .75 and the principal of the loan. Equation 2.17 calculates the interest due on the operating loans.

Taxable income, as defined by the Income Tax Act is equal to grain revenue (gr) minus operating expenses (toe), interest (int), depreciation (dep) plus off farm income (ofi). Equation 2.18 calculates taxable income. In recent years off farm income has become a strategy used by producers to stabilize and supplement the income of the enterprise. The average off farm income of producers in Manitoba in 1984 was $6,655 (see table 2). One would expect that in general the off farm income would increase yearly by the inflation rate. Equation 2.19 initializes off farm income to $6,655 and is increased yearly by the inflation rate. If taxable income (taxinc) is greater than 0 then a tax liability (ptaxpay) exists. The liability is equal to the product of the marginal tax rate (mtr) and taxable income (taxinc). For the purposes of this study a marginal tax rate of 35% is assumed (equation 2.22). The calculation of positive tax payable (ptaxpay) is done using equations 2.20 and 2.21. Cash flow from grain sales (cfgs) is grain revenue minus total operating expenses, interest and tax payable (equation 2.23). This is the identical measure of cash flow used in the WGSP methodology in determining payments. Cash flow is cash flow from grain sales minus actual machinery replacement, long term debt, last years operating loan, plus current years operating loan and off farm income. The previous years operating loan deducted from cash flow is the repayment of principal of last years operating loan (if any). The model does not include owner withdrawls. Net current assets (nac) in year 1 is equal to $63900 plus year 1 cash flow (see adjusted balance sheet). In each subsequent year net current assets is equal to the previous year plus the current cash flow (equation 2.26). Equation 2.27 calulates the absolute value of net current assets.

2.3 CASE 1 MODEL

The case 1 model is identical to the benchmark situation except that it includes the WGSP. Tables 5, 6, 7, and 8 provide historical values and computations for all of the variables that are modeled. Values for WGSP aggregates are available up to the 84/85 crop year. Thus year 1 of the simulation is the 85/86 crop year.

TABLE 5

Historical WGSP Statistics

crop year	1 ggp million dollars	2 ggm million tonnes	3 avgp dollars per/tonne	4 gge million dollars	area seeded thousand acres
71/72	1204.1	24.308	49.54	511.0	46123.3
72/73	1564.8	25.650	61.01	549.0	43088.5
73/74	3327.4	22.330	149.01	730.0	45678.5
74/75	3076.6	18.484	166.45	899.0	43569
75/76	3120.1	22.173	140.72	1197.0	44984.5
76/77	2566.7	23.444	109.48	1400.6	45420
77/78	2981.1	26.605	112.05	1513.1	45638
78/79	3329.4	25.319	131.50	1783.8	48445
79/80	4389.6	27.412	160.13	2070.2	48483
80/81	6382.8	31.571	202.17	2229.1	48141
81/82	5592.4	31.624	176.84	2819.7	51685.2
82/83	6119.9	36.836	166.14	3127.7	52579
83/84	5884.2	34.048	172.82	3439.0	53561.5
84/85	5411.2	27.790	194.72	3573.8	55450

1) ggp = gross grain proceeds

2) ggm = gross grain marketings

3) avgp = average price

4) gge = gross grain expenses

source: Western Grain Stabilization Administration, Western Grain Stabilization Program Report, unpublished data, Nov.15, 1985 p.62.

TABLE 6

Standardized Gross Grain Expenses and Marketings

crop year	gge/a ($/acre)	ggm/a (tonnes/acre)
71/72	11.07	.527022
72/73	12.74	.595286
73/74	15.98	.488851
74/75	20.64	.424247
75/76	26.61	.492903
76/77	30.84	.516160
77/78	33.15	.582957
78/79	36.82	.522634
79/80	42.70	.565394
80/81	46.30	.655803
81/82	54.56	.611858
82/83	59.49	.700584
83/84	64.20	.635680
84/85	64.45	.501172

gge/a = gross grain expenses / total acreage

ggm/a = gross grain marketings / total acreage

TABLE 7

Historical Percentages of Total Production

crop year	wheat	oats	barley	rye	flaxseed	rapeseed	mustard seed
71/72	.59	.025	.28	.016	.023	.065	.003
72/73	.68	.023	.211	.009	.018	.055	.023
73/74	.66	.029	.237	.008	.018	.044	.005
74/75	.626	.036	.25	.014	.015	.05	.005
75/76	.65	.038	.22	.014	.018	.063	.002
76/77	.64	.038	.253	.013	.010	.044	.001
77/78	.66	.03	.21	.012	.017	.065	.003
78/79	.60	.018	.23	.014	.021	.11	.003
79/80	.65	.015	.218	.014	.022	.083	.002
80/81	.67	.014	.225	.011	.012	.068	.003
81/82	.624	.018	.253	.017	.013	.073	.002
82/83	.693	.012	.204	.015	.014	.060	.002
83/84	.68	.013	.204	.0195	.014	.069	.0019
84/85	.66	.013	.193	.012	.019	.093	.0035

source: Western Grain Stabilization Administration, Western Grain Stabilization Program Report, unpublished data, Nov.15,1985.

2.3.1 Gross Grain Expenses, Marketings and Acreage

The purpose of this section is to calculate gross grain expenses, and gross grain marketings for the Canadian Wheat Board (CWB) area. Gross grain expenses in the CWB area is a function of area seeded, the price level in the input industry and management practices of producers. Gross grain marketings is a function of the area seeded and yields.

2.28 $ggepa_t = ggepa_{(t-1)} * (1 + inf)$

where; $ggepa_t$= gross grain expenses ($/acre) in year t.

2.29 $gge_t = ggepa_t * totacr / 1000$

where; gge_t= gross grain expenses ($) in year t.

totacr= total acreage (acres)

2.30 totacr = 55450

where; totacr = total acres in the CWB area

2.31 $ggmpa_t$ = cumrandr (.424247, .492903, .501172, .516160, .522634, .565394, .582957, .611858, .635680, .655803, .700584)

where; $ggmpa_t$ = gross grain marketings (tonnes per acre) in year t.

2.32 $ggm_t = ggmpa_t * totacr$

where; ggm_t = gross grain marketings (tonnes) in year t.

Gross grain expenditures are standardized on a per acre basis and are increased yearly by the inflation rate. The historical values for gross grain expenditures per acre (ggepa) are in table 6. The values in table 6 illustrate the increasing trend in gross grain expenses. In year 1 ggepa is initialize to the 84/85 crop year times inf (equation 2.28). In each subsequent year the ggepa is equal to the product of the previous years value and the inflation rate. Gross grain expenses is the product of ggepa and total acreage (totacr) as shown in equation 2.29. The constant of 1000 is to adjust for units . Total acreage (totacr) is set at 55450 (1985 acreage) and remains constant (equation 2.30). Gross grain marketings per acre (ggmpa) are generated from a cummulative probability distribution based on the historical values from 1975 -1985 (equation 2.31, see table 6). This method is identical to the use of the cummulative probability functions for the price of wheat and farm level yields. Gross grain marketings (ggm) is equal to the product of ggmpa and totacr (equation 2.32).

2.3.2 Prices of the 7 Grains and the Aggregate Price

The purpose of this section is to calculate the prices of the 6 other grains covered by the WGSP and the average price per tonne for the Wheat Board area. Historically the price of wheat relative to the 6 other respective grains have moved together. The price of wheat from the benchmark model is used to calculate the price of oats, barley, flax, rye, mustard seed and rapeseed. The constants in equations 2.33 thru 2.38 were determined from the historical relationship between the price of wheat and the respective grain.

2.33 $po_t = pw_t / 2.63$

where; po_t = price of oats ($/bu.) in year t.

2.34 $pb_t = pw_t / 1.72$

where; pb_t = price of barley ($/bu.) in year t.

2.35 $pf_t = pw_t / .54$

where; pf_t = price of flax ($/bu.) in year t.

2.36 $pr_t = pw_t / 1.51$

where; pr_t = price of rye ($/bu.) in year t.

2.37 $pms_t = pw_t * 1.87$

where; pms_t = price of mustard seed ($/bu.) in year t.

2.38 $prap_t = pw_t / .71$

where; $prap_t$ = price of rapeseed ($/bu.) in year t.

2.39 $$avgp_t = (pw_t * .68 * 36.744) + (po_t * .013 * 64.842) + (pb_t * .2 * 45.930) + (pr_t * .013 * 39.368) + (pf_t * .019 * 39.368) + (prap_t * .073 * 44.092) + (pms_t * .002 * 44.092)$$

where; $avgp_t$ = average price (\$/tonne) in year t.

The average price (avgp) is calculated using the prices of the seven grains weighted by the historic percentage of total production each grain represents. Table 8 lists the historic percentages of production for the seven grains. In general the value for the 84/85 crop year was used as long as it was representative of the previous 5 years. Equation 2.39 calculates the average price (avgp) and converts the price from \$/bu. to \$/tonne.

2.3.3 Calculation of WGSP Aggregates

The purpose of this section is to calculate the aggregates used by the WGSP. Equations 2.40 thru 2.52 calculate the aggregates employed by the WGSP. The calculations are identical to the method used by the WGSP with some assumptions.

2.40 $ggp_t = avgp_t * ggm_t$

where; ggp_t = gross grain proceeds (\$) in year t.

2.41 $nge_t = gge_t * .8$

where; nge_t = net grain expenses (\$) in year t.

2.42 $ngp_t = ggp_t - nge_t$

where; ngp_t = net grain proceeds (\$) in year t.

2.43 $ncf_t = ngp_t * .7853 * .9263$

where; ncf_t = net cash flow ($) in year t.

2.44 $egm_t = ggm_t * .7853 * .9263$

where; egm_t = eligible grain marketings (tonnes) in year t.

2.45 $ncfpu_t = ncf_t / egm_t$

where; $ncfpu_t$= net cash flow per unit ($/tonne) in year t.

2.46 $acf_t = (acf_{(t-5)} + acf_{(t-4)} + acf_{(t-3)} + acf_{(t-2)} + acf_{(t-1)}) / 5$

where; acf_t = five year average cash flow ($) in year t.

2.47 $acfpu_t = (acfpu_{(t-5)} + acfpu_{(t-4)} + acfpu_{(t-3)} + acfpu_{(t-2)} + acfpu_{(t-1)}) / 5$

where; $acfpu_t$ = average cash flow per unit ($/tonne) in year t.

2.48 $pp1_t$ = maximum $(0, acf_t - ncf_t)$

where; $pp1_t$= potential payout from methodolgy 1 of the WGSP($) in year t.

2.49 $pp2_t$ = maximum$(0,(acfpu_t -ncfpu_t) * egm_t)$

where; $pp2_t$ = potential payout from methodolgy 2 of the WGSP($) in year t.

2.50 $actp1_t = pp1_t * .78$

where; $actp1_t$ = actual payout from methodolgy 1 ($) in year t.

2.51 $actp2_t = pp2_t * .78$

where; $actp2_t$ = actual payout from methodolgy 2 ($) in year t.

2.52 $totp_t = maximum (actp1_t, actp2_t)$

where; $totp_t$= total payout to prairies ($) in year t.

Gross grain proceeds (ggp) is the product of average price (avgp) and gross grain marketings (ggm). Net grain expenses (Nge) is the product of gross grain expenses (gge) and .8. The constant of .8 assumes a marketing to production ratio of 80% throughout the simulation. Net grain proceeds (ngp) is the difference between gross grain proceeds and net grain expenses. Net cash flow (ncf) is the product of net grain proceeds (ngp), .7853 and .9263. The constant .7853 is used to eliminate the value of grain in excess of the $60,000 limit. The constant of .9263 is used to exclude the value of grain marketed by interested parties such as corporations and landlords. Historicaly both constants show very little fluctuation over the past 5 years and thus will be assumed to to remain constant for the duration of the simulation. Similarily eligible grain marketings (egm) is the product of gross grain marketings, .7853 and .9263. Net cash flow per unit (ncfpu) is net cash flow dividied by eligible grain marketings. Equations 2.46 and 2.47 calculate the 5 year average of cash flow and cash flow per unit. In year 1 the 5 year averages are equal to the actual averages of the WGSP from 1984/1985 crop year and in each successive year the simulated value displaces the oldest value. The potential payout from each mechanism is calculated in equations 2.48 and 2.49. The potential payouts are multiplied by .78 in order to determine the actual payouts (actp1,actp2) so as only to stabilize the cash flow to the extent of participation in the program(ie .78 is the participation ratio). Historicaly the participation ratio has shown very little deviation from 78% and will be assumed constant. Equation 2.52 chooses the maximum value of the actp1 and actp2 in accordance with the operations of the WGSP. The method used by the WGSP indicates that the probability of a payout is not only a function of the current year but the current year relative to the previous 5 year average.

2.3.4 Producer Payouts and Levy

The purpose of this section is to determine the producers payouts from the WGSP and levies contributed. The amount of payout is determined by the operations of the WGSP and it is assumed that the producer desires to contribute the maximum levy allowable. Equation 2.53 calculates the individuals share of the aggregate payment while 2.54 calculates the levy paid into the program by the producer.

2.53 $payout_t = \text{if } totp_t > 0 \text{ then}$

$$.018307426 * totp_t * 1000$$

$$\text{else } 0$$

where; $payout_t$ = the individuals share of the total payment to the prairies ($) in year t.

2.54 $levy_t = \text{minimum}(1200, .02 * gr_t)$

where $levy_t$= the levy paid by the producer ($) in year t.

2.55 $sumpo_t = sumpo_{(t-1)} + payout_t$

where; $sumpo_t$ = total payout ($) in year t.

The constant of .018307426 is based on the average historical percentages received by producers who contributed the maximum since the start of the program (see table 8). Table 8 illustrates the determination of the constant. It is assumed that the producer wishes to contribute the maximum allowable. Thus in equation 2.54 the levy is the lessor of $1200 or 2% of the grain revenue. The $1200 is the current maximum contribution allowed. The levy rate of 2.0% is assumed to be constant. The equations for cash flow from grain sales (2.23) and taxable income (2.18) now include payouts and levys(+ payout,- levy).

TABLE 8

Historical Percentages of Total Payout

year	Producer Payout	Total Payout	Percentage of Total
	$ / farm	($ '000)	
1977	$2,196.76	$114,957	1.9109406%
1978	$4,698.90	$252,937	1.8577353%
1983/1984	$3,852.97	$222,905	1.7285256%
1984/1985	$9,527.30	$521,824	1.8257688%

average of percentages = .018307426

source : Agriculture Canada, Western Grain Stabilization Annual Report 1984/85, p.5.

2.4 CASE 2 MODEL

The case 2 model consists of the indentical farm model from the benchmark with the addition of a self administered stabilization program utilizing a system of tax credits and rebates.

2.56 $taxreb_t$ = if $cfgs_t \geq 0$ then 0

else if $abscfgs_t \geq taxpay_t$ then $abscfgs_t - taxpay_t$

else 0

where; $taxreb_t$ = tax rebate ($) in year t.

$abscfgs_t$ = absolute value of cfgs ($) in year t.

2.57 $abscfgs_t$ = abs (cfgs)

where; abs = IFPS absolute value function

$abscfgs_t$ = absolute value of cfgs in year t.

2.58 $ataxpay_t$ = if $taxreb_t \leq 0$ then $taxpay_t$

else if $abscfgs_t \geq taxpay_t$ then 0

else $taxpay_t - abscfgs_t$

where; $ataxpay_t$ = actual tax payable ($) in year t.

2.59 $txcr_t = taxpay_t - ataxpay_t$

where; $txcr_t$ = tax credit ($) in year t.

2.60 $cfgswc_t = cfgs_t + taxreb_t - ataxpay_t + taxpay_t$

where; $cfgswc_t$ = cash flow from grain sales with credit ($) in year t.

2.61 $totreb_t = totreb_{(t-1)} + taxreb_t$

where; $totreb_t$ = total rebate ($) in year t.

2.62 $tottxcr_t = tottxcr_{(t-1)} + txcr_t$

where $tottxcr_t$ = total tax credit ($) in year t.

2.63 $totsub_t = totsub_{(t-1)} + taxreb_t + txcr_t$

where; $totsub_t$ = total subsidy ($) in year t.

The self administered plan has two elements. One is a tax rebate and the other is a tax credit. A tax rebate is a transfer of money from the government to the producer. A tax credit is a deduction from tax liability and therefore represents lost revenue to the government and cash saving to the producer. Equation 2.56 determines if a rebate is used. If cash flow from grain sales (cfgs) is greater than or equal to 0 then no rebate is used. If the loss from grain sales (abscfgs) is greater than the tax liability (taxpay) then a rebate equal to the difference is available. If the loss from grain sales (abscfgs) is less than the tax liability a tax credit is used. Equation 2.58 performs additional tax calculations. If no rebate is taken then actual tax payable (ataxpay) equals taxpay. If the the absolute value of cash flow from grain sales is greater than taxes payable then actual taxes payable equals 0. The tax credit (txcr) is defined as the difference between taxes payable and actual taxes payable. Qualitatively the policy works as follows. If the cash flow from grain sales is less than 0 then income stabilization is available. The form of the support depends on the size of the loss relative to tax liability. If the loss is less than the tax liability then support is in the form of a tax credit which reduces the tax liability. If the loss is greater than the tax liability then a tax credit is used to offset the tax liability and the difference is the tax rebate. Equations 2.61 and 2.62 accumulate the tax credits and rebates respectively. Equation 2.63 accumulates the combined support.

Chapter III

EXPERIMENTS AND SCENARIOS

3.1 NOTES ON THE MODEL

The model presented in chapter 2 is used for the analysis. However a few points need to be discussed as to how the final modeling techniques were arrived at. One such point is the relationship between risk area yields, aggregate production and gross grain marketings. In order to test the strength of the relationship 2 alternatives were explored.

Firstly, risk area yields were regressed on aggregate yields of the seven grains covered in the WGSP. Of the 15 risk areas only 5 regions had a statistically significant relationship at the 10% level.[18] However only 30% of the variation in aggregate yields could be explained by the variation in risk area yields while the error term accounts for 70%. From a modeling perspective this was considered unacceptable.

Secondly risk area yields were regressed on the gross grain marketings of the WGSP. Of the 15 risk areas 6 regions had a statistically significant relationship at the 10% level. However only 30% of the variation in gross grain marketings could be explained by the variation in risk area yields. This relationship was also considered unacceptable. Thus the model assumes no annual dependence between individual farm yields and the gross grain marketings at the aggregate level.

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[18] Agriculture Canada, The Manitoba Crop Insurance Corporation Annual Report 1984-85, p.26.

3.2 EXPERIMENTS

The first experiment is to determine the effect of a constant grain price and a debt to equity ratio of 16% for the farm. This is achieved by specifying that the price from the probability distribution equals $4.03 (equation 2.1) which is the price for 1985. This will provide a means to evaluate how the different policy alternatives handle just variation in sales and production risk. The price of 1985 also is an indication of the U.S. policy of lower loan rates. The U.S. loan rate is considered to have considerable impact on the world price of wheat because of the market share held by the U.S.

The second experiment uses the same constant price of wheat but with a debt to equity ratio of 30%. At this level of debt the yearly debt payments become $14,123.30 (see table 3). Thus the difference between experiment 2 relative to 1 is the increase in debt relative to equity.

The third experiment uses the historical price variation with a debt to equity ratio of 16%. Thus the difference between experiment 3 relative to 1 is the of price variation.

The fourth experiment uses the historical price variation with a debt to equity ratio of 30%. Thus the difference between experiment 4 relative to 3 is a higher debt to equity ratio with price variation.

The Farm Credit Corporation has classified all Manitoba producers according to debt to equity ratios. Approximately one third of all producers have less than 77% equity. Another third has equity between 77% and 97%. The remaining third has equity greater than 97%. The two debt to equity ratios used are representative of the classes with the lowest levels of equity. All four experiments are simulated using yield data from risk area 3. Risk area 3 has a historic coeffecient of variation of 36.20 for wheat which is high among Manitoba risk areas.

Chapter IV

RESULTS AND CONCLUSIONS

4.1 RESULTS

Table 9 lists the critical probabilities of the benchmark model(no stabilization) for experiments 1 thru 4.[19] Critical probability is defined as the probability that cash flow from grain sales is less than 0. Critical probability is one measure of risk in that it calculates the probability of a certain event happening with the measure of risk being the probability. The level at which the probability is measured (ie p(cfgs<0)) is based on the microeconomic relationship discussed in section 1.4.

Under the conditions of experiment 1 (constant real price of wheat equal to $4.03 per bushel, debt to equity ratio of 30%) the probability that cash flow from grain sales being less than 0 is equal to .2718 in year 2. This is the only year in which the probability of cfgs being less than 0 is greater than 0. Clearly the risk associated with a constant real price of wheat at $4.03 per bushel and debt to equity ratio of 16% is low. Under the conditions of experiment 1 the WGSP pays a producer who who participates to the maximum extent possible a sum of $82,679 over the 20 years. In experiment 1 the only aggregate random variable is gross grain marketings (equation 2.31) as real prices are

[19] Derek Bunn, Applied Decision Analysis (New York: Mc Graw-Hill Inc., 1984), p.34.

constant. The probability that the cfgs being less then 0 under the case 1 model for experiment 1 is 0 for 19 of the 20 years. Thus the WGSP is effective in stabilizing the income of producers under experiment 1 at a cost of $82,679 per participant with no real price variation. Alternatively the sum of tax credits and rebates over the 20 year period under the case 2 model is $3,508. The case 2 model is also effective at eliminating the probability of cfgs being less than 0 by the very nature of the modeling (see equations 2.56-59). The net current assets of the enterprise at the end of the 20 years under the case 2 model is $217,996 (mean value). Clearly the enterprise is in a financial position to repay the tax credits and rebates taken. The net current assets does not include withdrawls from the business for household consumption. Therefore the absolute level of net current assets is overstated but relatively no difference exists between the models. Therefore pure income stabilization is feasible under experiment 1 with relatively little cost to the government (time value of credits and rebates) relative to the WGSP.

Under the conditions of experiment 2 in 12 of the 20 years there is a probability greater than 0 of cash flow from grain sales being less than 0. The sum of the critical probabilities over the 20 year period is 1.5005. Relative to experiment 1, the increase in the debt to equity ratio has increased the risk substantialy. This is because with the higher annual debt payments the probability of needing a operating loan increases. Consequently, the cash flow from grain sales has a higher probability of being less than zero because of the inclusion of interest expense in cash flow from grain sales. Under the conditions of experiment 2 the WGSP is effective in reducing the critical probability to 0 in 14 of the 20 years. The only difference in experiment 2 relative to experiment 1 is the increase in debt to equity ratio therfore the sum of the payouts over the 20 year period is the same ($82,679). The case 2 model under experiment 2 by it's nature also reduces the critical probabilities to 0 in every year. The sum of the tax credits and rebates over the 20 year period is $11,419. Again the case 2 model is able to stabilize the cash flow from grain sales above 0 for substantialy less than the WGSP ($11,419 versus $82,679). The net current assets at the end of the 20 year period in the case 2 model are $91,420 (mean value) with no allowance for withdrawls. The enterprise is in a financial position to repay the tax credits and rebates used thus pure income stabilization is feasible under the conditions of experiment 2.

Experiment 3 introduces price variation based on the historical prices received as shown in equation 2.1 and table 4. In each of the 20 years there is a probability greater than 0 of cash flow from grain sales being less than 0 in the benchmak model. The sum of the critical probabilities under experiment 3 is 1.613. Thus the introduction of price variation has increased the level of risk relative to no real price variation in experiment 1. The WGSP is effective at reducing the critical probabilities to 0 in every year. The sum of the payouts over the 20 year period under experiment 3 is $142,815. The sum of the tax credits and rebates over the twenty year period in the case 2 model is $38,451. Again the case 2 model is able to reduce the critical probabilities to 0 in every year for significantly less money. The net current assets of the enterprise at the end of the 20 year period is equal to $278,894 (mean value) with no allowance for withdrawls. The enterprise is in a financial postion to repay the tax credits and rebates used thus pure income stabilization is feasible under the conditions of experiment 3.

Under the conditions of experiment 4 in each of the 20 years there is a probability greater than 0 of cash flow from grain sales being less than 0 in the benchmark model. The sum of the critical probabilities over the 20 year period is 2.6671. Under the conditions of experiment 4 the WGSP is effective at reducing the critical probability to 0 in all but one year. The sum of the payouts over the 20 year period is the same as experiment 3 ($142,815). The sum of the tax credits and rebates over the 20 year period is $44,655. The case 2 model is once again able to reduce the critical probabilities for less money. The net current assets at the end of the simulation of $159,765 (mean value) with no allowance for withdrawls, enable the enterprise to repay the tax credits and rebates used. Thus pure income stabilization is feasible under experiment 4.

In order to facilitate a comparison between the probability distibution of net current assets in year 20 of the case 1 and 2 models a simple adjustment is made to the distribution of net current assets in the case 2 model. Firstly the level of income support under all 4 experiments is calculated for the case 1 model. This is accomplished by subtracting the levies contributed by the producer from the sum of the payouts received under all 4 experiments of the case 1 model. The subtraction of the sum of the tax credits and rebates from the level of income support gives the adjustment factor. This calculation is shown in table 10. The adjustment factor is then added to each percentile of the case 2 model to achieve an equal level of income support under the 2 models. Under this comparison the producer no longer pays back the credits and rebates. Since the level of income support is now equal the government and producers should be indifferent. The adjusted probability distribution of net current assets for each experiment is shown in table 12. It is interesting to note that the adjusted probability distribution of net current assets for the case 2 model is first degree stochastic dominant over the case 1 model for experiments 1,3 and 4.[20] That is to say that as long as a producer prefers more to less then that producer would prefer the adjusted distribution of net current assets to the distribution from the case 1 model (WGSP). The government should prefer provididng producers with the adjusted distribution because of the time value of money. That is the tax credits and rebates are no longer a liability to the enterprise and the payment to make the distributions equal in terms of income support comes in the final year. One can only speculate what improvement (ie, at what level of income) producers could stabilize their income if the entire support was available in year 1.

Table 12 also expresses the probability distributions of net current assets in year 20 as percentages of the change relative to the benchmark model. The percentages are calculated as follows. The benchmark model value in each percentile is subtracted from the case 1 and 2 models and summed for each experiment. Then the change in each percentile relative to the benchmark model is expressed as a percentage of the total change for the particular experiment. The case 1 model percentages are rela-

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[20] Ibid., pp 68-70.

tively constant across the percentiles whereas the case 2 model affects the lower end of the distribution to a greater degree. Thus the case 2 model provides greater reducion in risk relative to thecase 1 model.

TABLE 9

Critical Probabilities of Benchmark Model

year	Experiment 1 [1]	Experiment 2 [2]	Experiment 3 [3]	Experiment 4 [4]
1	0	0	.0112	.0112
2	.2718	.2718	.2493	.2493
3	0	0	.0129	.0129
4	0	0	.0209	.0183
5	0	0	.1959	.1938
6	0	.0643	.0176	.0018
7	0	0	.0236	.0179
8	0	.0207	.0292	.1985
9	0	0	.1893	.1796
10	0	.1742	.0290	.1871
11	0	0	.0053	.1887
12	0	.1623	.0240	.1789
13	0	0	.1765	.1579
14	0	.1599	.1983	.1407
15	0	.0718	.0061	.1767
16	0	.1617	.0225	.1598
17	0	.0630	.1820	.1472
18	0	.1433	.1927	.1272
19	0	.0704	.0070	.1644
20	0	.1371	.0197	.1552
	.2718	1.5005	1.613	2.6671

note: Critical probabilities are defined as the probability that cash flow from grain sales is less than 0 (ie; p(cfgs<0)).

1) Experiment 1 (constant real price of wheat equal to $4.03 per bu. and debt to equity ratio of 16%)

2) Experiment 2 (consatnt real price of wheat equal to $4.03 per bu. and debt to equity ratio of 30%)

3) Experiment 3 (historical price variation and debt to equity ratio of 16%)

4) Experiment 4 (historical price variation and debt to equity ratio of 30%)

TABLE 10

Statistics for Adjustment Factor Calculation

	Experiments[1]			
	1	2	3	4
Sum Of Payouts From WGSP	$82,679	$82,679	$142,815	$142,815
Sum Of Levies Paid	($24,000)	($24,000)	($24,000)	($24,000)
	-----------	-----------	----------	----------
Income Support (payouts-levies)	$58,679	$58,679	$118,815	$118,815
Sum Of Tax Credits and Rebates	($3,508)	($11,419)	($38,451)	($44,655)
	------------	-----------	----------	-----------
Adjustment factor	$55,171	$47,260	$80,364	$74,160
Mean of Net Current Assets in Year 20 Of Case 2 Model	$217,996	$91,420	$278,894	$159,765

1) Experiments 1 thru 4 are defined in table 9.

TABLE 11

Probability Distributions of
Net Current Assets ($) in Year 20

Benchmark Model (No Stabilization)

Experiemnt[1]	Percentiles 10	30	50	70	90
1	142,853	186,700	212,154	242,319	280,186
2	-13,092	41,211	76,661	114,767	152,975
3	130,828	192,748	235,453	278,541	342,837
4	-19,676	66,324	113,998	155,567	224,972

Case 1 Model (Western Grain Stabilization Program)

Experiment[1]	Percentiles 10	30	50	70	90
1	193,924	232,403	255,050	280,816	317,050
2	64,061	114,532	134,874	161,639	204,434
3	244,794	291,300	327,072	369,269	422,587
4	123,890	172,396	212,570	255,594	309,490

Case 2 Model (Fiscal Policy)

Experiment[1]	Percentiles 10	30	50	70	90
1	150,307	191,908	215,926	247,068	281,278
2	26,797	58,793	89,565	120,568	154,977
3	197,670	238,894	276,325	312,607	364,537
4	74,501	120,247	155,432	191,712	249,192

1) Experiments 1 thru 4 are defined in table 9.

TABLE 12

Adjusted Probability Distributions of
Net Current Assets ($) in Year 20

Case 2 model Adjusted
Income Support Equal to the WGSP

Experiment[1]	10	30	50	70	90
	Percentiles				
1	205,478	247,079	271,097	302,239	336,449
2	74,057	106,053	136,825	167,828	202,237
3	278,034	319,258	356,689	392,971	444,901
4	148,661	194,407	229,592	265,872	323,352

Case 1 Model Changes Expressed as Percentages

Experiment[1]	10	30	50	70	90
1	23.75	21.25	19.95	17.90	17.14
2	25.13	23.88	18.96	15.27	16.76
3	24.01	20.76	19.30	19.12	16.80
4	26.95	19.91	18.50	18.78	15.86

Case 2 Model Changes Expressed as Percentages

Experiment[1]	10	30	50	70	90
1	33.46	23.88	16.93	21.32	4.90
2	51.02	22.49	16.51	7.42	2.56
3	31.89	22.01	19.50	16.25	10.35
4	37.67	21.58	16.58	14.46	9.69

1) Experiments 1 thru 4 are defined in table 9.

4.2 CONCLUSIONS

Based on the above results one can derive the following conclusions. Firstly, that a fiscal policy (tax cedits and rebates) would enable producers to stabilize their cash flow from grain sales to produce in the short run with the only cost to the government being the time value of the cedits and rebates. The cost of the self sustaining tax policy (ie time value of credits and rebates) is far less than the cost of the WGSP in all four experiments. Producers are in a position at the end of the 20 year simulation to repay the credits and rebates used. From a pure stabilization perspective the use of fiscal policy is more efficient and at least as effective. The first degree stochastic dominance of the adjusted case 2 model over the case 1 model in three of the four experiments illustrates the potential benefit to both producers and the government of a individualized stabilization program. Secondly the WGSP increases the mean income of producers however provides little reduction in risk relative to a individualized program. The model and methodology of the study are sound. However, to the extent one feels the assumptions and premises are realistic will determine the level of confidence one has in the conclusions.

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