EVALUATING NISA AS A STABILIZATION PROGRAM: A FIRM-LEVEL SIMULATION ANALYSIS

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ABSTRACT

This paper examines alternative risk management strategies in terms of their effectiveness for three representative Alberta farm operations. Stochastic dynamic simulation methods are used to model financial performance for these farms. The results suggest that government programs such as the Net Income Stabilization Account (NISA) program or the Farm Income Disaster Program (FIDP) in Alberta have some benefits in terms of supporting income levels and reducing the chances of farm failure. Neither program is very effective, however, in stabilizing year to year income or cash flow for the farm operations. The performance of NISA relative to alternative risk management programs and strategies such as FIDP, forward contracting or crop insurance, is mixed. In some cases, NISA does not seem to provide benefits beyond those available from other strategies.

INTRODUCTION

Canadian agriculture has a long history of government involvement in programs designed to stabilize prices and incomes. These programs have come under renewed scrutiny due to the combined effects of government budget constraints and international trade negotiations. The result has been a move from commodity specific and price based programs towards programs that stabilize net income. This fundamental policy reform is consistent with shifts in attitudes towards government intervention in agriculture (Agriculture Canada 1989).

The Net Income Stabilization Account (NISA) program initiated by the federal government is intended to provide long term stabilization of net income for participating farmers. NISA is essentially a savings account. Farmers make contributions in years of high income and draw from their account in low income years, based on certain program triggers. There is currently little information on the potential effectiveness of NISA in stabilizing income or improving financial performance (e.g., wealth enhancement).[1] It is also unknown whether NISA is any

more effective than alternative risk management or stabilization strategies available to Canadian farmers. Given the long term implications of participation in NISA and the potential cost to Canadian taxpayers, these are important issues.

The objectives of this paper are to a) evaluate NISA in terms of its ability to stabilize returns or otherwise improve financial performance over time for different types of farming operations; and b) compare NISA to alternative risk management programs and strategies currently available to Canadian farmers. The "effectiveness" of any particular program or strategy is determined based on three criteria; the ability to stabilize returns over time, the ability to improve financial performance, and the ability to reduce the risk of business failure (i.e., bankruptcy).

These objectives are achieved through the use of dynamic stochastic simulation for representative Alberta farm operations. Participation in NISA is evaluated, relative to non-participation, using three criteria; ending wealth levels, the ability to support and stabilize income and cash flow over the relevant time horizon, and the probability of bankruptcy. In addition, alternative risk management strategies are modelled for the representative farms, and compared to NISA using the same three criteria.

SAFETY NET PROGRAMS

The term safety net is used to describe public programs that are intended to support and/or stabilize producer incomes. NISA is an example of a safety net program. Two other safety net programs are also considered in this paper; the Farm Income Disaster Program (FIDP) and crop insurance. A brief description of these three programs is provided below.

Net Income Stabilization Account (NISA)

As noted in the introduction, NISA is a type of savings account for agricultural producers in Canada. It is a voluntary program jointly administered by the federal and provincial governments, with the objective of providing a mechanism by which

agricultural producers may stabilize revenues over time. This is done by setting aside money in an account during high income years and then drawing from this account in low income years.

Producers may contribute up to 20 percent of net sales into a program account each year. Net sales are total farm sales minus purchases of all agricultural products, and represent the net value of agricultural production for the farm operation. The government matches farmer contributions up to a level of two percent of net sales. Unused non-matching eligible deposits may be carried forward by the farmer. Interest is paid on the program account at a rate consistent with market interest rates. Farmer contributions earn a three percent bonus as well. There are dollar value limits placed on annual contributions and account balances.

NISA withdrawals are "triggered" by shortfalls in either of two performance measures. If gross margin for the farm falls below the five-year historical average, the farmer may withdraw an amount up to the difference between the two values. If net income for the farm falls below $10,000, the farmer may withdraw an amount up to the difference between the two values. Gross margin is equal to net sales minus eligible expenses (i.e., most farm expenses excluding interest, depreciation, lease or rental payments, and improvement costs). Net income is equal to net sales minus operating and fixed costs for the farm operation (i.e., before-tax profit). The farmer may withdraw the larger of the two amounts indicated by the triggers. The withdrawal may not exceed the program account balance.

Farm Income Disaster Program (FIDP)[2]

FIDP is a voluntary support program initiated and funded by the Alberta provincial government. It is intended to lessen extreme income reductions that occur because of circumstances that are beyond the control of the producer. The mechanics of the program are relatively simple. In any given year, a producer may apply for a program payment if the producer's program margin is less than 70 percent of his/her average

program margin for the previous three years. The payment is equal to the difference between these two values. The program margin for FIDP calculations is basically the same as gross margin for NISA; that is, net sales minus the same eligible expenses. If the program margin is negative, the payment will be equal to the 70 percent of the three year historical average value; that is, there is no support for negative program margins. Finally, FIDP payments are reduced by the amount of any government contributions to producers' NISA accounts.

Crop Insurance

Crop insurance is a well-established risk management tool for crop producers. Typically, crop insurance is a voluntary program designed to provide some protection against yield risk for crop producers. In Alberta, crop insurance is jointly funded by participating producers (50 percent) and the provincial (25 percent) and federal (25 percent) governments. The producers' contributions arise from premiums paid for insurance coverage.

Producers enrol in crop insurance by paying a per acre premium. This premium varies by crop and by risk area. Crop insurance risk areas are determined by climate, soil type, etc. The insurance coverage received by the producer is equal to 70 percent of the long-term area yield for the specific crop, adjusted by a factor that reflects the producer's average yields relative to the area average. If the actual crop yield obtained by the producer is below the coverage level, a crop insurance payment is generated. The payment is equal to the yield shortfall (i.e., coverage level minus actual yield) multiplied by the relevant crop price.

METHODOLOGY

The methodology used for this study consists of three parts; identification of representative farms, simulation procedures, and risk management program analysis. Representative firm analysis is used to model the effectiveness of alternative risk management options and programs for Alberta farm operations. Three representative

farms are defined for this purpose; a beef feedlot, a cropping operation and a farrow-to-finish hog operation. The financial performance for each of these farming operations, assuming different risk management scenarios, is modelled using stochastic, dynamic simulation procedures. Each of these aspects is discussed in more detail below.

Representative Farms

The three representative farms (i.e., beef, crop and hog) defined and used in the simulation analysis are not intended to be "average" farms. Instead, they are representative in that they could be considered as being "typical" of many commercial farm operations in Alberta. For each farm, production and technical characteristics are developed using historical data. These characteristics include capital structure (i.e., dollar values for land, buildings, equipment, etc.), production levels and patterns (e.g., crop acreage and yields), costs and returns for the different enterprises (e.g., feed costs, machinery expenses, output prices, crop yields), as well as marketing patterns.

The beef operation is a feedlot that markets 5000 head of cattle per year. There are no crop enterprises and all inputs are purchased including cattle and feed. The feedlot operator utilizes seasonal marketing, with one-half of the animals being marketed in June and July and the other half being marketed in November through January. The asset base for this operation (i.e., land, buildings and equipment) is approximately $950,000. Data used to develop the production and financial characteristics for this farm operation are obtained from Novak and Viney (1995).

The cropping operation is a 1600 acre farm that is located near Trochu, Alberta. The farm makes use of conventional tillage systems, and has a crop rotation consisting of wheat-barley-canola. The asset base for this operation (i.e., land, buildings and equipment) is approximately $1,285,000. Data used to develop the production and financial characteristics for this farm operation are obtained from Bauer et al (1995).

The hog farm is a farrow-to-finish operation with 350 sows. The farm does not have any crop enterprises and purchases all feed and breeding stock replacements. The operation utilizes a uniform marketing strategy, marketing 132 pigs per week. The asset base for this operation (i.e., land, buildings, equipment and breeding stock) is approximately $1,200,000. Data used to develop the production and financial characteristics for this farm operation are obtained from Bresee (1997).

Rather than assume a particular debt level for the farms, the simulation analysis is carried out for alternative debt scenarios; low, medium and high. This provides an opportunity to examine the effects of debt level (i.e., financial risk) on the effectiveness of alternative risk management strategies. In each case, the debt scenario is characterized by a particular debt-to-asset ratio (i.e., D/A). Low debt is represented by a D/A of 0.25, medium debt by a D/A of 0.50, and high debt is represented by a D/A of 0.75. The particular D/A ratio is then multiplied by total assets for the farm to obtain the initial debt level.

Simulation Analysis

The representative farms are modelled using multi-period stochastic simulation. The simulation model calculates annual sales and expenses, debt servicing requirements, income and cash flow measures, ending financial position (i.e., ending wealth) on a year by year basis. The model also incorporates the possibility of financial failure, as the farm operation is declared bankrupt if ending wealth is negative at any point in the simulation.

Each combination of representative farm, debt level and risk management option is simulated over a seven year time horizon. The simulation is stochastic in that 1000 iterations are used for each combination. Annual costs and returns are drawn from specified probability distributions, which are based on historical data (same sources as for representative farm characteristics). The only exception for this is the crop farm

for which crop yields and prices, rather than gross revenue, are drawn from separate distributions.[3]

The alternative risk management strategies are compared and evaluated in terms of their "effectiveness". As noted in the introduction, three criteria are used to measure effectiveness. First, the strategies are assessed in terms of their ability to stabilize returns over time. Stability refers to the ability to reduce variability for a particular measure. In terms of the risk management strategies, stability is measured in terms of income and cash flow. Net income and net cash flow are measured on an annual basis. From this, average values and variability are calculated and compared between alternative strategies.

Effectiveness is also measured in terms of the ability to support income; that is, improve financial performance. The ability of a strategy to "support" income can be measured by net income. Alternatively, ending wealth also incorporates profit levels. Higher net income levels result in higher ending wealth levels. Therefore, average ending wealth is used to compare strategies in this respect. Average ending wealth is the farm's equity position after seven years, averaged over all solvent iterations.

Improved financial performance can also be measured in terms of liquidity; that is, the ability to support cash flow. Cash flow support is measured by the probability of illiquidity. This is the proportion of solvent years over the 1000 iterations that have a negative net cash flow. If one strategy supports cash flow to a greater extent, it might be expected that the probability of illiquidity would be lower for that strategy.

The third criterion is the ability to reduce the risk of business failure. Each strategy is assessed with respect to the probability of bankruptcy. The probability of bankruptcy represents the proportion of the 1000 iterations ending in bankruptcy, measured as a percentage.

Risk Management Options

For each representative farm/debt level combination, several risk management options or strategies are modelled. The base scenario in each case is non-participation in any risk management program or strategy, referred to as the BASE scenario. Participation in the NISA program is the NISA scenario. It is assumed that producers make the maximum matchable NISA contribution in each year (i.e., two percent of net sales), even if borrowing is necessary to obtain the funds.[4] Participation in the provincial FIDP program is referred to as the FIDP scenario. Finally, a "combination scenario" is modelled for each farm, involving participation in both NISA and FIDP. This is referred to as the BOTH scenario.

An additional risk management strategy is modelled for the beef farm and the cropping operation. This is done to assess the performance of NISA (and FIDP) relative to alternative strategies currently available to producers. The particular alternative varies by farm, as discussed below. This is done for two reasons. First, different types of farm operations have access to different types of risk management strategies, depending on the particular enterprise. Secondly, each of the alternatives affects the farm-level distributions in somewhat unique ways, making a more interesting and complete comparison with NISA (and FIDP).

For the beef farm, the alternative modelled is the use of selective forward contracting for the cattle. If the terms are favourable the producer will utilize forward contracting to reduce price risk. This scenario, referred to as CONTRACT, has the effect of reducing the mean and variability for the producer's net sales.

For the cropping operation, the alternative strategy is participation in crop insurance. It is assumed that the producer insures all acres of all three crops. As discussed earlier, in return for paying a per acre premium, the producer receives a certain yield guarantee (i.e., 70 percent of the adjusted long-term area yield). Within the simulation

analysis this scenario, referred to as INSURE, has the effect of truncating the yield distributions at the coverage level.

RESULTS AND DISCUSSION

Tables 1, 2 and 3 provide a summary of the simulation results for the three representative farms. From these tables, some general trends are identified and discussed below.

In assessing the effectiveness of the safety net programs, one criterion identified earlier is the degree to which the chances of business failure are affected. Both NISA and FIDP reduce the probability of bankruptcy for the farms. This is consistent across farms and debt levels. As well, both NISA and FIDP improve the average ending wealth levels for the farms and reduce the relative variability (i.e., the coefficient of variation), when compared with the BASE scenario. Thus, the safety net programs are effective in reducing the chances of business failure.

Another criterion used to evaluate NISA and FIDP is the degree to which they support income and cash flows for the farms. Average ending wealth provides an indication of this with respect to income. Given the method of asset valuation used (i.e., cost-based), wealth only increases if the business generates positive profits. As can be seen from the tabular results, both NISA and FIDP result in increased wealth levels, suggesting that net income levels are increased as well.

In terms of liquidity, one way of assessing this criterion is to examine the probability of illiquidity; that is, the proportion of solvent years in which net cash flow is negative. If net cash flows are supported by these programs, the probability of illiquidity should decrease significantly. This is true, to a certain extent. NISA and FIDP consistently decrease this probability, although not always to a great extent. It would seem, then, that the safety net programs are more effective in supporting income than cash flows.

The other criterion used to evaluate the safety net programs is the degree to which they stabilize income and net cash flows. This may be done by examining the impact of NISA and FIDP on the variability of these measures over time, relative to the BASE scenario. If NISA and FIDP are effective in stabilizing income and cash flow, it is expected that the degree of variability will be reduced. The statistical confidence intervals around average values over time are compared for the alternative scenarios. The simulation results (not presented) suggest that NISA and FIDP have some stabilizing effects on net income; that is, the confidence interval around the average value is reduced. However, this is not the case for net cash flows.

Much of the difference in the ability of NISA or FIDP to support and stabilize income versus cash flow is due to the timing of withdrawals or payments from these programs. Payments from NISA or FIDP occur in the calendar year following the year in which the shortfall occurred, due to the fact that the calculations are based on tax filer information.

The two safety net programs can also be compared to each other, using these same criteria. In general, it may be said that FIDP is more effective than NISA in terms of supporting and stabilizing income and cash flows, as well as reducing the probability of business failure. This trend is consistent across farms and debt levels. The difference in performance may be largely attributed to the mechanics of the two programs. In order to be effective, NISA requires the farmer to contribute funds to the program account. Assuming that the farmer always makes the maximum matchable contribution, this can actually exacerbate cash flow problems already existing within the farm operation. In contrast, FIDP requires no equivalent contributions as the program is completely funded by the provincial government. As might be expected, this improved performance comes at a cost. The average annual government cost of FIDP (i.e., government payments) is greater than the cost for NISA (i.e., matching contributions to accounts plus bonus interest payments).[5]

As might be expected, the use of both NISA and FIDP (i.e., BOTH scenario) improves financial performance to an even greater extent relative to participation in either program alone. This is particularly true with respect to support for income (i.e., ending wealth levels)and the probability of financial failure (i.e., probability of bankruptcy). Variability of ending wealth is also reduced to a greater extent, when compared to the BASE scenario. However, even the combined programs do not provide significant benefits in terms of stabilizing income or cash flows. Once again, the improved performance comes at an increased government cost, relative to participation in either of the programs in isolation.

The results in Tables 1, 2 and 3 allow an examination of the effects of debt levels on the effectiveness of risk management strategies. Not surprisingly, financial performance for any particular scenario deteriorates with increased debt. The impact of increased debt on the effectiveness of the risk management strategies is mixed. The relative improvement in the probability of bankruptcy attributable to participation in NISA or FIDP decreases with increased debt levels. For example, participation in NISA for the low debt beef feedlot (Table 1) reduces the probability of bankruptcy by 36.5 percent (i.e., from 19.7 percent to 12.5 percent). For the same farm with high debt, the reduction attributable to NISA is only 18.6 percent (i.e., from 64.5 percent to 52.5 percent). This pattern is consistent for all farms and all NISA/FIDP scenarios. The same pattern also exists for the probability of illiquidity.

The effect of debt level on the relative improvement in ending wealth levels varies by program. In general, the ability of NISA to improve ending wealth (i.e., support income levels) is not adversely affected by debt levels. For example, participation in NISA by the low debt beef feedlot (Table 1) results in a 22.8 percent increase in average ending wealth (i.e., from $1,029,850 to $1,264,785). For the same farm with high debt, the improvement is 25 percent (i.e., from $657, 418 to $821,917). Conversely, the ability of FIDP to improve ending wealth is weakened with increased debt levels. Using the same farm (i.e., beef feedlot results in Table 1), the

improvement in average ending wealth attributable to FIDP is 30 percent for the low debt scenario and 14.3 percent for the high debt scenario.

These differences between NISA and FIDP are at least partly due to differences in program objectives and mechanics. FIDP is not intended to address variability in returns due to debt servicing requirements. As a result, the payment "trigger" is based on program margin calculations which do not include interest costs. In the case of NISA, there are two withdrawal "triggers", one of which is based on net income which includes debt servicing costs. This allows some support for producers with higher debt servicing costs.

One other point may be made with respect to debt levels. To a certain extent, program participation (i.e., NISA, FIDP or BOTH scenarios) allows producers to increase debt levels while maintaining a certain level of risk exposure. Using the beef feedlot as an example (Table 1), the probability of bankruptcy for the low debt farm and no risk management strategy is approximately 20 percent. If the debt level is increased to "high" (i.e., debt-to-asset ratio increased from 0.25 to 0.75), participation in both NISA and FIDP (i.e., the BOTH scenario) results in the probability of bankruptcy being virtually unchanged (i.e., approximately 19 percent). This has implications for agricultural producers who are considering expansion strategies where a significant amount of the financing will come from debt sources.

The performance of the alternative risk management strategies for the farms is mixed. The selective contracting (CONTRACT) strategy for the beef feedlot does not provide significant benefits relative to the BASE scenario. The performance is weaker than either NISA or FIDP. The crop insurance strategy (INSURE scenario) for the cropping operation is somewhat effective in managing risk. In terms of effectiveness, crop insurance is not as effective as FIDP. If compared to NISA, crop insurance is as effective or more effective at low and medium debt levels. This may be seen by

comparing ending wealth, and probabilities of bankruptcy and illiquidity. However, crop insurance is not as effective at high debt levels.

CONCLUDING COMMENTS

The effectiveness of NISA as a risk management program is mixed. The version of NISA examined in this paper is somewhat effective in supporting net income for participating producers. It is also effective in reducing the chances of financial failure. However, NISA is not very effective in supporting or stabilizing cash flows for the farm operation, largely due to the time lag between when shortfalls occur and when withdrawals are made available.

The FIDP program implemented by the provincial government in Alberta is more effective than NISA in managing risk; that is, reducing the chances of financial failure and increased support for income. However, this effectiveness comes at a greater program cost to the government. As well, FIDP has the same shortcomings as NISA in terms of a lack of effectiveness in stabilization of income and cash flow. With higher debt levels, NISA outperforms FIDP, at least in terms of income support. This is due to differences in the criteria for triggering payments/withdrawals from the two programs.

If compared to alternative risk management strategies (e.g., selective contracting, crop insurance), the performance of NISA is mixed. It would appear that, to a certain extent, agricultural producers already have access to risk management strategies that may provide the same level of protection from risk. However, it is also evident that NISA does provide some advantages for certain groups of producers.

NOTES

1. Spriggs and Taylor (1995) do examine the effects of NISA on Saskatchewan grain farms. As well, Spriggs et al (1995) examine the aggregate effects of NISA for the Saskatchewan agricultural sector.

2. The discussion of the mechanics for FIDP and crop insurance are based on information from Block (1996).

3. This procedure is used for the crop farm due to the necessity of being able to identify crop yields for the purposes of modelling participation in crop insurance.

4. This represents one possible "decision rule" for NISA contribution decisions. Other decision rules are modelled in this study, including making contribution decisions based on net cash flow considerations or operating balance (i.e., chequing account balance) considerations. The simulation results based on these decision rules are not reported in this paper.

5. The actual version of FIDP implemented in Alberta includes a payment cap for individual producers; that is, a maximum limit on annual payments from the program. This cap would affect larger farm operations, and is not incorporated into this analysis.

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Table 1: Simulation Results for the Beef Feedlot

	Risk Management Scenario				
	BASE	NISA	FIDP	BOTH	CONTRACT
Low Debt					
Ending Wealth					
- Average	$1,029,850	$1,264,785	$1,338,499	$1,613,432	$1,011,090
- Standard Deviation	$577,674	$632,589	$586,380	$596,464	$552,678
Prob. Of Bankruptcy	19.7%	12.5%	6.1%	2.4%	18.9%
Prob. Of Illiquidity	41.3%	39.2%	37.8%	35.8%	42.1%
Medium Debt					
Ending Wealth					
- Average	$791,641	$978,695	$987,159	$1,221,816	$799,517
- Standard Deviation	$475,976	$536,188	$500,093	$530,720	$458,493
Prob. Of Bankruptcy	42.2%	30.3%	17.4%	9.1%	36.1%
Prob. Of Illiquidity	44.0%	42.0%	40.8%	38.6%	42.5%
High Debt					
Ending Wealth					
- Average	$657,418	$821,917	$751,117	$942,783	$598,112
- Standard Deviation	$381,350	$436,582	$390,526	$429,970	$356,060
Prob. Of Bankruptcy	64.5%	52.5%	32.3%	19.2%	62.2%
Prob. Of Illiquidity	43.1%	41.4%	40.1%	38.6%	44.4%

Table 2: Simulation Results for the Cropping Operation

	Risk Management Scenario				
	BASE	NISA	FIDP	BOTH	INSURE
Low Debt					
Ending Wealth					
- Average	$1,185,814	$1,219,759	$1,379,529	$1,393,625	$1,264,513
- Standard Deviation	$316,343	$321,817	$295,097	$289,830	$275,797
Prob. Of Bankruptcy	0.0%	0.0%	0.0%	0.0%	0.0%
Prob. Of Illiquidity	43.0%	41.5%	32.8%	31.6%	37.2%
Medium Debt					
Ending Wealth					
- Average	$609,481	$638,621	$772,123	$789,258	$660,296
- Standard Deviation	$317,571	$327,118	$320,986	$314,900	$291,794
Prob. Of Bankruptcy	5.7%	4.8%	0.5%	0.3%	0.8%
Prob. Of Illiquidity	67.0%	65.3%	56.3%	54.9%	66.9%
High Debt					
Ending Wealth					
- Average	$290,809	$304,256	$339,115	$339,349	$271,950
- Standard Deviation	$222,253	$231,942	$243,118	$244,874	$209,024
Prob. Of Bankruptcy	60.5%	56.6%	37.5%	35.1%	51.2%
Prob. Of Illiquidity	83.7%	82.9%	77.7%	75.9%	85.5%

Table 3: Simulation Results for the Hog Farm

	Risk Management Scenario			
	BASE	NISA	FIDP	BOTH
Low Debt				
Ending Wealth				
- Average	$1,262,964	$1,425,659	$1,619,475	$1,693,740
- Standard Deviation	$481,106	$490,392	$465,976	$460,148
Prob. Of Bankruptcy	0.2%	0.0%	0.0%	0.0%
Prob. Of Illiquidity	42.6%	39.3%	31.3%	30.5%
Medium Debt				
Ending Wealth				
- Average	$769,142	$895,057	$1,061,538	$1,129,251
- Standard Deviation	$427,394	$459,634	$454,468	$460,975
Prob. Of Bankruptcy	9.8%	4.9%	1.8%	1.1%
Prob. Of Illiquidity	56.1%	51.8%	43.9%	42.9%
High Debt				
Ending Wealth				
- Average	$446,530	$539,359	$616,547	$652,529
- Standard Deviation	$324,168	$348,228	$365,524	$377,545
Prob. Of Bankruptcy	49.0%	38.2%	22.5%	17.7%
Prob. Of Illiquidity	68.0%	64.3%	57.6%	56.7%

BIOGRAPHICAL SKETCH

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