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THE ECONOMICS OF GENERIC INCOME STABILIZATION SCHEMES

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Abstract

Generic income stabilization schemes, which resemble an actual NISA policy adopted recently in Canada, encourage farmers to set aside funds in high income year for use in low income years through a formal procedure. Their economic effects are investigated using the prudent farm household model. The effects of generic income stabilization schemes are hinged on the interaction between generic stabilization schemes and precautionary saving. It is also found that the designs of generic income stabilization schemes are fundamentally important for their potential supply effects. Conditions for characterizing various generic income stabilization schemes as either production neutral or decoupled are derived. Generic income stabilization scheme operated as a pure stabilization program has little stabilizing value for the optimal prudent farm household.

Key Words: Generic income stabilization, NISA, prudent farm household model, consumption, production neutrality, decoupled, and agricultural policy.

The Economics of Generic Income Stabilization Schemes

The observation that existing agricultural policies have been ineffective in promoting the efficient allocation of resources (Gardner 1992) has not resulted in the complete deregulation of agriculture. Rather budgetary pressure and international trade negociation have led governments in developed countries to look for new policies that provide farmers with reasonable income protection for the lowest possible cost and which are also considered *decoupled*[1] from the production process, at least in the context of the multilateral trade negotiations. One recent policy innovation in Canadian agriculture is the introduction of the Net Income Stabilization Account (NISA) program[2]. Intended as decoupled and budget-effective, the NISA represents a fundamental shift in Canadian agricultural policy and a new approach to stabilizing farm incomes.

The principal of NISA is to encourage farmers to set aside funds in high income years for use in low income years through a formal procedure. NISA allows farmers to deposit a certain percentage of their income into their own NISA account and receive a matching contribution from government. The farmer's own deposit also earns a bonus interest rate. In years of declining income, farmers can withdraw money from the NISA account through trigger mechanisms. NISA is therefore a dynamic form of stabilization that smooths income over time, and is closely related to the concept of precautionary saving. The success of the program as a stabilization program is crucially contingent on

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[1]*Decoupling* is a concept which originated in the Organization for Economic Co-operation and Development (OECD). There is, however, no agreed definition of *decoupling* among agricultural economists and policy-makers. While the formal discussion of *decoupling* will be taken up later, it is sufficient for the time-being to see the concept as suggesting a situation where government support provided to farmers causes minimal distortions on production, consumption, and trade.

[2] After a long negociation between federal and provincial government, NISA has finally endorsed as a major policy for Canadian agriculture in September 1995. Its operation is described in the Policy handbook published by the NISA administration committee.

two presumptions.[3] First, there exists a precautionary motive in a farm household's behavior. Second, there is inadequate precautionary saving made by farm households. Unfortunately there is little research on precautionary savings in agriculture. Nevertheless, understanding precautionary saving behavior of farm households is a key to the evaluation of NISA type programs and would help policy-makers design NISA to reach specific goals.

The objective of this research is to provide an analytical tool within which NISA can be assessed. As NISA is closely related to precautionary saving, the analytical tool should allow interactions between NISA, production, precautionary savings, and risk. One recent model, which examined the production behavior of farm households who have a precautionary motive for savings[4], is particularly suitable to investigate such interactions (Chen *et. al.* 1995). To examine policy effects, a two-period model of a prudent farm household will be used as the benchmark model. The analytical efforts focus on whether and in what manner does a prudent farm household adjust its supply in response to the NISA type stabilization scheme. This is because, among many concerns regarding the NISA, its potential supply effects are a key issue among policy-makers. First, the welfare analysis of any agricultural stabilization program is conditioned on the supply response of farm households. Second, in the context of international trade negotiations, the degree of supply response is important in assessing whether a specific policy is *decoupled.* Third, the study of supply response is important for the design of agricultural policy itself. Meanwhile, since NISA is intended to be a whole farm plan, and hence directly effects the

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[3]One can, of course, argue that decoupling-intended programs like NISA mainly aim at transferring income to farmers rather than stabilizing farmers' income. Success of such programs should then be evaluated against alternatives on the ground of transfer efficiency. Though it is an important subject and will be related to the current study in some ways, there is no explicit attempt to address this issue within the scope of this research. The premise is that before a judgment can be made on the issue of transfer efficiency, more must be known about optimal response of individual farms to the whole farm NISA.

[4]In Kimball's terms, a farm household is prudent. Chen and Meilke call their theory the prudent farm household model (PFHM).

household's well-being, it is important to examine the effect of NISA type stabilization schemes on the household's consumption patterns.

The term 'NISA type' is used to signal that the stabilization schemes analyzed in this paper are not identical to any actual policy, in practice, but are stylized versions thereof. Our intention is to capture the main characteristics of actual net income stabilization plans while still allowing analytical tractability. But, despite the real world motivation for this research, we do not provide comments on any specific NISA proposal. Rather we intended to make general observations on the possible effects of particular types of generic income stabilization schemes. This paper begins with a presentation of generic income stabilization schemes which resembles the actual NISA. Following a presentation of the prudent farm household model (PFHM), it proceeds to investigate the economic effects of various generic income stabilization schemes. The implications for *decoupling* are then discussed. Conclusions are finally drawn.

Generic Income Stabilization Schemes

To generate a generic income stabilization scheme, several features of the actual NISA program are considered.

First, NISA is not a pure stabilization program as it involves direct income transfers from taxpayers to farmers. It is important to recognize the distinction between the stabilization and income transfer components of the so-called stabilization policy. To do so, two types of generic income stabilization policies are considered: mean-preserving and mean-augmenting. The former is a pure stabilization scheme that effects the dispersion of farm income across time but not its (discounted) mean, while the latter is an income transfer scheme that increases the mean while reducing the dispersion of farm income.

Second, NISA is currently commodity group-specific. To qualify as a *decoupled* program, a program should be available for all agricultural commodities. It is thus interesting to divide generic income stabilization schemes by the commodity coverage into two types: whole-farm and commodity-specific.

Third, NISA allows farmers to contribute to the NISA account up to two percent of their net eligible sales. To extend NISA to the livestock sector, the use of a Value-Added NISA (VAISA) as a contribution base has been suggested. To capture the possible effects of different contribution bases, generic income stabilization schemes are categorized as profit-based and gross-revenue-based.

Fourth, NISA is voluntary. By the nature of participation, generic income stabilization schemes can be further classified as either mandatory or voluntary.

The above considerations result in various types of generic income stabilization schemes which are presented in Figure 1. However, there is no need to analyze each of the potential combinations and it suffices to investigate the following six forms:

(1) a mandatory whole farm mean-preserving-profit-based (MPPB) scheme;

(2) a voluntary MPPB scheme;

(3) a mandatory whole farm mean-augmenting-profit-based (MAPB) scheme;

(4) a voluntary MAPB scheme;

(5) a mandatory whole farm mean-augmenting-revenue-based (MARB) scheme;

(6) a commodity specific mandatory MAPB scheme.

Generic income stabilization schemes are assumed to have the following common features: 1) the program is financed by government tax revenue if the program is subsidized; 2) there are zero transaction costs (e.g. no administration costs); 3) there are individualized stabilization accounts and the farm household's contribution to the account is made by a percentage of the chosen contribution base; and 4) all funds in the stabilization account are consumed in the second period as we use two-period model.

While the first three assumptions are trivial, the last assumption needs some qualification. In reality NISA allows for the deposits or withdrawals with a five-year moving average trigger mechanism. This raises the question of whether it is appropriate to use a two-period model, rather than a multi-period model, to examine NISA-related policies. It can be shown in that a multi-period model incorporating a moving average trigger mechanism is the same as a simple two-period model as long as all NISA balances are eventually returned to farm households. This feature allows the effects of generic income stabilization schemes to be examined in a two-period model.

The Model

Chen *et. al.* (1995) shows that precautionary savings impinges in a non-trivial fashion on the decision of how much to produce. By facilitating stable consumption over time, precautionary savings enables prudent farm households to absorb more risk than it could in the absence of precautionary saving. This insurance aspect of precautionary savings results in farm households reacting differently towards risk. An expected utility-maximizing, prudent farm household may find it optimal to produce either more, less or the same level of output as that which maximizes expected utility of terminal wealth, or profits. While details on the development of the model can be found in Chen *et. al.* (1995), its basic structure is laid out below

A prudent farm household is assumed to know its first period (the present) farm income, but not its second period (the future) farm income.[5] This feature of the model allows for the examination of the production behavior of prudent farm households and relevant policies in both deterministic and stochastic settings. The decision problem faced by the farm household is to decide at the end of the first period, prior to the realization of the second period's income shock, how much to save and how much to produce in order to maximize the expected value of utility. Formally, the two-period expected utility maximization problem of the i^{th} farm household can be written as

[5]Stochastic farm income can result from many sources such as wealther, insect, prices and idiosyncramatic factors.

$$\underset{(C_1,C_2)}{\text{Max}}\, E\left[U(C_1,C_2)\right] = U(C_1) + \beta EU(C_2) \tag{1}$$

subject to

$$C_1 = \pi_1 - S_1 \tag{2a}$$

$$C_2 = \pi_2 + (1+r)S_1 \tag{2b}$$

$$\pi_1 = p_1 y_1 - c_1(y_1) - f_1 \tag{2c}$$

$$\pi_2 = \int_{\pi_2^-}^{\pi_2^+} \left[p_2 y_2 - c_2(y_2) - f_2\right] dF(\pi_2,\sigma) \tag{2d}$$

where E is the expectation operator, C_i is the aggregate index of consumption, π_i is profit, S_1 is savings, r is the exogenous rate of return on savings, p_i is an output price, $c_i(\cdot)$ is the total variable cost function, f_i is fixed cost, $F(\pi_2,\sigma)$ is a cumulative distribution function, σ is a measure of riskness of the distribution $F(\cdot)$, and subscript i = *1,2*. The regularity conditions for a cost function are satisfied, particularly $c^{'}(\cdot) > 0$ and $c^{''}(\cdot) \geq 0$.

Then above maximization problem can be written as

$$\underset{(S_1,y_1,y_2)}{\text{Max}}\, EU(\cdot) = U\left[p_1 y_1 - \mathrm{c}_1(y_1) - \mathrm{f}_1 - S_1\right] + \beta \int_{\pi_2^-}^{\pi_2^+} U\left[p_2 y_2 - c_2(y_2) - f_2 + (1+r)S_1\right] dF(\pi_2,\sigma) \tag{3}$$

The first order conditions (FOCs) are

$$EU_{S_1} = EU'(C_2) - U'(C_1) = 0 \tag{4a}$$

$$EU_{y_1} = U'(C_1)\left[p_1 - c_1^{'}(y_1)\right] = 0 \tag{4b}$$

$$EU_{y_2} = \beta EU'(C_2)\left[p_2 - c_2^{'}(y_2)\right] = 0 \tag{4c}$$

The second order conditions (SOCs) are assumed to be satisfied.

Equations (4a) to (4c) indicate a linkage between precautionary savings and production decisions. Optimal precautionary savings requires holding income back from current consumption such that the marginal utility of current consumption is equal to the present value of future consumption, so that expected lifetime utility is maximized. The condition for optimal output in the first period is similar to that in the deterministic setting. The farm household chooses the optimal output y_1^* by equating the marginal cost to output price, as indicated by (4b), implying a separability between savings and the first period production decision. Equation (4c) shows that optimal output in the second period may be affected by the farm households' prudent behavior. The optimal amount of precautionary savings to be kept for next year depends on expected income and thus production next year, but optimal production next year depends on the amount of income saved.

Economic Effects of Generic Income Stabilization Schemes

The introduction of a generic income stabilization scheme in to above model may change not only the expected value but also the variability of the underlying parameters. Consequently, it may induce changes in the equilibrium levels of precautionary saving and output as well as farm household welfare.

Effects of a Whole Farm MPPB Scheme

A whole farm MPPB is introduced as a formal procedure to induce or force farm households to save more in a good year for a bad year. A distinguishing feature of a whole farm MPPB is that there is no public subsidy involved. MPPB is thus an actuarially fair scheme which can be either mandatory or voluntary. We begins the discussion with a mandatory MPPB and then moves to examine the implications of a voluntary MPPB.

Effects of a Mandatory Whole Farm MPPB Scheme

Under mandatory MPPB, a farm household is required to contribute a certain percentage, denoted as t^0, of the farm household's net income to the MPPB stabilization account. The farm household's consumption in the first and the second periods with a MPPB are thus

$$C_1 = (1-t^0)[p_1y_1 - c_1] - S_1 \quad (5a)$$

$$C_2 = (p_2y_2 - c_2) + (1+r)t^0(p_1y_1 - c_1) + (1+r)S_1 \quad (5b)$$

The maximization problem faced by the household is

$$\underset{(S_1,y_1,y_2)}{\text{Max}} \; EU(\cdot) = U\left[(1-t^0)(p_1y_1 - c_1) - S_1\right] + \beta EU\left[(p_2y_2 - c_2) + (1+r)t^0(p_1y_1 - c_1) + (1+r)S_1\right] \quad (6)$$

where S_1 stands for private precautionary saving and $t^0(p_1y_1 - c_1)$ is the public precautionary saving required by a mandatory MPPB. With a mandatory MPPB, public precautionary savings is equal in size to the MPPB stabilization fund. The sum of private and public precautionary savings thus equals the total contingency fund for the farm household. This formulation implicitly assumes that private and public precautionary savings are perfect substitutes.[6]

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[6]Private and public provision of precautionary savings may not be perfect substitutes. In reality, the public provision of precautionary savings through NISA is distinguished from private provision of precautionary savings due to the trigger mechnism. There may be cases in which a farm household cannot withdraw money from its stabilization account if it is not triggered, which causes imperfect substitution between the private and public savings. Though the model presented here does not capture this effect, incorporating this effect into the model will not change the essence of the following analytical results.

The FOCs for this problem are similar to equations (2a) to (2c), which are reintroduced below

$$EU_{S_1} = EU'(C_2) - U'(C_1) = 0 \tag{7a}$$

$$EU_{y_1} = \left[(1-t^0)U'(C_1) + t^0 EU'(C_2)\right](p_1 - c_1') = 0 \tag{7b}$$

$$EU_{y_2} = \beta EU'(C_2)(p_2 - c_2') = 0 \tag{7c}$$

Let us first restrict the attention to the case of interior solutions, such that there is positive private precautionary savings in the presence of a mandatory MPPB. Denote this saving as $\left[(S_1^*)^{mmp}\right]$. Equation (7a) shows that the previous condition regarding the optimal level of precautionary savings remains the same qualitatively. Equation (7b) indicates that the presence of a mandatory MPPB has no effect on first period output. In other words, a mandatory MPPB is production-neutral in a deterministic setting. Similarly, equation (3.9) still applies. As a result, only the effects of a mandatory MPPB on the optimal y_2 and S_1 are the concern of comparative static analysis. Totally differentiating equations (7a) and (7c) with respect to t^0 and solving gives

$$\frac{\partial S_1^*}{\partial t^0} = -\frac{EU_{S_1 t^0} EU_{y_2 y_2} - EU_{y_2 t^0} EU_{S_1 y_2}}{H} \tag{8a}$$

and

$$\frac{\partial y_2^*}{\partial t^0} = -\frac{EU_{y_2 t^0} EU_{S_1 S_1} - EU_{S_1 t^0} EU_{y_2 S_1}}{H} \tag{8b}$$

where $H > 0$, $EU_{S_1 t^0} = \left[(1+r)EU''(C_2) + U''(C_1)\right]\pi_1$ and
$EU_{y_2 t^0} = \beta EU''(C_2)(p_2 - c_2')\pi_1$.

Recall $EU_{S_1S_1} = (1+r)EU''(C_2) + U''(C_1)$

$$EU_{S_1y_2} = EU_{y_2S_1} = \beta EU''(C_2)(p_2 - c_2').$$

Algebraic manipulation yields $EU_{S_1t^0} = \pi_1 EU_{S_1S}$ and $EU_{y_2t^0} = \pi_1 EU_{S_1y_2}$. Substituting these terms into (8a) and (8b) gives

$$\frac{\partial S_1^*}{\partial t^0} = -\pi_1 \tag{9a}$$

and

$$\frac{\partial y_2^*}{\partial t^0} = 0. \tag{9b}$$

This shows that with positive precautionary savings under the stabilization scheme $(S_1^*)^{mmp} > 0$, an increase in t^0 reduces the optimal level of private precautionary savings and that a change in t^0 has no effect on the optimal level of output. The implication of this result is that a mandatory MPPB is production neutral in a stochastic setting as long as the farm household has positive private precautionary savings in the presence of the program. Intuitively, if the farm household saves more than the contribution limit, the program does not provide any marginal incentive or dis-incentive to save or produce.

To understand how this result arises, dividing equation (9a) by π_1 yields

$$\frac{\partial S_1^*}{\partial t^0 \pi_1} = -1 \tag{10}$$

Equation (10) states that private precautionary savings and a mandatory MPPB stabilization fund are perfect substitutes. In response to the introduction of a mandatory

MPPB, the farm household simply moves the funds used for private precautionary savings, into the mandatory MPPB stabilization account. The total contingency fund is thus unchanged. Consequently, changes in t^0 have no effect on the farm household's output in the second period. By the same token, it has no effect on either the first or second period consumption and thus on the household's welfare. To conclude, a mandatory MPPB does not alter the consumption and production behavior of the optimal prudent farm household when the program is designed in a way that leaves the total contingency fund equal to the optimal private savings level for the prudent farm household without a mandatory MPPB. Mathematically, $\left(S_1^*\right)^{mmp} + t^0\pi_1 = S_1^*$, where $\left(S_1^*\right)$ is the private precautionary savings made in the absence of a generic income stabilization scheme.

Suppose that a farm household behaves myopically before the introduction of a mandatory MPPB. The introduction of a mandatory MPPB forces farm households to save more for future contingencies, improves the efficiency of the household's intertemporal allocation, and increases the welfare of the farm household. Moreover, a supply-enhancing effect may be observed since an MPPB may reduce the risk faced by farm households in the second period. This potential positive supply response, however, is beneficial as it flows from the pure stabilization effect of the program. For a nondistortionary mandatory MPPB, the following condition must hold:

$$\left(S_1^*\right)^{mmp} + t^0\pi_1 \leq S_1^* \qquad (11)$$

These results, however, cannot hold when $\left(S_1^*\right)^{mmp} = 0$. $\left(S_1^*\right)^{mmp} = 0$ arises when the optimal private precautionary savings without a mandatory MPPB is less than the public precautionary savings with a mandatory MPPB. Mathematically, $S_1^* < t^0\pi_1$. Since a mandatory MPPB forces the farm household to save more than its optimal level, it results in an inefficient intertemporal consumption bundle (consuming too little today and too much tomorrow) and lowers farm household welfare.

What happens to the optimal output when $(S_1^*)^{mmp} = 0$? Since $(S_1^*)^{mmp} = 0$, the effect of an increase in t^0 on y_2^* can be determined by totally differentiating the first order conditions (2c) with respect to t^0 to obtain

$$\frac{\partial y_2^*}{\partial t^0} = -\frac{EU_{x_2 t^0}}{EU_{y_2 y_2}} = -\pi_1 \frac{EU_{S_1 y_2}}{EU_{y_2 y_2}} \tag{12}$$

Since the SOCs imply $EU_{y_2 y_2} < 0$, the sign of equation (12) depends on the sign of $EU_{S_1 y_2}$. It can be shown that $EU_{y_2 S_1} > 0$ is implied by decreasing absolute risk aversion (DARA) while $EU_{y_2 S_1} = 0$ is implied by constant absolute risk aversion (CARA). That is, $\frac{\partial y_2^*}{\partial t^0} > 0$ if DARA is assumed and $\frac{\partial y_2^*}{\partial t^0} = 0$ if CARA is assumed. The intuition of this result is that when a farm household is forced to save more, to hedge uncertainty, it causes a decrease in the DARA farm household's aversion to risk, which encourages it to produce more output. Hence, a mandatory MPPB is not production-neutral when $(S_1^*)^{mmp} = 0$ and DARA is assumed. However, under CARA a mandatory MPPB is production-neutral even when $(S_1^*)^{mmp} = 0$.

Unlike the case of $(S_1^*)^{mmp} > 0$, the production and consumption effects of a mandatory MPPB on the farm household are unclear when $(S_1^*)^{mmp} = 0$, if a farm household behaves myopically before the introduction of the stabilization schemes. Intuitively, it is difficult to judge whether over-saving is good or bad compared with under-saving without knowledge of the individual's utility function and risk preferences.

Effects of a Voluntary Whole Farm MPPB Scheme

Under a voluntary MPPB, a farm household can choose whether to participate in the program, as well as the percentage of income to contribute. As t is a decision variable, the maximization problem faced by the farm household can be rewritten as

$$\underset{(S_1,t,y_1,y_2)}{\text{Max}} \; EU(\cdot) = U\left[(1-t)(p_1 y_1 - c_1) - S_1\right] + \beta EU\left[(p_2 y_2 - c_2) + (1+r)t(p_1 y_1 - c_1) + (1+r)S_1\right] \quad (13)$$

While equations (2a), (2b), and (2c) carry through, there is an additional FOC related to the optimal choice of t

$$EU_t = \pi_1\left[EU'(C_2) - U'(C_1)\right] = 0 \quad (14)$$

Equation (14) is actually the same as (2a). It shows that a farm household is indifferent between private precautionary savings and a voluntary MPPB in this model. If farm households behave prudently before the introduction of a voluntary MPPB it will have no effect on the farm household's consumption and production. In other words, a voluntary MPPB generates neither benefits nor costs and is an unnecessary policy for the prudent farm household which optimizes. If farm households behave myopically before the introduction of a voluntary MPPB, then the program can serve as an education tool for farm households. The existence of a voluntary MPPB may encourage farm households to save for a rainy day. If one believes that a voluntary MPPB would induce myopic farm households to save, then there will be positive effects on the farm household's consumption and production patterns.

Effects of a Whole Farm MAPB Scheme

The feature separating MAPB from MPPB is whether they involve a public subsidy. Under MAPB, governments contribute to the stabilization account by a certain percentage, say δ, of the farm household's own contribution. In reality, Canadian governments also subsidize NISA through interest rates and administration costs and these could also be incorporated into the analysis. However, as will be discussed later, such complications add no additional insights to the simple case where governments subsidize NISA through match-up funds only. Similar to the case of MPPB, MAPB can be either be mandatory or voluntary.

Effects of a Mandatory MAPB Scheme

Under a mandatory MAPB, when a farm household contributes the amount $t\pi_1$, the government matches this amount by δ percentage. Rewriting equation (5b) gives

$$C_2 = (p_2 y_2 - c_2) + (1+r)(1+\delta)t^0(p_1 y_1 - c_1) + (1+r)S_1 \tag{15}$$

The maximization problem faced by the farm household is

$$\begin{aligned} \underset{(S_1, y_1, y_2)}{\text{Max}}\ EU(\cdot) = & U\left[(1 - t^0)(p_1 y_1 - c_1) - S_1\right] \\ & + \beta EU\left[(p_2 y_2 - c_2) + (1+r)(1+\delta)t^0(p_1 y_1 - c_1) + (1+r)S_1\right] \end{aligned} \tag{16}$$

where $t^0(p_1 y_1 - c_1)$ is the public precautionary saving required by a mandatory MAPB. A MAPB stabilization fund equals the required public precautionary saving plus the government contribution. The total contingency fund equals the funds in the MAPB plus the private precautionary savings.

Equations (2a), (2b), and (2c) hold for this maximization problem. The presence of a mandatory MAPB has no effect on the first period output. In other words, a mandatory MAPB is production neutral in a deterministic setting. With a mandatory MAPB, governments can influence the behavior of farm households through two channels: the contribution rate (t) and the government matching contribution (δ). The effect of an increase in contribution rate on the optimal y_2 and S_1 can be determined by totally differentiating the first order conditions (2a) and (2c) with respect to t^0 and solving to obtain equations similar to (8a) and (8b). However, expressions for $EU_{S_1t^0}$ and $EU_{y_2t^0}$ are slightly different

$$EU_{S_1t^0} = \left[(1+r)(1+\delta)EU'(C_2) + U'(C_1)\right]\pi_1 \tag{17a}$$

and

$$EU_{y_2t^0} = \beta EU'(C_2)(p_2 - c_2')\pi_1(1+\delta). \tag{17b}$$

As before, algebraic manipulation yields $EU_{S_1t^0} = \pi_1 EU_{s_1s_1} + \pi_1\delta(1+r)EU''(C_2)$ and $EU_{y_2t^0} = (1+\delta)\pi_1 EU_{y_2s_1}$; substituting into (8a) and (8b) yields

$$\frac{\partial S_1^*}{\partial t^0} = -(1+\delta)\pi_1 + \delta\pi_1 \frac{U''(C_1)EU_{y_2y_2}}{H} \tag{18a}$$

and

$$\frac{\partial y_2^*}{\partial t^0} = -\delta\pi_1 \frac{U''(C_1)EU_{y_2S_1}}{H}. \tag{18b}$$

The sign of equation (18a) is ambiguous, while the sign of (18b) depends on the sign of $EU_{x_2S_1}$, where $\frac{\partial y_2^*}{\partial t^0} > 0$ if DARA is assumed and $\frac{\partial y_2^*}{\partial t^0} = 0$ if CARA is assumed.

Dividing equation (4.16) by $(1+\delta)\pi_1$ gives

$$\frac{\partial S_1^*}{\partial(1+\delta)t^0\pi_1} = -1 + \frac{\delta}{1+\delta}\frac{U''(C_1)EU_{y_2y_2}}{H} \tag{19}$$

This shows that, unlike the case of a mandatory MPPB, private precautionary savings and a mandatory MAPB stabilization fund are no longer perfect substitutes. The intuition behind this result can be understood by noting that there are two opposite effects of an increase in the governments contribution rate on private precautionary savings; namely, substitution and wealth effects. An increase in t^0 leads to an increase in public precautionary savings. This increase induces the farm household to decrease private precautionary savings in the same amount (substitution effect). However, an increase in t^0 can also be viewed as an increase in the rate of return to a farm household's contribution to a mandatory MAPB. When this return is increased, there is an incentive for the farm household to increase its contributions. Since the percentage of income that a farmer is allowed to contribute is fixed, a farm household will increase its private precautionary savings as a result of the wealth effect, but the net effect is always negative.

Substituting $U'(C_1) = EU_{S_1S_1} - (1+r)(1+\delta)EU'(C_2)$ in equation (20) yields

$$0 > \frac{\partial S_1^*}{\partial (1+\delta)t^0\pi_1} > -1 \tag{20}$$

Equation (20) indicates that the substitution effect will always dominate the wealth effect. In other words, contributions to the stabilization account are increased and private precautionary savings are decreased less than proportionally. As a result, the total contingency fund is increased, which causes a decrease in the DARA farm household's aversion to risk. Hence a DARA prudent farm household will produce more output. That is, a MAPB is not production neutral when a farm household displays DARA risk preferences even with a positive $\left(S_1^*\right)^{mma}$. This supply effect is solely caused by the subsidy and thus is welfare decreasing. To see this, $\delta = 0$ implies $\frac{\partial y_2^*}{\partial t^0} = 0$.

What happens to the farm household's consumption? Since the total contingency fund is increased, so is second period consumption. However, first period consumption could also increase if the stabilization fund is less than the private precautionary savings without the program. Mathematically, $\left(S_1^* + t^0\pi_1\right)^{mma} < S_1^*$, where *mma* stands for a mandatory MAPB. This condition is implied by $\left(S_1^* + t^0\pi_1\right)^{mma} < \left(S_1^* + t^0\pi_1\right)^{mmp}$ since $\left(S_1^* + t^0\pi_1\right)^{mmp} = S_1^*$. Similar to equation (20),

$$\frac{\partial S_1^*}{\partial t^0\pi_1} < -1 \tag{21}$$

which shows that private precautionary savings decreases less than public precautionary savings increase. This result implies that $\left(S_1^*\right)^{mma} < \left(S_1^*\right)^{mmp}$. Since $\left(t^0\pi_1\right)^{mma} = \left(t^0\pi_1\right)^{mmp}$ is given by policy, one has $\left(S_1^* + t^0\pi_1\right)^{mma} < \left(S_1^* + t^0\pi_1\right)^{mmp}$. Therefore, a mandatory MAPB increases consumption in both periods and thus increases the household's welfare with a positive $\left(S_1^*\right)^{mmp}$. In other words, a mandatory MAPB is no longer consumption neutral even with a positive $\left(S_1^*\right)^{mmp}$. Similarly, this positive consumption effect is solely caused by the subsidy. To see this, $\delta = 0$ implies $\frac{\partial S_1^*}{\partial t^0} = -1$.

The effects of a mandatory MAPB on myopic farm households are similar to those of a mandatory MPPB. Unlike the case of a mandatory MPPB, however, the potential positive supply response induced by a mandatory MAPB may contain both beneficial and harmful components.

When $\left(S_1^*\right)^{mma}$ = *0*, the effects of a MAPB on optimal output is

$$\frac{\partial y_2^*}{\partial t^0} = -\frac{EU_{y_2t^0}}{EU_{y_2y_2}} = -(1+\delta)\pi_1\frac{EU_{S_1y_2}}{EU_{y_2y_2}} \tag{22}$$

That is, $\frac{\partial y_2^*}{\partial t^0} > 0$ if DARA is assumed and $\frac{\partial y_2^*}{\partial t^0} = 0$ if CARA is assumed. A MAPB has a non-negative effect on the optimal output when $\left(S_1^*\right)^{mma} = 0$. Combining equation (22) with (18b) gives

$$\left(\frac{\partial y_2^*}{\partial t^0}\right)^{mma} = \left(\frac{\partial y_2^*}{\partial t^0}\right)^{mp} - \delta\pi_1 \frac{EU_{S_1 y_2}}{EU_{y_2 y_2}} \tag{23}$$

where *mp* stands for a mandatory MPPB. When $\left(S_1^*\right)^{mma} = 0$, the supply effects of a MAPB can be decomposed into two components: a pure stabilization effect (the first term), and a subsidy effect (the second term). Given $(1+\delta)t^0\pi_1 > S_1^*$, it is clear that a mandatory MAPB increases consumption in the second period, while it has an ambiguous effect on the first period consumption. However, as long as $t^0\pi_1 < S_1^*$, a mandatory MAPB increases consumption in the first period as well. Unlike a MPPB, a MAPB effects on the farm household's consumption and thus welfare are not clear when $\left(S_1^*\right)^{mma} = 0$.

MAPB also affects precautionary savings and output through the policy parameter δ. However, it can be shown that the effect of an increase in δ is exactly the same as the effect of an increase in t^0.

Effects of a Voluntary Whole Farm MAPB Scheme

Under a voluntary MAPB, a farm household can choose whether to participate in the program as well as the percentage to contribute up to the maximum rate so that

$$t \leq t^0. \tag{24}$$

Since t is a decision variable, the maximization problem faced by the farm household can be rewritten as

$$\underset{(S_1,t,y_1,y_2)}{\text{Max}} \; EU(\cdot) = U\big[(1-t)(p_1y_1 - c_1) - S_1\big] + \beta EU\big[(p_2y_2 - c_2) + (1+r)(1+\delta)t(p_1y_1 - c_1) + (1+r)S_1\big] \tag{25}$$

subject to (24).

The Kuhn-Tucker conditions for this problem are

$$EU_{S_1} = EU'(C_2) - U'(C_1) = 0 \tag{26a}$$

$$EU_{y_1} = \big[(1-t)U'(C_1) + t(1+\delta)EU'(C_2)\big]\big[p_1 - c_1'(y_1)\big] = 0 \tag{26b}$$

$$EU_{y_2} = \beta EU'(C_2)\big[p_2 - c_2'(y_2)\big] = 0 \tag{26c}$$

$$EU_t = \pi_1\big[(1+\delta)EU'(C_2) - U'(C_1)\big] - \lambda = 0 \tag{26d}$$

$$EU_\lambda = t^0 - t \geq 0;\; t^0 - t > 0 \text{ if } \lambda = 0 \tag{26e}$$

where λ is a Kuhn-Tucker multiplier.[7] Due to the presence of the inequality (24), there are two cases which must be considered:

<u>Case 1: λ = 0</u>

This implies that contribution limit is not binding. In this case, t is no longer an exogenous policy parameter but an endogenous variable. Equation (26d) can be rewritten as

$$(1+\delta)EU'(C_2) - U'(C_1) = 0, \tag{26d$'$}$$

and combining (26a) and (26d)' gives

[7]Note that the Kuhn-Tucker multiplier is non-negative.

$$\frac{1}{1+\delta} = 1. \tag{27}$$

Since $\delta > 0$ is a maintained assumption in the model, this equality cannot hold. Hence, (26a) is redundant. The intuition behind this result can be best understood by noting that the term on the left hand side of (27) is the normalized shadow price of a voluntary MAPB and the term in the right hand side is the price of precautionary saving that is normalized to unity. Given that $\delta > 0$, a voluntary MAPB is cheaper than private precautionary savings in providing protection against future contingencies. Hence, a prudent farm household will fully participate in a MAPB and undertake no private precautionary savings when the contribution limit is not binding.

It is also clear from (26b) that the condition for optimal output in the first period is the same as before. In other words, a voluntary MAPB has no supply effect in a deterministic setting. Therefore only (26d) and (26c) are relevant in examining the effects of a voluntary MAPB. To derive the comparative statics, the equilibrium conditions in (26d)' and (26c) are totally differentiated, yielding

$$\begin{bmatrix} EU_{tt} & EU_{ty_2} \\ EU_{y_2t} & EU_{y_2y_2} \end{bmatrix} \begin{bmatrix} dt \\ dy_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \tag{28}$$

where $EU_{tt} = (1+r)(1+\delta)^2 EU''(C_2)\pi_1 + U''(C_1)\pi_1$

$EU_{y_2t} = (1+\delta)\pi_1 EU''(C_2)(p_2 - c_2')$.

As a farm household undertakes no private precautionary saving, the only concern is how much a farm household will contribute to a voluntary MAPB and the effect on output. Since constraint (24) is not binding, governments can only affect the production decisions of the farm household through a change in δ. The effect of an increase in δ on the optimal y_2 and t can be determined by totally differentiating (4.25d) and (4.25b) with respect to δ and solving to obtain

$$\frac{\partial t^*}{\partial \delta} = -\frac{EU_{t\delta}EU_{y_2y_2} - EU_{y_2\delta}EU_{ty_2}}{H} \tag{29a}$$

and

$$\frac{\partial y_2^*}{\partial \delta} = -\frac{EU_{y_2\delta}EU_{tt} - EU_{t\delta}EU_{y_2t}}{H} \tag{29b}$$

where $EU_{t\delta} = (1+r)(1+\delta)t\pi_1 EU''(C_2) + EU'(C_2)$

$EU_{y_2\delta} = t\pi_1 EU''(C_2)(p_2 - c_2') = \frac{t}{1+\delta}EU_{ty_2}$.

Using the expression for EU_{tt} in equation (28) gives

$$EU_{t\delta} = \frac{t}{(1+\delta)}EU_{tt} - \frac{t}{(1+\delta)}U''(C_1)\pi_1' - EU'(C_2) \tag{30}$$

Substituting (30) into (28) and (29) gives

$$\frac{\partial t^*}{\partial \delta} = \frac{t}{1+\delta}\left(\frac{\pi_1 U''(C_1)EU_{y_2y_2}}{H} - 1\right) - \frac{EU'(C_2)EU_{y_2y_2}}{H} \tag{31a}$$

and

$$\frac{\partial y_2^*}{\partial \delta} = \left[EU'(C_2) - \frac{t}{1+\delta}\pi_1 U'(C_1)\right]\frac{EU_{S_1y_2}}{H} \tag{31b}$$

The sign of equation (31a) cannot be determined. There are two opposite effects of an increase in government matching funds on public precautionary savings. When δ is increased, there is an incentive for the farm household to increase its contribution to a voluntary MAPB. In contrast, an increase in δ also means that a farm household now can contribute less to a voluntary MAPB to meet its consumption smoothing objective. Hence, the ambiguous sign of equation (31a) is not surprising, and is similar to a standard result in the analysis of saving (Henderson and Quandt 1980, p 333). The sign of equation (31b) depends on the sign of EU_{y_2t} as the term in the bracket is positive. $\frac{\partial y_2^*}{\partial \delta} > 0$ if DARA is assumed and $\frac{\partial y_2^*}{\partial \delta} = 0$ if CARA is assumed.

Case 2: $\lambda > 0$

In this case, the contribution limit is binding and t becomes an exogenous policy parameter as in the case of a mandatory MAPB. Each period, the farm household will first contribute to a voluntary MAPB until the limit is reached; only then would it engage in private precautionary savings. The analytical results regarding the effects of exogenous shifts of the policy parameters t^0 and δ on the optimal level of precautionary saving and output are similar to the case of a mandatory MAPB.

Effects of a Mandatory Whole Farm MARB Scheme

MARB referes to a mean augmenting revenue based stabilization scheme. In reality, a farm household makes contributions to NISA on the basis of eligible net sales. A proposed alternative is to base contributions on value-added. Both of these contribution bases represent a departure from the economic profit base that has been discussed so far. The question is whether this departure causes inefficiencies.

To answer this question, it is sufficient to show whether a mandatory MARB plan causes inefficiency as both net eligible sales and value-added are intermediate cases between gross revenue and profit. Suppose a farm household contributes to a mandatory whole farm MARB by a percentage of its gross revenue instead of their profit. Net income in the first and the second periods are

$$C_1 = \left(1 - t^0\right) p_1 y_1 - c_1 - S_1 \tag{32a}$$

$$C_2 = \left(p_2 y_2 - c_2\right) + (1+r)(1+\delta) t^0 p_1 y_1 + (1+r) S_1 \tag{32b}$$

The maximization problem faced by the farm household is

$$\begin{aligned} \underset{(S_1, y_1, y_2)}{\text{Max}} \; EU(\cdot) = U\left[\left(1 - t^0\right) p_1 y_1 - c_1 - S_1\right] \\ + \beta EU\left[\left(p_2 y_2 - c_2\right) + (1+r)(1+\delta) t^0 p_1 y_1 + (1+r) S_1\right] \end{aligned} \tag{33}$$

While equations (2a) and (2c) carry through, the FOC related to the optimal choice of first period output becomes

$$EU_{y_1} = U'\left(C_1\right)\left[\left(1 - t^0\right) p_1 - c_1\right] + t^0 p_1 (1+\delta) EU'\left(C_2\right) = 0 \tag{34}$$

Combining equations (2a) and (34) gives

$$p_1 - c_1 = -t^0 \delta p_1 < 0 \tag{35}$$

This shows that the farm household would produce more in the first period in response to a mandatory MARB. As shown previously, this distortion would not occur with a mandatory MAPB. In other words, the inefficient use of resources in the first period occurs when the contribution base in a mandatory MAPB departs from a pure economic profit base. It is important to note that this result has nothing to do with risk.

A whole farm mandatory MAPB is no longer production neutral even in a deterministic setting. The cause of this distortion is intuitive. Rewriting (35) yields

$$\left(1+t^0\delta\right)p_1 - c_1 = 0 \tag{36}$$

With a gross revenue contribution base, the government's matching fund increases the output price in the first period by $t^0\delta$ and the farm household naturally produces more. In terms of policy design, a contribution base should approximate the theoretical ideal (economic profit) as closely as possible to avoid efficiency loss.[8] It follows from this that an income stabilization plan with a value-added base would be less distortionary than an income stabilization plan using net eligible sales.

There are some special cases. If $t^0 = \delta = 0$, the right hand side term disappears and the usual optimal condition for output in the first period is restored. This case is rather boring, since $t^0 = 0$ implies no policy scheme. A more interesting case arises when $t^0 > 0$ and $\delta = 0$, as this implies a MPPB. In this case, it is clear that (36) is reduced to (2b). That is, a whole farm mean-preserving-gross-revenue-based (MPRB) scheme has no effect on the first period supply. The implication of this result is that there is no gain associated with a shift from other contribution bases towards a profit base with a mandatory MPRB. In light of previous results, this is true only if positive private precautionary saving remains with a mandatory MPRB.

Comparative statics analysis similar to those above can be carried out to examine the effects of various forms of gross-revenue-based income stabilization plans. The difference is that an MARB now affects first period production as well. It can be shown that this complication does not change the previous results regarding the effects of various

[8]However, practical difficulties must be overcome before a contribution base of this kind could be implemented.

profit-based income stabilization plans on precautionary saving and output in the second period.

Effects of Commodity-Specific MAPB

The empirical significance of this issue is obvious since the current net income stabilization plan is commodity-specific. To examine portfolio effects,[9] we consider a farm household with two production activities, A and B, and with a joint limitation on production capacity. Assume that the output of each technology can be characterized by constant returns to scale. Suppose λ^A is capacity allocated to activity A, and λ^B is capacity allocated to activity B. The jointness in production is due to a physical capacity constraint which can be represented, without loss of generality, as $\lambda^A + \lambda^B = 1$. This model formulation is common in agricultural problems (i.e. Just and Zilberman 1986, Famchamps 1992). Assume that a mandatory mean-augmenting net income stabilization plan is in effect for production activity A. We have

$$C_1 = (1-t)\lambda_1\pi_1^A + (1-\lambda_1)\pi_1^B - S_1 \tag{37a}$$

$$C_2 = \lambda_2\pi_2^A + (1-\lambda_2)\pi_2^B + (1+r)(1+\delta)t\pi_1^A + (1+r)S_1 \tag{37b}$$

Formally, the maximization problem of the farm household can be written as

$$\begin{aligned}\underset{(S_1,\lambda_1,\lambda_2)}{\text{Max}}\ EU = {} & U\left[(1-t)\lambda_1\pi_1^A + (1-\lambda_1)\pi_1^B - S_1\right] \\ & + \beta EU\left[\lambda_2\pi_2^A + (1-\lambda_2)\pi_2^B + (1+r)S_1 + (1+r)(1+\delta)t\pi_1^A\right]\end{aligned} \tag{38}$$

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[9]The typical portfolio choice problem in a consumer study refers to the following situation: a consumer allocates the sum of assets and labor income between consumption and a menu of assets in the first stage and decides how many assets to hold in the second stage. The allocation problem in the second stage refers to portfolio choice. However, when we talk about portfolio choice in a farm household model, we refer to the choice of output mix in production.

The FOCs are

$$EU_{s_1} = EU'(C_2) - U'(C_1) = 0 \tag{39a}$$

$$EU_{\lambda_1} = U'(C_1)\left[(1-t))\pi_1^A - \pi_1^B\right] + EU'(C_2)t(1+\delta)\pi_1^A = 0 \tag{39b}$$

$$EU_{\lambda_2} = \beta\left\{\alpha EU'(C_1)\left[\pi_2^A(.|\theta) - \pi_2^B\right] + (1-\alpha)U'(C_2)\left[\pi_2^A(.|\theta) - \pi_2^B\right]\right\} = 0 \tag{39c}$$

Combining equations (34a) and (34b) gives

$$\pi_1^A - \pi_1^B = -t\delta\pi_1^A < 0 \tag{40}$$

This shows that the farm household would invest more in production activity A in the first period in response to the introduction of a commodity-specific MAPB. Such a distortion would not occur with a whole farm profit based net income stabilization plan. In other words, the inefficient use of resources in the first period is inevitable when a mandatory MAPB is commodity specific. Like the case of a revenue contribution base, this result has nothing to do with risk. In other words, a commodity specific MAPB is not production neutral in a deterministic setting. The cause of this distortion is again intuitive. With a mean-augmenting NISA for activity A, the governments matching funds increases the revenue of activity A relative to that of activity B. Consequently, a farm household produces more of A.

An interesting case arises when $t^0>0$ and $\delta=0$, as it implies a commodity-specific MPPB. In this case, it is clear that (39b) is reduced to (2b). That is, a commodity-specific MPPB has no effect on the first period portfolio decisions. This of course is true only if there are positive private precautionary savings with a commodity-specific MPPB.

Before proceeding to discuss the policy implications of our analysis, the supply effects of the various alternative are summarized in Table 1 and the consumption effects are summarized in Table 2. A scheme is said to be neutral if it does not affect a farm household's consumption and production behavior. A scheme is said to be production neutral if it does not affect a farm household's production behavior and is said to be consumption neutral if it does not affect a farm household's consumption behavior. An observation is that no general conclusions regarding whether generic income stabilization programs are neutral can be drawn without imposing certain restrictions. One exception is a whole farm voluntary MPPB, which is neutral. Even an actuarially fair mandatory MPPB is not necessarily neutral. It is neutral, however, when a farm household still has a positive private precautionary saving in the presence of the program. It is clear from Table 1 that no other generic income stabilization schemes are both consumption and production neutral. Nevertheless, when certain restrictions are met, some schemes may be production-neutral. Under CARA, for example, whole farm MPPB and MAPB are production neutral but not consumption neutral. Programs such as MARB and commodity-specific schemes are not neutral in any circumstances.

Policy Implications

An interesting question is what the implications of above results are for decoupled farm policy as decoupled farm policy is considered to be the most desirable. *Decoupled* is one of these comfortable short-hand expressions which people tend to use without close examination of its precise content. No entry under decoupling or decoupled is contained in "The New Palgrave Dictionary of Economics" or the "The Penguin Dictionary of Economics." People seem to have different definitions in mind when they refer to decoupling. In fact, the terms decoupled and neutrality are sometimes used interchangeably by agricultural economists and policy makers, at least implicitly.

Although *decoupled* is closely related to the economic concept of neutrality, they differ in one important aspect. While neutrality is an economic concept, decoupled is not. In the real world, whether a specific farm policy in a country is decoupled or not is determined by international trade negotiations. The negotiations are summarized in the

GATT agreement on agriculture. It is thus fair to say that *decoupled* is a political concept rather than an economic term. The concept of what is *decoupled* will undoubtedly evolve over time to reflect the new order of world trade negotiations. The confusion over the relationship between neutrality and decoupled is caused by the loose definition of *decoupled*. A decoupled farm program is often defined by agricultural economists as a program which provides support to producers but does not distort production, consumption, and trade (Carr *et. al.* 1990). By this definition, there is virtually no distinction between *decoupled* and economic neutrality. However, it is important to realize that economic neutrality implies *decoupled* but not *vice versa*. It is thus more constructive to consider *decoupled* as a working definition of economic neutrality in the context of international trade negotiations. This is necessary because economic neutrality is a very abstract concept and difficult to apply in a real situation.

Therefore no attempt is made to define *decoupled* in this paper. Rather, *decoupled* is defined in light of the GATT agreement on agriculture. It is believed that economists have a more important role to play in ensuring that the implications of the proposed decoupled policies or reforms are fully understood. Interestingly, although decoupled farm policies are sought by governments around world, the GATT does not explicitly provide criteria for decoupled farm policies. This is because decoupled is not a concept of GATT. Nevertheless, GATT does provide the basis for the exemption of domestic support from the reduction commitments, which can be used to assess whether a particular policy is decoupled.[10] In Annex 2 of the GATT Agreement on Agriculture, all decoupled policies are required to meet the following two basic criteria:

(1) the support should not involve direct transfers from consumers;

(2) the support should not have the effect of providing price support to producers.

These criteria consist of a solid core for a *decoupled* farm policy.

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[10] Of course, GATT (1994) also states de minimis standard which a policy is considered minimally trade distorting. These criteria are important to evaluate any real policy. As we focus on hypothetical policy, we refer ourselve to general criteria only.

It has been shown that generic income stabilization programs are, in general, not production-neutral except in a few limited cases. However, it has not been proven that those schemes are not *decoupled*. A program, to be *decoupled* program, must meet the above criteria.

Generic income stabilization is a taxpayer-funded government program and thus meets the first basic criteria. Does it meet the second criteria? The answer depends on the form of the income stabilization scheme being considered. It has been shown that an MPPB and an MAPB are production-neutral in a deterministic setting but not in a stochastic setting. As the risk-reducing effect of farm policy is not a factor in the GATT criteria for a decoupled program, both MPPB and MAPB meet the second criteria. MARB and commodity-specific schemes are shown to be production-distorted in either a deterministic or stochastic settings and hence do not meet the second criteria.

There are several specific policy criteria that must be met as well for a farm policy to be considered *decoupled*. The most relevant criteria for generic income stabilization schemes are those set out in paragraphs 6 and 7 in Annex 2 of the GATT Agreement on Agriculture. While the former sets out conditions for *decoupled* income support, the latter sets out conditions for a *decoupled* safety net program. Is a generic income stabilization scheme a *decoupled* income support program? As an MPPB does not involve income support, it cannot be classified as an income support program. The remaining three forms of generic income stabilization schemes appear to violate two of the five criteria, articles (ii) and (v), for a *decoupled* income support:

(ii) the amount of support in any given year shall not be related to, or based on, the type or volume of production undertaken by the producer in any year after the base period; and

(v) no production shall be required to receive such payments.

Can they qualify as *decoupled* income safety-net programs? While an MAPB meets all four criteria, MARB and commodity specific schemes apparently violate the following criteria:

(iii) the amount of any support shall relate solely to income; it shall not relate to the type or volume of production undertaken by the producer; or to the prices, domestic or international, applying to such production; or to the factors of production employed.

While it is difficult to modify the above three forms of generic income stabilization schemes in order that they may be considered as decoupled income support programs, it is feasible to make them decoupled safety net programs. To make them eligible for consideration as a decoupled program, one can do two things: first, one can make them whole farm programs, and second, one can make them profit-based. Information on whether a specific generic income stabilization scheme is decoupled is summarized in the sixth column of Table 1.

An very attempting question is what we can say about a current NISA program? Though we do not intend to provide definite comments on any specific NISA proposal, the framework presented in this paper does help to identify the key variables and state the nature of their impact. First, NISA can be best described as a voluntary commodity-specific net-eligible sales based income stabilization scheme. Hence it is not decoupled, let alone production-neutral.[11] Our results thus rationalize policy moves from a commodity-specific net income stabilization plan to a whole farm net income stabilization plan and from an eligible net sales based net income stabilization plan to an value-added based net income stabilization plan.

Conclusions and Limitations

The central message of this paper is that the design of net income stabilization programs are fundamentally important for their potential supply effects. Gross revenue based and

[11] Once again we apply general criteria only.

commodity specific net income stabilization plans, for example, are clearly not production neutral. Whether a profit based net income stabilization plan is production neutral hinges on the structure of risk preferences. If farm households exhibit constant absolute risk aversion, a profit based net income stabilization plan will be production neutral. If farm households exhibits decreasing absolute risk aversion, a profit based net income stabilization plan will not be production neutral. Its degree of non neutrality, however, depends on the level of precautionary savings, the level of subsidy, and the nature of participation. A voluntary value added whole farm net income stabilization plan, for example, is likely to be *near* production neutral so long as the subsidy is small. The reason is that the supply effects of the net income stabilization plan on prudent farm households are smaller than that of the net income stabilization plan on the farm firm which maximizes the terminal wealth.

An income stabilization plan operating as a pure stabilization program has little stabilizing value for the optimal prudent farm household. In other words, it cannot be rationalized in a world of the prudent farm households even with an absence of complete markets. When an income stabilization scheme is subsidized, a positive effect on the farm household's well-being becomes possible but is not guaranteed. The reason is that while the net income stabilization plan unambiguously increases second period consumption, it has an ambiguous effect on first period consumption, depending on the magnitudes of public precautionary savings. Realistically, however, the positive effect on the household's well-being is likely to occur so long as the discount factor is in a reasonable range. In a world of myopic farm households, the story is quite different. An income stabilization plan operated as either a pure stabilization program or income transfer program could increase the household's well-being.

This study limited itself to examine generic income stabilization schemes, which resemble NISA. Among the large number of questions that the adoption of NISA in Canadian agriculture raises for economic analysis, only a select few were addressed. The most important omission is how NISA affects capital formation and income distribution (equity). Fortunately, the effect of NISA on capital formation can be examined by incorporating the financial decisions into the basic prudent farm household model, while the equity issue can be addressed by extending the model to non-identical farm households. Moreover, NISA could affect the consumption and production behavior of farm households through other channels. The following three directions are the most important:

(1) Moral hazard. This problem arises if farm households are able to take hidden action (in the sense that the action is not observable by other parties, i.e. government) to affect expected loss and increase the likelihood of indemnities. It is conceivable that a farmer with a more variable income over time could benefit more relative to a farmer with lower income variability. This would provide a farmer with an incentive to de-stabilize income to extract additional benefits from NISA. If it is indeed so, income variability could be higher with NISA.

(2) Subsidy 'extracting' problem. This problem arises, like tax evasion, if farm households are able to take hidden action to affect the contribution base. If net eligible sales are used as the contribution base, for example, a farmer can increase his or her base by moving the raw product further up the marketing chain (e.g. packaging, processing, transportation, etc.). A farmer can capture the increased receipts generated, while not deducting the associated costs.

3) Asymmetric treatment of gains and losses. NISA with a value-added base, for example, could be negative. NISA provides no subsidy when this value-added base is negative, while NISA subsidizes farm households when the value-added base is positive. By the definition, riskier activities are naturally more vulnerable. As a consequence, such asymmetric treatment may discourage risk-taking.

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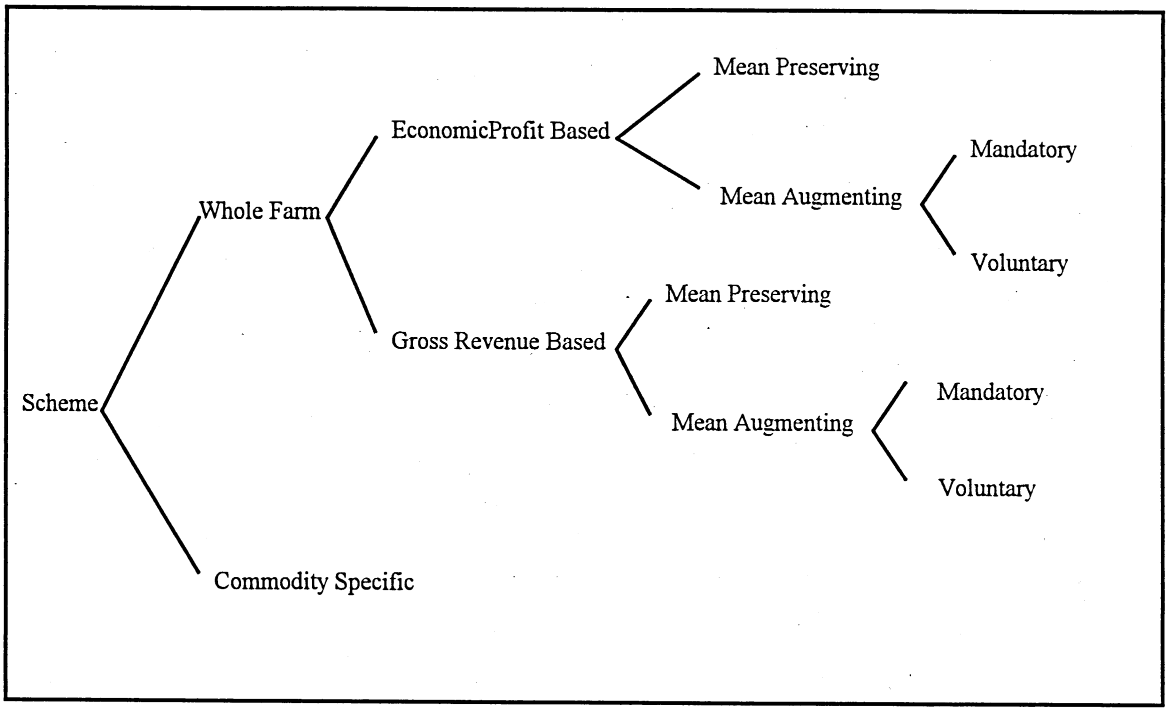

Figure 1 Generic Income Stabilization Schemes

Table 1 Supply Effects of Generic Income Stabilization Policy Schemes on Prudent Farm Households

Policy Schemes	Effects on Production: 1st Period Output (Deterministic case)	Effects on Production: 2nd Period Output (Stochastic Case)	Production-Neutral (Yes/No)	Decoupled (Yes/No)
Whole farm mandatory MPPB	0[b]	0 if $\left(s^*\right)^{mp} > 0$[c] + if $\left(s^*\right)^{mp} = 0$ & DARA 0 if $\left(s^*\right)^{mp} = 0$ & CARA	Yes either if $\left(s^*\right)^{mp} > 0$ or if $\left(s^*\right)^{mp} = 0$ & CARA No if $\left(s^*\right)^{mp} = 0$ & DARA	Yes
Whole farm voluntary MPPB	0	0	Yes	Yes
Whole farm mandatory MAPB	0	+ if DARA 0 if CARA	No if DARA Yes if CARA	Yes
Whole farm voluntary MAPB	0	+ if DARA 0 if CARA	No if DARA Yes if CARA	Yes
Whole farm mandatory MARB	+	+ if DARA 0 if CARA	No	No
Commodity-specific mandatory MAPB	+	+ if DARA 0 if CARA	No	No

[a]MPPB=mean-preserving-profit-based scheme, MAPB=mean-augmenting-profit-based scheme, and MAGR=mean-augmenting-gross-revenue-based scheme.

[b]0 means no effects and + means positive effects.

[c]Term $\left(s^*\right)^{mp}$ stands for the private precautionary saving under a mandatory MPPB scheme.

Table 2 Consumption Effects of Generic Income Stabilization Policy Schemes on Optimal Prudent Farm Households

Policy Schemes	Effects on Consumption		Effects on Private Precautionary Savings	Effects on Household's Welfare
	1st Period (Deterministic case)	2nd Period (Stochastic Case)		
Whole farm mandatory MPPB	0^b if $(s^*)^{mp}>0$ - if $(s^\bullet)^{mp}=0$	0 if $(s^*)^{mp}>0^c$ + if $(s^*)^{mp}=0$	-	0 if $(s^*)^{mp}>0$ - if $(s^*)^{mp}=0$
Whole farm voluntary MPPB	0	0	0	0
Whole farm mandatory MAPB	+if $(s^\bullet)^{ma}>0$ - if $(s^\bullet)^{ma}=0$	+if $(s^*)^{mp}>0$ + if $(s^*)^{mp}=0$	-	+if $(s^*)^{mp}>0$? if $(s^*)^{mp}=0$
Whole farm voluntary MAPB	? if $\lambda^d>0$ +if $(s^\bullet)^{vma}>0\&\lambda=0$ - if $(s^\bullet)^{vma}=0\&\lambda=0$	? if $\lambda^d>0$ +if $(s^\bullet)^{vma}>0\&\lambda=0$ - if $(s^\bullet)^{vma}=0\&\lambda=0$	? if $\lambda^d>0$ - if $\lambda=0$	? if $\lambda^d>0$ +if $(s^\bullet)^{mp}>0$? if $(s^*)^{mp}=0$
Whole farm mandatory MARB	+if $(s^\bullet)^{rma}>0$ - if $(s^*)^{mp}=0$	+if $(s^*)^{mp}>0$ + if $(s^*)^{mp}=0$	-	+if $(s^*)^{mp}>0$? if $(s^\bullet)^{rma}=0$
Commodity-specific mandatory MAPB	+if $(s^\bullet)^{cma}>0$ - if $(s^\bullet)^{cma}=0$	+if $(s^*)^{mp}>0$ + if $(s^*)^{mp}=0$	-	+if $(s^\bullet)^{cma}>0$? if $(s^*)^{mp}=0$

[a]MPPB=mean-preserving-profit-based scheme, MAPB=mean-augmenting-profit-based scheme, and MAGR=mean-augmenting-gross-revenue-based scheme.

[b]0 means no effects and + means positive effects.

[c] $(s^\bullet)^{mp}$ stands for the private precautionary saving under a mandatory MPPB scheme; $(s^\bullet)^{ma}$ stands for the private precautionary saving under a mandatory MAPB scheme; $(s^\bullet)^{vma}$ stands for the private precautionary saving under a voluntary MAPB scheme; $(s^\bullet)^{rma}$ stands for the private precautionary saving under a mandatory MARB scheme; $(s^\bullet)^{cma}$ stands for the private precautionary saving under a commodity spicific mandatory MAPB scheme.

[c] $\lambda>0$ means that contribution limit is nonbinding, while $\lambda=0$ means that contribution limit is binding.