ASSESSMENT OF THE SIMULATION STUDY USING THE FARM MODEL PREPARED BY AGRICULTURE AND AGRI-FOOD CANADA

By

Robert Romain, Ph. D.
Centre de recherche en économie agroalimentaire (CRÉA)
Faculté des sciences de l'agriculture et de l'alimentation (FSAA)
Université Laval

Report submitted to
Canadian International Trade Tribunal (CITT)

April 3, 1998

Acknowledgement : I greatly benefited from discussions with my colleague Bruno Larue during the preparation of this report.

ASSESSMENT OF THE SIMULATION STUDY USING THE FARM MODEL PREPARED BY AGRICULTURE AND AGRI-FOOD CANADA

Introduction

The Canadian International Trade Tribunal (CITT) is presently undergoing an inquiry into the importation of dairy product blends which are not included in the coverage of Canada's tariff rate quota, in particular the butteroil blend containing 51 % sugar and 49 % butteroil. As a part of the investigation, the CITT requested that the Policy Branch of Agriculture and Agri-Food Canada (AAFC) provide them with an economic analysis of the impact of such imports on the dairy industry and more generally on the Canadian economy. The CITT also requested the simulation of a few scenarios reflecting alternative policy responses to the current situation.

In order to respond to this request, AAFC used an existing economic model of the dairy sector, the FARM model, and made the necessary adjustments to be able to satisfy CITT's needs. The FARM model is an economic model that has been used for several years by AAFC to analyse the Canadian dairy sector.

The objective of this report is to assess the study prepared by AAFC. In particular, the following points will be addressed : i) the comprehensiveness and representativeness of the essential features of the dairy market in Canada; ii) the reasonableness of the assumptions vis-à-vis the realities in the Canadian market; iii) the theoretical validity of the model used for the analysis; iv) the credibility of the simulation results; and v) the robustness of the estimates.

This report is divided into three sections. The first section addresses the first three points by focusing on the representativeness and the theoretical validity of the model used in the AAFC analysis. The second section evaluates the implications of the major assumption of the model as well as the credibility of the scenario results. Finally, the last section summarises the report and provides an overall assessment of the AAFC study.

1. The general features of the AAFC model and its theoretical validity

The FARM model and the adjustments incorporated to it for this specific analysis reflect a demand driven sector. A minimum price for milk (target price) is first determined based on several indices reflecting the price of dairy ration, the wage rate, the interest rate and the general rate of inflation in the economy. These variables reflects the main factors that enter the cost of production formula which is considered by the Canadian Dairy Commission (CDC) to determine the target price (although the CDC also considers other policy objectives). Once the target price is determined, the price of the butterfat and solid non-fat components are derived. The price of butterfat is kept constant over the simulation period while the price of solid non-fat is adjusted to reflect changes in the target price. The price of fluid milk at the farm level is also linked to changes in the cost of production index. This approximation is acceptable even though the actual price received in each province is determined in a somewhat different fashion. Wholesale and retail margins for a variety of dairy products are thereafter calculated based on these farm prices, as well as on other economic variables (wage rate and consumer price index).

The demand side at the consumer level reflects twelve different markets for dairy products. Most demand equations reflect the impact of the own price of the product, the price of substitute products, disposable income, and a trend variable reflecting long term consumer preferences. Thus, these equations are generally respectful of what economic theory, and common sense, dictate. In a few cases though, per capita income does not enter the specification while in others, the choice of the substitute product (beef) is questionable. However, this would not affect the results of the scenarios.

It should be noted here that the ice cream demand equation does not include the price of other potential substitute products. Also, the price of ice cream does not enter into any of the other product demand equation. Therefore, any changes in the price of ice cream will affect only the demand for ice cream in the model. This assumption may seem somewhat restrictive but, considering that the definition of ice cream in the model includes ice cream mix, milkshake mix, sherbert and ice milk mix, it could be argued that ice cream and all other dairy products are independent. However, even if this convenient assumption is probably close to the truth, one

might wonder about a probable but small cross price effect with yoghurt since both yoghurt and ice cream can be considered as desserts.

The sum of consumer demands for all twelve dairy products, expressed in butterfat (or in solid non-fat) equivalent, combined to the exogenously determined levels of demand in certain class categories (5A, 5B, and 5C), determines the required Market Sharing Quota (MSQ). Of course, imports of dairy products (including the butteroil blend) are subtracted from domestic requirements. Total supply is assumed to be perfectly elastic and is equal to aggregate demand. The average farm price is a weighted average of the prices received for the different products, each of them being associated to a certain class of milk.

The model used to assess the economic implications of butteroil blend imports is therefore quite comprehensive with respect to the number of markets that are analysed. Also, it represents relatively well the current dairy policy in Canada. However, a limit would be that the model lacks a regional dimension. The impact of cheap butterfat will not be felt equally across Canada. The impact will mostly be felt in Ontario and Québec where most of the milk and ice cream are produced and consumed.

2 The major assumptions driving the model in the scenario analyses

There are three major assumptions that have a significant impact on the base scenario results, and especially on the alternative policy scenarios that are provided. First, all farmers are assumed to have identical cost structures, which implies that the marginal cost of producing milk across the country is the same. Second, the price transmission mechanisms are assumed to be independent of volume. Hence, processor and retail margins remain at the same per unit level whatever the level of MSQ and whatever the level of imports : all price variations in processors and retailers inputs are passed entirely to consumers. Third, the assumption about the level of the price elasticity of ice cream is crucial in the analysis since butteroil blend imports are assumed to affect only ice cream production. The implications of each of these assumptions on the scenario results are discussed below.

2.1 Farmers with identical constant marginal cost

The calculations of the variations in producer surplus are based on the assumption of a constant and unique marginal cost across producers. In reality, marginal cost is likely to differ significantly from one producer to another for a number of reasons, including different farm size, management capabilities, potential utilisation of fixed assets, and the location of the farm in the country.

The implication of wrongly imposing the assumption of constant marginal cost is the underestimation of the loss in producer surplus and the overestimation of the gain in producer surplus when production changes. In scenario 1 for example, MSQ increases and even though the average price decreases slightly, producer surplus increases relative to the base scenario. Under the more realistic assumption of increasing marginal costs, this calculated surplus would be less since every extra kilogram of milk would cost more to be produced than the previous one. On the other hand, the decrease in producer surplus under scenarios 2 and 3would be larger under increasing marginal costs than under constant marginal costs. In both cases, MSQ increases but the relative decrease in average farm price more than offset the volume effect on net revenue. Therefore, if marginal cost is increasing, producers loss would be higher than that reported in those scenarios. The difference between the constant marginal cost scenario and one reflecting an increasing marginal cost on producer welfare depends upon the steepness of the slope of the marginal cost function.

2.2 Constant per unit margin

The processing and retailing sectors are modelled by imposing margins that depend on exogenous wages and policy parameters like the butterfat price used in the target price. This way of modelling the cost of processing and retailing activities imposes the restriction that these costs are independent of the volume processed. In other words, the behaviour of processors and retailers does not change across policy scenarios. This tends to overestimate changes in equilibrium quantities of ice cream. In light of the high degree of concentration in processing and retailing, one might wonder to what extent a reduction in processing cost due to cheap imports of butteroil would translate into a lower retail ice cream price. The size of the processing and retailing margins and the "pass through" are important parameters for the welfare analysis because they

influence the positioning of the equilibrium on the retail demand curve. A lower "pass through" should bring about more subtle welfare changes while varying processing and retailing margins as volume changes affect the size of consumer and producer surplus variations.

2.3 The elasticity of ice cream demand

The results of all scenarios are essentially based on a single equation in the model : the ice cream retail demand equation. Therefore, the specification of this equation is of crucial importance, and in particular the use of the “true” coefficient of price elasticity. Given the importance of this parameter, and since the “true” coefficient is unknown, it would seem important to do a sensitivity analysis around its -0.62 value (say plus or minus 0.3, and maybe one scenario reflecting a coefficient slightly higher than 1). A priori, the scenario results could change significantly.

2.4 Assessment of the policy scenario results

The policy scenario results are consistent with a priori expectations based on economic theory. The direction of the change in economic welfare of producers and consumers satisfies economic anticipations considering the inelastic demand function for ice cream. The range of the results is also well in line with what could be reasonably expected.

There is, however, one slight mistake in the sensitivity analysis of the scenario of the pass through of milk cost change. Table 16, page 23, reports a net loss to the society of 45 to 58 million dollars the welfare impact of scenario 2a when only 50 % of cost savings are passed on to consumers. However, processors are also part of the society and their welfare level (processors surplus) is increased significantly. This amount should be added to producer and consumer surplus variations and the net loss to society would be much less.

3. Summary and concluding remarks

The model used to run the policy scenarios of interest for CITT is made up of several equations specified to capture the complexity of the Canadian dairy sector. In terms of the number of dairy products being modelled, there appears to be sufficient disaggregation. The single product at the primary level can be viewed in terms of milk components, butterfat and solids non-fat. These are the ingredients used by dairy processors whose needs vary across product types (i.e., butter vs cottage cheese). Thus, for the "ingredients clearing condition" to be respected in the model, one must insure that the quantity of milk supplied by producers is consistent with the quantities of milk components used by processors. On that ground, the model's specification is satisfactory. The model lacks a regional dimension and the effects associated with the various scenarios will mostly be felt in Ontario and Québec.

The Canadian dairy sector is heavily regulated and the model's specification internalises the regulations quite well. By definition, imports of dairy products and production of milk are restricted in a supply-managed system by the size of the retail demands for milk and dairy products. Thus, the key equations of the model are the demand equations and overall, the structure of the model reflects the institutional setting.

The model is heavily relying on elasticity parameters taken from various sources. This raises the issue of parameter compatibility and plausibility. One way to verify that potential incompatibility does not bring adverse consequences, is to assess the model's ability to replicate the observations from one or several "normal" years. It is also a common practice to check the plausibility of simple simulations for which we can be confident in our priors. Even though it is likely that such verification has been previously done with the dairy component of the FARM model, it is not reported nor referenced in the AAFC report. However, the validation would not change the fact that the simulation results are conditioned on various elasticity parameters such as the own-price elasticity of demand for ice cream. Given the importance of this parameter, it would seem natural to do a sensitivity analysis around its -0.62 value.

As a final point, it should be mentioned that the producer welfare impacts mainly translate into the

shadow price of quota. Therefore, scenarios reflecting increased producer surplus imply that quota prices will increase, which may not be the best alternative for increasing the competitiveness of the industry which will have to face a more global economy. On the other hand, decreases in producer surplus would imply lower quota prices and will likely be associated with lower milk prices. Producers who have recently bought quota would sustain a loss but for the majority of them, this would imply a decrease in their wealth level. The analysis of the potential impacts of alternative policy scenarios on quota values and on the structure and competitiveness of the industry has not been addressed in the AAFC study, nor has it been elsewhere in the literature. This subject would certainly deserve further research.