Economywide Effects of a Multilateral Trade Liberalization in Agriculture by Industrialized Market Economies on Canada, Japan, and the European Communities

Klaus Frohberg

Working Paper 88-WP 40
March 1989

Contents

Table

Abstract

This paper analyzes the economywide impacts of a multilateral trade liberalization in agriculture by industrialized market economies on Canada, Japan, and the European Market. The analysis takes changes in world market prices and in the price structures of the three countries from results obtained by SWOPSIM. It compares simulations of the free-trade scenarios with baseline results obtained over the period 1986-2000 for each of the countries.

Two types of responses are reported: the immediate response and those over the long run. Results from the analyses indicate that agriculture contracts in Japan and the EC and expands in Canada when agricultural trade is no longer protected. Gains from such policies are sufficiently large to compensate farmers in both the EC and Japan. Adjustments in factor markets are strong in all three countries analyzed.

Introduction

This analysis is part of a larger study on the impacts of multilateral trade liberalization in agriculture. The entire study has been conducted by several researchers or research teams.

Global and country-specific results for price, production, demand, and trade effects are obtained using SWOPSIM, a static world policy simulation modeling framework (Roningen 1986). The basic assumption underlying the free-trade scenario analyzed with SWOPSIM is that all industrialized market economies (IMEs) liberalize trade in a large number of agricultural commodities, those being mainly temperate food zone products.

In a second round of analyses, the economywide effects of the multilateral trade liberalization are studied for many of the IMEs. In general at this level, the country studies take the results obtained with SWOPSIM for the globe and the country under investigation and trace out the impact on GDP, factor movements, and resource use. This study reports on such results obtained for Canada, Japan, and the European Communities (EC).

The Country Models[1]

The three models used for the analysis have similar structures, with the parameters estimated using country-specific time series. They are applied general equilibrium models run recursively in annual time steps up to the year 2000. They describe the behavior of producers, consumers, and the government. Producers maximize profit and consumers

maximize utility. The government sets policy instruments (e.g., tariffs and quota) in pursuance of national policy goals.

The models contain two sectors: agriculture and nonagriculture. Agriculture produces nine aggregated commodities; all nonagricultural activities are combined into one single aggregate.[2] Total disappearance is the sum of human consumption, feed use (where appropriate), intermediate use, and stocks. The nonagricultural commodity is also used as an investment good and for processing and transporting agricultural goods.

The models respond to changes in relative prices. It is assumed that products are marketed with one period lag; i.e., at the beginning of each period, commodity supply is given. During the exchange process equilibrium prices are reached that determine value added in production and income of households. Of the four items of total disappearance, human consumption, feed, and stocks are obtained in the exchange process. Quantities used for intermediate consumption are determined simultaneously with production. They are not adjusted during exchange; neither is investment. Total investment is a linear function of two determinants: lagged income and an "accelerator" as a function of real income changes. Human consumption is described by a Linear Expenditure System with annually updated parameters.

Supply behavior is critically dependent on the availability of primary factors: land, labor, and capital. The former is used only in the agricultural sector, while the latter two are determinants of output in both agriculture and nonagriculture.

Labor is assumed to be a homogenous input. No distinction is made between skilled and unskilled labor, family and hired labor, and part-time and full-time farmers. Labor is mobile between the two sectors. Migration is a function of the income parity ratio of the two sectors and the ratio of their marginal value products. Hence, labor movement between the two sectors does not strictly follow the neoclassical principle which implies that wages are flexible in both relative and absolute terms.

Within agriculture, labor is allowed to move freely among the various enterprises. However, a certain degree of immobility of capital among the agricultural enterprises, especially between livestock and crop production, keeps labor from moving too rapidly within the agricultural sector.

Capital is accumulated through depreciation and investment. Once the investment is determined to be made in either agriculture or nonagriculture, the capital stock generated by that investment is fixed to that sector. This immobility of capital goods between the two sectors is an important characteristic of the models. Only with the passage of time and changed investment behavior can the capital stocks of the two sectors be altered.

For the agricultural sector it is assumed that capital is mobile among enterprises, but with some rigidity built in. Capital is substantially more mobile among the crop enterprises than among the livestock subsectors. A gradual shift from livestock to crops is possible, and vice versa.

The maximum amount of land available for cropping and use as pasture is not kept constant but is assumed to be very inelastic in its response to changing economic conditions. The adjustment is a function of the rate of return to land relative to the nonagricultural price index.

For each of the agricultural commodities, acreage, animal numbers, and yield levels are determined separately. Yield is a function of fertilizer application (crops) or feeding intensity (livestock). Feed use is optimized so as to obtain least-cost feed rations. Fertilizer (nitrogen) application levels are determined so as to equate marginal return and marginal cost. Once optimal yield levels are known, net revenues per acre and per livestock unit are calculated for all crops and livestock units. They are used in the allocation of land, labor, and capital. This is done so as to maximize the returns to these production factors. The allocation process results in crop acreages and animal numbers from which production is obtained when multiplied with the respective yields.

Technical progress is included in the model as biological technical progress in the yield functions of both livestock and crop commodities. Mechanical technical progress is part of the functions determining the level of crop acreages and livestock husbandry. Induced technical progress is not considered for any of these cases, nor for the nonagricultural sector.

The dynamic specification of the models is an important characteristic in analyzing consequences of trade liberalization. Several factors cause consumers and producers to react differently over

time to policy-induced changes in economic conditions. While it is mainly the formation of taste and habit that alter consumer responses, producers are most affected by their past investment decisions, by technical development, and by the relatively high transaction cost of pursuing different economic activities.

Consumers' taste and habit changes are endogenized in the model by annual updates of the demand system parameters based on past consumption patterns and the passage of time. For supply, the passage of time works in a more complex way in the models. Technological development is assumed to be largely exogenously determined. Past investment decisions by producers are reflected in current decisions through the lack of possibilities to employ the capital stock in many different enterprises. Transaction costs of pursuing new jobs are indirectly built in through the wedges allowed in the model between the marginal value products achieved by labor in agriculture and in nonagriculture. These considerations render the supply response in the model irreversible.

The models generate net trade. It is assumed that domestically produced and imported goods are perfect substitutes. For exporting goods a "transformation" that reflects processing, marketing, and domestic transportation and based on Leontief technology is required.

Border protection measures in Canada, Japan, and the EC are represented as tariff equivalents. Supply management of the dairy sector in both Canada and the EC is introduced in the form of a production quota.

The models are solved for a predetermined balance of trade. The trade deficit is set annually as a function of past per-capita income levels and the accumulation of debt or surplus.

Stock behavior is introduced in the model as an instrument for governments to stabilize prices. Private stocks are not included. The government is assumed to have a balanced budget.

Specification of the Trade Liberalization Scenario

The analysis is carried out for the period 1986-2000. The results of the trade liberalization scenario are compared with baseline results, which are generated by assuming price structures remain constant beginning in 1986. This holds for all types of prices; i.e., for world market, producer, consumer, and feed prices. It implies that the level of protection is also held constant beginning with 1986 for all future years. All other variables are allowed to adjust in the baseline. Production structures adjust because differential development of technical progress changes the comparative advantage within agriculture and between agriculture and the rest of the economy, inducing different investment levels and labor to migrate over time. Also, the taste and habit formation of consumers changes with the passage of time.

The trade liberalization scenario analyzed in this study is a partial one. Price changes at the world and domestic markets are taken from the SWOPSIM results. These price changes are assumed to take place over a three-year period beginning in 1986 and reaching their final

adjustment level in 1988. It is assumed that no further price changes take place after 1988.

The smoothing in of the price changes is assumed to be linear. In each year of the smoothing-in period, one third of the total price change is assumed to take place, regardless of whether the total price change is minor or substantial.

Since SWOPSIM generates price impacts only for a subset of all agricultural commodities and not at all for the nonagricultural sector, it is assumed that prices not explicitly included in the trade liberalization analysis by SWOPSIM are not affected. According to the commodity classification of the three models discussed in this report, this implies that the nonagricultural price and prices of vegetables, fruit, and industrial agricultural products must be assumed not to change between the baseline and the trade liberalization scenario.

It is further assumed that the EC and Canada terminate their supply management policies for milk under free trade. The production quota, binding in the reference run for both countries, is removed in the trade liberalization scenario. This implies that farmers in those two countries will produce milk at a level so that the marginal cost will equal the price of milk. In the reference run this is not the case. The holders of the milk production quota, assumed to be farmers, will lose the rent derived from the quota under free trade, which represents approximately 30 to 40 percent of the milk price in both the EC and Canada. A lower milk price in the free-trade scenario does not prompt a reduction in milk production as long as the price decline does not

exceed the rent of the quota. This is an important aspect that must be considered in interpreting the results obtained for both Canada and the EC.

Finally, feed prices for protein feed in the EC, and for protein feed and corn in Japan, are assumed to change according to changes in world market prices. In both those cases, imports of these two commodities are mainly for feeding purposes and are not subjected to any border protection. This means that these feed prices decline less than do the corresponding producer prices in the EC and Japan.

One important modification in implementing the price changes into the Japanese model had to be introduced. SWOPSIM results show a very strong increase in milk prices relative to the other agricultural prices; e.g., the ratio of milk price to beef price increases by more than a factor of three from the baseline for the free-trade scenario. Milk becomes more valuable under free trade in Japan (42 percent), while beef becomes cheaper (by 59 percent). Yet, SWOPSIM simulates a decline of milk production, which largely is a result of the positive cross-price elasticity between milk output and beef price included in that model. The model of Japan used in the present analysis behaves somewhat differently; for small price divergencies it simulates complementary relations between milk and beef, but for large relative changes these two products become substitutes. Faced with this problem of different model behavior, it was decided to not use the precise price changes for Japan as simulated by SWOPSIM. The dairy price was, rather,

decreased from the baseline to obtain output changes from the current model similar to those of SWOPSIM.

Results of the Trade Liberalization Scenario

Table 1 lists the impacts on the major macroeconomic variables for all three economies as percentage changes from the baseline in the year indicated. Since this analysis focuses on the economy-wide effects of a trade liberalization in agriculture, the impacts on production of and demand for the individual agricultural commodities are not reported. They are obtainable from SWOPSIM results (Roningen 1988). The table shows the short-term, or immediate, effect of a partial liberalization and the effects after the economy has adjusted to the new economic conditions.

Changes in Sectoral GDP

Because only part of the agricultural sector is liberalized and because agriculture itself constitutes a relatively small fraction of the total economy in all three countries considered, it can be anticipated that the impact on total value added is relatively small. Indeed, this is the case, as can be seen from the first line of the table. The impact is much stronger, of course, on agriculture than on nonagriculture and of opposite direction. Given that the decline of agricultural prices in Japan is twice that of EC prices, it is surprising to see that the agricultural sector in Japan shrinks no more than that in the EC. Agriculture in both countries contracts by 9 percent in the long run, while the nonagricultural sector picks up the

resources freed and increases its value added. In Canada, the opposite happens. The agricultural sector expands 7 percent, which is induced by a 4 percent improvement in agricultural prices relative to those in the nonagricultural sector. Moreover, the nonagricultural sector becomes less competitive for labor and capital and contracts by a small percentage.

Production Changes

Although these changes at the sectoral level seem to be relatively modest, they are caused by much stronger adjustments of individual commodities. Grain output, including rice, is reduced substantially in the EC and Japan and to a lesser extent in Canada. The EC and Japan also reduce bovine and ovine meat output. Canada's milk production increase dominates the adjustments in the agricultural sector, which also leads to a small increase in beef output. The increase in milk production in both Canada and the EC is induced by the removal of the milk quota. Japanese farmers increase production of pork, poultry, and eggs and reduce milk output.

A clear pattern of production changes emerges from this trade liberalization scenario. Value added in the grains sector declines relative to that of the livestock sector in all three countries. The remaining agricultural commodities--i.e., protein feed, "other food," and "nonfood agriculture"--are relatively less affected.

Factor Market Adjustments in Canada

The impact of trade liberalization on output and value added is strongly influenced by the adjustments occurring in the factor markets. In Canada more labor is employed in the agricultural sector in the free-trade scenario than in the reference run. But even under free trade, the agricultural labor force continues to shrink. The annual rate at which agricultural labor migrates from agriculture to other sectors of the economy reduces from 0.07 percent in the reference run to 0.04 percent under free trade. Also, more investment takes place in agriculture. The accumulation of capital increases approximately by 14 percent in the long run, which still translates into a modest annual increase of 1.0 percent from the baseline to the free-trade scenario when compounded.

Total land use in Canada changes very little. However, the strong decline of returns to land caused by the lack of alternative uses indicates that landowners have to bear a substantial share of total adjustment. The free-trade policies lead to a reallocation of land. Dairy becomes a strong competitor for land. Almost the same amount of land removed from grain production is shifted to roughage production to feed the expanded dairy herd.

Factor Market Adjustments in Japan

Japan's agricultural sector undergoes a far greater adjustment than does Canada's. The sector faces the strongest reduction of producer prices among the three countries under investigation in this study.

As in Canada, landowners in Japan also carry the heaviest burden of adjustment under free trade. Returns to land become zero since it is no longer profitable to cultivate all the land. Zero opportunity cost for land also has implications for the livestock sector, making roughage cheaper to produce. Some of the land taken out of crop production is shifted into roughage, thereby enabling Japanese farmers to retain a higher level of ruminant production than the price decline of beef, mutton, and lamb would suggest. The reduced opportunity costs for roughage production induce a substitution of roughage for grain in the feed rations. This substitution is enforced by the fact that corn used for feeding purposes in Japan does increase in price under the free-trade scenario.[3] In spite of the higher prices for corn, total feed costs for ruminants are reduced slightly.

Agricultural labor in Japan has undergone a substantial shift in its composition over the past 25 years. The majority of farmers now hold off-farm jobs, whereas most were employed full-time in agriculture more than two decades ago. The number of persons engaged in agriculture fell by 44 percent over the period 1960-1985, or by 3.8 percent as an annual average.[4] The baseline indicates a 2.6 percent annual decline in the agricultural labor force between 1990 and 2000, a substantial reduction in agricultural out-migration compared to the past. This decline in out-migration occurs even though the income disparity between agriculture and nonagriculture remains strong. This suggests that demographics play a major role in labor adjustment in Japan.

In the free-trade scenario, out-migration increases by about 0.5 percentage points annually. This seems to be a small increase, given the relatively strong decline in income parity by about 35-40 percent, and is the major cause for the agricultural GDP to show a relatively small decline.[5]

Japanese farmers also invest slightly less under free trade than in the baseline, causing the capital stock to shrink marginally. The capital stock per farmer or agricultural laborer, however, increases.

Factor Market Adjustments in the EC

Factor movement in the EC is more responsive to economic changes than in Japan. Rental values of land decline by 60 percent initially and by 75 percent in the long run. Similar to Canada and Japan, land used for grain production in the baseline scenario shifts to roughage production under free trade.

Labor migrates out of agriculture substantially faster when free trade is introduced. The migration rate increases by 20 percent, on average, over the period analyzed. Less investment takes place in agriculture, reducing the capital stock in the EC, however, at a smaller rate than the decline of the labor force.

Agricultural Trade Balance Adjustments

The changes in the agricultural trade balance are surprising at first glance. The assumption regarding the overall trade balance should be mentioned again. The overall trade balance does not change between the two scenarios. In other words, a change in the trade balance of the

agricultural sector must be offset by an opposite change in the trade balance of the nonagricultural sector. This is a very strong assumption and certainly has some influence on the results.

It comes as a surprise that the agricultural trade balance in Canada worsens. If one compares, however, the structure of trade in the reference run with that in the trade liberalization scenario, the reason becomes obvious. Canada substantially reduces exports of grains, her major export commodities in the reference run, and increases the export of dairy products. Reduction in grain exports is due to a decline in grain output and to an increase in grain used for feeding, since the livestock herd size increases as well as the production of poultry and eggs.

Changes of the agricultural trade balance in the other two countries are more in line with what one would expect. In the long run the agricultural trade balance worsens substantially--by about 50 percent--in both countries. Initially, however, the two responses differ. While Japan's agricultural trade balance declines from the very beginning, that of the EC improves in the short run. The EC starts to export products that have a higher value, such as dairy products, poultry, and eggs. On the other hand, grain exports are reduced, while imports of protein feed decline due to the more favorable feed prices of grains in comparison to soybean meal.

Summary and Conclusions

This paper has analyzed the potential impact on the economies of Canada, Japan, and the EC of a multilateral trade liberalization in temperate food products by all industrialized economies. The analysis indicates that landowners would have to carry the strongest burden of adjustment. Land rental values would decline strongly in Japan and the EC and significantly in Canada. Therefore, it seems to be very important to find ways for securing the support of landowners for such a policy.

A scheme could be set up to compensate the losers from a free-trade policy. All three economies analyzed show an increase, although very small, of value added. In addition, consumers in both Japan and the EC gain from lower food prices.

The study also points to the difficulties agricultural labor has in adjusting to changing economic environments. In all three countries, out-migration of labor from agriculture continues in the free-trade scenario. In Japan and the EC the rate with which farmers assume alternative employment opportunities increases, whereas it decreases in Canada. These changes are relatively small, indicating that demographic factors are having a substantial impact on migration. A more detailed analysis of labor migration would certainly add to a better understanding of the motives for migration.

Capital adjustments are also relatively small in all three countries, exceeding that of labor only in Canada. In Japan and the EC, disinvestment takes place in agriculture. This process also seems to be

slow because there are no alternative uses for agricultural capital. On the other hand, net investment still continues to be positive in most years in both countries.

Because of the small share agriculture has in the total economy, the nonagricultural sector is little affected by a trade liberalization in agriculture.

Table 1. Economywide impacts of a multilateral trade liberalization by all industrialized market economies on Canada, Japan, and the EC (in percent)

	Canada		Japan		EC	
	1988	2000	1988	2000	1988	2000
GDP[1]	0.1	+0.0[4]	-0.0	0.1	0.4	0.3
GDP-agriculture	1.2	7.5	-6.5	-9.5	-0.2	-9.4
GDP-nonagriculture	0.1	-0.1	0.1	0.3	0.4	0.6
PA/PNA[2]	4.9	4.5	-35.4	-37.5	-17.8	-17.5
Parity income	3.8	6.9	-39.7	-35.5	-14.6	-12.9
Labor-agriculture	2.1	5.2	-1.0	-6.7	-4.0	-14.5
Capital-agriculture	2.3	13.8	-0.0	-3.5	-1.1	-9.6
Land use	-1.2	+0.0	-19.8	-57.4	-3.2	-6.6
Land rental value	-24.0	-11.4	-100.0	-100.0	-64.5	-74.2
Agri. trade balance[3]	53.6	-32.4	-26.7	-54.2	+110.3[5]	-59.6

[1] At constant prices.
[2] Ratio of agricultural price index to that of nonagriculture.
[3] At world market prices.
[4] "+0.0" indicates a small increase and "-0.0" indicates a small decline.
[5] From a relatively small base value.

Endnotes

1. A detailed description of these models is given in Fischer et al. (1988).

2. The agricultural commodities are wheat, rice, coarse grains, bovine and ovine meat (mainly beef, veal, lamb, and mutton), dairy products, other animal products (mainly pork, poultry, eggs, and fish), protein feeds, other food (mainly fats and oils, sugar, fruits, vegetables, and beverages), and nonfood agriculture (fibers, tobacco, etc.)

3. Price of corn for feeding purposes might not increase as much as this analysis suggests if the feed industry becomes more competitive.

4. Estimates from the Ministry of Agriculture, Forestry, and Fisheries.

5. The migration functions for agricultural labor were estimated from time series generated when there was not such a dramatic decline in agricultural prices. Hence, it is possible that the functions somewhat underestimate the out-migration of labor from agriculture.

References

Fischer, G., K. Frohberg, M. Keyzer, and K. Parikh. 1988. Linked National Models: A Tool for International Food Policy Analysis. Boston: Kluwer Academic Publishers, for the International Institute of Applied Systems Analysis.

Roningen, V. O. 1986. "A Static World Policy Simulation (SWOPSIM) Modeling Framework." ERS Staff Report AGES860625, Washington, D.C.: USDA.

_____. 1988. "Trade Liberalization Results from ST86." Memorandum to IATRC symposium participants, Group II, May 17. Economic Research Service, USDA, Washington, D.C.