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# Economic Impacts of the U.S. Honey Support Programs on the Canadian Honey Trade and Producers Prices

by

Barry E. Prentice and Kwame Darko*

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*Barry Prentice is an Associate Professor, Department of Agricultural Economics, University of Manitoba and Kwame Darko is an Economic Consultant, Winnipeg, Manitoba.

Correspondence on requests for additional copies of this paper should be addressed to:

Barry E. Prentice
University of Manitoba
Department of Agricultural Economics
& Farm Management
Winnipeg, Manitoba R3T 2N2
CANADA

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Barry E. Prentice
Associate Professor
Department of Agricultural Economics
University of Manitoba

and

Kwame Darko
Economic Consultant
Winnipeg, Manitoba

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## EXECUTIVE SUMMARY

The integration of the Canadian and American honey industries has been encouraged by proximity and the openness of the border. Canada-U.S. import tariffs on honey are amongst the lowest in the world (less than one cent per pound) and there are no significant non-tariff barriers to trade. As a result, substantial volumes of raw and processed honey flow north and south each year. In addition, Canadian producers import beekeeping equipment and breeding stock from U.S. suppliers. Prior to the recent disease problems (varroa mite and tracheal mite), the U.S. exported over $7 million in package and queen bees to Canada annually.

The absence of trade barriers has enabled Canadian beekeepers to take advantage of export opportunities in the United States market. Integration with the U.S. market however, has been a double-edged sword. As the Canadian and American honey markets have become more entwined, the instability risk to Canadian beekeepers' incomes has increased. In particular, the economic links between Canadian and U.S. honey prices and input costs have made Canadian beekeepers vulnerable to changes in U.S. honey policy.

Between 1980 and 1985, U.S. Government subsidies to honey producers increased from $ 8.7 million to $ 80.8 million per year. These expenditures were triggered when market prices fell below the U.S. honey loan rate. As a result, the U.S. beekeepers found it more profitable to default on their loans with the Commodity Credit Corporation (CCC), than to sell their honey to commercial outlets.

The CCC was not permitted to re-sell the honey it received through the loan program at less than 110 percent of the purchase price. Consequently, these unwanted stocks were cleared through non-commercial markets (e.g. school lunch program). The resulting vacuum in the commercial market created by the CCC was filled with imported honey. During this period, U.S. imports increased from 58.6 to 138.2 million pounds per year, and the Canadian share of this market increased from 14 to 34 percent.

The obvious deficiencies in the U.S. honey program led to changes that were introduced in the 1985 Farm Bill. Under the new rules, the parity price formula was abandoned and the loan rate was set by statute. U.S. beekeepers were allowed to redeem their loans at a discount (the "buy-back" rate) and sell their honey commercially. As a result, forfeitures of honey to the CCC returned to the pre-1980 level, stocks of honey accumulated by the CCC (from 1980-1985) were gradually diminished, and commercial market prices declined to the level of the CCC "buy-back" price. In addition, U.S. honey import volumes returned to the pre-1980 level.

The decline of Canadian honey exports to the U.S. after 1985 was accompanied by a steep drop in prices, particularly in western Canada. Although the 1985 U.S. Farm Bill appeared to be responsible for the resulting change in Canadian honey producers'

incomes, other events and government policies were operating simultaneously that could influence the Canadian market. In order to isolate the impact of the U.S. honey program, an econometric model of U.S. production and trade, which was developed by Willett (1987), was modified to simulate the impact on Canada of removing the effectiveness of the U.S. honey program

Simulation Results

In the absence of the U.S. honey program, the model indicates that growth of the Canadian honey industry would have been extended after 1985. Colony numbers would have been higher, and more honey would have been produced. Although expansion of the world honey supply would have depressed the real price of honey received by Canadian beekeepers in any case, it would have declined less in the 1981-88 period, if there had been no U.S. honey subsidies.

U.S. honey imports were higher because of the purchase and disposal operations of the CCC. The model results indicate that U.S. programs increased Canadian honey exports and domestic Canadian consumption. The higher level of Canadian production, and lower volume of exports and domestic consumption (in the absence of the U.S. program) would have been accommodated by an increase in the ending stocks held in Canada.

The model results for the U.S. honey industry indicate that without the subsidies colony numbers in the U.S. would have continued to decline. Honey production, however, does not follow colony numbers. Production would have been higher from 1981-86, then lower in 1987-88. This implies that beekeepers would try to utilize their colonies more intensely when no subsidies were paid. This result may also reflect other features of the model such as the number of colonies employed in pollination services and the costs/returns in the production of package bees and queens.

In summary, there is sufficient evidence to determine that the U.S. honey program had a negative impact on the average prices received by Canadian honey producers. On the other hand, the operation of the U.S. honey program increased the volume of Canadian honey exports. In addition, the incomes of Canadian honey producers were improved to the extent that the costs of holding extra stocks were negated. Consequently, the net impact on the incomes of many Canadian honey producers is likely small.

One caveat that must be recognized in examining these results is the aggregation problem. The "national" model consists of an average of prices that are lower than those received in eastern Canada, and higher than the prices received in the prairie provinces. Consequently, the impacts of the U.S. program are likely more accentuated in western Canada, which is export dependent, than in other regions of the country.

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## INTRODUCTION

The honey markets of Canada and United States are connected through commodity prices and input costs. Tariff restrictions on the movement of honey between Canada and the United States are amongst the lowest in the world,[1] while there are no important non-tariff barriers. The absence of trade barriers has led to an active bilateral trade in honey between Canada and the United States. In most years Canadians purchase about 10 percent of U.S. honey exports, while over two-thirds of Canadian honey exports are shipped to the United States. In addition, the United States has supplied beekeeping equipment and breeding stock to Canada. Until the advent of recent disease problems, Canadian beekeepers imported over $7 million of U.S. package and queen bees each year. As a result of these important links between honey prices and costs of production, Canadian beekeepers are vulnerable when changes occur in U.S. honey policy.

Next to Germany, the United States is the largest single import market for honey. Consequently, changes in domestic U.S. honey programs that influence the volume of their imports can have a significant impact on the international trade of honey. During the first half of the 1980s, U.S. honey price-support programs created a surge of imports, while subsequent reforms introduced in the 1985 U.S. Farm Bill produced a steep decline in honey import volumes and prices in the last half of the decade. These changes in U.S. honey policy coincided with significant variations in Canadian honey exports to the U.S., as well as the level of Canadian honey prices.

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1. Prior to 1989, the Canadian import tariff on honey was C$.015 per pound, while the U.S. import tariff was US$.01 per pound. Under CUSTA these tariffs are being reduced by one tenth per year over a ten year phase-out period. The Canadian import tariff on beeswax (3 percent) is being eliminated over five years. The United States tariff on beeswax is already free.

## SCOPE AND OBJECTIVES

The purpose of this study is to quantify the impact of the U.S. honey policy on the Canadian honey industry. The study begins with an overview of the Canadian honey industry and its linkage to the U.S. market. This is followed by a review of the literature pertaining to the U.S. honey program and its relevance to the Canadian honey trade. Subsequently, an econometric model of U.S. and Canadian honey production and trade is developed for the period 1952 to 1988. Using the estimated coefficients, a base model of the Canada-U.S. honey industry is simulated for the 1981-1988 period when the U.S. honey program incurred significant disbursements. The simulation is re-estimated for the post-1980 period under the policy scenario that the U.S. honey program was ineffective in providing support to American beekeepers. A comparison of the base model and the "no support" scenario is used to measure the price/trade impacts created by the U.S. honey program.

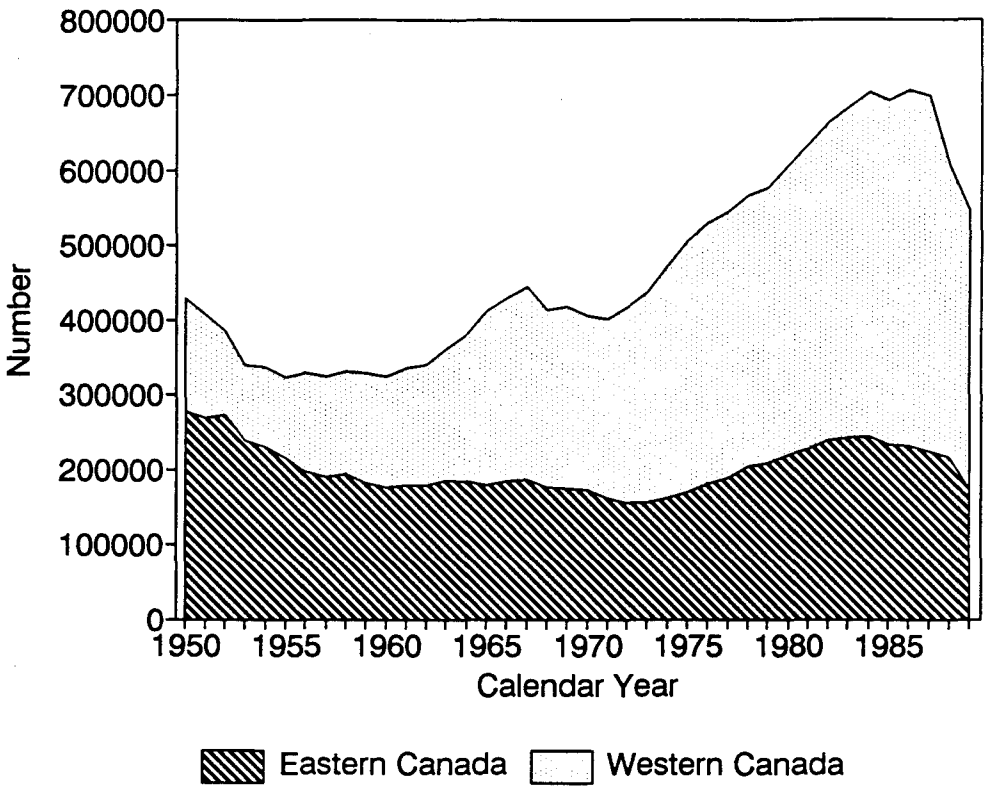
## CANADIAN HONEY INDUSTRY

Since 1950, the Canadian beekeeping industry has experienced a significant expansion. Although the number of beekeepers is almost the same (approximately 18,000), colony numbers have increased about 50 percent and honey production has more than tripled. Meanwhile, the farm value of Canadian honey has increased from $16 million in 1950 to $31 million in 1988, in constant (1981) dollars.

### Location and Production Trends

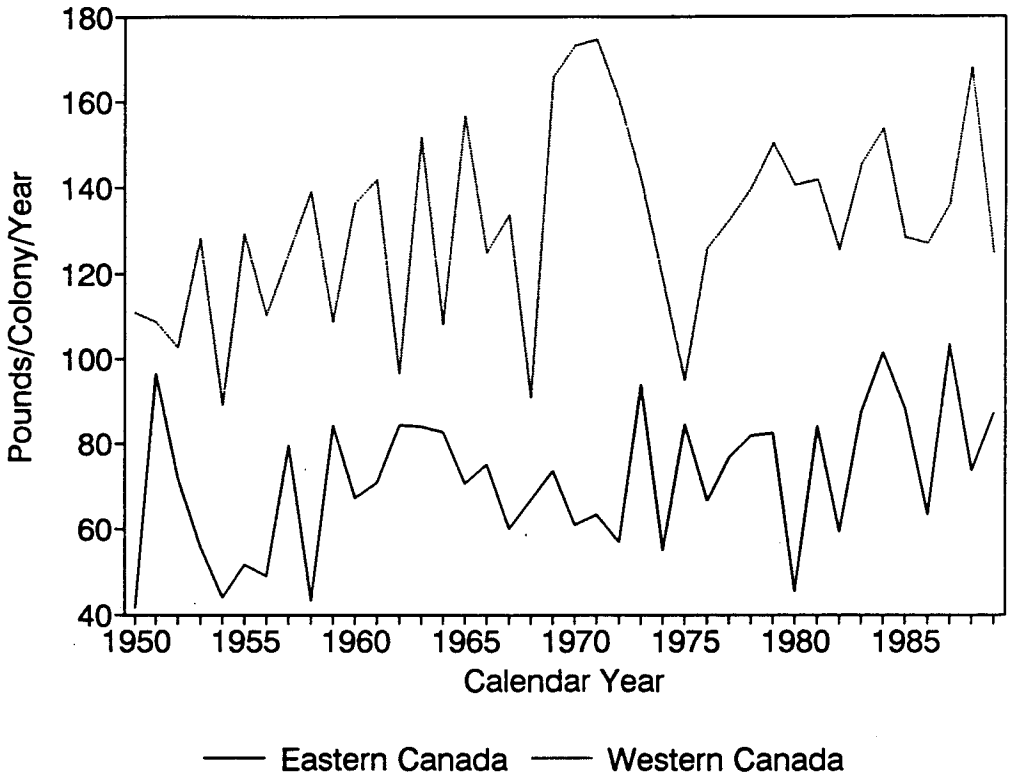
Over the past four decades, the center of honey production in Canada has shifted from east to west. In 1950, about three-quarters of all bee colonies were located in eastern Canada (Ontario, Quebec and the Atlantic provinces). By the 1980s, the situation had reversed; with 65 percent of all bee colonies located in western Canada (Manitoba, Saskatchewan, Alberta and British Columbia). The change in the location of bee colonies in eastern and western Canada is presented in Figure 1.

Figure 1 Number of Bee Colonies in Canada, 1950-89



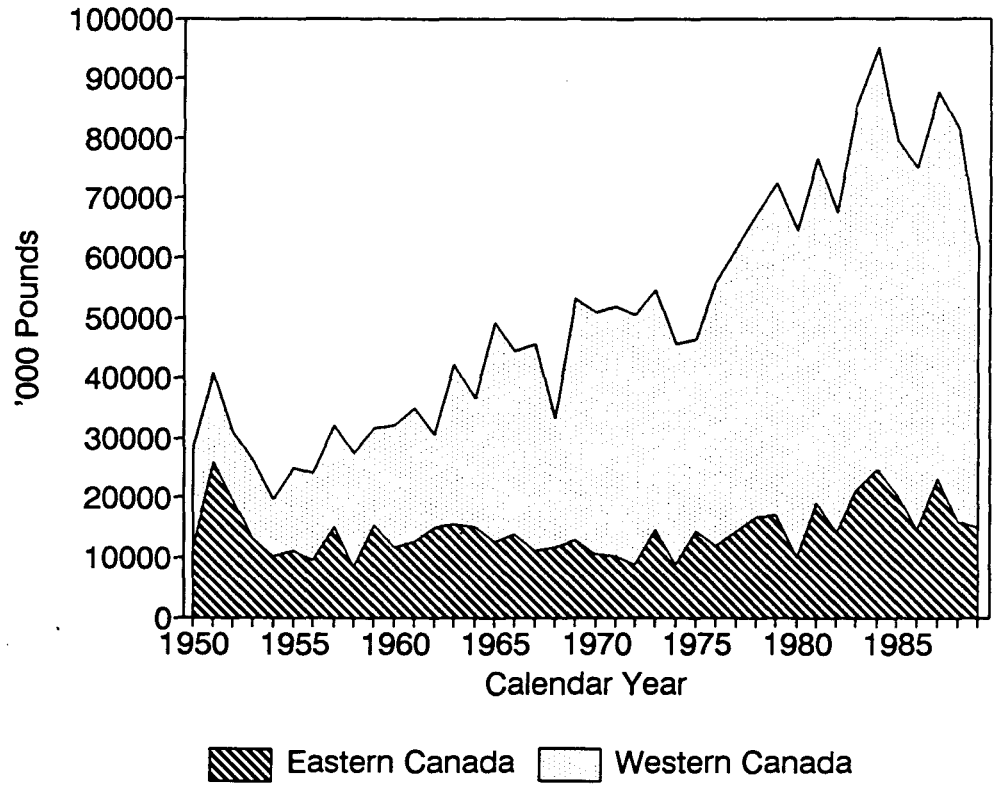

The shift in location of Canadian beekeepers has had a disproportionate impact on honey production because colony yields in western Canada are much higher than in eastern Canada. The annual yield per colony for each region from 1950 to 1989 is illustrated in Figure 2. During this period, honey production in western Canada averaged 131.5 pounds per colony, versus 71.7 pounds per colony in eastern Canada. The annual production of honey in Canada from 1950-1989 is presented in Figure 3. These data highlight the contribution that western Canada has made to the increase in Canadian honey production since the mid-1950s.

Figure 2 Annual Yield of Honey per Colony in Canada, 1950-1989




A significant proportion of the increased output of honey in western Canada can be attributed to a supply shift that occurred because of improved floral sources. During World War II, the industrial rapeseed crop, which produces an abundance of nectar, was introduced to western Canada. Following the war, plant breeders were able to modify the industrial rapeseed plant to produce an edible oil variety, called canola. Markets for canola in Canada and Japan, led to a rapid increase of this crop, and consequently, increased canola honey production.

Figure 3 Annual Honey Production in Canada, 1950-89




The impact of changes in canola acreage on western Canadian honey production is illustrated in Figure 4. The predicted honey production is based on an OLS regression of canola acreage.[2] These data imply that for every additional hectare of canola, western honey production increased about 7 kilograms. In addition to canola, hay production in western Canada expanded to serve export markets (dehydrated alfalfa pellets and cubes), and the domestic cattle industry. This increase in "bee pasture" permitted further growth of clover honey in western Canada.

In 1973-74, the export price of honey increased significantly. Figure 5 presents the nominal and real farm price of honey in Canada for the period 1950 to 1989. In the 15-20 years prior to these price increases, the real price of honey (in constant 1981 dollars) had

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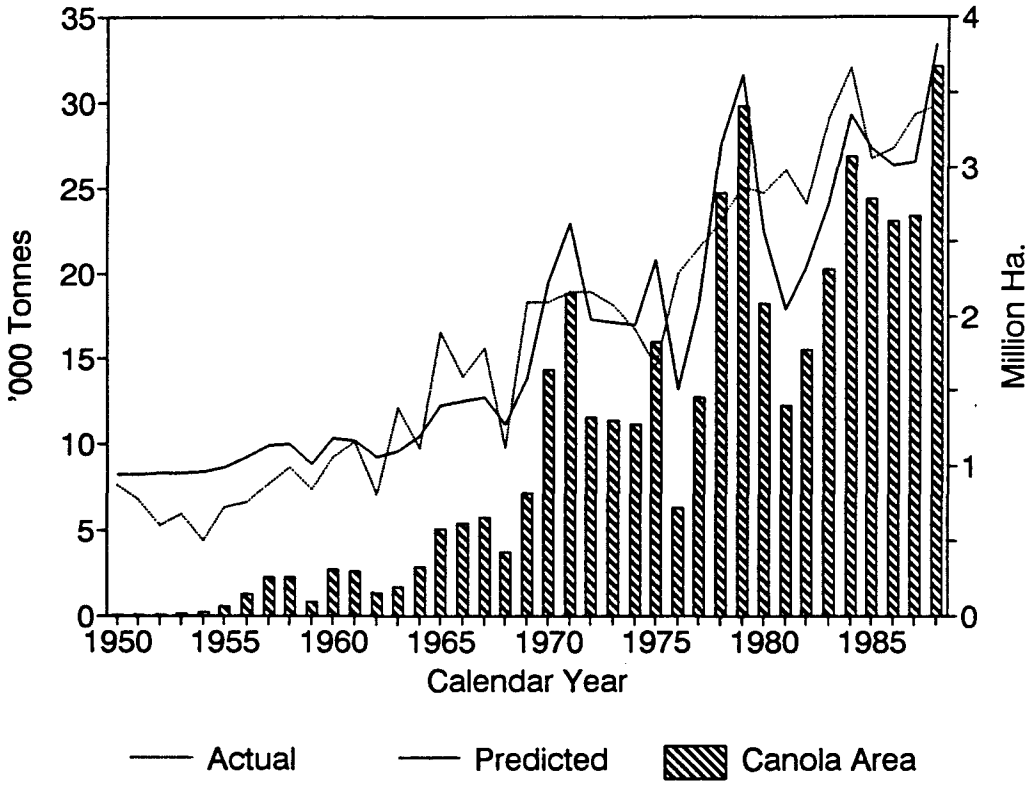
[2] The estimated equation is: Honey production ('000 tonnes) = 8.25 + 6.86 Canola ('000,000 hectares) $R^2$=.83

been declining. Consequently, the growth of production that had been stimulated by increased floral sources was encouraged to expand further.[3]

Figure 4 Actual and Predicted Honey Production in Western Canada and Area Seeded to Canola/Rapeseed, 1950-1988



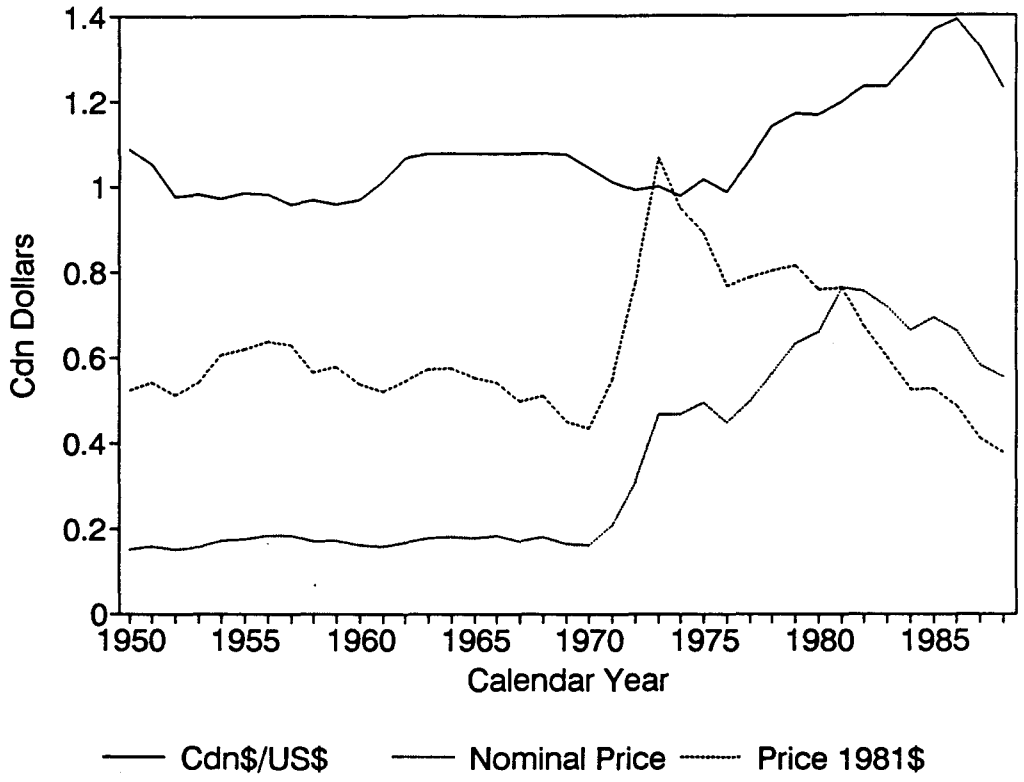

Prices and Trade

The high rate of inflation during the remainder of the decade reduced the real price of honey, but this was moderated by the decline in the value of the Canadian dollar. Between 1976 and 1985, the Canadian dollar lost approximately one quarter of its value relative to the U.S. dollar. This helped to sustain the level of prices received by Canadian

[3] Anecdotal evidence of this period includes reports of new beekeepers who were able to pay off their investment in the course of one season's production.

beekeepers, but the longer run downtrend in the real price of honey is evident throughout the 1980s.

Figure 5 Nominal and Real Farm Price of Honey in Canada and the Canada/United States Foreign Exchange Rates, 1950-1988

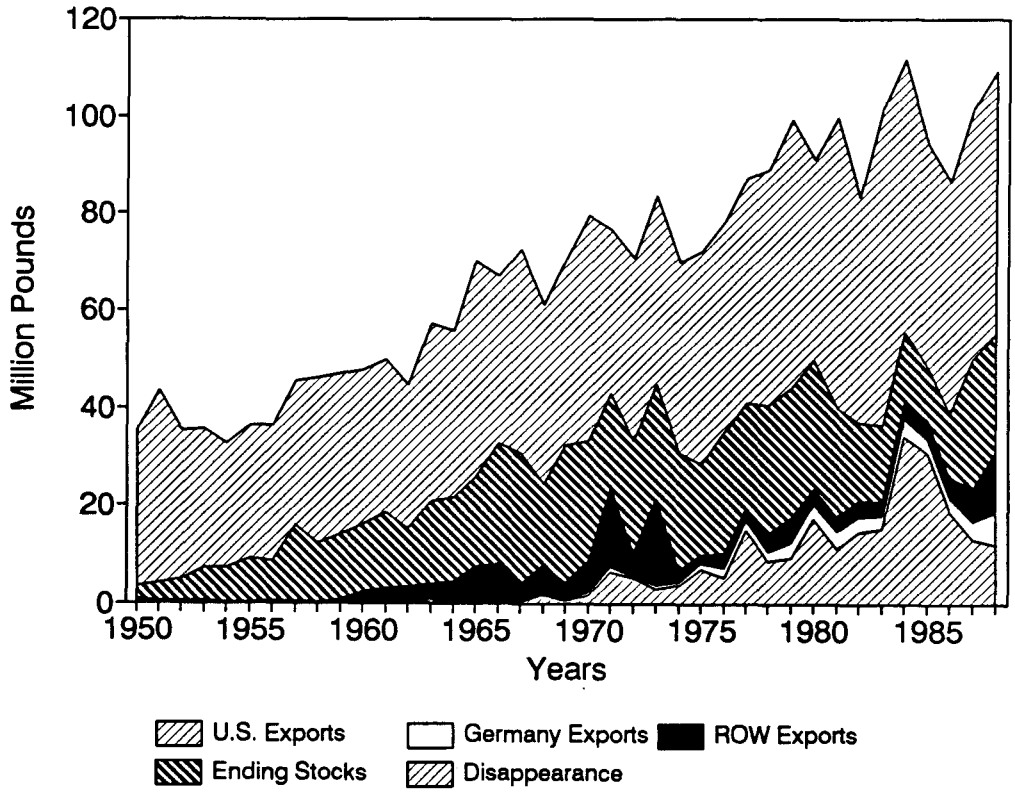



The increasing production of Canadian honey, which began to gather momentum in the 1960s, led to a significant increase in export sales. Trends in Canadian honey consumption and exports from 1950 to 1988 are presented in Figure 6. Although domestic disappearance expanded in tandem with increased population, most of the increased production after 1960 was sold in export markets.[4] In the 1960s, the United

[4] Domestic disappearance, which is the best available estimate of honey consumption in Canada, is recognized to be only approximate at best.

Kingdom and Japan were the two major export markets (listed with ROW), while Germany and the United States emerged as the largest single markets in the last two decades of the period. These data also reveal the increasing dependence of Canadian beekeepers on exports to the United States. At the peak in 1984-85, exports to the United States equalled one-third of total Canadian production.

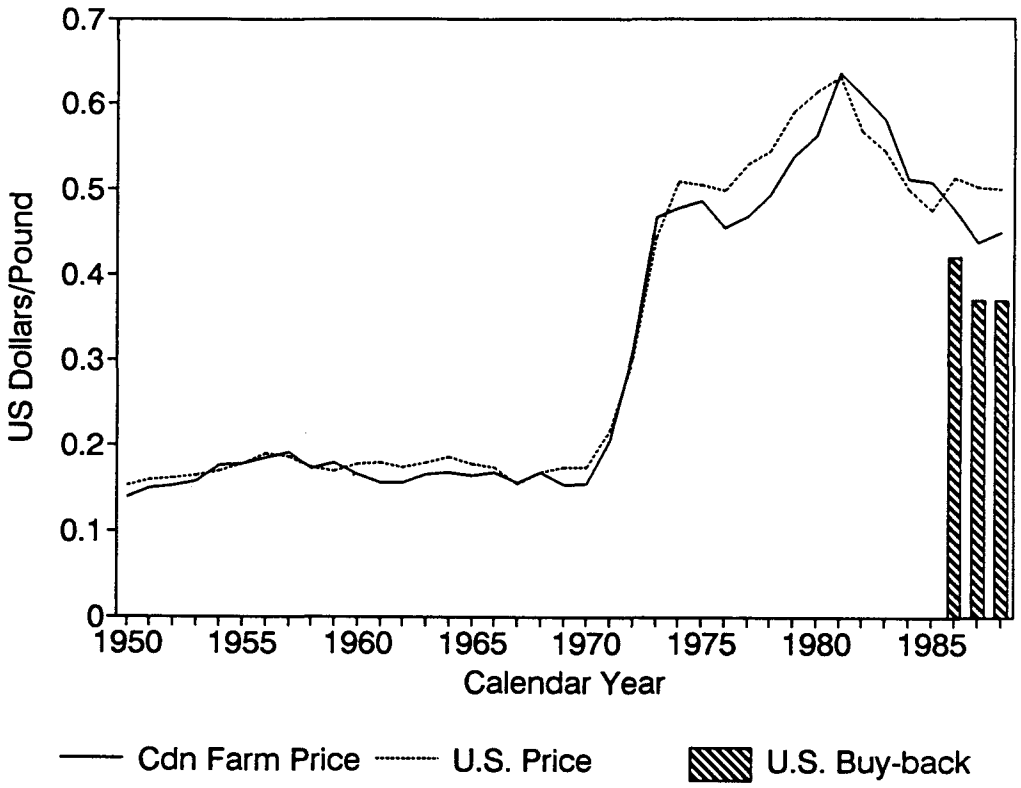
Figure 6 Canadian Honey Exports, Ending Stocks and Domestic Disappearance, 1950-1988




The close economic link between the U.S. and Canadian honey markets is illustrated in Figure 7, which presents the farm prices of honey in Canada and the United States. Throughout the 1950-88 period, there has been a parallel tracking of prices in these two markets. The widest spread between Canadian and U.S. farm prices for honey

has occurred since 1985 when the U.S. "buy-back" system on administering subsidies was introduced. The operations of the U.S. buy-back program and its influence on Canadian prices will be described in more detail in the section dealing with U.S. honey policy.

Figure 7 U.S. Honey Market Prices, Canadian Farm Prices, and U.S. "Buy-Back" Rates, 1950-1988



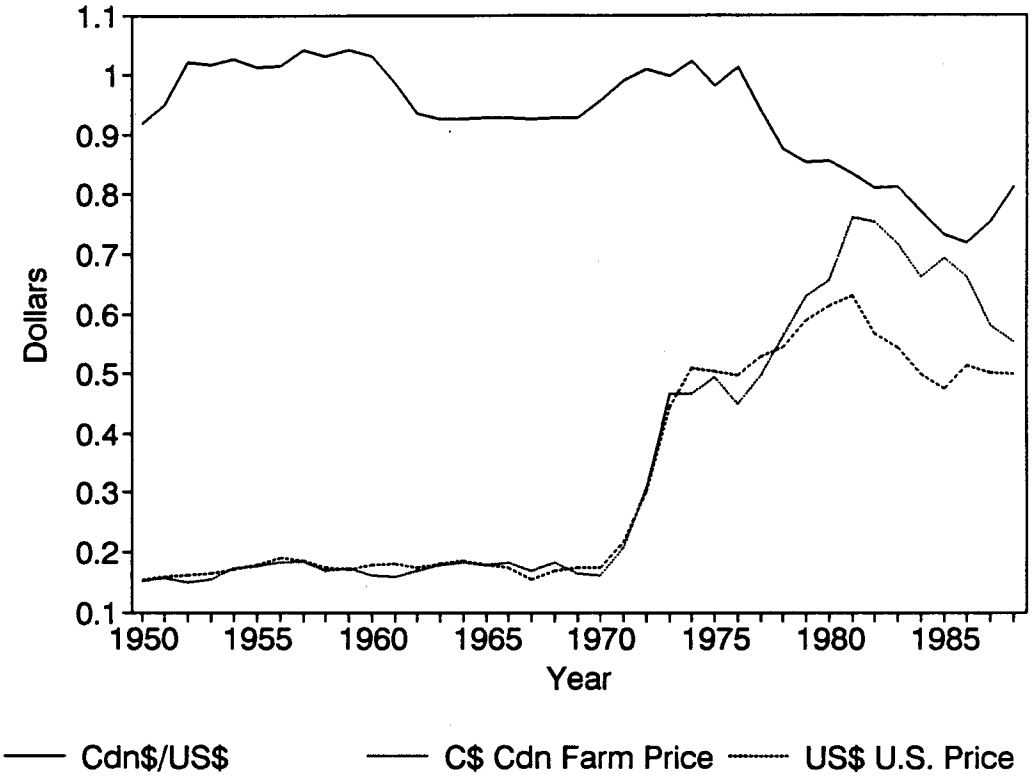

Current Economic Problems

In addition to the impact of changing U.S. honey subsidy programs, the Canadian beekeepers were subject to unfavourable macroeconomic changes, biological problems and increasing marketing costs that reduced the profitability of honey production.

Macroeconomic:

The macroeconomic affects have stemmed from the increasing value of the Canadian dollar and higher rates of interest that were required to support the dollar and curb inflation. The effect of the rising value of the Canadian dollar on the price of honey is illustrated in Figure 8.

Figure 8 Average U.S. Honey Prices, Canadian Farm Price of Honey and the Canada-U.S. Exchange Rate, 1950-1988




When the Canadian and U.S. dollars were trading at par, the average U.S. honey price (in U.S. dollars) and the Canadian farm price (in Canadian dollars) were almost identical. After 1976, as the Canadian dollar was depreciating in value, the farm price of

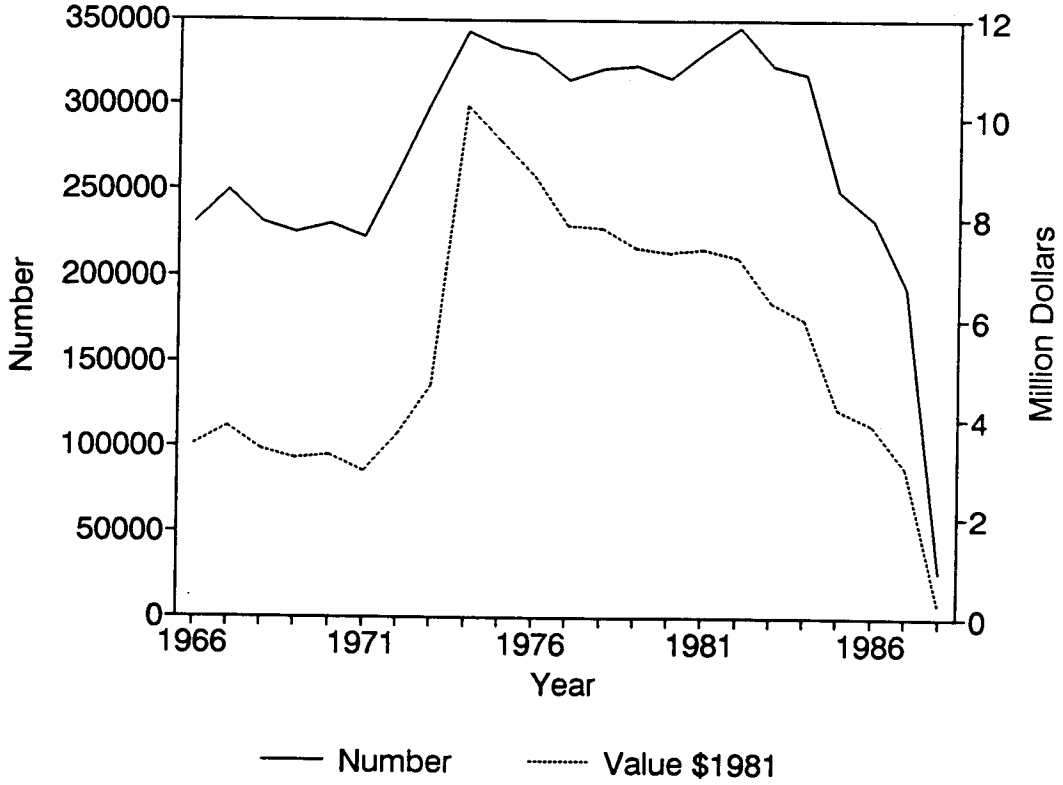
honey rose above the average price in the United States. Since 1987 however, the Canadian dollar has appreciated approximately 20 percent (in terms of the U.S. currency) and the price of honey received by Canadian beekeepers has fallen correspondingly.

The higher Canadian dollar is being supported by higher interest rates. The affects of higher interest rates are not uniform. Interest on beekeeper operating costs are relatively low (about 1 cent per pound of honey), while investment costs represent approximately 10 to 15 percent of total costs. For well-established beekeepers, variations in interest rates are not likely to have had a major impact on their operations. For new entrants however, higher interest rates may pose a significant challenge to their survival.

Biological:

Disease problems (varroa mite and tracheal mite) have increased the costs of honey production in two ways. First, diseased colonies do not produce as efficiently, and if the disease is detected the colony must be eradicated. Second, disease problems have forced the closure of the Canada-U.S. border to imports of package and queen bees. As a result, beekeepers have been forced to over-winter their colonies. This has increased costs, particularly in Western Canada where over-winter survival rates are lower, and new management practices have had to be developed. The change in the number of package bee imports to Canada is presented in Figure 9.

Figure 9 Canadian Imports of Package Bees: Number and Value in Constant 1981 dollars, 1966-1988




The change in the volume of package bee imports illustrate the effects of changing market incentives and the impact of the border closure.[5] The tripling of honey prices in 1973-74 created a surge in demand for package bees. The number of packaged bees imported likely under-estimates the true change because these data include all sizes (from 1 to 5 pounds). The dollar value of imports (in constant 1981 prices) suggests that imports virtually tripled. Subsequently, package bee imports declined in tandem with the declining real price of honey (previously illustrated in Figure 5). By 1987, the value of package bee imports had returned to the 1971 level. In 1988, following the closure of the U.S. border, package been imports were limited to those obtained from Australia and New Zealand.

These macro-economic and biological changes have influenced the profitability of honey production in Western Canada. In Table 1, cost and return data are presented for

[5] Data prior to 1966 are not available.

1978 and 1988. Caution must be exercised in reviewing these data because they are not representative of average production costs, they refer to differing scales of production, and are determined for two different production regions in the prairies (Peace River, Northern British Columbia-Alberta, and Manitoba). Nevertheless, these data may be considered indicative of the general economic situation.

The closure of the border to U.S. package and queen bee imports has had a notable impact on the distribution of production costs. In 1978, replacement bees represented 31.9 percent of costs, while feed (sugar) was less than one percent of total costs. In 1988, the importance of these inputs has been reversed. Sugar feed accounted for 21.4 percent of total costs, while bees (investment plus stock replacement) represents only 5.3 percent of costs. Other costs that are related to over-wintering are also higher, such as labour and miscellaneous operating costs (e.g. veterinary medicine and supplies).

Table 1 Beekeepers' Costs and Returns in the Peace River District (1978) and Manitoba (1988)

| | 1978 Peace River 1500 Hive Apiary (percent) | 1988 Manitoba 1000 Hive Apiary (percent) |
|---|---|---|
| Bees & Queens | 31.9 | 5.3 |
| Feed (sugar) | 0.9 | 21.4 |
| Labour (hired/owner) | 22.4 | 25.1 |
| Depreciation | 13.9 | 12.3 |
| Interest on: | | |
| Operating Capital | 2.3 | 1.9 |
| Investment | 14.2 | 10.1 |
| Miscellaneous Costs | 15.2 | 23.9 |
| Total Costs | 100.0 | 100.0 |
| Costs as a percent of farm value of honey | 87.3 | 130.1 |
| Return to Management | 14.4 | -23.1 |

Source: Government of B.C. (1979), Manitoba Agriculture (1989)

In 1978, the total costs of beekeepers who participated in the Peace River study represented only 87.3 percent of the average farm value of honey.[6] These producers were able to earn a 14.4 percent return to their risk and management. In contrast, the Manitoba producers in 1988 were unable to cover their full costs of production and had

[6] The average farm value of honey in Alberta is used in these calculations because it is more representative of prices in the Peace River than the average farm value of honey for British Columbia.

a negative return to their management (-23.1 percent). When producers with 1000 hives were essentially working for zero wages, smaller producers were likely approaching the "shut-down" stage of production. Undoubtedly, many of these beekeepers would have been forced to leave the industry if a National Tripartite Price Stabilization plan for honey had not been introduced. In 1988, participating Canadian beekeepers received their first payment of $0.12 per pound from this program.[7]

Marketing Costs:

The pricing behaviour of the retail distributors in Canada has also had a negative effect on Canadian beekeepers. From 1950 to 1980, the farm price and the retail price in Canada moved in lock step. During the 1980s, however, there has been a continuing increase in the retail price of honey, while the farm price has declined. These data, which are presented in Figure 10, document the widening retail-farm price margin. Between 1981 and 1988, the retail price of honey increased 26.3 percent and the farm price of honey fell 37.7 percent. If the traditional margin relationship had prevailed, the consumer price for honey would have been about 75 percent less in 1988 than actually occurred.

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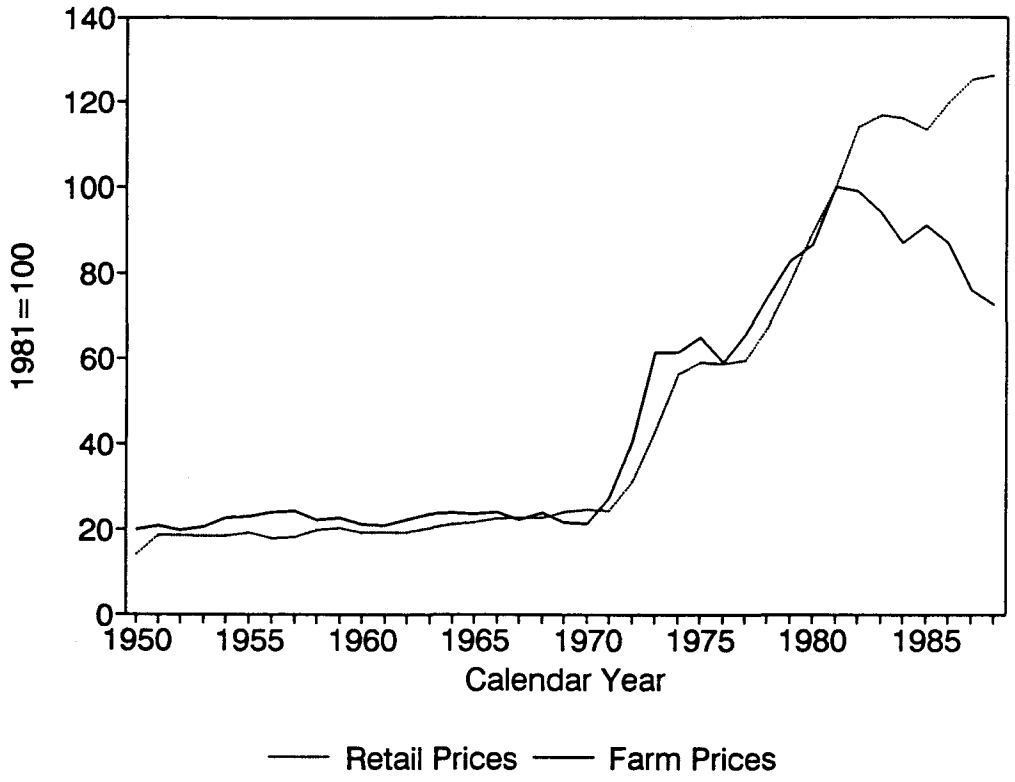
[7] This is approximately equal to 22.6 percent of the total costs as calculated in Table 1 for the 1000 hive apiary in 1988. Consequently, with the stabilization payment beekeepers at this scale of production would have covered their total costs.

Figure 10 Canadian Farm and Retail Price Indices, 1981=00, 1950-1988

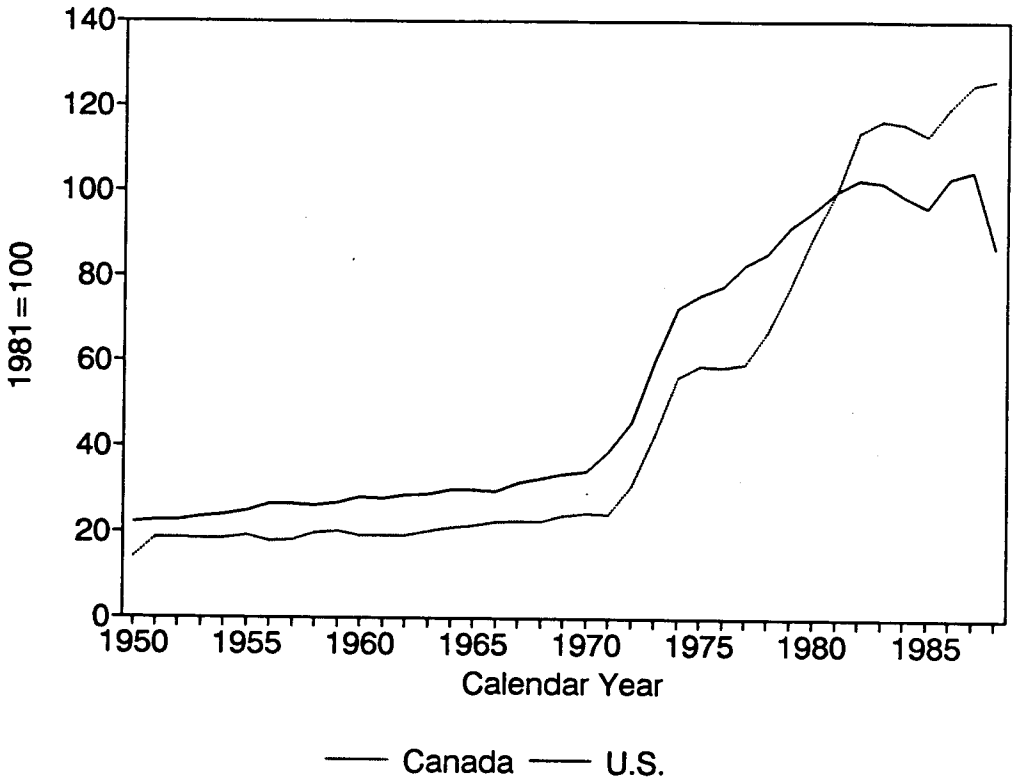



The source of the higher retail price for honey in Canada is what the industry calls "inside-programs". This is a term given to the discounts that the retail chain stores demand from the honey processors in return for securing shelf space. There are several components to these discounts: "co-operative advertising", "quantity discounts" and "trip programs." The co-operative advertising discount was initially requested by the retailers, if they featured a processor's product in their store advertisements. The discount, which is approximately 10 percent, is now collected whether or not there is any advertising, and in the case of honey, advertising is seldom observed. The "quantity discount" also began as a legitimate recognition of the cost savings associated with higher sales volumes. These discounts are now required regardless of quantity sold. The "trip program"

discount is used to fund incentives to reward retail store management. In total, these discounts can amount to 25-35 percent of the wholesale price. On top of these discounts, the retail chains add their "normal" profit margin.

In the United States, where the honey industry is not subject to "inside programs", retail prices have followed the declines in the farm price. In Figure 11, Canadian and U.S. retail price indices are compared. These data document the much higher rate of growth in Canadian retail prices since 1978, relative to U.S. retail prices. By 1988, the U.S. retail price index was approximately two-thirds of the Canadian retail price for honey.

Figure 11 Canadian and U.S. Retail Price Indices for Honey, 1981=100, 1950-1988



The impact on beekeepers of the Canadian retail pricing behaviour depends on their method of marketing. In western Canada, where most of the honey is marketed through processors, the "inside programs" have reduced the size of their domestic market as well as lowered their returns. In the more urbanized parts of Canada, however, beekeepers who sell direct to consumers have likely benefitted by the higher retail prices. This is suggested by the widening spread of farm prices across Canada. These data, which are presented in Table 2, indicate that differences in provincial honey prices have increased markedly between 1978 and 1988.

Table 2 Farm Price of Honey by Province, 1978 and 1988

| Province | Farm Value 1978 ($/kg) | Farm Value 1988 ($/kg) | Difference (percent) |
|---|---|---|---|
| B.C. | 1.48 | 1.98 | 33.8 |
| Alberta | 1.12 | .88 | -21.4 |
| Saskatchewan | 1.10 | .90 | -18.2 |
| Manitoba | 1.10 | .90 | -18.2 |
| Ontario | 1.43 | 1.95 | 36.3 |
| Quebec | 1.68 | 2.71 | 61.3 |
| N.B. | 1.99 | 2.90 | 45.7 |
| N.S. | 1.69 | 3.11 | 84.0 |
| P.E.I. | 1.95 | 3.33 | 70.8 |
| Production Weighted Average | 1.24 | 1.22 | -1.6 |

Source: Statistics Canada

Excluding the western provinces, beekeepers' prices (not adjusted for inflation) have increased 33 to 84 percent between 1978 and 1988. In the prairies, farm values have decreased 18-21 percent over the same period of time. These data also reveal that the "average" return to Canadian beekeepers has decreased 1.6 percent over the last ten years. Clearly, however, it is the beekeepers of western Canada, who depend on the export market, that have suffered the most serious economic problems.

## BACKGROUND TO THE U.S. HONEY POLICY

The United States has a long history of providing income support to its honey industry. Beekeepers in the United States have been supported by the Agricultural Act of 1949, the Beekeeper Indemnity Payment Program, and the Honey Market Research and Consumer Information Order. In recent years, honey producers have also benefited from the Targeted Export Assistance (TEA) program that is used for export promotion.

### Agricultural Adjustment Act

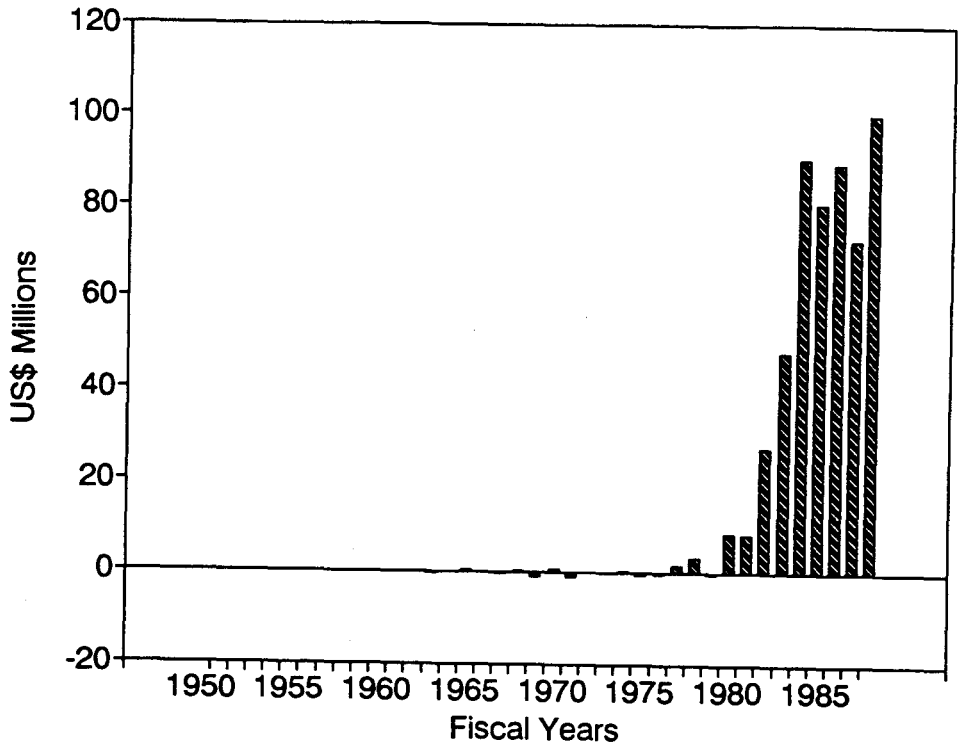
The initial support to the beekeeping industry was provided as assistance to adjust for the over-expansion that had occurred as a result of World War II. Production was stimulated during the war to supply beeswax for the munitions industry and honey to substitute for rationed sugar. Following the war, beekeepers incomes were depressed by the build up of large honey inventories. As a result, the Congress added honey to the expanded price-support programs for basic commodities under the Agricultural Adjustment Act of 1949 (GAO, 1985).

In addition to the need to help beekeepers adjust to the post-war conditions, the honey support program was viewed as a means of ensuring that an adequate supply of honeybees would be available to pollinate seed, fruit, nut and vegetable crops. This justification for the program was subject to strong criticism in a study by the U.S. General Accounting Office (GAO) in 1985. The GAO study describes the benefits of honeybee pollination as exaggerated, it notes that the location of production does not correspond with crops that require insect pollination, and that the payments of the program are received by a relatively small number of large commercial apiarists who move their bees to take advantage of floral abundance, rather than the need for pollination service.

Despite these criticisms of the honey program, the guarantee of crop pollination is still identified as the prime reason for the 1949 Act. "The basic purpose of the honey price support legislation in the 1949 Act and subsequent legislation is to induce beekeepers to remain in business so that necessary pollination of certain agricultural crops is maintained" (Hoff and Philips, 1989:p.22).

Prior to 1980, net government expenditures for the honey price support program varied between $3.5 and -$1.7 million per year. In 1980, net expenditures jumped to $8.7. Subsequently, the costs of the price support program have been multiplied ten times.[8] The net expenditures between 1980 and 1988 are graphed in Figure 12.

Figure 12 Net Government Expenditures on U.S. Honey Support Program, 1980-1988




[8] The sharp increase subsidies in 1988 is attributed to the size of the 1987 crop and the removal of the maximum payment ($250,000) restriction that permitted large producers to place part of their 1987 crop under loan in 1988 (Phillips and Hoff, 1989).

The policy changes that underlie these higher levels of government expenditure are discussed in a following section.

Beekeeper Indemnity Payment Program

Between 1967 and 1980, the Beekeeper Indemnity Payment Program (BIPP) disbursed over $23 million to U.S. producers. The BIPP was designed to compensate the beekeeping industry for losses that were incurred because of pesticide induced bee-kills. The program was suspended in 1980 because of its cost and the narrow range of its cliental. It is estimated that the twenty largest payees, who received 28 percent of the payments, had only 3 percent of the colonies. In addition, government officials felt that beekeepers who operate in high risk areas could get this "risk premium" from the market. Willett (1987) presents data for California pollination fees that supports this assumption.

Honey Research, Promotion and Consumer Information Order

The Honey Research, Promotion and Consumer Information Order was approved in 1986 by a referendum of honey producers and importers. The Honey Board Promotion Program, which supports marketing research, promotion and advertising, is supported by an assessment of 1 cent on each pound of domestic, imported, and exported honey. The Order permits the assessment to be raised by one-half cent per year to a maximum of four cents per pound. Based on current levels of production and imports, the program should be receiving between $2.5 and $3 million per year.

Targeted Export Promotion Program

The Targeted Export Assistance program has been used to promote U.S. honey exports in European, Middle Eastern and Asian markets. In 1989, U.S. $500,000 was given to the National Honey Board to promote exports, while assistance of U.S. $1,000,000 has been announced for the 1990 fiscal year.

## STAGES OF THE U.S. HONEY PRICE SUPPORT PROGRAM

The Agricultural Adjustment Act alters the effective price beekeepers receive for honey through the purchase and loan operations of the Commodity Credit Corporation (CCC). With the exception of some modifications from the first years of the program, and the suspension of the loan program in the 1975-76 crop years, the basic operations of the price support program were consistent from 1952-1985.[9] Since 1985, the formula for calculating the loan rate has been abandoned in favour of a statutory level of support, and the subsidy to producers is administered through a lower loan repayment (buy-back) level.

Although the U.S. honey price support program has operated for nearly four decades, honey producers only received significant income support during the 1980s. Under the Food Security Act of 1985, the method of administering the subsidy was revised which altered the distribution of the benefits. As a result, the honey price-support program can be described as having three distinct phases: 1952-1979, 1980-1985, 1986-present. A synopsis of the program for each period is provided in the following sections.

### 1952-1980

From 1952 to 1980, the price support program operated as a "low strung" safety net for honey producers. Under the Act, the loan rate for honey was established at no less than 60 percent and no more than 90 percent of "parity". Parity is an index that measures the purchasing power of farm commodities in current dollars relative to their purchasing power in the 1910-14 base period. Prior to 1981, the loan rate was generally exceeded by the market price. As a result, U.S. honey producers could earn higher incomes by repaying their loans to the CCC and selling their honey on the commercial market.

The loan rates and buy-back prices of CCC, and the market prices for honey, are presented in Figure 13 for the period 1950 to 1988. During the period 1952-1980, honey

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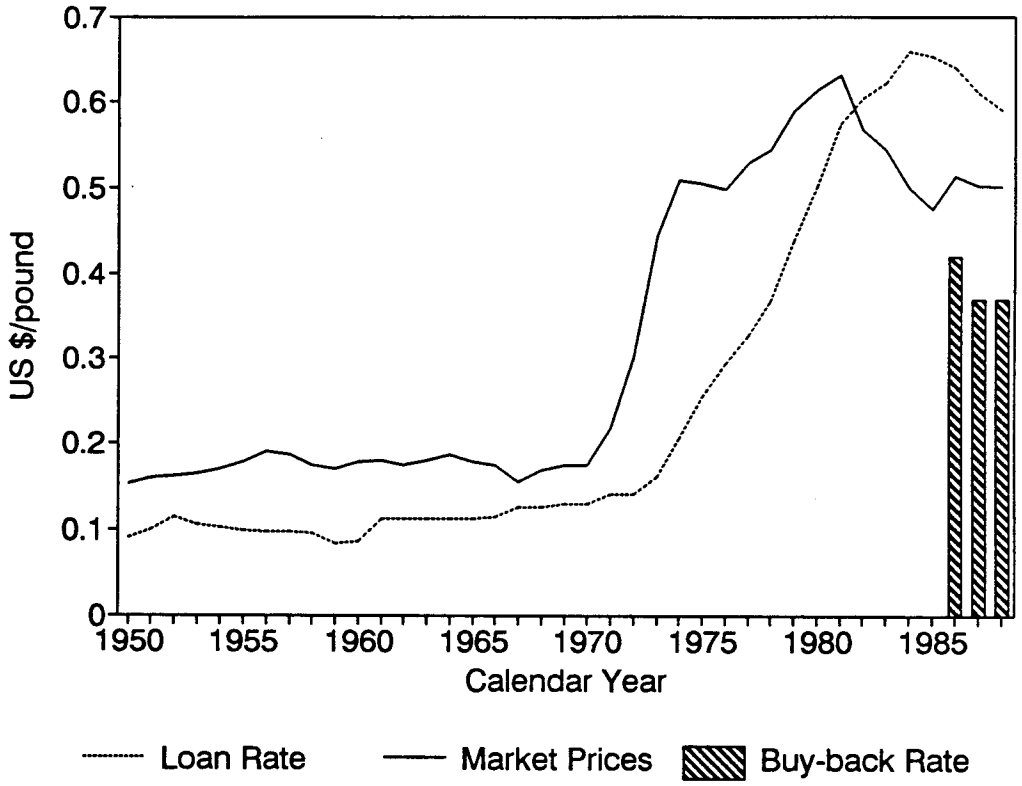
[9] Phillips and Hoff (1989) present a concise history of the U.S. honey price support programs from 1950 to 1988.

was placed in the loan program by producers that needed cash flow assistance, to hold their honey prior to sale. Producers were required to pay interest on their loans if they were redeemed, but because of the higher market prices few forfeitures occurred. While the program guaranteed producers a floor price, in operation, there was virtually no income subsidy transferred prior to 1981.

Figure 13 Wholesale Market Prices and Commodity Credit Corporation Loan Rates, and Buy-back Prices, 1950-1988.

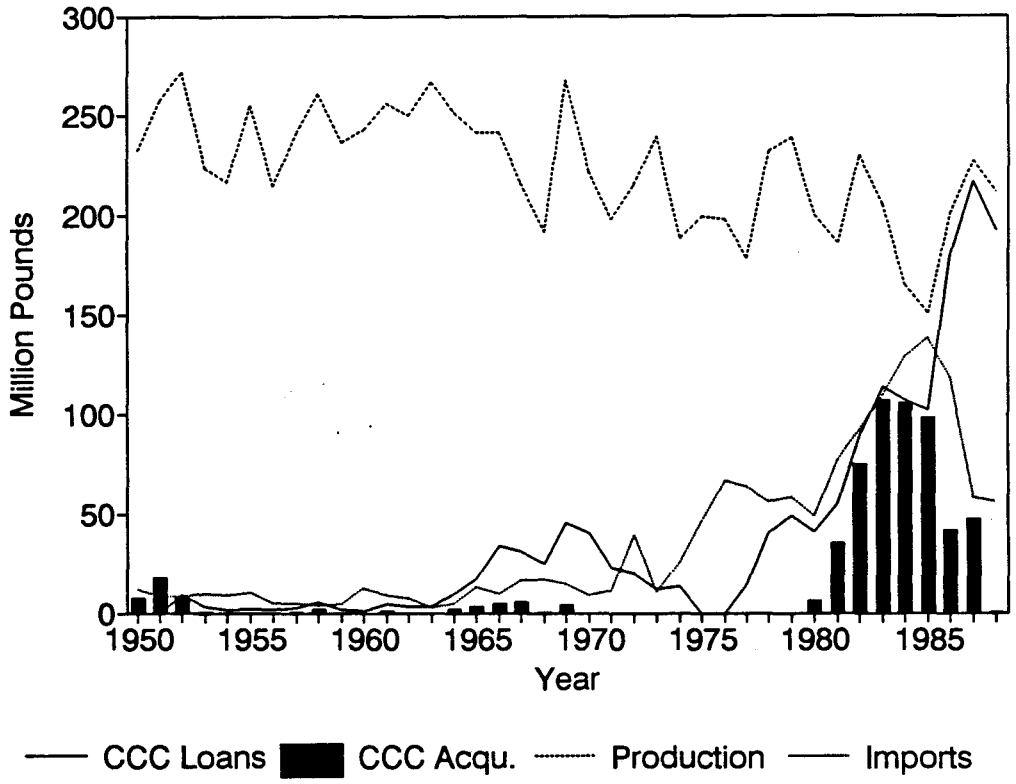



1981-1985

From 1981 to 1985, the market price received by honey producers was less than the loan rate guaranteed by the government. As a result, an increasing number of beekeepers forfeited their honey rather than redeem loans with the CCC. Each year

more of the crop was placed under loan and stocks held by the CCC began to build. By 1985, the CCC was acquiring over three quarters of total U.S. honey production through the loan program. In Figure 14, U.S honey production, acquisitions of the CCC, and U.S. honey imports are plotted for the 1950-1988 period.

Figure 14 U.S. Honey Production, CCC Acquisitions, and U.S. Honey Imports, 1950-1988




Under the rules of the CCC, honey stocks could not be sold for less than 110 percent of acquisition price. The CCC disposed of the majority of its honey stocks in "non-market" outlets such as the School Lunch Program, food banks participating in the Temporary Emergency Food Assistance Program, Indian reservations and the Bureau of Prisons. As the difference between the farm price of honey and loan rate increased, the

CCC acquired more stocks, and commercial supplies became scarce. U.S. processors and packers found it more profitable to import less expensive honey than to purchase domestic products to fill the vacuum in the market created by the CCC.

Since the mid-1960s, the United States had been a net importer of honey. As U.S. honey production failed to increase with population, the volume of imported honey gradually increased. The artificial market condition created by the U.S. price support policy caused imports to surge. Between 1980 and 1985, the volume of U.S. honey imports increased 182 percent from 49 million to 138 million pounds per year.

1986-present

The administration of the Agricultural Act of 1949 was amended by the 1985 U.S. Farm Bill. Under the revised program, the purchase option was discontinued and producers could receive only loans from the CCC. Also the parity price formula was dropped and a declining schedule of income support was introduced.[10] In order to avoid accumulating stocks, the Secretary of Agriculture was given discretion to set a lower loan repayment level for producers, which is now commonly referred to as the "buy-back" rate. Consequently, beekeepers have the option of forfeiting their honey, or "buying back" the loan at a discounted price and selling their honey on the open market.

In effect, this changed the nature of the honey program from a "purchase and disposal price support" operation, to a direct "producer deficiency payment" program. In addition to the deficiency payment, beekeepers who liquidated their loans after 1986 at the lower repayment rate were not charged interest. As a result, the volume of honey placed in the loan program increased to almost equal total U.S. production, while the volume of honey forfeited to the CCC declined rapidly.

The discounted price of the "buy-back" program, which is illustrated in Figure 13, became the new "market" price for honey in the United States. The combination of lower

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[10] In 1986, the national average support price was set at 64 cents per pound, with provisions for future support prices to decline by 5 percent per year until 1990. In addition, the Omnibus Reconciliation Act of 1987 required a further 1 cent per pound decrease in 1989 and a quarter-cent decrease in 1990.

market prices and the increased availability of U.S. honey caused honey imports to decline to the pre-1980 level. In addition, the buy-back program affected world prices. "The repayment level [buy-back price] acts as a price floor, and, given the role of the United States as a major importer, partially determines the world price for honey." (USDA, 1989:p.4)

## WORLD TRADE OF HONEY: MARKET ANALYSIS

The Canadian honey industry operates as a net exporter to the world market. Consequently, shifts in the international supply and demand of honey, as well as changes in foreign agricultural trade policies, can influence the level of Canadian prices and trade flows. There is a tendency in Canada to view U.S. agricultural policy as leading the international market, rather than responding to the impact of shifting world supply and demand. Evidence suggests however, that the roots of the current situation in Canada lie in the fundamental economic changes in the world market that preceded and triggered the U.S. subsidy programs. While the U.S. beekeepers were protected by government subsidies throughout the 1980s however, Canadian honey producers were exposed to the vagaries of the market as well as the distortions created by the U.S. subsidies.

The interaction of shifting world trade patterns and U.S. honey subsidies can be explained with partial equilibrium interregional trade diagrams and supporting data. Four separate periods are described: a period of price stability - 1950 to 1972; a period of shifting supply and demand - 1973-1980; the U.S. honey purchase and disposal program - 1981-1985; and, the U.S. "buy-back" deficiency payment program - 1986 to the present. Following this descriptive analysis, the econometric simulation of the Canada-U.S. honey market is presented, which is designed to isolate and quantify the impacts of the U.S. subsidies on the Canadian honey industry.

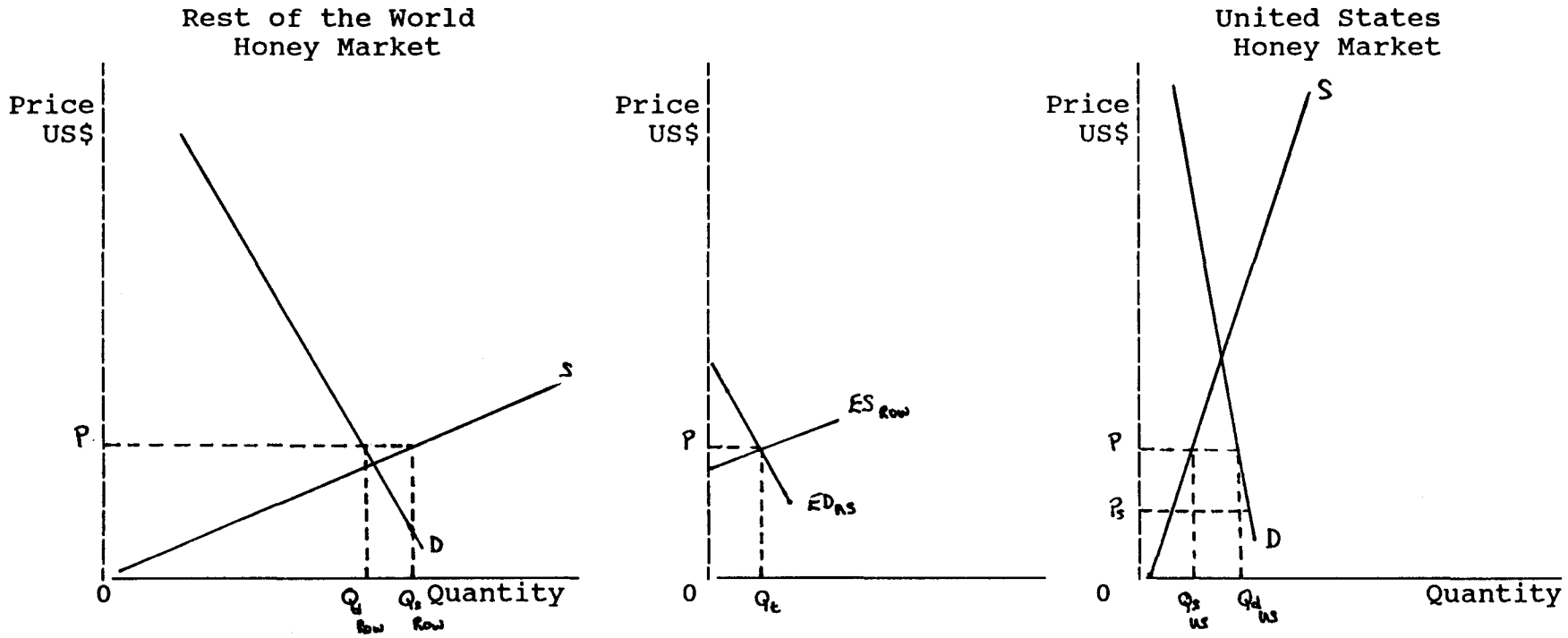
### 1950-1972: International Price Stability

In Figure 15, the world trade situation for honey is illustrated for the period 1950-1972. The partial equilibrium trade model consists of the United States as an importing region (on the right), the Rest of the World (ROW) as the exporting region (on the left),

and the trade sector (in the centre). The trade sector illustrates the U.S. demand for imports, ED (US excess demand), and the ROW supply of exports, ES (ROW excess supply). The world price, P, which is determined at the intersection of the excess supply and excess demand, is assumed to equal the U.S. honey price.[11]

[11] The prices in the model are assumed to be adjusted for transportation costs and are converted to a common currency.

Figure 15 Honey Trade Model 1950-1972: Period of Price Stability



At these prices, the U.S. produces $Q_s$ and consumes $Q_d$ (U.S), while the rest of the world produces $Q_s$ and consumes $Q_d$ (ROW). The difference between the quantity produced and consumed in each market is equal to $Q_t$, the volume of honey trade to the United States.[12] During this period when the U.S. support price $P_S$, is less than the world price ($P_{US}=P_{ROW}$), the U.S. honey program has no impact on the world trade or prices.

It is important to note that this representation of the world market employs the "large" nation assumption (Houck, 1986). As a result, the excess supply curve of the Rest of the World (ROW) is positively sloped with respect to the United States. This assumes that the United States' import volumes are large enough to have an impact on world prices. Any changes in the U.S. market, because of fundamental economic influences or government policy, will alter the world price of honey.[13]

Although the U.S. is assumed to be a "large" nation, it accounts for less than 10-20 percent of world honey production and trade. Also, the supply and demand relationships for honey in the United States are likely to be more inelastic than the supply and demand of the Rest of the World. The graphical analysis is presented with these proportions and characteristics in mind.

1973-1980: Shifting Supply and Demand

In 1973-4, the prices of virtually all food commodities were subject to an unprecedented increase. The rapid change in prices can be attributed to several

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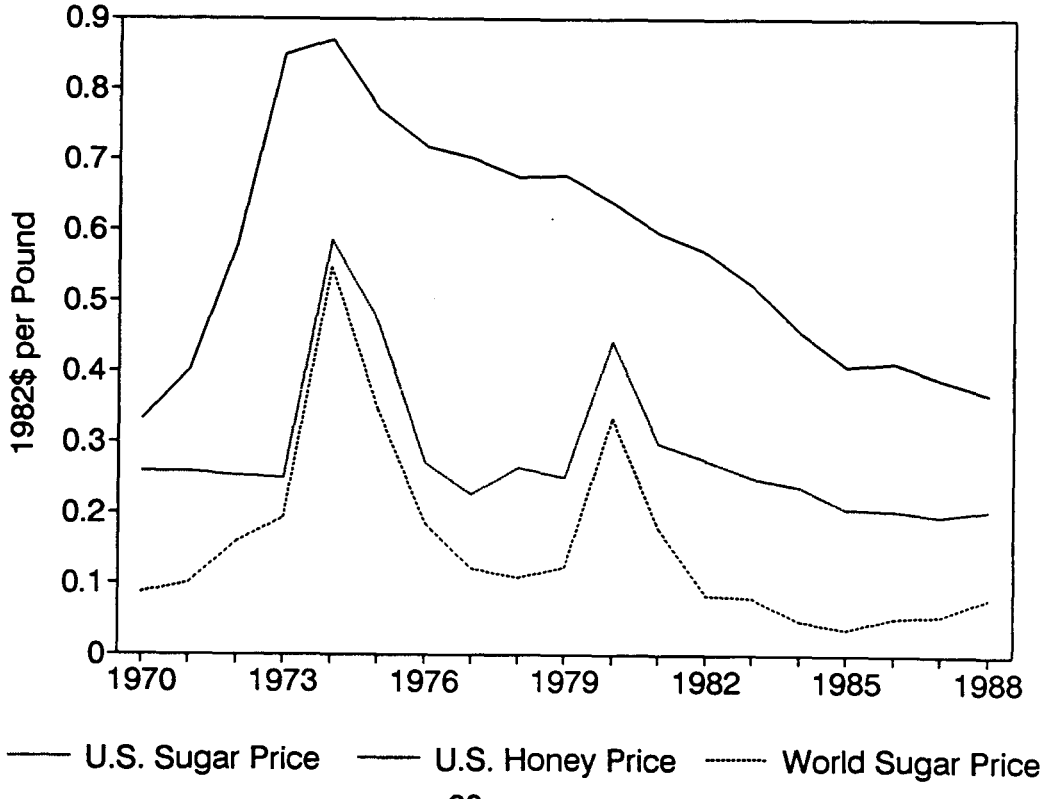
[12] The situation illustrated in this diagram is more representative of the U.S. at the end of the period 1950-1972, than at the beginning, because until 1967 the United States' honey exports were equal to, or greater than, its imports. After 1967, however, the U.S. became a large net importer of honey (with the exception of 1973).

[13] The alternative assumption is that the United States represents the "small" nation case. This assumes that the excess supply ROW is flat, and that changes in U.S. imports have no effect on the world price, whatsoever. Smargiassi and Willett (1989) employ the "small" nation assumption in their analysis of the U.S. honey program.

phenomena that occurred in the early 1970s: the significant devaluation of the U.S. dollar that occurred between 1971 and 1973 (Schuh, 1974); a rapid escalation of energy prices that was created by the OPEC oil cartel; an unexpectedly large export sale of U.S. grain to the Soviet Union, which reduced inventories to record lows; and, the failure of the Peruvian anchovy harvest in mid-1973 that increased the world price of protein feeds. As a result of these inflationary pressures in the international economy, and concerns about a "food shortage", the prices of virtually all agricultural commodities tripled. In tandem with the increase in agricultural commodity prices, prices of sugar and honey also tripled in value.

In Figure 16, the world price of sugar, and the U.S. prices of sugar and honey are plotted in constant (1982) U.S. dollars. While the large price increase for sugar was relatively short-lived, the decline in the "real" price of honey was quite protracted. By 1977, the deflated price of sugar in the U.S. had returned to the 1971 level. In contrast, the 1971 price level of honey (in 1982 dollars) was not reached until 1985.

Figure 16 Deflated (1982$) Prices of U.S. Sugar and Honey and World Sugar Prices, 1970-1988



The difference in the movements of honey and sugar prices may be explained by the relative size of their markets and elasticity of demand. As the dominant sweetener in both industrial and consumer markets, changes in the price of sugar create significant substitution effects and large variations in world trade. Honey, which represents a minor component of consumer expenditure, has an inelastic demand and few close substitutes. As a result, honey prices tend to be "upward flexible, and downward sticky". In other words, honey price increases are quickly passed on to consumers because there is relatively little impact on the quantity demanded. When prices start to drop, however, there is no incentive to decrease the consumer price of honey because the change in sales volume will not be sufficient to maintain the same value of sales.[14]

The increase in world sweetener prices caused a substantial shift in the demand for honey in the United States. In Figure 17, the demand shift is represented by the new demand curve, D'. The demand shift causes the U.S. excess demand to shift to ED'. U.S. imports and world prices are now determined at the intersection of the excess supply ES, and the new excess demand curve, ED'. The higher U.S. price, represented by P', would encourage greater domestic honey production and an increase of imports, from $Q_t$ to $Q_t$'.[15]

Although the U.S. sugar policy has an impact on other sweeteners, including honey, it is not necessarily a benefit to U.S. honey producers, or consistent with the U.S. honey policy. A brief discussion of the interaction of the U.S. sugar and honey policies is presented in Appendix I.

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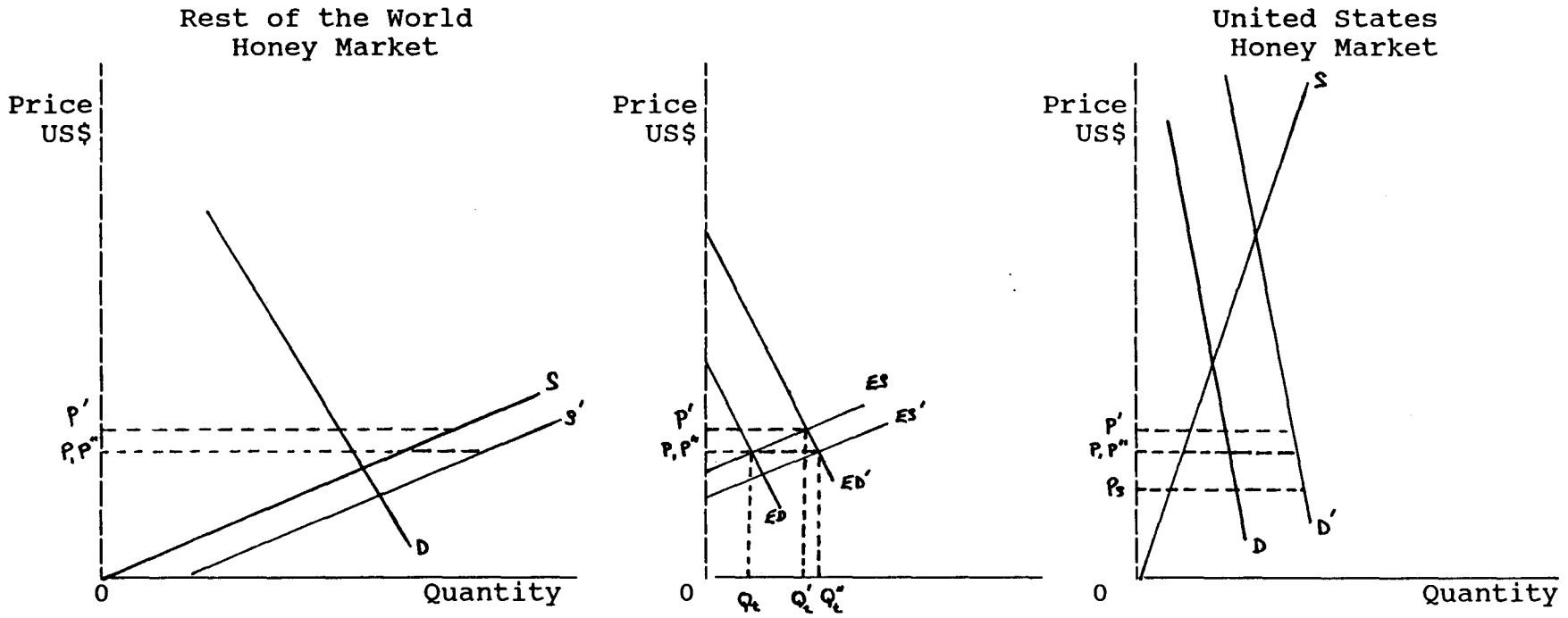
[14] Willett notes that during the 1970s consumers were also influenced by the trend toward "more natural" products which may have helped to sustain the higher price of honey longer than would have been the case otherwise.

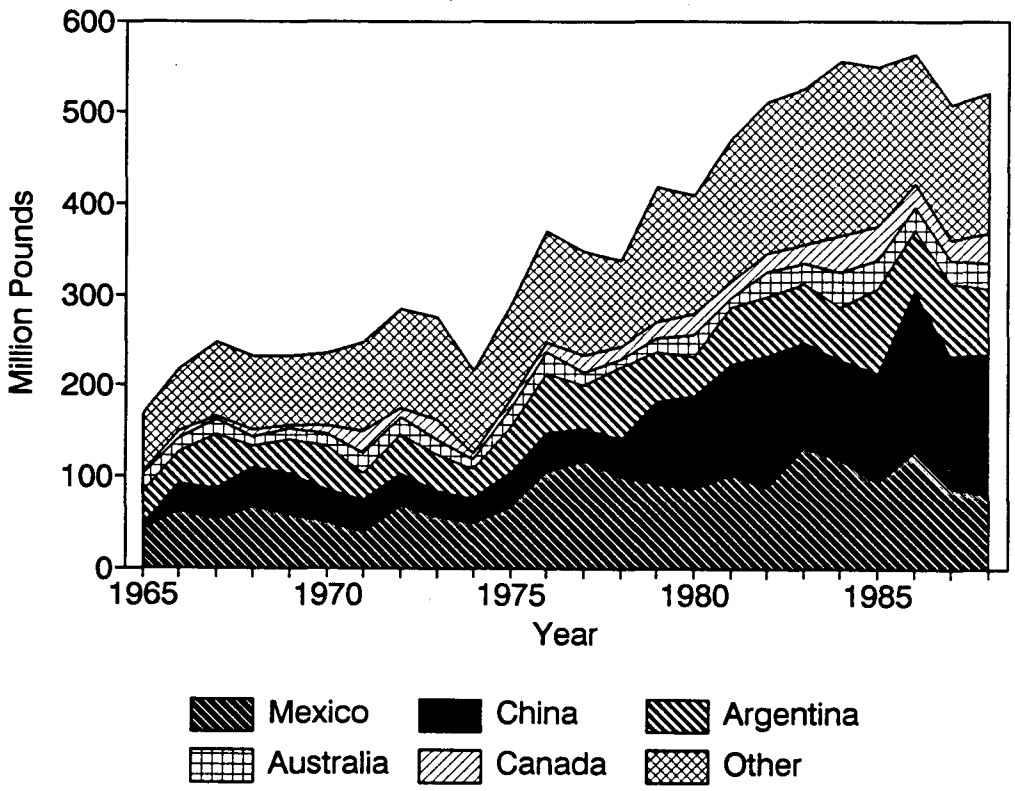
[15] The changes in the quantity supplied and demanded in the U.S. and ROW are not illustrated because of space limitations. The reader can construct these relationships by drawing vertical lines to the quantity axis (as in Figure 15) where the dashed price lines intersect the supply and demand curves.

Figure 17 Honey Trade Model 1973-1980: Period of Shifting Supply and Demand



Although higher world prices for honey would have encouraged greater production and trade in any case, the volume of trade was accentuated by a structural change in the world production of honey during the late-1970s. The world trade of honey from 1965 to 1988 is presented in Figure 18. These data illustrate the dramatic increase of honey exports from China that occurred after 1977. China, which was already a large honey exporter prior to 1977 (average Chinese exports from 1966 to 1977 were approximately equal to the peak volume of Canadian honey exports in 1984), doubled its exports of honey in 1979, and doubled these exports again by 1986.

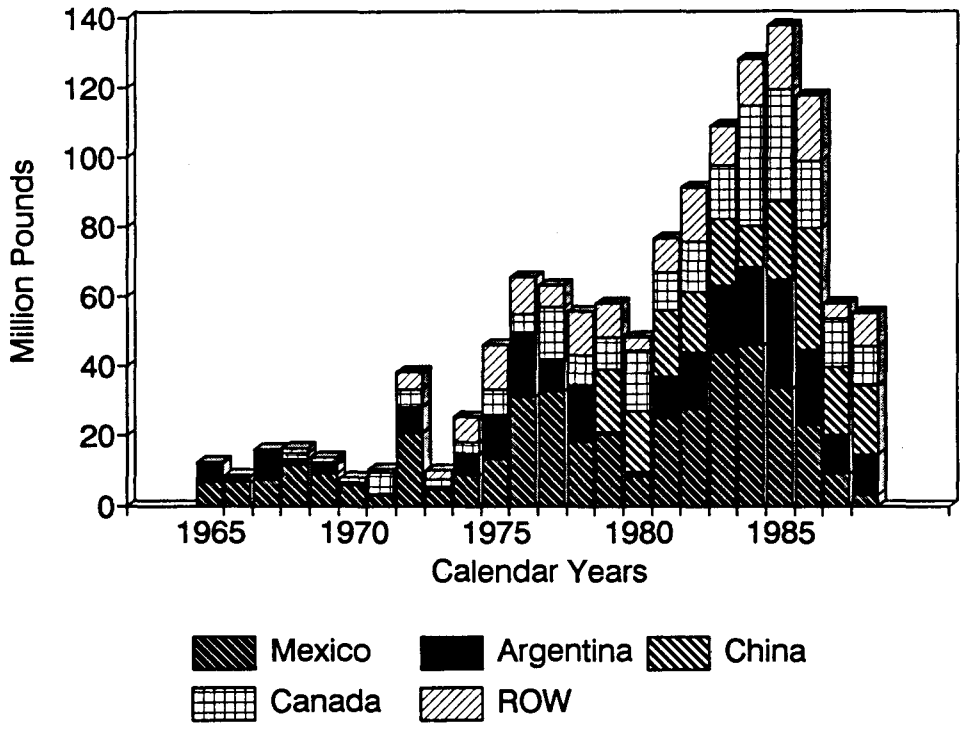
Figure 18 World Trade of Honey, 1965-1988



The structural change in the world trade of honey is represented by a supply shift in the ROW diagram of Figure 17, from S to S'. The new supply curve, S', shifts the excess supply curve to ES', and a new price level is established at P". The volume of U.S. imports also increase at this new lower price, from $Q_t$' to $Q_t$".

The results of the world supply shift on the U.S. market are documented in Figure 19, which presents U.S. honey import data by country of origin. These data record the change in Chinese honey exports to the U.S. from the status of a minor supplier prior to 1979, to a leading supplier of the U.S. market.

Figure 19 U.S. Honey Imports, 1965-1988




Despite the higher volume of honey imports, the U.S. farm price remained above the support price, $P_S$, until 1980. Consequently, there were no subsidies paid to the U.S.

beekeepers. As the world supply shift continued, however, the market price eventually declined below the U.S. support price, which was based on an index of U.S. honey production costs. By 1981, a new demand source for honey, in the form of the U.S. Government purchases, emerged to absorb part of the increased world supply.

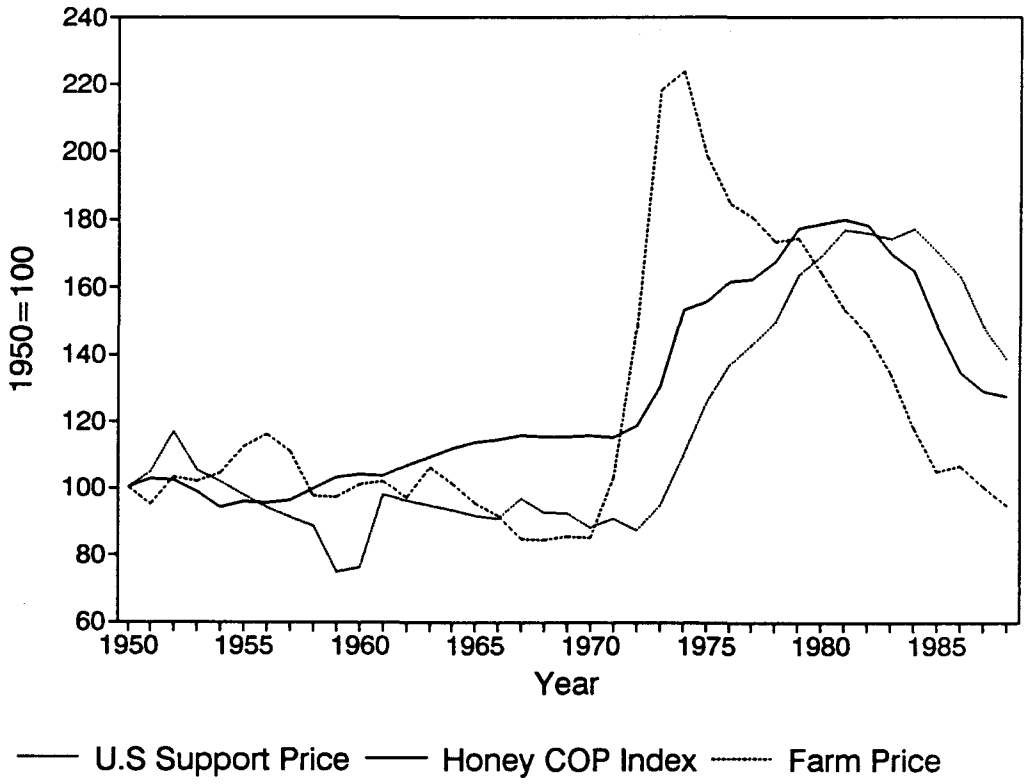
1981-1985: U.S. Purchase and Disposal Program

Higher U.S. honey prices, following the commodity price surge in the early 1970s, encouraged more imports, but the domestic supply response appears to have been muted.[16] This may be explained by the chronic "cost-price" squeeze that has affected U.S. beekeepers for most of the last three decades. In Figure 20, the farm price of honey, a honey cost of production index (Willett, 1987), and the U.S. honey support price are converted to constant 1982 dollars and set equal to a common base (1950=100). Throughout the 1960s honey production costs were increasing faster than farm prices, although cost increases were partially offset by higher yields (1950-59 average 45 pounds/colony, 1960-69 average 51 pounds/colony).

The dramatic price increases of the early 1970s made U.S. honey production profitable again, but the incentive to increase production was short-lived. Adjusted for inflation, production costs in the U.S. continued to rise throughout the decade, while the market price for honey declined.

[16] U.S. honey production figures are illustrated in Figure 14.

Figure 20 U.S. Farm Prices for Honey, Costs of Production and Support Prices (constant 1982 dollars) based to 1950=100



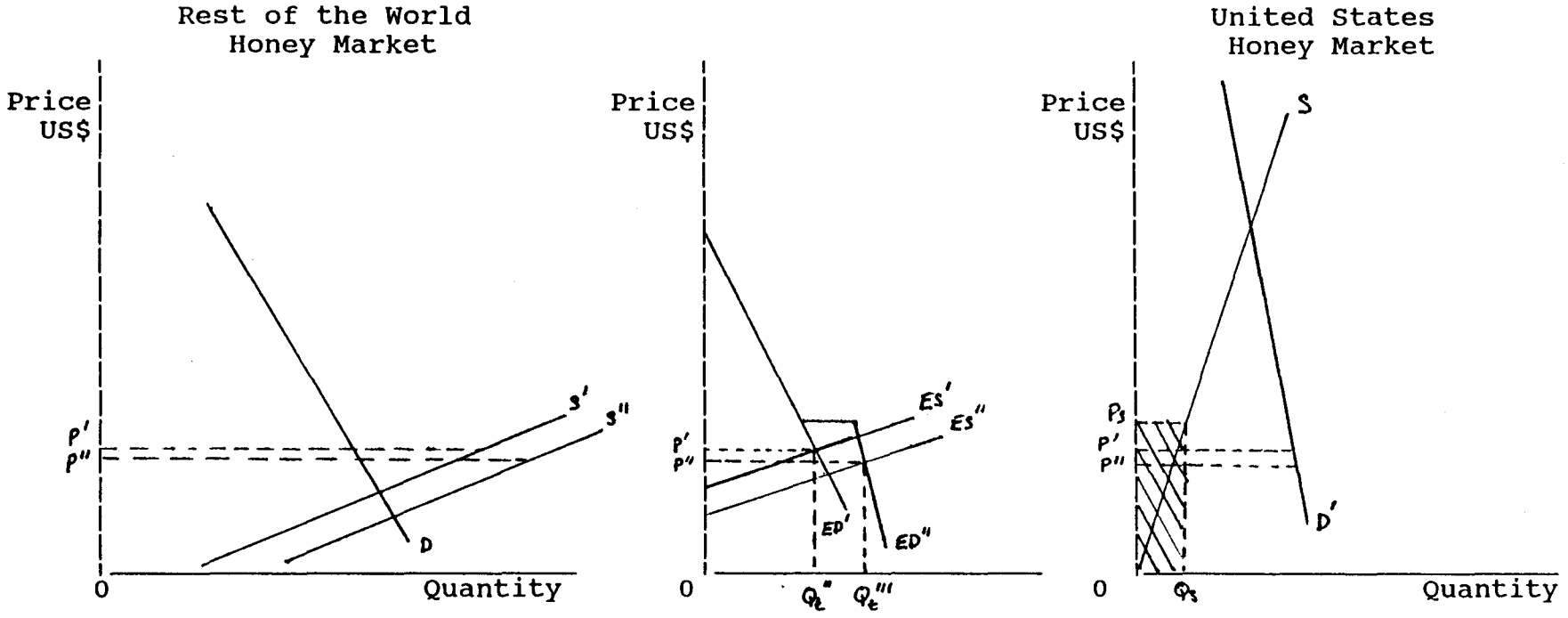

The higher costs for honey production were picked up in the parity price formula that was used to calculate the U.S. loan rate for honey. After 1980, the loan rate exceeded the farm price and the Commodity Credit Corporation began to accumulate stocks of forfeited U.S. honey.

In Figure 21, the support price $P_S$ exceeds the market price P' in the United States. As a result, U.S. producers forfeit their honey to the CCC which causes a budgetary expenditure of $P_S*Q_S$ and removes the quantity $0Q_s$ from the market. This also causes the U.S. excess demand curve to shift and become more steep at ED". The purchase and disposal activities of the CCC should have increased the U.S. market price. Throughout the period however, the expansion of honey production and exports from

China (and Canada) continued to shift the ROW supply curve from S' to S". In turn, the ROW excess supply curve shifts from ES' to ES". Where the new U.S. excess demand curve, ED", crosses the world excess supply curve, ES", a new quantity of imports $Q_t$"' is determined.

Prices decline during the period 1981-1985 from P' to P", but this is mainly the result of the higher quantities of honey supplied to the market. If the CCC program operated without any "leakages", its actions would not be a cause for honey prices to decline. If the CCC were unable to keep their disposal operations separate from the commercial market, the competition of large quantities of "free" honey could, however, drive down U.S. market prices, and consequently affect world prices.

Figure 21 Honey Trade Model 1981-1985: U.S. Price Support Through Purchase and Disposal

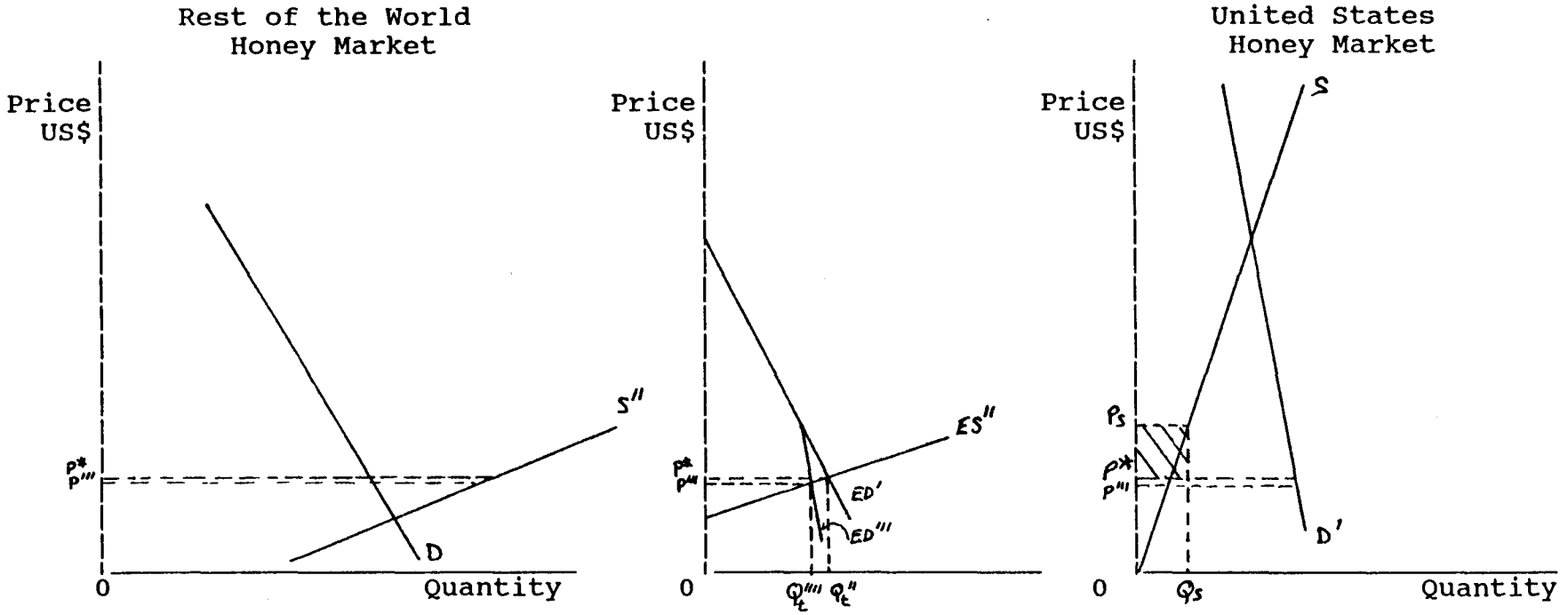


1986-Present: U.S. Buy-Back Program

In Figure 22, the buy-back program is modelled as a deficiency payment. The support price, $P_s$, exceeds the world price of honey, P"', and this difference times the quantity $Q_s$ is paid to U.S. honey producers. The deficiency payments cause the U.S. excess demand curve ED' to bend toward the origin and form a new segment, ED", below the U.S. support price $P_s$. At the new intersection with the ES", the quantity of honey imports, $Q_t$"" is determined. If there had been no deficiency payment, a slightly higher world price, P*, would have prevailed, and imports, $Q_t$", would have been made to the United States.

Smargiassi and Willett (1989) concede that the growth of U.S. imports during the 1980-1985 period may have influenced the world price of honey, but argue that the deficiency payments after 1986 did not affect the world price because previously established import levels were maintained. "U.S. honey imports were higher than average from 1980 through 1986; they peaked in 1985 (at 51% of total supply, which is approximately 6% of the world honey supply) and by 1987 had returned to historical levels. Whether imports levels were high enough to influence the world honey price during those years [1980-85] is debatable."(p.13)

Figure 22 Honey Trade Model 1986-Present: U.S. "Buy-Back" Deficiency Payments Program



As noted previously, the debate hinges on whether the U.S. is subject to the "large nation" or the "small nation" assumption. Deficiency payments are not viewed as causing trade distortions if the quantities traded by the importing country are small in relation to world trade. If the importing country accounts for a significant share of total world trade however, its deficiency payments can cause world prices to decline. This is essentially an empirical question that can only be satisfied by reference to the data.

## ECONOMETRIC MODEL OF THE CANADA-U.S. HONEY TRADE

In order to examine the impact of the U.S. honey policy on Canadian beekeepers, a Canadian trade sub-model has been designed that can be linked to the U.S. honey market model that was developed by Willett (1987) and extended by Willett and French.

The specification of the empirical model of the U.S. honey industry is presented in Willett (1987), while the elements of a Canadian sub-model and its links to the U.S. model are presented in Appendix II.

### Simulation Results

The impacts of the U.S. honey support program are analyzed in relation to a base case. The key endogenous variables in the model, which are estimated using a dynamic simulation, are compared to the results under a change in policy. The simulation predicts the levels of prices and other variables for the Canadian and U.S. honey industry that would have occurred if no expenditures (i.e. no subsidies) had been made under the U.S honey program. In this comparison, it is the directions and magnitudes of change that are of interest, rather than the actual levels that are predicted.

The simulation results for the base case and the scenario of "no U.S. honey program" are presented in Figure 23. In each graph, the actual data are illustrated for the period 1970 to 1980. Subsequently, the graph depicts the model simulation for the impact that actually occurred, and what would have happened if the U.S. honey price program had not been effective. The analysis assumes that the actual supplies of imported honey would have been available from all countries, except for Canada where a production response function is included in the model.

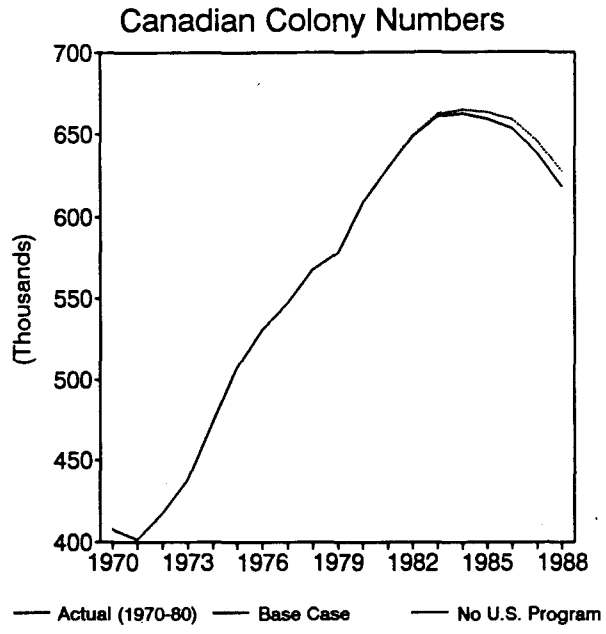
The results of the model for Canada indicate that in the absence of the U.S. honey program (1980-1985), the growth of the Canadian honey industry would have been extended longer. Colony numbers would have been higher, and more honey would have been produced. Although the real price of honey received by Canadian beekeepers would have dropped throughout the period 1981-88, it would have declined less, if there had been no U.S. honey program.

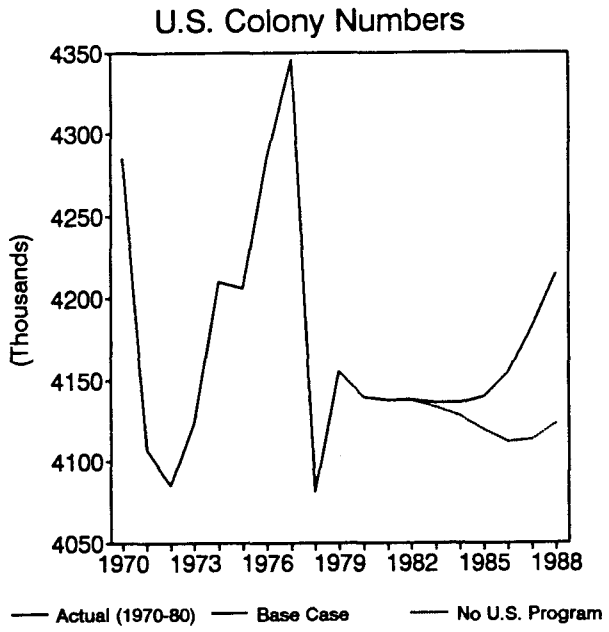
These results appear consistent with the general circumstances of the Canadian industry. Despite the gradually declining real price of honey, production continued to expand. This is attributed to the increasing size of canola and hay acreage in western Canada that enabled more honey to be produced. With higher prices, more production could have occurred, at the margin, and the honey industry could have been somewhat larger.

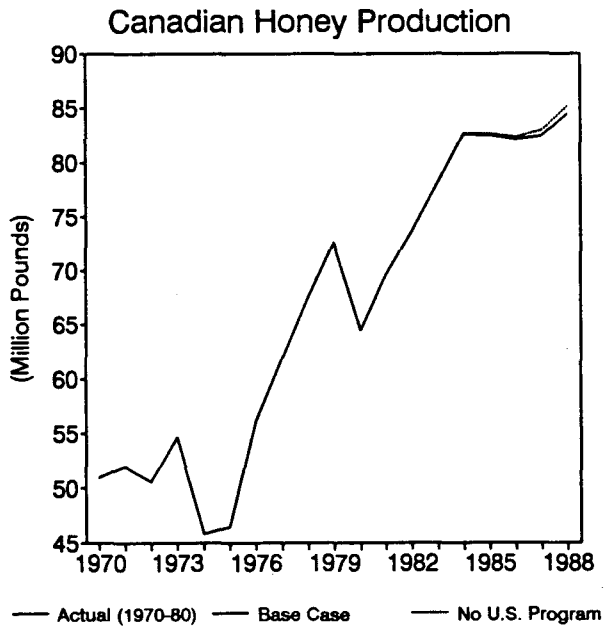
The simulation confirms that U.S. honey imports were higher because of the purchase and disposal operations of the CCC. The model results indicate that U.S. programs increased Canadian honey exports to the U.S. and other markets (i.e., Germany) and that domestic Canadian consumption was higher than in the absence of the subsidies. This is consistent with the higher prices for Canadian honey that are generated in the simulations. The model indicates that in the absence of U.S. subsidies, the lower level of Canadian exports and consumption are accommodated by an increase in the volume of ending stocks held in Canada.

Although Canadian exports to the U.S. declined without the influence of the U.S. honey program, exports from other countries would have declined relatively more. The higher market share for Canadian honey without the U.S. program is attributed to the preference of U.S. buyers for Canadian honey which is of higher quality than most other imports.

Figure 23 Canada-U.S. Honey Trade Simulation Model Results



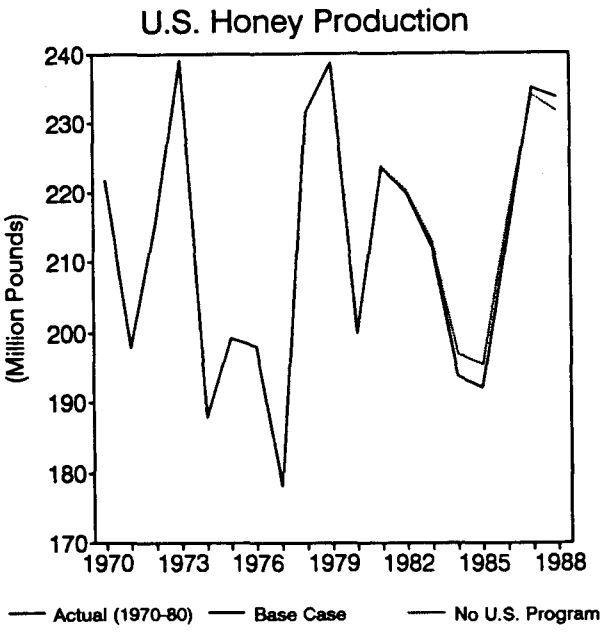
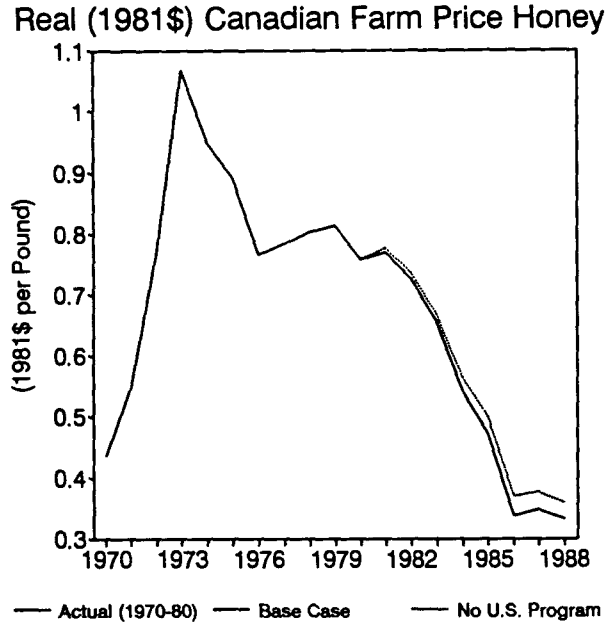
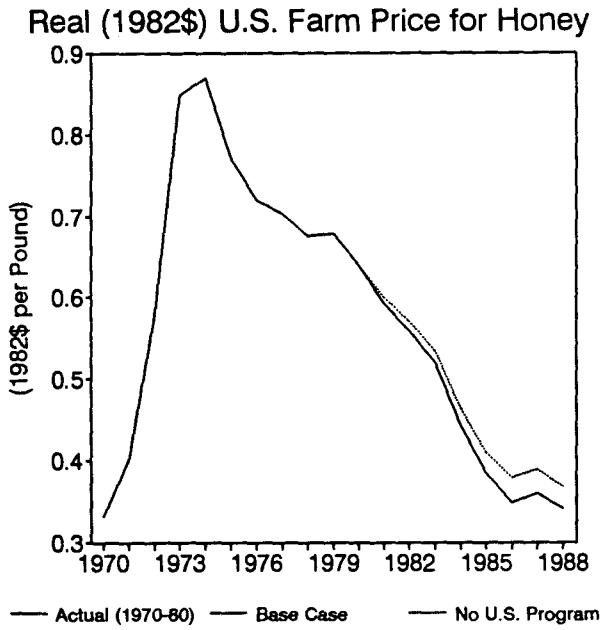
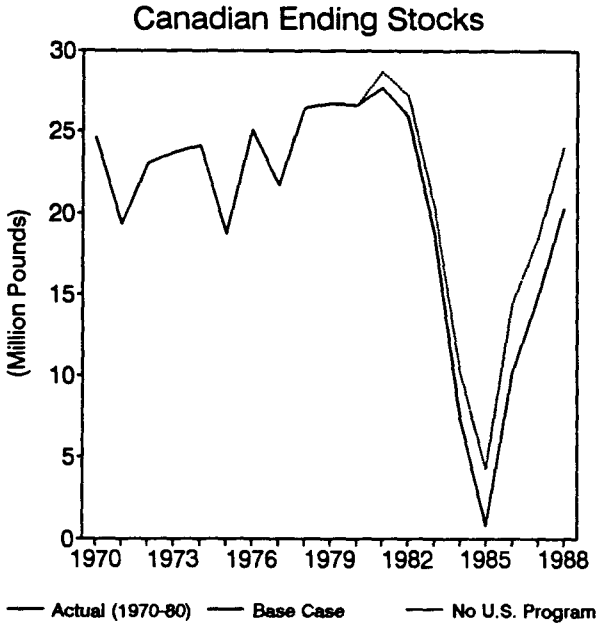



Figure 23 (continued)



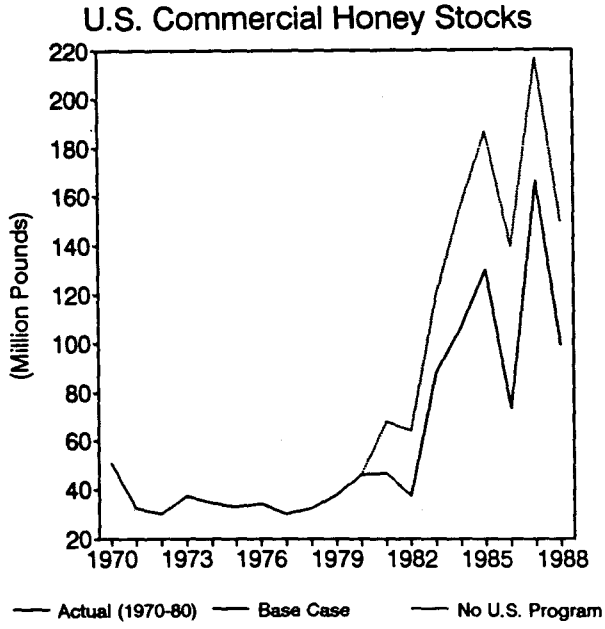
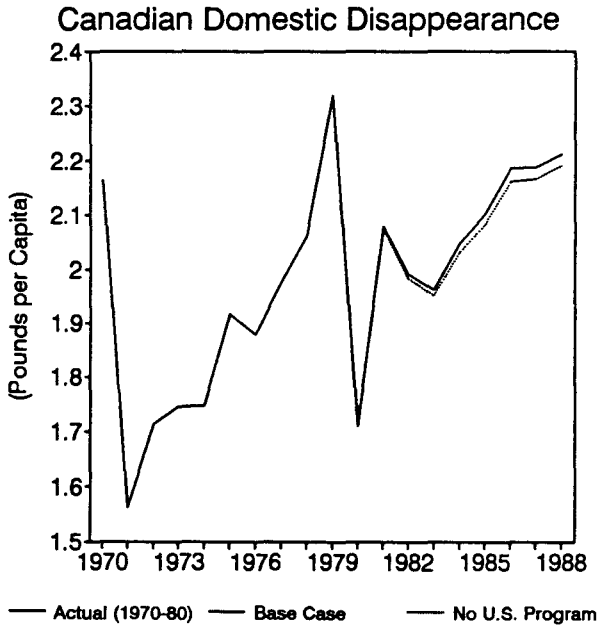
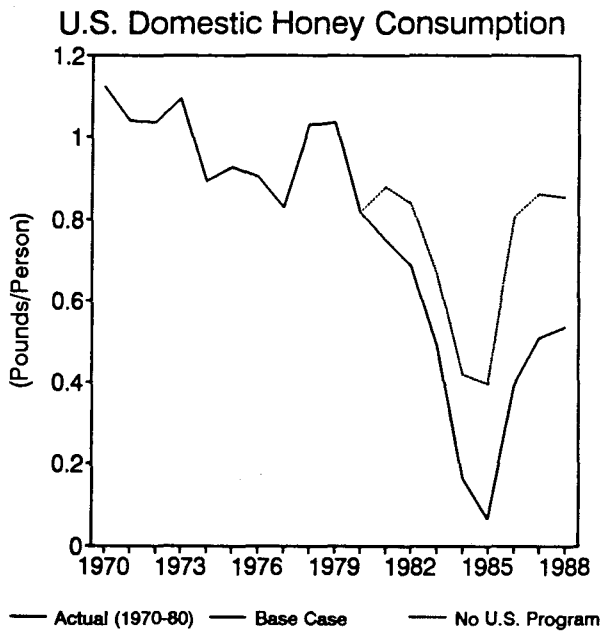
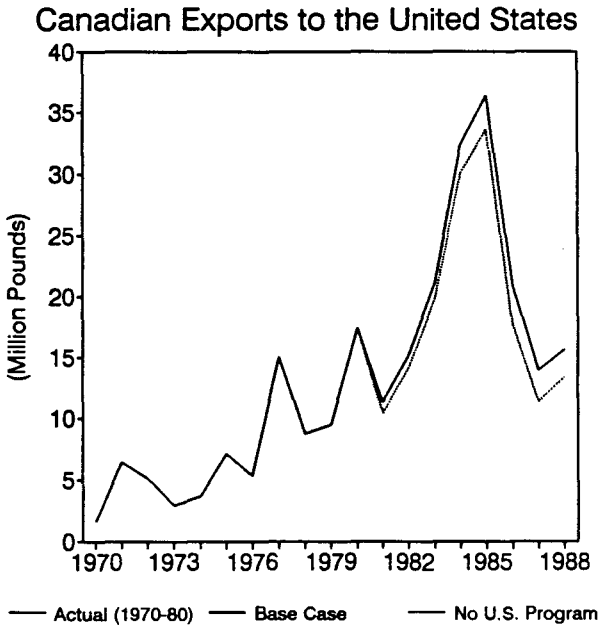
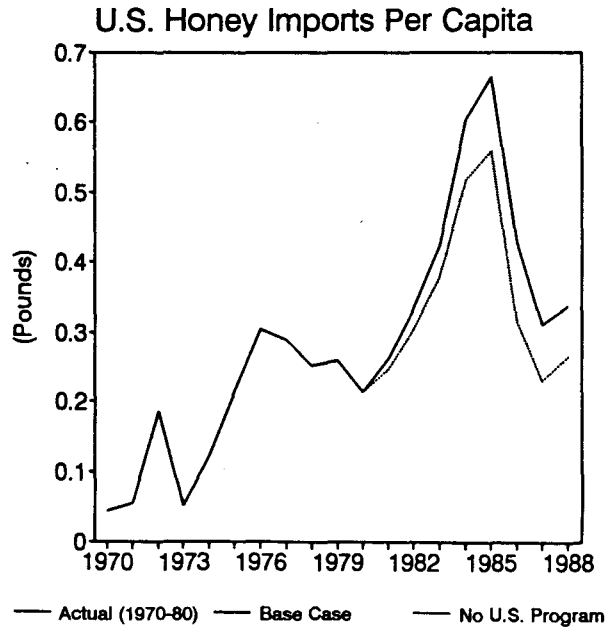



Figure 23 (continued)



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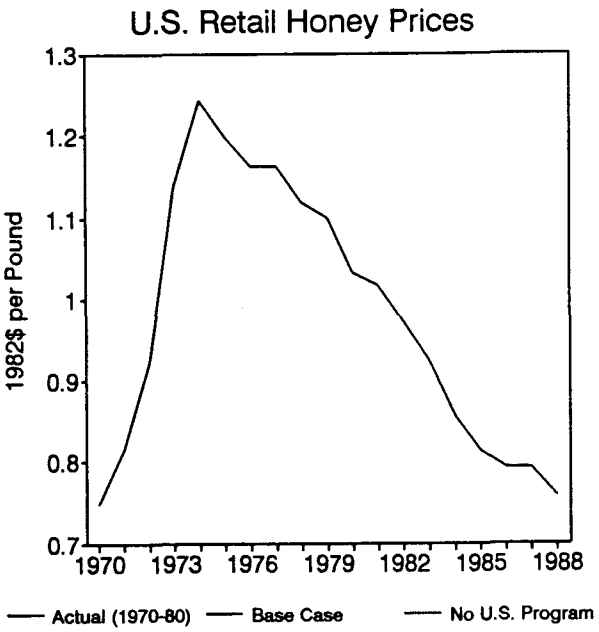


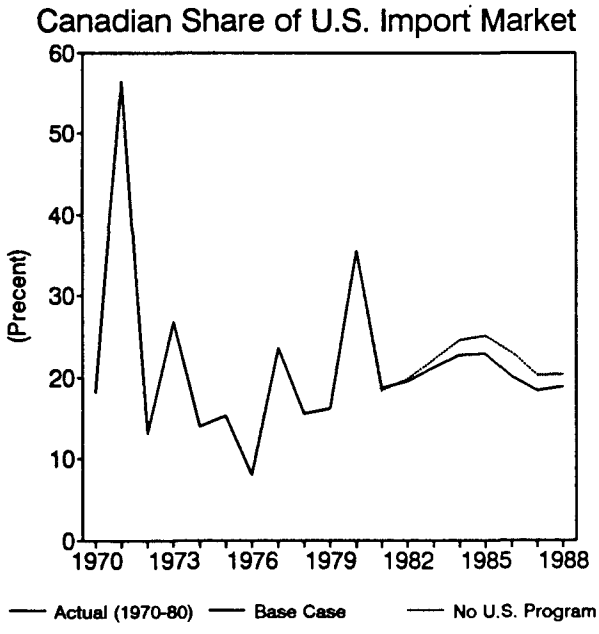


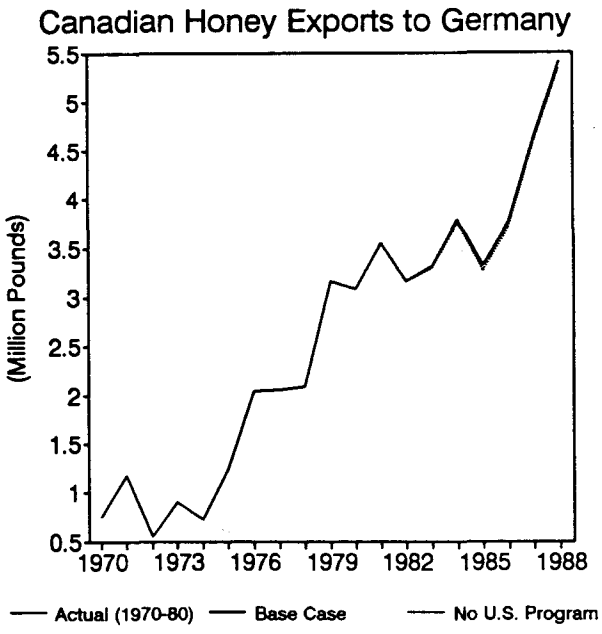

The model results for the U.S. honey industry indicate that without the subsidies colony numbers would have been continued to decline. Honey production, however, does not follow colony numbers. Production would have been higher from 1981-86, then lower in 1987-88. This implies that beekeepers would try to utilize their colonies more intensely when no subsidies were paid. This result may also reflect other features of the model such as the number of colonies employed in pollination services and the costs/returns in the production of package bees and queens.

In the absence of the honey program (i.e., no purchases and disposal by the CCC), the consumption of U.S. honey is higher.[17] Commercial honey stocks are higher, because the U.S. beekeepers would have had to compete against large supplies of imported honey.

There is almost no change in the retail price of honey in the U.S., while the price at the farm level rises without the subsidy payments. The reduced margin at the processor level suggests that this group captured part of the benefits of the honey subsidy program.

The impact of the U.S. subsidy program on third country markets is examined with respect to Germany. Canadian exports to Germany are reduced slightly in the absence of the U.S. subsidy program. This follows from the higher Canadian prices, which would have prevailed, and the elastic export demand of Germany (Appendix II).

In summary, there is sufficient evidence to determine that the U.S. honey program had a negative impact on the prices received by Canadian honey producers. On the other hand, the operation of the U.S. honey program increased the volume of Canadian honey exports to the U.S. and Germany. In addition, the incomes of Canadian honey producers were improved to the extent that the costs of holding extra stocks were negated.

One caveat that must be recognized in examining these results is the aggregation problem. The "national" model consists of an average of prices which are lower than

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[17] This refers to commercial consumption, rather than total consumption that also includes the honey given away by the CCC.

received in eastern Canada, and higher than received in the prairie provinces. Consequently, the impacts of the U.S. program are likely more accentuated in western Canada than in other regions.

Concluding Remarks

This study finds that U.S. honey subsidies had a negative effect on the incomes of Canadian honey producers, but that the size of the impact was relatively small. The more enduring legacy of the U.S. honey program, however, may be the introduction of direct government support for Canadian honey producers. For 121 years following Confederation, the Canadian honey industry operated with minimal government intervention, and without any form of income subsidization. In 1988, following several years of highly variable and low returns, which were linked to the U.S. honey program, a National Tripartite Stabilization Program (NTSP) was introduced for the Canadian honey industry.

The payments under the Canadian NTSP are designed to limit losses and not stimulate production. Nevertheless, the creation of this program demonstrates an important principle: the payment of producer subsidies in one country, ultimately leads to corresponding payments in competing countries. Although this observation is by no means new, the case of the Canadian honey industry is one of the few in which a cause and effect relationship can be so clearly discerned. If there had been no subsidies paid out under the U.S. Honey Program, it is very unlikely that the Canadian NTSP would have been introduced.

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## APPENDIX I

### INTERACTION OF THE U.S. SUGAR AND HONEY POLICIES

Government intervention in the U.S. sugar market underpins the entire price structure of the American sweetener industry. Through restrictions on sugar imports, the government guarantees a return to U.S. sugar producers that is greater than world market price. As a result, the prices of other sweeteners, such as high fructose corn syrup (HFCS), honey, maple syrup, edible molasses and low-calorie sweeteners (e.g. saccharin), are maintained at a higher level than would be the case if the U.S. sugar industry were not protected from international competition.

It is frequently argued that the international trade of sugar is subject to so much intervention that the "world" price for sugar is a misnomer. Although more than 110 countries produce sugar, and over one-quarter of total production enters into world trade, only about half this volume is sold in open markets. The other half is traded under bilateral agreements at prices that are typically higher than the "world" price. As a result, the trade of sugar in the open market can fluctuate widely in price, from US $0.29 per pound in 1980 to an average of US $0.065 cents per pound in 1982-87. During this period, the average cost of production for 61 sugar producing countries was estimated to range from US $0.126-0.154 per pound (Barry, 1990).

The U.S. Government does not attempt to control the volume of domestic cane or beet sugar production. In order to sustain the market stabilization price for U.S. sugar, which averaged US $0.217 cents per pound during this period, import quotas on foreign sugar are adjusted to manage available supply.[18] While U.S. sugar production has been relatively stable, the consumption of less expensive substitutes, such as HFCS, has expanded significantly and replaced imported sugar. Between 1975 and 1988, refined sugar consumption declined from 9.6 to 7.6 million tons, while HFCS increased from 0.5

[18] The countries that have quotas to export sugar to the United States receive the higher U.S. market price, rather than the "world price" for their sugar.

to 5.9 million tons. In addition, the U.S. quota on raw sugar imports has contributed to an increase in the import of sugar-containing products (Jabara, 1988).

A complete analysis of the U.S. sugar policy, and its interaction with the U.S. honey industry is beyond the scope of this study. In the opinion of the author, however, the sugar policy does not operate in the interests of the U.S. beekeepers. The U.S. sugar program makes honey more price competitive in processed food and retail products, and consequently expands the domestic demand for honey, but in the absence of a quota on the import of honey, the U.S. industry must compete with foreign honey for the domestic market. Ultimately, the U.S. honey price is determined by the world market. Consequently, it is doubtful that the revenues of U.S. beekeepers are actually increased significantly by the U.S. sugar program.

On the cost side, the U.S. sugar program is likely to be detrimental to the honey industry. Beekeepers must feed sugar syrups to their bees in the spring and fall when there are insufficient flowers to maintain the development of the colonies. Most U.S. beekeepers feed HFCS-55, which has varied in price from 10 to 25 percent less than the price of sugar.[19] As a feed stock for bees HFCS-55 has some advantages over cane/beet sugar syrups, but it is not widely used in Canada because its price is significantly higher than the cost of imported cane sugar.

Sugar/HFCS is a major input cost item for honey production. In Canada, sugar syrups can account for over 40 percent of the operating costs if bees are wintered over (Manitoba Agriculture,1989).[20] To the extent that the U.S. sugar program raises this cost for U.S. beekeepers relative to foreign beekeepers, it makes U.S. production less competitive in the world market.

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[19] HFCS-55 is the same grade of high fructose corn syrup that is used by soft drink bottlers.

[20] Sugar feed has increased as a component of Canadian honey production because the spread of disease has closed the border to package bees imports. The U.S. border states, e.g. North Dakota, can still obtain package bees, which may diminish these costs.

In summary, the sugar and honey policies of the United States appear to conflict. Though border controls, U.S. citizens (as consumers) are forced to pay an inflated price for sugar, and other sweeteners. These higher sugar prices raise the costs of production for U.S. beekeepers, and make U.S. honey less competitive with foreign imports. Consequently, U.S. citizens (as taxpayers) are required to subsidize the domestic honey industry.

## APPENDIX II

Canadian Sub-Model

This technical appendix presents the structure and estimation of a sub-model for the Canadian honey industry. The sub-model consists of nine equations of which two are identities. The individual equations in the sub-model are;

i) Colony Response,
ii) Honey Supply,
iii) Wax Supply,
iv) Domestic Honey Demand,
v) Wax Demand,
vi) Export Demand by the United States,
vii) Export Demand by West Germany
viii) Import of Honey by Canada, and
ix) Ending Stocks of Honey

Absent from the model are separate equations for processor and retail level demands. These two demand components are aggregated as the Domestic Demand equation due to lack of data.

Colony Response:

Essential to honey production are the colonies of bees. Colonies are akin to acreage in crop production and as such its structure can be derived from a production function or investment framework. Using a production function framework, it is easily seen that colony response is derived to be a function of input prices, product prices of honey and wax since the two are produced jointly. Since the response equation is estimated at an aggregate level, micro-level variables that are not available at such a level of aggregation are excluded from the list of explanatory variables. Beekeeping depends on the availability of nectar producing flowers. In Canada, casual observation shows that there is a relationship between the number of colonies and canola acreage, at least in western Canada. Advantage is taken of this relationship by including the canola acreage in the colony response equation.

Although pollination services are provided by beekeepers, payment for these activities is generally limited to orchardists. Only in parts of Ontario and British Columbia is there a significant number of orchards to create a pollination service industry. Lack of data on the number of pollination services and their relatively small contribution to the Canadian honey industry precludes an estimation for its services.

The general form of the industry response is specified as;

i) $CCOL_t = f(CCOL_{t-1}, PFARM_t^*, CANOLA_t, TREND)$

where $CCOL_t$ is the number of colonies in period t, $PFARM_t^*$ is the expected price of honey, $CANOLA_t$ is the planted acreage of canola crop, and TREND is a time trend variable included to capture productivity and other technological improvements in beekeeping. The lagged colony variable, $CCOL_{t-1}$ is included to capture inertia in colony response.

Honey Supply:

The actual supply of honey is modeled as a function of expected honey price, colony numbers, canola acreage and the price of package bees. In the short run, the supply of honey can be expanded through the increase in colony numbers. Market signals transmitted through honey prices also play a key role in the supply of the product. The price of honey is therefore used as an indicator of honey production profitability. Honey supply is specified to be;

2) $CANPROD_t = f(CCOL_t, RFARM^*_t, CANOLA_t, BEEPRICE_t)$

Since wax production is a by-product of honey, it is assumed that there is a fixed relationship between the two. Canadian supply of wax is specified to be an identity determined as;

3) $WAXPROD_t = HONRATIO * CANPROD_t$

where HONRATIO is the wax to honey conversion factor.

Product Demand:

The two by-products of honey production are raw honey and wax. These two products have different end uses so an attempt is made to estimate their demands separately. As noted earlier, the absence of quality data to allow estimation based on end-use demand categories dictates the use of available data to arrive at "hybrid" demand equations. This approach, though not preferable, can be rationalized on the basis of a data generation process (DGP). In such a framework, one allows the data to dictate the selection of the model and at the same time being cognizant of the underlying economic theory. With this in mind, the aggregate demand for wax is specified price inverse form as;

4) $WAXPR_t = f(WAXPR_{t-1}, CCOL_t, WAXPROD_t, CNINCOM_t$

The per-capita demand for raw honey on the other hand is specified in quantity dependent form as;

5) $CNDMD_t = f(RFARM_t, SUGARP_{t-1}, CNINCOM_t)$

The farm prices of wax and honey are used in the above demand equations due to lack of price data on the two products at either the processor, or retail levels. The consumer price index for honey was tried in the estimation phase in place of the farm price in the honey demand equations. The anomalous result obtained using this price index necessitate dropping it from the analysis.

Prices:

Price determination on the world honey market is influenced by changing volumes of international trade as well as U.S. support programs. Given the openness of the Canadian economy and proportion of the honey crop that is exported each year, Canadian production hardly influences prices received in Canada. Therefore, the relevant considerations regarding domestic prices in Canada are exports to the U.S. market and

U.S. producer support levels. In addition, we include a wage index variable to proxy domestic cost conditions. To the extent that U.S. export demand of Canadian honey is influenced by U.S. production, support level and C.C.C. acquisitions, these U.S. variables will indirectly influence the price determination process in Canada. A time trend variable is also included to capture other developments affecting the price determination process over time. The above discussion suggests a price equation of the general form;

6) $RFARM_t = p(RFARM_{t-1}, CNWAGE^*_t, CNXUSQ_t, TREND)$

The next equation in the system is export demand by West Germany. Canada's second largest export market is West Germany. Thus, the German demand for Canadian honey is included to assess the impact of U.S. support programs on exports to this market. The export demand by West Germany is specified as;

7) $GERMEXM_t = g(GERMEXM_{t-1}, CANSUPM_t, RFARM_t*MARKCDOL_t, TREND)$

The German mark per Canadian dollar is entered into the equation multiplicatively in order to express Canadian price into its German equivalent. Also, available Canadian supplies, $CANSUPM_t$, is included in the equation to examine domestic production conditions on the exports.

The final behavioural equation in the system is the import demand of honey by Canada. This equation has three major determinants: lagged imports, available Canadian supplies, and the Canadian farm price. The general of the import-demand equation is;

8) $CIMPORT_t = i(CIMPORT_{t-1}, CANSUPM_t, RFARM_t)$

In the import equation, it is expected that increased available domestic supply and prices will have a depressing effect on the quantity of honey imports.

Carry-over Stocks:

Ending stocks are determined by the following closing identity;

9) $CNSTOKE_{t+1} = CANPROD_t + CNSTOKE_t + (CIMPORT_t - CNDMD_t - GERMEXM_t) * CNPOPN_t - CNXUSQ_t - OTHEXP_t$

Equations (1) to (9) form the complete system of the sub-model of the Canadian honey sector. This sub-model can be estimated by itself, or linked to the U.S. model to form a North American system.

An analysis of the data used in estimating the model indicates periods of possible structural change in the Canadian sector. Two periods of change from the analysis of the data are; i) pre-1973 and; ii) the post-1986 period. The pre-1973 period corresponds to a similar change that occurred in the U.S. sector. The post-1986 period on the other hand corresponds to the period of gradual phasing out of the U.S. honey support programs. Dummy variables are defined to capture these two periods in the estimation phase. The pre-1973 dummy, DUM73, is introduced into the price equation and exports to West Germany. The post-1986 dummy, DUM86, only appears in the equation defining exports to West Germany.

The full system of equations is now specified as;

CANADIAN COLONY RESPONSE

$$CCOL_t = a_0 + \overset{(+)}{a_1}CCOL_t + \overset{(+)}{a_2}RFARM_{t-1} + \overset{(-)}{a_3}CANOLA + \overset{(+/-)}{a_4}TREND + V_{1t}$$

CANADIAN PRODUCT SUPPLY AND DEMAND

Honey Supply

$$CANPROD = b_0 + \overset{(+)}{b_1}CCOL_t + \overset{(+)}{b_2}RFARM_{t-1} + \overset{(+)}{b_3}CANOLA_t + \overset{(-)}{b_4}RCNPQN_t + V_{2t}$$

Wax Supply

$$WAXPROD_t = HONRATIO * CANPROD_t$$

Wax Demand

$$WAXPR_t = c_0 + \overset{(+)}{c_1}WAXPR_{t-1} + \overset{(-)}{c_2}CCOL_t + \overset{(-)}{c_3}WAXPROD_t + \overset{(+)}{c_4}CNINCSM_t + V_{3t}$$

Domestic Disappearance of Honey

$$CNDMD_t = d_0 + \overset{(-)}{d_1}RFARM_t + \overset{(+/-)}{d_2}SUGARP_{t-1} + \overset{(+)}{d_3}CNINCOM_t + V_{4t}$$

Canadian Honey Trade

Export Demand by the U.S.

$$RFARM_t = e_0 + \overset{(+)}{e_1}RFARM_{t-1} + \overset{(+)}{e_2}RCNWAGE_{t-1} + \overset{(-)}{e_3}CNXUSQ_t + \overset{(+/-)}{e_4}TREND + \overset{(+/-)}{e_5}DUM73 + V_{5t}$$

Export Demand by West Germany

$$GERMEXM_t = f_0 + \overset{(+)}{f_1}GERMEXM_{t-1} + \overset{(+)}{f_2}CANSUPM_t + \overset{(-)}{f_3} * (RFARM_t * MARKCDOL_t) + \overset{(+/-)}{f_4}TREND + \overset{(+/-)}{f_5}DUM73 + \overset{(+/-)}{f_6}DUM86 + V_{6t}$$

Canadian Import Demand of Honey

$$CIMPORT_t = g_0 + g_1CIMPORT_{t-1} + g_2CANSUPM_t + g_3RFARM_t + v_{7t}$$

Closing Identity for Carry-over Stocks

$$CNSTOKE_{t+1} = CANPROD_t + CNSTOKE_t - (CIMPORT_t - CNDMD_t - GERMEXM_t) * CNPOPN_t - CNXUSQ_t - OTHEXP_t$$

In the above specification, the following variables, $CNDND_t$, $CIMPORT_t$, and GERMEXM are all expressed in per capita terms. In the general specification of the system of equations in (1) to (9), the expected values of certain variables were denoted with asterisks (*) against them. These expectations appear in equations (1), (2), and (6). In the actual specifications and estimation, however, these expectations are replaced by

their one period lagged values. Such expectation formulations, though naive, are common.

In addition, we allow inertia to be built into the equations by including one period lags of the dependent variables where necessary.

The system is linear in parameters. Thus, one could estimate it by two stage least squares (2SLS). The two-stage procedure does not allow specification errors to be propagated through the whole system due to restrictions on the variance-covariance matrix of the error terms. However, since the sub-model will be linked with the U.S. model which estimated via a three stage least squares (3SLS) technique, we forego estimating the Canadian sub-model by 2SLS and use the same estimating technique as done on the U.S. side.

Data and Its Problems

The sample data for the Canadian sub-model has to include the same number of observations as the U.S. model in order to avoid truncation problems. The data used is annual and spans the period 1950 to 1988. However, in the actual estimation, the sample period is from 1952 to 1988 to allow for initialization of the lagged variables.

In any econometric exercise, the quality of the data has a bearing on the validity of the estimated parameters and the policy conclusions to be drawn from them. Some problems regarding data quality and lack of the appropriate data series are discussed below.

Prices: In market economies, prices are the signals that ensure the optimal allocation of resources among competing uses. In the case of the Canadian honey sector, there appears to be no market-determined prices for honey. In this study, one price series that appear in the majority of the equations is the farm price received. This price series is derived as the ratio of the farm value of honey production to the quantity of honey produced in any given year through a Statistics Canada survey of beekeepers. To the extent that the quantity of honey produced is measured with error, and/or the reported

value of production is inaccurate, the resulting price series will also be measured with error.

Inconsistency of Data Sources: Available data for the Canadian honey market are not obtained from a single source. There is no agency that has reconciled all the honey market data used in this study. For example, whereas farm production, beginning stocks, and domestic disappearance might come from one source, the same cannot be said of the trade side of the identity. Exports and imports of honey come from the Statistic Canada publications Exports and Imports of Commodities by Country. These series, adjusted for National Income Accounting purposes will therefore be measured with error. And when combined with the production side data to derive either carry-over stocks or domestic disappearance as the residual in the closing identity, there is bound to be a huge discrepancy.

Unavailability of Processor and Retailer Level Demand Data: Domestic disappearance of honey has been used in this study to be a "catch-all" term for processor and retail level demands for honey. The lack of adequate data will therefore make it impossible to quantitatively assess any policy impacts on either level of demand. For example, what are the industrial uses of honey/wax, and does policy-related price changes induce any substitution or a search for synthetic substitutes

The quality of parameter estimates and simulations runs of the Canadian sub-model should be interpreted with care in light of the data deficiencies enumerated above. Hopefully, the above data problems will generate enough discussion to highlight the need for good quality data useable for policy analysis. Failure to recognize the data inadequacies for certain traded commodities will cast aspersions about the usefulness of econometrics in policy debates. However, one should not forget that no matter how well grounded in economic theory one's specifications, when confronted with real world data, no amount of econometric "magic" can save the day.

Empirical Results: The estimates of the parameters of the sub-model over the 1954 to 1988 period are presented in Table 1. The majority of the estimated coefficients are in accord with a priori expectations. The reported Durbin-Watson and Durbin's h values show a possible auto-regressive structure in the error process of the colony response equations. At the 5% level of significance, the critical value of h is 1.645. This critical level is exceeded by the $CCOL_t$ equation. The $R^2$ values are also reported for each equation. However, a word of caution is in order about these values. In a simultaneous system of equations, $R^2$ values are not within the normal 0,1 range but lie between $-\infty$,1.

The model's parameter estimates have the correct signs in the majority of cases. The honey supply equation does not respond to changes in the farm price and the price of package bees. These two variables are statistically insignificant suggesting that price signals are not of major importance in determining the level of supply. Overall, most of the coefficient estimates are significant at the 5% level.

Elasticity Measures for Policy Analysis: Table 2 below reports the short-run and long-run elasticity and flexibility estimates. These measures are all evaluated at the mean values of the sample data. The distinction between elasticities and flexibilities should be apparent. In the former case, the measure corresponds to equations in which the endogenous variables are in quantity dependent form, but are expressed in price-dependent form for flexibilities. For example, in Table 2 $E_{CCOL,\ RFARM}$ refers to the elasticity of colonies with respect to the real farm price.

In the short-run, only three elasticity measures are elastic. These are: i) honey supply with respect to colonies, ii) per capita export demand by Germany with respect to total available Canadian honey supply and, iii) Canadian import demand of honey with respect to total available supplies of Canadian honey. In the supply equation, the elasticity of supply with respect to colonies border on unitary elasticity, meaning a one percentage change in the number of colonies induces a corresponding one percentage change in the Canadian supply of honey. The total available supply of Canadian honey (i.e., current production plus beginning stocks) induce large responses wherever it appears in the model. In the import equation, a one percent increase in total supplies

leads to a 2.3% reduction in per capita honey imports. In the German equation on the other hand, a one percent increase in total available Canadian supplies induces a 2.3% increase in per capita exports to West Germany.

One disappointing result is the price flexibility of Canadian farm price with respect to exports to the United States. The short-run flexibility coefficient with respect to exports to the U.S. market is 0.082. Caution should be exercised in interpreting this flexibility measure as the reciprocal of the elasticity measure. For example, in equations with no lagged dependent variables on the right hand side, the inverse relationship could be close depending on the functional of the equation under consideration.

The rest of the elasticity measures, with respect to the induced farm price variable are all inelastic. Given the poor quality of the data used in this study, it is difficult to tell whether the low price elasticities are data generated or what one should expect. In the absence of any other study detailing the magnitudes of elasticity estimates for the Canadian honey industry, the elasticities reported here could be indicative of what is out there. In any event, these elasticity measures have to be regarded as tentative.

Simulations: The sub-model discussed above can be linked to the U.S. model in a number of ways. One approach is to establish a linkage whereby relevant endogenous policy variables from the U.S. sector are included in the Canadian sub-model. This approach was tried without any success. This then led to the second alternative in which the original Willet (1987) and Willet and French (1990) models had to be modified slightly. The modification of the Willet models were of two kinds: i) the price deflators are rebased to 1981 and the inclusion of DUM86, as discussed on the Canadian side, in some equations and, ii) the major modification being a disaggregation of the U.S. demand for imported honey into imports from Canada and the rest of the world. This provides the necessary linkage needed to perform the simulations.

The modification of the "Willett models" means that the parameters on the U.S. side have to be re-estimated. The results of our version of the Willett model are presented in Table 3. With minor reservations, the new parameter estimates are in accord with the original version of the model.

Having made the necessary changes, the combined Canadian-U.S. honey sector models are used in simulating the effect of policy changes on the U.S. side and examine the channels through which these changes are transmitted to the Canadian sector.

**ECONOMETRIC MODEL OF THE CANADIAN HONEY INDUSTRY**
Table 1

CANADIAN COLONY RESPONSE

Colony:

$$CCOL_t = -31137 + 0.9451\ CCOL_{t-1} + 75216\ RFARM_{t-1}$$
$$[1.598]\quad [15.466]\qquad\qquad [4.020]$$

$$- 7.5956\ CANOLA_t + 1232.4\ TRND_t \qquad (h = 2.31)$$
$$[1.605]\qquad\qquad [1.298] \qquad R^2 = 0.983$$

CANADIAN PRODUCT SUPPLY AND DEMAND

Honey Supply:

$$CANPROD_t = 0.25512 + 0.00012\ CCOL_t - 13.652\ RFARM_{t-1}$$
$$[.114]\quad [9.245]\qquad\qquad [0.964]$$

$$+ 0.0044\ CANOLA_t - 0.3108\ RCNPQN_t \qquad (DW = 1.89)$$
$$[2.867]\qquad\qquad [0.268] \qquad R^2 = 0.923$$

Wax Supply:

$$WAXPROD_t = HONRATIO_t * CANPROD_t$$

Wax Demand:

$$WAXPR_t = - 0.16877 + 0.7819\ WAXPR_{t-1} - 1.009\ E\text{-}6\ CCOL_t$$
$$[0.682]\quad [8.092]\qquad\qquad [1.943]$$

$$- 0.21856\ WAXPROD_t + 0.0005569\ CNINCOM_t \qquad (h = -0.23)$$
$$[1.091]\qquad\qquad [3.302] \qquad R^2 = 0.785$$

Domestic Honey Demand:

$$CNDMD_t = 1.5806 - 0.77486\ RFARM_t + 0.002564\ SUGARP_{t-1}$$
$$[6.231]\quad [2.553]\qquad\qquad [1.850]$$

$$+ 0.000302\ CNINCOM_t \qquad (DW = 2.28)$$
$$[2.835] \qquad R^2 = 0.215$$

CANADIAN HONEY TRADE

Export Demand to the U.S.:

$$RFARM_t = \underset{[2.443]}{0.3651} + \underset{[2.148]}{0.29194}\ RFARM_{t-1} + \underset{[1.440]}{0.00001824}\ RCNWAGE_{t-1} - \underset{[1.139]}{0.00474}\ TRND_t + \underset{[2.109]}{0.22519}\ DUM73_t - \underset{[1.501]}{0.007543}\ CNXUSQ_t$$

(h = 0.68)
$R^2 = 0.873$

Exports Demand to West Germany:

$$GERMEXM_t = \underset{[0.155]}{-0.022257} + \underset{[5.158]}{0.68434}\ GERMEXM_{t-1} + \underset{[3.784]}{0.04331}\ CANSUPM_t - \underset{[1.805]}{0.01759}\ (RFARM*MARKCDOL)_t - \underset{[3.177]}{0.00399}\ TRND_t + \underset{[3.449]}{0.04991}\ DUM73_t + \underset{[4.292]}{0.09036}\ DUM86_t$$

(h = 1.62)
$R^2 = 0.880$

Canadian imports of honey

$$CIMPORT_t = \underset{[3.901]}{0.30709} + \underset{[3.949]}{0.43812}\ CIMPORT_{t-1} - \underset{[4.204]}{0.074479}\ CANSUPM_t + \underset{[0.104]}{0.005252}\ RFARM_t$$

(h = 0.91)
$R^2 = 0.668$

Closing identity: ending stocks

$$CNSTOKE_{t+1} = CANPROD_t + CNSTOKB_t + CIMPORT_t*CNPOPN_t - CNDMD_t*CNPOPN_t - CNXUSQ_t - GERMEXM_t*CNPOPN_t - OTHEXP_t$$

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Notes:

The absolute T-values are reported in square brackets.

The POS variable takes either the highest positive value or zero.

Table 2

Canadian Price Elasticities and Flexibilities
Evaluated at Means

| | Short Run | Long Run |
|---|---|---|
| **Colony Response** | | |
| $E_{CCOL,\ RFARM}$ | 0.099 | 1.810 |
| $E_{CCOL,\ CANOLA}$ | -0.021 | -0.337 |
| **Honey Supply** | | |
| $E_{CANPROD,\ CCOL}$ | 1.091 | -- |
| $E_{CANPROD,\ RFARM}$ | -0.164* | -- |
| $E_{CANPROD,\ CANOLA}$ | 0.109 | -- |
| **Wax Demand** | | |
| $E_{WAXPR,\ CCOL}$ | -0.411 | -1.884 |
| $E_{WAXPR,\ WAXPROD}$ | -0.166* | -0.762** |
| $E_{WAXPR,\ CNINCOM}$ | 0.914 | 4.193 |
| **Domestic Demand** | | |
| $E_{CNDMD,\ RFARM}$ | 0.254 | -- |
| $E_{CNDMD,\ SUGARP}$ | 0.100 | -- |
| $E_{CNDMD,\ CNINCOM}$ | 0.331 | -- |
| **Export Demand by U.S.** | | |
| $E_{RFARM,\ RCNWAGE}$ | 0.241 | 0.340 |
| $E_{RFARM,\ CNXUSQ}$ | -0.082 | 0.115 |

Table 2 (cont'd)

| | | |
|---|---|---|
| Export Demand by W. Germany | | |
| $E_{GERMEXM', CANSUPM}$ | 2.309 | 7.315 |
| $E_{GERMEXM', RFARM}$ | -0.548 | -1.735 |
| Canadian Import Demand for Honey | | |
| $E_{CIMPORT', CANSUPM}$ | -2.267 | -4.035 |

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* Elasticity of wrong sign and insignificant.

** Elasticity of right sign but insignificant.

**ECONOMETRIC MODEL OF THE AMERICAN HONEY INDUSTRY**
Table 3

COLONY RESPONSE

Colony:

$COL_t = 52.539 + 0.9477\ COL_{t-1} + 178.79\ FACMT2_t$ h = 0.015

[0.422] [43.999] [3.339] $R^2 = 0.974$

Average Profitability (lagged Endogenous):

$FACMT2_t = (1/3)*[(FHOPRM_{t-1} + FHOPRM_{t-2})/2 + (FPKPRM_{t-1} + FPKPRM_{t-2})/2 + (FPOPRM_{t-1} + FPOPRM_{t-2})/2]$

Farm Price Maximum:

$PHMAXD_t = PHFD_t + POS(PHSD_t - PHFD_t)$

Honey Profitability:

$FHOPRM_t = [(PHMAXD_t*100+PWXD_t*1+PPODC_t*1+PPKDC_t*0.6+PQNDC_t*0.00)/(PPKDC_t*1.3182+PQNDC_t*0.00+CHOPXD_t)]$

Bee Production Profitability:

$FPKPRM_t = [(PHMAXD_t*20+PWXD_t*1+PPODC_t*1+PPKDC_t*8.0+PQNDC_t*4.00)/(PPKDC_t*0.000+PQNDC_t*0.00+CPKPXD_t)]$

Pollination Profitability:

$FPOPRM_t = [(PHMAXD_t*25+PWXD_t*1+PPODC_t*1.65+PPKDC_t*0.8+PQNDC_t*0.00)/(PPKDC_t*0.000+PQNDC_t*2.535+CPOPXD_t)]$

PRODUCT SUPPLY AND DEMAND

Honey Supply:

$QHF_t = 156.45 + 0.02117\ COL_t - 36.923\ FHOPRM_t$ DW = 1.930

[5.797] [3.869] [2.787] $R^2 = 0.484$

$- 43.404\ FPKPRM_t + 84.004\ FPOPRM_t - 278.98\ DUMPHSD_t$

[2.540] [1.975] [3.650]

Wax Supply:

$QWX_t = WXHOR_t * QHF_t$

Pollination Price Setting:

$$PPODC_t = \underset{[2.846]}{7.2891} + \underset{[24.768]}{0.80663}\ PPODC_{t-1} + \underset{[9.181]}{0.00548}\ QPOC_t \qquad h = 1.501,\ R^2 = 0.991$$

$$- \underset{[3.053]}{0.001359}\ COL_{t-1} + \underset{[3.574]}{2.1022}\ PHMAXD_{t-1} - \underset{[4.942]}{0.1755}\ TRND_t$$

Package Price Setting:

$$PPKDC_t = - \underset{[4.676]}{1.6908} + \underset{[12.981]}{9.1878}\ PHFD_{t-1} \qquad DW = 0.101,\ R^2 = 0.481$$

Queen Price Setting:

$$PQNDC_t = - \underset{[4.610]}{0.22841} + \underset{[52.453]}{0.88355}\ PPKDC_t + \underset{[3.509]}{3.0864}\ QQNCOL_t \qquad DW = 1.51,\ R^2 = 0.986$$

Package Bee Demand:

$$QPKCOLL_t = \underset{[1.707]}{0.00955} - \underset{[2.337]}{0.00385}\ PPKDC_t + \underset{[2.113]}{0.032183}\ PHMAXD_{t-1} \qquad DW = 1.632,\ R^2 = 0.940$$

$$+ \underset{[19.359]}{1.1258}\ QQNCOL_t - \underset{[7.629]}{0.27452}\ DUMPHSD_t + \underset{[10.314]}{0.026334}\ DUM65_t$$

Queen Demand:

$$QQNCOL_t = - \underset{[0.742]}{0.003284} + \underset{[0.659]}{0.00103}\ PQNDC_t + \underset{[0.619]}{0.00647}\ PHMAXD_{t-1}$$

$$+ \underset{[13.302]}{0.40767}\ QPKCOLL_t + \underset{[2.458]}{0.06097}\ DUMPHSD_t$$

$$+ \underset{[6.217]}{0.001461}\ TRND_t \qquad DW = 1.396,\ R^2 = 0.953$$

Allocation of Honey between CCC and Processors:

$$QHC_t = AHC_t * QHF_t$$

$$AHC_t = POS(-0.72676 + 0.92913\ PHSFARD_t)$$

$$PHSFARD_t = PHSD_t / PHFD_t$$

$$QHP_t = (1 - AHC_t) * QHF_t$$

Demand for Beekeepers' Honey:

$$PHFD_t = \underset{[0.962]}{0.074} + \underset{[1.789]}{0.03722}\ QSHPM_t - \underset{[2.583]}{0.001749}\ ICHPD_t$$

$$+ \underset{[2.650]}{0.1765}\ PHRDF_{t-1} + \underset{[0.838]}{0.02405}\ DHM_{t-1} + \underset{[14.751]}{0.74947}\ PHID_t$$

$$+ \underset{[5.880]}{0.15528}\ DUM73_t - \underset{[2.792]}{0.48412}\ DUMPHSD_t + \underset{[3.189]}{0.063813}\ DUM86_t$$

$$- \underset{[1.339]}{0.074862}\ PSWD_t \qquad DW = 1.479,\ R^2 = 0.974$$

$$QSHPM_t = QHP_t/M_t + SHP_t/M_t$$

Demand for Imported Honey:

$$CNXUSQ_t = \underset{[2.082]}{9.8456} - \underset{[2.561]}{3.5627}\ QSHPM_t + \underset{[0.552]}{4.4415}\ PHMAXD_t$$

$$- \underset{[0.257]}{1.2688}\ PHRDF_{t-1} - \underset{[1.501]}{11.081}\ PHID_t + \underset{[4.926]}{6.909}\ DUM73_t$$

$$+ \underset{[11.703]}{135.87}\ DUMPHSD_t \qquad DW = 2.069,\ R^2 = 0.911$$

$$OTHUSM_t = \underset{[0.332]}{0.02056} - \underset{[2.252]}{0.03967}\ QSHPM_t + \underset{[3.819]}{0.40238}\ PHMAXD_t$$

$$+ \underset{[3.118]}{0.20303}\ PHRDF_{t-1} - \underset{[7.183]}{0.65135}\ PHID_t + \underset{[2.470]}{0.048527}\ DUM73_t$$

$$+ \underset{[9.385]}{1.4428}\ DUMPHSD_t \qquad DW = 2.031,\ R^2 = 0.884$$

$$IHM_t = OTHUSM_t + CNXUSQ_t$$

Wax Demand:

$$PWXD_t = \underset{[0.489]}{0.43627} - \underset{[.089]}{1.7024}\ QWXM_t + \underset{[4.444]}{0.77957}\ FHOPRM_{t-1}$$

$$+ \underset{[0.374]}{0.0000238}\ YDM_t - \underset{[3.808]}{4.855}\ DUMPHSD_t \qquad DW = 1.959,\ R^2 = 0.260$$

$$QWXM_t = QWX_t/M_t$$

PROCESSORS' MARKETING

Domestic Supply of Processed Honey:

$$QDHMM_t = 0.40723 + 0.59988\ QSHPM_t - 0.26263\ PHRDFX_t + 0.29786\ PHMAXDX_t - 0.0054504M4\ TRND_t - 3.3666\ DUMPHSD_t$$

[13.021] [39.490] [4.101] [4.567] [7.797] [23.577]

DW = 1.506
$R^2$ = 0.952

$$PHRDFX_t = PHRDF_t - PHRDF_{t-1}$$

$$PHMAXDX_t = PHMAXD_t - PHMAXD_{t-1}$$

Demand for Processed Honey:

$$PHRDF_t = 0.78001 + 0.0004056\ DHM_t + 0.46201\ DUM73_t - 0.027133\ TRND73_t - 0.52843\ DUMPHSD_t + 0.43981\ DUM86_t + 0.054732\ RSPD_t$$

[22.239] [0.018] [28.267] [12.681] [3.442] [15.693] [1.218]

DW = 1.964
$R^2$ = 0.936

$$DHM_t = QDHMM_t + IHM_t - EH_t/M_t$$

Carryover Stocks:

$$SHPF_{t+1} = QHP_t + (IHM_t*M_t) + SHP_t - (DHM_t*M_t) - EH_t$$

U.S.-Canadian Honey Model Variables

| Name | Definition | Measure |
|---|---|---|
| AHC | Allocation of Honey to the CCC | (proportion) |
| CCOL | Honey Colonies in Canada | (colonies) |
| CANDISAP | Canadian Honey Disappearance | (mil. lbs) |
| CANIMP | Canadian Honey Imports | (mil. lbs) |
| CANOLA | Area of Canola in Western Canada | (hectares) |
| CANPROD | Canadian Honey Production | (mil. lbs) |
| CANSUPLY | Canadian Honey Supply | (mil. lbs) |
| CDPUSD | Canada-U.S. Dollar Exchange Rate | (C$/US$) |
| CHOPXD | Deflated Exogenous Input Costs | (82$/colony) |
| CNFARMP | Canadian Farm Price of Honey | ($/lb) |
| CNPOPN | Canadian Population | (millions) |
| CNPRDEF | Canadian Price Deflator | (1981=100) |
| CNSTOKB | Canadian Beginning Stocks of Honey | (mil. lbs) |
| CNSTOKE | Canadian Ending Stocks of Honey | (mil. lbs) |
| CNWAGE | Canadian Hired Farm Labour Wage Index | (1981=100) |
| CNXUSQ | Canadian Honey Exports to the United States | (mil. lbs) |
| COL | Honey Colonies in the U.S. | (thousands) |
| CPKPXD | Exogenous Input Costs for Package Bee Producer | ($/colony) |
| CPOPXD | Deflated Exogenous Input Costs | (82$/colony) |
| DHM | Disappearance of Honey in the U.S. | (lbs/person) |
| DUM65 | Dummy in 1965 and After | (0 or 1) |
| DUM73 | Dummy in 1973 and After | (0 or 1) |
| DUM86 | Dummy in 1986 and After | (0 or 1) |
| DUMPHSD | Dummy Variable for Support Program | (0 or 72$/lb) |
| EH | U.S. Exports of Honey | (mil. lbs) |
| FACMT1 | U.S. Profitability Ratio for all products t-1 | (n.d.) |
| FACMT2 | U.S. Profitability Ratio for all products t-1 and t-2 | (n.d.) |
| FHOPRM | U.S.Profitability Ratio for Honey Production | (n.d.) |
| FPKPRM | U.S.Profitability Ratio for Package Bee Production | (n.d.) |
| FPOPRM | U.S.Profitability Ratio for Pollination Services | (n.d.) |
| ICHPD | Index of Costs of Honey Processing | (1972=100) |
| IH | Imports of Honey | (mil. lbs) |
| IHM | U.S. Imports of Honey | (lbs/person) |
| M | U.S. Population | (millions) |
| MARKCDOL | German Mark - Canadian Dollar Exchange Rate | (GM/C$) |
| PHFD | Deflated U.S. Farm Price of Honey | (82$/lb) |
| PHID | Deflated Price of U.S. Honey Imports | (82$/lb) |
| PHMAXD | Deflated Maximum U.S. Farm Price of Honey | (82$/lb) |
| PHRDF | Deflated U.S. Retail Price of Honey | (82$/lb) |
| PHSD | Deflated U.S. Support Price for Honey | (82$/lb) |

| | | |
|---|---|---|
| PHSFARD | U.S. Support Price for Honey | (n.d.) |
| PPKDC | Deflated California Price for Package Bees | (82$/bee) |
| PPODC | Deflated California Price for Pollination Services | (82$/service) |
| PQNDC | Deflated California Price for Queen Bees | (82$/bee) |
| PSWD | U.S. Wholesale Price of Sugar | (82$/lb) |
| PWXD | Deflated U.S. Price of Wax | (82$/lb) |
| QCNXGERM | Quantity of Canadian Honey Exports to Germany | (million lbs) |
| QDHMM | Quantity of U.S. Honey Marketed | (lbs/person) |
| QHC | Quantity of Honey to the CCC | (million lbs) |
| QHF | U.S. Honey Production | (million lbs) |
| QHP | Quantity of U.S. Honey to Processors | (million lbs) |
| QPK | California Package Bee Production | (thousand lbs) |
| QPOC | Quantity of Pollination Services (California) | (thousand services) |
| QQNC | Quantity of Queen Bees (California) | (thousand bees) |
| QSHPM | Total Domestic Quantity of Honey at the Processor | (lbs/person) |
| QSIHPM | Total Quantity of Honey at the Processor | (lbs/person) |
| QWX | Quantity of U.S. Wax Production | (million lbs) |
| QWXM | Quantity of Wax | (lbs./person) |
| RSPD | U.S. Retail Sugar Price | (1982=100) |
| RCNNDEXP | Real Non-durable Expenditure in Canada | (1981$ mil) |
| SHP | Stocks of Honey | (million lbs) |
| SUGARP | Canadian Retail Sugar Price Index | (1981=100) |
| TCNEXPTS | Total Canadian Honey Exports | (mil. lbs) |
| TRND | Linear Time Trend | (year, 1952-=3) |
| TRND73 | Time Trend Beginning in 1973 | (year, 1973=1) |
| WAXPR | Canadian Wax Price | ($/lb) |
| WAXPROD | Canadian Wax Production | (mil. lbs) |
| WXHOR | Wax to Honey Production Ratio | (lbs/lbs) |
| YDM | Personal Expenditures | (72$/person) |

```
RFARM = (100*CNFARMP)/CNPRDEF;
OTHUS = IH - CNXUSQ;
OTHUSM = OTHUS/M
CNXUSQM = CNXUSQ/M
PHRDFX = PHRDF - PHRDF(-1)
PHMAXDX = PHMAXD - PHMAXD(-1)
SHPF = QHP + (IHM*M) + SHP(-1) - (DHM*M) - EH
QQNCOL = QQNC/COL
QQNCOLL = QQNC/COL(-1)
QPOCOLL = QPOC/COL
QPKCOLL = QPK/COL(-1)
RCNWAGE = 100*CNWAGE/CNPRDEF
```

CNDMD = CANDISAP/CNPOPN
CANIMPORT = CANIMP/CANPOPN
CANSUPM = CANSUPPLY/CANPOPN
HONRATIO = WAXPROD/CANPROD
WAXPROD = HONRATIO*CANPROD
CNINCOM = RCNNDEXP/CNPOPN
GERMEXM = QCNXGERM/CNPOPN
GERMSUP = GERMPROD/GERMPOP
RCNPQN = PQN*CDPUSD/CNPRDEF
RCNPPK = PPK*CDPUSD/CNPRDEF
OTHEXP = TCNEXPTS - CNXUSQ - QCNXGERM

## HONEY DATA

The data series for the model are available in Lotus 1-2-3 format. For a copy of the diskette (5 1¼" or 3½"), please send $10.00 to cover costs of preparation, packaging and postage, to:

Dr. Barry E. Prentice
Transport Institute
University of Manitoba
Winnipeg, Manitoba, CANADA
R3T 2N2

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