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**THE US-CANADIAN FREE TRADE AGREEMENT AND EC BEEF SALES TO CANADA:  
IMPLICATIONS FOR AUSTRALIA**

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*North America continues to be Australia's most important beef market, currently absorbing around two-thirds of total exports. The signing of the US-Canadian Free Trade Agreement will encourage an even more unified North American beef market, and both countries have agreed to exempt each other from their respective beef import control arrangements. In the early 1980s the European Community began subsidising the export of manufacturing beef to Canada, thus gaining access to the relatively higher priced Pacific Basin beef market. The Canadian government imposed countervailing duties on imports of EC beef in 1986, effectively stopping these imports. It has yet to respond to a GATT ruling on these duties. Under existing GATT trading arrangements, the European Community has limited, quota controlled access to the US beef market, but unlimited access to Canada.*

*A resumption of EC beef sales to Canada could have important implications for Australian beef producers. The impact on Australia would depend not only on the quantity involved but on whether it caused North American import controls to be triggered. To analyse this issue a model of the Canadian beef market has been developed and incorporated into the Bureau's EMABA model of Pacific Basin beef trade. Some forecast simulations were conducted using the model, to assess the potential implications for the Australian beef industry.*

## Introduction

Canada is an important export market for Australian beef. In the early 1980s the European Community began subsidising the export of significant quantities of manufacturing beef to Canada. Australia's beef trade with Canada declined, and EC exports reached 22.8 kt in 1984. In 1986 the Canadian government responded to these developments by placing countervailing duties on Irish and Danish beef which effectively closed the market to EC beef. Subsequently, a General Agreement on Tariffs and Trade (GATT) panel found that the countervailing duties contravened GATT regulations. Canada has yet to respond to this finding; it is possible that it may agree to a resumption of the EC trade.

One effect of the signing of the US-Canada Free Trade Agreement (FTA) has been to make the North American beef market even more unified than in the past. The two countries will be exempt from one another's import controls (which are 'triggered' when some specified total level of imports is anticipated), and they are likely to combine these controls so that both are triggered together. A resumption of subsidised EC beef sales to Canada would increase competition for Australian beef sales to this region. Additional product entering Canada from non-traditional suppliers, together with imports from the traditional supplying countries - Australia and New Zealand - would also increase the risk of triggering Canadian and US beef import controls. (Canadian import controls were triggered in 1985.) Thus, the consequences for Australia would depend on the quantity of EC beef supplied and its effect on permitted levels of access to the Canadian and US beef markets. The objective in this paper is to examine how North America import controls would alter the effects of EC-Canadian beef sales on Australian beef producers.

To examine this issue, a model of the Canadian beef market was developed. The model, which includes new estimates of supply and demand elasticities for the Canadian beef market, was linked with a model of the Pacific Basin beef trade that forms a major component of the Bureau's Econometric Model of Australian Broadacre Agriculture (EMABA). The model was used to perform some forecast simulation experiments to examine the implications for Australia of subsidised EC beef sales to Canada.

The paper begins with a brief description of the Canadian beef market and its position in the Pacific Basin beef trade. This is followed by a outline of the method used to model Canadian beef supply and a discussion of the estimated beef supply demand elasticities. Results of the simulation experiments and their implications for Australia are discussed, and the final section provides some concluding comments.

## The Pacific Basin Beef Trade and the Canadian Beef Market

### The Pacific Basin beef market

The Pacific Basin beef market may be defined as the regions of North America (the United States and Canada), North Asia (Japan and South Korea), Oceania (Australia and New Zealand), South-East Asia (Taiwan, Singapore, Malaysia, Hong Kong and the Philippines) and the Central American countries. Trade flows link these regions to form a trading bloc largely separate from the rest of the world. In recent years the total movement of product both into and out of the Pacific has accounted for less than 5 per cent of total imports and total exports by Pacific Basin countries.

This separation within world beef trade is primarily due to a ban on beef imports from countries where foot-and-mouth disease is endemic, imposed by the United States, Canada, Japan, South Korea and Taiwan - the major importing countries of the Pacific Basin - which are free of this disease. Australia, New Zealand and the United States, the main foot-and-mouth free beef exporters, together account for more than 90 per cent of beef traded within the Pacific Basin. The United States imports large quantities of manufacturing grade grass fed beef, and exports grain fed beef to Japan and other Asian markets. Ireland and Denmark offer the only significant non-Pacific supply of foot-and-mouth free product. Their penetration of Pacific markets has been limited by relatively high transport costs to Asian markets and the Andriessen-Kerin Agreement which prevents the European Community from exporting subsidised beef to Australia's 'traditional' Asian markets.

There are some small trade flows both into and out of the Pacific Basin beef market. Under bilateral quota arrangements which have been permitted by GATT, small quantities of foot-and-mouth free beef flow from Australia and the United States to the European Community and from the latter to the United States. GATT has sanctioned the US imposition of a very low limit on beef imports from the European Community, but has not approved any restraint on such imports by Canada. Because of these GATT decisions (further detailed below) and the Andriessen-Kerin Agreement on Asian markets, Canada is the only point of entry for EC beef into the Pacific Basin market.

In recent years small quantities of South American beef have also been shipped into certain South-East Asian markets which have relaxed their foot-and-mouth trade restrictions. Trade flows from Pacific suppliers to the Middle East - the only significant outflow that is not quota controlled - have declined to negligible levels due to competition from subsidised EC beef. Significant price declines in the Pacific Basin or large price rises in the rest of the world would be required before this Middle East trade flow would affect developments in the Pacific Basin beef market.

#### The Canadian beef market

The Canadian beef industry is primarily oriented toward producing grain fed cattle for slaughter. Generally calves are reared on specialist cow-calf farms, with most steers and heifers that are not used for breeding sent to specialist feedlots for finishing prior to slaughter. Nearly all cull cows are finished on grass. Around 30 per cent of Canadian total cow inventories are dairy cattle, located mainly in Western Canada.

Product from grain fed cattle is referred to as 'fed' beef, while production derived from the grass fed culled breeding cattle is referred to as 'non-fed' beef. Most of this non-fed beef is combined with fed meat trimmings to produce a variety of processed beef products such as burger. For consumers, these 'processing beef' products form a segment of the beef market distinguishable from the fed beef products sold as 'table beef'. Around 60 per cent of all Canadian beef produced is table quality; the balance is used for processing.

Canada, like the United States, imports and exports significant quantities of beef. Canadian imports from overseas have mostly been of manufacturing beef, sourced largely from Australia and New Zealand. In early to mid 1980s subsidised EC exports of manufacturing beef from Ireland and Denmark, which are foot-and-mouth free, gained a significant share of this market. In 1986, Canada imposed countervailing duties which put an end to this trade. Canada also sources significant quantities of table quality beef

from the United States. Around 95 per cent of Canadian beef exports are of processing quality and are sent to the United States. Canada also sends small quantities of table quality beef to Japan and other markets.

Both Canada and the United States use 'countercyclical' meat import laws to protect their markets from high levels of imports when cow beef production is high (Spill and Harris 1989). When beef imports are expected to exceed some predetermined 'trigger' level, constraints are negotiated with the exporting countries. Trade between the United States and Canada is largely unrestricted, though the United States has not in the past exempted Canada from the effects of its meat import law. Neither countries' meat import laws place restrictions on trade in live cattle. Border tariffs on imports from third countries are low, and those between the United States and Canada are being phased out under the terms of the Free Trade Agreement (FTA). With only minimal impediments to trade between the United States and Canada, the Canadian market functions as an integral part of a much larger North American market. With the signing of the US-Canadian FTA in 1989 there is a strong possibility that the two countries will move to coordinate their meat import laws. This would effectively prevent Canada from being used as an entry point to the North American (and hence Pacific) market at times when US import restrictions were in force.

#### Canadian Beef Supply Response

Most of the previously published models of Canadian beef supply are based on quarterly data and a division of Canadian beef production into two regions, East and West. Martin and Haack (1977) used a five-equation model and ordinary least squares to estimate short and long run response of breeding inventories with respect to steer prices for East and West Canada. Kulshrethsha (1976) used a quarterly distributed lag analysis, of a flexible polynomial form, to estimate both short and long run response of cattle slaughter to changes in slaughter cattle prices.

The approach used here was based on the theoretical framework of livestock supply response as developed by Jarvis (1974). A similar approach has been used to develop beef supply models for Australia, New Zealand, the United States and South Korea in the EMABA model (Dewbre, Shaw, Corra and Harris 1985). In this representation, there is at any given time a fixed supply of animals, for which there are two types of demand: consumer demand for current consumption and producer demand for herd retentions and subsequent profits. Whether or not an animal is retained in the herd depends on the relative strengths of producer and consumer demands. Producer decisions on current-period cattle sales are determined by comparing current returns with an uncertain future return obtainable if the stock is retained for sale at some later date. Market prices provide both a measure of the current value of breeding stock and - through an expectations process - the returns available from retention for breeding purposes.

Changes in long run beef supply are primarily a function of changes in the number of breeding cows. The two most important variables affecting female herd inventories are cow slaughter and heifer retentions. In addition, since steer and heifer slaughter varies only within a narrow range due to the predominance of finishing cattle in feedlots, short run variability in beef supplies will largely be the result of changes in the slaughter of cows and, to a lesser extent, heifers.

The basic economic relationship in the cow slaughter and heifer promotion equations lies in the coefficients attached to current price

(measuring 'sell now' values) and to an expected margin or net return variable (measuring 'hold for future' values). In the present case, a gross margin to cow and calf producers was calculated using fixed input weightings and variable input prices. The input weightings for the cow-calf margin were taken from Nix (1976). The gross margins variable consists of income from the sale each year of a 450 lb feeder calf along with a portion of culled cows, less the costs of hay, soybean meal, farm labour, fuels, energy and a portion of the cost of replacement heifers.

The essential components of the model include a cow inventory identity and explanatory equation for cow slaughter (SLCF) and heifer promotions (HP).

$$KC = KC_{-1} - SLCF + HP + NTC - DC$$

$$EGMC_2 = \sum_{i=0}^1 (GMC_i / CPI_i) / 2$$

$$EGMC_3 = \sum_{i=0}^3 (GMC_i / CPI_i) / 3$$

$$SLCF / KC_{-1} = f(EGMC_2)$$

$$HP = f(EGMC_3; KC_{-1})$$

where KC is end-of-year cow inventory; SLCF is cow slaughter; HP is promotions of heifers to the cow herd; NTC is net trade in live cows; DC is deaths of cows; EGMC<sub>2</sub> and EGMC<sub>3</sub> are alternative expected gross margins for the cow-calf enterprise (respectively, 2-year and 3-year moving averages of current and past returns); and CPI is the consumer price index.

Cow slaughter (SLCF) as a proportion of cow opening inventories (KC<sub>-1</sub>) is modelled as a function of expected real cow-calf returns (EGMC<sub>2</sub>). A priori reasoning suggests that the rate of cow slaughter should be a negative function of expected returns (the 'hold for future values' option).

Heifer promotions (HP) is modelled as a function of the expected gross margins for cow-calf producers (EGMC<sub>3</sub>) and of opening cow inventories (KC<sub>-1</sub>). Here, the gross margin variable is a proxy for expected real returns. If expected real beef returns increase, producers will promote heifers so as to increase future production and profits. Opening cow inventories are included in this equation to account for the female promotions required for maintenance of the cow herd.

Assumptions about the manner in which producers form price expectations are essential to the specification of supply equations. In this model an adaptive expectations process is used in modelling both heifer retention and cow slaughter. It is assumed that expected price is a function of current and past prices. For those equations in which price expectations appear, different lags were tested and the final choice was based upon their single-equation statistical performance. A three-year moving average of the

expected gross margin (EGMC<sub>3</sub>) is used to model heifer promotions. A two-year lag is used (EGMC<sub>2</sub>) in the cow slaughter equation. A longer expectations process for heifer promotions than cow slaughter appears reasonable, as the decision to promote a heifer into the cow herd for future slaughter has a longer planning horizon than a decision to slaughter a cow.

In the supply model, Canadian beef production is divided into two categories, processing and table beef. Processing beef production (QSH) was defined as the sum of all production from the slaughter of cows and bulls plus 22.45 per cent<sup>1</sup> of production from the slaughter of steers and heifers and 50 per cent of veal production. Table beef production (QST) was defined as the difference between total beef (QS) and processing beef production. These definitions are adapted from a recent model of the Canadian beef market by Charlebois (1987).

$$QSH = f(SLCF)$$

$$QST = f(KC_{2(-1)}; HP/KC_{-1})$$

$$QS = QSH + QST$$

$$KC_2 = \sum_{i=0}^1 KC_i / 2$$

Processing beef production (QSH) is modelled as a function of cow slaughter. Since most of this product comes from cows, a positive sign was expected on this variable. Table beef production (QST), which is mostly from the slaughter of steers and heifers, is expressed as a function of the moving average of previous and past cow inventory, which is the breeding pool for these animals. Assuming a constant reproductive technology, the size of the cow herd limits the turnoff of young grain fed slaughter animals, and thus the expected sign is positive. The ratio of heifer promotions to opening cow inventories is also included in this equation, because an increase in heifer promotions reduces short term beef production from grain fed heifers; thus, a negative sign is expected on this variable.

First-difference log-linear functional forms were used for all supply equations. EMABA employs log-linear functions; the first-difference specification was chosen as it appeared to replicate historical data well. Ordinary least squares regression results obtained for the Canadian beef supply model are presented in Appendix A. Standard error of regression (SER) statistics indicate that the explanatory power of the estimated equations is satisfactory.<sup>2</sup> With two exceptions, coefficient estimates have signs consistent with a priori expectations and are significant at the 5 per cent level. The exceptions are the cow inventory variable in the heifer promotion equation, and the heifer promotion variable in the table beef equation. Both

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<sup>1</sup> According to Agriculture Canada (Service D information) an average half carcass of A1 or B1 graded (high quality) beef will yield 49 lb of ground beef out of 218.3 lb of edible meat.

<sup>2</sup> Because equations are estimated in double log form, estimates of the standard error of regression (SER) can be interpreted as 'percentage error of regression'. The larger the SER the better the equation fits the data. In double log equations, the standard use of R<sup>2</sup> in judging the data fit is of little relevance.

variables were retained as they were considered to be important explanatory variables in their respective equations.

Static and dynamic simulations were used to assess the performance of the supply model, and these also are reported in the Appendix. A static simulation uses actual values of the lagged endogenous variables; a dynamic simulation uses model solutions for those variables. Historical simulations over the period 1970 to 1986 indicate a satisfactory level of performance, with mean dynamic simulation errors (root mean square) of less than 12 per cent for the important endogenous variables. The stability and dynamic behavioral characteristics of the model were also tested. A forecast simulation experiment was performed with exogenous variables set at constant values for all future periods to discover whether solutions were convergent or divergent. Solutions for all endogenous variables converged to stable values, providing some evidence of model stability.

Because of the nonlinear dynamic nature of the supply system, coefficient estimates cannot be directly interpreted as elasticities. This is because full adjustment of supply to price will be delayed by lags incorporated in the price expectations mechanism. Table 1 contains estimates, generated by model simulations, of Canadian beef supply elasticities with respect to saleyard beef price. A baseline 'control' simulation was obtained by setting all exogenous variables to 1984 values and simulating a sufficient number of years into the future to obtain a stable set of values for endogenous variables. The elasticity estimates were obtained by comparing this control simulation with an alternative simulation in which beef prices were perturbed. Elasticities obtained by this approach are explicitly time dimensioned (Dewbre et al. 1985).

The initial negative responses in total and processing beef supply represent the withholding of cows from slaughter for an expected increase in future returns. Total supply response becomes positive from year four onward, when table beef production increases as the additional turnoff of fed steers and heifers more than compensates for reductions in cow beef production from herd rebuilding. The medium term table beef supply response of 0.35 is similar to the 0.40 obtained for the United States by Dewbre et al. (1985).

TABLE 1  
Estimates of Canadian Beef Supply Elasticities

Supply elasticity with respect to permanent change in saleyard beef prices			
Period	Total beef	Processing beef	Table beef
1 year	-0.05	-0.13	0.01
5 years	0.12	-0.06	0.25
10 years	0.42	0.14	0.62
Long term	0.69	0.32	0.96



### Canadian Beef Demand

There have been several previous studies on the demand for beef in Canada, and the results of these studies are summarised in Table 2. Here, an Almost Ideal Demand System (Deaton and Muellbauer 1980) was used. This system is based on a two-stage budgeting process, in which the first stage determines a budget allocation for total meat purchases and the second allocates between the various individual meat categories. The estimated model was of the following form:

$$W_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log(X/P)$$

$$\log P = \sum_i W_i \log p_i$$

where  $W_i$  is the share of the  $i$ th meat in total meat expenditure;  $p_i$  ( $p_j$ ) is the price of the  $i$ th ( $j$ th) meat;  $P$  is the index of meat prices; and  $X$  is total expenditure on meat.

The standard restrictions from consumer demand theory were imposed. These restrictions are that budget shares add to unity, that a uniform increase in retail prices leaves market shares unaffected, and that cross-substitution effects are symmetrical. That is:

$$\sum_i \alpha_i = 1; \sum_i \beta_i = 0; \sum_i \gamma_{ij} = 0; \sum_j \gamma_{ij} = 0; \text{ and } \gamma_{ij} = \gamma_{ji}$$

For estimation purposes, the Canadian model of beef demand is specified as follows:

$$\begin{aligned} \text{BEXP} &= (\text{QDT.RPT}) + (\text{QDH.RPH}) \\ \text{CEXP} &= \text{QDC.RPC} \\ \text{MEXP} &= (\text{QDT.RPT}) + (\text{QDH.RPH}) + (\text{QDC.RPC}) + (\text{QDP.RPP}) \\ \text{BEXP} &= f(\text{RPB}, \text{RPC}, \text{RPP}, (\text{MEXP/POP})/\text{RPM}) \\ \text{MEXP} &= f(\text{RPB}, \text{RPL}, \text{RPP}, (\text{MEXP/POP})/\text{RPM}) \\ (\text{MEXP/POP})/\text{RPM} &= f((\text{PCE/POP})/\text{CPI}, \text{RPM/CPI}) \end{aligned}$$

where MEXP is expenditure on meat; QDT is consumption of table beef; RPT is retail price of table beef; QDH is consumption of processing beef; RPH is retail price of hamburger; QDC is consumption of poultry; RPC is retail price of chicken; CEXP is expenditure on poultry; QDP is consumption of pork; RPP is retail price of pork; BEXP is expenditure on beef; RPB is a retail price of beef index; RPM is retail price of meat index; PCE is personal consumption expenditure; CPI is the consumer price index; and POP is population.

Table 3 contains the estimated parameters for the Almost Ideal Demand System estimated over the period 1963-87. The total meat demand equation has a first-difference log-linear functional form; the results are reported in Appendix A. Uncompensated price and income elasticity estimates are reported in Table 4. The own-price elasticity for beef of -0.44 is just below the range of other estimates available from previous studies (see Table 2). Over a similar data period the results obtained by Zafiriou (1987) are very

TABLE 2

## Previous Estimates of Canadian Beef Demand Elasticities at Retail Level

Source	Period	Method of estimation (a)	Periodicity	Income	Demand elasticity		
					Own price	Pork price	Chicken price
Kulshrethsha and Wilson (1972)	1949-69	TSLS	Annual	1.04	-0.80	0.06	
Hassan and Katz (1975)	1954-72	FIML	Annual	0.59	-0.85	0.24	
	1957-72	SUR	Annual	0.49	-0.72	0.20	
Dadgostar (1986)	1952-82	TSB	Annual	0.86	-0.76	0.15	-0.69 (b)
Zafirion (1987)	1963-83	OLS	Annual	0.51	-0.47	0.42	
Charlebois (1987)	1966-86	OLS (c)	Quarterly	0.38	-0.74	0.04	
		OLS (d)	Quarterly	0.43	-0.41	0.31	
This study	1963-87	AIDS	Annual	0.38 (e)	-0.44	0.32	0.04

(a) TSLS: Two-stage least squares; SUR: Seemingly Unrelated Regression; FIML: Full Information Maximum Likelihood; TSB: Two-stage budgeting; OLS: Ordinary least squares; AIDS: Almost Ideal Demand System. (b) Statistically insignificant at the 5 per cent level. (c) High quality beef. (d) Low quality beef. (e) Personal consumption expenditure.

TABLE 3

Estimated Parameters for Almost Ideal Demand System  
Analysis of Meat Consumption, 1963-87

Parameter(a)	Estimate	Standard error
$\alpha_1$	0.437	0.422
$\alpha_2$	-0.032	0.032
$\gamma_{11}$	0.069	0.042
$\gamma_{12}$	-0.044	0.078
$\gamma_{22}$	0.090	0.058
$\rho_1$	0.009	0.080
$\rho_2$	0.152	0.060

(a) 1, beef; 2, chicken; 3, pork.

TABLE 4

Uncompensated Price and Income Elasticities from Almost Ideal Demand  
System Analysis of Meat Consumption, 1963-87

Elasticity of consumption of:	with respect to:			
	Beef price	Pork price	Chicken price	Personal consumption expenditure
Beef	-0.44	0.32	0.04	0.38
Pork	0.29	-0.33	0.00	0.24
Chicken	0.13	0.06	-0.42	0.79

similar to those obtained in this study. A 1 per cent change in the price of pork results in a 0.32 per cent change in beef consumption; the same change in chicken prices causes a 0.13 per cent rise in beef consumption.

All 'income' elasticities - that is, elasticities with respect to personal consumption expenditure - are positive and lie between zero and one, indicating that the meats analysed are normal goods. The figure

'income' elasticity of demand for beef of 0.38 is similar to that obtained by Charlebois (1987); that for pork, 0.24, is similar to that obtained by Zafiriou (1987); and that for chicken, 0.79, is similar to the 0.73 estimate obtained by Hassan and Katz (1975) and slightly higher than the 0.60 estimate of Dadgostar (1986).

#### Potential Effect of Subsidised EC Beef Sales

The incursion of subsidised EC beef into Canada in the mid-1980s caused some disruption to Australia's beef trade with Canada. In future, because of free trade between the United States and Canada, any beef trade arrangements between the European Community and Canada will affect the demand for imported grass fed beef in both Canada and the United States. The Canadian-US Free Trade Agreement (FTA) ensures that these two countries will constitute an even more unified North American beef market than in the past. Canada will treat imports from the United States as domestic product, while imports from third countries will remain subject to the Canadian Meat Import Act. Similarly, the United States has exempted Canada from the Meat Import Law (although the right to impose restrictions on Canada has been retained). This agreement enables the United States to limit indirect access to its market by third countries.

At present, the European Community still has, under GATT, unlimited access to the Canadian market (subject to Canadian import duties), while its access to the US market is limited by a GATT sanctioned bilateral quota arrangement. Due to the signing of the FTA and related changes to North American import controls, subsidised EC sales could, if they were resumed, have a greater effect on Australian beef producers than they had in the mid-1980s. The effect on Australia would depend on how the EC beef sales affected third-country access to North America.

To analyse the potential effect of EC beef sales to Canada, the model of the Canadian beef market was linked into ABARE's Econometric Model of Australian Broadacre Agriculture (EMARA). EMABA includes an annual model of Pacific Basin beef trade, incorporating representations of beef demand and supply in Australia, New Zealand, Japan, the United States, South Korea and Taiwan. The model includes endogenous formulas for US beef import controls under the Meat Import Law (MIL). In future the imposition of Canadian beef import controls is likely to become more closely aligned with the operations of the MIL. In the simulation experiments, therefore, the endogenous equations for US import controls were also used to trigger Canadian import controls (which are not otherwise represented in the model). The Canadian quota level (maximum permitted imports) was assumed to equal the country's global minimum access quantity (adjusted for population growth), which was announced in 1980 following the Tokyo round (Spill and Harris 1989). During free access periods relative prices determine both US and Canadian total imports (Dewbre et al. 1985).

The potential effect of EC beef sales to Canada was analysed using a forecast simulation approach. A 'baseline' forecast simulation was obtained for the 1990-95 period using assumptions for exogenous variables based on the Bureau forecasts prepared for the 1990 National Agriculture and Resources Outlook Conference and published in the December edition of Agriculture and Resources Quarterly (ABARE 1989). This baseline included the recent agreed changes to Japanese access for imported beef. A summary of the baseline results are presented in Appendix B. An important feature of the baseline forecast simulation is that North American import restrictions were not triggered in any year of the simulation period.

The effect of subsidised EC beef sales to Canada on the Australian beef industry will depend on the quantity of beef sold and its effect on North American import controls. For the first alternative simulation, it was assumed that the European Community supplied 50 kt of beef to Canada in each year over the 1990-95 period inclusive. This quantity is well within the bounds of potential EC supplies. The combined opening stocks of Ireland and Denmark, the two foot-and-mouth free producers in the Community, have averaged between 60 and 120 kt during the 1980s. Furthermore, the Community has plans to become foot-and-mouth free by 1991-92. If it achieved this objective, a considerably greater quantity of beef could be made available for export to Canada.

In this first simulation, the US and Canadian import controls are not triggered by the 50 kt of grass fed beef supplied by the Community. As the North American market maintains free access, the EC incursion is effectively an addition to overall grass fed beef supplies in the Pacific Basin. The net

TABLE 5

Selected Price and Quantity Effects of EC Subsidised Beef Sales to Canada: North American Import Controls not Triggered

Country and variable	1990	1991	1992	1993	1994	1995
	%	%	%	%	%	%
<u>Australia(a)</u>						
Production	-	0.2	0.3	0.2	-	-0.1
Consumption	0.7	0.9	0.8	0.8	1.0	1.2
Exports - total	-0.5	-0.3	-	-0.3	-0.7	-0.9
Farm level price	-1.8	-2.2	-1.9	-2.0	-2.4	-3.0
<u>New Zealand(b)</u>						
Production	0.1	0.2	0.2	-	-0.2	-0.3
Consumption	0.6	1.0	1.2	1.2	1.3	1.5
Exports - total	-	-0.1	-0.1	-0.3	-0.6	-0.8
Farm level price	-1.7	-2.2	-1.8	-1.9	-2.3	-2.9
<u>Canada(c)</u>						
Production	-	-	-	-	0.1	0.1
Consumption	0.7	0.7	0.8	1.0	1.3	1.6
Imports - total	56.5	59.3	64.1	64.5	63.5	59.7
- from Australia	-1.2	-1.2	-1.6	-2.3	-3.3	-3.9
- from New Zealand	-1.2	-1.2	-1.6	-2.3	-3.3	-3.9
Farm level price	-0.3	-1.0	-1.3	-1.8	-2.6	-3.3
<u>United States(c)</u>						
Production	-0.1	-	0.1	0.4	0.8	1.1
Consumption	0.4	0.5	0.5	0.7	1.0	1.2
Imports - total	-1.2	-0.9	-1.1	-1.7	-2.4	-2.6
- from Australia	-1.3	-1.0	-1.2	-1.9	-2.6	-2.8
- from New Zealand	-1.3	-1.0	-1.2	-1.9	-2.6	-2.8
Exports	-0.5	-0.4	-0.2	0.2	0.8	1.1
Farm level price	-0.3	-1.0	-1.3	-1.8	-2.6	-3.3

(a) Year ended June. (b) Year ended September. (c) Calendar years.

effect on Pacific Basin beef supplies is, however, somewhat less than the 50 kt entering Canada from Europe. Pacific market prices adjust downward to the increased grass fed beef supplies, causing production to adjust downward in the traditional supplying countries, Australia and New Zealand. The results in Table 5 show that by 1995 Australian and New Zealand farm level prices are 3.0 per cent lower than baseline levels and beef production 0.1 per cent and 0.3 per cent lower respectively.

To show the effect on Australian beef producers of a triggering of North American import controls during the period of resumption in EC sales to Canada, a second simulation experiment was performed. Here it was assumed that the entry of 50 kt of EC beef would cause the closure of both the Canadian and US markets. In these circumstances, the impact on Australia would depend on how much EC beef was landed in Canada prior to market closure. Government authorities would allocate the remaining access quantity on the basis of historical shares. For the purposes of this experiment a worst case scenario was chosen, in which the Community lands all of the

TABLE 6

Selected Price and Quantity Effects of EC Subsidised Beef Sales  
to Canada: North American Import Controls Triggered

Country and variable	1990	1991	1992	1993	1994	1995
	%	%	%	%	%	%
<u>Australia(a)</u>						
Production	0.2	2.1	1.5	-0.9	-1.8	-2.6
Consumption	7.6	2.0	2.8	0.6	1.3	0.7
Exports - total	-6.0	2.3	0.5	-2.1	-3.9	-4.7
Farm level price	-18.4	-3.9	-6.2	-1.5	-3.2	-2.0
<u>New Zealand(b)</u>						
Production	1.5	0.7	0.4	-1.2	-1.9	-2.1
Consumption	7.4	4.0	5.0	1.9	1.2	0.3
Exports - total	-0.4	-0.3	-0.8	-2.8	-2.8	-2.9
Farm level price	-17.8	-3.8	-6.0	-1.4	-3.1	-2.0
<u>Canada(c)</u>						
Production	-	-	-	-	-	-
Consumption	-0.5	-0.2	-0.2	-0.4	-0.6	-0.8
Imports - total	-21.0	-16.5	-8.9	-7.2	-7.4	-11.6
- from Australia	-59.5	-51.1	-46.3	-42.9	-42.4	-47.1
- from New Zealand	-64.1	-60.7	-58.8	-57.1	-57.1	-60.9
Farm level price	0.4	0.6	0.5	0.8	1.2	1.5
<u>United States(c)</u>						
Production	0.1	-0.1	-0.1	-0.2	-0.3	-0.4
Consumption	-	-0.1	-0.1	-0.2	-0.3	-0.5
Imports - total	-	-	-	-	-	-
- from Australia	22.2	17.4	16.0	9.5	10.2	9.5
- from New Zealand	-30.5	-33.5	-35.4	-36.5	-37.5	-38.7
Exports	-7.0	-5.7	-5.6	-4.2	-4.0	-3.7
Farm level price	0.4	0.6	0.5	0.8	1.2	1.5

(a) Year ended June. (b) Year ended September. (c) Calendar year.

assumed 50 kt in Canada and access for Australia and New Zealand is adjusted downward by the same quantity. In addition, the trigger level for US import controls was assumed to equal the level of US beef imports in the baseline free-entry simulation results.

The results of this second simulation experiment (Table 6) indicate a much larger immediate 18.4 per cent price impact for Australian and New Zealand beef producers. Access to North American markets is restricted, and is reduced by the 50 kt of European imports in each year of this second simulation experiment. Consequently, there is a much larger adjustment in beef production, with respective Australian and New Zealand beef supplies 2.6 per cent and 2.1 per cent below base levels by 1995. Australian exports are 4.7 per cent lower by that year, and prices 2.0 per cent lower. In Canada and the United States, the restricting of market access insulates the domestic industries from adjustment in the short run. In the longer run, North American prices are around 1.5 per cent higher than base levels, which results in lower domestic beef demand and smaller cattle herds. The higher US beef prices also result in lower US beef exports to Japan, while Australian shipments to Japan are higher due to the lower grass fed beef prices.

In the baseline simulation US beef imports from Australia are much lower than the historical Australian share of restricted access levels. Consequently, US shipments from Australia are higher under this second simulation experiment, due to the higher prices prevailing in the United States. For New Zealand the reverse applies, with baseline import levels higher than historical access shares and the triggering of import controls resulting in lower New Zealand shipments in this second simulation.

Table 7 provides estimates of the discounted cumulative changes in producer and consumer surplus over the 1990-1995 period for the four main Pacific Basin markets that would be affected by EC beef sales. As expected, Australia, the main supplier to the North American beef market, experiences a significant net loss to the economy in both simulations. In contrast the United States and Canada obtain small net gains for their economies due to the relatively larger gains achieved by consumers. However, Canadian and US producers would experience significantly larger losses if their import controls were abolished.

### Conclusions

The objective of this paper has been to analyse the potential impact on the Australian beef industry of a resumption in uncontrolled EC subsidised beef sales to Canada. A model of the Canadian beef market was developed and linked to a larger model of the Pacific Basin beef trade incorporated in the Bureau's EMABA model. Using a forecast simulation approach, a series of simulation experiments were performed. The results indicate that a 50 kt flow of subsidised beef from the European Community to Canada would cause significant losses to Australia's beef industry. This assumed level of European shipments would not be sufficient product to cause a triggering of North American import controls during the 1990-1995 period. Canada and the United States would experience lower beef prices, like Australia and New Zealand, as the beef herds of each country were adjusted to accommodate the larger supplies of beef.

A triggering of North American import controls by subsidised EC beef sales to Canada would generate a different set of impacts on the Pacific Basin beef trade. The imposition of US and Canadian import controls would,

TABLE 7

Estimated Net Present Values of Cumulative Changes in Producer and Consumer Surplus Produced by EC Exports of 50 kt; 1990-1995(a)

Country and effect	Import controls not triggered	Import controls triggered
	US\$m	US\$m
<u>Australia</u>		
Change in consumer surplus	111.0	354.2
Change in producer surplus	-273.1	-810.0
Net gains to the economy	-162.1	-162 (b)
<u>New Zealand</u>		
Change in consumer surplus	17.0	51.3
Change in producer surplus	-81.7	-221.4
Net gains to the economy	-64.7	14.3 (b)
<u>Canada</u>		
Change in consumer surplus	285.9	-136.4
Change in producer surplus	-273.1	131.3
Net gains to the economy	12.8	-5.1
<u>United States</u>		
Change in consumer surplus	2949.0	-1414.2
Change in producer surplus	-2788.2	1341.4
Net gains to the economy	160.8	-72.8

(a) Assuming discount rate of 10 per cent. (b) Includes tariff equivalent rents from exports to the United States

to some extent, insulate North American beef producers from increased beef imports. An early triggering of import controls (as distinct from the 'worst case' late triggering simulated) would limit the quantity of EC beef that gained access to the North American market. The reductions in Australian and New Zealand access to Canada, brought about by the EC access, would also be limited. A later triggering of import controls would result in larger entries of EC beef and greater reductions in North American access for Australian and New Zealand beef.

Australian and New Zealand product would be diverted away from North America in the short run, resulting in lower beef prices providing gains for consumers in Oceania and other Pacific Basin importing countries such as Japan and South Korea. In the longer run the triggering of North American import controls would result in larger production adjustments for Australia and New Zealand than would be the case if these import control schemes are not triggered. The extent of this disruption to Australian beef producers would depend on the quantity of EC product landed prior to the market closure. Therefore, the North American import controls act as a safety valve against large quantities of EC beef sales into the Pacific Basin. Once triggered these import controls force the burden of adjustment on to Australian and New Zealand beef producers.



triggered these import controls force the burden of adjustment on to Australian and New Zealand beef producers.

As part of the current round of GATT negotiations there is also some possibility of the abolition of the North American meat import laws. Permanent removal of North American import controls would provide the European Community with unlimited access to the higher priced Pacific Basin beef market and the opportunity for beef sales in excess of the 50 kt assumed above. Despite the gains from unlimited access to the North American market for Australian beef large quantities of subsidised EC beef sales would result in lower beef prices and a major disruption for the Australian beef industry.

## APPENDIX A

### The Model and Estimation Results

#### Supply equations

##### Equation A1: Gross margin for cow-calf operations

$$\begin{aligned} \text{GMC} = & 0.16 \text{ SPC.SWC/ADY} + 4.5 \text{ SPF} - (28.92 \text{ PFH}/49.12 \\ & + \text{EUC.PSM}/10.61 + 21.32 \text{ PFL}/79 + 7.56 \text{ EUC.PFE}/79 \\ & + 0.18(6.5 \text{ SPF } 0.807)). \end{aligned}$$

##### Equation A2: Total beef supply

$$\text{QS} = \text{QSH} + \text{QST}$$

##### Equation A3: Cow inventory

$$\text{KC} = \text{KC}_{-1} - \text{SLCF} + \text{HP} + \text{NTC} - \text{DC}$$

##### Equation A4: Heifer promotions

$$\begin{aligned} \log(\text{HP}) = & \underset{(2.18)}{0.20} \log \left( \sum_{i=-3}^{-1} \text{GMC}_i / \text{CPI}_i \right) / 3 + \underset{(1.18)}{0.62} \Delta \log(\text{KC}_{-1}) \end{aligned}$$

Range 1970 to 1986; NOB = 17; NOVAR = 2;

$$R^2 = 0.34; \text{CR}^2 = 0.29; F(2/15) = \text{NA};$$

$$\text{SER} = 0.072; \text{SSR} = 0.078; \text{DW} = 1.30; \text{Cond.} = 1.23.$$

Here and below, t ratios are reported in parentheses below the regression coefficients.

#### Heifer Promotion (HP): Static and Dynamic Simulation Results

Measure	Actual	Static		Dynamic	
		Forecast	Percentage error	Forecast	Percentage error
Mean	1162.97	1163.23	0.07	1049.33	-8.78
RMS	1176.59	1179.45	6.77	1053.01	11.62
Std dev.	183.96	200.94	6.98	90.642	7.85

Equation A5: Cow slaughterings

$$\log(\text{SLCF}/\text{KC}_{-1}) = -0.36 \log \left( \sum_{i=-1}^0 (\text{GMC}_i / \text{CPI}_i) / 2 \right) \\ (-4.82)$$

Range 1968 to 1986; NOB = 19; NOVAR = 1;

$R^2 = 0.56$ ;  $\text{CR}^2 = 0.56$ ;  $F(1/18) = \text{NA}$ ;

SER = 0.073; SSR = 0.096; DW = 2.47; Cond. = 1.

Cow Slaughter (SLCF): Static and Dynamic Simulation Results

Measure	Actual	Static		Dynamic	
		Forecast	Percentage error	Forecast	Percentage error
Mean	684.51	679.39	-0.30	659.42	-3.38
RMS	690.77	684.10	6.77	665.97	8.54
Std dev.	95.61	82.56	6.97	96.03	8.08

Equation A6: Processed beef production

$$\log(\text{QSH}) = 0.01 + 0.58 \log(\text{SLCF}) \\ (2.37)(18.37)$$

Range 1963 to 1986; NOB = 24; NOVAR = 2;

$R^2 = 0.94$ ;  $\text{CR}^2 = 0.94$ ;  $F(1/22) = 337.42$ ;

SER = 0.020; SSR = 0.009; DW = 1.26; Cond. = 1.01.

Processed Beef Production (QSH): Static and Dynamic Simulation Results

Measure	Actual	Static		Dynamic	
		Forecast	Percentage error	Forecast	Percentage error
Mean	902.63	903.50	0.19	891.71	-1.13
RMS	906.48	906.98	3.38	895.23	3.73
Std dev.	85.99	81.88	3.47	81.74	3.66

Equation A7: Table beef production

$$\log(\text{QST}) = 0.02 + 0.92 \log\left(\sum_{i=-2}^{-1} \text{KC}_i / 2\right) - 0.07 \log(\text{HP/KC}_{-1})$$

(2.01) (2.62)                      (-0.51)

Range 1968 to 1986; NOB = 19; NOVAR = 3;

$R^2 = 0.35$ ;  $\text{CR}^2 = 0.27$ ;  $F(2/16) = 4.34$ ;

SER = 0.045; SSR = 0.032; DW = 2.05; Cond. = 1.40.

Table Beef Production (QST): Static and Dynamic Simulation Results

Measure	Actual	Static		Dynamic	
		Forecast	Percentage error	Forecast	Percentage error
Mean	1305.09	1309.53	0.44	1265.92	-2.74
RMS	1309.56	1313.75	3.99	1268.84	6.10
Std dev.	111.45	108.51	4.09	88.71	5.62

Demand equations

Equation A8: Total meat expenditure equation

$$\log((\text{MEXP}/\text{POP})/\text{RPM}) = -0.002 - 0.14 \log(\text{RPM}/\text{CPI})$$

(-0.33) (-1.88)

$$+ 0.45 \log((\text{PCE}/\text{POP})/\text{CPI})$$

(1.94)

Range 1964 to 1987; NOB = 24; NOVAR = 3;

$R^2 = 0.26$ ;  $\text{CR}^2 = 0.19$ ;  $F(7/21) = 3.65$ ;

SER = 0.04; SSR = 0.012; DW = 2.50; Cond. = 2.74.

Total Meat Expenditure ((MEXP/POP)/RPM): Static and Dynamic Simulation Results

Measure	Actual	Static		Dynamic	
		Forecast	Percentage error	Forecast	Percentage error
Mean	608 072	617 666	0.19	617 666	0.19
RMS	702 331	717 725	6.22	717 725	6.22
Std. Dev.	358 967	373 399	6.76	373 399	6.76

Equation A9: Imports from Australia

$$\log(QCZ + QCA) = 0.87 - 1.11 \log(SPA.EAC/(2.20 SPC)) \\ (0.70) (-3.91)$$

$$+ 0.69 \log(QCZ_{-1} + QCA_{-1}) - 0.34 UD \\ (2.17) (-1.98)$$

Range 1971 to 1976 and 1979 to 1986; NOB = 14; NOVAR = 4;

$$R^2 = 0.69; CR^2 = 0.59; F(3/10) = 7.25;$$

$$SER = 0.14; SSR = 0.210; DW = 1.62; Cond. = 81.94$$

Beef Imports to Canada from Australia (QCA): Static and Dynamic Simulation Results

Measure	Actual	Static		Dynamic	
		Forecast	Percentage error	Forecast	Percentage error
Mean	24.235	0.624	9.00	2.616	17.43
RMS	25.603	8.325	37.28	9.610	41.68
Std dev.	8.527	8.557	37.29	9.531	39.02

Equation A10: Imports from New Zealand

$$\log(QCZ/(QCZ + QCA)) = 0.38 + 0.45 \log(QCZ_{-1}/(QCZ_{-1} + QCA_{-1})) \\ (-3.02) (2.38)$$

Range 1960 to 1976 and 1979 to 1986; NOB = 14; NOVAR = 2;

$$R^2 = 0.198; CR^2 = 0.163; F(1/23) = 5.663;$$

$$SER = 0.192; SSR = 0.846; DW = 2.003 Cond. = 6.38$$

Beef Imports to Canada from New Zealand (QCZ): Static and Dynamic Simulation Results

Measure	Actual	Static		Dynamic	
		Forecast	Percentage error	Forecast	Percentage error
Mean	25.086	25.990	4.97	2.605	11.14
RMS	25.476	26.743	23.73	8.026	29.27
Std dev.	4.58	6.475	23.92	7.825	27.90

# DATA LISTING(a)

Variable	Definition	Unit
ADY	Average dressing yield for inspected cattle slaughter	Percentage
BEXP	Beef expenditure share	Percentage
PCE	Personal consumption expenditures	Can\$ '000 million
CEXP	Chicken expenditure share	Percentage
CPI	Consumer price index for all items	1980-100
DC	Deaths of cows	'000 head
EAC	Canadian-Australian exchange rate	Can\$ per A\$1
EUC	Canadian-US exchange rate	Can\$ per US\$1
GMC	Gross margin for cow-calf operations	Can c/head
EGMC <sub>2</sub>	Expected gross margin for cow-calf operations (2-year moving average)	Can c/head
EGMC <sub>3</sub>	Expected gross margin for cow/calf operations (3-year moving average)	Can c/head
HP	Promotion of heifers into the cow herd	'000 head
KC	Inventory of cows	'000 head
MEXP	Total meat expenditure	Can\$ million
NTC	Net live trade in cows	'000 head
PFE	Prices paid index for fuels and energy, United States	1977-100
PFH	Price of farm hay	Can\$/2000 lbs
PFL	Prices paid index for hired farm labour	1981-100
POP	Population of Canada	million
PSM	Prices paid index for soybean meal, United States	USc/lb
QCA	Canadian beef imports from Australia	million lb
QCZ	Canadian beef imports from New Zealand	million lb
QDT	Domestic consumption of table beef	million lbs
QDC	Domestic consumption of poultry	million lb

Variable	Definition	Unit
QDH	Domestic consumption of processing beef	million lb
QDP	Domestic consumption of pork	million lb
QS	Production of beef and veal	million lb
QSH	Production of processing beef	million lb
QST	Production of table beef	million lb
RPB	Retail price of beef index (derived)	index
RPC	Retail price of chicken	Can c/lb
RPH	Retail price of processing beef	Can c/lb
RPM	Retail price of meat index (derived)	index
RPP	Retail price of pork	Can c/lb
RPT	Retail price of table beef	Can c/lb
SLCF	Slaughter of cows	'000 head
SWG	Slaughter weight of cows	lb (cwe)
SPA	Saleyard price of beef, Australia	Ac/kg (cwe)
SPC	Saleyard price of cows, Canada	Can c/lb
SPF	Saleyard price of feeder calves, Canada	Can c/lb
UD	Dummy for years when US beef imports restricted	

(a) A copy of all data and their sources is available from the authors upon request. (b) Meat consumption data were converted to retail consumption weight using the conversion factors, beef 0.74, pork 0.94, chicken 1.0.



# APPENDIX B

## Summary of Forecast Baseline Simulation Results for Pacific Basin Beef Market(a)

	Unit	1989(b)	1991	1993	1995
<u>Australia</u>					
Beef production	kt	1 471	1 456	1 470	1 720
Beef consumption	kt	663	617	597	601
Beef exports	kt	574	589	613	797
Beef farm level price (c)	Ac/kg	210	239	254	246
<u>New Zealand</u>					
Beef production	kt	566	550	684	789
Beef consumption	kt	141	131	130	150
Beef exports	kt	280	270	356	405
Beef farm level price (c)	NZc/kg	200	212	216	200
<u>United States</u>					
Beef production	kt	10 516	10 706	10 972	11 053
Beef consumption	kt	11 170	11 311	11 579	11 821
Beef exports (d)	kt	288	274	279	284
Beef imports (d)	kt	526	509	517	606
Beef farm level price (e)	USc/kg	161	169	177	192
<u>Canada</u>					
Beef production	kt	1 043	1 098	1 142	1 168
Beef consumption	kt	1 094	1 140	1 181	1 223
Beef imports (d)	kt	84	66	59	64
Beef farm level price (e)	CNc/kg	189	190	199	219
<u>Japan</u>					
Beef production	kt	522	555	569	561
Beef consumption	kt	1 160	1 332	1 491	1 678
Beef imports (f)	kt	333	487	627	775
Beef farm level price (c)	¥/kg	1 256	656	604	548
<u>South Korea</u>					
Beef production	kt	120	102	110	117
Beef consumption	kt	218	228	264	299
Beef imports	kt	70	90	110	130
Beef farm level price (e)	Won/kg	4 324	5 880	6 181	6 834

(a) Production and consumption figures are in carcass weight equivalent. Imports and export figures are in shipped weight. (b) ABARE estimate. (c) Dressed weight. (d) Excludes beef trade between Canada and the United States. (e) Liveweight. (f) Includes diaphragm beef.

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