Australasian Agribusiness Review - Vol.14 - 2006

Paper 3

ISSN 1442-6951

Impacts of Mandatory Meat Hygiene Regulations on the New Zealand Meat Trade*

K Cao[a] and R Johnson[b]

[a]Ministry of Agriculture and Forestry, Wellington, New Zealand

[b]Consulting Economist,Wellington, New Zealand

* We acknowledge helpful suggestions from a referee in preparing this article.

Address for correspondence: Dr R Johnson, 59 Allington Rd, Wellington 5, New Zealand

johnsonr1@paradise.net.nz

Key words: agricultural trade, non-tariff barriers, gravity models, meat products, New Zealand.

JEL numbers: C2, F1, Q1

Summary

As with most agricultural products in world trade, trade in meat products is restricted by a variety of non-tariff barriers in different countries. In the case of New Zealand meat products there are quota restrictions in the USA, Canada, and EU markets and hygiene regulations of varying standards in most markets. The building of demand models for such products is fraught with difficulties associated with such restrictions as well as problems of specification and error distribution. Gravity models of traded goods offer a possible methodology for handling these difficulties. This paper sets out a combined cross-section and time series model of the New Zealand meat trade for the period 1994-

2003 including the impact of quotas and the adoption of mandatory meat hygiene regulations to trade.

1. Introduction

While the WTO negotiations over several Rounds have embraced the multitude of tariff restriction on trade with some success, the negotiations on non-tariff barriers (NTM) to trade have been beset by problems of definition and measurement. Non-tariff barriers include import quotas, tariff quotas, technical regulations and standards, anti-dumping measures, and monopolistic practices (state importing). This paper is concerned with quotas and technical standards which are thought to make up over one-half of all non-tariff measures for agricultural products traded (Ndayisenga and Kinsey 1994). Technical standards include health and safety regulations, prohibitions, certifications, quarantine arrangements, product standards (including minimum residue limits), and marking and packing requirements and prohibitions. Of these, health and safety requirements predominate.

In a 1994 survey of agricultural products traded, nearly half of measures sampled in the UNCTAD database were quantity control measures and one third health measures as shown below (Nyayisenga and Kinsey, 1994). The survey excluded export measures such as subsidies and export bans (e.g US Export Enhancement Program, EC export refunds, Canadian Wheat Board), government procurement policies (e.g domestic sourcing), and measures implemented for the purpose of administering other regulations and environmental measures. Not all countries reported health and safety measures including the EC countries.

- Quantity control measures 44.5%
- Technical regulations and standards 33.0%
- Tariff quota and paratariff measures 19.0%
- Antidumping and countervailing measures 2.1%
- Monopolistic measures (state imports) 1.5%

Technical standards were reported to cost US agricultural exporters an estimated amount of $5 billion (Crutchfield *et al*, 2000). Among these technical standards, food safety barriers accounted for about one-forth of the number of restrictions, but about one-half of the estimated export revenue losses as many of them restrict sales of high value products. To overcome the trade distortive effects of quality and hygiene standards, many countries have attempted to coordinate their standards. The widespread adoption of the principles of Hazard Analysis Critical Control Point (HACCP) is one example of countries' efforts to harmonise their food safety regulations. In New Zealand, the Animal Products Act 1999 required the adoption of risk management programmes which embrace the principles of HACCP for all meat and seafood processing plants.

A tariff rate quota specifies the physical quantity of imports allowed at a concessionary tariff rate and implies that any extra imports will be allowed at the normal tariff rate. In

this paper we analyse tariff quotas for beef in the USA and Canadian markets and for lamb in the EU market.

The characteristic feature of NTMs is that the importing country has imposed them for domestic policy reasons and only later do they become a potential barrier to trade when other countries seek to enlarge their exports to such countries. Secondly, while the frequency of such measures is commonly observed, very little is known of their impacts or effects on other parties. Further, the presence of technical barriers particularly gives no clues to the importance of such barriers in protectionist terms. Much discussion in WTO has taken place in the absence of quantitative measures though with considerable awareness of their possible detriments. This paper is about how such impacts, if any, may be quantified and the usefulness of gravity models of trade between countries for such analysis.

The main research objective is to quantify changes in trade patterns that result from the use of different regulatory instruments. Gravity regression models offer some hope in isolating the particular effects on trade in goods by changes in quotas and technical standards and health measures and other restrictions. Gravity models use combined cross-section and time series data to examine trade flows between countries in the context of changing demand. They can be based on single commodities or a Standard International Trade Classification (SITC) industry group. Our hypothesis would be to ask if quotas and health and technical standards make a difference to such trade flows between countries?

The standard approach is to use the flow of trade in an SITC category between pairs of countries, and look for a trade response to different policy instruments. By pooling of time series and cross-section data the analyst can potentially identify country effects, regulatory effects and economic effects. A regulatory instrument approach is examined by Otsuki and Wilson (2000) using SITC categories for `dried grains' (wheat, rice, maize, dried and preserved fruit and nuts) for 31 exporting countries and 15 importing countries between 1995 and 1998. The standard tested was the permitted level of aflatoxin B allowed by importing countries as measured in parts per million. After allowing for GNP, population, distance, and membership of MERCOSUR, ASEAN and NAFTA, there was a negative [and significant] trade response to lower permitted levels of contaminant as would be expected. If the Codex standard for aflatoxin B were imposed across all countries [some are above and some are below] there would be considerable increases in the grain trade, and if countries were confined to the [more stringent] EU standard there would be a 6 per cent fall in trade.

In another study by Wilson, Otsuki and Majumbar (2003), the impact of regulations concerning hormone residues in beef is tested. The test is for minimum levels of tetracycline in parts per million in bovine meat, and the model encompasses 16 exporting countries and 5 importing countries for the period 1995-2000. In this case, the aflatoxin result is repeated [at a significant level] with an elasticity of less than one. At the CODEX MRL standard, trade would increase by 57 per cent and at the EU MRL standard, trade would decrease by 34 per cent. In the earlier result, Australia would increase its exports to Canada, EU, New Zealand and Japan, but decrease them to the

United States. New Zealand would increase exports to Australia and Canada, EU and Japan, but lose exports to the United States [The US has the highest permitted MRL standard].

This paper is concerned with the impact of importing country meat quota arrangements and meat hygiene arrangements on New Zealand exports of meat. The latter arrangements are based on the recent introduction of HACCP regulations on the meat trade between New Zealand and its main customers, Australia, Canada, China, France, Germany, Japan, Korea, the UK and the US. HACCP is a microbiological testing system first developed for the US space agencies. Previous to its becoming mandatory in 1999, inspection of meat products was by visual and organoleptic [sensory] systems. The hypothesis is that the regression coefficient for the dummy variable representing the period after mandatory inspection will be positive and probably less than unity (low response).

2. Structure of the Market

The international market for chilled and frozen meat products is characterised by free exchange between countries subject to import quotas in some countries (EU, Canada, Japan and USA) and hygiene regulations in all countries. Food safety management practice such as HACCP is required in most significant overseas markets. Private shippers in New Zealand work through agents in the main country markets and are generally fully aware of current price expectations in each market. An annual model of market relationships can therefore be regarded as reflecting current supply and demand conditions within the constraints set by the importing countries. The market is characterised by long shipping routes; two weeks to the west coast of the US and five weeks to Rotterdam.

Table 1: Trends in New Zealand Meat Exports 1990-2003 (shipping weight 000 tonnes)

Sept Year to	Lamb	Mutton	Beef & Veal	Total Big 3
1990	261	77	346	684
1995	292	67	341	700
1999	270	54	299	623
2000	292	50	311	653
2001	299	58	331	688
2002	287	53	326	666
2003	298	60	374	732
2004	295	57	425	777
2005	302	59	390	751

Source: Meat & Wool New Zealand - Economic Service

The New Zealand meat trade is split roughly equally between sheepmeat and cattlemeat (Table 1). Lamb and mutton are exported to different markets according to demand requirements (different income elasticities) though veal and beef are not so differentiated but end uses differ. After a surge of production increases through the 1960s and 1970s the size of the industry has stabilised at around exports of 700-770 thousand tonnes per year. The principal markets are lamb consumers in the EU and beef consumers in the USA. Significant amounts of lamb are also exported to China and the USA; and significant amounts of beef are exported to Canada, Japan and Korea (Table 2). In terms of all nine countries covered by our model (Australia, Canada, China, France, Germany, Japan, Korea, the UK and the USA), 74 per cent of exports of lamb, 77 per cent of exports of beef, and 76 per cent of all meat exports were going to these 9 destinations in the 2002-03 September year. There has been a slow shift to chilled meat over the study period, however the model employed assumes the volume of trade is measured in tonnes of homogeneous meat product.

Table 2: Shifts in New Zealand Meat Trade 1991-2003

(shipping weight, % of total trade)

Destination	**Sheepmeat**		**Beef**		**All-Meat**	
	1991-92	2002=03	1991-92	2002-03	1991-92	2002-03
Australia	0.1	0.1	0.8	0.4	0.4	0.3
Canada	2.3	3.4	6.3	10.8	3.5	6.4
China	-	10.0	-	0.3	0.2	4.4
France	5.7	9.2	0.1	0.1	3.0	3.8
Germany	6.6	7.7	0.1	0.1	3.5	3.5
Japan	5.5	2.7	2.8	4.3	4.4	3.8
Korea	5.2	0.2	3.8	6.1	4.4	3.5
UK	30.5	32.9	0.1	0.1	14.8	11.0
USA	2.3	7.9	74.5	54.9	30.3	39.8
Other	41.8	35.9	11.5	22.9	35.5	23.5
Total	100	100	100	100	100	100
Coverage %	58.2	74.1	88.5	77.1	64.5	76.5

Source: Meat and Wool Innovation Annual Review

There are quota restrictions for beef and veal in the USA and Canada, for sheepmeat and goatmeat in the EU, for high quality beef in the EU (very small amount – 0.1% of total beef). Table 3 shows the quota limitation and utilization for beef and veal into the US for the last 10 years. Table 4 shows the EU sheepmeat and goatmeat quota utilization into the EU for recent years. It is characteristic that NZ fills the EU lamb quota every year but does not always fill the US beef quota. Quota markets generally earn higher prices than world prices to cover the tariff, though the quota limits the quantity that can be sold at that price.

Table 3: US Beef and Veal Quota Utilization (tonnes product weight)			
Year	Quota	US Customs Import Volume	Per cent
1994	184400	176174	95.5
1995	213402	185762	87.0
1996	213402	162939	76.4
1997	213402	190079	89.1
1998	213402	191242	89.6
1999	213402	179142	83.9
2000	213402	213402	100.0
2001	213402	209681	98.3
2002	213402	199163	93.3
2003	213402	211549	99.1
2004	213402	211655	99.2

Source: Meat New Zealand

Table 4: EU Sheepmeat and Goatmeat Quota Utilization (tonnes c.w.e.)			
Year	TRQ	Exports	Per cent
1995	216150	210529	97.4
1996	226700	221675	97.8
1997	226700	222622	98.2
1998	226700	222722	98.3
1999	226700	220868	97.4
2000	226700	226672	99.9
2001	226700	226585	99.9
2002	226700	226638	99.9
2003	226700	226216	99.8

Source: Meat New Zealand

Meat cannot be regarded as an entirely homogeneous product and disaggregation of demand should be pursued to reduce the heterogeneity of the product mix. In this analysis lamb and mutton (sheepmeat), and beef and veal (beef), are aggregated at first and then treated separately where applicable. There has been an increase in the proportion of chilled meat products, however, due to data limitations we do not disaggregate to this level in this study.

3. The Model

The gravity model adapts the gravitational concept to the form of any exchange between two groups (Dascal *et al*, 2002). In its basic form, the amount of trade between two countries is a function of their national incomes and the distance between them which is used as a proxy for transportation costs. Any flow from country *i* to country *j* can be explained by economic forces at the flow's origin, economic forces at the flow's destination, and the economic forces either aiding or resisting the flow's movement from origin to destination (Bergstrand, 1985). These models commonly use dummy variables in order to capture contiguity effects, cultural and historical similarities, common languages, regional integration, political blocs and patent rights.

The commodity-specific gravity model (Equation (1)), as derived by Bergstrand, therefore explains bilateral trade flows as a function of levels of economic activity, on the one hand, and the extent of impediments to trade on the other. The former are represented by GDP and population (or GDP per capita) for each country, while the latter are represented by transport costs, quota arrangements and health regulations:

$$Y_{ij} = b_0 X_i^{b1} X_j^{b2} L_i^{b3} L_j^{b4} C_{ij}^{b5} A_{ij}^{b6} e^{Uij} \qquad (1)$$

where Y_{ij} is the value (or volume) of real trade flows of a specific commodity from country *i* to country *j*, X_i and X_j are GDP of the two countries, L_i and L_j are their populations, C_{ij} is the transportation cost between *i* and each *j*, A_{ij} comprises other impediments to trade, and e is an error term. This equation is the reduced form equation from a general equilibrium model of supply and demand (Koo and Karemera 1991). In what follows we examine trade in a generic commodity group (meat) from a single country (NZ) to nine other countries over a period of 10 years in a combined time series and cross-section analysis.

In its estimation form, and using more descriptive variable nomenclature, we can write the function:

$$\ln Y_{ijt} = b_0 + b_1 \ln X_{it} + b_2 \ln X_{jt} + b_3 \ln L_{it} + b_4 \ln L_{jt} + b_5 \ln DIST_{ij} + b_6 QUOTA_{ij} + b_7 \ln ER_{ijt} + b_8 \ln PR_{ijt} + b_9 \ln PROD_{jt} + b_{10} HACCP_{ij} + U_{ijt} \qquad (2)$$

where

Y_{ijt} is volume of meat exported to each country market,

$DIST_{ij}$ is the distance between the two countries, used as a proxy for transportation costs,

$QUOTA_{ij}$ is a dummy variable which takes into account the years in which tariff rate quota arrangements were in place in a particular country,

ER_{ijt} is the exchange rate - the value of NZ dollars expressed in terms of each foreign currency,

PR_{ijt} is unit meat export price at shipping point to destination *j* in year t,

$PROD_{jt}$ is the volume of meat production in country *j* which is used as a proxy for changes in price of meats in each country(internal supply effect), and

$HACCP_{ij}$ is a dummy variable which takes value 1 from 1999/2000 when it was mandated.

It is expected that income coefficients are positively related to trade as countries with high incomes tend to trade more. On the other hand, population is often expected to have a negative sign as it takes an opposite sign with per capita income. According to Bergstrand (1989), income coefficients are positive if the commodity is the luxury end of consumption, capital intensive in production, and has an elasticity of substitution exceeding unity. However, this may not be the case always for NZ meat products.

In a general gravity model, distance coefficient is normally expected to be negative as high transportation costs could impede trade. Again this may not always be the case for a country specific model as other trade enhancement factors may outweigh this negative influence.

The presence of tariff rate quota (QUOTA) has a simple treatment in the model. The dummy variable takes value one in the years when the present quota arrangement commenced (i.e. from 1994 for exports of beef to the US and from 1995 for exports of sheepmeat to the EU). In doing this we simply assume that the quota is binding during this period. The sign of this coefficient will therefore depend on whether the presence of the quota has discouraged trade to these countries as compared with other countries.

The exchange rate is expected to have a negative sign as an appreciation of the NZ dollar relative to other currencies tends to have a negative impact on NZ exports. Export price (PR) is generally expected to have a positive sign as higher price encourages more exports. However, due to the cross-sectional effect, the price coefficient may also be negative if trade has been expanded in those markets where the premium has not been as high as in other markets. The production coefficient (PROD.IMP) is generally expected to be negative as an increase in meat production in importing countries should have a negative impact on NZ meat imports to that country. However this is only true when meat is treated as a homogenous product. If product differentiation is taken into account, the sign of this coefficient may change depending on consumer preference for NZ products.

HACCP is a dummy variable that takes value one from 1999/2000 when it was mandated. Although voluntary adoption of the programme before 1999 has happened in various plants in the meat industry, it is the uniform adoption of the principles of HACCP that should facilitate exports (Cao, 2005). The impact of HACCP in this study should be interpreted as the additional impact of a uniform adoption of the programme as compared with its voluntary adoption. The coefficient is expected to have a positive sign as agreement on better food safety practises should, in theory, enhance market access and favour countries which recognise NZ status with regard to HACCP.

4. Data Sources

Data of bilateral trade in meat products between NZ and 9 major trading partners (as identified in Table 2) over the period 1994-2003 are used to estimate the model (as specified in equation 2). These data are provided by Statistics NZ and the Meat and Wool Economic Service. GDP and population data are taken from International Financial Statistics Yearbook (IMF, 2003). All financial data have been converted to their real values by the appropriate CPI indexes. Production data is taken from FAO Statistical Database (http://apps.fao.org). Distances between countries are calculated as distances between capital cities, data is taken from http://www.geobytes.com/CityDistance Tool.htm?loadpage.

5. Estimation Results

Diagnostic tests for the combined data set show both evidence of autocorrelation and heteroscedasticity (results available on request). Therefore to estimate the gravity model POOL command in SHAZAM is used. The POOL command applies a generalised least squares procedure (GLS) to first estimate the model by Ordinary Least Squares (OLS) then transforms the observations using the estimated residuals and applies OLS to the transformed model. Estimation results for beef, sheepmeat, and total meat are presented in Table 5. The countries considered are Australia, Canada, China, France, Germany, Japan, Korea, UK and USA.

Income coefficients are all significant and positive except for the beef model. Similarly population coefficients have the expected signs for sheepmeat and total meat (although not significant for NZ population), but not for beef. The result for GDP.IMP suggests that beef and lamb exports to the selected countries during 1994-2003 do have the expected characteristics of luxury goods as well as being capital intensive in production.

Distance is significant in all cases but negative for beef and positive for sheepmeat and total meats. The beef result reflects increased costs to distant markets but the result for sheepmeat appears to reflect that the main market is the most distant one.

Exchange rate is not significant for beef but significant and negative for sheepmeat and total meat. The significant result for sheepmeat confirms the hypothesis that an appreciation of the NZ dollar has a negative impact on exports. The impact is not strong in the case of beef exports to the countries of the study.

Importing country production is negative for beef and positive for sheepmeat. It reflects that the major markets for beef are totally driven by domestic production whereas local production is not important for sheepmeat.

Price coefficients are significant and negative in all models. The negative sign suggests that exports are supplied at the going price rather than responding to price signals. It could also be influenced by the fact that meat exports have expanded in some markets

where the average price is significantly lower than the traditional markets (for example, real average price for China is $1.5/kg as compared with $6/kg in the EU).

Quota is significant in all cases but has negative sign for sheepmeat and total meat while positive for beef. The negative sign for sheepmeat reflects that during the study period exports to non-quota countries (e.g. China) have increased more rapidly than exports to quota countries. The results for beef reflect that the US market is still the dominant market.

Finally, the HACCP coefficient is positive in all cases but only significant for sheepmeat and total meat. It suggests that a uniform adoption of HACCP principles has a positive influence on sheepmeat and general meat exports. The influence is not strong in the case of beef. It suggests that earlier conformation with US requirements has obviated any recent effects of mandatory regulations.

Table 5: Estimation Results: Volume of Exports 1994-03

Variable	Beef	Sheepmeat	Total Meat
$GDP._{nz}$	-9.52***	2.26*	0.82*
$GDP._{imp}$	1.44***	1.76***	1.07***
$POP._{nz}$	17.86***	4.00	-0.16
$POP._{imp}$	0.21	-1.27***	-0.54***
DIST	-1.50***	3.10***	1.39***
ER	0.08	-0.15***	-0.13***
$PROD._{imp}$	-0.86**	0.18***	-0.18
PRICE	-0.66***	-2.92***	-1.41***
QUOTA	3.44***	-0.24***	-0.20**
HACCP	0.06	0.29***	0.17***
Const	41.26**	-39.42***	-6.40*
R^2	0.911	0.972	0.952

6. Summary and Conclusions

This paper has outlined the different types of non-tariff technical barriers to trade and utilised a gravity model approach to analyse NZ meat exports to significant markets during the 1994-2003 period. In common with the MRLs for aflatoxin B in grains and tetracycline in bovine meat, the results show a partial trade impact for mandatory meat hygiene regulations from the date they were introduced. This implies that countries' efforts in coordinating their hygiene standards in the sheepmeat sector has paid off in recent years.

There are several limitations. Firstly, non-tariff quotas were treated quite simply in the analysis. With the assumption of a binding quota, the quota dummy variable is more a regional dummy for countries granting non-tariff quota access to NZ meats. The result is not useful in any interpretation of the general impacts of quotas on trade. Further study is needed in this area.

Secondly, gravity model results seem to be sensitive to the choice of export destinations. As the current study is limited to nine trading partners in the 1994-2003 period, a larger set of data may be able to produce a more robust conclusion.

The results in Table 5 show that the gravity model for volumes of exports is generally highly descriptive of the main factors influencing trade over the period concerned. Better clarity is obtained by separating the beef and the sheepmeat market as would be expected. The dominant factors in the analysis appear to incomes in importing countries and net prices received in the exporting country, New Zealand. Quotas clearly shape the total market New Zealand faces in the world and exporters accommodate themselves to its realities. The impact of hygiene regulations is not strong in the case of beef but is clear-cut in the case of sheepmeat.

7. References

Bergstrand J H (1985), The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence, *The Review of Economics and Statistics, 474-481.*

Cao K (2005), *An Economic Study of the Impacts of RMP/HACCP on the NZ Meat Industry*. Unpublished PhD thesis, The University of Waikato, New Zealand.

Crutchfield S, Busby J, Frenzen P, Allhouse J, and Roberts D (2000), *The Economics of Food Safety and International Trade in Food Products*, Paper presented at the International Institute of Fisheries Economics and Trade (IIFET) Conference, Oregon State University.

Cyrus T L (2002), Income in the Gravity Model of Bilateral Trade: Does Endogeneity Matter?, *The International Trade Journal XVI*, No 2.

Dascal D, Mattas K and Tzouvelekas V (2002), An Analysis of EU Wine Trade: A Gravity Model Approach, *International Advances in Economic Research 8(2), 135-147.*

International Monetary Fund (2003), *International Financial Statistics Yearbook*, Washington.

Koo WW and Karemera D (1991), Determinants of World Wheat Trade Flows and Policy Analysis, *Canadian Journal of Agricultural Economics* 39, 439-455.

Ndayisenga F and Kinsey J (1994), The Structure of Nontariff Trade measures on Agricultural products in High-Income Countries, *Agribusiness 19*, (4), 275-292.

Otsuki T and Wilson J S (2000), Food Safety Regulations and Global Food Trade Patterns, American Agricultural Economics Association Annual Meeting,.

Wilson J S, Otsuki T and Majumbar B (2003), Balancing Food Safety and Risk: Do Drug Residue Limits Affect International Trade in Beef?, American Agricultural Association Annual Meeting, Montreal.