DISCUSSION PAPER

Estimating the Social Welfare Effects of New Zealand Apple Imports

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Abstract

This paper provides a demonstration of how a comprehensive economic framework, which takes into account both the gains from trade and the costs of invasive species outbreaks, can inform decision-makers when making quarantine decisions. Using the theoretical framework developed in Cook and Fraser (2008) an empirical estimation is made of the economic welfare consequences for Australia of allowing quarantine-restricted trade in New Zealand apples to take place. The results suggest the returns to Australian society from importing New Zealand apples are likely to be negative. The price differential between the landed product with SPS measures in place and the autarkic price is insufficient to outweigh the increase in expected damage resulting from increased fire blight risk. As a consequence, this empirical analysis does not support the opening up of this trade.

1. Introduction

In many ways, the use of economic models in the analysis of market access requests represents a new innovation in policy research. In Australia, these models have only been used in a handful of cases, all dealing with long-standing, high profile cases. This is perhaps due to the fact that until recently quarantine has been considered solely an area of scientific interest. In modern times, with the coming into being of the World Trade Organisation (WTO) and an ever-increasing emphasis being placed on quantitative and semi-quantitative risk assessments, economics is set to play a key role in quarantine policy formulation and justification as a supplement to scientific methodology. With this in mind, this paper attempts to promote a definitive role for economic analysis and apply it to the much-talked-about case study of apples imported to Australia from New Zealand (NZ) growers.

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The methodological basis of the paper is the theoretical approach developed in Cook and Fraser (2008) which, in considering a proposal to allow imports of a product, reconciles the benefits of trade in this product with the potential costs of an outbreak of invasive species as a consequence of the trade in this product.

This reconciliation is significant because import risk analyses (IRA) typically exclude the benefits of trade in favour of either quantitative or qualitative assessments of possible invasive species impacts. This is the case in most WTO Member countries, including Australia. Article 5 of the WTO Agreement on the Application of Sanitary and Phytosanitary Measures, commonly referred to as the SPS Agreement, identifies the factors considered paramount from a WTO perspective in assessing the extent of quarantine risks. But a conspicuous omission from this list of relevant factors is *consumer gains from trade*. This becomes highly important when attempting to use measures of societal welfare to examine the impact of market access requests because consumers constitute a large proportion of society.

In particular, if the economic benefits of importation can be clearly demonstrated to be above and beyond the quantifiable increase in pest damage risk, trade will result in a net gain to society. This being the case, the prohibition of these imports is effectively costing society. However, if the benefits of importing are insufficient to offset increased risk of pest damage, prohibition is justified on the grounds that it will prevent a net social welfare loss (Cook and Fraser, 2008).

At this point it should be recognised that the issue of importing New Zealand apples into Australia, and the analysis of this issue, has considerable history to it. Specifically, Hinchy and Low (1990) addressed a New Zealand request made in 1989 to import apples into Australia, where the major disease transference concern was (and remains) fire blight. Fire blight is a disease caused by the bacteria *Erwinia amylovora* that affects plants from the family *Rosaceae*, including apples and pears. Once established the bacteria can not be eliminated from an orchard, but costly measures such as an aggressive pruning regime can be taken to limit the extent of infection (Buckner, 1995). The disease originated in the United States, but has spread to most apple growing areas of the world with the exception of Australia[1]. It was first discovered in New Zealand in 1919, and apples have been refused entry to Australia since 1921 (BA, 2004).

Australia's detailed response to NZ's 1989 request, coordinated by the Australian Quarantine and Inspection Service (AQIS), was partly motivated by

[1] The likelihood of fire blight establishment in Australia has recently been shown to be very high using self organising map (SOM) analysis, which is a type of artificial neural network. This technique uses worldwide species associations to determine which species have the highest likelihood of establishing (Worner and Gevrey, 2006). A SOM analysis was performed on the worldwide distribution of 131 bacterial pathogens (CABI/EPPO, 2003), of which 71 are currently absent from Australia. The analysis ranked fire blight 17th in this list (Paini et al., in press).

the so-called 'Lindsay Review' of Australian quarantine (DPIE, 1988) that recommended moves away from 'zero risk' policies towards 'acceptable' quarantine risk. The economic component provided by Hinchy and Low (1990) was accompanied by a biological component, Roberts (1991)[2]. The former took the form of a benefit cost analysis comparing the expected consumer and producer surplus changes resulting from relaxing quarantine laws protecting the apple industry. In 1995 New Zealand made another request to access the Australian apple market. This time the economic analysis came in the form of Bhati and Rees (1996), which was quite different in approach to that of Hinchy and Low (1990). Expected consumer surplus change is not discussed. The analysis only considers possible producer surplus losses to pome fruit growers if a fire blight outbreak were to occur[3]. Both import access requests were denied. Viljoen *et al.* (1997) presents evidence that the import ban was indeed justified given that the pear industry in Australia could collapse in the event of a fire blight outbreak.

NZ again submitted an application to Australia to access the apple market in 1999 in which it asked specifically for management procedures that might be applied in order to reduce the risk of biological contamination below Australia's Appropriate Level of Protection (ALOP). Following the release of a draft IRA in February 2004 which recommended that market access be granted subject to strict pre-entry quarantine measures, mistakes were identified in the spreadsheet models used to ascertain the risks associated with certain pests. When these mistakes were corrected and the final IRA released in late 2006 market access was still deemed to present a sub-ALOP level of risk, but only if an even more stringent set of SPS measures were applied.

These restrictions were considered by NZ to be inconsistent with Australia's obligations under the SPS Agreement, and in early 2007 requested consultations with Australia using the WTO's Dispute Settlement Process (DSP). Subsequently, the European Union, United States requested to join the consultations. Despite the DSP initially targeting a completion date of June 2009, at the time of writing the dispute remains unresolved.

Given this controversial background, this paper applies the methodology of Cook and Fraser (2008), which represents a coherent economic framework of analysis of such trade decisions, to the empirical context of importing New Zealand apples with the aim of evaluating the social welfare consequences of allowing this trade.

The structure of the paper is as follows. Section 2 briefly outlines the theoretical model developed in Cook and Fraser (2008) for analysing the social welfare consequences of allowing new international trade in a product which is a potential source of invasive species outbreaks domestically. As

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[2] A theoretical discussion of the techniques used in this analysis appears in Hinchy and Fisher (1991).

[3] Like Hinchy and Low (1990), Bhati and Rees (1996) base their assumptions about the impact of the fire blight disease on the information contained in Roberts (1991).

stated previously, these consequences are in two main parts: the potential welfare gains from trade, and the potential welfare costs from invasive species outbreaks. On this basis, Section 3.1 estimates empirically the potential gains from trade in allowing New Zealand apple imports, while Section 3.2 estimates empirically the potential costs of outbreaks of fire blight among domestic apple crops. The paper ends with a brief summary which synthesizes these findings to produce an overall estimate of the social welfare consequences of allowing trade in New Zealand apples, and briefly discusses the associated policy implications.

2. The Theoretical Model

The choice facing the decision-maker is whether or not to import a homogenous good from another country. This good has the potential to act as a pathway for a harmful host-specific pest or disease that the source country has but the importing country does not. Assume that in the absence of price-inflating SPS measures, the landed price of imported product (p^{**}) is below that of a domestic equivalent (p_0), and that the domestic market is small relative to the rest of the world in terms of its influence on the world price. The domestic market for the product is characterised by a downward sloping demand curve, $f(q)$, and an upward sloping supply curve, $g(q)$. This is situation and is depicted in Figure 1, the details of which are explained below.

The domestic losses that could result from an exotic pest or disease outbreak resulting from contaminated imports can be estimated as the total expected change in producer surplus brought about by an incursion-induced (negative) supply shock, plus the cost of controlling the species (be it eradication or suppression). The probability of arrival (r) is most likely an increasing function of the quantity of imported product, q^*, and a decreasing function of the pre-border and border SPS measures the good is subjected to in the process of importation with cost t (i.e. $r(q^*, t)$). To simplify the effects of uncertainty, it is useful to assume a deterministic change in the probability of arrival with SPS compliant imports from abroad (r^*) relative to the probability of arrival without imports (r) (i.e. $r^* > r$).

As a starting point, a closed economy involves domestic producers with a supply schedule $g(q)$ providing the total supply (q_0) to the domestic market at a price p_0. If an incursion were to occur (despite there being no trade pathway) the supply curve will shift inwards to $h(q)$, and the new equilibrium price will rise to p_1 at which q_1 will be demanded. Note that even when no trade takes place $0 < r < 1$.

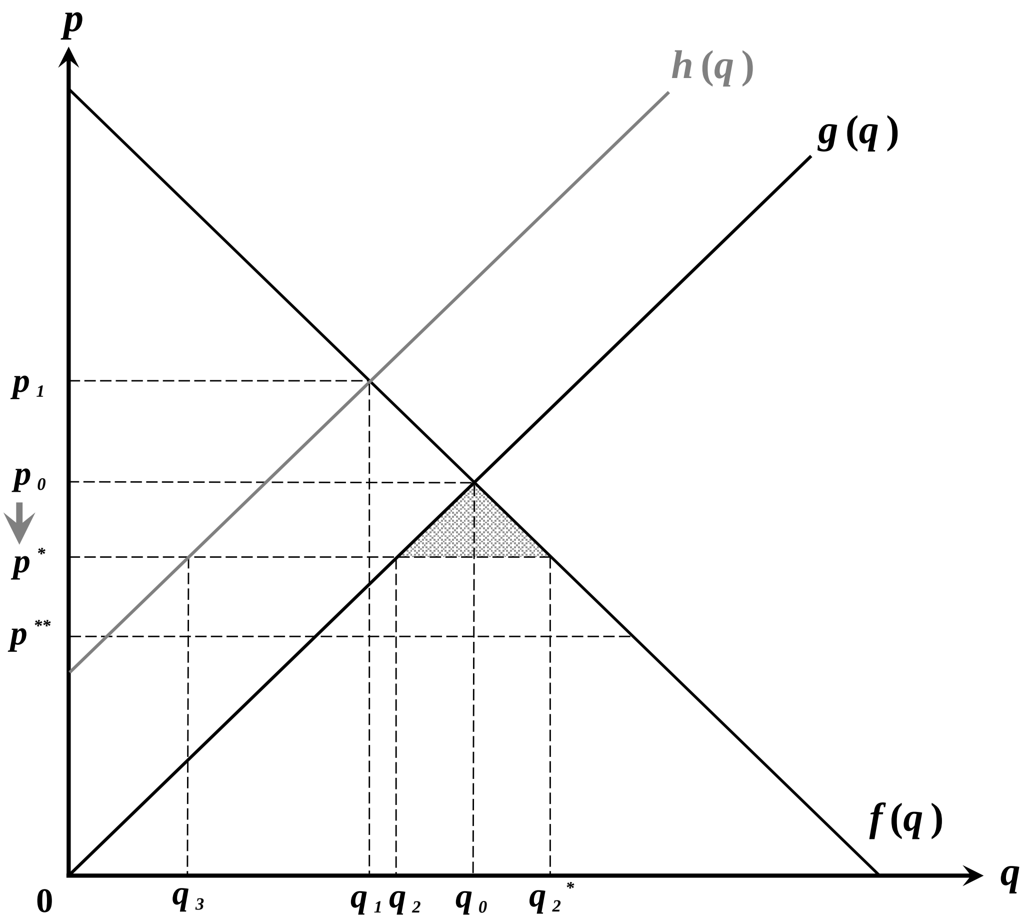

Figure 1. The quarantine-restricted trade decision from a closed economy position

If the market were to move from a closed to a quarantine-restricted trade situation the prevailing market price will fall to the world price (p^{**}) plus *t* (i.e. $p^{*} = p^{**} + t$ where *t* is sufficiently low to ensure that $p_0 > p^{*}$). Domestic producers will remain suppliers to the domestic market as long as p^{*} remains above the minimum average variable cost of production, supplying a lower quantity q_2. However, if trade takes place the likelihood of contaminated product reaching Australia via the trade pathway provided by $q_2^{*} - q_2$ imports increases from *r* to r^{*}. In the event that a pest or disease incursion does result the supply curve will shift inwards to $h(q)$, further reducing the quantity supplied by domestic producers to q_3.

Following an incursion, a co-ordinated control campaign is mounted against the invasive species to either eradicate it or restrict its abundance and distribution. Assume the total cost of control will depend only on the size of the outbreak upon detection (s) and the total reduction in abundance and distribution sought by the campaign (a), and is denoted $c(s,a)$ (Olson and Roy, 2005). Total control costs are assumed to be increasing in both a and s, while marginal control costs are increasing in a and non-increasing in s.

On this basis, *Expected Impact* of the invasive species if no trade takes place (EI_A) is given by:

$$EI_A = r.\left[\left(p_0 - \int_0^{q_0} g(q)\right)dq - \left(p_1 - \int_0^{q_1} h(q)\right)dq\right] + r.c(s,a) \quad (1)$$

Equation 1 states that EI_A is equal to the expected difference between the producer surplus under autarchy if no outbreak occurs and the producer surplus under autarchy if an outbreak occurs, plus the expected cost of control.

Secondly, the decision-maker needs to know the expected impact of the invasive species if trade takes place (EI_Q):

$$EI_Q = r^*.\left[\left(p^* - \int_0^{q_2} g(q)\right)dq - \left(p^* - \int_0^{q_3} h(q)\right)dq\right] + r^*.c(s,a) \quad (2)$$

Equation 2 states that EI_Q is the expected difference between the producer surplus with trade if SPS measures are 100 per cent effective and the producer surplus if an outbreak occurs, plus the expected cost of control.

But the importation of potentially contaminated goods also brings with it potential gains from trade with a lowering of prices. Imports provide a greater quantity of the good to consumers at a lower price, p^*, compared to the closed economy (autarchy) situation which, as shown in Figure 1, imposes costs to consumers and provides gains to domestic producers. Therefore, the decision of whether to import a commodity subject to SPS measures must be made relative to a closed economy situation, and must also establish the consumer benefits achieved and producer costs imposed by permitting trade.

In moving from a closed economy to a quarantine-restricted trade situation the prevailing market price would be expected to fall to p^* at which domestic producers are willing to supply q_2 of the total quantity demanded, q_2^*. The total consumer surplus gained by allowing quarantine-restricted trade is given by:

$$\Delta CS = \left(\int_0^{q_2^*} f(q) - p^*\right)dq - \left(\int_0^{q_0} f(q) - p_0\right)dq \quad (3)$$

This change in consumer surplus is the difference between the post-quarantine trade consumer surplus and autarkic consumer surplus. This gain comes at the cost of competition-induced producer surplus losses to domestic producers:

$$\Delta PS = \left(p_0 - \int_0^{q_0} g(q) \right) dq - \left(p^* - \int_0^{q_2} g(q) \right) dq \qquad (4)$$

This producer surplus change is calculated as the difference between the autarkic producer surplus and post-trade producer surplus. The resultant net gains, termed *traditional gains from trade* in Snape and Orden (2001), are simply the difference between consumer surplus gain and producer surplus loss ignoring the possibility of an invasive species incursion. That is, the traditional gains from trade here represent the change in producer and consumer surplus as a result of price differentials between the domestic equilibrium and landed price of imports:

$$GT = \Delta CS - \Delta PS \qquad (5)$$

This is represented as the shaded region in Figure 1.

However, as shown previously, these traditional trade effects do not take into account the effects on producers of the increase in invasive species risk (EI^*) brought about by trade (i.e. $EI^* = EI_Q - EI_A$). Therefore, the total gains to consumers resulting from trade must be sufficiently high to offset all the expected losses to domestic producers for there to be a net gain from moving from a closed economy to a quarantine-restricted trade setting.

More specifically, combining the changes in consumer and producer surplus with the expected impact of an invasion on producers, the expected net gains from trade (NG_E) can be stated as:

$$NG_E = GT - EI^* \qquad (6)$$

It follows that the decision of whether or not to import the potentially contaminated product is either:

a) If $GT - EI^* > 0$, allow trade to occur, or

b) If $GT - EI^* < 0$, do not allow trade to occur.

3. Empirical Estimation

3.1 Estimating the Gains from Trade from New Zealand Apple

The model used in this analysis is a simple comparative static spreadsheet model based on the theoretical model developed in section 2. It determines the likely changes in consumer and producer surplus brought about by different levels of competition from external suppliers. To incorporate uncertainty in parameter estimates, the *@Risk* software package is used[4]. In

[4] Palisade Corporation.

all, 10,000 iterations of the model were used to simulate all possible scenarios and to reveal the likely economic effects of apple imports.

3.1.1 Model Parameters

The data used to form parameter estimates are detailed below:

Elasticity of Supply – Estimated using a pert distribution with a minimum value of 0.2, a most likely value of 0.5, and a maximum value of 0.8 (approximated using Valdes and Zietz (1980) and Bhati and Rees (1996) as guides)[5];

Elasticity of Demand – Estimated using a pert distribution with a minimum value of -0.4, a most likely value of -0.6, and a maximum value of -0.8 (approximated using Valdes and Zietz (1980) and Bhati and Rees (1996) as guides);

Closed Economy Quantity Supplied (Q_3) – The closed economy quantity supplied was estimated at 290,300T (ABS, 2004; HAL, 2004).

Closed-Economy, or Autarchic Price (p_c) – $1,200/T (HAL, 2004).

Free Trade Price (p_f) - This represents the price at which apples from external sources can be supplied to the Australian market with no quarantine treatments required. O'Rourke (2007) ranked Australia 16th in a study of the production efficiency of 28 of the world's apple producing countries, while NZ was ranked 2nd. Given the relatively close proximity of NZ apple producers to the Australian market, this suggests that the landed price of NZ apples is a reasonable proxy for the world price. Using figures from Cook (2008) as a guide, we assume that shipping costs (including loading and road freight costs) involved in transporting product from NZ to Australia are in the order of $400/T. Data from FAO (2009) from 2002 to 2006 was used to construct a linear time series to project a 2008 NZ farm gate price of $680/T. This implies a landed price of NZ apples in Australia of around $1,080/T.

Post-Quarantine, or Import Price (p_q) - In the absence of time-series price differentials in a closed and quarantine-restricted market, an approximate quarantine-induced price rise of 10 per cent above the free trade price is assumed (i.e. $1,190/T), at which 2,650T will be imported.

Wholesale and Retail Marketing Margins - Wholesale margins are specified as a pert distribution with a minimum value of 10 per cent, a most-likely value of 20 per cent and a maximum value of 30 per cent. Retail margins are estimated using a pert distribution with a minimum value of 30 per cent, a most-likely value of 45 per cent and a maximum value of 60 per cent (Cook, 2008). Both wholesale and retail-marketing margins are assumed constant in percentage terms.

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[5] Generally, the approach taken was to estimate parameters characterised by *variability* using pert distributions. These are a form of beta distribution specified using minimum, most likely (i.e. skewness) and maximum values.

3.1.2 Results

The information outlined above was used to calculate the net gains from trade resulting from the import of NZ apples (subject to quarantine treatments) into Australia. This represents a movement from a closed-economy situation (autarchy) to one of quarantine-restricted trade. Results are presented in Table 1.

Table 1. The Gains from Trade Resulting from Apple Imports from New Zealand

	5% Confidence Interval	Mean	95% Confidence Interval
Change in Consumer Surplus (ΔCS)	$43,775,310	$46,343,070	$48,947,360
Change in Producer Surplus (ΔPS)	-$30,073,040	-$30,731,670	-$31,373,100
Gains from Trade (GT)	$13,702,270	$15,611,400	$17,574,260

Since the variability of parameters has been incorporated in the analysis, results are probability distributions rather than point estimates. They are described in the table simply by using the mean, 5th percentile and 95th percentile values within the distribution. With the demand and supply curve specifications used in this exercise, the results indicate that the net gains from trade to the Australian economy from allowing NZ apples into the country subject to quarantine treatments (rather than excluding them completely) are expected to be around $15.6 million per year with a standard deviation of approximately $1.6 million. Figure 2 shows the flow of these gains from trade over a 30-year period, showing the average present value ± 1 standard deviation from the mean. The discount rate used in these calculations is 8 per cent.

Sensitive parameters in the model include the landed price of NZ apples under both a free trade and quarantine-restricted scenario. *Ceteris paribus* (i.e. all other things being equal), if freight and transport costs are as low as $300/T the landed price of apples may be as low as $980/T. This would mean net gains from quarantine-restricted trade of $17.3 million, and therefore a higher break-even level of invasive species risk. On the other hand, if rising oil prices continue to increase the cost of freight to the point where they reach $600/T the landed price of apples may be as high as $1,280/T. This would mean the cost of quarantine-restrictions to Australian consumers would be negligible. Likewise, if SPS measures imposed on imported apples increase the landed price of NZ apples by more than 20 per cent (above the base case level of $1,080/T), the gains to Australian consumers are negligible as the post-quarantine price would be equivalent to an autarkic price.

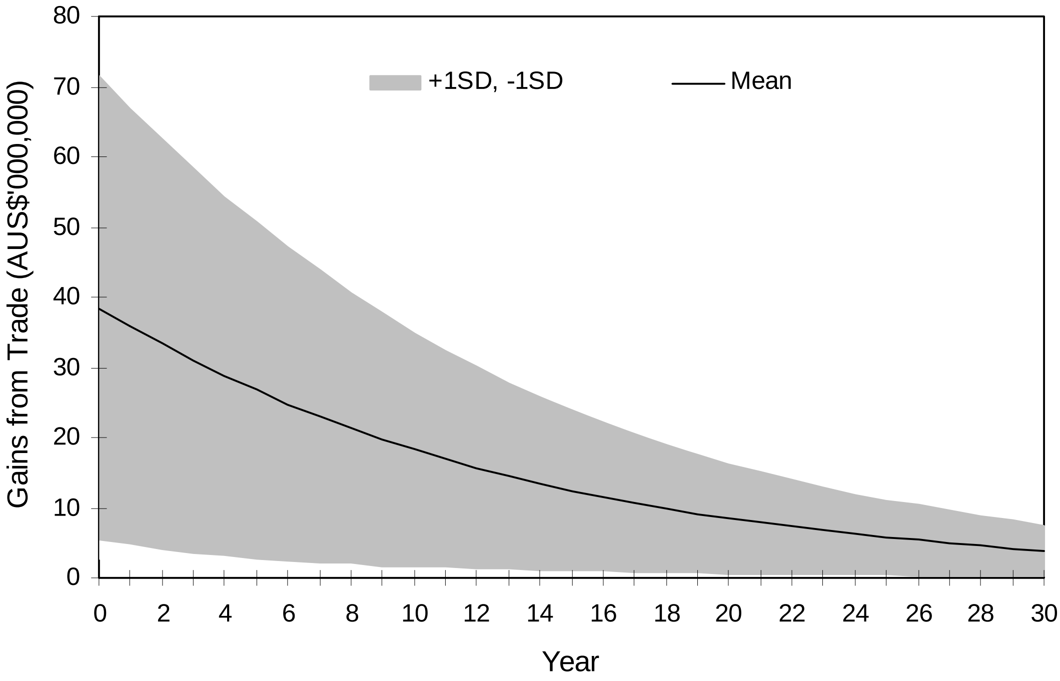

Figure 2: Present value of gains from trade over 30-years

3.2 Estimating the Expected Impact of Fire Blight

In order to estimate the invasion costs in both the autarkic and quarantine-restricted trade scenarios, a bioeconomic model is used to simulate national costs associated with fire blight incursions over a 30-year time period (Cook et al., 2009). Over time the pathogen may spread to other orchards in spite of local control, detection and eradication. The cost of these management efforts and market revenue loss of infected host plants for the pathogen are calculated using 1,000 stochastic runs of the model built in Stella™[6].

Figure 3 presents a stylised view of the model structure. The first point to notice about this diagram is that spread is simulated at both an orchard or farm level and a national level. Spatial homogeneity is assumed in the sense that different host plants and orchards, in spite of their different micro-environment in reality (i.e. location, elevation, temperature, water etc), have the same likelihood of infection[7]. If uncontrolled, fire blight will continue to spread to the point where it becomes *naturalised*. Naturalisation is complete when a species spreads to its full capacity within an environment, such that descendents of the original specimens introduced into that environment become permanent, non-spreading members of the flora/fauna (Mack, 1996; Mack and Lonsdale, 2001).

[6] Research version 9.1, isee systems, Inc. Hanover, New Hampshire, U.S.A.
[7] Future extension of the model may involve more complex biophysical modelling of susceptibility and resilience to infection (e.g. Hester and Cacho, 2003).

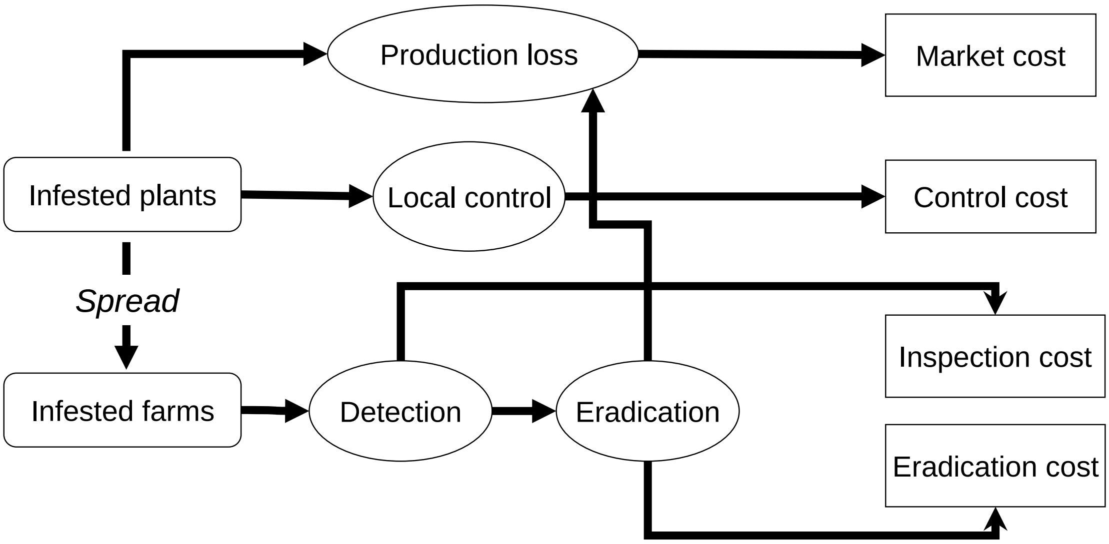

Figure 3. Model Structure

Three different levels of management activities are simulated in the model: (1) local control at orchard level; (2) detection; and (3) national-level eradication. Local control refers to all management activities that growers engage in (e.g. suppression using chemical sprays and/or pruning) after a specified proportion of their crop is infected. This proportion is termed the *start control threshold* (see Table 2 below). Central detection is an ongoing process where a portion of Australian orchards are inspected randomly. When a fire blight infection is found eradication immediately follows and the area of the orchard concerned will be deducted from the total productive land in the country. The model assumes that local control will stop when eradication starts. However, detection and eradication will not be terminated until it is prohibitively expensive to continue. The point at which this occurs in the model is termed the *central control choke price*.

The model simulates two types of economic costs attributable to fire blight incursions over time[8]. Firstly, revenue losses are comprised of direct losses of marketable product despite control and eradication efforts. This effect may be as high as 100 per cent in some cases, while in others it may be negligible. Secondly, management costs are determined from necessary control activities. These include inspection costs (which are increased after an initial infection is detected), control cost due to additional management actions taken to minimise crop damage, and eradication costs associated with the

[8] The importance of potential economic costs of non-market (e.g. impact on native biota) and indirect market (e.g. impacts on fertilizer sale after a major industry is devastated by an invader) impacts is acknowledged. However, it is difficult to incorporate these costs due to high level of uncertainty. Our model only captures impacts on market goods.

removal and destruction of infected trees[9], habitat manipulation and quarantine expenses.

The model is used to calculate the Present Value (PV) of future market costs of fire blight incursions over a 30-year period under both an autarchic and quarantine-restricted trade scenario. The difference between the predicted damages in each scenario indicates the change in expected impact of the disease over time as a result of granting NZ access to the Australian market for fresh apples.

3.2.1 Model Parameters

A list of the model parameters and their values for the autarchy and quarantine-restricted trade scenarios are presented in Table 2. The two sets of parameters values differ in terms of entry probability, quantity of apples imported and export price of Australian apples.

Table 2. Parameters and Their Values for Both Modelling Scenarios.

Parameters (unit)	Quarantine Restricted Trade	Autarchic Trade
Probability of entry (unitless)	0.5	0.175
Probability of establishment (unitless)	0.85	0.85
Local infection rate (number of host/infected tree)	2.5	2.5
Spatial infection rate (number of farm/infected tree)	0.1	0.1
Average orchard size (ha)	11	11
Total area of Australian production land (ha)	13,260	13,260
Area occupied by a host (number of host/ha)	0.00067	0.00067
Time to maturity (year)	6	6
Cost of control technique ($/ha)	18,650	18,650
Cost of inspection ($/ha)	1,200	1,200
Cost of eradication ($/ha)	300	300
Inspection budget pre1st detection ($/year)	100,000	100,000
Inspection budget post1st detection ($/year)	500,000	500,000
Central control choke price ($/year)	10,000,000	10,000,000
Preinfect export (kg)	2,705,000	2,705,000
Import (kg)	2,650,000	0
Pre-infect productivity (kg/ha)	20,400	20,400
Post-infect production % left (unitless)	0.8	0.8

[9] The model assumes the eradicated farms are immediately replanted. After a certain number of years (as defined by the parameter of time to maturity), these farms become productive again. Another assumption made is infestation doesn't happen on immature land.

Post-infect export% drop (unitless)	0	0
Pre-infect domestic price ($/kg)	1.19	1.2
Domestic choke price multiplier (unitless)	3	3
Supply elasticity (unitless)	0	0
Demand elasticity (unitless)	-0.6	-0.6
Export price ($/kg)	1.08	1.38
Discount rate (unitless)	0.08	0.08
Start control threshold (unitless)	0.03	0.03
Control tech effectiveness (unitless)	0.4	0.4
Detection probability if inspected (unitless)	1	1
Search efficiency (unitless)	1	1
Initial time since last detection (year)	1,000	1,000
No. of detect years before eradication declared (year)	3	3

3.2.2 Results

The total invasion costs over a 30-year period were calculated for both the quarantine restricted trade and Autarchic trade, and then the difference between them taken to give the change in expected impact. The present value of annual damages expected to result from fire blight incursions over the simulation period are given in Table 3. These results are obtained using the parameter values given in Table 2. Sensitivity tests indicate that the model is sensitive to changes in eight of the 31 parameters listed in Table 2. These include: probability of entry; probability of establishment; local infestation rate; spatial infestation rate; pre-infestation inspection budget; post-infestation infection budget; and the discount rate.

Table 3. Expected damage per year from fire blight incursions

	5% Confidence Interval	Mean	95% Confidence Interval
Expected Impact Under Autarchy (EI_A)	$33,195,360	$51,389,040	$73,048,980
Expected Impact Under Quarantine-Restricted Trade (EI_Q)	$49,986,540	$70,230,220	$95,792,360
Change in Expected Impact (EI^*)	$16,791,180	$18,841,180	$22,743,380

The average present value from 1,000 iterations of the model ± 1 standard deviation from the mean is shown in Figure 4. It is apparent that the increase in expected losses from fire blight incursions resulting from contaminated NZ apple imports will be negligible until year 15, after which they increase dramatically. This lag period is attributable to the SPS measures imposed on apple imports being relatively effective. Under the SPS-restricted trade scenario the model predicts an incursion event will occur approximately two years earlier than under an autarchy situation. However, despite the difference in expected impact occurring well into the future (and hence being subject to the erosive effects of an 8 per cent discount rate), the damage caused is on a very large scale.

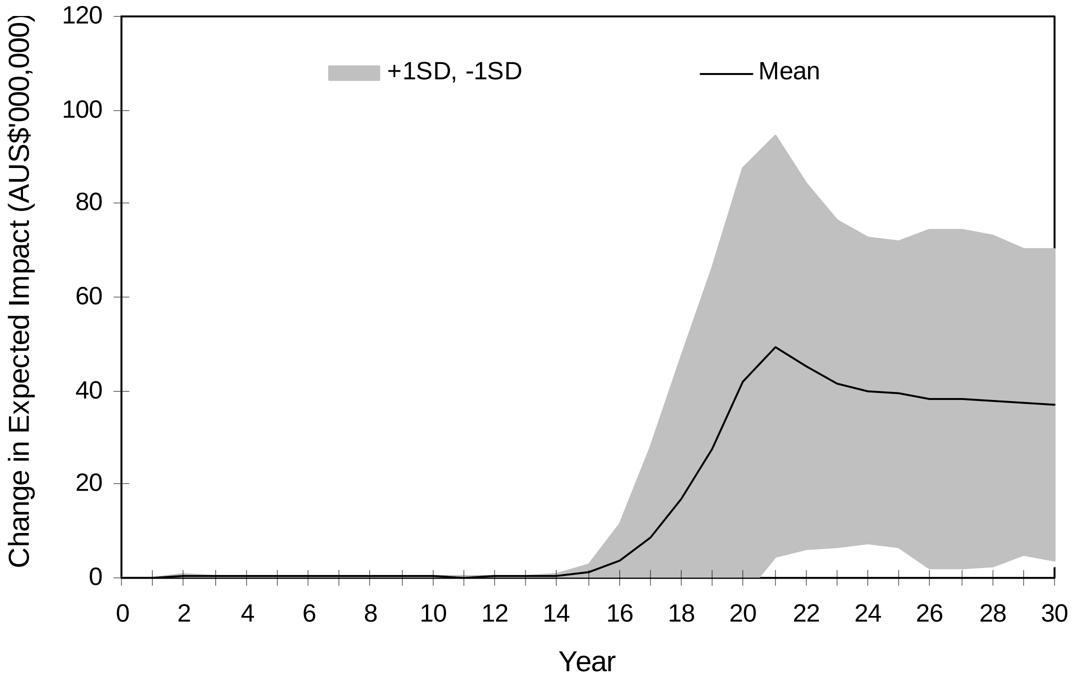

Figure 4: Change in expected impact over time

The overall effects on the economy can be seen by plotting the change in expected impact with the gains from trade, as in Figure 5. Here the net change in social welfare proxied by changes in consumer and producer surpluses under the autarchic and SPS-restricted trade scenarios is also plotted. Net social welfare is likely to be improved substantially by opening up trade to NZ apples until year 17. After this point the increase in fire blight damages resulting from an increased likelihood of incursion (albeit small) will be such that net welfare becomes negative. This is despite the effects of discounting on future values.

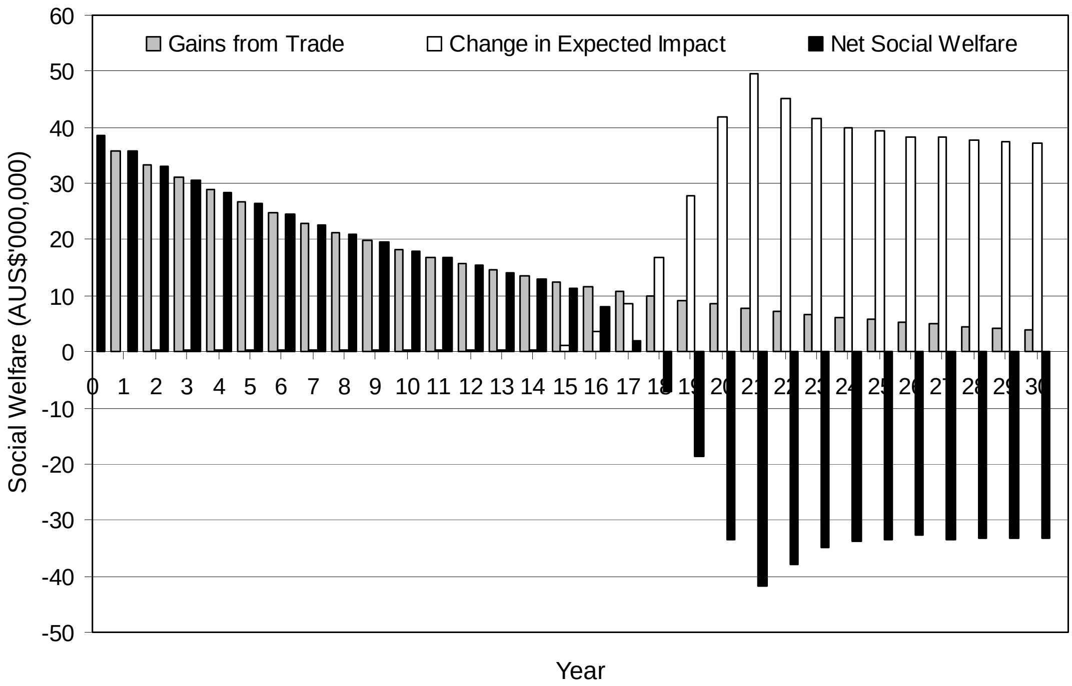

Figure 5: Change in social welfare over time

Given the intertemporal nature of trade benefit and cost accrual, it is difficult to make comparisons since a great deal hinges on the time frame being considered by decision-makers. Assuming this to be the full thirty years and taking the mean present annual value of gains from trade and change expected impact resulting from a move from autarchy to SPS-restricted trade, the net impact on social welfare is likely to be negative. Over this time period, the ratio of trade benefits to expected costs is approximately 0.8:1.

4. Conclusions

The use of economic analysis in the assessment of import requests remains 'new ground' in many ways. While examples have been provided in the past there has yet to be a consistent and generally accepted approach to quarantine policy analysis. This paper has provided a demonstration of how a comprehensive economic framework, which takes into account both the gains from trade and the costs of invasive species outbreaks, can inform decision-makers when making quarantine decisions. In particular, this paper has utilised the framework developed in Cook and Fraser (2008) to make an empirical estimation of the economic welfare consequences for Australia of allowing quarantine-restricted trade in New Zealand apples to take place.

Based on the theoretical model outlined in Section 2, it is estimated in Section 3.1 that liberalising trade to allow apples to be imported from NZ subject to quarantine restrictions is expected to increase net economic welfare (primarily in terms of benefits to consumers) by between $13.7 million and $17.6 million per year. However, in opening up the market to trade, the domestic apple industry is exposed to a higher level of biosecurity risk due to the presence of potentially harmful pests and diseases in external apple sources. In Section 3.2 an economic assessment of the potential impact of fire blight if introduced via NZ apple imports reveals an overall increase in likely annual damage (assessed over a 30-year period) of between $16.8 million and $22.7 million per year.

Combining the results of the estimations in Sections 3.1 and 3.2, suggests the returns to Australian society expected to result from importing apples from New Zealand are marginal. The price differential between the landed product with SPS measures in place and the autarkic price is insufficient to outweigh the increase in expected damage resulting from increased fire blight risk. As a consequence, this empirical analysis does not support the opening up of this trade.

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