Tariffs, quotas and terms-of-trade: The case of New Zealand

Liliana Winkelmann[*], Rainer Winkelmann

Department of Economics, University of Canterbury, Christchurch, New Zealand

Abstract

This paper reports quantitative information on the effects of tariffs and quotas on prices of individual goods. The analyses uses the natural experiment provided by a comprehensive unilateral trade policy reform in New Zealand to examine the response of foreign exporters to an incident of liberalisation that is unique in the developed world. The price effects of tariffs and quotas are estimated using a multidestination 7-digit longitudinal product-level dataset on export values and quantities. The effects are found to be by no means equivalent: Whereas tariffs display no significant effect, the impact that quantitative restrictions have on the terms-of-trade of the country that imposes them are unequivocally detrimental and quantitatively important. © 1998 Elsevier Science B.V. All rights reserved.

Keywords: Nontariff barriers; Quantitative restrictions; Trade liberalisation; Trade policy

JEL classification: F13; F14

1. Introduction

The years 1984–1988 represent a watershed in the area of New Zealand trade policy. By the end of the period, the edifice of import licensing that grew out of the import-substitution policies of the previous half century was largely torn down. Accompanying reductions in tariff levels that commenced in 1986 furthered the

[*]Corresponding author. Tel.: +64-3-3642731; fax: +64-3-3642635; e-mail: l.winkelmann@econ.canterbury.ac.nz

process thus to turn the 'Fortress New Zealand' into one of the world's most competitive economies.

We use this unique circumstance of massive trade reform to empirically assess the effects that a liberalisation of tariffs and quotas had on the prices charged by foreign exporters selling to the country. Both the sign and magnitude of these effects have come to be the matter of some controversy. Traditionally, it is only the price effect of quotas that was considered unclear; via stating by how much the price at home exceeds that in the rest of the world, tariffs seemed by themselves a good indicator of the effect they have on domestic goods prices. Later work on trade policy under imperfect competition has suggested, however, that the effect of either measure on terms-of-trade is likely to depend on usually unknowable details about market conduct.[1] Thus, the terms-of-trade effects of the measures are ultimately an empirical matter.[2]

Three features of the New Zealand incident greatly facilitate an empirical analysis of the effects of trade policies on product prices. One is that the country is definitely a 'small' country. Recovered price effects, if any, are hence un-equivocally indicative of the firms' pricing behaviour being subject to the (choice of the) policy imposed.[3]

Next, the extent of the reforms in terms of the range of products covered allows for examining the effects of restrictions in product markets that differ considerably in the degree of market power that sellers are expected to have.[4]

Last but not least, the fact that our dataset is fairly thick in terms of number of years allows to estimate the impact of the barriers on prices by comparing the price in the barrier-restrained market to that in the 'same' market without the barrier. A few additional attributes of the New Zealand protective regime are highlighted in a following section; altogether, they ensure that our findings are what we consider comfortably convincing.

Our central conclusion is that quotas and tariffs have vastly different effects on the terms-of-trade. Specifically, tariffs have no consistent, discernable effect on prices charged by foreign firms whereas detrimental effects of quotas on those

---

[1] Helpman and Krugman (1989) is a standard reference.

[2] Quantitative information on these effects is scarce, with Feenstra (1989) being the seminal reference. Feenstra's findings demonstrate an 'incomplete pass-through' of the tariff, i.e. suggest that exporters will generally not allow consumer prices at the destination to rise by the full amount of the tariff.

[3] For a 'large' country, the recovered price effects, if any, might be due to a change in the world demand for the good under consideration (as in the standard optimal tariff argument).

[4] In this sense, the study builds on Feenstra (1992, 1993); Goldberg (1995) and Berry et al. (1994), who investigate the VERs on automobiles and their effects on domestic prices, quality upgrading, profits and profit margins. Since New Zealand is the only developed country that has undertaken a comprehensive trade liberalisation program, the study complements those of Levinsohn (1993) and Harrison (1994) who examine effects of trade liberalisation in Turkey and Côte d'Ivoire respectively. It further supplements those studies by focusing on the pricing behaviour of foreign exporters, rather than the mark-ups of domestic producers.

prices are ubiquitous and quantitatively important. The analysis indicates that these findings are robust and fairly stable across industries.

In what follows we first convey the essential points of the controversy surrounding the terms-of-trade effects of tariffs and the quantitative restrictions (Section 2) and then review some pertinent features of the New Zealand protection and liberalisation experience (Section 3). The data and empirical model used to estimate the price effects of tariffs and quotas are presented in Section 4 while the results are reported and discussed in Section 5. Section 6 concludes.

2. Effects of trade barriers on export prices[5]

There are basically two ways to think of the effects of trade barriers on export prices. A particularly convenient one is to conjecture that, for the product market in question, the price is costs determined, with other factors, if any, having no noticeable impact on it. Fig. 1 depicts the case. A quota Q_q and an 'equivalent' *ad valorem* tariff rate $\tau = (p_q/p_f - 1)$ both raise domestic price to p_q, while the external price remains unaltered at p_f. In other words, the policies are deemed to
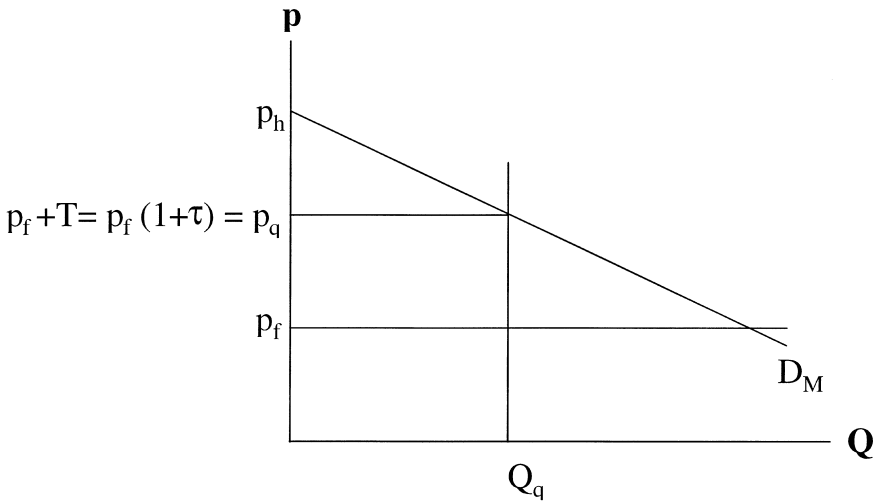

Fig. 1. Trade policies and prices with no market power in foreign supply.

have no effect whatsoever on the price charged by foreign exporters selling to these markets.[6]

Quite to the contrary, not only protection itself but also its form get a crucial determinant of the export price once market power in foreign supply is assumed instead. A benchmark case is that of a monopolist selling to a segmented destination market (Fig. 2). Whereas the price (p_q) under quota Q_q exceeds the free-trade price level p_f, the price ($p_q - T$) charged under an import-equivalent tariff of size T is lower than the free-trade price and, hence, lower than the quota induced price.[7]

This result, however, turns out to be sensitive to factors such as demand conditions and restrictiveness of the quota. For instance, the relative size of the destinations' markets can interact in a way that makes an imposition of a restrictive quota improve rather than worsen the terms-of-trade of the country that imposes it (Krishna, 1990).[8]

The responsiveness of price to the choice of policy becomes even more evident in oligopolistic settings where firms' strategic behaviour comes into play. On one hand, the nature of competition (price vis-à-vis quantity) becomes a major determinant of the effect that a barrier has on prices; on the other, introducing a barrier might alter the nature of competition. Nuances such as size of the quota or
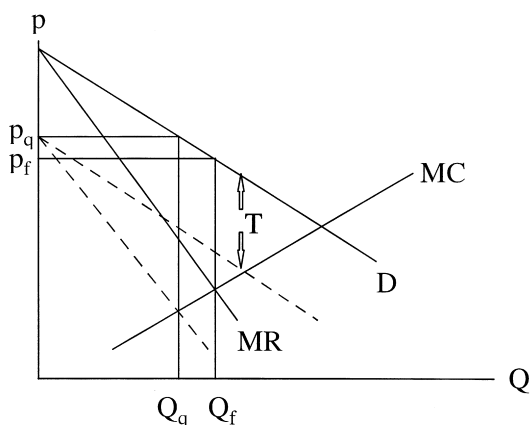
Fig. 2. Trade policies and prices with monopoly power in foreign supply.

---

[6]Presence of domestic market power does not change this result. As long as the foreign supply is infinitely elastic, the export price remains exogenously determined.

[7]The result applies whenever demand is less convex than a constant elasticity demand curve.

[8]This effect is the strongest if the domestic country is small and the domestic (residual) demand curve inelastic.

history of the industry then play a major role in determining the sign and magnitude of the effects.[9]

Yet, apart from establishing that a proper analysis of quotas and tariffs' effects on prices charged by foreign firms needs to take into account the induced effect of the measures on market conduct, the theoretical work did not take it much further. Moreover, by showing how inconclusive and sensitive to assumptions the effects are, the work has indicated that the only way to make those insights policy relevant is to assess the effects empirically.

3. Import protection in New Zealand[10]

3.1. Breadth and depth of the coverage

A major appeal of the New Zealand case for an empirical analysis derives from the fact that the extent of the protection as well as of its liberalisation renders the effects of trade barriers on the individual goods prices empirically identifiable. Laird and Yeats (1990) report the extent of the nontariff barrier (NTB) coverage for New Zealand and the rest of the OECD countries, for 1981, 1983 and 1986, using two measures of coverage, namely a frequency ratio (showing the percentage of tariff lines covered by NTBs) and a trade coverage ratio (showing a share of total imports subject to NTBs).[11]

Throughout the period New Zealand ranked highest in terms of both indices. For instance, its frequency ratio in 1981 (45%) was twenty five percentage points higher than the next highest frequency ratio listed (for Norway) while the next highest trade coverage ratio (of Japan) was more than twenty percentage points lower than the corresponding ratios for New Zealand (46.4%). Moreover, in terms of either index, the share of New Zealand's imports subject to NTBs by far exceeded the average of the OECD countries as a whole (where the frequency ratio and the trade coverage ratio were 12.2 and 15.1 respectively) as well as that of the OECD developing countries (where the frequency ratio and the trade coverage ratio were 18.7 and 18.8 respectively).

The extent of the liberalisation was no less pronounced. Its pace was accelerated

---

[9]For these results, see Fung (1989); Harris (1985); Itoh and Ono (1982a), (1982b); Krishna (1989); Mai and Hwang (1988), (1989); Nordström (1992); Rotemberg and Saloner (1989).

[10]The history of import protection in New Zealand is detailed in publications of the Ministry of Commerce (1987), (1990), (1994).

[11]An aggregate nature of the measure precludes their usage in assessing quotas' effects on prices of individual goods. Moreover, to the extent that one's interest is in the severity of the restrictions, neither index conveys the correct information. In particular, rather than stating how much trade is prevented from taking place because of the restrictions, the indices show how much trade takes place under the restriction.

in 1984, by a movement to sell import licenses in a competitive bidding process. So obtained licence prices were then used to remove quotas by converting them into 'equivalent' tariffs. The phased removal of import licensing was completed by the end of 1992 and accompanied by several years of tariff harmonisation and reduction. Between July 1988 and July 1992, nonindustry plan tariffs were reduced using a formula that had the effect of reducing high tariff rates more than low ones, thus tending to level the average tariff rate out.[12] A post-1992 tariff programme, announced in March 1990, provided that most tariffs would reduce to a maximum level of ten percent until July 1996.[13]

3.2. Composition of protection

Another appealing feature of the New Zealand protection concerns its composition in terms of both products covered and the measures used to do so. As to the latter, tariffs and quantitative restrictions were the exclusive measures practised. Furthermore, the incidence of the quantitative restrictions was confined to only two measures: nonautomatic licensing regulations (requirements for an approval which is not granted freely or automatically, as a prior condition to importation) and quotas (global or bilateral, other than VERs and MFA restraints). Although a few licences were administered on a volume basis (leather goods, footwear, writing instruments, wallpaper, golf clubs and badminton rackets), most New Zealand import licensing restrictions were denominated in value terms, meaning that they restricted value rather than quantity of imports.

In contrast to the quantitative restrictions coverage of the agricultural sector that has been characteristic of most OECD countries and the EC countries in particular, an emphasis on the protection of manufacturers is typical of the coverage in New Zealand. The quantitative restrictions applied to virtually all import-competing goods produced while covering more than twenty five percent of the country's 1981 imports. Incidentally, the most important import category (30.4 percent of all imports in June 1982), Machinery and Transport Equipment, was also the category with the smallest proportion of imports (49.2 percent) exempt from import licensing.[14]

Finally, note that trade barriers in New Zealand were put in place to counter the country's deteriorating overseas currency reserves difficulties, rather than in response to trade performance. This detail hedges our estimates against the

---

[12]The formula was introduced by the Swiss and used to harmonise the tariff levels around the world following the final Tokyo Round Agreement (1979). It is: tariff reduction $= \tau/(\tau + 0.14)$, where $\tau =$ the existing tariff rate. Hence, a 70 percent existing tariff rate would be cut by about 83 percent whereas a 10 percent existing tariff would be cut by 42 percent.

[13]As compared to, let's say, 1981 when the average tariff rate was about 28 per cent.

[14]The quantitative information in this section comes from Laird and Yeats (1990).

simultaneity problem that arises when barriers are put in place in response to the international trade outcomes.

4. Data and the empirical model

4.1. Data

Our empirical analysis uses a 7-digit longitudinal product-level data set on annual values and quantities over the period 1973 to 1994. The data were pooled from publications of the U.S. Department of Commerce and include annual value and quantity exported from the United States to eight destination countries for eight SITC classification categories. The control destinations, Canada, Denmark, United Kingdom, Germany, Switzerland, Japan and Australia, are selected to include major trading partners of the source country and to provide variation in terms of both size and distance from the US.

The choice of industries (cars, cartires, airplanes, motorcycles, film, paper, bourbon, books) was driven by several factors. One was to provide a variety as to the extent of protection and the type of products in terms of the degree of market power that sellers are expected to have. Another was to include products that are important and continuing import categories for New Zealand but also for the control destinations, in an attempt to develop a balanced panel.[15] In addition to the time span involved, the latter task was obstructed by difficulties involved in designing a concordance map required for putting the data set together. To start with, the U.S. Department of Commerce publications used three different classification schemes, namely TSUS, SITC(R2) and HS based classifications. The difficulties were compounded by the fact that the Customs Tariff of New Zealand has undergone seven (non one-to-one) transformations during the 1973–1994 period. The tariff data were taken from these seven publications.[16]

The data on annual values are in units of the exporter's currency ($US) at the port of export (f.o.b. prices).[17] They are divided by the corresponding annual destination-specific export quantities to construct a data set of unit values that are then used as the dependant variable–the export price. Since they are all expressed in $US, these unit values have the virtue of being readily comparable across destinations.

The multidestination data on export values and quantities are available at the

---

[15]This has, unfortunately, proved impossible at the end, mostly due to the length of the time period. Even among the industries sampled, data on paper, film and motorcycles are available until 1988 only.

[16]The assistance of Brian Sheard of New Zealand Customs in designing the latter concordance is gratefully acknowledged. While a comparison of the tariff coefficients across destination markets would be interesting, for the issue analysed here it is of somewhat marginal relevance and thus does not justify the costs it would entail.

[17]F.o.b. prices are free of transportation and distribution costs as well as retail and tariff markups.

7-digit industry level only. Thus, it is possible in principle that unit values to a particular destination may decline due to a change in the variety of goods purchased within the category rather than a change in price of each variety. Whether this can explain the behaviour of prices of exports to New Zealand relative to other destinations will be considered once the evidence is presented. To foreshadow that discussion, we find this an extremely unlikely explanation of the findings.

4.2. The model

To analyse the export price adjustment for a 7-digit industry we estimate the following model:

$$p_{it} = \gamma \tau_{\mathrm{NZ},t} + \lambda_{\mathrm{NZ}} d_t + \beta x_{it} + \varepsilon_{it}$$

$$\varepsilon_{it} = \lambda_i + \theta_t + u_{it}$$

where i ($i = 1, 2,...,N$) and t ($t = 1, 2,...,T$) index the destination market for exports and time, respectively, p is the log of the destination-specific export price (as defined above), $\tau_{\mathrm{NZ},t}$ is the log of the tariff rate, x is a matrix of control variables that include the exchange rate and GDP, and

$$d_t = \begin{cases} 1 & \text{if } t \geq 1987 \text{ and destination is New Zealand} \\ 0 & \text{otherwise} \end{cases}$$

The model extends Knetter (1994) specification of an export price equation by introducing a more general covariance matrix as to allow estimation in the presence of AR(1) autocorrelation within panels and heteroscedasticity across panels.[18] In other words, we assume

$$E[u_{it}] = 0$$

$$E[u_{it}u_{js}] = \begin{cases} 0 & \text{for } i \neq j \\ \sigma_i^2 \rho^{|t-s|} & \text{for } i = j \end{cases}$$

The time effects, θ_t, are introduced to capture the unobservable effects that are

---

[18]We have estimated a more general version where the autocorrelation parameter varies across panels. The model, however, did not offer a significant improvement. We have also considered estimating a system of seemingly unrelated regressions. One way to do it would be to interpret the data as a cross-section of time series, and allow for contemporaneous correlation between errors across destinations. In addition to the fact that the time effects account for all common shocks to prices across countries anyway, two factors spoke against this option. First, the model greatly proliferates the number of parameters to be estimated; second, the SUR estimator requires a balanced panel, and the consequent loss in efficiency due to a reduced sample size would by far outweigh the gains obtained by assuming a more general covariance matrix. The latter factor played a major role for not pursuing the other, albeit more appealing possibility, namely pooling across industries to capture correlations across industries for a given year and destination.

constant across destinations but may vary over time and, hence, account for changes in costs of production through time. The destination-specific effects, λ_i, control, on the other hand, for the unobservable effects that are constant over time but assumed to vary across destinations. As such, they account for potential time-invariant differences in the composition of imports within category or differences in the competitive conditions across destinations. Thus, the model makes it feasible to, for a given average quality of destination-specific imports, disentangle the change in price due to a change in the destination-specific markup from one that comes from a cost change.

In general, one can choose to model λ_is and θ_ts as random effects or as fixed effects. We opted for the latter for a couple of reasons. First, we are interested in the magnitude of the parameters.[19] Second, we suspect that the destination-specific effects are correlated with the explanatory variables.[20] In estimation, one time- and one destination-specific effect must be dropped to avoid singularity. Here, the destination effect for New Zealand is dropped and, consequently, the destination-specific effect for each country will measure the average export price difference (in percentage terms) between destination i and New Zealand during the pre-1987 period. Similarly, year 1973 is excluded. Since our control variables, the country-specific GDP and exchange rate, are normalised around their means, the constant term equals the price to NZ in 1973 at the average values of the GDP and exchange rate series.[21]

The motivation to control for exchange rate effects comes from the pricing to market literature (see e.g. Marston, 1990; Knetter, 1993), where exchange rates were found to be significant determinants of the changes in the destination-specific markups. Taking into account that a heavy depreciation of the currency paralleled New Zealand's trade liberalisation program of the mid-80s, we include the exchange rate as an explanatory variable in order to isolate the effects of trade restrictions. Moreover, the estimated exchange rate coefficients will be used to test for the symmetric pass-through of tariffs and exchange rates à la Feenstra (1989). GDP is included as a demand shifter.

---

[19]The estimation can be done in levels or in differences. By estimating in first differences we would difference out all the country-specific effects except for the NZ dummy in the period when the reforms occurred. These, however, can be of interest since the timing of the reforms bite is fairly inexact. We thus decided to use the levels specification.

[20]It is, for instance, highly likely that the composition of imports is correlated with the country's income.

[21]The exchange rate series is expressed in units of buyer's currency per US$, and deflated by the wholesale price index in the destination market. To construct it, the annual average nominal exchange rates and the wholesale price indices published in various issues of the International Financial Statistics are used. Adjusting the series by taking the log of the series divided by its mean, imposes the condition that export prices are unaffected by the changes in the exchange rate that are linked to inflation in the destination country. To construct the GDP variable, we use the IFS series on real GDP (in 1990 prices) in local currency. For Germany, this series is not available for the entire period and, hence, we deflate nominal GDP by the CPI. This series is then also adjusted by taking logs and normalising around the mean.

Feenstra (1989) work is the one that provides a seminal evidence on the quantitative effects of tariffs on the prices of individual goods. The export prices may be unaffected by tariffs; in that case, the pass-through of the tariff is said to be complete. Alternatively, exporters may lower their prices following a tariff increase; the tariff pass-through is then referred to as incomplete and local prices will be found to increase by less than the amount of the tariff. The coefficient γ measures the price-effect of the tariff. It will be zero in the former and negative in the latter case.

As for λ_is, there might be country-specific characteristics that cause the average prices to differ across destinations. A higher λ_i might, for instance, reflect a persistently higher quality of goods within the specific export category.[22] Systematically higher λ_is across industries are more likely, however, to indicate a country-specific idiosyncrasy, such as substantially more anticompetitive import restrictions relative to the rest of the world.[23] The restrictions would enable exporters to capture some of the associated rent, and the export prices to that destination would thus be higher than to those charged to the rest of the world.

If the quantitative restrictions in New Zealand were significant and the rents were not fully captured by domestic importers, the average level of markup over cost to New Zealand should have fallen following the liberalisation. The coefficient λ_{NZ} is introduced to measure this effect. In the case that the average post-liberalisation markup has decreased, we ought to find $\lambda_{NZ} < 0$.

Is it possible that a reduction, if any, in λ_{NZ} reflects a liberalisation induced fall in quality purchased? Work by Feenstra (1993) and others has, in fact, suggested that quotas may induce quality upgrading which could have the effect of increasing unit values even if the price of a given quality remained unchanged. The fact that quotas in New Zealand were denominated in value, rather than volume terms is, therefore, crucial. Importers who are constrained by the value of goods they import maximise their returns with respect to each dollar of import entitlement. Consequently, their actions do not affect the relative price and, hence, the composition of imports within the restricted category relative to free trade.[24]

---

[22]The model allows that goods shipped to different destinations are similar rather than identical. The prices that firms charge for those goods will be in different ratios to marginal cost.

[23]To see why, recall that the equilibrium prices in each market will eventually be determined by the exporters' perceptions of the elasticities of demand facing them in those markets and, therefore, be not necessarily the same. Since there is no reason to believe that shapes of (residual) industry demand schedules for a wide range of industries differ systematically across destinations, systematic country-specific relationships in relative prices in those industries are better interpreted as country- rather than industry-specific.

[24]To see the latter, suppose that p_i and p_j, and p_i^{exp} and p_j^{exp} stand for the domestic and export prices of a cheaper and a more expensive variety of the import category under consideration. If importers are facing a limit on the value of imports, they will find it profitable to import each variety up to the point where the return per dollar spent is the same for both varieties, i.e. until $(p_i - p_i^{exp})/p_i^{exp} = (p_j - p_j^{exp})/p_j^{exp}$. Thus, in equilibrium, the relative price at home does not differ from the relative export price, i.e. $p_i/p_j = p_i^{exp}/p_j^{exp}$. The case is in contrast to that of volume quotas, where importers are optimising at the point where premia for both varieties are equal.

5. Interpretation of the results

To examine the price impact of tariffs and quotas, we begin by an exploratory analysis of the export price charged to New Zealand relative to the export price charged to 'rest of the world' throughout the sample period. We compute the latter price as an average of the unit values charged to all other destinations, namely
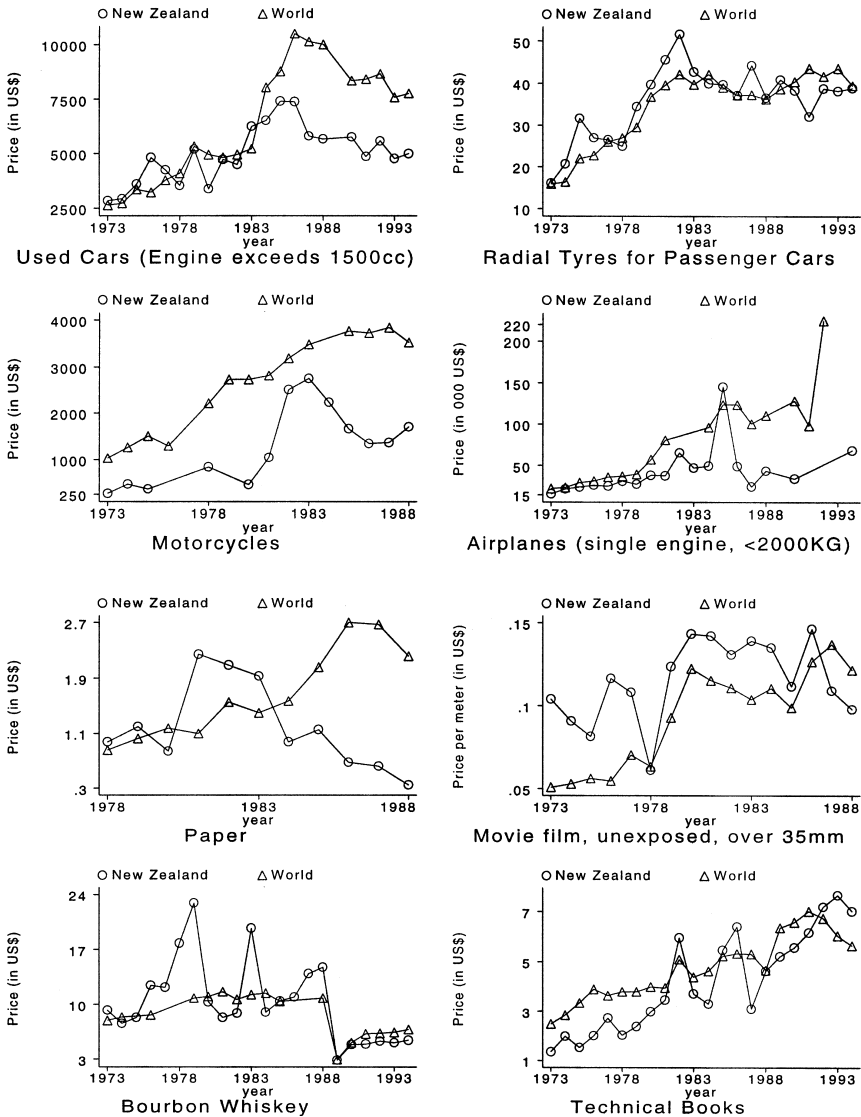

Fig. 3. US Export prices to New Zealand and to World.

Canada, Denmark, United Kingdom, Germany, Switzerland, Japan and Australia. The resulting time-series plots are depicted in Fig. 3.

A first notable pattern is that the two prices move approximately in the same direction in most of the cases (in particular, only the prices for paper and motorcycles seem to, for an extended period of time, move in directions opposite to those in which the world prices for the respective goods do). This indicates that it is, indeed, the same factor—marginal cost—that is the main determinant of these prices. A closer look at the data, however, reveals an idiosyncrasy of the New Zealand price movements. While having a tendency to exceed those in the rest of the world throughout the first half of the period, the prices fell below the average 'world' price level around the mid or late 80s and have remained there until the end of the period.

To further unravel this pattern, we calculate 'differences in differences', i.e. changes in the log-difference in export prices to New Zealand relative to the rest of the world. Table 1 reports the numbers.

The Price to NZ relative to world price/Prereform is computed by subtracting the logarithmic average 'world' price for each year in the prereform period from the logarithm of the price to New Zealand in that particular year. These differences can be used to gauge the percentage difference in the price between New Zealand and the rest of the world in that year. For instance, the price charged on car

Table 1
Price to New Zealand relative to world price, pre and postreform[a]

Industry	Prereform	Postreform	t-test for change in relative price[b]
Cars	−.0991	−.4536	4.88
	(0.067)	(0.028)	
Car-tires	.0949	−.0876	3.11
	(0.029)	(0.051)	
Airplanes	−.3520	−1.2161	5.10
	(0.088)	(0.145)	
Motorcycles	−0.9932	−0.9273	−0.36
	(0.154)	(0.098)	
Film	0.3249	−0.1016	3.09
	(0.065)	(0.122)	
Paper	0.0297	−1.5656	7.51
	(0.159)	(0.141)	
Bourbon	.0917	−.0867	1.31
	(0.113)	(0.075)	
Books	−.3100	−.0660	−2.02
	(0.081)	(0.090)	

Notes: [a]Log-difference. Standard errors are in parentheses. The world price is the average price charged to Canada, Denmark, the United Kingdom, Germany, Switzerland, Japan and Australia.
[b]The null hypothesis is that the log-difference between the New Zealand price and the world price is unchanged over the two periods.

shipments to New Zealand was on average 9.4 percent lower than the price charged on shipments to the rest of destinations during the period preceding the liberalisation.[25]

The average log-differences in prices to New Zealand relative to prices to the rest of world in the period following the liberalisation, Postreform, are computed in a way analogous to the above and reported in the third column of Table 1. We see, for example, that the average log-difference in the car price increased to $-.453$, i.e. to -36.5 percent. Thus, the relative car price charged to New Zealand fell by about 29.8 percent following the liberalisation. The associated *t*-statistic of 4.88 indicates that the decline is statistically significant, i.e. we can reject the hypothesis of no change between the two sub-periods. This economically substantial decline in export prices is supported by the rest of the data. The decrease in the relative price varies from 16.3 percent for bourbon to 79.7 percent for paper. It might be interesting to notice that the average price of books (that had no restriction imposed) actually rose. Finally, the unchanged price of motorcycles is most likely due to the fact that the sample period ends in 1988, i.e. it is too short for the changes to be accounted for.

Although the falling prices to New Zealand described in Fig. 3 and Table 1 could, in principle, result from a potential downward trend in costs of production, the rising price differentials indicate that something more ought to be going on. Incidentally, the recovered pattern in price differentials is compatible with an anticompetitive nature of quantitative restrictions. Our regression analysis strongly supports this conjecture.

A summary of the regression results is reported in Table 2. The GLS coefficients displayed are estimated with both destination specific heteroscedasticity and AR(1) errors.[26] For each industry (except for books on whose imports no restriction had been imposed), the results are given for both unrestricted and restricted specifications. The restricted model constrains the tariff and exchange rate effects to be equal. The hypothesis of symmetric pass-through of tariffs and exchange rates, along the lines of Feenstra (1989), was tested by a likelihood ratio test.[27] The tests showed that this restriction cannot be rejected in any of the industries at the 5 percent level of significance, thus confirming Feenstra's findings.

---

[25]The percentage difference is computed as $e^x - 1$, where x is the log-difference.

[26]We tested for nonstationarity. Separate unit root tests for the regression residuals for each destination and industry were conducted. There are 63 such residual series varying in length from 11 to 22 annual observations. We address the problem of potentially low power in rejecting the null hypothesis by using the Dickey–Fuller–GLS test as recently proposed by Elliott et al. (1996). This test rejected the null hypothesis of nonstationarity in 7 out of 10 cases. Rejection failed mostly where only relatively few data points were available. While more powerful test statistics based on joint residuals in a panel regression have yet to be developed, we take this as evidence that nonstationarity is not a serious problem in our data.

[27]The tests were based on the approximate likelihood ratio statistics, as recommended in Greene (1993).

Table 2
GLS regression results for the price effects of tariffs and quotas

	Cars (1)	Cars (2)	Tires (1)	Tires (2)	Airplanes (1)	Airplanes (2)	Motor Cycles (1)	Motor Cycles (2)	Film (1)	Film (2)	Paper (1)	Paper (2)	Bourbon (1)	Bourbon (2)	Books
Canada	-.5042* (.161)	-.4694* (.156)	-.2290* (.055)	-.2652* (.050)	.0196 (.092)	.177 (.091)	1.014* (.219)	1.058* (.214)	-.6146* (.179)	-.6114* (.178)	-.9820* (.262)	-1.014* (.254)	-.2772* (.118)	-.2743* (.117)	.0588 (.147)
Denmark	-.0742 (.109)	-.0406 (.103)	.0509 (.066)	.0159 (.061)	.4068* (.132)	.4059* (.131)	.6558* (.276)	.7033* (.269)	-.4301* (.138)	-.4291* (.136)	.3812 (.390)	.3499 (.387)	-.1514 (.118)	-.1484 (.117)	.2458* (.112)
United Kingdom	.0709 (.105)	.1009 (.100)	.0151 (.067)	-.0168 (.064)	.1007 (.114)	.0978 (.113)	.6744* (.173)	.7184* (.169)	-.4892* (.130)	-.4868* (.129)	-.4253 (.310)	-.4362 (.308)	-.0434 (.112)	-.0391 (.111)	.2385* (.120)
Germany	.1088 (.099)	.1412 (.092)	-.1170* (.066)	-.1515* (.062)	.4805* (.101)	.4805* (.101)	.9547* (.164)	1.000* (.159)	-.3531* (.128)	-.3511* (.127)	.2787 (.301)	.2630 (.299)	-.2229 (.122)	-.2193* (.121)	.2287 (.143)
Switzerland	.3744* (.114)	.4070* (.108)	.0260 (.061)	-.0082 (.055)	.3305* (.101)	.3304* (.101)	1.083* (.170)	1.127* (.165)	-.0760 (.114)	-.0753 (.113)	.2205 (.328)	.2019 (.326)	-.1497 (.115)	-.1463 (.114)	.4769* (.138)
Japan	.2173* (.112)	.2479* (.107)	-.1720* (.068)	-.2048* (.064)	.6088* (.127)	.6069* (.126)	1.074* (.190)	1.118* (.186)	-.6565* (.110)	-.6494* (.108)	.4179 (.272)	.4121 (.273)	-.1734 (.118)	-.1691 (.116)	.0506 (.127)
Australia	-.3225* (.134)	-.2877* (.128)	-.0490 (.073)	-.0850 (.069)	.0855 (.116)	.0878 (.116)	.9136* (.177)	.9588* (.173)	-.4900* (.110)	-.4875* (.109)	-.2900 (.273)	-.3176 (.274)	-.0681 (.121)	-.0652 (.120)	.0365 (.522)
GDP	-.1287 (.426)	-.1332 (.426)	-.2481 (.234)	-.2692 (.233)	.0680 (.472)	.0679 (.470)	.6626 (.628)	.6592 (.634)	-1.206* (.554)	-1.152* (.549)	.2158 (1.649)	.4998 (1.62)	-.0206 (.321)	-.0141 (.319)	.0672 (.327)
Exchange Rate	-.2203 (.302)		-.3172* (.135)		.1893 (.317)		.3722 (.344)		-.0666 (.331)		-.0752 (.532)		-.1270 (.203)		
Tariff	-.6397 (.463)		.1330 (.296)		.0634 (.078)		-.7139 (.791)		.1719 (.140)		.5105 (.998)		-.0322 (.271)		
Exchange Rate = Tariff		-.3338 (.268)		-.2312* (.121)		.0713 (.075)		.1886 (.323)		.1464 (.132)		.1604 (.442)		-.0920 (.168)	
NZ Trade Reform	-.6660* (.315)	-.4810* (.220)	-.0971 (.158)	-.2637* (.103)	-.7145* (.197)	-.7137* (.196)	.0842 (.297)	.1330 (.293)	-.4031* (.174)	-.4009* (.172)	-1.217* (.382)	-1.271* (.374)	-.2605 (.163)	-.2544 (.161)	.0966 (.168)
Log-Likelihood	114.75	114.55	233.87	232.28	73.00	72.68	73.08	71.69	81.15	80.47	30.10	30.05	161.58	161.46	98.23
LR test statistic	0.40		3.18		0.64		2.78		1.36		0.10		0.24		
Time period	73-94	73-94	73-94	73-94	73-94	73-94	73-88	73-88	73-88	73-88	78-88	78-88	73-94	73-94	73-94
Observations	168		176		156		115		125		88		169		154

The dependent variable is the logarithmic export unit value. Standard errors are in parentheses. Coefficients marked with a * are significant at the 10% significance level.
Results are given for both unrestricted and restricted specifications (except for books where tariffs do not apply). Tariff and exchange rate effects are unconstrained in (1) and constrained to be equal in (2). The likelihood ratio test statistic is for a test of (2) against (1). The critical value for a $\chi^2(1)$ variables are 2.7 at the 10 percent and 3.8 at the 5 percent level of significance.
Each regression includes a constant and a set of $T-1$ period specific dummy variables, and all models are estimated by GLS with destination specific heteroscedasticity and AR(1) errors.

To further examine the price effects of tariffs, consider their price elasticities based on the unrestricted model.[28] Conceptually, they are much the same as the pass-through elasticities reported in Feenstra (1989). The first thing to notice is that the coefficients are largely insignificant.[29] They also indicate that the tariff induced export price adjustment, if any, tends to differ across industries. In some, such as airplanes, tires, film and paper, exporters seem to have lowered their prices in response to the tariff liberalisation. In others, namely, cars, motorcycles and bourbon, the export prices rose as tariffs declined, indicating an incomplete pass-through of tariffs to the consumer prices in those industries. In other words, the tariff liberalisation there has led to a terms-of-trade loss for the country that liberalised, despite the fact that the country under consideration is definitely a small country.

What do the industries within the two clusters have in common? One factor that could explain the differences in price effects is the share of the US imports in total imports of the corresponding categories. In particular, the smaller the share, the more likely it is that the price effect of a tariff will be negative. So, in all, airplanes, tires, film and paper, US imports constituted a significant chunk of total imports and the tariff effect was positive. In contrast, the US shares in cars, bourbon and motorcycles were relatively negligible thus apparently motivating the sellers to 'price to market'.

The magnitude of the elasticities ranges from .03 for bourbon to .71 for motorcycles in the case of the negative price effects, and .06 (airplanes) to .51 (paper) for the positive price effects. In addition to the considerations discussed above, it appears to be a function of the conditions in domestic supply. Thus, a notable size of the point estimate for paper (0.51 (0.99)), where there existed a high degree of market power in domestic supply, stands in a sharp contrast with that of the point estimate for airplanes (0.06 (0.08)), where the domestic supply is virtually nonexistent. Along the same lines, one can argue that the presence of one or another form of domestic competition has led to a more pronounced price response to tariff changes in cars (−0.64 (0.46)) or motorcycles (0.71 (0.79)) relative to bourbon (0.03 (0.27)).

The fuzziness surrounding the price effects of tariffs and their overall insignificance in particular does, in a way, make the findings on the price impact of quotas a genuinely striking and interesting result. The relevant information is again shown in Table 2 where, in the NZ Trade Reform row, the (GLS) point estimates for λ_{NZ}s for different industries are reported. As explained earlier, the estimates of these coefficients can be used to gauge the price impact of quotas, for they equal the

---

[28] As apparent from Table 2, imposing the restriction increases the efficiency with which the other parameters are estimated. The gains are, however, small.

[29] Likewise, estimates of the exchange rate coefficients differ across industries and, in most cases, are not significant. These results are in line with those reported elsewhere. (See, for instance, Knetter, 1993).

percentage change in the relative price charged to New Zealand's quota-restrained market as compared to the relative price charged to the same market without quota, ceteris paribus.[30]

The estimated price impacts are all but one (motorcycles) negative.[31] Moreover, four out of the remaining six are significant at the ten percent level (five out of the remaining six when based on the model that imposes symmetry of exchange rate and tariff pass-through). The most remarkable feature of the estimates, however, is their magnitude. It indicates that prices charged by foreign exporters fell from about 10 percent for tires to about 49 and 51 percent for cars and airplanes, respectively. The most sizeable decrease in price (70%) was found for paper, the industry that is characterised by highly concentrated market power in domestic supply, whereas the price effect of the quota liberalisation was among the lowest in bourbon (23%) where no substantial market power in either domestic or foreign supply existed. Thus, our analysis not only shows how ubiquitous and significant the detrimental effects of quotas on the terms-of-trade are, but also testifies how the magnitude of the effect surges when the quota comes to facilitate collusion between the domestic and foreign suppliers.

One can play with these numbers to get some feeling for how much the import licensing really cost the country. One interesting calculation involves computing approximate partial equilibrium welfare losses due to quotas. We ignore triangles and calculate the losses as a product of the volume of imports in the year 1985 and the estimated price effect of liberalisation. The following numbers ensued: $279 790 for cars, $22 100 for tires, $891 480 for airplanes, $21 250 for film, $177 800 for paper and $73 830 for bourbon.

If one is willing to presume that these price effects are indicative of the effects that the licensing had on prices charged by the US exporters as a whole, it makes some sense to compute an average welfare loss associated with quotas on the US imports. We again consider year 1985. The total value of the US exports to New Zealand amounted to 727 million dollars. The average price drop, computed as the arithmetic mean of all the price effects of quotas in our sample, was about 27 percent. Thus, we gauge that the welfare loss due to quotas on the US imports in 1985 was about 196 million dollars, which amounts to almost one percent of the country's GNP at the time.[32]

The clear-cut nature and the robustness of these findings are evident from the information displayed in Table 3. First, the results are not sensitive to our choice

---

[30]Such a measure of the impact of the quota on price resembles quite closely that suggested by Feenstra (1995). The measure improves on all measures used so far and discussed in Laird and Yeats (1990) (pp. 28–30).

[31]An insufficient time-span of the data on motorcycles is the most likely reason for the insignificant and positive coefficient found there. The positive coefficient on books, although perhaps interesting in its own right, has no substantial bearing on the questions posed here since no restriction has existed on imports of books throughout the period. The category was included for comparison purposes only.

[32]All the numbers are in the 1985 US dollars.

Table 3
Sensitivity Analysis

	Cars	Tires	Airplane	Motorcycles	Film	Paper	Bourbon	Books
1. Variations in the New Zealand dummy timing								
t	−.6660*	−.0971	−.7145*	.0842	−.4031*	−1.217*	−.2605	.0966
	(.315)	(.158)	(.198)	(.297)	(.174)	(.382)	(.163)	(.168)
t+1	−.3900*	−.2139*	−.7116*	.0913	−.3980*	−.9608*	−.1808	.3089*
	(.164)	(.115)	(.161)	(.277)	(.164)	(.407)	(.162)	(.157)
t−1	−.3339*	−.2378	−.3571	.1700	−.5260*	−.7096	−.1173	.3901*
	(.190)	(.166)	(.287)	(.332)	(.188)	(.518)	(.172)	(.163)
2. Variations in reference country								
Canada	−.0872	−.1159*	.0777	.1862	−.6248*	.4090*	.2971*	
	(.297)	(.052)	(.168)	(.358)	(.306)	(.213)	(.098)	
Denmark	.0053	.0546	−.0100	−.5483	.3983	−.5009	−.0863	.2630
	(.163)	(.094)	(.252)	(.366)	(.286)	(.527)	(.101)	(.212)
United Kingdom	.0024	.0523	−.1843	−.0156	.3124	−.2796	.1567*	.0252
	(.148)	(.098)	(.188)	(.184)	(.228)	(.330)	(.080)	(.121)
Germany	−.0215	.2149*	−.0286	−.0788	.2676	.7153*	.2166*	.0055
	(.124)	(.082)	(.154)	(.103)	(.209)	(.255)	(.112)	(.142)
Switzerland	−.0672	.1563*	.1522	.2513	.2584	.8576*	−.2159*	−.2763
	(.179)	(.072)	(.169)	(.152)	(.199)	(.360)	(.085)	(.199)
Japan	.3371*	−.2094*	.9568*	−.1297	.1960	.2128	−.0195	−.1076
	(.151)	(.100)	(.143)	(.226)	(.153)	(.246)	(.120)	(.202)
Australia	−.1665	−.0375	−.3509*	.0852	−.4409*	−.7074*	−.2188*	−.0369
	(.229)	(.112)	(.187)	(.203)	(.165)	(.199)	(.115)	(.171)

Notes: All coefficients are based on GLS regressions. Standard errors in parentheses. Coefficients marked with a * are significant at the 10% significance level.

of the cutoff years.[33] The breaking point was chosen ex ante and to strike a balance between several considerations namely, (i) the calendar year of the exemption date (having all goods exempt license), (ii) that not all data are available for the entire period, leading to an imprecise measurement and high variability of, predominantly, the postreform price differences, and (iii) that quantitatively measurable effects will appear only towards the end of the 80s.

The first row in Table 3 restates the point estimates for λ_{NZ}s based on our choice of cutoff years, t, as explained above. We reran the regressions with $t-1$ and $t+1$ instead. So obtained point estimates are shown in the corresponding rows. None of the results is invalidated by these changes. All the coefficients that are significant in t remain significant in $t+1$ (and slightly lower in magnitude). It is also noteworthy that point estimates for airplanes and paper are not significant in $t-1$, yet become significant in t and are still significant in $t+1$. Finally, the point estimate for tires (-0.21 (0.11)), which comes to be significant in $t+1$ only, indicates that the reforms (in some sectors) required time to bite in.

A final caveat with respect to interpretation of our findings relates to the fact that some country (or countries) other then New Zealand could be the real story. That is, some other country may have experienced rising prices after the mideighties which could help account for the declining relative price to New Zealand. To address this concern, we reran the original regression while consecutively replacing the New Zealand dummy by dummy variables for all the other countries in the sample. The lower part of Table 3 presents the findings. Actually, there is a country in the sample whose point estimates display alike behaviour in the sense that four of them are negative and significant—Australia. But this, in fact, only supports our conclusions and is due to the fact that Australia has undergone a trade policy reform as well, and approximately at the same time. Furthermore, the fact that two markets had reforms concurrently means that the estimated time effects will reflect some of this as a general downward trend in price. In other words, this feature of the data is likely to lead to an underestimation of the New Zealand price effects.

6. Conclusion

The experiences of New Zealand product markets in the aftermath of the trade policy reform of the mid eighties provide a natural experiment with which to investigate empirically the extent to which the terms-of-trade of a country are affected by its protective regime. The theoretical work on trade policy has suggested that these effects are inconclusive and that even their signs are highly sensitive to the form of protection adopted.

---

[33]The year '1987' in definition of the dummy variable d_t stands, in fact, for 1986 (for paper, film, bourbon and motorcycles), 1989 (for cars and tires) and 1987 (otherwise).

Yet, this study shows that the reality is much less equivocal. The estimates are based on a longitudinal data set and thus superior to all the measures proposed in the literature so far. They indicate that the price effects of tariffs and quotas are in fact fairly clear and stable across industries: tariffs show no significant effect; quotas unambiguously increase the export prices. Tariffs and quotas are, hence, not at all equivalent. Consequently, the usage of so-called tariff equivalents of quotas in gauging the price and welfare impact of the latter is a highly questionable exercise. The computable general and partial equilibrium models that are commonly used for evaluating these effects in practice tend thus vastly to understate the benefits of trade liberalisation.

The final and principal message of the analysis is that quotas are a very expensive form of protection. The deteriorating effects quotas have on the terms-of-trade of the country that imposes them are quantitatively important and ubiquitous. Inasmuch as the economic impact of nontariff barriers is akin to those of quotas, their apparent burgeoning across the industrialised world ought to be cause for concern. Putting aside their redistribute effects within a country, the nontariff barriers redistribute income away from, and thus have a pronounced detrimental effect on the welfare of the country that erects them. The quantitative information exhibited in this paper is our case for dismantling nontariff barriers to trade.

Acknowledgements

References

Berry S., Levinsohn, J., Pakes, A., 1994. Voluntary export restraints on automobiles: Evaluating a strategic trade policy. Yale University and University of Michigan, mimeo.

Elliott, G., Rothenberg, T.J., Stock, J.H., 1996. Efficient tests for an autoregressive root. Econometrica 64 (4), 813–836.

Feenstra, R.C., 1989. Symmetric pass-through of tariffs and exchange rates under imperfect competition: An empirical test. Journal of International Economics 27, 25–45.

Feenstra, R.C., 1992. How costly is protectionism?. Journal of Economic Perspectives 6, 159–178.

Feenstra, R.C., 1993. Measuring the welfare effect of quality change: Theory and application to Japanese autos. NBER Working Paper #4401.

Feenstra, R.C., 1995. Estimating the effects of trade policy. NBER Working Paper #5051.

Fung, K.C., 1989. Tariffs, quotas and international oligopoly. Oxford Economic Papers, 749-757.

Goldberg, P.K., 1995. Product differentiation and oligopoly in international markets: The case of the US automobile industry. Econometrica 63 (4), 891–951.

Greene, W.H., 1993. Econometric Analysis, 2nd ed. Macmillan, New York.

Harris, R., 1985. Why voluntary export restraints are voluntary. Canadian Journal of Economics 18 (4), 799–809.

Harrison, A., 1994. Productivity, imperfect competition and trade reform. Journal of International Economics 36 (1/2), 53–74.

Helpman, E., Krugman, P., 1989. Trade Policy and Market Structure. MIT Press, Cambridge.

Itoh, M., Ono, Y., 1982a. Tariffs, quotas and market structure. Quarterly Journal of Economics, May, 295–305.

Itoh, M., Ono, Y., 1982b. Tariffs vs quotas under duopoly of heterogeneous goods. Journal of International Economics 17, 359–373.

Knetter, M., 1993. International comparisons of PTM behavior. American Economic Review 83, 473–486.

Knetter M., 1994. Did the strong Dollar increase competition in U.S. product markets? Review of Economics and Statistics, February, 192–96.

Krishna, K., 1989. Trade restrictions as facilitating practices. Journal of International Economics 26 (3/4), 251–270.

Krishna, K., 1990. The case of the vanishing revenues: Auction quotas with monopoly. American Economic Review 80, 828–836.

Laird, S., Yeats, A., 1990. Quantitative Methods for Trade-Barrier Analysis. New York University Press, New York.

Levinsohn, J., 1993. Testing the imports-as-market-discipline hypothesis. Journal of International Economics 35 (1/2), 1–22.

Mai, C., Hwang, H., 1988. Tariffs vs ratio quotas under duopoly. Journal of International Economics 27, 177–183.

Mai C., Hwang, H., 1989. Why voluntary export restraints are voluntary: An extension. Canadian Journal of Economics, November, 877–882.

Marston, R., 1990. Pricing to market in Japanese manufacturing. Journal of International Economics 29, 217–236.

Ministry of Commerce, 1987. Tariff Working Party Report to the Minister of Trade and Industry. Wellington, New Zealand.

Ministry of Commerce, 1990. A Brief History of the Import Licensing System. Wellington, New Zealand.

Ministry of Commerce, 1994. Review of post-1996 Tariff Policy. Wellington, New Zealand.

Nordström, H., 1992. A Comment on Tariffs vs Quotas with Implicit Collusion by Rotemberg and Saloner. In: Nordström, H., Studies in Trade Policy and Economic Growth, Monograph Series No. 20. Institute for International Economic Studies, Stockolm, pp. 119–24.

Rotemberg, J.J., Saloner, G., 1989. Tariffs vs quotas with implicit collusion. Canadian Journal of Economics, May, 237–44.

U.S. Department of Commerce, U.S. Exports: Schedule E Commodity by Country. Washington, D.C., various issues.