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Abstract

Under Section 201 of the Trade Act of 1974, the so-called escape clause, a domestic industry that is seriously injured can obtain temporary relief if imports are the substantial cause of such injury. This paper develops a methodology that can be used to determine the change in a domestic industry's production as a result of changes in import supply, demand or domestic supply and so determine whether or not an industry is entitled to relief under Section 201. This methodology is illustrated by application to two recent Section 201 investigations.

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I. INTRODUCTION

Since 1947 trade between the major industrialized nations of the world has been conducted according to the General Agreement on Trade and Tariffs, or GATT. Article XIX, paragraph 1a of the GATT provides that:

> If, as a result of unforeseen developments of the effect of the obligations incurred by a contracting party under this Agreement, including tariff concessions, any product is being imported into the territory of that contracting party in such increased quantities and under such conditions as to cause or threaten serious injury to domestic producers in that territory of like or directly competitive products, the contracting party shall be free, in respect of such product, and to the extent and for such time as may be necessary to present or remedy such injury, to suspend the obligation in whole or in part or to withdraw or modify the concession.

This part of the GATT, known as the escape clause, was inserted at the insistence of the United States. The United States Congress was concerned that, although the relaxation of trade restraints could benefit American consumers as a whole, some industries might suffer dislocations as a result. As was the case in previous bilateral trade treaties, it wanted to ensure that temporary relief from imports could be provided to those domestic industries that are seriously injured or are threatened with serious injury as the result of increased imports.

In the United States the escape clause is administered under Section 201 of the Trade Act of 1974. Section 201 provides that upon a

receipt of a petition for escape clause relief the U.S. International Trade Commission "shall promptly make an investigation to determine whether an article is being imported into the United States in such increased quantitities as to be a substantial cause of serious injury, or the threat thereof, to the domestic industry producing an article like or directly competitive with the imported article."[1] In conducting its investigation in a Section 201 case, the International Trade Commission must (a) determine the relevant industry, (2) determine whether or not that industry has been seriously injured or is threatened with serious injury, and (3) if the industry has been seriously injured or is threatened with serious injury, whether or not imports are the substantial cause of that injury or threat. The Commission reports the findings of its investigation to the President. If the Commission finds that the industry is seriously injured, or threatened with such injury, it must also recommend a remedy to the President. The President can impose tariffs or quotas, negotiate orderly marketing agreements or grant adjustment assistance to the industry and its workers. Alternatively, the President can grant no relief if in his opinion such relief is not in the national interest. If the Commission finds that the industry has neither been seriously injured nor is threatened with serious injury by increased imports, no relief can be granted.[2]

This paper is concerned with the final phase of the ITC's decision process, establishing the cause of injury to an industry. It discusses the meaning of injury and causality in the sense meant by Congress, and shows how causality can be determined from the

information that is typically available to the Commission in a Section 201 investigation. This methodology is illustrated by applications to two recent escape clause investigations.

II. INJURY AND CAUSALITY

The Trade Law of 1974 does not define the term "serious injury," but only provides indicia of serious injury. These indicia include "the significant idling of productive facilities in the industry, the inability of a significant number of firms to operate at a reasonable level of profit, and significant unemployment or underemployment within the industry."[3] Indicia of the threat of serious injury to an industry include "a decline in sales, a higher and growing inventory . . . , and a downward trend in production, profits, wages or employment . . . ."[4] The legislative history of the act suggests that serious injury is injury sufficiently severe as to threaten the very existence of the injury.[5]

For any of these indicia of serious injury to occur, there must be a significant movement down the domestic industry's long run supply curve; the indicia of a threat of serious injury are all consistent with an imminent significant move down the industry's long run supply curve. This suggests that domestic production would be a good proxy to use as a quantitative measure of such injury.[6]

How an increase in imports can injure a domestic industry is shown in Figure 1. Figure 1 illustrates an industry where D_1 represents domestic demand for the product, S_{d1} represents supply by the domestic industry of the product, and S_{m1} represents the import supply of the

product. S_1 is the sum of domestic supply S_{d1} and import supply S_{m1}. Were import supply were to increase from S_{m1} to S_{m2}, aggregate supply would shift from S_1 to S_2. Price would fall, imports would increase and domestic production would fall from Q_{d1} to Q_{d2}. In such a circumstance, the increase in import supply would be the sole and total cause of injury to the domestic industry.

There are ways in which the domestic industry could be injured other than by an increase in import supply. Demand, for example, could decrease, as in Figure 2, or costs to the domestic industry could increase, causing a decrease in domestic supply, as in Figure 3. In the former case the absolute quantity of imports would fall, though the share of imports relative to total domestic consumption may increase.[7] In the latter case imports would increase. However, even though we would observe the indicia of injury that Congress enumerated, increased imports are not the cause of that injury. In these two cases the increase in imports is a consequence of the true cause of injury to the domestic industry, rather than the cause of that injury.[8]

If the ITC has determined that a given domestic industry has suffered serious injury, and that imports have increased, it must then determine whether or not imports are a "substantial cause" of that injury. The Trade Act of 1974 defines substantial cause as a cause "which is important and not less than any other cause."[9] Congress was quite clear that injury to the domestic industry caused by a decrease in demand or a decrease in domestic supply are not grounds for Section 201 relief.[10]

If we could be certain that only a single curve had shifted, it

would be quite simple to infer the cause of injury to the domestic industry by observing the changes in prices and quantities. Decreased consumption and a lower price would mean that demand had decreased. Increased consumption and a lower price would mean that import supply had increased, while lower consumption and a higher price would mean that domestic supply had decreased. However, in general all three functions will shift over time as the underlying variables that determine them change.

In principle, a simultaneous equations model of demand, domestic supply and import supply might be estimated as functions of prices, quantities and a set of exogenous variables. The estimated changes in the exogenous variables in each function could then be used to compute the magnitudes of the changes in each of the three functions and the impacts of such changes on domestic output.

In practice, it will usually be very difficult to construct and estimate a complete simultaneous equations model,[11] especially given the tight statutory deadlines that the ITC must operate under in deciding escape clause cases. Grossman (1986) and Pindyck and Rottemberg (1987) have estimated reduced form equations in order to assess the role of imports in causing injury. However, data limitations often make even these approaches impossible. The industries that are the objects of escape clause investigations are frequently narrowly defined, and so data on an industry's production and prices are often not publically available. The ITC typically relies upon questionaires sent to firms in the industry. These questionaires are frequently the only source of reliable price and

quantity data. Since these questionaires typically cover the previous five years of an industry's history, a researcher will not have sufficient degrees of freedom to estimate a simultaneous equations model with three or more endogenous variables.

However, ITC investigations do obtain information about the supply and demand functions of the industry that will permit us to make some inferences about the magnitudes of the elasticities. Furthermore, it may be possible to make some statistical inference about one of the three equations.[12] In fact, the ITC relies upon such information in making recommendations on remedy in those cases where it finds imports a substantial cause of serious injury to an industry. This information, together with the observed changes in prices and quantities, makes the supply and demand model a useful tool that can give insights into the changes that have occured in an industry over time and on the cause of any injury to the domestic industry.

The methodology for doing so is introduced in the next section. In Section IV, this analysis is extended to cover the case where the imported good and the domestically produced good are differentiated, and therefore have different demand functions. Section V extends the analysis for those situations in which market power can make supply and demand analysis inappropriate.

III. CAUSALITY WITH A HOMOGENEOUS GOOD

We begin by considering a supply and demand model for a good that is produced abroad as well as domestically. Buyers consider the differences between the imported product and the domestically produced

product to be sufficiently minor that they can be treated as one homogeneous good. In equilibrium then $D(P,\alpha) = S_d(P,\beta) + S_m(P,\gamma)$, where D is demand, S_d is domestic supply, S_m is import supply, P is price, and α, β and γ are vectors of exogenous variables. The equilibrium level of domestic production, Q_d, will therefore be a function of the exogenous variables α, β and γ. We are interested in the change in domestic production, Q_d, as a function of the changes in these exogenous variables. Taking a Taylor series expansion of Q_d around its initial value gives:

$$\Delta Q_d = \frac{\partial Q_d}{\partial \alpha} \Delta\alpha + \frac{\partial Q_d}{\partial \beta} \Delta\beta + \frac{\partial Q_d}{\partial \gamma} \Delta\gamma + R,$$

where the remainder term R will consist of higher order terms, including cross product terms. These cross product terms represent the interactions between changes in the exogenous variables upon domestic production.

When such interactions take place, the effect of multiple changes will be greater or less than the sum of the independent effects. This is illustrated in Figure 4. Initially, domestic production is at Q_d^0. Either an increase in import supply or a decrease in demand would, independently, reduce domestic production to Q_d'. The combined effect of these two changes is to lower domestic production to Q_d'', and the decrease in domestic production is more than twice $Q_d^0 - Q_d'$. Therefore, the change in domestic production due to the increase in import supply will not in general be well defined when demand or domestic supply also change.

The impact of the changes in the exogenous variables on domestic

production will be independent if and only if $R = 0$, which will only be true if Q_d is a linear function of the exogenous variables. This in turn implies that the underlying model of supply and demand is linear. Therefore, taking a first order Taylor Series approximation to the change in domestic production as a function of the changes in demand, domestic supply and import supply is tantamount to assuming that these three functions are linear.[13]

When Congress discussed causation, it spoke as if causes were independent, and that total injury was the sum of its parts. It did not, apparently, consider that there might be interactions between causes and that it is not possible, in general, to separate out the independent effects of changes in the economy that can result in injury to a domestic industry. In the absence of further guidance, it would seem appropriate and consistent with Congressional intent to measure the injury to the domestic injury by a change in import supply, demand or domestic supply by the first order Taylor series approximation of the change in domestic production.

Since taking a first order Taylor series approximation is equivalent to taking linear approximations of the supply and demand functions, consider the following linear model for supply and demand for a homogeneous good that is both produced domestically and imported:

$$D = a + bP, \quad b<0,$$

$$S_d = d_1 + f_1P, \quad f_1>0,$$

$$S_m = d_2 + f_2P, \quad f_2>0,$$

$$D = S_d + S_m,$$

where D is domestic demand, S_d is domestic supply and S_m is import

supply. The parameters a, d_1 and d_2 are the shift paramaters of the system, and are functions of the exogenous variables (α, β and γ) that determine supply and demand. Changes in these parameters represent the shifts in demand, domestic supply and import supply over time.[14] The parameters b, f_1 and f_2 are behavioral parameters that are assumed to remain fixed over the period of analysis.

It is possible to solve for the equilibrium values of price, domestic production Q_d and imports Q_m as functions of the parameters of the system:

$$P = \frac{d_1 + d_2 - a}{b - f_1 - f_2},$$

$$Q_d = d_1 + \frac{f_1(d_1 + d_2 - a)}{b - f_1 - f_2},$$

$$Q_m = d_2 + \frac{f_2(d_1 + d_2 - a)}{b - f_1 - f_2}.$$

The change in price, domestic production and imports over time can be written as:

$$\Delta P = \frac{\partial P}{\partial a}\Delta a + \frac{\partial P}{\partial d_1}\Delta d_1 + \frac{\partial P}{\partial d_2}\Delta d_2, \qquad 1(a)$$

$$\Delta Q_d = \frac{\partial Q_d}{\partial a}\Delta a + \frac{\partial Q_d}{\partial d_1}\Delta d_1 + \frac{\partial Q_d}{\partial d_2}\Delta d_2, \qquad 1(b)$$

$$\Delta Q_m = \frac{\partial Q_m}{\partial a}\Delta a + \frac{\partial Q_m}{\partial d_1}\Delta d_1 + \frac{\partial Q_m}{\partial d_2}\Delta d_2. \qquad 1(c)$$

These equations can be expressed in matrix form as:

$$\Delta o = D\Delta s,$$

where $\Delta o = [\Delta P, \Delta Q_d, \Delta Q_m]'$ is the 3x1 vector of changes in prices and quantities, $\Delta s = [\Delta a, \Delta d_1, \Delta d_2]'$ is the 3x1 vector of changes in the shift parameters and D is the 3x3 matrix of derivatives of the prices

and quantities with respect to the shift parameters:

$$\mathbf{D} = \frac{1}{(b-f_1-f_2)} \begin{bmatrix} -1 & 1 & 1 \\ -f_1 & b-f_2 & f_1 \\ -f_2 & f_2 & b-f_1 \end{bmatrix}$$

The vector Δo is observable from the data that is typically available in an escape clause investigation. The non-singular matrix **D** is seen to contain only the behavioral parameters. We can therefore solve for the vector $\Delta s = \mathbf{D}^{-1}\Delta o$ as an expression in terms of the changes in the observed variables and the behavioral parameters:

$$\Delta a = -(b\Delta P - \Delta Q_d - \Delta Q_m),$$

$$\Delta d_1 = -(f_1\Delta P - \Delta Q_d),$$

$$\Delta d_2 = -(f_2\Delta P - \Delta Q_m).$$

These terms can be inserted into equation 1(b) to get the change in domestic production as a function of the changes in demand, domestic supply and import supply:

$$\Delta Q_d = \frac{f_1(b\Delta P - \Delta Q_d - \Delta Q_m)}{b - f_1 - f_2} \quad \{\text{demand}\}$$

$$- \frac{(b - f_2)(f_1\Delta P - \Delta Q_d)}{b - f_1 - f_2} \quad \{\text{domestic supply}\}$$

$$- \frac{f_1 (f_2\Delta P - \Delta Q_m)}{b - f_1 - f_2} \quad \{\text{import supply}\}.$$

This expression can be rewritten in terms of elasticities as follows:

$$\Delta Q_d = \frac{w_1\eta_d(\epsilon Q(\Delta P/P) - \Delta Q)}{\epsilon - w_1\eta_d - w_2\eta_m} \quad \{\text{demand}\}$$

$$- \frac{(\epsilon - w_2\eta_m)(\eta_d Q_d(\Delta P/P) - \Delta Q_d)}{\epsilon - w_1\eta_d - w_2\eta_m} \quad \{\text{domestic supply}\}$$

$$- \frac{w_1\eta_d(\eta_m Q_m(\Delta P/P) - \Delta Q_m)}{\epsilon - w_1\eta_d - w_2\eta_m} \quad \{\text{import supply}\},$$

where η_d and η_m are the (initial) domestic and import supply elasticities, respectively, ϵ is the (initial) elasticity of demand, and $w_1 = Q_d/Q$ and $w_2 = Q_m/Q$ are the initial shares of domestic production and imports of total domestic consumption. Therefore, $w_1\eta_d + w_2\eta_m$ is the elasticity of aggregate supply.

The changes in domestic production, imports and price are typically determined in the investigation. These numbers can be put into the above expression to get a decomposition of the change in domestic production in terms of the elasticities. The investigation will usually discover information about the elasticities, e.g., whether or not there are substitute products, how easy it would be for domestic producers or importers to expand output in response to a price change, etc., that might allow inferences to be made about these elasticities even if it is not always possible to estimate them. In fact, such information is routinely used by ITC economists to advise the Commission about the impact of different remedies.

Alternatively, the expression can be solved for the values of the elasticities that would be necessary for the change in import supply to be responsible for a greater change in domestic production than either the change in domestic supply or the change in demand. If such elasticities are not plausible given the information found in the investigation, we can be sure that increased imports are not the substantial cause of the domestic industry's injury.

An Application

This methodology can be illustrated with the ITC's investigation of Wooden Shakes and Shingles, Investigation No. TA-201-56. On

September 25, 1985 the ITC began a Section 201 investigation of the industry following receipt of a petition from the domestic wood shingle and shake producers requesting import relief.

Wood shakes and shingles are used as coverings for the roofs and sides of buildings. As of 1982 there were 252 companies operating 290 establishments producing wood shakes or shingles. These firms are concentrated in the Pacific Northwest. Average employment for firms making wood shakes and/or shingles ranged from 6.2 in 1982 to 10.5 in 1978. The large number of small firms who have no individual influence over market price and the absence of large buyers make the use of a competitive model an appropriate tool for examining the economics of this industry.

The investigation found that between 85% and 95% of the wood shakes and shingles produced in the United States are produced from western red cedar logs. Since the Commission's remedy recommendation was limited to western red cedar shakes and shingles and excluded imports made from other species, these items will be the focus of this discussion.

Imports to the United States of western red cedar shakes and shingles are entirely from Canada. There are no significant differences between imported cedar shakes and shingles and domestically produced shakes and shingles, nor do consumers perceive any. It is therefore appropriate to treat the imported and the domestically produced product as being homogeneous.

Domestic production of western red cedar shakes and shingles (less exports) fell from 4,223,962 units in 1978 to 2,030,084 units in 1984,

a decline of over 50%. Imports of western red cedar shakes and shingles rose from 3,312,272 to 3,662,860 units during this same time period, an increase of over 10%. A composite price index for western red cedar shakes and shingles, deflated by a price index of lumber and building supplies, declined from 204.48 for the final quarter of 1977 to 102.3 for the final quarter of 1984, a decrease of over 50%.

On March 25, 1986 the Commission reported to the President that it had found (by a 4 to 2 vote) that domestic producers of western red cedar shakes and shingles had been injured by imports from Canada. Three of these commissioners recommended to the President that a 35% tariff on imported cedar shakes and shingles be imposed.[15]

What light can the analysis of this section shed on this issue? The recommendation for a 35% tariff was based upon an analysis by ITC economists John Ryan and Paul Gibson.[16] They used a range of elasticity estimates to prepare their analysis of remedy. Because cedar shakes and shingles must compete with other roofing and siding materials, the elasticity of demand was expected to be relatively elastic. Their estimates of ϵ ranged from -3.0 to -1. Using the methodology of Leamer, Ryan and Gibson found that the elasticity of import supply η_m ranged from .4 to .8. They felt that the elasticity of domestic supply would be somewhat greater than that of import supply because of differnces in contractual arrangements in lumbering in Canada versus the United States. The combination of relatively elastic demand with relatively inelastic supply implied that it would take a large tariff to have a significant change in domestic production.

Table 1 computes the decomposition of the change in domestic

production as the result of changes in demand, domestic supply and import supply that are implied by these elasticities:

Table 1

The Change in Domestic Production of Red Cedar Shakes and Shingles, 1978-1984

ϵ	-3.0	-1.0	-3.0	-1.0
η_d	.9	.9	.5	.5
η_m	.8	.8	.4	.4
D	-1,722,978	-1,527,176	-1,067,997	-1,081,509
S_d	- 251,360	- 210,594	-1,043,626	- 917,128
S_m	-219,540	- 456,107	- 82,256	- 195,241

Therefore, given the assumptions that the ITC majority made about the elasticities in making its remedy recommendation, imports are not a substantial cause of the decrease in domestic production between 1978 and 1984. No matter which elasticity figures in the relevant ranges are used, the observed changes in price, domestic production and imports indicate that a decrease in demand is the substantial cause of injury to the domestic red cedar shake and shingle industry.

Although the ITC majority opinion did discuss injury to the domestic industry as far back as 1978, it focused primarily upon the decrease in domestic production and the increase in imports between 1983 and 1985. Even for this period, however, the assumptions upon which the Commission majority based its remedy recommendation are not consistent with a finding of imports as a substantial cause of injury.

The Commission did not have data on production, consumption or imports for all of 1985, but only for the first nine months. We can extrapolate the data we do have on production and import by multiplying

them, respectively, by the ratios of total 1984 production to production in the first nine months of the year and 1984 imports to imports in the first nine months. This extrapolation procedure indicates that domestic production of red cedar shakes and shingles fell from 2,335,231 units in 1983 to 1,459,206 units in 1985, a decrease of 876,025. Imports appear to have increased by nearly the same amount, going from 3,213,878 units in 1983 to 4,068,337 for 1985, an increase of 854,459. This implies that consumption fell by 33,156 units. Real prices remained almost constant between 1983 and 1985, increasing by .76 percent.

As can be seen from Table 2, these figures, combined with the elasticity assumptions used by the ITC to make their remedy recommendation, do not support the finding that imports are a substantial cause of injury to the domestic red cedar shake and shingle industry:

Table 2

The Change in the Domestic Production of Red Cedar Shakes and Shingles, 1983-1985(est.)

ϵ	-3.0	-1.0	-3.0	-1.0
η_d	.9	.9	.5	.5
η_m	.8	.8	.4	.4
D	10,416	4,285	6,459	3,041
S_d	- 804,146	- 708,667	- 830,851	- 755,825
S_m	- 82,294	- 171,644	- 51,633	- 123,241

These figures suggest that the overwhelming cause of the reduction in domestic production between 1983 and 1985 is an apparent decrease in the domestic supply curve.

The ITC majority opinion considered but rejected the argument made

by the respondents in this case that a decreasing supply of western red cedar logs suitable for making shakes and shingles is the primary cause of injury. It noted that there appeared to be adequate inventories of trees, and that the price of red cedar logs had remained essentially unchanged between 1983 and 1985.

This observation is not, however, dispositive. As the ITC staff report notes, red cedar shake and shingle prices tend to track the prices of red cedar logs. The domestic supply curve for red cedar shakes and shingles is determined by the supply curve for red cedar logs, not just the price of those logs in equilibrium. Just as the fact that red cedar shake and shingle prices remained almost constant between 1983 and 1985 does not mean that the domestic supply curve has not changed, so the fact that the price of the input has remained constant does not mean that the supply curve of that input has remained constant. The data are entirely consistent with a decrease in the supply of red cedar logs over this period, which in turn caused the apparent decrease in the domestic supply of red cedar shakes and shingles.[17]

On May 22, 1986, President Reagan announced that he would impose a tariff of 35% on imports of red cedar shakes and shingles. This decision caused a very strong negative reaction from the government and the public in Canada. The Canadian government had been preparing for talks with the United States on establishing a free trade zone with the United States. The Canadian government soon announced retaliatory measures against U.S. exports to Canada of books, computers and semiconductors.

The above analysis indicates that this "trade war" was unnecessary. The U.S. shake and shingle producers were not entitled to import relief under U.S. law. The decrease in demand for their products and the decreased supply of their input are more important causes of injury to their industry than imports. The increased imports of red cedar shakes and shingles were not a cause of their injury, but were rather a consequence of the true causes of injury.

IV CAUSALITY WITH DIFFERENTIATED GOODS

In the previous section, the domestically produced product and the imported product were homogeneous; consumers viewed them as being identical products. There will frequently be circumstances where this assumption will not be tenable. For example, there may be physical differences between the products, as in the case of automobiles. As a result, the domestic product and the imported product will not be perfect substitutes.

Even if there are no apparent physical differences between a domestically produced product and an imported one, the product's source of origin may nevertheless affect its demand. This is often the case for many intermediate manufactured goods. An American manufacturer will frequently purchase a portion of its input requirements overseas, but will be unwilling to depend entirely on imports for its production, even when it is cheaper than its domestic counterpart. For example, a truck manufacturer might be able to save a considerable amount of money by sourcing a part overseas. However, should shipments of the part be cut of because of war or a transportation strike anywhere along the line of supply, the savings would be dwarfed by the cost of shutting

down an entire production line for a part that costs a few dollars a unit.

A linear model of supply and demand for differentiated domestic imported goods can be written as:

$$D_d = a_1 + b_1P_d + c_1P_m, \quad c_1, b_2, f_1, f_2 > 0,$$

$$D_m = a_2 + b_2P_d + c_2P_m, \quad b_1, c_2 < 0,$$

$$S_d = d_1 + f_1P_d, \qquad |b_1| > c_1, \ |c_2| > b_2,$$

$$S_m = d_2 + f_2P_m.$$

Once again, the b's, c's and f's are behavioral parameters that are assumed to remain constant over the period of investigation, while the a's and the d's are the shift parameters of the model, which we expect will change over the time as the exogenous variables that determine them change.

This model can be solved for expressions of P_d, P_m, Q_d and Q_m as functions of the paramaters:

$$P_d = \frac{(d_1 - a_1)(c_2 - f_2) - c_1(d_2 - a_2)}{(b_1 - f_1)(c_2 - f_2) - b_2c_1},$$

$$P_m = \frac{(b_1 - f_1)(d_2 - a_2) - b_2(d_1 - a_1)}{(b_1 - f_1)(c_2 - f_2) - b_2c_1},$$

$$Q_d = d_1 + \frac{f_1(d_1 - a_1)(c_2 - f_2) - f_1c_1(d_2 - a_2)}{(b_1 - f_1)(c_2 - f_2) - b_2c_1},$$

$$Q_m = d_2 + \frac{f_2(b_1 - f_1)(d_2 - a_2) - f_2b_2(d_1 - a_1)}{(b_1 - f_1)(c_2 - f_2) - b_2c_1}.$$

The changes in the observed prices and quantities can be written in matrix form as

$$\Delta o = D\Delta s$$

where $\Delta o = [\Delta P_d, \ \Delta P_m, \ \Delta Q_d, \ \Delta Q_m]'$ is the 4x1 vector of changes in the

observed variables, $\Delta s = [\Delta a_1, \Delta a_2, \Delta d_1, \Delta d_2]'$ is the 4x1 vector of changes in the shift parameters and D is the 4x4 matrix of the derivatives of the observed variables with respect to the shift parameters:

$$D = \frac{1}{den} \begin{bmatrix} -f_1(c_2-f_1) & f_1c_1 & (c_2-f_2)b_1-b_2c_1 & -f_1c_1 \\ f_2b_2 & -f_2(b_1-f_1) & -f_2b_2 & c_2(b_1-f_1)-b_2c_1 \\ f_2-c_2 & c_1 & c_2-f_2 & -c_1 \\ b_2 & f_1-b_1 & -b_2 & b_1-f_1 \end{bmatrix}$$

where $den = (b_1-f_1)(c_2-f_2) - b_2c_1$.

This system of equations can then be solved for the change in domestic production, decomposed into the change as the result of each shift parameter:

$$\Delta Q_d = \frac{-f_1(c_2 - f_2)(\Delta Q_d - b_1\Delta P_d - c_1\Delta P_m)}{(b_1 - f_1)(c_2 - f_2) - b_2c_1} \quad \{\Delta \text{ in } a_1\}$$

$$+ \frac{f_1c_1(\Delta Q_m - b_2\Delta P_d - c_2\Delta P_m)}{(b_1 - f_1)(c_2 - f_2) - b_2c_1} \quad \{\Delta \text{ in } a_2\}$$

$$+ \frac{[(c_2 - f_2)b_1 - b_2c_1][\Delta Q_d - f_1\Delta P_d]}{(b_1 - f_1)(c_2 - f_2) - b_2c_1} \quad \{\Delta \text{ in } d_1\}$$

$$- \frac{f_1c_1(\Delta Q_m - f_2\Delta P_m)}{(b_1 - f_1)(c_2 - f_2) - b_2c_1}. \quad \{\Delta \text{ in } d_2\}$$

This can be rewritten using elasticities as:

$$\frac{\Delta Q_d}{Q_d} = \frac{-\eta_d(\epsilon_m - \eta_m)(\%\Delta Q_d - \epsilon_d\%\Delta P_d - \epsilon_{dm}\%\Delta P_m)}{(\epsilon_d - \eta_d)(\epsilon_m - \eta_m) - \epsilon_{dm}\epsilon_{md}} \quad (\Delta \text{ in } a_1)$$

$$+ \frac{\eta_d\epsilon_{dm}(\%\Delta Q_m - \epsilon_{md}\%\Delta P_d - \epsilon_m\%\Delta P_m)}{(\epsilon_d - \eta_d)(\epsilon_m - \eta_m) - \epsilon_{dm}\epsilon_{md}} \quad (\Delta \text{ in } a_2)$$

$$+ \frac{[(\epsilon_m - \eta_m)\epsilon_d - \epsilon_{dm}\epsilon_{md}](\%\Delta Q_d - \eta_d\%\Delta P_d)}{(\epsilon_d - \eta_d)(\epsilon_m - \eta_m) - \epsilon_{dm}\epsilon_{md}} \quad (\Delta \text{ in } d_1)$$

$$- \frac{\eta_d\epsilon_{dm}(\%\Delta Q_m - \eta_m\%\Delta P_m)}{(\epsilon_d - \eta_d)(\epsilon_m - \eta_m) - \epsilon_{dm}\epsilon_{md}}, \quad (\Delta \text{ in } d_2)$$

where ϵ_d is the elasticity of demand for the domestic product, ϵ_m is the elasticity of demand for the imported product, ϵ_{dm} is the cross price elasticity of demand for the domestic product with respect to a change in price of the imported product and ϵ_{md} is the cross price elasticity of demand for the imported product with respect to a change in the price of the domestic product.

An Application

On December 31, 1984 the U.S. International Trade Commission began a Section 201 investigation of the nonrubber footwear industry (TA-201-55).

The Commission's investigation found that domestic production of nonrubber footwear (less imports) fell from 386,311,000 pairs in 1980 to 289,577,000 for 1984, a decrease of 21.7%. Imports during this same period rose from 365,743,000 to 725,893,000, an increase of 98.5%. Furthermore a price index of imported nonrubber footwear deflated by the producer price index declined by 21.1% over the period, versus a decline of 17.9% for domestically produced nonrubber footwear.

On July 1, 1985 the Commission transmitted its finding to the President that imports of nonrubber footwear were a cause of serious

injury or posed a threat of such injury.[18] A majority of the Commission recommended to the President that quotas on imports of nonrubber footwear be imposed for the next five years. The Commission used the following set of elasticities to make its recommendation: ϵ_d = -1.8, ϵ_m = -2, ϵ_{dm} = 2.1, ϵ_{md} = 1.7, η_d = 4.2, η_m = ∞.

How does the Commission's recommendation square with the observed changes in prices and quantities and the estimated elasticities? Since the Commission assumed that import supply was infinitely elastic, the substitution of the elasticity figures in the decomposition equation will give indeterminate forms. It is therefore necessary to use L'Hopital's Rule to compute the changes in domestic production due to each supply and demand change.

Differentiating the numerator and the denominator of the percentage change in domestic production caused by a change in demand for the domestic product gives:

$$\frac{\eta_d(\%\Delta Q_d - \epsilon_d\%\Delta P_d - \epsilon_{dm}\%\Delta P_m)}{\eta_d - \epsilon_d}.$$

Using the data and the elasticity estimates that were used by the ITC implies that the change in demand for domestically produced rubber footwear accounted for a decrease in domestic production of 6.7%.

When an infinite import elasticity is used in the formula for the change in domestic production caused by a change in demand for the imported product, the figure goes to zero. The reason for this is that the demand for the imported product can only affect the demand or supply of the domestically produced product through the price of the imported product. If the elasticity of supply is infinite, demand can have no influence on price, and hence changes in the demand can not

affect the quantity of the domestically produced product.

Differentiating the numerator and the denominator of the percentage change in domestic production caused by a change in domestic supply with respect to η_m gives:

$$\frac{-\epsilon_d(\%\Delta Q_d - \eta_d \%\Delta P_d)}{\eta_d - \epsilon_d}.$$

Using the data and the elasticity estimates implies that domestic output was 16% higher than it otherwise would have been in the absence of a shift in domestic supply.

Finally, differentiating the numerator and the denominator of the effect of a change in import supply on the percentage change in domestic production with respect to η_m gives:

$$\frac{\eta_d \epsilon_{dm} \%\Delta P_m}{\eta_d - \epsilon_d}.$$

The estimated elasticities and the observed changes in prices and quantities imply that increased import supply of nonrubber footwear is responsible for a decrease of 31% in domestic production. Therefore, the ITC's finding that increased imports were a substantial cause of injury to the domestic nonrubber footwear industry was consistent with the elasticity figures used to make the remedy recommendation.

V. CAUSALITY WITH MONOPOLY POWER

The above analysis showed how the impact of an increase in import supply could affect a domestic industry. Whether for the three curve analysis of homogeneous goods or the four curve analysis of heterogeneous goods, the use of supply and demand analysis implied that buyers and sellers act as perfectly competitive agents. There may be

circumstances where this is an unrealistic assumption. There have been a number of escape clause investigations where the petitioner was the sole U.S. producer of the product in question, such as electric shavers. This section will show that the methodology used above can be adapted to cases where there is monopoly power.

We will consider the case where there is only a single domestic seller of a homogeneous good. The foreign producers act as a competitive fringe to the domestic dominant firm, who sets the price and supplies the residual demand. Once again, the underlying model is a linear one:

$$D = a + bP$$

$$S_m = d_2 + f_2P$$

$$C_d = d_1 + cQ_d$$

where C_d is the total cost of the domestic firm. The domestic firm faces a residual demand of $D - S_m$, or $a - d_2 + (b - f_2)P$. The firm's profit, Π, will therefore be

$$\Pi = (a-d_2)P + (b-f_2)P^2 - d_1 - c(a-d_2) - c(b-f_2)P.$$

By differentiating Π with respect to P and setting it equal to zero we can solve for price P, domestic production Q_d and imports Q_m:

$$P = \frac{c(b-f_2) + d_2 - a}{2(b-f_2)}$$

$$Q_d = a - d_2 + \frac{c(b-f_2) + d_2 - a}{2}$$

$$Q_m = d_2 + \frac{f_2[c(b-f_2) + d_2 - a]}{2(b-f_2)}.$$

We notice that d_1, the fixed cost of the domestic firm, plays no role in determining price or quantities. This is of course a familiar

result for a monopolist or, in this case, a dominant firm. Only changes in demand (a), import supply (d_2) or the domestic firm's marginal cost (c) will affect the level of domestic production Q_d.

The expressions for the changes in price, domestic production and imports can be written as:

$$\Delta P = \frac{\partial P}{\partial a}\Delta a + \frac{\partial P}{\partial c}\Delta c + \frac{\partial P}{\partial d_2}\Delta d_2,$$

$$\Delta Q_d = \frac{\partial Q_d}{\partial a}\Delta a + \frac{\partial Q_d}{\partial c}\Delta c + \frac{\partial Q_d}{\partial d_2}\Delta d_2,$$

$$\Delta Q_m = \frac{\partial Q_m}{\partial a}\Delta a + \frac{\partial Q_m}{\partial c}\Delta c + \frac{\partial Q_m}{\partial d_2}\Delta d_2.$$

This can be expressed in matrix form as

$$\Delta o = D\Delta s,$$

where $\Delta o = [\Delta P, \Delta Q_d, \Delta Q_m]'$ is the 3x1 vector of changes in prices and quantities, $\Delta s = [\Delta a, \Delta c, \Delta d_2]'$ is the 3x1 vector of changes in the shift paramaters and D is the 3x3 matrix of derivatives of the prices and quantities with respect to the shift parameters:

$$D = \frac{1}{2(b-f_2)} \begin{bmatrix} -1 & b-f_2 & 1 \\ b-f_2 & 1 & f_2-b \\ -f_2 & f_2(b-f_2) & 2b-f_2 \end{bmatrix}$$

As was the case when domestic production was competitive, we can decompose the change in domestic production as a function of the changes in the observed variables:

$$\Delta Q_d = \frac{\Delta Qd + \Delta Qm - b\Delta P}{2} \quad \text{(change in demand)}$$

$$+ \frac{\Delta Qd + (b-f_2)\Delta P}{2} \quad \text{(change in domestic costs)}$$

$$+ \frac{f_2\Delta P - \Delta Q_m}{2} \quad \text{(change in import supply)}$$

which can be rewritten in terms of elasticities as follows:

$$= .5[\Delta Q - \epsilon Q\%\Delta P] \quad \text{(change in demand)}$$

$$+ .5[(\epsilon Q - \eta_m Q_m)\%\Delta P + \Delta Q_d] \quad \text{(change in domestic costs)}$$

$$+ .5[\eta_m Q_m\%\Delta P - \Delta Q_m] \quad \text{(change in import supply).}$$

It is therefore possible to extend the results of the previous sections to cases where some of the participants have market power and therefore cannot be modeled as having supply or demand schedules.

VI. CAN IMPORTS BE THE SUBSTANTIAL CAUSE OF INJURY WHEN THEY DECLINE?

The Trade Act of 1974 requires the International Trade Commission to "determine whether an article is being imported into the United States in such increased quantities as to be a substantial cause of serious injury, or the threat thereof."[19] If the Commission finds that imports have not increased, it may not recommend any remedy.[20]

There is a vigorous debate over the meaning of the term "increased quantitities." Some ITC commissioners believe that the term increased quantities can be met if imports decline in absolute quantity but increase in relative market share. This is disputed by others who

claim that the legislative language is clear.[21]

While the debate is a legal one, it raises an interesting economic question: is it possible for imports to be the substantial cause of injury in the meaning of Section 201 if the quantity of imports decline? If the answer is no, the debate would be meaningless, since a finding that imports had declined in absolute terms would mean that no further inquiry into causality would be necessary.

In fact, it is possible to construct a counterexample in which imports are the substantial cause of injury even though imports decline. Consider a market for a homogeneous good in which domestic production is initially 500,000 units as are imports. The initial price is taken to be one. Suppose that price were to fall to .8, domestic production were to fall to 300,000 and imports were to decline to 450,000. If $\epsilon = -.1$, $\eta_d = 2$ and $\eta_m = 10$, use of the decomposition equation would indicate that a decrease in demand was responsible for a decrease in domestic production of 44,262 units while an increase in import supply was responsible for the remaining decrease of 155,738 units. Hence, it is indeed possible for an increase in import supply to be the substantial cause of injury to a domestic industry while observing a decrease in the quantity of imports.

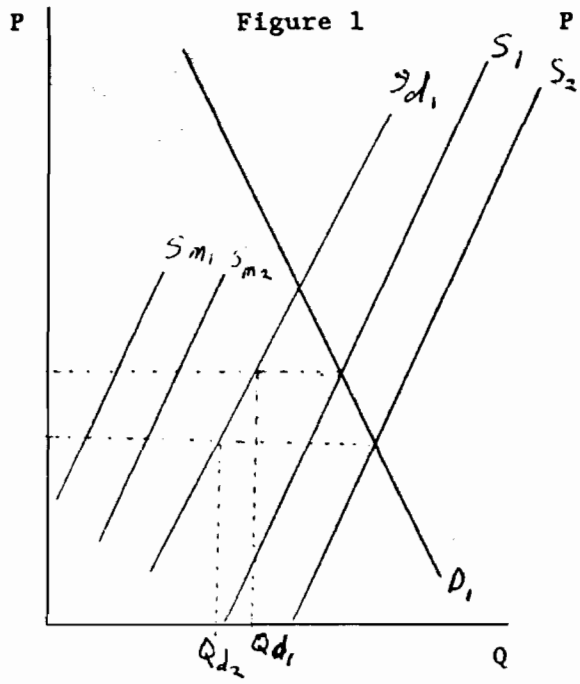
VII. CONCLUSION

The United States International Trade Commission has the responsibility of investigating the causes of injury to industries that may be adversely affected by increased imports. The standard economic analysis of supply and demand can be a useful tool in carrying out this

task, even when the available data does not permit a complete econometric determination of all of the factors influencing domestic production.

Observed changes in prices and quantities, together with a priori information about the elasticities of supply and demand, can be used to make inferences about relative changes in supply and demand, and hence about the causes of injury to an industry. The decomposition of causality into separate changes in linear supply and demand functions may be of use to researchers in other fields who face similar problems of having to analyze causation but are unable to estimate a complete econometric model of a market.[22]

Figures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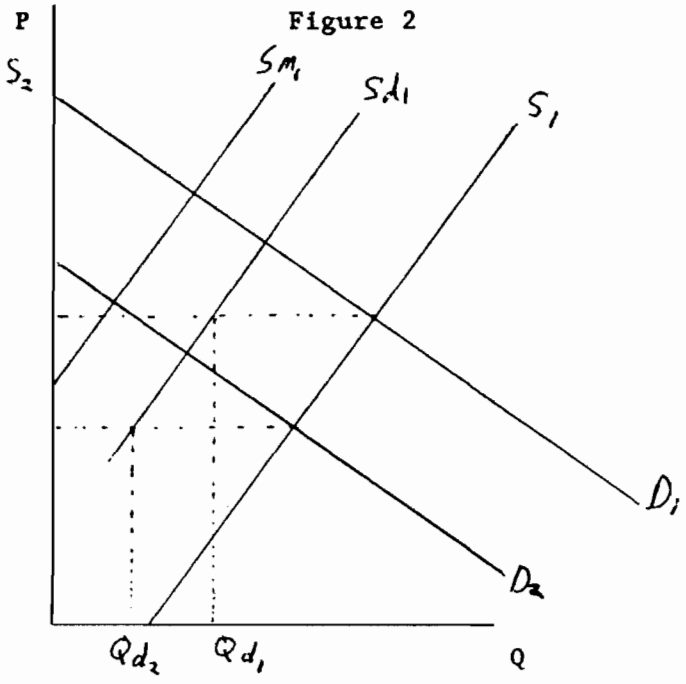
S_2
S_{d_1}
S_{m_1} S_{m_2}
D_1
Q_{d_2} Q_{d_1}
Q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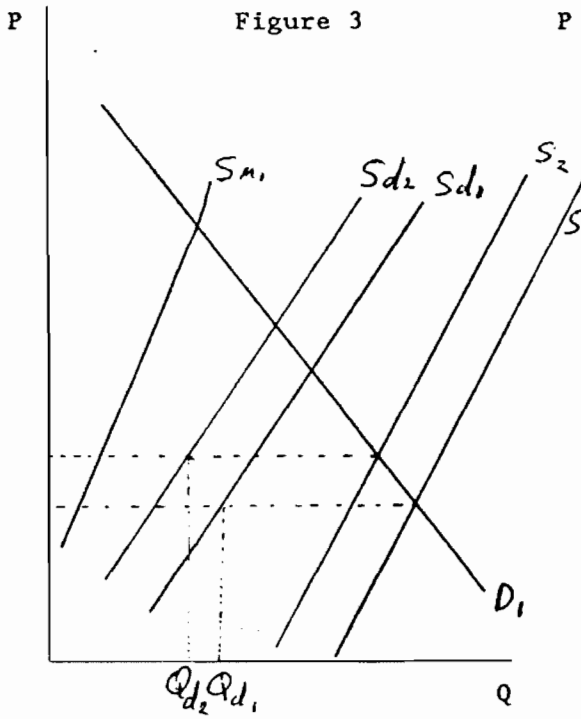
S_{d_1}
S_1
D_1
D_2
Q_{d_2} Q_{d_1}
Q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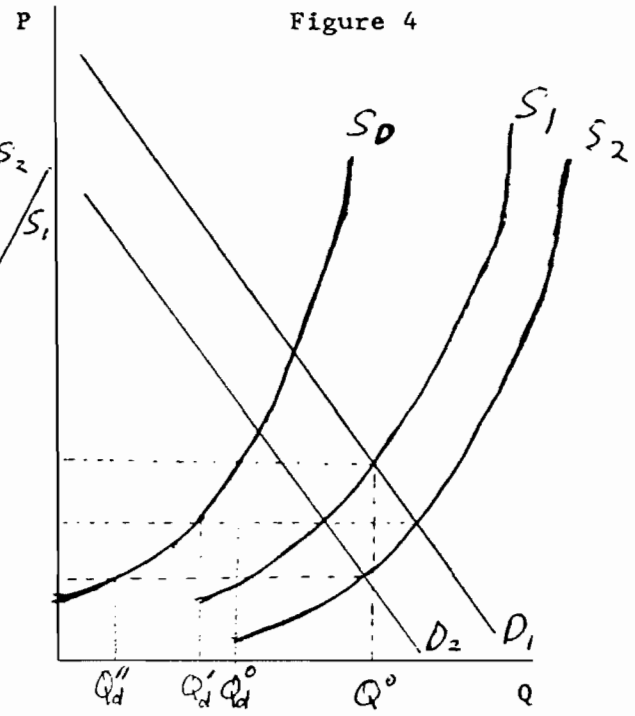
S_2
S_1
D_1
Q_{d_2} Q_{d_1}
Q


P
Figure 4
S_D
S_1
S_2
D_2
D_1
Q''_d Q'_d Q^0_d Q^0
Q

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Footnotes

1.Trade Act of 1974, Sec. 201(b)(1), 19 U.S.C. Sec. 2251(b)(1). Petitions for escape clause relief under Sec. 201 can come from a firm or a group of firms or workers that is representative of an industry, the President, the U.S. Trade Representative, the Ways and Means Committee of the House of Representatives or the Senate Finance Committee. The International Trade Commission is also authorized to begin investigations on its own initiative, but seldom does so.

2.There have, however, been instances when the President has sought voluntary restraint agreements from foreign producers after a negative determination by the ITC. An example of this are the recent restraints on imports of automobiles from Japan.

3.Trade Act of 1974, Sec. 201(b)(2)(A).

4.Trade Act of 1974, Sec. 201(b)(2)(B).

5.The Report of the Senate Finance Committee states: "The rationale for the 'escape clause' has been, and remains, that as barriers to international trade are lowered, some industries and workers inevitably face serious injury, dislocation and perhaps economic extinction. The 'escape clause' is aimed at providing temporary relief for an industry suffering from serious injury, or the threat thereof, so that the industry will have sufficient time to adjust to the freer international competition." [S. Rep. No. 1298, 93d Cong. 2d Sess. 119 (1974).]

6.Other authors have used other proxies for serious injury. Gene Grossman used employment as the measure of industry in looking at the steel industry, while Robert Pindyck and Julio Rotemberg used both domestic production and employment as measures of injury to the copper industry. We would expect that changes in output will be highly correlated with the other indicia of injury enumerated by Congress, particularly given the magnitude of these changes that are implied by the term "serious injury."

7.As will be discussed below, there is a dispute as to whether or not a domestic industry can qualify for import relief under section 201 if imports decrease in absolute terms.

8.This interpretation of section 201 was originally developed by David Tarr in the Federal Trade Commission's brief to the International Trade Commission in the later's investigation of steel in 1984. This interpretation is accepted by Grossman, but is rejected by Pindyck and Rotemberg, first of all on the grounds that it does not conform to the statutory language. Prior to 1974 the application of the escape clause was limited to injury resulting from the elimination of existing trade restrictions; such injury is clearly the result of a shift in the import supply schedule, rather than a movement along it. The 1974 Trade Law relaxed this to allow relief from increased imports, but the legislative history of the act makes clear that injury resulting from

changes in domestic supply or demand are not grounds for granting import relief (see notes 5 and 10). I therefore believe that the approach taken here is the one most consistent with Congressional intent.

They further object to this interpretation on the grounds that it is difficult to implement empirically, and they note that Grossman was forced to assume that import supply was infinitely elastic. This paper will show that such an interpretation is workable under rather broad assumptions.

9.Trade Act of 1974, Sec. 201(b)(4). Prior to 1974, imports had to be as important a cause of injury as all other causes in aggregate. Although Congress changed this to be at least as important as any other individual cause, it said nothing about the level of aggregation for these alternative causes. If the level of aggregation is taken to be sufficiently low, it will be possible to make imports the most important cause of injury. Imagine that the industry is injured because of the increase in the prices of several inputs to the industry, and that the resultant shift in the domestic supply curve has a greater impact upon the industry than an increase in import supply. However, the injury to the domestic industry caused by a shift in the domestic supply curve caused by the increase in price of any single input may be less than the injury caused by the increase in import supply. Are imports a substantial cause of injury, or not?

Alternatively, imagine a case where injury that would be caused by the increase in price of a single input exceeds the injury caused by increased import supply, but because of other changes in domestic supply, such as increased productivity, the injury caused the decrease in domestic supply is less than the injury caused by the increase in import supply. Are increased imports a cause of injury in this case?

The analysis in this paper considers sources of injury at the same level of aggregation. The only sources of injury are therefore a change in demand, a change in domestic supply, or a change in import supply.

10.The legislative history of the 1974 Trade Act notes that "The existence of any of these factors such as the growth in inventory would not in itself be relevant to the threat of injury from imports if it resulted from conditions unrelated to imports. Such conditions could arise from a variety of other causes, such as changes in technology or in consumer tases, domestic competition from substitute products, plant obsolescence, or poor management."[S.Rep. 1298, 93rd Cong., 2d Sess. 120 (1974)]. All of these other causes can be characterized as shifts in either the demand or the domestic supply curves.

11. Grossman (1986), for example, says "If we are to attribute developments in the time path of industry employment to their proximate causes, we might in principle wish to understand all of the structural relationships that together determine the level of output of domestic steel and the technique of production that is used to manufacture that output. Such a full-blown model of the steel industry would be very

difficult to implement empirically, however, especially since data on many of the requisite variables are not collected under a consistent definition of the industry."

12.For example, Edward E. Leamer has shown a technique that can place bounds upon the value of an elasticity in a supply and demand model.

13. Pindyck and Rottemberg (1987) also assume linearity.

14. If one were to attempt to estimate econometrically the supply and demand equations, one would typically add a stochastic error term to the equation, with the (usually implicit) explanation that this error term consists of variables that are excluded from the regression. These variables are therefore included in the shift parameters.

15. Two commissioners dissented from the finding that imports were a substantial cause of injury to the domestic industry. Their dissenting opinion noted that imports had increased, while prices had declined. This was evidence that the import supply curve had in fact increased, and was a source of injury to the domestic industry. At the same time though, consumption had fallen by about 19% even though prices had fallen by half. This could only be consistent with a decrease in demand. The dissenting opinion found that the combination of an elastic demand with an inelastic domestic supply indicated that it was the decrease in demand, not the increase in import supply, that was substantially responsible for the decrease in domestic production.

16.United States International Trade Commission Memorandum EC-J-114, March 11, 1986. It should be noted that ITC economists make no recommendations to the Commission on determinations.

17.Because of restraints on the export of logs by the Canadian government, the price of logs can be lower in Canada than in the United States. Hence, the domestic supply curve for shakes and shingles could shift as the result of a decrease in the supply of the input without this shift affecting the import supply curve.

18.Three commissioners found imports to have caused serious injury, while the other two commissioners found imports to pose the threat of such injury.

19.19 U.S.C. Sec. 2251(b)(1) (1982).

20.19 U.S.C. Sec. 2251(d)(1) (1982).

21.See the Views of Vice Chairman Liebeler and Commissioner Brunsdale in Re: Wood Shakes and Shingles, Investigation No. TA-201-56, p. 45.

22. For example, the technique may be of value to economic historians. Robert Brooke Zevin (1971) assumed elasticities in a decomposition formula to analyze textile production in the 19th Century United States

when faced with insufficient data to estimate these elasticities; however, the formula that he used is only an approximation to the one used in this paper.