

THE ROLE OF PRICE ELASTICITIES OF DEMAND IN THE ECONOMIC IMPACT OF A PORT

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Abstract—The standard approach to estimating the economic impact of a port overestimates the port's direct impacts on exports and imports. The overestimates result because all export and import activity in the impact area is assumed to fall to zero in the absence of the port. We argue that this assumption is incorrect in general. How much exports and imports fall depends on the elasticity of demand for exports and imports. These elasticities may be infinitely large, which is what is implicitly assumed in the standard approach, but they may be less than infinity, in which case, not all of the export or import activity will be lost. We develop a methodology that explicitly accounts for the elasticity of demand for exports and imports and apply that methodology to the Port of Tampa. Comparing estimates of the direct impact using the standard methodology and ours confirms that substantial overestimates would have resulted from using the standard methodology.

I. INTRODUCTION

There are many economic impact studies of ports. We have compiled a bibliography of 45 port impact studies (available on request), and there are surely many more. There is even a quasi-official methodology. The *Port Economic Impact Kit* (Temple, Barker & Sloane, Inc. et al. 1985), developed under the auspices of the U.S. Maritime Administration, is a handbook, with supporting software, for performing a port economic impact study. Sixteen of the 45 studies referred to above have used the *Port Economic Impact Kit*. In this paper, we will use the *Port Economic Impact Kit* as representative of standard methodology.

All port impact studies estimate the direct impacts of a port. They then apply impact multipliers, drawn from a model of the regional economy, to the direct impacts to convert direct impacts into total impacts. This paper is concerned with the appropriate way of estimating the direct impacts of a port, not with the models used to generate the impact multipliers.

Previous criticism of direct-impact estimation has focused on overestimation. Davis (1983, 62), among others, has decried the tendency "to include in the primary [direct] impact: (1) all economic activities located in the spatial area designated as the port, and (2) the entirety of economic activity utilizing the port facilities for exporting and importing."

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Concentrating on Davis's second point, we contend that the standard methodology for estimating the economic impact of a port produces overestimates of the port's direct impacts on exports and imports. The overestimate is the result of assuming that all export and import activity in the impact area would fall to zero in the absence of the port. We argue that this activity would not necessarily fall to zero and that how much it does fall depends on the elasticity of demand for exports and imports.

We develop an alternative methodology and apply it to the Port of Tampa. Comparing estimates of the direct impact using the standard methodology with ours confirms that substantial overestimates would have resulted from using the standard methodology.

In our formulation, the direct impact of a port on inland transportation also depends on the elasticities of demand for imports and exports. This is so because the change in exports and imports will affect how much inland transportation occurs. To shorten this paper, however, we deal only with the direct impacts of a port on exports and imports. Our complete study (DeSalvo and Fuller 1988) provides direct impacts of the Port of Tampa on the inland transportation industry and on the "port industry" (i.e., all port-dependent activities other than exports, imports, and inland transportation) as well as on exports and imports.

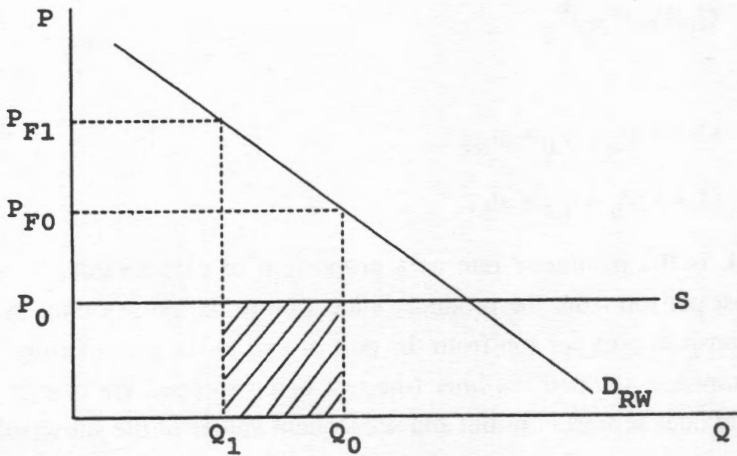
II. METHODOLOGY

Exports

In Figure 1, DRW represents the rest of the world's demand for the local export industry's product. There may also be a local demand for the product, but this plays no role in the analysis and is therefore omitted. We assume that the local export industry can supply the product at constant unit cost, so the supply curve, labeled S , is drawn horizontally. (This paper's methodology is independent of the regional model used to generate the impact multipliers. Nevertheless, some of the assumptions used in this paper, such as perfectly elastic industry supply, are the same as those used in input-output analysis, commonly used in port economic impact studies to model the regional economy.)

In the absence of out-of-area purchases of the export and under competitive conditions, the local export industry would sell its output at the producer price P_0 in Figure 1 (the quantity sold locally is not shown). Since there is out-of-area demand for the product and since the local industry is capable of expanding its production at constant unit cost, the local industry will export the good if its

FIGURE 1
Direct Impact of a Port on Exports



delivered price at the receiving port is equal to or less than the price of the same product available from other suppliers.

Let P_{F0} be the delivered price to a "foreign," i.e., non-local, buyer at the buyer's port of entry, where $P_{F0} - P_0$ equals transportation costs incurred in moving the product from the producer's location to the buyer's port of entry, including insurance and customs duties as well as inland and overseas transportation costs per unit of output. (In this paper, "overseas" refers to all waterborne transportation, including domestic barge and domestic vessel transportation, if any.)

In Figure 1, local exporters will sell Q_0 units of the product outside the local area at a price of P_{F0} . If the port ceased operations, export firms would seek alternative ports from which to ship their products. This would increase inland transport costs per unit of product, and, although overseas transport costs per unit of product might rise or fall depending on the location of the alternative port, presumably per-unit total transportation costs would rise. In Figure 1, this is shown as an increase in the price to foreign buyers from P_{F0} to P_{F1} . Output exported would fall from Q_0 to Q_1 , the amount of the decrease in Q depending on the price elasticity of demand.

The direct impact of a port on exports (DI_E) is the change in output valued at producer price, given graphically by the shaded area in Figure 1 or algebraically by

$$DI_E = P_0(Q_1 - Q_0). \quad (1)$$

If the constant-elasticity demand curve, $Q = A(P_F)^E$, where A is a level parameter and E is the price elasticity of demand, passes through the point (P_{F0}, Q_0) , then

$$Q_1 = Q_0(P_{F1}/P_{F0})^E,$$

where

$$P_{F0} = (1 + k)P_0 + t_{L0} + at_{S0},$$

$$P_{F1} = (1 + k)P_0 + t_{L1} + at_{S1},$$

and where k is the insurance rate as a proportion of cargo value, t_L is inland transport cost per ton from the producer's location to the port of exit, t_S is overseas liner transport cost per ton from the port of exit to the port of entry, a is the fraction of tonnage shipped via liner (the rest being shipped via charter vessel), and zeros and ones represent initial and subsequent values of the subscripted variables. (We intend t_{S0} and t_{S1} to represent transportation rates of all waterborne vessels including domestic barges and vessels.)

The appearance of the liner proportion, a , in Equation (1) requires some justification. Suppose a shipper uses a shipping line for transporting 80 percent of his cargo tonnage and uses charter vessels for the remaining 20 percent. Then the cost of shipping an additional ton is 80 percent of the liner rate per ton (i.e., 0.8 ton goes via liner, and 0.2 ton, by charter vessel, but the additional cost of the charter is zero, assuming the charter vessel is not already at capacity). Hence, in the estimation formula, the liner rate is multiplied by the proportion of tonnage shipped by liner. More formally, if both liner and charter vessels are used, the total cost of getting the exporter's product to market is

$$C = P_0Q + t_S(aQ) + T_S + t_LQ + kP_0Q,$$

where, in addition to the variables defined above, T_S is the cost of chartering a vessel. Marginal cost is

$$MC = (1 + k)P_0 + at_S + t_L.$$

(If $a = 1$, then $T_S = 0$, and $MC = (1 + k)P_0 + t_S + t_L$.) Under competitive conditions, this is also the price paid by the buyer at the foreign port, or P_F .

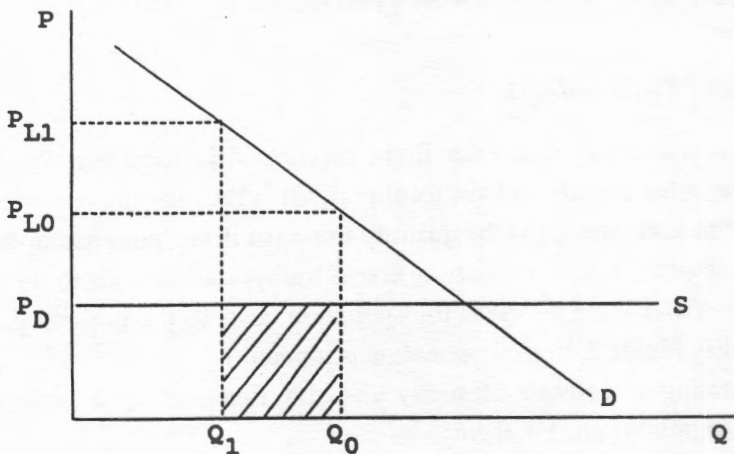
In the absence of the local port, the delivered foreign price of local exports would be P_{F1} . If rest-of-world demand were either perfectly elastic at P_{F0} or at least more elastic than depicted in Figure 1, such that it intersected the price axis at or below P_{F1} , then the quantity of local exports demanded by the rest of the

world would be zero. No exports would occur. Under this circumstance, $DI_E = P_0 Q_0$, that is, the direct impact would be the loss of the entire quantity formerly exported. This is what is implicitly assumed in most port economic impact studies. Hence, the economic impact of a port on exports is typically overestimated.

Imports

In Figure 2, D represents the demand in the impact area for an imported good. (The import is assumed to be noncomparable, i.e., the same product is not produced locally. We return to this point later.) Local demand depends on the local delivered price, which consists of domestic port value plus inland transport costs per unit of product. Domestic port value, in turn, is equal to the producer price of the export plus insurance, customs duties, and overseas transport costs, all expressed per unit of the product.

FIGURE 2
Direct Impact of a Port on Imports



Let P_{L0} be the local delivered price and P_D be domestic port value per unit. In Figure 2, at price P_{L0} , Q_0 units are sold to local importers. In the absence of the port, inland (and perhaps overseas) transport costs per unit of product shipped would be increased, and local delivered price would rise. In Figure 2, this higher local price is P_{L1} , at which quantity demanded is Q_1 .

Since it is customary to value imports at domestic port value, the direct impact is the shaded area in Figure 2. Note that in this case, as opposed to the case of

exports, the direct impact is the decrease in the quantity *imported*, rather than the decrease in the quantity *produced*. Nevertheless, the increase in price of imported goods into the local area and the consequent reduction in their use will adversely affect local output since the imports are used as inputs to local production or are distributed by local wholesalers and retailers.

Although this paper deals with the estimation of direct impacts, not total impacts, it might be useful to note how the direct impact as defined above could be converted into a total impact, as well as noting an alternative approach. Since we define the direct impact of noncomparable imports as the change in imports, rather than the change in production, we used input-output supply multipliers to obtain the total impacts in our study of the Port of Tampa (DeSalvo and Fuller 1988, 119-121, 138-161, 299-305, 313-319, 327-333, 348-361, 369-375). (For a discussion of input-output supply multipliers, see Miller and Blair (1985, 317-322). Davis (1983, 66-68, 77), on the other hand, suggests defining the direct impact as the change in the output of local industries and applying a "total-output multiplier" to get the total impact. Either way is possible, and we have discussed both elsewhere (DeSalvo and Fuller 1988, 185-190). However, the approach presented in this paper is simpler and requires less data than the alternative.

In general, the direct impact of a port on imports (DI_M) is

$$DI_M = P_{D1}Q_1 - P_{D0}Q_0, \quad (2)$$

where P_{D1} is domestic port value in the absence of the local port, P_{D0} is domestic port value in the presence of the local port, Q_1 is the quantity imported in the absence of the port, and Q_0 is the quantity imported in the presence of the port. The P_D 's are allowed to vary because overseas transportation costs to the new port of entry may differ from overseas transportation costs to the original port of entry. (To simplify Figure 2, this complication is ignored.)

Assuming a constant-elasticity demand function, $Q = A(P_L)^E$, passing through the point (P_{L0}, Q_0) , then

$$Q_1 = Q_0(P_{L1}/P_{L0})^E,$$

where

$$P_{L0} = P_{D0} + t_{L0}$$

and

$$P_{L1} = P_{D1} + t_{L1}.$$

Customs duties may be levied as either a percentage of cargo value or as a fixed amount per ton, and the estimable forms for the direct impact of imports will differ slightly depending on which method is used. When customs duties are levied per dollar of value,

$$P_{D0} = (1 + k + c_v)P_0 + at_{S0}$$

and

$$P_{D1} = (1 + k + c_v)P_0 + at_{S1}.$$

When customs duties are levied as an amount per cargo ton,

$$P_{D0} = (1 + k)P_0 + c_q + at_{S0},$$

and

$$P_{D1} = (1 + k)P_0 + c_q + at_{S1}.$$

In the absence of the local port, the delivered local price of imports would be P_{L1} , which is greater than P_{L0} . If local demand were either perfectly elastic at P_{L0} or at least more elastic than depicted in Figure 2, such that it intersected the price axis at or below P_{L1} , then the quantity of imports locally demanded would be zero. None of the product would be imported into the local area, and $DI_M = P_{D0}Q_0$, that is, the direct impact would be the loss of the entire quantity formerly imported. This is what is implicitly assumed in most port economic impact studies. Hence, the economic impact of a port on imports is typically overestimated.

We are ignoring comparable imports, i.e., products identical to those produced in the impact area. The increased price of comparable imports into the impact area raises the price of locally produced substitutes, which, given upward sloping supply, results in increased local production. Thus, to exclude comparable imports when they existed would result in an *underestimation* of the direct, and total, impact of the port. We ignore comparable imports because there were none during the period to which our data apply, and it is likely that if researchers have access to disaggregated data, such as we did, they may find no comparable imports for their impact areas. The impact estimation formula in the case of comparable imports may be found in DeSalvo and Fuller (1988, 191-195).

III. APPLICATION

The variables necessary to estimate the direct impacts of a port on both exports and imports are producer price (P_0), initial quantity exported or imported (Q_0), price elasticity of demand (E), insurance as a proportion of value (k), initial and subsequent inland transport costs per ton (t_{L0} and t_{L1}), initial and subsequent overseas liner costs per ton (t_{S0} and t_{S1}), and the proportion shipped via liner (a). In addition, for imports, we also need customs duties per dollar of value (c_v) and as a dollar amount per ton (c_q).

Producer Price (P_0) and Quantity Exported or Imported (Q_0)

We obtained the declared value of each commodity exported from and imported into the Port of Tampa in fiscal year 1985-86 from the U.S. Department of Commerce (1986a). These highly disaggregated data were aggregated into categories conforming to those in the Port Authority's fiscal year 1985-86 cargo report (Port of Tampa 1986). With minor exceptions, quantities exported and imported were taken from the Port Authority's fiscal year 1985-86 cargo report.

Aggregated values were divided by aggregated quantities for each group of exports and imports to obtain unit value, a proxy for producer price. Unit values and quantities may be found in DeSalvo and Fuller (1988, 58-59, 81-82). (To keep this paper to a reasonable length, we shall provide only data that are likely to be of general interest.)

Price Elasticity of Demand (E)

We used published price elasticities from constant-elasticity demand functions, where available, adjusted for market share. There are more constant-elasticity estimates than others, and the use of constant elasticities avoids the necessity of assuming that the price-quantity point at which the reported elasticity is evaluated corresponds to the price-quantity combination in our data. That is why the estimable forms presented above assume constant elasticities. In those cases where there was no constant-elasticity estimate, we used whatever was available, generally an estimate from a linear demand function.

Table 1 presents some of the elasticities used in our study. The ones given in Table 1 are for those commodities whose quantities exported or imported would not have fallen to zero in the absence of the Port of Tampa (this is discussed further later). The remaining elasticities may be found in DeSalvo and Fuller (1988, 62, 84, 226, 236). In Table 1, the first column is the commodity for which the published price elasticity was estimated. The second column presents the publish-

TABLE 1
Price Elasticities of Demand for Exports and Imports

Commodity	Published Elasticity	Source	Export or Import	Market Share	Adjusted Elasticity
Exports					
Building board	1.914	Shiells et al. 1986, p. 510	Building materials	20,260.47	38,778.54
Fruit	0.359	Deaton 1975, p. 266	Citrus, fresh	5.75	2.06
Beverages	0.329	Deaton 1975, p. 266	Citrus juice, bottled	597.10	196.45
Beverages	0.329	Deaton 1975, p. 266	Citrus juice, canned	597.10	196.45
Grain	1.823	Shiells et al. 1986, p. 508	Citrus pellets	43.95	80.12
Grain	1.823	Shiells et al. 1986, p. 508	Feed, bagged	2,194.93	4,001.36
Fertilizer	0.529	Griliches 1958, p. 602	Fertilizer, bagged	2,421.28	1,280.86
Textiles and hardware	0.050	Deaton 1975, p. 266	Hardware	48.85	2.44
Furniture and household equip.	0.780	Philps 1983, p. 260	Household appliances	24,629.99	19,211.39
Matches, soap, etc.	0.136	Deaton 1975, p. 266	Household gds. & pers. effects	3,785.38	514.81
Paperboard	2.039	Shiells et al. 1986, p. 510	Linerboard	187.08	381.46
Wines and spirits	0.339	Deaton 1975, p. 266	Liquor, wine	31,581.32	10,706.07
Tractors	1.500	Griliches 1960, p. 191	Machinery	3,664.78	5,497.17
Chemists' goods	0.890	Deaton 1975, p. 266	Medical supplies	1,959.98	1,744.38
Gasoline and oil	0.156	Houthakker & Taylor 1966, p. 116	Petroleum, n.o.s., packaged	15.40	2.40
Fertilizer	0.529	Griliches 1958, p. 602	Phosphate chemicals, bagged	2.68	1.42
Fertilizer	0.529	Griliches 1958, p. 602	Phosphate chemicals, bulk	100.38	53.10
Fertilizer	0.529	Griliches 1958, p. 602	Phosphate rock, bulk	3.10	1.64
Fertilizer	0.529	Griliches 1958, p. 602	Phosphoric acid	5.65	2.99
Heating and plumbing products	0.990	Walter 1975, p. 94	Pipe, plastic	4,259.07	4,216.48
Heating and plumbing products	0.990	Walter 1975, p. 94	Pipe (other than steel)	10,687.32	10,580.45
Heating and plumbing products	0.990	Walter 1975, p. 94	Plumbing supplies	29,520.61	29,225.40
Steel	0.400	Yntema 1981, p. 36	Scrap metal	4.22	1.69
Steel	0.400	Yntema 1981, p. 36	Steel pipe	13,836.08	5,534.43
Steel	0.400	Yntema 1981, p. 36	Steel, pipe fittings	9,751.14	3,900.46
Oils and fats	0.266	Deaton 1975, p. 266	Tallow	23.68	6.30
Clothing	0.720	Deaton 1975, p. 266	Textiles	1,433.32	1,031.99
Automobiles & parts	1.720	Philps 1983, p. 167	Vehicles, n.o.s., <10,000 lbs.	2,505.65	4,309.71
Imports					
Fabricated metal	0.274	Shiells et al. 1986, p. 510	Aluminum	72,504.86	19,866.33
Fertilizer	0.529	Griliches 1958, p. 602	Ammonia, anhydrous	6.37	3.37
Fertilizer	0.529	Griliches 1958, p. 602	Ammonium sulfate	238.57	126.20
New and used cars	0.958	Houthakker & Taylor 1966, p. 112	Automobiles <10,000 lbs.	2,348,720.16	2,250,073.91
New and used cars	0.958	Houthakker & Taylor 1966, p. 112	Automobiles >10,000 lbs.	682,092.78	633,444.88
Bananas	0.620	Deaton & Muelbauer 1980, p. 63	Bananas	4.53	2.81
Fertilizer	0.529	Griliches 1958, p. 602	Calcium nitrate	63.88	33.79
Cement	2.145	Shiells et al. 1986, p. 513	Cement, bulk	669.36	1,435.78
Cement	2.145	Shiells et al. 1986, p. 513	Cement, clinker, bulk	594.44	1,275.07
Oils and fats	0.266	Deaton 1975, p. 266	Citrus oil	21.69	5.77
Concrete and gypsum	0.667	Shiells et al. 1986, p. 510	Clay, bagged	6,024,368.86	4,018,254.03
Coal	0.321	Deaton 1975, p. 266	Coal	19.23	6.17
Beverages	0.329	Deaton 1975, p. 266	Concentrate, apple, drummed	9.43	3.10
Beverages	0.329	Deaton 1975, p. 266	Concentrate, Citrus, Bulk	9.85	3.24
Beverages	0.329	Deaton 1975, p. 266	Concentrate, Grapefruit	9.85	3.24
Beverages	0.329	Deaton 1975, p. 266	Concentrate, Orange, Drummed	396.29	130.38
Beverages	0.329	Deaton 1975, p. 266	Concentrate, Other	9.85	3.24
Beverages	0.329	Deaton 1975, p. 266	Concentrate, Pincapple	9.85	3.24
Toilet Articles & Preps.	0.769	Houthakker & Taylor, 1966, p. 74	Essence	1,360.75	1,046.42

TABLE 1 (Continued)

Commodity	Published Elasticity	Source	Imports (Continued)		Export or Import	Market Share	Adjusted Elasticity
Fertilizer	0.529	Griliches 1958, p. 602			Fertilizer materials	446.55	236.22
Other mfg. food	1.180	Deaton 1975, p. 266			Food, n.o.s.	361,289.69	426,321.83
Fruit	0.359	Deaton 1975, p. 266			Fruit, fresh	112.42	40.36
Furniture and household equip.	0.780	Philips 1983, p. 260			Furniture	830,419,107.46	647,726,903.82
Glass products	2.457	Shiells et al. 1986, p. 512			Glass products	395,069.50	970,685.76
Grain	1.823	Shiells et al. 1986, p. 508			Grains, n.o.s., bulk	183.47	334.47
Concrete and gypsum	0.667	Shiells et al. 1986, p. 510			Granite rock, bulk	50.19	33.48
Concrete and gypsum	0.667	Shiells et al. 1986, p. 510			Gypsum rock	100.71	67.17
Building board	1.914	Shiells et al. 1986, p. 510			Hardware	313.17	599.41
Textiles and hardware	0.050	Deaton 1975, p. 266			Hardware	231.20	11.56
Sugar and sweets	0.192	Deaton 1975, p. 266			Honey, packaged	656.71	126.09
Douglas fir lumber	0.870	Robinson 1974, p. 175			Lumber, cedar	1,502.06	1,306.79
Douglas fir lumber	0.870	Robinson 1974, p. 175			Lumber, hemlock	2,956.77	2,572.39
Douglas fir lumber	0.870	Robinson 1974, p. 175			Lumber, hemlock-fir	2,759.14	2,400.45
Douglas fir lumber	0.870	Robinson 1974, p. 175			Lumber, n.o.s.	897.87	781.15
Douglas fir lumber	0.870	Robinson 1974, p. 175			Lumber, pine	1,744.67	1,517.86
Douglas fir lumber	0.870	Robinson 1974, p. 175			Lumber, spruce	2,017.02	1,754.81
Douglas fir lumber	0.870	Robinson 1974, p. 175			Lumber, tomato stakes	4.36	3.79
Meat and bacon	0.439	Deaton 1975, p. 266			Meat (fresh or frozen)	7,169.53	3,147.42
Paper and newsprint	0.881	Shiells et al. 1986, p. 508			Newsprint and cores	565.95	498.60
Chemists' goods	0.890	Deaton 1975, p. 266			Nitrate of soda	206.28	183.59
Paints	1.068	Shiells et al. 1986, p. 509			Paints and lacquers	101,034.75	107,905.11
Gasoline and oil	0.156	Houthakker & Taylor 1966, p. 116			Petroleum products	14.57	2.27
Plywood and veneer	3.443	Shiells et al. 1986, p. 510			Plywood	4,557.17	15,690.34
Fertilizer	0.529	Griliches 1958, p. 602			Potash, bulk	133.48	70.61
Fertilizer	0.529	Griliches 1958, p. 602			Potassium nitrate, bagged	46.71	24.71
Fertilizer	0.529	Griliches 1958, p. 602			Potassium nitrate, bulk	35.95	19.02
Fish	0.094	Deaton 1975, p. 266			Seafood, fresh and frozen	158.64	14.91
Fish	0.094	Deaton 1975, p. 266			Seafood, prepared and preserved	13.57	1.28
Yachts	25.850	Shiells et al. 1986, p. 513			Ships, boats, and yachts	5,372.74	138,885.33
Steel	0.400	Yntema 1981, p. 36			Slag	73.67	29.47
Steel	0.400	Yntema 1981, p. 36			Steel, angles	1,653.36	661.34
Steel	0.400	Yntema 1981, p. 36			Steel, bars	7,043.16	2,817.26
Steel	0.400	Yntema 1981, p. 36			Steel, beams	293.07	117.23
Steel	0.400	Yntema 1981, p. 36			Steel, billets, blooms	45,719.15	18,287.66
Steel	0.400	Yntema 1981, p. 36			Steel, coils	154.37	61.75
Steel	0.400	Yntema 1981, p. 36			Steel, miscellaneous	5,429.94	2,171.98
Steel	0.400	Yntema 1981, p. 36			Steel, pipe	220.57	88.23
Steel	0.400	Yntema 1981, p. 36			Steel, pipe fittings	41,074.56	16,429.82
Steel	0.400	Yntema 1981, p. 36			Steel, plates and sheets	599.94	239.98
Steel	0.400	Yntema 1981, p. 36			Steel, strip	5,667.61	2,267.04
Steel	0.400	Yntema 1981, p. 36			Steel, tubing	2,375.36	950.14
Steel	0.400	Yntema 1981, p. 36			Steel, wire rod	1,241.22	496.49
Textiles, n.e.c.	0.529	Griliches 1958, p. 602			Sulphur, liquid	2.22	1.17
Textiles, n.e.c.	0.875	Shiells et al. 1986, p. 508			Textiles	3,486.15	3,050.38
Refined nonferrous metals	0.727	Shiells et al. 1986, p. 509			Tin plate	1,168.59	849.56
Tobacco	0.480	Stone 1954, p. 390			Tobacco, unmanufactured	423.03	203.05

n.e.c. = not elsewhere classified.
n.o.s. = not otherwise specified.

ed elasticities. The third column provides the source of the published elasticity. The fourth column lists the exported or imported commodity as described in the Port of Tampa's cargo report (Port of Tampa 1986).

Conversations with Port of Tampa personnel were very useful in helping us associate the commodities used in the published studies with the Port's exports and imports. Nevertheless, some of the associations are a bit strained, e.g., associating the commodity class, "matches, soap, etc." with the export, "house hold goods and personal effects."

Because the published elasticities were estimated for the United States or the United Kingdom, they are not directly applicable to our impact area, which consists of five contiguous counties in the Tampa Bay area. To obtain elasticities relevant to our impact area, we adjusted the published elasticities by a market-share factor. This converted the published elasticities into elasticities that reflect the responsiveness of non-impact-area buyers to changes in prices of impact-area exports and the responsiveness of local imports to changes in delivered price in the impact area.

To obtain the requisite elasticities, a relationship between market demand elasticity and market share must be hypothesized. To capture this idea, let

$$P = P(Q)$$

be the world inverse demand function, where P is price and Q is world sales (i.e., output). The change in world price with respect to a change in output produced by firms in the i th region (for exports) or output purchased by firms in the i th region (for imports) is

$$\begin{aligned} dP/dq_i &= (dP/dQ)(dQ/dq_i) \\ &= dP/dQ, \end{aligned}$$

where q_i is the output produced by or purchased by firms in the i th region and $\sum q_i = Q$. Multiplying both sides of the preceding equation by q_i/P and the right-hand side by Q/Q yields, upon rearranging,

$$(q_i/P)(dP/dq_i) = (q_i/Q)(Q/P)(dP/dQ),$$

or, assuming $P(Q)$ is invertible,

$$E_i = E/s_i,$$

where E_i is the i th regions's price elasticity of demand, E is the world price elasticity of demand, and $s_i = q_i/Q$ is the i th region's share of world output sold (in the case of exports) or bought (in the case of imports). The relationship derived here may be found in Maurice and Phillips (1992, 546-547); however, their derivation uses linear demand, whereas ours is general.

As noted earlier, all the empirical price elasticities used in this study were estimated either for the United States or the United Kingdom, so the E_i and s_i in the preceding equation refer to U.S. or U.K. elasticities and shares. Consequently, we had to convert these elasticities and shares to make them representative of the much smaller geographical area constituting our impact area.

Rearranging the preceding equation, we have

$$E = (E_i)(s_i),$$

then

$$E_T = E/s_T = [(E_i)(s_i)]/s_T,$$

where E_T is the price elasticity of world demand for the Tampa impact area's exports or the price elasticity of the Tampa impact area's demand for imports, and s_T is the Tampa impact area's sales (for exporters) or purchases (for importers) as a share of world sales (for exporters) or purchases (for importers).

When estimating export demand elasticities for our impact area, we used the U.S.'s or U.K.'s share of world production as s_i and the Tampa impact area's exports as a share of world production as s_T . The use of world production in lieu of world sales assumes no end-of-year inventories. The use of the impact-area's exports instead of impact-area sales assumes that all production of impact-area exports is sold outside the impact area.

When estimating import demand elasticities for our impact area, we used the U.S.'s or U.K.'s share of world consumption as s_i and the Tampa impact area's imports as a share of world consumption as s_T . World consumption is, by definition, equal to world purchases. We used "apparent consumption," defined by the United Nations as world production less exports plus imports. The use of impact-area imports in lieu of impact-area purchases assumes that impact-area imports are all noncomparable (i.e., there is no local production of imported goods).

Geographical area production figures came from the Department of International Economic and Social Affairs, Statistical Office of the United Nations (1986, various pages). Geographical area export and import values came from the Department of International Economic and Social Affairs, Statistical Office of the United Nations (1987, various pages), the Commodity Research Bureau (1987, 21, 188, and 211), and the U.S. Department of Commerce (1986c, 660, 726, and 727).

Column 5 of Table 1 provides the market-share factor, s_i/s_T , which, when multiplied by the published elasticity, produces the adjusted elasticity given in column 6 of Table 1. It is these elasticities we used in the study. Data on apparent consumption of exports and imports, Port of Tampa export and import value, and

their ratios for all commodities passing through the Port of Tampa in fiscal year 1985-86 may be found in DeSalvo and Fuller (1988, 227-228, 237-238).

The smallest elasticity in column 6 is 1.17 for liquid sulphur, a domestic vessel import from Louisiana, used as an input into the production of fertilizer of which the Tampa Bay area is a major world supplier. The largest elasticity is 647,726,904 for imported furniture, for which the Tampa Bay area is obviously not a major market (more on this particular elasticity later). Many of the elasticities in Table 1 are quite large but were left in the table if the quantity demanded of the commodity to which they relate would not have fallen to zero in the absence of the Port of Tampa. This will be discussed further later.

Insurance (k) and Inland Transport Rates (t_{L0} , t_{L1})

According to maritime insurance industry personnel we interviewed in Tampa, cargo insurance on most goods is charged at the rate of 1 percent of the value of the commodity, regardless of destination. Insurance costs therefore will not vary with the port of exit, but with the value of the cargo. Essentially, insurance costs act to raise the producer price by 1 percent.

The estimation of inland transport rates (t_{L0} and t_{L1}) was more complicated. Based on interviews with personnel of the five ports closest to Tampa, we estimated unused capacity available to handle cargo exported from the Port of Tampa in fiscal year 1985-86. Consideration was given to type of cargo, e.g., some ports did not have refrigerated facilities and some would not have handled toxic chemicals. The estimated unused capacities may be found in DeSalvo and Fuller (1988, 229-230).

We then estimated the tonnages exported from each county in the impact area and the average distances those exports needed to be shipped to the Port of Tampa and to the alternative ports. With the aid of several freight forwarders, each export manufactured in or distributed from the impact area was categorized by SIC code according to the principal business activity of the exporter. For these exports, we used data from the Florida Department of Labor and Employment Security (1985-86) to determine the number of establishments in each industry and county of the impact area.

The number of establishments in each county was then expressed as a percentage of the total number of establishments by industry. This percentage was used to estimate the tonnage of each commodity exported from each county in our impact area. We measured the distances in miles from the midpoint of each county in our impact area to the Port of Tampa from maps of the local area. The estimated tonnages and distances may be found in DeSalvo and Fuller (1988, 231-233).

For commodities traveling over land by truck, we obtained inland transportation rates by commodity class code for various truck load sizes and for various distances. These data were obtained from American Freight Systems, a trucking firm with freight rates available on computer. These rates were then converted into rates per ton. For commodities traveling over land by rail, we obtained rates per ton from various origins and destinations from CSX Transport and Georgia Freight Bureau.

A weighted average inland transportation rate was calculated for all shipments from counties in the impact area to the Port of Tampa. The rate from the midpoint of each county to the port was weighted by the percentage of the product produced in each county. A similar procedure was used to calculate a weighted average inland transportation rate for each commodity to each alternative port from the counties in the impact area. These rates were multiplied by the percentage of unused capacity at the respective alternative ports for the good in question and summed to obtain the weighted average cost per ton of transporting a good from the county of production or distribution to an alternative port of exit. The estimated rates may be found in DeSalvo and Fuller (1988, 70-71).

Similar procedures were used to estimate inland transport rates on imports. Based on estimates of unutilized capacity, cargo tonnages that could have been handled by alternative ports in the absence of the Port of Tampa were calculated. Each import was assigned an SIC code based on the principal business activity of users of imported commodities. Florida Department of Labor establishment data were used to estimate the number of establishments in each industry and county of the impact area. The number of establishments in each county was expressed as a percentage of the total number of establishments by industry, and it was assumed that these percentages represented the distribution of imported goods used by each industry in each county. The cost per ton of transporting each import overland from the Port of Tampa and from each alternative port was estimated as a weighted average, as in the case of exports. The component estimations and resulting transport rates may be found in DeSalvo and Fuller (1988, 87-88, 239-242).

Overseas Transport Rates (ts_0 and ts_1), Proportion Liner (a), and Customs Duties (c_v and c_q)

To calculate the per-ton liner rate for shipping commodities overseas from the Port of Tampa and from alternative ports, we first determined the country importing the product or, if more than one country, the country importing the largest quantity (Port of Tampa 1986). We then obtained shipping rates to each country from a variety of sources (*The Florida Shipper* 1987; *Shipping Digest* 1987; *The*

Journal of Commerce and Commercial Shipyards 1987; and personal interviews with personnel of Nexos Lines, Inc., and Hamilton Brothers, Inc.). These data may be found in DeSalvo and Fuller (1988, 234-235).

The rate in the absence of the Port of Tampa was calculated as a weighted average of liner rates by commodity. The weights were the percentages of unutilized capacity of the alternative ports in fiscal year 1985-86, which had already been estimated for use in estimating inland transport rates. The resulting rates may be found in DeSalvo and Fuller (1988, 73-74).

Similar procedures were used for imports. For those imports for which tonnage was moved via liner, we determined the most frequent port of origin of imports entering our impact area (U.S. Department of Commerce 1986b). The country exporting the largest amount of each commodity imported into the local area was considered to be the country of origin for that item. Liner rates were obtained as for exports. The supporting estimates and resulting rates may be found in DeSalvo and Fuller (1988, 90-91, 243-244).

The liner rate in the absence of the Port of Tampa was calculated as a weighted average of liner rates by commodity: the percentage of each commodity entering each alternative port, based on unutilized capacity in fiscal year 1985-86, was multiplied by the freight rate associated with that alternative port and summed, by import commodity, over all alternative ports.

Using Port Authority data showing shipment tonnages by commodity and by vessel in fiscal year 1985-86 (Port of Tampa 1986), we calculated the percentage of each commodity shipped via liner. The data on liner rates and percent liner may be found in DeSalvo and Fuller (1988, 90-91).

Customs duties were provided by the District Director of the U.S. Customs Office in Tampa.

IV. RESULTS

Tables 2 and 3 present our results. Table 2 deals with exports, and Table 3 deals with imports. The stub of Table 2 lists all commodities exported from the Port of Tampa during fiscal year 1985-86. Likewise, the stub of Table 3 lists all commodities imported into the Port of Tampa during the same period. Column 1 in each table presents the direct impacts as estimated by the standard method. Column 2 of each table presents the direct impacts as estimated by our method. In each table, column 3 gives the dollar overestimate of the standard approach, while column 4 gives the percentage overestimate. The commodities for which the overestimate in column 3 is zero are those for which the standard method and our method yield the same result, or for which the standard method's implicitly as-

TABLE 2
Direct Impact of the Port of Tampa on Exports, FY 1985-86
Standard Method vs. Our Method

Commodity	Direct Impact		Overestimate	
	Standard Method (\$)	Our Method (\$)	Standard Method (\$)	Standard Method (%)
Alcohol, denatured, drummed	44,149	44,149	0	0
Asphalt, packaged	183,610	183,610	0	0
Automobile(s) 10,000 lbs.	1,464,577	1,464,577	0	0
Automobile(s) 10,000 lbs.	477,598	477,598	0	0
Batteries	8,998	8,998	0	0
Building materials	938,934	938,537	397	0
Canned goods	73,803	73,803	0	0
Cattle, live	5,077,411	5,077,411	0	0
Caustic soda	12,195	12,195	0	0
Cement, bagged	1,515	1,515	0	0
Chemicals, packaged	1,963,832	1,963,832	0	0
Citrus, fresh	28,023,981	1,833,826	26,190,155	1,428
Citrus juice, bottled	140,449	41,700	98,749	237
Citrus juice, canned	109,594	54,802	54,792	100
Citrus oil	7,511	7,511	0	0
Citrus pellets	67,349,096	52,305,079	15,044,017	29
Commodities, n.o.s., packaged	28,852,867	28,852,867	0	0
Concrete products	1,138	1,138	0	0
Electrical equipment	414,105	414,105	0	0
Feed, bagged	1,724,569	1,724,521	48	0
Fertilizer, bagged	321,235	0	321,235	0
Flour and meal, bagged	72,102	72,102	0	0
Food, n.o.s.	962,522	962,522	0	0
Fruit, fresh	107,955	107,955	0	0
Fruit, frozen	5,796	5,796	0	0
Fruit juice, canned	2,333	2,333	0	0
Furniture	126,658	126,658	0	0
Gypsum wallboard	37,373	37,373	0	0
Hardboard	12,158	12,158	0	0
Hardware	1,919,006	6,613	1,912,393	28,918
Hides & skins	9,149	9,149	0	0
Household appliances	749,916	749,913	3	0
Household goods & personal effects	967,781	490,411	477,370	97
Insecticides & fungicides, packaged	10,877,692	10,877,692	0	0
Linerboard	6,367,631	6,131,238	236,393	4
Liquor, beer	219,823	219,823	0	0
Liquor, wine	21,767	21,765	2	0
Lube oil, packaged	765,367	765,367	0	0
Lumber, cedar	2,243	2,243	0	0
Lumber, n.o.s.	32,557	32,557	0	0
Lumber, pine	388,236	388,236	0	0
Lumber, spruce	115,933	115,933	0	0
Lumber, trusses	2,129	2,129	0	0
Machinery	15,133,438	15,120,037	13,400	0
Medical supplies	3,797,108	2,701,075	1,096,033	41
Modular unit(s) 10,000	1,922	1,922	0	0
Modular unit(s) 10,000	17,777	17,777	0	0
Paints & lacquers	388,984	388,984	0	0
Paper, waste	229,784	229,784	0	0
Paper & paper products	183,986	183,986	0	0
Petroleum	3,030	3,030	0	0
Petroleum, n.o.s., packaged	8,596	62	8,534	13,800
Petroleum products	16,511,543	16,511,543	0	0

TABLE 2 (Continued)

Commodity	Direct Impact		Overestimate	
	Standard Method (\$)	Our Method (\$)	Standard Method (\$)	(%)
Petroleum solvents, packaged	41,790	41,790	0	0
Phosphate chemicals, bagged	502,069	1,331	500,738	37,632
Phosphate chemicals, bulk	2,022,976,537	1,367,637,281	655,339,255	48
Phosphate rock, bulk	405,882,922	172,862,154	233,020,768	135
Phosphoric acid	622,201,488	5,004,193	617,197,295	12,334
Pipe, plastic	61,720	59,540	2,180	4
Pipe (other than steel)	2,548	2,458	90	4
Plastic	595,695	595,695	0	0
Plumbing supplies	254,271	253,408	863	0
Plywood	72,085	72,085	0	0
Rubber products	287,140	287,140	0	0
Sand, silica, bagged	2,812	2,812	0	0
Scrap metal	28,376,301	1,349,941	27,026,360	2,002
Ships, yachts, & boats	136,728	136,728	0	0
Steel, angles	7,621	7,621	0	0
Steel, bars	710,866	710,866	0	0
Steel, miscellaneous	1,401,977	1,401,977	0	0
Steel, pipe	480,369	480,368	2	0
Steel, pipe fittings	327,779	279,408	48,370	17
Totals	3,293,040,118	1,708,013,852	1,585,026,266	93

n.o.s. = not otherwise specified.

sumed infinite price elasticity of demand is correct. Table 1, discussed earlier, gives the elasticities of demand for the commodities with non-zero entries in column 3 of Tables 2 and 3.

Before discussing the overall results, we note two technical points and explain how the direct impact of some of the commodities with extremely high elasticities remains positive. First, a constant-elasticity demand function approaches the price axis asymptotically, so quantity demanded can never be exactly zero, but it can be approximately zero, and the resulting direct impact can be zero when rounded to the nearest dollar, which is the case for the zero entries in column 3 of Tables 2 and 3.

Second, some of the percentage overestimates are zero while the dollar overestimates are not, e.g., buildings material in Table 2. As a practical matter, it is likely that some of these products would not have been exported or imported if the Port of Tampa were unavailable since the quantities demanded are relatively small. Nevertheless, we decided not to presume that this would happen, but to use the numbers generated by the estimation formulas as our estimates of direct impacts.

Finally, take the case of furniture imports as an example of how a commodity with a huge elasticity nevertheless produces a positive direct impact. In

TABLE 3
Direct Impact of the Port of Tampa on Imports, Fiscal Year 1985-86
Standard Method vs. Our Method

Commodity	Direct Impact		Overestimate	
	Standard Method (\$)	Our Method (\$)	Standard Method (\$)	(%)
Aggregate, n.o.s.	46,432	46,432	0	0
Aluminum	201,701	518	201,183	38,851
Ammonia, anhydrous	118,526,853	45,458,754	73,068,099	161
Ammonium sulfate	2,067,606	2,059,950	7,656	0
Asphalt, packaged	43,471	43,471	0	0
Automobile(s) 10,000 lbs.	114,518	4,499	110,020	2,446
Automobile(s) 10,000 lbs.	907,277	2,033	905,244	44,520
Bananas	41,648,375	1,697,961	39,950,414	2,353
Building materials	100,479	100,479	0	0
Calcium nitrate	1,557,590	1,122,459	435,131	39
Caustic soda	10,493,549	10,493,549	0	0
Cement, bulk	8,954,165	8,953,107	1,057	0
Cement, clinker, bulk	10,034,735	2,212,980	7,821,755	353
Chemicals, packaged	43,094	43,094	0	0
Citrus oil	3,038,657	24,944	3,013,713	12,082
Clay, bagged	2,526	112	2,413	2,146
Coal	174,601,997	167,322,517	7,279,480	4
Coffee	4,115,666	4,115,666	0	0
Coke	91,239	91,239	0	0
Commodities, n.o.s., packaged	8,917,880	8,917,880	0	0
Concentrate, apple, drummed	824,940	54,538	770,402	1,413
Concentrate, citrus, bulk	11,442,187	506,185	10,936,001	2,160
Concentrate, grapefruit	1,034,268	37,276	996,991	2,675
Concentrate, orange, drummed	638,363	447,933	190,430	43
Concentrate, other	1,145,661	116,825	1,028,837	881
Concentrate, pineapple	13,328	881	12,448	1,414
Electrical equipment	133,942	133,942	0	0
Essence	248,762	246,973	1,789	1
Feed, bagged	8,435	8,435	0	0
Fertilizer materials	2,962,166	2,882,429	79,737	3
Food, n.o.s.	664,922	494,215	170,707	35
Fruit, fresh	11,537,298	4,886,873	6,650,425	136
Furniture	912,909	863,162	49,747	6
Glass products	97,190	896	96,294	10,742
Grains, n.o.s., bulk	21,691,828	21,671,547	20,280	0
Granite rock, bulk	66,352,388	13,545,525	52,806,863	390
Gypsum rock	3,823,494	3,749,699	73,795	2
Hardboard	1,170,174	1,161,191	8,982	1
Hardware	680,124	112,453	567,671	505
Honey, packaged	112,448	78,445	34,003	43
Household goods & personal effects	187,176	187,176	0	0
Iron sulfate	438,882	438,882	0	0
Kierserite	364,130	364,130	0	0
Limestone	350,523	350,523	0	0
Liquor, beer	13,037	13,037	0	0
Lumber, cedar	3,294,747	3,248,672	46,074	1
Lumber, douglas fir	154,742	154,742	0	0
Lumber, hemlock	1,129,824	1,127,373	2,451	0
Lumber, hemlock-fir	1,239,997	1,234,964	5,033	0
Lumber, n.o.s.	15,464,493	14,742,551	721,942	5
Lumber, pine	7,370,687	337,494	7,033,193	2,084
Lumber, spruce	3,077,619	77,418	3,000,201	3,875
Lumber, tomato stakes	13,750,960	557,011	13,193,949	2,369

TABLE 3 (Continued)

Commodity	Direct Impact		Overestimate	
	Standard Method (\$)	Our Method (\$)	Standard Method (\$)	(%)
Meat, canned	225,750	225,750	0	0
Meat (fresh or frozen)	1,154,147	1,032,579	121,568	12
Medical supplies	26,593	26,593	0	0
Metals	33,657	33,657	0	0
Minerals & ores, bulk	1,036,189	1,036,189	0	0
Newsprint and cores	10,959,693	9,053,932	1,905,762	21
Nitrate of soda	2,052,323	1,907,756	144,567	8
Paints and lacquers	30,642	994	29,647	2,982
Paper & paper products	8,541	8,541	0	0
Petroleum products	1,538,342,030	785,049,567	753,292,463	96
Plastics	902,089	902,089	0	0
Plumbing supplies	9,878	9,878	0	0
Plywood	4,414,492	4,294,878	119,615	3
Potash, bagged	72,682	72,682	0	0
Potash, bulk	3,813,399	3,802,809	10,590	0
Potassium nitrate, bagged	2,725,271	95,038	2,630,233	2,768
Potassium nitrate, bulk	3,525,288	916,705	2,608,583	285
Salt, bulk	720,146	720,146	0	0
Scrap metal	10,360	10,360	0	0
Seafood, fresh & frozen	6,005,228	54,539	5,950,688	10,911
Seafood, prepared & preserved	23,833,386	12,027	23,821,359	198,061
Ships, yachts, & boats	18,918	18,179	739	4
Slag	3,562,898	2,845,764	717,134	25
Steel, angles	507,030	462,585	44,444	10
Steel, bars	1,765,062	7,357	1,757,705	23,891
Steel, beams	13,332,405	4,658,237	8,674,168	186
Steel, billets, blooms	78,607	578	78,029	13,506
Steel, coils	13,943,100	4,181,197	9,761,903	233
Steel, miscellaneous	34,922,784	33,381,515	1,541,269	5
Steel, pipe	32,431,556	7,586,343	24,845,213	327
Steel, pipe fittings	94,288	61,049	33,239	54
Steel, plates & sheets	36,542,527	8,809,544	27,732,983	315
Steel, strip	702,816	702,792	24	0
Steel, tubing	1,417,674	1,366,502	51,173	4
Steel, wire rod	1,943,952	1,734,550	209,402	12
Sulphur, liquid	370,479,932	159,670,195	210,809,737	132
Textiles	2,033,071	1,907,278	125,793	7
Tile	474,910	474,910	0	0
Tin plate	305,944	228,226	77,719	34
Tobacco, manufactured	2,258,358	2,258,358	0	0
Tobacco, unmanufactured	934,940	745,401	189,539	25
Tools	33,576	33,576	0	0
Vegetables, fresh	8,496	8,496	0	0
Totals	2,676,549,675	1,367,969,979	1,308,579,696	96

n.o.s. = not otherwise specified.

fact, for four of the five counties in our impact area, our estimation formula produced zero as the direct impact of this product. However, for the remaining county, the local delivered price of furniture would not have changed and, hence, that county would have continued to import the same amount as if the Port of Tampa were available.

The delivered price remains the same for this county because the rise in the inland transportation rate is exactly offset by the fall in the overseas transportation rate, whereas for the other counties the rise in the inland transportation rate outweighs the fall in the liner rate so that the delivered price rises.

The overseas transportation rate falls because the import would arrive from Europe at a port on the east coast of Florida, rather than the Port of Tampa, which is on the west coast of Florida. This would make for a shorter overseas trip and a lower rate. The county for which the delivered price was unchanged was the eastern-most county in our impact area. Consequently, the rise in inland transportation rates would be lowest for this county.

A similar situation occurs for some of the other commodities with extremely high elasticities, but in all of these cases, e.g., bagged clay and new and used cars, the change in delivered price is extremely small, rather than zero, as with furniture for one county.

We turn now to the results. The total direct impact of the Port of Tampa on exports was slightly more than \$1.7 billion in fiscal year 1985-86. Exporters of phosphate chemicals would have been most adversely affected by the port's closure, the value of their exports, both foreign and domestic, declining nearly \$1.4 billion. Exporters of phosphate rock would also have been affected severely, the value of their output declining nearly \$173 million. The rest of the direct impact of exports is spread over a wide variety of products, ranging from live cattle to personal effects of households.

If we had assumed an infinite price elasticity of demand for all exported commodities, i.e., had we used the standard methodology, the direct impact of the Port of Tampa on exports would have been nearly \$3.3 billion, an overestimate of nearly \$1.6 billion or 93 percent.

Because the Tampa Bay area is a major producer of phosphate rock, phosphate chemicals, and phosphoric acid, the price elasticities of world demand for the area's phosphate products are not as large as those of commodities for which the area is a minor supplier. Consequently, it might be suspected that the presence of the phosphate industry in the Tampa area tends to result in a greater overestimate than otherwise would be the case. Subtracting the phosphate impacts (phosphate chemicals, phosphate rock, and phosphoric acid) of \$1,545,504,959 by our method and \$3,051,563,016 by the standard method from both impact totals produces a non-phosphate impact of \$162,508,893 by our method and

\$241,477,102 by the standard method, resulting in an overestimate of 49 percent. As suspected, the overestimate is lower but still significant.

As can be seen in Table 3, the direct impact of the Port of Tampa on imports was nearly \$1.4 billion. Imports of petroleum products would have been most adversely affected by the Port's closure during fiscal year 1985-86, falling by over \$785 million. Coal and liquid sulphur imports would also have been hard hit, falling by over \$167 million and nearly \$160 million, respectively. Had the standard methodology been used, the total direct impact of the Port of Tampa on imports in fiscal year 1985-86 would have been nearly \$2.7 billion, an overestimate of over \$1.3 billion or 96 percent.

V. CONCLUSION

The contention of this paper is that port direct impacts are overestimated unless the price elasticities of demand for exports and imports are taken into account. We think this point is theoretically indisputable, but the question remains whether in practice the benefits of performing the additional work outweigh the costs. As this paper has indicated, estimating the impact formulas of Equations (1) and (2) requires a good deal of data collection and processing, more than with the standard approach. We cannot provide a general answer to the benefit-cost question, but we can give an indication of the importance of our methodology in the case of the economic impact of the Port of Tampa.

Although a substantial number of products that were exported from and imported into the Tampa area have price elasticities of demand of infinity, had the demand for the remaining products been assumed to be infinity, the direct impact of the Port of Tampa on exports would have been overestimated by \$1.6 billion or 93 percent, while the direct impact of imports would have been overestimated by \$1.3 billion or 96 percent.

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