

“We’d Have to Sink the Ships”: Impact Studies and the 2002 West Coast Port Lockout¹

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During the West Coast port lockout in fall 2002, a widely quoted estimate claimed that a 10-day shutdown of port facilities would cost the U.S. economy \$1.94 billion a day. This article argues that the estimated economic losses were vastly overinflated, and the episode provides an opportunity to reflect on the use of economic impact studies to study short-term disruptions of infrastructure services. Port impact studies are deficient in this task because they do not adequately address the possibilities for substitution, even in the short run. In part, this is because port impact studies are poorly designed to deal with the changing nature of the relationship between seaport operations and regional economic development. Impact studies assume a continuous monotonic relationship between cargo throughput and economic measures. This ignores the fact that port-using firms have differential abilities to adjust to disruptions and that their adjustment behavior creates both losers and winners.

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During the West Coast port lockout in the fall of 2002, a widely quoted estimate claimed that a 10-day shutdown of port facilities would cost the U.S. economy \$1.94 billion a day (Martin Associates, 2001a). The estimate—neatly rounded up to \$2 billion per day by the public media—played an important political role in the labor dispute. Its source was a port impact study commissioned by the Pacific Maritime Association (PMA), the body representing employers from San Diego to Seattle in negotiations with the International Longshoremen’s and Warehousemen’s Union (ILWU). The consultant responsible for preparing the impact study, Martin Associates, is both widely used and respected, having prepared economic impact studies for more than 100 seaport and airport authorities. However, by the time the labor dispute had been resolved, a “competing” study (Anderson, 2002) and many major newspapers were reporting that the figure was probably an overestimate (Iritani & Dickerson, 2002; Pritchard, 2002; Rivera, 2002; Zuckerman, 2002).

Impact studies are an often criticized yet widely used tool for estimating the economic contribution of infrastructure facilities such as seaports, airports, major manufacturing plants, sports stadiums, convention centers, and casinos.² They are especially controversial when they are used prospectively to justify public subsidy or extraordinary planning permission. Indeed, public port authorities were actively involved in developing the technique to demonstrate the value of their contributions to local and regional economies and to justify public investments (Luberoff & Walder, 2000). One of the long-standing criticisms of port impact studies is that they typically assume fixed technology, industrial structure, and demand (see Waters, 1977; response from Chang, 1978). This renders estimates especially unreliable as more time passes. In contrast, this West Coast episode provides an opportunity to examine whether port impact studies are appropri-

ate for estimating the costs of short-term infrastructure disruptions. It also provides an opportunity to consider the political deployment of impact studies as technical knowledge.

This article argues that traditional port impact studies are an unhelpful and misleading analytical tool for understanding the costs of a temporary disruption to seaport and related transportation infrastructure. Port impact studies translate the cargo handled by a port into various measures of economic activity using a continuous monotonic function. The more cargo throughput that is disrupted, the greater the cumulative (or even exponential) impact. In so doing, impact studies incorrectly assume that existing spatial-organizational production structures are fixed. Hence, they do not adequately address the possibilities for substitution within and between sectors even in the short run, and they do not address the discontinuous nature of the impacts. In part, this problem results from the fact that impact studies are poorly designed to deal with the changing nature of the relationship between seaport operations and economic development, specifically the increasing spatial disconnection of cargo-related economic activity from the waterfront. Generally speaking, port impact studies represent in static and fixed terms what are actually strategic and dynamic processes of economic decision making.

I begin with a brief discussion of the West Coast waterfront labor dispute and the role of the impact study in that dispute. I argue that the amount of \$1.94 billion per day vastly overestimated the losses incurred by the U.S. economy. This opens the door to a wider discussion of using impact studies to understand the relationship between seaport infrastructure and economic development. I briefly review a revised set of estimates prepared by Martin Associates (2003) months after the lockout. This post hoc study addresses some of the criticisms raised here but introduces new errors, and repeats others, to produce a new set of overinflated estimates. I conclude with a discussion of the limited ways in which port impact studies might be appropriately deployed in planning and public policy discourse.

THE 2002 WEST COAST PORT LOCKOUT

In 2001, ports on the U.S. West Coast handled about 253 million tons of cargo (Pacific Maritime Association, 2002). This cargo has enormous trade significance; according to Maritime Administration statistics, imports and exports constituted some 183 million tons of cargo. The traded cargo was worth just over \$300 billion, or 42% of all U.S. waterborne trade. The six largest container ports on the West Coast—Los Angeles, Long Beach, Oakland, Seattle, Tacoma, and Portland—handled slightly more than half of all the foreign origin or destination containers passing through U.S. ports. The economic significance of these facilities, especially to the export-oriented economies of East Asia, is beyond doubt.

Some 16,000 longshoremen on the West Coast handle the movement of all this cargo between ocean- and land-based transportation modes. The current labor relations on the U.S. West Coast have their origins in a protracted recognition strike in 1934 and the subsequent formation of the PMA in 1936 and the ILWU in 1937 (Hartman, 1969). The PMA includes all employers of longshoremen in the 29 cargo ports in the states of Washington, Oregon, and California, including steamship lines, terminal operators, and stevedores. The Longshoring Division of the ILWU represents more than 10,000 active members and is internally structured into 36 locals that represent the longshoremen (those who drive the cranes or yard vehicles and fasten and unfasten lashing, etc.), clerks (those who process paperwork and undertake various planning functions), and foremen (those who supervise longshoremen and clerks).³ Another 6,000 casual workers are regularly employed on the docks, especially in the busy hub ports of the San Pedro Bay (the ports of Long Beach and Los Angeles).

A full discussion of the origins and prospects of employment, work rules, and practices on the waterfront is beyond the scope of this article. Instead, I want to draw attention to two key features of the structure of collective bargaining on the U.S. West Coast. First, collective bargaining is conducted on a coastwise basis; one master contract governs labor-management relations in all 29 ports. This all but eliminates the possibility of competition between the ports on the basis of formal work rules, wage rates, and so on, and dramatically reduces the power of steamship lines to play

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stevedores and workers in one port against those in another. It also means that a labor-based disruption to port operations affects all ports simultaneously, thus intensifying the aggregate effects of any disruption.

Second, the relative success of the ILWU in securing high wages and benefits in the face of reduced overall employment, considerable technological and organizational change, and deregulation in the transportation sector is widely recognized in the literature (Finlay, 1988; Herod, 2001; Ircha & Garey, 1992; Kagan, 1990; Talley, 2001; Wellman, 1995). In general terms, longshoremen and employers have traded higher wages for fewer jobs in the second half of the 20th century.⁴ In addition to the rapid expansion in trans-Pacific trade and the coastwise structure of bargaining, observers also point to the ILWU's control over many aspects of the work process as a source of union strength. Control of the work process, specifically the rate, nature, and consequences of technological change, was central to the recent dispute between the ILWU and PMA.

Since 1937, the PMA and ILWU have negotiated labor contracts every 3 to 5 years, including the 1960 Mechanization and Modernization Agreement in which the ILWU agreed to technological innovation, especially containerization, in exchange for guarantees of job security (Hartman, 1969). However, the relationship has also been punctuated by periods of conflict, including strikes in 1948, 1951, and 1971. During the 1999 contract negotiations, ILWU members were apparently able to exert bargaining power by engaging in a work-to-rule slowdown (Mongelluzzo, 1999) and by exploiting divisions within the PMA.⁵ An important change between the 1999 and 2002 contract rounds was the formation of the West Coast Waterfront Coalition (WCWC), a group representing both major shippers (cargo importers and exporters) and the PMA. For the first time, a formal mechanism existed whereby shippers could be kept informed of developments in the contract negotiations and intervene in them.

The 1999 contract expired on July 1, 2002, and after almost 3 months had passed without significant progress being made at the bargaining table, the employers' body locked out the union on September 27, 2002. The specific or proximate cause of the lockout is in dispute but is not material to this discussion.⁶ On October 2, 2002, the WCWC sent an open letter to President George W. Bush, citing the mounting economic effect and urging him to "use all means necessary to bring an end to the shutdown of West Coast Ports" (Lanier, 2002, p. 1). The president then sought and obtained a court injunction that forced employers to reopen the docks and workers to engage in normal work practices. The docks were reopened on October 9, 2002, although it did take several weeks for the resulting congestion and cargo backlogs to be cleared.

The president obtained the court injunction by invoking the 1947 Taft-Hartley Act, representing the first time the act had been used to end an employer lockout. The last time the Taft-Hartley Act had been used was in 1978, when striking mineworkers were ordered back to work. To obtain the injunction, the plaintiff had to demonstrate that the national economy would suffer damage. It is within this context that the large estimate of the economic effect of a port shutdown gained political salience. In seeking the court injunction, the administration argued that the lockout was having "a crippling effect on the national economy" ("West Coast Ports Re-Open," 2002, p. 1A).

Clearly it was in the bargaining interests of the PMA that the estimated costs of the shutdown be readily available and be as large as possible. The PMA had commissioned a similar economic impact report from Martin Associates in advance of the 1999 contract negotiations (Cohen & Wilson, 1999) and also had commissioned a University of California professor to frame the estimated costs of the disruption in the context of trans-Pacific trade (Cohen, 2002). After the lockout began, the impact estimate received considerable media attention.

How did Martin Associates go about translating a 10-day disruption to normal port operations into a loss to the economy of \$1.94 billion per day? Martin Associates (1996, 2001a, 2001b) employ a fairly typical approach to estimating the economic impacts of a port. In port economic impact studies, the relationship between various economic measures is modeled as a continuous monotonic function of the amount and value of cargo handled. Hence, to estimate the economic impact of a disruption to cargo throughput, a credible estimate of the amount and value of cargo lost as the result of the disruption must be obtained as a starting point for the analysis. This assumption of "absolute" loss is the first indication of the shortcomings in the way in which eco-

TABLE 1
Direct Employment Resulting from Cargo Throughput

<i>Vessel-Related Activities</i>		<i>Cargo-Related Activities</i>	
Marine services	Pilotage, tugs, dredging services, port construction, berthing services, lighthouses	Cargo services	Cargo infrastructure, bulk appliances, break-bulk cargo handling, container terminal, container cartage, pipeline services
Offshore services	Towage, launch/helicopter services, offshore bunkering	Stevedoring	Securing and lashing, ship-board cargo handling, specialized equipment
Bunkering services	Pipeline and barge, bunker brokers	Ships agency	Freight canvassing, freight services
Ships agency	Port husbandry, customs clearances, security	Clearing and forwarding agents	Documentation, crew support, financial services
Ships chandler	Deck and engine spares, victualling	Local, state and federal departments and agencies	Immigration, customs, port authority
Ship repairers	Dry-dock repairs, afloat repairs, painting and cleaning, diving services, marine surveyors, classification societies	Terminal operators	Bulk, neo-bulk, combi-terminals, liquid-bulk handling, petroleum products, containers
Ship owners and operators	Owners and representatives, charter brokers, ship brokers	Landside distribution	Railways, road haulage, warehousing
Legal and insurance	Maritime insurance, maritime lawyers	Container services	Construction/repair, container stuffing

SOURCE: Adapted from Jones (1997).

conomic impact methodology implicitly understands the relationship between ports and economic development.

ECONOMIC IMPACT METHODOLOGY

The easiest way to understand how a port impact study works is to consider the categories of employment that are created when cargo moves through a port. When a ship arrives in a port, it requires certain services in addition to the tasks of loading and unloading the cargo that provide longshoremen (and clerks and foremen) with employment. These services include surface transportation (i.e., rail and trucking), maritime service (i.e., shipping lines, their local agents, stevedores and longshoremen, clearing and forwarding agents), the port authority itself, and banking, insurance, legal, and other services (see Table 1). As maritime activity results in business revenue, firms are able to directly employ, retain earnings, pay taxes, and purchase goods and services. The direct impacts are typically measured using a survey of employers associated with the port. Of course, different cargoes have different propensities to generate economic activity. For example, preparing boxed fruit for shipment on wooden pallets requires large labor inputs. Thus, a ton of such traditional break-bulk cargo results in greater direct employment benefits than, say, a ton of crude oil or some other bulk commodity. Port impact studies prepared by consultants generally do identify jobs and other impacts per ton for the major commodity types.

The direct impacts of cargo handling have additional economic effects, known as indirect or induced impacts. By purchasing goods and services, the firms directly involved in cargo movement indirectly create jobs. By directly employing, they create personal income, which results in responding multipliers and, hence, induced jobs and the payment of taxes by individuals. Typically, indirect and induced impacts are estimated from direct impacts using a multiplier derived

from the Economic Census or an input-output matrix.⁷ Both direct and multiplier effects may be reported in terms of income or employment.

Jobs do not result from the handling of cargo alone but also from the utilization of the cargo in production. However, measuring these port-dependent impacts is especially difficult because of the possibility of substitution. In theoretical terms, the port-dependent impacts represent the number of jobs (and incomes, business revenue, taxes, etc.) in firms consuming or producing cargo imported or exported through the port that would be lost if the port were to close. Martin Associates estimate the port-dependent impacts by multiplying the value of cargo exported and imported by an estimate of the jobs per dollar of goods produced for export or deployed as an intermediary input. The employment-to-value coefficients per commodity group are obtained from the U.S. Bureau of Economic Analysis, Regional Input-Output Model (Martin Associates, 1996, 2001a, 2001b). However, it cannot simply be assumed that all the jobs in the cargo-using firms would disappear if the port did not exist (more on this later; see also Erie, 1996). The consultants concede that “these firms are only users of the Port and not dependent upon the Port, since they typically use multiple ports for maritime transportation” (Martin Associates, 1996, pp. III-13). In other words, if the port were not there, many of these jobs might still be created by using other ports, using other transportation modes, sourcing from local suppliers, or selling in domestic markets.

The possibilities for long-run (intertemporal) substitution have been widely recognized as a weakness of the input-output models that are used in impact studies. For example, in a discussion of their port impact model, Heikkila, Gordon, Richardson, and Jun (1992)⁸ noted that the long-run utility of the model is limited because there is no mechanism for endogenizing changes in cargo volumes or geographic shifts in economic activity. For example, if a given port ceased operating, over time, users might be expected to find alternative routes, and industrial structures would change as a consequence. As the authors noted, “this limitation is particularly telling for long run forecasts where it is reasonable to expect the spatial-economic structure of the region to evolve” (Heikkila et al., 1992, p. 20).

THE CHANGING RELATIONSHIP BETWEEN PORTS AND ECONOMIC DEVELOPMENT

The remarkable growth in international maritime trade since the 1970s implies considerable growth in port-dependent effects. However, these effects have gotten even harder to measure because of changes in freight transportation systems.

The problem of substitution over time is exacerbated by the fact that changes in the economic relationships between ports and their hinterlands have generated greater possibilities for spatial substitution. The remarkable growth in international maritime trade since the 1970s implies considerable growth in port-dependent effects. However, these effects have gotten even harder to measure because of changes in freight transportation systems. With containerization, and specifically the rise of intermodal inland transportation systems, the hinterland potentially served by a given port has expanded enormously. For many commodities, the hinterlands of the West Coast ports now extend clear across the continent. At the same time, this confounds the problem of ascribing the economic activity resulting from a given import to a given port (or range of ports). Although bauxite delivered to a given aluminum smelter in the Pacific Northwest may be routed only through a single port, intermediate inputs to an assembly facility in Ohio may potentially enter the United States through any of a number of ports on either coast.

At the same time, the easily measured direct (and their induced) impacts have declined in relative importance. Table 2 highlights several dimensions of the decline in direct port employment in the past 20 years. Employment in the transportation sector overall declined a compound 1.6% per annum in the United States from 1980 to 1998. The decline was even greater in the immediate hinterlands of a representative group of 21 of the nation’s major cargo ports. Employment performance in the marine cargo-handling and terminal operations subsector in the counties and metropolitan areas containing these ports was better than in the nation as a whole but occurred in the context of a nationwide 2.8% compound per annum decline in the subsector. Overall employment growth in port cities lagged that in the nation as a whole, and performance was worse closer to the waterfront. In Table 2, compare the 1.2% compound per annum growth in the narrow (county) hin-

TABLE 2
Annual Employment Growth in the United States and in the Hinterlands of
Major Cargo Ports, 1980-1998

	United States (%)	21 Major Cargo Ports	
		Broad Hinterland (%)	Narrow Hinterland (%)
Marine cargo handling and terminal operations	-2.8	-1.9	-1.3
Water transportation	-2.0	-1.2	-1.0
Land freight transportation	2.5	2.2	2.0
All transportation	-1.6	-2.0	-1.9
All sectors	2.1	1.8	1.2

SOURCE: Author's analysis of County Business Patterns employment data (U.S. Bureau of the Census, 1980, 1998).

NOTE: Narrow hinterland corresponds to the county or counties containing the port facilities; broad hinterland encompasses the consolidated or primary metropolitan statistical area containing the port facilities. All major U.S. container and automobile (roll-on, roll-off) ports are included.

terlands with the 1.8% growth in the broad (metropolitan area) hinterlands and 2.1% growth in the nation as a whole.

These aggregate numbers confirm Campbell's (1993) case study findings for the former break-bulk ports of Oakland and San Francisco. The Port of San Francisco has largely been converted to tourism land uses, whereas the Port of Oakland is now a relatively successful container port. However, although break-bulk ports used to confer considerable direct employment benefits on their immediate locality, the direct local employment benefits of ports have declined substantially with containerization. At the same time, the trading hinterlands of ports, the potential locations of port-dependent employment, have increased substantially. Hence, Campbell's (1993) conclusions that although the benefits of ports have become more dispersed, the costs (of employment opportunity loss and potential alternative land uses) have become increasingly locally concentrated (Gripaios & Gripaios, 1995; Helling & Poister, 2000).

Together, these structural changes in the transportation system mean that port impact studies are more accurate in estimating the relatively unimportant and declining direct employment and other benefits of cargo-handling activities, but they are increasingly unreliable at estimating the much more significant and growing economic contributions that are represented by the cargo itself. To the extent that port impact studies seek to show large and growing economic effects, these changes in the relationship between ports and economic development in their hinterlands present something of a problem to the port impact consulting industry, especially for the impact study being discussed here.

The overwhelming majority of the losses estimated by Martin Associates (2001a) arose from port-dependent impacts on the importers and exporters of the cargo. Direct and induced impacts (in other words, the lost earnings of those handling the cargo and the multiplier effects of their spending) accounted for less than 4% (\$0.07 billion of the \$1.94 billion) of the estimated daily losses. Although these would be substantial losses for the individual firms and workers involved, they are orders of magnitude far below the estimated impact. Analysts may differ on the assumptions employed in deriving this portion of the impact estimate, but any errors made here will be relatively unimportant in inflating the overall impact estimate.⁹ The only way to get to an amount of \$1.94 billion per day is to turn to the port-dependent impacts of the shutdown, but this is precisely where port impact studies are least reliable.

To estimate the port-dependent impacts, Martin Associates (2001a) assumed that each day the ports were closed, most of the value of the cargo normally handled by the port would be lost. This assertion is constructed around the notion that the final users of the cargo would be unable to make contingency arrangements:

Under a work stoppage of 10 days or greater, it is assumed that 75% of the daily containerized imports will be lost from the system since a majority of the imports are time sensitive

retail cargoes destined for retail sales (many are seasonal in nature or sold under contract with a fixed delivery date), resulting in a direct loss in sales revenue. (p. 7)

Hence, Martin Associates effectively assumed away the possibility of short-run substitution for most imports. Or in other words, they assumed that the ships carrying the cargo sank. How realistic is this assumption?

SHORT-TERM SUBSTITUTION EFFECTS

Most of the criticisms that have been applied to impact studies have focused on their inability to deal with long-term changes in industrial organization, demand, macroeconomic conditions, and production and transportation technologies.

Most of the criticisms that have been applied to impact studies have focused on their inability to deal with long-term changes in industrial organization, demand, macroeconomic conditions, and production and transportation technologies. Thus far, I have echoed these criticisms, in particular highlighting the long-term structural changes in the relationship between ports and economic development. In this section, I consider the appropriateness of impact studies for estimating short-term or temporary phenomena. I find that impact studies also fall short here because they do not address the question of substitution.

There are several examples of the ways in which substitution behavior significantly reduced the aggregate economic impact of the shutdown. Firms adjusted production schedules, conducted training or maintenance activities when parts ran out, sought alternative transportation routes or modes, and obtained goods from alternative sources. Likewise, consumers also delayed or switched purchases. These actions certainly resulted in the spatial, temporal, and social redistribution of economic activity, but the economic value was not simply lost.

The most tangible substitution actions by firms involved the control of time. Firms accelerated or postponed normal operations to deal with the disruption. Soon after the port shutdown, media reports emerged that many firms had actually anticipated the shutdown. At an aggregate level, the U.S. national trade deficit reached record levels in the months of August and September 2002 “as shippers rushed to get goods into the country ahead of the deadline for resolving the labor dispute with dockworkers” (“Port Lockout Narrowed Trade Deficit,” 2002, p. C2). This anticipatory behavior also resulted in some measurable changes in the cargo statistics in the months leading up to the shutdown. Normally, October is the busiest month of the year in West Coast container ports, as retailers prepare for the holiday shopping season. The combined container throughput of the ports of Long Beach and Los Angeles peaked earlier in 2002, reaching an all-time record high in August. In that month, container handling for the ports combined was up 12.4% on the previous year, in a year in which overall container growth was up 7.6%.¹⁰

According to a nationwide survey sponsored by the logistics firm BDP International and conducted by Adler Research in late October 2002, only 44% of supply chain managers said that they had prepared contingency plans prior to the lockout (Gallagher, 2002). Although some individual shippers were caught unawares, the largest shippers were more likely to have prepared contingency plans. This applied especially to those large shippers actively involved in the WCWC and those more actively involved in the management of their supply chains. This impression is borne out by anecdotal evidence from the high-tech industry. Although some consumer electronics importers were apparently hit hard, in the words of a Cisco spokeswoman, “[we] made alternative plans with our suppliers, for example, allocating space agreements with airline carriers to ensure we have component parts when and where we need them” (“Mixed Impact of Port Strike,” 2002, p. 5B).

After the lockout began, firms substituted across transport modes, with various industry sources reporting that the port lockout had been good for airfreight carriers. U.S. air cargo volumes jumped 19% in October 2002 over October 2001 (Thuermer, 2002; “West Coast Port Strike Boosts Air Cargo,” 2002). Likewise, a few importers were able to use the Mexican port of Ensenada (south of San Diego) and overland trucking to get perishable shipments to market. The alternative modes and routes were undoubtedly more expensive than the original ones, and so we would expect there to be some absolute (“deadweight”) losses and some redistribution of income toward the alterna-

TABLE 3
Correlation Between Employment Growth and Cargo Handling, 1980-2000

	<i>21 Major Cargo Ports</i>	
	<i>Broad Hinterland</i>	<i>Narrow Hinterland</i>
Automobile parts manufacture	0.620**	0.388*
Automobile assembly	-0.260	-0.014
All manufacture	0.065	-0.265

SOURCE: Author's analysis of County Business Patterns employment (U.S. Bureau of the Census, 1980, 1998), waterborne commerce of the U.S. cargo handling (U.S. Army Corps of Engineers, 1982, 1999), and port import-export reporting service automobile import (Journal of Commerce, 1980, 2000) data.

NOTE: This table reports the partial correlation coefficients (standardized betas) between growth in cargo handling and growth in employment in 21 port hinterlands. Results were obtained from linear regressions estimating sectoral employment growth (1980-1998) as a function of automobile import share growth (1980-2000), cargo handling growth (1982-1999), and growth in employment in all sectors (1980-1998). Narrow hinterland corresponds to the county or counties containing the port facilities; broad hinterland encompasses the consolidated or primary metropolitan statistical area containing the port facilities.

* $p < 0.10$. ** $p < 0.05$.

tive carriers. However, the absolute losses would be only a fraction of the cargo value, whereas the redistributed income needed to be deducted from the absolute impact estimate.

In general, agricultural producers are especially limited in their ability to substitute transportation arrangements in the short-term; absolute losses may result if food spoils. Industry sources at Port Hueneme (an agricultural niche port in Ventura County, just north of Los Angeles) stated that \$2.3 million was lost because of fruit spoiling and from diverting table fruit to juice production.¹¹ An executive vice president of the Pacific Northwest Grain and Feed Association was quoted as saying that each day of the shutdown cost wheat and grain farmers some \$4 million (Nyhan, 2002). A port shutdown at a sensitive moment in the harvest cycle would result in severe losses. Modeling the economic impact of these losses of perishable goods using a monotonic function of disrupted cargo throughput is somewhat appropriate, with two important caveats. First, the relationship between lost throughput and economic loss is discontinuous to the extent that "sell by" dates vary from one commodity to another. Second, substitution possibilities are not entirely excluded; food-stuffs may be rerouted at higher cost, redirected into juicing or canning, and so on.

A great deal was made of the effect of the port lockout on automobile assemblers, with several foreign-owned assemblers temporarily halting production during the lockout. For example, according to media reports, Toyota, the first firm to shut down its production lines at its Fremont, California, plant, estimated the costs of delayed shipment of cars and parts to be \$80 million (Lemke, 2002). Restructuring in the automobile industry—specifically the adoption of just-in-time inventory control and the rise in North American assembly by non-U.S.-owned automobile firms—makes some firms in this sector more dependent than others on port operations. This is indicated in the positive correlation between cargo handling and employment growth in the automobile parts manufacturing sector in the hinterlands of ports, shown in Table 3. Ports that have experienced growth in cargo throughput are associated with growth in automobile parts assembly in the metropolitan areas and counties that contain them. This reflects ongoing changes in the organization of the automobile parts supply industry (Sturgeon & Florida, 2000), specifically the consolidation and modularization of both locally produced and imported automobile parts in port cities. However, the same positive correlation does not exist between cargo handling and all manufacturing or, for that matter, automobile assembly. The more general point is that different sectors have a differential ability to substitute on short notice. Hence, an economywide substitution factor cannot be read from a single sector.

Not only do sectors differ in the extent to which they can substitute in the short term, firms within the same sector also have differing abilities to substitute. For example, presumably a small retailer would be more negatively affected by the delay of one container than would a larger retailer because each delayed container constitutes a larger proportion of the smaller firm's total ship-

ments. Furthermore, large retailers typically make use of cargo expeditors to shepherd their containers through the docks more rapidly and, thus, were able to secure preferential treatment for their cargo before and after the lockout. The port shutdown also would be expected to have had differential impacts on retailers according to the particular mix of imported and locally sourced products they stocked.

Similarly, consider the differences between two importers of finished automobiles that use West Coast ports.¹² Honda imports new vehicles to the United States through just two port facilities, both located on the West Coast (Portland and San Diego). The firm purchases transportation services from a variety of intermediaries, including steamship lines, terminal operators, automobile import processing firms, railroads, and truckers and emphasizes getting the vehicles to dealers as quickly as possible. In contrast, Toyota maintains direct control over several aspects of its logistics system, operating a subsidiary steamship line and an in-house automobile import processing operation. It is also closely tied to two West Coast ports (Long Beach and Portland), leasing large pieces of port land for in-house processing, storage, and customization of imported vehicles. However, Toyota also operates similar facilities at three East Coast ports to handle imported vehicles (New York, Baltimore, and Jacksonville).

These observations raise further doubts about the assumed monotonic relationship between the disruption in cargo throughput and economic loss. Had the lockout persisted, Toyota might have been expected to switch imports to its East Coast facilities, whereas Honda may have sought to contract these operations to some East Coast parties.¹³ In this case, the losses might actually decrease over time. Although these alternatives are surely more costly than the existing arrangements, it would be incorrect to include more than a fraction of the cargo value in the impact estimate. In other words, each firm possesses what may be regarded as some inherent redundancies in its logistics system, and so the separate losses to each from the lockout cannot be adequately comprehended as a continuous monotonic function of the disrupted cargo value.

Which firm was more vulnerable in the port shutdown? Which had more ability to substitute in response? The answers to these questions need to start with the recognition that both Honda and Toyota do have some measure of flexibility. Both firms are neither entirely dependent on one port, or on one coast, nor entirely footloose with respect to their existing logistics arrangements. Toyota's immobility comes from being heavily invested in the ports that it uses, but the firm gains flexibility by maintaining port facilities on both coasts. Honda's immobility comes from normally using only West Coast ports, but its overall logistics structure is more flexible. In other words, the incidence of the costs of the disruption is firm-specific. This is because of interfirm variations in inventory levels, distribution systems, and other differences in the organization of the logistics chain (Hall, 2004). Port impact studies ignore the fact that advancements in inventory control and the logistics chain have been differentially applied and adopted.

The fact that firms in the same sector have a differential ability to deal with the port shutdown is significant. If one firm is able to deal with the shutdown more effectively than its competitors, then this firm would expect to gain market share at the expense of other firms. In other words, consumers would likely engage in substitution behavior, purchasing products unaffected by the West Coast shutdown, including those from local sources or those imported through East Coast ports. For port impact studies, this redistribution of market share entails a major conceptual challenge. The shutdown of West Coast ports resulted not only in losses but also in net gains for other economic actors, both within the same sector and beyond. Port impact studies ignore these effects, thus committing a major error in the aggregation of total economic impacts.

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REVISED ESTIMATES

In early 2003, Martin Associates issued a retrospective report estimating the impacts of the actual 11-day lockout at West Coast ports. The report was apparently based on interviews with more than 200 terminal operators, ocean carriers, importers, and exporters and contained many anecdotes about individual firm losses, although the actual estimates were based on some highly aggregated loss assumptions. The revised estimates of the total costs of the shutdown were some

\$15.6 billion, of which \$14.4 billion was lost by importers and exporters.¹⁴ The revised estimate was lower, but of the same order of magnitude as the original estimate of some \$21.4 billion (i.e., \$1.94 billion per day over 11 days). However, although implicitly conceding some of the points made here about the grossly inflated value of perishable cargo lost, the revisions introduced new sources of error and continued to ignore substitution possibilities.

The revised report was based on the value of containerized and noncontainerized cargo, whereas the prospective report was based only on the value of containerized cargo. This inflated the value of cargo potentially disrupted by about 40% (from \$257.7 billion worth of containerized cargo to \$360 billion worth of noncontainerized and containerized cargo). Because both containerized and noncontainerized cargoes were disrupted by the lockout, the adjustment was, in principle, correct. However, again, no attempt was made to disaggregate the degree of substitution within the noncontainerized cargo category. Compare, for example, the shelf-life of a finished automobile with that of a pallet of bananas. Then, instead of assuming that 75% of the value of imported cargo was lost, the report posited a more realistic estimate that 10% of the value of imported cargo was lost. This adjustment was a step in the right direction,¹⁵ although clearly a more disaggregated approach would be better.

Together, these two adjustments should have reduced the overall loss attributable to importers and exporters to less than one fifth of the original estimate (incorporating noncontainerized cargoes added 40% to total cargo value potentially lost, but the revised number assumed that only 10% of imported cargo value was lost versus 75% of cargo value previously assumed lost). How then did Martin Associates (2003) come up with a revision that was three quarters of the original? The chief change was the inclusion of inventory-carrying costs, estimated at 10% of the daily value of all cargo disrupted less the value of cargo lost, for a period of 28 days. As with the prospective estimates, this vastly overestimated the economic effects of the lockout.

It is appropriate to include some additional inventory costs in the estimated effect of port disruption. The assumption that the disruption lasted 28 days is also not unrealistic, because firms would have incurred higher inventory costs before the lockout because of preemptive stockpiling and after the lockout because of the disruption to normal port operations. However, assuming that inventory costs were 10% of the daily value of the cargo is simply implausible.

Martin Associates (2003, p. 10) claimed that the 10% inventory cost figure was based on interviews with key importers. Although this may be true for perishable goods such as bananas, which rapidly lose market value as they go brown and spoil, presumably, the losses associated with such goods were already included in the value of cargo lost. Conversely, it is hard to see how there could be any additional inventory-carrying costs in the automobile sector, where the industry standard is an inventory buffer of 60 days' worth of fully assembled vehicles. Although inventory-carrying costs vary considerably, the logistics industry rule of thumb is that inventory-carrying costs are 25% per year of the value of the cargo (Johnson & Wood, 1990; Lambert & Stock, 1993). This translates into less than one tenth of 1% of the value of the inventoried goods per day, or less than .01% of the inventory-carrying costs Martin Associates (2003) assumed. In summary, the losses resulting from inventory-carrying costs are real but negligible in comparison to the estimated effects.

CONCLUSION

There is no doubt that the West Coast port lockout in fall 2002 resulted in real, hard-felt economic losses. Perishable foodstuffs were destroyed, some production costs rose, and firms and workers directly involved in cargo handling lost earnings. However, there is convincing evidence that many corporate logistics planners were able to deal with the shutdown in a variety of ways. Port impact studies offer very little useful analysis of this short-run substitution behavior. The shutdown is likely to have some long-term effects as firms look to diversify their patterns of transportation usage. For instance, some importers are apparently examining options in Mexican and East Coast ports (Flanigan, 2002), whereas others may expand inventories (Virgin, 2002).¹⁶ Port impact

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studies also offer very little useful analysis of these long-run effects because they assume fixed production techniques, industrial structures, and associated logistics arrangements.

If port economic impact studies are neither appropriate for estimating the short-term costs of temporary disruptions nor for the long-term effects of structural change, what are they good for? Additional data and more sophisticated econometric (general equilibrium) modeling may address some of the concerns raised here, but in the absence of readily available alternatives, a more complete and honest reporting of the limitations of impact studies is required. At the same time, producers and consumers of port impact studies need to realize that they are poorly designed to estimate the most significant economic impacts of port cargo handling, namely, those related to the production and consumption of that cargo in increasingly dispersed hinterlands.

Other adjustments to the standard impact estimation methods would help. At the very least, the fact that such disruptions create both losers and winners needs to be made explicit in any credible estimate. It would also be desirable to report ranges of impacts for commodity groups in a sensitivity analysis. For example, it should be relatively easy to estimate upper and lower impact estimates by assuming that no sales of finished automobiles and between 50% and 75% of all banana sales were lost. The interviews Martin Associates (2003) conducted in preparation of the retrospective report should have been able to generate credible loss ranges for different commodity groupings. Note, however, that this improvement would not solve the problems associated with substitution. Instead, firm-specific case study work is needed to add to the understanding of how different firms structure flexibility into their logistics systems.

Port impact studies remain useful for describing the economic effects of cargo-handling activities at or near the docks. For this reason, they remain useful for policy questions where parameters can be neatly and tightly defined, such as when assessing the short-term costs and benefits of cargo incentive schemes. Cargo incentive schemes are popular ways of increasing cargo throughput in many ports. In exchange for some guaranteed increase in ship calls or cargo throughput, port authorities have offered carriers reduced terminal and other handling charges. In these cases, port impact studies provide useful ways of comparing the increased employment, income, and tax benefits of more cargo handling against the costs of decreased port revenues. However, the reason the impact method works for this type of policy question is precisely because the change in cargo volume is known in advance and because the benefits measured are directly related to cargo-handling activities.

This context points toward more intractable questions about the political usage of economic impact studies in the planning and policy context. Both the prospective and revised impact studies of the 2002 West Coast port lockout delivered implausibly large, yet politically influential, estimates of the costs to the economy. By ignoring the possibilities for substitution in the short run, the impact estimates effectively discounted the temporal, spatial, sectoral, and social redistribution of income from firms and workers in the West Coast port industry to freight airlines, East Coast ports, domestic manufacturers, and other economic actors. Although it is an open question whether this redistribution constitutes grounds for government intervention, it is quite clear that most of the harm was not being caused to "the national economy," but rather to a more limited set of interests. Many of these interests, but by no means all, were active participants in the labor dispute that gave rise to the lockout. A more accurate assessment of the costs of the shutdown and their incidence might not have changed the outcome of the labor dispute, but it would certainly not have had such salience in the political process surrounding the lockout.

Besides, there is a curious irony in the commission, creation, and dissemination of port impact studies. Port impact studies suggest that we are living in a world in which port users are pretty unstrategic about anticipating and adjusting to temporary disruptions. Yet the more inflated the estimates become, the more likely port users are to engage in precisely the behavior that reduces the technical accuracy of those inflated estimates. Economic agents do not just commission consultants' reports; they also act on them.

NOTES

1. The title of this article is a quotation attributed to Patrick L. Anderson, principal of the Anderson Economic Group. In a press release statement attached to a report critical of the Martin Associates port impact study (Anderson, 2002), he is reported as saying that “to actually lose a billion dollars a day for two weeks, we’d have to sink the ships” (p. 1).
2. For an example of an airport economic impact study that emphasizes employment effects, see Hakfoort, Poot, and Rietveld (2001). For an evaluation of prospective and retrospective impact studies of sports stadiums, see Baade (1996). For a discussion of the costs and benefits of tourism infrastructure, see Shaw and Williams (1994) and Fainstein and Stokes (1998). For a critical review of convention center feasibility studies, see Sanders (2002).
3. The International Longshoremen’s and Warehousemen’s Union (ILWU) also represents longshoremen in Hawaii, British Columbia, and Alaska, as well as warehouse and office workers on the U.S. mainland and agricultural and service workers in Hawaii.
4. According to County Business Patterns data (U.S. Bureau of the Census, 1980, 1998), the number of people employed throughout the United States in the Terminal Operations and Cargo Handling subsector declined from about 90,000 in 1980 to little more than 50,000 in 1998. Most of this decline occurred in the 1980s.
5. Although the distinctions between steamship lines (which carry goods by sea), stevedores (who manage cargo loading and discharge operations), and terminal operators have declined in recent years because of the ongoing consolidation in the industry (Martin & Thomas, 2001; Slack, McCalla, & Comtois, 2002), West Coast port employers have remained somewhat divided in their bargaining positions. In simplified terms, the mostly Asian-owned steamship lines have generally been more willing to reach agreements with the ILWU because they do not want their ships to lie idle in port, whereas U.S.-based stevedoring and terminal operating firms are especially concerned about reducing the costs of port labor. For some discussion on this topic, see Hiltzik (2002).
6. Employers have alleged that the ILWU disrupted normal port operations by manufacturing a series of health and safety disputes and, thus, was effectively engaging in a work-to-rule slowdown. Longshoremen have alleged that the Pacific Maritime Association (PMA) manufactured evidence of a slowdown as part of a conscious strategy to secure federal government intervention.
7. The most commonly used input-output models for port impact studies in the United States are the 525-sector IMPLAN and 531-sector RIMS II, both developed by the U.S. Department of Commerce’s Bureau of Economic Analysis. The Maritime Administrations’ PortKit is based on a 30-sector input-output matrix similar to the IMPLAN model. Throughout this article, I have assumed that the input-output matrix used by Martin Associates (2001a) is both accurate and up-to-date; in practice, this may not be the case, and so this may be an additional source of error.
8. Heikkila, Gordon, Richardson, and Jun (1992) developed a spatially disaggregated input-output model for the ports of Los Angeles and Long Beach to estimate the income effects resulting from exogenous changes in cargo handling. Changes in income were traced through a 93-by-494 cell occupation-industry matrix. The model produced estimates of direct and induced income and employment effects in much the same way as those produced by the less disaggregated Martin Associates methodology. These effects were then spatially allocated to 65 geographic zones in the greater Los Angeles region taking intrametropolitan travel patterns into account. However, because of data limitations, the spatial allocations could be applied to only 12 economic sectors plus an aggregate household sector.
9. My own back-of-the-envelope estimate of the direct and induced impacts of the port lockout on cargo handling activity is \$43 million per day. Although this is somewhat lower than the \$74 million per day estimated by Martin Associates (2001a), the difference is dwarfed by the estimated impacts on cargo importers and exporters. Adding together all the workers in the water transportation, water transportation support (this sector includes the 16,000 longshoremen, clerks, and foremen), and the local trucking sectors in the three affected states (California, Oregon, and Washington) using the 1997 Economic Census totals 53,598 jobs. Some of these people were able to keep on working during the port lockout. But assuming they all stopped working, if they earned an average of \$100,000 a year—which they don’t—then their annual earnings would be about \$5.4 billion a year. Applying a multiplier of 2 to account for indirect and induced impacts would still give us only \$10.7 billion a year, or \$43 million per working day. I chose a multiplier of 2 for illustrative purposes only. Helling and Poister (2000) cited a total industry output multiplier of 1.94 for the United States water transport sector in 1992. The 1999 SIC-based *Annual Input-Output Table Two-Digit* (Bureau of Economic Analysis, 2003a) reported a multiplier of 1.95. The 1997 NAICS-based *Benchmark Input-Output Accounts of the United States* (Bureau of Economic Analysis, 2003b) reported a multiplier of 2.20. To derive economy-wide losses of \$1.94 billion per day from the lost earnings of water and local trucking transportation workers alone, would need a multiplier of 90.5. In other words, almost all of the estimated impacts derive from the value of the cargo rather than from its handling.
10. Admittedly, this assertion exists without a quantifiable counterfactual. Throughput for the year might have been higher without the labor dispute, but this seems highly unlikely. Data for this comparison come from the respective port authorities and refer only to fully loaded containers. I combined cargo statistics for the ports of Long Beach and Los Angeles because of the relocation of a major steamship line from Long Beach to Los Angeles in the summer 2002.
11. However, there were reports that some fruit found its way into food pantries, which some might regard as a socially desirable redistribution as opposed to a loss.
12. For a fuller comparison of the automobile import logistics of Toyota and Honda, see Hall (2004).
13. The possibilities for redirecting automobile imports to East Coast ports arise partly from the fact that car carrier ships are able to navigate the Panama Canal. This option is available to only some of the container ships that visit West Coast ports, and it is not available to the largest so-called post-Panamax vessels. The general point stands: The possibilities for rerouting and, hence, for substitution are differential within and across economic sectors.

14. Although most of the estimated impact is attributed to port-dependent impacts, it is worth noting that Martin Associates (2003) repeated in the revisions its double-counting errors with respect to the impact of the shutdown on cargo handling. For example, the report noted that “truck retrieval of containers from the yard was very slow, and truckers’ income, which is based on loads moved per day to and from the port, was severely impacted” (p. 9). However, the report then went on to note that “after the ports reopened, consolidators needed to find additional storage capacity for the surge in boxes, which resulted in increased drayage costs to distant container yards” (p. 9). Increased drayage represents increased income for truckers.

15. According to Maritime Administration statistics, agricultural products accounted for some \$80 billion of the \$671 billion worth of cargo moving through all U.S. ports in 1999. Although many of these products would not spoil in 10 days (such as coffee, corn, leather, etc.), assuming that 10% of the value was lost was definitely an improvement over the earlier 75% assumption.

16. To the extent that the experience of the port shutdown leads to unnecessary (or irrational) additional investment in logistics systems, these costs may be attributed to the lockout. At the same time, the argument of this article is that redundancies of this nature, which are present in all firms, are partly responsible for reducing the aggregate impact of the lockout.

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