California's Global Gateways: Trends and Issues

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Foreword

In the late 1990s, PPIC launched a research effort on California's economy called Global California. At that time, there were plenty of reasons to study the state's economy in a global context. Immigrant labor, for example, had long influenced the character of California's economic activity. Moreover, foreign direct investment in California was a significant engine of growth. Indeed, foreign investors owned and operated 25 percent of the firms registered in Silicon Valley and employed an equal share of the labor force. Throughout this period, too, Asian imports became an increasingly large share of total U.S. imports, and critics blamed job losses on the "hollowing out" of a labor force losing ground to offshore production. Yet shortly after PPIC launched Global California, it became even clearer that the only practical way to understand California's economy was in its global context. Both the threat of terrorist attacks after September 2001 and the West Coast port closure of 2002 underscored the fact that international trade—and the ports that made it possible—were critical factors in the regional economy.

As part of PPIC's research effort, Jon Haveman and David Hummels undertook an analysis of the state's shipping activities in *California's Global Gateways: Trends and Issues*. As they point out, political obstacles to trade have eroded or in some cases disappeared, and the demand for shipping services has increased dramatically. California's seaports and airports reaped the benefits of that heightened demand and, while increased trade traffic brought profits, jobs, and tax revenues, it also produced unwelcome by-products such as congestion, pollution, and infrastructure wear and tear in and around the state's major urban areas. Investing enormous sums of money, California's ports expanded their facilities to absorb this increased trade volume. Even so, some of them lost market share to other ports during this time.

For these and other reasons, Haveman and Hummels note that further growth in California's trade traffic, should the state decide to pursue it, will require a significant policy response. Part of this response would likely focus on the more efficient use of current facilities, including off-hours distribution schemes. A related option is to impose user fees at or around the state's major gateways. Although there is already resistance to this proposal, the alternative seems to be an ever-increasing demand for precious space on nearby freeways and local roads. Expanding the state's trade infrastructure facilities is yet another option, but building consensus for that expansion—much less planning, financing, and implementing it—is by no means a straightforward or easy task.

The challenges facing California's trade gateways are similar in type and importance to those facing the infrastructure system more generally. Expansion is slow, difficult, and expensive, but neglect or even maintaining the status quo will lead to higher transaction costs and dampen future economic growth. This quandary often shifts the focus of the policy discussion to more efficient uses of existing facilities. Whether the topic is schools, parks, roads, water supply systems, or ports, the message is the same—make better use of what we have. In this sense, Haveman and Hummels make it abundantly clear that Global California is finally inseparable from Local California, and that visionary solutions at this level can affect the state's competitive position in the world economy.

David W. Lyon
President and CEO
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Summary

The ability to transport goods efficiently and the quality of trade infrastructure have become key determinants of international competitiveness. At the same time that political barriers to trade have dropped, the transportation requirements of manufacturers have become more complex. Multinational firms rely on fast, flexible, and reliable shipping to link far-flung plants into a well-integrated manufacturing chain. Transportation breakdowns or problems as simple as port congestion can idle an entire global production network. In this environment, the capacity of ocean ports, airports, and multimodal linkages becomes critical to a region's competitive position.

These issues are especially important in California, whose airports and seaports are among the busiest in the country. Los Angeles and San Francisco International Airports rank second and third (behind only New York's JFK International Airport) in terms of the value of imports and exports processed, and the Ports of Los Angeles and Long Beach are the two largest port complexes in the country. Combined, these two ports handle a greater volume than all of the world's ports other than Hong Kong and Singapore.

Although California's businesses are active importers and exporters, much of the trade passing through its global gateways either originates in or is destined for use in other states. This fact makes California a significant entrepôt, or distribution center, for the country's trade. In 2000, California serviced $297 billion in trade for other states, $176 billion in excess of California's trade that was shipped through other states. This difference represents an extra 32 billion kilograms worth of goods flowing on California's highways and railways. Although this flow is a relatively small proportion of all goods movement in the state, it is very heavily concentrated in the large urban areas with Los Angeles and San Francisco at their centers. Mingling as it does with already significant traffic flows, this international trade traffic contributes

significantly to congestion and pollution in these regions. Quantifying these deleterious effects of California's entrepôt status is extremely difficult, but the severity of the congestion and pollution problems in Los Angeles and the San Francisco Bay area are sufficient to give one pause when considering the benefits to the state of handling this trade.

Although California's entrepôt status also benefits the gateway regions through increased employment, business profits, and state and local tax revenue, congestion, pollution, and wear and tear on California's highways generated by shippers are costs for which the taxpayers and citizens of California are not compensated. In effect, California is subsidizing economic activity in other states. In principle, these services could be paid for through the collection of user fees or transfers of federal tax dollars, but this is not currently happening. That Californians are only partially compensated for the services required to move goods through the state suggests that promoting California's entrepôt status is not obviously beneficial but is part of a large and complex policy calculus.

Trade through California's gateways will wax and wane for a variety of reasons, only one of which is its entrepôt status. Principal among these reasons are changes in the pattern of overall U.S. trade. As trade shifts regionally from Europe to Asia, trade flows through California will naturally expand. Between 1970 and 2002, imports from Asia as a share of U.S. trade increased by a factor of five from 8 percent to 40 percent, dramatically increasing the flow of imports through California's gateways. Further, the composition of U.S. trade has been shifting toward lighter goods that are more likely to be shipped by air. Bulk commodities as a share of U.S. imports have fallen from 38 percent to just 19 percent. Manufactured goods, which tend to be lighter and higher in value, have experienced a corresponding increase as a share of U.S. imports.

Although there is very little that can be done regarding changes in the regional and compositional changes in U.S. trade flows, port authorities and politicians are keenly aware of the competitive position of local gateways vis à vis gateways in other states. There is in fact significant evidence that some of California's global gateways, airports in particular, are not keeping pace. Although the value of trade through

California's airports increased in the latter half of the 1990s, their share in U.S. trade dropped precipitously between 1995 and 2002 (from 38 percent to 21 percent). Some of this decline was a result of changes in the commodity and country composition of U.S. trade, but over half was simply because shippers preferred other points of entry or exit. There is little question that congestion in and around the airports is partially responsible, but increases in the range of airplanes and an expansion of cargo-handling facilities in Alaska have also contributed to the erosion in the growth of trade through California's airports. Although not an obvious transit point for Asian trade, Anchorage lies much closer than airports in California to the path representing the shortest distance from Asia to much of the Eastern portion of the United States.

Discrete events, such as the West Coast port closure of 2002 and the terrorist attacks in September 2001, also play a significant role in determining shippers' preferences for one gateway over another. Given that alternatives to shipping through West Coast ports do exist, events such as the port closure are likely to result in a diversification of shipping patterns for domestic importers and exporters. This diversification shifts trade to other seaports or to other modes of transport. In either case, the port shutdown may well have resulted in a permanent reduction in the share of U.S. trade flowing through California. It is too soon to tell whether the port closure will have such long-term effects, but in the months following the shutdown, the share of trade processed by West Coast ports was lower than it has been in any of the previous five years. Between 1998 and 2001, the share of U.S. imports from Asia entering California ports was consistently between 77 and 78. Through the first six months of 2003, this share has fallen to just under 74 percent. This is a significant drop, but it remains to be seen if it represents a permanent or transitory diversion of imports away from California's gateways.

The response to terrorist attacks also has the potential to affect trade through California's ports. If expanded security measures—designed to protect the ports from attack and the movement of weapons material beyond the ports—reduce the efficiency with which goods flow into the country, overall, U.S. trade will diminish as could ocean relative to air shipping. The primary federal initiative, the Container Security Initiative, mandates that suspect cargos be inspected at their foreign port.

Presumably, this initiative will result in a greater frequency with which containers are inspected. As a result, shipping delays will be more common and arrival times at U.S. ports will be less certain. For firms with a just-in-time inventory system in place, by increasing uncertainty in the shipping process, increased inspections effectively raise the cost of importing.

Initiatives are also being implemented that are likely to reduce the cost of trading. In particular, the Customs-Trade Partnership Against Terrorism encourages shippers and carriers to develop security plans for their cargo while it is in transit. These enhanced security measures will not only protect cargo from tampering related to terrorist activity but will also protect it from more mundane dangers such as simple theft. As the process of protecting U.S. trade from terrorist activities is still relatively young, it is unclear how these offsetting influences will affect shipping costs and hence trade flows.

Despite these events, and the recent reorientation of air trade away from California's airports, trade flows through California are expected to increase dramatically in the next 15 to 20 years. By 2020, the value of exports through California is expected to nearly triple and imports to nearly double. By weight, overall trade flows are expected to triple, with the overwhelming majority of this increase occurring at the seaports. However, this increase in trade through California will not occur without an accommodative policy response. Should infrastructure provision remain at its current levels, much of this trade will surely find a path of less resistance.

Trade with Asia is expected to provide almost three-quarters of the trade growth through California. Despite this fact, and China's growing contribution to U.S. and world trade flows, imports through California are expected to grow more slowly than are imports through other U.S. gateways. This trend in import growth applies to both ocean- and air-based trade and is almost equally explained by changes in commodity and country mix. At the same time, exports through California are expected to grow more quickly than are overall U.S. exports. Here, it is primarily changes in the country composition of exports as Asia is expected to grow rapidly in the coming decades. Despite this imbalanced growth through California, the gap between imports and exports is expected to increase over time, especially when measured by weight.

Certainly growth in trade through the state requires some policy response. Without it, congestion and pollution problems most assuredly will worsen. However, the form of this response is unclear. Most frequently, policy responses have focused on accommodating the increased flow, with too little consideration given to managing it. Too little thought is given to assessing alternative routes through which the trade might flow—for instance, greater use of the Panama Canal for Asia trade destined for the Eastern United States—or to alternative means of transport—encouraging rail over trucking. At the same time, there does seem to be an increasing recognition among policymakers and port authorities that existing infrastructure must be used more efficiently. In Los Angeles, for instance, there is an active movement to encourage the delivery of cargo from the ports to inland distribution centers at all hours of the day rather than concentrating them in the highly congested daylight hours.

Regardless of the form of policy response that is appropriate, accommodating or managing the expected growth in trade through California will require the application of significant resources to bolster the capacity of the local infrastructure in both the Los Angeles and San Francisco regions. This need comes at a time that is opportune on the federal level but a tremendous challenge at the state level. Given the current budgetary problems facing the state, the financial resources need to come from other sources. There is potential in a pair of other sources. First, the federal government is in the process of reauthorizing TEA-21, the Transportation Equity Act for the 21st Century, which regulates the allocation of federal funds to surface transportation infrastructure. In an effort to expand California's share of federal resources for goods movement infrastructure, policymakers at the state, regional, and federal level have been actively involved in efforts to highlight California's trouble spots. Second, imposing user fees at the ports and on some surrounding infrastructure holds significant potential for raising needed resources. Efforts to impose these fees have been aggressively resisted by shippers, carriers, and others involved in goods movement, making them very difficult to implement politically.

Although the expansion of resources for trade infrastructure is important for the smooth functioning of economic activity in parts of California, it remains an open question as to what is the best source of these funds and just how they should be spent. Should increasingly scarce tax revenues continue to be used for these projects, or should the users of the infrastructure bear a greater portion of the cost? Should policy be focused on accommodating anticipated increases in trade flows, or should it be devoted to managing those flows? Answers to these questions are far from clear, but the increased demand that international commerce is likely to place on California's ports and people make their consideration crucial.

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1. Introduction

"Transportation is the industry that connects other industries . . .
it is the key to globalization."

Lawrence H. Summers, Secretary, U.S. Department of Treasury
International Transportation Symposium
October 10, 2000, Washington, D.C.

The ability to transport goods efficiently has become a key determinant of international competitiveness. The rising importance of transportation can be traced to the removal of other barriers to integration and the increased demands of manufacturing firms for sophisticated shipping services. Recent studies conducted by academic researchers and transportation specialists at the World Bank and the International Monetary Fund confirm the importance of shipping costs and transportation infrastructure in global trading arrangements.[1] They demonstrate that inland shipping and port costs constitute the majority of international freight costs, and that improving port administration and efficiency significantly lowers shipping costs. Shipping costs, in turn, dramatically affect the sourcing decisions of firms engaged in international trade.

At the same time that political barriers to trade have dropped, the transportation requirements of manufacturers have become more complex. Multinational firms rely on fast, flexible, and reliable shipping to link far-flung plants into a well-integrated manufacturing chain. Transportation breakdowns, or problems as simple as port congestion, can idle an entire global production network. In this environment, the efficiency of ocean ports, airports, and multimodal linkages become critical to a region's competitive position in manufacturing.

[1] For an overview of these studies, see Fink (2002).

These issues are especially important in California. Were California an independent country, it would be the 11th largest exporter in the world, between Singapore and the Russian Federation. California also serves as an international commerce gateway between the United States and some of its most important trade partners. A majority of U.S. trade with Asia passes through California's ports, and Asia trade has seen much more rapid growth than historically important trading partners such as Europe. Since 1990, East Asian exports to the United States have grown 7 percent per year but European exports have grown only 4.5 percent per year. And this is only the beginning. U.S. trade with China is forecast to grow by more than 220 percent in the next two decades.

California's gateways are important for their regional economic effects as well. International commerce requires ancillary services, including transportation and warehousing. As a result, regions that process significant volumes of international trade experience positive economic spillovers. In particular, the sectors listed above employed over 420,000 workers in California. A large share of this employment is due to the high volume of traded goods flowing through California's ports. For this reason, competition among port regions is intense. Like water, internationally traded goods take the path of least resistance. Costly and inefficient port operation can lead to a significant decline in the demand for trade services, and hence employment, at any particular location. California port facilities compete among themselves, with domestic ports in other states, and with foreign alternatives in Canada and Mexico.

This report provides an overview of issues related to California's international trade infrastructure as well as trends in goods transportation into, out of, and through the state. We analyze these trends to ask if California is keeping up, and we look forward to ask what California must do next. The analysis raises more basic policy questions. Does California really want a significant increase in the movement of freight through its ports and cities? Should California be doing more to facilitate freight movement or, by failing to respond to growing demand, let international cargo go elsewhere? These are not research questions, and we do not seek to answer them here. The report's findings, however, provide useful context for those larger policy questions.

The report begins with an overview of California's gateways and recent changes in the economic environment in which they operate. Chapter 2 describes California's gateways for ocean, air, and land transport, highlighting the distinctive nature of each major gateway, the type of cargo it moves, and the problems facing each. Although California producers and consumers contribute to the trade flows through its gateways, significant quantities, particularly of imports, also flow through California to facilitate commerce for producers in other states. In Chapter 3, we discuss the importance of California as an international trade entrepôt. Our focus is on the shipping service balance for California, that is, to what extent California is a net provider of shipping services to other U.S. states. Providing this service is potentially costly to California and we provide a discussion of potential benefits and costs.

Chapter 4 presents evidence on trends for trade through California and the United States as a whole. It also draws out the implications of these trends for transportation demand. Chapter 5 analyzes the competitive position of California's gateways, focusing on changes in the demand for and use of these facilities relative to other U.S. gateways. If California's facilities are improving in terms of quality and cost of service, shippers will make use of them, and we will see this most clearly in the trade statistics. If California's facilities are lagging, this too will be clear in declining market share.

In Chapter 6, we discuss important recent events that affect demand for California's transportation services, including the port lockout and security considerations in the wake of the 9/11 terrorist attacks. Initial estimates of the costs of the port lockout to the U.S. economy were almost certainly overstated, largely because they ignored the ability of shippers to respond flexibly, to build up anticipatory inventories, and to divert traffic around West Coast ports during and after the lockout. We provide some evidence for these responses including data that suggest continued diversion long after the lockout had ended. We also provide detailed information on the Container Security Initiative, enacted in the wake of 9/11, and what it implies for goods movement through California.

Chapter 7 forecasts demand for transportation services and compares these estimates to California's current transport capacity. Output in East Asia is growing much faster than output in traditional European trading partners. Further, the "weight" of Asian output is growing even faster than overall output growth, as Pacific Rim countries specialize in heavy manufacturing, whereas the United States and European countries specialize in information-intensive goods. These facts in combination mean that U.S. trade and transport capacity will become increasingly West Coast oriented. We combine estimates of trade growth with calculations that enable us to pinpoint likely entry locations to determine whether California's transport capacity stands ready to absorb the coming deluge.

Chapters 2 through 7 of this report illuminate a variety of policy issues pertaining to California's international trade infrastructure. In Chapter 8, we discuss some remaining policy implications of our work and the key points of our analysis. In many ways, that analysis raises more questions than it answers, and we therefore see this report as the first part of a research agenda designed to study California's trade infrastructure and its relationship to dramatic changes in the trade landscape. These include shifts in the types of goods being traded (microchips versus steel), the countries with whom trade takes place (Latin America and the Pacific Rim replacing Europe), and the use of transportation modes (air replacing ocean). Sensible policy must be forward-looking because infrastructure investment can be extremely costly with economic effects that last for decades. Given the competition in the shipping services industry, mistakes or missteps can have significant long-term costs.

2. California's Major Gateways

In 2002, California's international gateways handled one-fifth of all U.S. international trade. A quick snapshot of major gateways into the United States indicates the importance of California's ports. In particular, California's top airports and seaports are among the largest in the country and serve as major gateways for goods from and to locations all across the country. Although Mexico is America's second largest trading partner, the flow of internationally traded goods through the heavily populated Southern California border region is small compared to that of other U.S. border crossings.

Regardless of their importance for U.S. trade flows, each gateway is likely to face the common challenge of handling rapidly growing trade flows. The problems faced in accommodating this increased demand, however, vary by mode of transportation. This chapter provides a discussion of the trade that moves through California's major gateways, highlighting the problems facing each.

Airports

California's airports are among the busiest in the country in moving U.S. merchandise trade (Table 2.1). California's airports handle 23 percent of U.S. airborne trade by value (19 percent by weight). JFK in New York handles the largest load, but Los Angeles and San Francisco Airports are ranked second and third by value; by weight, they are third and fifth, respectively. Oakland International Airport is the only other California airport handling significant volumes of international trade, ranked 18th by value (30th by weight). California's airports handle trade with a significantly higher value per kilogram than other airports. San Francisco, in particular, has a value-to-weight ratio more than twice that of most other major airports. Outside California's big three, six other airports in California handle internationally traded goods, although their

Table 2.1

Top 25 U.S. Airports for U.S. International Merchandise Trade, by Value and Weight, 2002

Rank, by Value	Rank, by Weight	Air Gateway	Value (billion $)	Weight (million kg)
1	1	J.F.K. International Airport, New York	112.7	1,102.7
2	3	**Los Angeles International Airport, CA**	60.6	763.3
3	5	**San Francisco International Airport, CA**	49.7	317.8
4	2	Chicago, IL	47.8	768.4
5	7	New Orleans, LA	26.6	219.0
6	8	Anchorage, AK	22.7	205.8
7	4	Miami International Airport, FL	21.1	717.1
8	9	Dallas-Fort Worth, TX	19.7	159.6
9	6	Atlanta, GA	17.5	291.4
10	10	Cleveland, OH	16.4	139.4
11	25	San Juan International Airport, PR	8.7	21.7
12	15	Philadelphia International Airport, PA	8.7	83.2
13	13	Logan Airport, Boston, MA	8.5	93.2
14	11	Newark, NJ	8.3	124.7
15	12	Houston Intercontinental Airport, TX	7.4	107.7
16	16	Seattle-Tacoma International Airport, WA	7.3	75.5
17	14	Washington, D.C.	6.3	86.7
18	30	**Oakland, CA**	3.0	14.2
19	17	Detroit, MI	2.7	75.1
20	19	Indianapolis, IN	2.7	36.8
21	23	Cincinnati-Lawrenceburg, OH	2.6	26.1
22	22	Memphis, TN	2.6	28.4
23	18	Honolulu International Airport, HI	2.6	39.2
24	28	Nashville, TN	2.5	14.8
25	20	Huntsville, AL	2.3	32.3
		Total, top 25 airports	471.2	5,544.1
		Total, airborne trade	498.5	5,869.1

SOURCE: MISER Port SITC database.

collective volume accounts for less than 1 percent of California's air trade.[1]

In 2002, the Los Angeles International Airport (LAX) handled 68 percent, by weight, of all trade through California's airports, and just over half by value. Goods shipped through LAX are dominated by

[1]Listed in order of their volume in 2002, they are San Jose International Airport, San Diego International Airport, Sacramento International Airport, Southern California Logistics Airport VI, Ontario International Airport, and the San Bernardino International Airport.

electronic integrated circuits, computers and parts, and parts for aircraft and spacecraft. Exports through LAX slightly exceed imports. The primary markets for these products are in Asia, particularly, Japan, South Korea, and Taiwan.

Trade through the San Francisco International Airport (SFO), although smaller in volume than that through LAX, is very similar in its product and partner country composition. Differences include the absence of aircraft and parts from SFO exports and a much larger role played by electronic integrated circuits in both imports and exports. Japan, South Korea, and Taiwan are again the top three trading partners for goods through SFO.

The volume of trade handled at the Oakland International Airport (OAK) is significantly less than that of the other major California airports. Part of the reason for its small size is that OAK is focused almost entirely on exports. In 2002, $2.9 billion in U.S. exports and $121 million in imports passed through OAK. As with LAX and SFO, exports through Oakland are dominated by electronic integrated circuits, which account for more than one-half of the total. The remainder consists of small amounts of computer and office equipment, measuring and controlling devices, medical instruments and supplies, and aircraft and parts. Trade through OAK is primarily with Japan, Hong Kong, and Taiwan.

Other airports in California handle very small amounts of trade. As a group, they receive greater quantities of imports than exports, with most of the trade consisting of electronic components, aircraft and parts, and computer and office equipment. Japan is the primary source of both imports and exports for these airports, and nontraditional countries make up much of the rest. For example, in 2002, Kazakhstan was the number two destination for exports, whereas Italy and Brazil were the number two and number three sources of imports into these airports, respectively. The exports to Kazakhstan appear to be a one-off shipment of spacecraft and spacecraft launch vehicles through the San Jose International Airport. Coincidentally, the imports from Italy were also spacecraft and spacecraft launch vehicles.

The primary issues constraining California's airports revolve around congestion beyond the airport gate and limitations on the expansion of facilities. Congestion surrounding the airports results from factors outside the airports' control. For LAX and SFO, the primary constraint is passenger traffic on nearby highways. In both cases, the primary highways providing access to the airports are major commuter thoroughfares. In the case of SFO, it is federal highway 101, which links the peninsula and Silicon Valley to San Francisco. In Los Angeles, Interstates 105 and 405 provide the most direct access to the airport, but both are used heavily by passenger as well as commercial vehicles. The Oakland International Airport is similarly constrained by external traffic congestion, but the primary cause of its congestion is its proximity to the Port of Oakland and its associated truck traffic.

The inability to expand airport facilities poses an even greater constraint on airport operations. All three airports are bounded on one side by water. Residential developments surround them on other borders, and each airport has confronted community concerns over noise levels. Expansion seaward is technically possible only for SFO and OAK. SFO has developed plans to expand seaward, but the plans have generated concerns regarding the environmental impact on the greater San Francisco Bay. Oakland has not developed such plans but has instead focused on developing more of the land already under its control. This effort has also been stalled by environmental impact concerns as much of the undeveloped area is categorized as wetlands.

Seaports

California's seaports are the heavy lifters of California's global gateways. Table 2.2 describes the top 25 U.S. maritime ports, ranked by value, four of which are in California. Los Angeles and Long Beach top the list in value terms, although both are much further down the list in weight terms. Gulf Coast ports are oriented toward handling bulk commodities, especially crude oil, whereas the California ports handle a much higher fraction of high-value manufactured trade, resulting in a lower volume by weight. Los Angeles, Long Beach, Oakland, and Port Hueneme handled 42 percent of all containers moved through U.S.

Table 2.2

Top 25 U.S. International Maritime Ports, by Value and Weight, 2001

Rank, by Value	Rank, by Weight	Maritime Port	Value (million $)	Weight (million kg)
1	7	**Los Angeles, CA**	104.2	41.9
2	9	**Long Beach, CA**	94.7	40.0
3	3	New York, NY	85.9	71.7
4	1	Houston, TX	44.5	118.2
5	22	Charleston, SC	33.4	16.1
6	25	Seattle, WA	28.6	13.4
7	24	**Oakland, CA**	25.0	14.8
8	15	Norfolk, VA	24.9	22.5
9	13	Baltimore, MD	20.8	23.3
10	28	Tacoma, WA	18.7	10.4
11	23	Savannah, GA	17.2	15.1
12	4	New Orleans, LA	17.0	65.3
13	38	Miami, FL	16.6	5.6
14	31	Jacksonville, FL	10.8	9.3
15	27	Portland, OR	10.7	12.3
16	34	Port Everglades, FL	10.3	7.8
17	2	Port of South LA	10.0	75.4
18	10	Philadelphia, PA	10.0	36.8
19	6	Morgan City, LA	7.8	47.7
20	5	Corpus Christie, TX	7.7	48.8
21	8	Beaumont, TX	7.7	41.2
22	26	Boston, MA	6.1	12.7
23	17	Christiansted, VI	5.8	21.9
24	21	Wilmington, DE	5.7	16.6
25	85	**Port Hueneme, CA**	4.8	1.0
		Total, top 25 ports	628.8	789.8
		Total, waterborne trade	719.2	1,160.6

SOURCE: U.S. Department of Transportation, *Waterborne Databank.*

seaports, turning them over at a rate of 20,760 20-foot-equivalent units (TEUs) per day.[2]

The top ten container ports handle 83 percent of all U.S. trade, a substantial increase over even the recent past. The driving force behind this concentration is the growing size of container ships. As ships grow

[2]Container data are taken from U.S. Department of Transportation, *U.S. International Trade and Freight Transportation Trends* (2003).

larger, there are fewer ports deep enough or capable of providing the larger cranes, berths, and storage yards necessary to handle them. This concentration, in turn, creates growing congestion inland of these megaports. Inland investments, such as the Alameda Corridor in Southern California and the FAST Corridor in Washington, become necessary to handle the increased traffic.

The Ports of Los Angeles and Long Beach occupy contiguous spaces on San Pedro Bay; together they form the third-largest port in the world, handling 10.5 million containers in 2002. These ports are primarily used for importing: Imports arriving in San Pedro Bay outstrip exports by a ratio of almost seven to one.[3] These ports handle primarily containerized cargo but continue to accept cargo in bulk, break-bulk, and ro-ro ("roll-on, roll-off") forms. Increasingly, the ports find noncontainerized cargo to be unprofitable because land is at a premium and noncontainerized cargo is land-intensive. (Containers are packed more densely and can be stacked to yield much more efficient land use.) Noncontainerized cargos, such as automobiles, are increasingly being displaced to nearby ports such as Port Hueneme and San Diego.

China and Japan are the primary sources of imported products, accounting for nearly 60 percent of all imports. Imports from China have the largest share at more than 37 percent. Other significant sources of supply include Taiwan and South Korea. Imported goods are heavily dominated by motor vehicles and equipment and computer and office equipment. Also important are toys, sporting goods, and household audio and video equipment. Exports through these ports are similarly destined for Japan and China, with Japan absorbing more than 24 percent and China 12 percent. Australia, Hong Kong, and Taiwan are also important export markets. Primary export goods are plastic materials and synthetics, industrial organic chemicals, and meat products.

Between 50 and 60 percent of all shipments arriving at these ports are bound for points beyond the local area. This means that cargo beginning at San Pedro Bay must transit a massive and crowded

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[3]The numbers of containers arriving at and departing from these ports are almost equal, with many containers departing empty.

metropolis to reach its ultimate destination. Further, the majority of goods are transported through the port's gates and to points inland on the bed of a truck. As a consequence, traffic from the port generates substantial congestion, with the I-710 Corridor heavily populated with trucks pulling containers. Passenger travel through this corridor is adversely affected in terms of speed, safety, and general driver comfort.[4] Congestion is also a serious problem on local streets because of the rail traffic into and out of the port. Opening the Alameda Corridor has significantly reduced this burden but has not led to a significant reduction of truck traffic through the ports (see Box 2.1).

Port traffic also contributes to substantial air pollution, both directly from trucks entering and exiting the plants and indirectly from idling cars stuck in the traffic congestion these trucks create. As one prong of an attack on this problem, the Port of Los Angeles is considering a terminal capable of storing liquefied natural gas. Over time, the conversion to trucks powered by liquid natural gas could help alleviate the direct, if not the indirect, pollution problem.

The Port of Oakland is the 7th largest U.S. port by value. It handles exclusively containerized cargo with 1.7 million TEUs passing through it in 2002, making it the 4th largest U.S. container port. Relative to other large ports in the state, the Port of Oakland has relatively balanced trade flows, with loaded containers for export exceeding containers for import by about one-third. A partial explanation for the preponderance of exports shipped out of Oakland results from common shipping patterns. A common routing is for a ship from Asia to unload first at either Los Angeles or Long Beach and then to head north to Oakland. This practice is beneficial for two reasons. First, organizing imports and exports on the same ship is logistically difficult—it is much easier to load the exports once all of the imports have been unloaded. Second, delivering goods directly to Oakland reduces shipment delays associated with making a second port call.

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[4]The Southern California Association of Governments (SCAG) has estimated that travel on some highways in the Los Angeles region is slowed by more than 60 percent because of port traffic.

Box 2.1

The Alameda Corridor

The Alameda Corridor is a 20-mile-long series of bridges, underpasses, overpasses, and trenches that links the Ports of Los Angeles and Long Beach to the transcontinental rail yards in downtown Los Angeles. Construction was initiated in April 1997 and completed in April 2002. The corridor replaces over 90 miles of branch railroad lines, combining them into a single 20-mile expressway, including the 10-mile Mid-Corridor Trench that lies entirely below street level.

The corridor was meant to increase the efficiency of the cargo distribution system beyond the fences of the San Pedro Bay ports. Such efficiency enhancements were crucial in light of the growing flow of internationally traded goods that transit through the region. According to James C. Hankla, CEO of the Alameda Corridor Transit Authority (Hankla, n.d.),

> The purpose [of the Corridor] is not to reduce truck traffic on local freeways. The principal market for the Alameda Corridor is cargo bound for or originating in markets outside of Southern California—approximately half of the cargo handled by the ports. The other half of the cargo is bound for or originates in Southern California, and those containers are transported principally by truck.

The corridor has been relatively successful. By eliminating conflicts with surface streets at 200 street-level rail crossings, it has cut the transit time between the ports and the rail yard in half. In the process, it has slashed emissions from idling cars, trucks, and locomotives. The Alameda Corridor currently handles 35 train movements daily, carrying approximately 36 percent of all containers transiting the ports. By 2020, the corridor is expected to handle over 100 train movements, approaching a capacity of 150 movements per day.

The corridor was built at a cost of $2.4 billion. These funds were raised through a public-private partnership, with most of the funds coming from a $1.165 billion bond issue. Much of the rest came in roughly equal shares in the form of loans from the federal government, grants from the Ports of Los Angeles and Long Beach, and funds from the Los Angeles Country Metropolitan Transportation Authority. The debt will be retired through the collection of fees of containers originating or terminating at the San Pedro Bay port facilities.

The fees are determined by the Alameda Corridor Transportation Authority (ACTA) and are to be in effect for 35 years. Currently, the fee is approximately $15 for a loaded 20-foot equivalent container and $4 dollars for a similar container if it is either empty or not for waterborne use. Through May 2003, ACTA has assessed the railroads approximately $60.9 million on 4.6 million 20-foot equivalent container units. The revenue from fees is consistent with initial projections, so the corridor appears to be on schedule for the repayment of its debts.

SOURCES: Alameda Corridor Transportation Authority (1998, 2003); Melendres (2003).

Trade through the Port of Oakland is primarily with China (including Hong Kong) and Japan. Together, they account for more than half of all exports and half of all imports. Other major markets on the export side include South Korea and Taiwan. The largest non-Asia destination for exports through the port is the United Kingdom, which accounts for slightly less than 4 percent by volume. On the import side, Australia, Thailand, and Taiwan are important sources. The Netherlands, Italy, and France are the largest sources outside Asia, accounting for slightly less than 3 percent of imports by volume.

The primary item exported through the Port of Oakland in 2002 was waste paper, accounting for just over 19 percent of the volume of all exports. Animal feeds, red meat, and wine are also exported through the port in significant volumes. The vast majority of exported products originate in California, primarily in the San Francisco Bay region but also in the northern part of California's Central Valley. Imports were led by auto parts, iron and steel, and wood and wood products other than furniture. The auto parts were largely destined for the New United Motor Manufacturing, Inc. (NUMMI) plant just north of San Jose on the eastern side of the San Francisco Bay. NUMMI is a joint venture between General Motors and Toyota Motor Corporation.

Although the port has a significant intermodal facility on site, most shipments enter and exit the port by truck. Ninety percent of imported products are shipped inland by truck, indicating that goods are largely destined for locations within 700 miles of Oakland. As is the case with the Ports of Los Angeles and Long Beach, a major metropolitan area lies between the port and the origin or destination of most shipments. Consequently, pollution and congestion on local highways are increasingly problematic. Two potential solutions to crowding have been suggested by the port management. The first involves transporting containers by barge to or from the Stockton area for further distribution. The second is to implement short-haul rail service between the port and an inland distribution center. Desirable locations for an inland port are somewhere in the Central Valley between Stockton and Fresno. Such an inland port would dramatically reduce truck traffic in the broader Oakland region.

More immediate opportunities for the port, however, lie entirely within its gates. These include dredging, expanding landside space, and updating existing facilities. A dredging project in progress will deepen the shipping channel to just over 50 feet. This depth is necessary to make the port accessible to the latest generation of shipping vessels. The opportunities for expanding existing land space are limited at the Port of Oakland. The port is in the process of turning the former Oakland army base into useful space, but further expansion is severely limited, primarily by I-880, which delineates the eastern boundary of the port. Updating these facilities takes other forms as well: One wharf is supported by wood beams, which are neither practical nor environmentally sound, and other wharves lack the technology to make efficient use of the available land.

The Port of Hueneme is considerably smaller than its nearby cousins to the south. Its low volume is primarily due to the commodities it handles. A so-called "niche" port, Hueneme primarily handles five products: citrus and collectible automobiles exports and banana, pineapple, and automobile imports. Hueneme is the most active California port for shipping automobiles, including those produced by BMW, Jaguar, Land Rover, and Mazda. Despite its relatively modest and highly constrained size, the Port of Hueneme grew rapidly during the 1990s, almost tripling both the value and weight of cargo handled between 1990 and 2001. The value of imports transiting Hueneme, as with that for the ports on San Pedro Bay, vastly exceeds the value of exported products. This imbalance arises primarily from the high value of imported automobiles relative to the low value of exported citrus products.

Unlike the larger ports on San Pedro and San Francisco Bays, however, Port Hueneme is significantly more constrained inside the fence than out. Although located on a sizeable inlet, the port shares the available wharf space with the Port Hueneme Navy base. However, the prospects for expansion are favorable, given a new round of base relocation and conversion (BRAC) negotiations to be launched by the federal government next year. The wharfage provided by the base is underused, so some handover to the port seems likely. Congestion outside the port is much less pressing. Relatively low volumes move through the port, the neighboring urban area is small, and the movement of goods by truck and rail to major transit routes is generally unobstructed.

A significant project currently under way will improve the intermodal land access between the port and major transportation arteries. This $88.4 million access project has been partially completed with over $44 million in state, local, and federal formula funds provided under both the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Transportation Equity Act for the 21st Century (TEA-21). Following the completion of this project, other needs remain, including the construction of an on-dock intermodal rail yard, the widening of some local roads, and a grade separation for improved rail and truck freight movement.

The depth of the channel is currently 35 feet, which significantly limits the size of vessels that call on the port. Only refrigerated vessels, ro-ros, and first- and second-generation container vessels are within this range. Dredging could expand the fleet of ships that could access Hueneme, and the port has recently purchased its first container crane. Unlike many major ports, the inlet is not at the mouth of a river, reducing the need for regular dredging.

The remaining seaports collectively handle trade valued at about 10 percent of either of the San Pedro Bay ports. Approximately 36 percent of this trade is with Japan. Imports are highly concentrated in the motor vehicles and equipment category in addition to crude petroleum and natural gas. Exports consist of a wide variety of products, with no one category standing out. As is the case with most California ports, exports are far outpaced by imports, both by value and by volume.

Land Gateways

California has four significant international land border crossings. They are, from west to east, San Ysidro, Otay Mesa, Tecate, and Calexico. Of these, San Ysidro accommodates the smallest volume of trade and Otay Mesa and Calexico handle the largest volume (Table 2.3). The largest California land gateway, Otay Mesa Station, ranks sixth in the country, well behind the major access points to Canada (Detroit, Port Huron, and Buffalo) and to Mexico (Laredo and El Paso). Of the

Table 2.3

Top 25 Land Ports for North American Merchandise Trade, 2002

Rank, by Value	Land Ports	Value (billion $)
1	Detroit, MI	100.8
2	Laredo, TX	79.3
3	Port Huron, MI	57.4
4	Buffalo-Niagara Falls, NY	55.1
5	El Paso, TX	38.5
6	**Otay Mesa Station, CA**	20.4
7	Champlain-Rouses Pt., NY	14.8
8	Hildago, TX	12.7
9	Blaine, WA	11.4
10	Nogales, AZ	10.8
11	Alexandria Bay, NY	10.7
12	Brownsville-Cameron, TX	10.3
13	Pembina, ND	8.7
14	**Calexico-East, CA**	8.4
15	Sweetgrass, MT	7.5
16	Eagle Pass, TX	6.1
17	Portal, ND	6
18	Highgate Springs-Alburg, VT	4.7
19	Int. Falls-Ranier, MN	4.5
20	Eastport, ID	4.2
21	Chicago, IL (customs district)[a]	2.9
22	Calais, ME	2.7
23	Del Rio, TX	2.7
24	Great Falls, MT	2.3
25	Burlington, VT	2.1
	Total, top 25 land ports	485
	U.S. North American trade	539.6

SOURCE: U.S. Department of Transportation, *Transborder Surface Freight Database* (2002).

[a]Nonborder ports with low activity are combined at their parent customs district.

$541 billion of international trade that passed through a U.S. land border in 2002, only $29 billion made use of California's gateways.

Although it seems that California would have a natural advantage for Mexican trade, a large fraction of this trade takes place through Texas. This is likely because these goods are bound for the Midwest or Eastern states, and Texas presents the more direct routing. It is also the case that the primary port of embarkation for Mexican exports to Asia is Houston, not Los Angeles. The infrastructure for delivery to Houston from much of Mexico is more advanced than it is south of the California border.

Table 2.4 further sorts land access into truck and rail traffic.[5] Nearly all the flows transiting to and from Mexico come via truck. Unlike air and ocean modes, and to a lesser degree rail, trucking does not exhibit the same degree of geographic concentration. Air, sea, and rail require substantial infrastructure and are therefore arranged around central hubs. Hubs are important because they attract ancillary industries, such as warehousing, as well as manufacturers seeking easy access to the hub. In contrast, trucking takes place on a far smaller scale, allowing greater dispersion of ancillary industries and manufacturing. In short, California ranks low as a truck gateway to Mexico, but truck gateways are far less important than air and ocean gateways as generators of spillover benefits.

Trucking far outweighs rail at California's land gateways, but this is not because there are no significant congestion issues: quite the contrary. Otay Mesa, the largest truck gateway, has almost legendary congestion issues, with trucks sitting idle for the better part of a day on some occasions. This congestion goes both ways, north and south, as many empty containers return to Mexico for another load. Calexico suffers from similar problems but to a lesser degree.

Goods transiting U.S. land borders by rail are far outnumbered by those carried by truck, and this is especially true for goods passing through California's land gateways. Less than one-fifth of 1 percent of all rail-based land trade across U.S. borders occurs in California. Further, less than 1 percent of U.S. land trade by rail with Mexico occurs at a California gateway. Although this small fraction currently has as much to do with infrastructure investments deep in Mexico as it does with constraints at the border, rail infrastructure at the border is in need of significant improvement. In particular, the primary rail line through San Ysidro flows directly through downtown San Diego, slowing progress significantly.

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[5]Trade does flow through land gateways via other modes of transportation, for example, pipeline. However, this flow is less than 10 percent of all U.S. land-based trade and accounts for only trace amounts of trade through California's land gateways.

Table 2.4

California and Top Five Land Ports for North American Merchandise Trade by Truck and Rail, 2002

Rank in 2002	U.S. Port	Annual Trade Value (million $)	Value per Day (million $)	Annual Incoming Truck Crossings or Rail Containers	Truck Crossings or Rail Container/ Entries per Day
			Truck		
	U.S. North American trade	397,763	1,090	11,342,566	31,076
1	Detroit, MI	85,062	233	1,670,565	4,577
2	Laredo, TX	55,801	153	807,291	2,212
3	Buffalo-Niagara Falls, NY	43,732	120	1,208,095	3,310
4	El Paso, TX	35,094	96	705,199	1,932
5	Port Huron, MI	32,876	90	907,729	2,487
6	**Otay Mesa Station, CA**	**20,368**	**56**	**731,291**	**2,004**
13	**Calexico, CA**	**8,281**	**23**	**276,390**	**757**
28	**Tecate, CA**	**950**	**3**	**57,655**	**158**
			Rail		
	U.S. North American trade	91,875	252	2,427,298	6,650
1	Laredo, TX	23,265	64	296,782	813
2	Port Huron, MI	22,376	61	424,635	1,163
3	Detroit, MI	15,607	43	293,300	804
4	Buffalo-Niagara Falls, NY	8,786	24	149,359	409
5	Int. Falls-Ranier, MN	4,093	11	238,515	653
23	**Calexico, CA**	**128**	**0**	**5,549**	**15**
25	**San Ysidro, CA**	**66**	**0**	**3,548**	**10**
104	**Tecate, CA**	**(a)**	**0**	**1,635**[b]	**4**

SOURCES: Trade value data are from U.S. Department of Transportation, *Transborder Surface Freight Database* (2002). Crossings data are from U.S. Department of Transportation, *Border Crossings Data* (2002).

NOTE: Nonborder ports with low activity are combined at their parent customs district.

[a]Value is less than $500,000.

[b]Does not include empty containers.

3. California as an Entrepôt

The previous chapter explored the flows of internationally traded goods through California's gateways. Some of these flows come from California itself, which is both a significant source of U.S. exports and a consumer of imports. Of course, inland states wishing to import or export via ocean vessels must first send goods through coastal states to reach ports. Trade flows involving inland states represent a significant portion of the cargo handled in California's gateways. Over half the cargo moving through the Ports of Los Angeles and Long Beach is either destined for, or originates in, other parts of the country. This makes California a kind of international trade entrepôt, or distribution center, for other states.

California's entrepôt status generates economic benefits and costs. The benefits take the form of direct employment in the transportation sector as well as indirect employment in ancillary industries and manufacturing supported by the ports. The costs involve the provision and maintenance of transportation infrastructure, congestion, and pollution. User fees and federal funding offset some of the infrastructure costs, but congestion and pollution costs are largely uncompensated.

Of course, some internationally traded goods produced and consumed in California are shipped through other states as well. As surely as trade through California burdens residents here, California's trade through other states imposes a burden on others. This chapter provides an accounting of the shipping services surplus or deficit between California and the other states in the continental United States.[1]

A "shipping services surplus" measures the extent to which one state provides more shipping services to another state than it receives in return.

[1]This chapter is drawn from Haveman (2003b), which includes detailed methodological notes, data sources, breakdowns by industrial sector, and complete tables by state.

The tabulation of this surplus considers both imports and exports, implying four components to the calculation. From California's perspective, these components include

- Exports flowing through California that originate in some other state,
- Exports flowing out of California but leaving U.S. shores from a portal in another state,
- Imports arriving in California that are ultimately destined for use in another state, and
- Imports destined for use in California but that first arrived on U.S. shores in another state.

This calculation omits both California exports that go abroad without traveling through another state and imports into California that are absorbed by consumers and producers in California.

In what follows, we present an overview of California's international freight-related shipping services balance. This overview is followed by separate presentations of the contribution of exports and imports to the services balance. In each case, we present evidence on the balance by value and weight. The balance by value indicates the level of economic activity that is supported by this trade, whereas the balance by weight is a better indicator of the actual burden placed on infrastructure resources.

Overall Shipping Services Balance

In 2000, $297.4 billion worth of traded goods entered California with an ultimate source or destination outside the state. This figure represents some 111 billion kilograms, or approximately 3.2 percent of the weight of all freight shipped through the state. When California's trade through other states is factored in, California's gateways handled some $177 billion worth of goods weighing in at over 32 billion kilograms in excess of what Californians demand from other states (Table 3.1). The majority of this shipping surplus arose from the transshipment of imported products. Almost 90 percent, or $156 billion, of the $177 billion surplus came from imports. By weight, imported products account for two-thirds, or 22 billion kilograms, of the 32 billion kilogram imbalance.

Table 3.1

California's Aggregate International Trade-Related Shipping Services Surplus, 2000

	Shipments for California Through Other States[a]	Shipments for Other States Through California[b]	Shipping Services Surplus
	Billion dollars		
Exports	29.1	49.4	20.3
Imports	91.8	248.0	156.2
Total	120.9	297.4	176.5
	Billion kg		
Exports	9.9	20.5	10.6
Imports	68.2	90.0	21.8
Total	78.1	110.5	32.4

[a]These figures include both imports for Californians that arrive on U.S. shores in other states and California exports that depart from U.S. shores via port facilities in other states.

[b]Similarly, the figures in this column also account for both imports arriving in California and exports departing through California ports.

To put this surplus in perspective, we compare the flows presented above to total freight shipments in California. From U.S. Department of Transportation (2002a), we are able to generate figures for both the total value and weight of all freight shipments making use of California's infrastructure. The data there indicate total shipments originating in and destined for California in 1997. These figures are not directly comparable to those in Table 3.1, which are for 2000. Instead, we assume that freight shipments involving California grew at the same rate as gross state product for the United States as a whole between 1997 and 2000. After making this adjustment, we estimate that total freight shipments through California totaled $1,908 billion and weighed a total of 1,757 billion kilograms. Accordingly, the shipping services surplus for California amounted to 9.3 percent of the total value and 1.8 percent of the weight of all goods placing demand on California's infrastructure.

Servicing this traffic is costly to California, particularly when the modes of transportation employed are financed in large part from state

Table 3.2

Shipping Services, by Mode of Transportation

	By Value (million $)			By Weight (million kg)		
Mode	Shipments for California Through Other States	Shipments for Other States Through California	Shipping Services Surplus	Shipments for California Through Other States	Shipments for Other States Through California	Shipping Services Surplus
Total	121,021	297,509	176,488	78,097	110,537	32,440
Air	6,337	16,006	9,669	4	12	8
Rail	5,899	9,554	3,655	3,816	3,147	–669
Truck	81,607	201,985	120,378	73,116	106,151	33,035
Parcel	17,600	50,192	32,592	68	200	132
Water	1,176	1,451	275	425	397	–28
Pipeline	695	714	19	246	216	–30
Rail and water	59	37	–22	56	34	–22
Truck and rail	1,584	3,263	1,679	7	12	5
Truck and water	65	121	56	0	0	0
Other multiple mode	11	12	1	0	0	0
Other unknown	5,988	14,173	8,185	358	369	11

resources. Table 3.2 presents a decomposition of the surplus by mode of transportation. Both by value and by weight, the majority of the surplus is shipped by truck. Trucking is likely to be the most costly form of transport for a state to bear, given that it is the most heavily supported by state resources.[2] A larger proportion of air transportation infrastructure is borne by the federal government, and the rail system is largely privately owned and operated. Likewise, the costs of intrastate transportation by water are largely borne by those engaged in the activity rather than by the state. Given the composition of the shipping surplus by mode, this service to other states is likely to be very costly for California.

All states are not uniformly engaged in international trade, and it is therefore helpful to assess the sources of the imbalance on a state-by-state basis. Table 3.3 lists the states with which California has the largest surpluses and deficits, by weight. In all, there are 38 states with which California maintains a surplus. This surplus is particularly significant for five states: Ohio, North Carolina, New Jersey, Illinois, and Indiana. The imbalances with these states are largely the result of an imbalance with respect to imports. Three of these are large inland states, and the flow of imports that enter through California and find their way to these states is substantial. Conversely, both the value and weight of imports that are used by California that first arrive in these states are very small.

California runs a deficit with the remaining ten states in the continental United States. The deficits with two states in particular are sizable. Louisiana and New York combined account for almost 14 billion kilograms of deficit, implying that they service substantially more trade for California than California services for them. These states both receive significant volumes of imports, which is the driving force behind this imbalance.

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[2]U.S. Department of Transportation, *Government Transportation Financial Statistics 2001* (2001), provides great detail on transportation expenditures by mode and by state. On a ton-mile basis, trucking received 200 times the government expenditures than did rail. Data on relative expenditures for the other modes are much more difficult to come by. By ton shipped, highway expenditures were five times those for water transportation. A comparison by air is complicated by expenditures on passenger travel facilities.

Table 3.3

Selected Shipping Services Balances, by State

State	By Value (million $)			By Weight (million kg)		
	Shipments for California Through Other States	Shipments for Other States Through California	Shipping Services Surplus	Shipments for California Through Other States	Shipments for Other States Through California	Shipping Services Surplus
Total	121,021	297,509	176,488	78,097	110,537	32,440
Ohio	5,574	14,362	8,788	1,012	5,315	4,302
North Carolina	324	9,238	8,914	254	3,933	3,679
New Jersey	1,231	9,850	8,619	626	3,844	3,218
Illinois	4,699	16,192	11,493	2,282	5,285	3,002
Indiana	615	8,489	7,873	100	3,081	2,981
Montana	1,075	568	–507	1,509	292	–1,217
Michigan	14,726	14,504	–221	6,085	4,675	–1,410
Washington	9,331	7,060	–2,271	5,197	2,502	–2,695
Texas	19,502	30,718	11,217	15,472	12,733	–2,739
Louisiana	7,959	4,323	–3,636	8,955	3,134	–5,821
New York	26,989	21,091	–5,898	14,777	6,675	–8,102

To shed additional light on these patterns, we decompose the shipments into their export and import components. In each case, the state-to-state relationships are disaggregated by mode of transport.

Exports

This section discusses the extent to which California provides more in the way of export transportation services to other states than it requires in return. This exercise takes into account both goods exported by other states through California and goods exported by California through other states. In fact, a significant proportion of California's exports do not flow directly through a California port. Approximately one-quarter of California's 2001 exports, by value, left U.S. soil by way of a port in some other state.

California is running a significant trade surplus, both by weight and by value, in the provision of export freight transportation services (Table 3.4). On a value basis, exports account for only 12 percent of the total trade shipping surplus, and almost a third of the weight-based surplus.

By value, more than $20 billion more exports flow through California on their way to foreign shores than California ships through other states.[3] Given California's position on the West Coast of the

Table 3.4

California's Export Shipping Trade Balance

	California's Exports Through Other States	Other States' Exports Through California	California's Shipping Surplus
By value (billion $)	29.1	49.4	20.3
By weight (billion kg)	9.9	20.5	10.6

[3]This number may actually understate California's surplus. These statistics are based on a series maintained by the Census Bureau that is referred to as the Origin of Movement series. This series records the location where goods started their export journey, which is often not the same as where they were produced. There is a tendency for shipments to be attributed to California when in fact the goods were manufactured in other states. The same problem arises when calculating the value of California's exports through other states. However, if the same proportion of goods is misclassified regardless of state of origin, the figures for California are understated by a smaller amount than are the figures for other U.S. exports through California and the surplus is understated.

United States, this result is not surprising. Regardless of their state of origin, most goods destined for Asia or the South Pacific by ship will travel through California. According to the U.S. Department of Transportation (2002b), the $49 billion figure represents approximately 16 percent of all goods shipped to California from other states. Reflecting this significant excess of goods flowing through California over those shipped by California through other states, the surplus is almost 11 billion kilograms by weight.

Table 3.5 provides detail on California's export shipping surplus by mode of transportation. Of a shipping surplus in excess of $20 billion, just under three-quarters is accounted for by truck, the mode that imposes the greatest cost on a hosting state. Parcel mode is a distant second, followed by air and rail.[4] Other modes, or mode combinations, are rare relative to those four, with correspondingly small trade balances, but all are nonetheless positive. This is also true on a weight basis, with trucking accounting for more than 95 percent of the surplus.

California is a net provider of shipping services to exporters in 39 of the 48 continental states, and the surplus is distributed quite evenly across them. In fact, California runs a trade surplus of over $1 billion with only one state (Texas) and a deficit of the same size with only one other (Louisiana). Table 3.6 presents greater detail on California's state-to-state export freight balances for those states with the largest surpluses and deficits. By far, the largest amount of state-to-state export swapping is undertaken with Texas. Total export flows between the two states amount to almost $14 billion. Texas is also the state to which California is the largest net provider of export shipping services. The excess of Texas's exports through California over California's exports through Texas accounts for one-third of California's surplus by value and almost one-quarter of the surplus by weight, more than twice as much as any other state.

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[4]Goods shipped by parcel also travel by truck, air, and rail. As such, the other categories are to some extent understated.

Table 3.5

Export Balance, by Mode

	By Value (million $)			By Weight (million kg)		
Mode	Shipments for California Through Other States	Shipments for Other States Through California	Shipping Services Surplus	Shipments for California Through Other States	Shipments for Other States Through California	Shipping Services Surplus
Total	29,185	49,492	20,308	9,898	20,490	10,592
Air	1,690	2,647	957	1	2	1
Rail	943	1,898	955	263	752	489
Truck	19,249	33,318	14,069	9,475	19,470	9,995
Parcel	5,264	8,142	2,878	20	30	10
Water	226	409	183	70	108	38
Pipeline	85	210	125	28	49	20
Rail and water	2	6	5	1	6	5
Truck and rail	306	529	223	1	2	1
Truck and water	15	28	13	0	0	0
Other multiple mode	2	3	2	0	0	0
Other unknown	1,404	2,302	898	39	72	33

Table 3.6

Selected California Export Freight Balances, by State

	By Value (million $)			By Weight (million kg)		
State	Shipments for California Through Other States	Shipments for Other States Through California	Shipping Services Surplus	Shipments for California Through Other States	Shipments for Other States Through California	Shipping Services Surplus
Total	29,185	49,492	20,308	9,898	20,490	10,592
Texas	3,987	9,868	5,881	1,407	3,699	2,291
Oregon	354	2,943	2,589	308	1,153	844
Utah	1	1,200	1,200	0	792	792
Arizona	388	4,761	4,373	84	857	773
Virginia	78	1,154	1,076	46	812	766
North Carolina	36	1,155	1,119	63	821	758
Washington	2,055	988	–1,067	950	420	–530
New York	4,519	1,480	–3,039	1,303	523	–780
Michigan	4,434	1,538	–2,897	1,446	566	–880
Louisiana	4,312	849	–3,463	2,242	962	–1,280

Imports

Imports are the other side of the trade equation, and they are responsible for the majority of California's overall surplus both by value and by weight. In 2000, California was a net provider of shipping services in the amount of $156 billion or almost 22 billion kilograms of imports (Table 3.7). Comparing the import figures by value to shipping data from U.S. Department of Transportation (2002a), the $156 billion in imports handled by California for other states accounts for almost 17 percent of the value but only 3.8 percent of the weight of all goods shipped from California to other states.

As with exports, imports are shipped primarily by truck (Table 3.8). By value, trucking accounts for a little over two-thirds of the shipping services surplus that California holds over other states. By weight, however, trucking makes up the vast majority of imports shipped and is equal to 115 percent of California's import-related shipping services surplus. This surplus in trucking is primarily offset by a deficit in the rail category equal to about 5 percent of the surplus in trucking. Four other categories also have small deficits. Compared to other states' shipments of imported goods, California's imports are more commonly shipped by rail and less commonly shipped by truck.

The distribution of the surplus resulting from the shipment of imported goods is much more even than is the case for exports (Table 3.9). California has a significant surplus with several states and a significant deficit with several others. When the states listed in Table 3.9 are compared to those in Table 3.3, it is clear that the shipment of

Table 3.7

California's Import Shipping Trade Balance

	California's Imports Through Other States	Other States' Imports Through California	California's Trade Surplus
By value (billion $)	91.8	248.0	156.2
By weight (billion kg)	68.2	90.0	21.8

Table 3.8

Import Balance, by Mode

	By Value (million $)			By Weight (million kg)		
Mode	Shipments for California Through Other States	Shipments for Other States Through California	Shipping Services Surplus	Shipments for California Through Other States	Shipments for Other States Through California	Shipping Services Surplus
Total	91,836	248,017	156,180	68,199	90,047	21,848
Air	4,647	13,359	8,711	3	10	6
Rail	4,956	7,656	2,700	3,553	2,395	–1,158
Truck	62,358	168,667	106,309	63,641	86,681	23,040
Parcel	12,336	42,050	29,713	48	170	122
Water	950	1,042	92	355	289	–66
Pipeline	610	504	–106	218	167	–52
Rail and water	57	31	–26	55	28	–26
Truck and rail	1,278	2,734	1,457	6	10	5
Truck and water	50	93	43	0	0	0
Other multiple mode	9	9	0	0	0	0
Other unknown	4,584	11,871	7,287	319	297	–22

Table 3.9

Selected California Import Freight Balances, by State

	By Value (million $)			By Weight (million kg)		
State	Shipments for California Through Other States	Shipments for Other States Through California	Shipping Services Surplus	Shipments for California Through Other States	Shipments for Other States Through California	Shipping Services Surplus
Total	91,836	248,017	156,180	68,199	90,047	21,848
Ohio	1,924	12,721	10,797	470	4,558	4,088
North Carolina	287	8,083	7,795	191	3,112	2,920
New Jersey	961	9,096	8,135	564	3,479	2,914
Indiana	84	7,433	7,349	21	2,705	2,684
Illinois	4,209	13,565	9,357	2,202	4,519	2,317
North Dakota	995	504	–491	1,099	198	–901
Montana	550	537	–12	1,330	256	–1,074
Washington	7,276	6,072	–1,204	4,247	2,082	–2,165
Louisiana	3,647	3,473	–173	6,713	2,173	–4,541
Texas	15,515	20,851	5,336	14,064	9,035	–5,030
New York	22,470	19,611	–2,859	13,473	6,152	–7,322

imports is driving the overall freight shipping balances between California and other states. The same states are listed here as having the largest import freight shipping surplus as were listed in Table 3.3. In addition, five of the six states listed in Table 3.3 are listed here as having the largest freight shipping deficits with California. North Dakota replaces Michigan in this table, indicating that Michigan services a greater volume of exports for California than does North Dakota.

Summary and Discussion

California provides shipping services on $177 billion worth of traded goods for other states in excess of what other states provide for California's international trade activities. Of perhaps greater importance is the finding that, when measured by weight, this surplus amounts to more than 32 billion kilograms of goods shipped via California's transportation facilities. Further, California's highways support a surplus of 33 billion kilograms with other states.

Although both the value and weight of trade with Texas dwarfs the totals of any of California's other bilateral relationships, it is with inland states (such as Ohio, Illinois, and Indiana) that California has a significant shipping surplus. These large states have important industrial sectors and demand significant quantities of imports, much of which enter the United States through ports in California. The surplus is large because none of these states is likely to be the first point of contact for imports to California or the point of departure for exports from California.

By value and weight, imports contributed the most significantly to the surplus. This surplus, along with the fact that most intracontinental shipping takes place on highways, is very important for California. The provision of infrastructure for trucking is, by a significant margin, the most costly in terms of wear and tear on California's infrastructure investments. It is also very costly in terms of the pollution and congestion problems plaguing much of California. Although this surplus represents a relatively small share (1.8 percent by weight) of all shipping that takes place in California, it is highly concentrated on a small number of very important highways. The fact that San Pedro Bay lies on the other side of a vast metropolis from the source or destination of these goods is especially relevant. The contribution of traded goods to the congestion and pollution problems of the Los Angeles area are significant; the horror stories of congestion on I-710, in particular, are well known throughout the Los Angeles region.[5]

Despite these congestion costs, playing the part of an entrepôt for other states is a mixed bag for California. There are certainly positive elements of the role in the form of greater demand for services provided by Californians. This demand then results in more jobs and tax revenues for the state. At the same time, however, the flow of traded goods through the state imposes an uncompensated burden on the state's residents. Although this discussion is relevant for many states, including inland states through which many traded goods flow, it is decidedly more important for California and other states possessing significant global gateways.

In excess of 10 billion kilograms of exports and 20 billion kilograms of imports travel on a select number of California's highways in excess of what California ships on the highways of other states. Although there are benefits and costs to providing these services, it is reasonably clear that there are uncompensated costs for the state. The total cost of moving goods through Southern California includes the cost of labor and other compensable services provided, in addition to the cost of pollution, congestion, and deterioration of the highways. The benefits, jobs, business profits, and tax revenue are derived from fees paid by shippers for services. The costs of providing this service, then, exceed the benefits received, as pollution, congestion, and highway wear and tear remain uncompensated.

This imbalance between benefits and costs represents a subsidy from the state of California to producers and consumers in other states. This subsidy, when applied to exports, makes it less expensive for producers in other states to make their product available for sale in foreign markets, potentially disadvantaging California producers exporting to those same markets. When applied to imports, this subsidy reduces either the cost

[5]Approximately 30 percent of the goods arriving at the Ports of Los Angeles and Long Beach now exits the area by way of the Alameda Corridor, which leaves these goods just east of downtown Los Angeles. These goods must still travel by rail through much of the Los Angeles metropolitan region.

to individuals in their consumption of imports or the cost to producers of obtaining intermediate inputs for the production of some good. By artificially lowering the costs of production in other states relative to the costs for California producers, the subsidization of imports is even more likely to disadvantage California producers as it affects competition in domestic markets rather than abroad.

The extent to which the subsidization of imports or exports affects the competitive dynamics between firms depends on the size of the subsidy and the extent to which it is concentrated in specific industries. If it is widely dispersed across industries in other states, then the burden borne by California producers is likely to be small. The overall size of the subsidy, however, is likely to be large and unrelated to its concentration across industries.

In principle, federal highway funds could be used to offset a portion of this subsidy, but federal formulas for the disbursal of those funds do not sufficiently account for the burden of goods movement in allocating these funds across states.[6] Solutions to the burden imposed by pollution and congestion are less clear. Although some form of user fee could be imposed to solve the problem, such fees are historically very difficult to implement politically. Although both of these measures have received some attention, it appears likely that California will have to continue to bear this burden for the foreseeable future.

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[6]See Ransdell and Boloorian (2003) for more on these formulas.

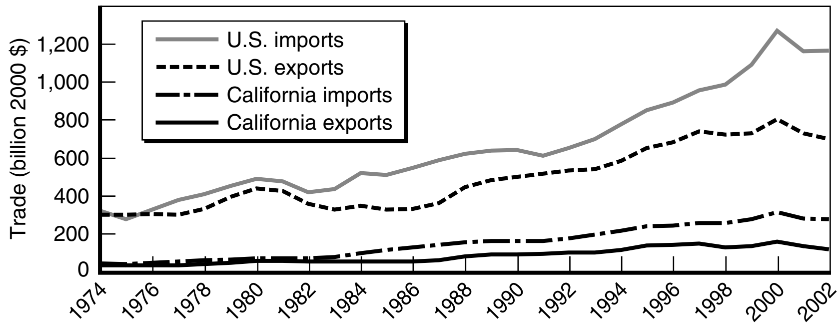
4. U.S. Trade Trends

Because international trade flows determine the demand for services at California's numerous trade gateways, familiarity with trends in this area is critical for thinking about California's trade infrastructure issues. This chapter describes trade trends for California and the United States as a whole, paying particular attention to trade growth and its composition across products, partner countries, and transport modes. Along the way, it emphasizes the implications of these trends for transportation demand and provides important background for the discussion and analysis in subsequent chapters.

U.S. Trade Growth

In the last three decades of the 20th century, international trade grew rapidly. Between 1974 and 2000, U.S. imports by value quadrupled and exports more than doubled. After accelerating in the 1990s, however, trade growth came to an abrupt halt in 2000 (Figure 4.1).

The lower series in Figure 4.1 show the portion of aggregate trade that flowed through California's gateways. From 1974 to its peak in 2000, trade through California grew from $71 billion to just over $460 billion, or nearly one-quarter of all U.S. trade. The rate of increase in imports through California was much more rapid than that of the United States as a whole. By 2000, imports entering California represented a quarter of the U.S. total, increasing particularly quickly between the mid-1980s and the mid-1990s. Exports departing from California also increased faster than those of the United States as a whole, but again, not as rapidly as imports. The trade imbalance we see in the U.S. data is mirrored in the California data, with imports exceeding exports by some $155 billion in 2000. A striking observation from this chart is the faster growth of aggregate U.S. imports relative to imports through California in the late 1990s. As we will see in the next chapter,



SOURCES: Council of Economic Advisers (2003); U.S. Census Bureau, *U.S. Exports/ Imports of Merchandise*.

Figure 4.1—Growth in Real U.S. Imports and Exports[1]

this is a result of air trade being diverted away from California's airports resulting in slower growth through these gateways.

During the period depicted in Figure 4.1, U.S. trade flows grew more rapidly than did U.S. gross domestic product. This means that increased trade flows were not directly attributable to increased incomes in the United States. This trade growth has three primary explanations: growth in world income, reductions in tariffs, and improvements in communications and transportation technology. During the 1970s and 1980s, growth outside the United States, and in Asia in particular, exceeded U.S. growth. Although an expansion in world income does not appear to have been a significant driving force behind this growth, trade growth through California between 1985 and 1995 coincided with rapid growth in Asia, a primary source of trade through California's gateways.

Tariffs, or import taxes, raise the cost of imported goods relative to those produced domestically. Historically, tariffs have been an important political barrier to international trade, with U.S. tariff rates as high as 60 percent before World War II. In the postwar era, successive rounds of negotiations through the General Agreement on Trade and Tariffs (GATT), now the World Trade Organization (WTO), have whittled tariffs down to very low levels. U.S. tariffs currently average 1.9 percent.

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[1]The import and export value data presented in this report are all presented in constant 2002 dollars. The gross domestic product implicit price index was used as a deflator.

Tariffs in other countries have a similar history, with very high tariffs early in the last century and steady postwar declines. In 1974, tariffs in the major industrial countries averaged 7.1 percent; today, they are less than 2 percent. As the vast majority of U.S. trade is with other industrialized nations, these are the tariffs that shape U.S. trade flows most directly. Average tariffs for all U.S. trading partners are now 3 percent.

Obviously, the actual distance between countries never changes, but improvements in transportation and communications technology reduce the effective distance between them. It is well known how recent changes in communications technology have substantially eased worldwide information exchange. However, these are just the most recent in a long line of innovations with similar effects. On the transportation side, changes in technology and scale have been critical. Two technological changes stand out. The first was the adoption of jet engines in the 1960s, which increased the carrying capacity, range, and speed of commercial aircraft. The second was "unitized" cargo, in which a single storage container is packed once and then moved intact from one mode to the next. This saves considerably on loading and unloading expenses and eases the movement of cargo between modes. Some unitization has occurred with air cargo, but most of the real efficiencies have been in maritime transport with the use of standardized containers and container ships.

Trade growth depends on the costs of transportation, which in turn depend on growth in trade. That is, transport costs can rise when trade grows and key transportation inputs are scarce. At the same time, however, larger trade flows allow the use of technologies that would be too costly with smaller volumes. In particular, the size and technological sophistication of the vessels committed to a particular trade route can be easily adjusted as trade grows. This means that densely traded shipping routes can handle large volumes without encountering a shortage of shipping capacity. In fact, there is some evidence for substantial scale benefits in higher volumes. The source of these scale benefits lies in ship scheduling, technology adoption, and pro-competitive effects on prices. The capacity of a modern ocean-going liner is large relative to the quantities that an exporter has available to ship at any given time. Shipping companies can respond either by visiting ports less frequently or by stopping at dozens of ports in many different countries. On more heavily traded routes, liners can take more direct routes with fewer port calls, visit each port more frequently, and more effectively exploit hub and spoke shipping economies.

The efficient movement of some goods also requires specialized vessels. Examples include ships specialized to move bulk commodities, petroleum products, refrigerated produce, and automobiles. Increased quantities allow introduction of these specialized ships along a route. Similarly, larger ships will be introduced on heavily traded routes, and these ships enjoy substantial cost savings relative to older smaller models still in use. (One source of scale advantage is in crew costs, which are roughly independent of ship size.)

Commodity Composition of U.S. Trade

An additional trend that has contributed to trade growth has to do with the composition of commodities commonly traded. Table 4.1 shows the share of trade by broad commodity classification for the United States and the world as a whole. The trade shares of chemicals, machinery and transportation, and miscellaneous manufactures have risen substantially, whereas trade shares of bulk commodities, including agriculture and mining, have fallen dramatically.[2]

A result of this compositional shift can be seen in Figure 4.2, which displays the average price per kilogram of goods shipped through California and through the United States as a whole. Trade by weight has grown but much more slowly than trade by value. In other words, trade is growing "lighter." A (real) dollar of U.S. trade in 1974 weighed just over 4.4 kilograms; that same dollar of trade today weighs less than one kilogram.

Two differences between the price of all U.S. trade and the price of goods flowing through California are notable. First, the value per kilogram is between two and four times higher for California's trade than for U.S. trade as a whole throughout the period. This reflects the fact that California's trade is much less oriented toward bulk commodities than is trade through the East and Gulf Coasts. Second, the average price

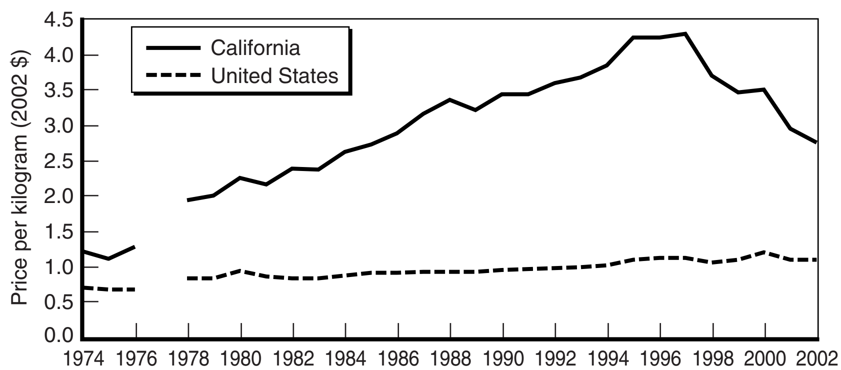
[2]Import shares of beverages and tobacco also increased during this period, but their share of trade is so small that its effect on infrastructure demand is negligible.

Table 4.1

The Commodity Composition of U.S. and World Imports

	U.S. Imports			World Imports		
Commodity	1974	1997	% Change 1974–1997	1974	1997	% Change 1974–1997
Food and live animals	10.0	6.5	–35.6	9.3	3.7	–60.0
Beverages and tobacco	0.9	1.1	14.0	1.2	0.8	–27.9
Crude materials	7.9	3.6	–54.3	5.8	2.6	–55.6
Mineral fuels	19.3	7.5	–61.1	25.2	8.2	–67.5
Animal and vegetable oils	0.8	0.5	–45.5	0.5	0.2	–65.8
Chemicals	7.6	8.9	18.2	3.9	5.9	53.5
Manufactures (by material)	18.3	14.9	–18.4	18.1	11.1	–38.6
Machinery and transport equipment	23.2	38.7	66.8	25.2	45.4	80.4
Miscellaneous manufactures	7.1	13.1	85.2	8.7	17.2	96.9

SOURCE: Statistics Canada bilateral trade database.



SOURCE: U.S. Census Bureau, *U.S. Exports/Imports of Merchandise*.

Figure 4.2—Average Price of Traded Goods Shipped by Air and Vessel

per kilogram of U.S. trade grew steadily throughout the period, whereas the price per kilogram for California rose more sharply, peaked in 1997, and has dropped sharply since. The sharper rise and fall for California closely reflects trends in air cargo through California.[3] Goods that are air-

[3]The causes of this sharp change are further discussed in Chapter 5.

shipped have, on average, a much higher price per kilogram than those ocean-shipped. As a consequence, rises and falls in the air share of trade lead to increases and decreases in the price per kilogram shipped.

The lightening of trade has three interesting implications. First, the growth of trade by value significantly overstates demand for freight services. When imports by value were increasing fourfold, freight demand in weight terms only doubled. Second, as trade gets lighter, demand for air relative to ocean-shipping grows, largely because the cost of air-shipping a kilogram is much higher than that for ocean-shipping. Goods with very high weight-to-value ratios (notably bulk commodities, such as grains, iron ore, and scrap metal) are invariably shipped via ocean vessel because it is less expensive to do so. As traded goods become lighter, air cargo becomes a feasible alternative for a growing fraction of traded goods.

Third, the ad valorem cost of shipping (i.e., the cost of shipping a good measured relative to that good's value) drops as traded goods get lighter. To illustrate this, a kilogram of computer memory chips is much more valuable than a kilogram of scrap metal, but the shipping price per kilogram is roughly the same for the two. Because the foreign demand for traded goods depends on their price inclusive of ad valorem costs, reductions in the per unit weight of traded goods lead to an expansion in the value of trade.

This last point has interesting implications for the pricing power of shipping firms and ports. Consumers do not value transportation directly; rather, they value it only as part of a process of accessing internationally traded goods. Put another way, consumers are sensitive to changes in the delivered price of products, not to changes in the transportation price. When goods get lighter, the contribution of transport costs to the delivered price of the product falls. As a result, consumers become less sensitive to changes in transport prices. This gives shipping firms and ports more pricing power. The diminishing effect of transportation costs on the final product price also means that decisions about modal use and port choice are increasingly driven by such factors as timeliness or reliability.

Regional Orientation of U.S. Trade

Changes in the regional orientation of U.S. trade can also have important consequences for global gateways and their infrastructure needs. U.S. trade is roughly split into thirds between Asia, North America, and all others combined. This composition represents a substantial westward shift in trade orientation. Between 1970 and 2002, imports from Asia increased from 8 percent to 36.9 percent of total U.S. imports, and U.S. exports to Asia rose from 8 percent to 25.7 percent of the total. North American trade has also seen substantial growth. Between 1989 and 2002, trade with Mexico and Canada grew from 25 percent to 33 percent of total U.S. trade.

When the orientation of U.S. trade shifts from one continent to another, there can be substantial consequences for cargo-shipping services on one coast relative to another. To illustrate these points, Table 4.2 reports the major U.S. coast that serves as the origin of or destination for U.S. trade with each continent. It also reports the share of vessel trade and air trade accounted for by the major destination.

In each case, the main entry/exit point for U.S. trade depends primarily on geographic proximity. Cargo ships and planes take direct routes whenever possible: Countries bordering the Pacific will naturally

Table 4.2

Continental Patterns of U.S. Trade Flows, 2002

	Continental Shares of U.S. Trade Flows (%)			Value of Shipments Through California's Gateways (billion $)		
Continent	Nearest U.S. Coast	Vessel Share	Air Share	Air	Vessel	Other
Africa	East	95	81	0.4	1.0	0.0
Asia	West	73	52	85.5	204.3	1.8
Europe	East	88	67	20.6	14.5	0.4
Latin America	East	96	88	0.3	1.2	0.0
Middle East	East	88	82	1.5	3.6	0.0
North America	East	87	44	2.5	1.6	30.2
Oceania	West	57	55	3.1	6.4	0.4
South America	East	93	85	1.0	3.4	0.0
Total				114.9	236.0	32.8

SOURCE: U.S. Census Bureau, *U.S. Exports/Imports of Merchandise.*

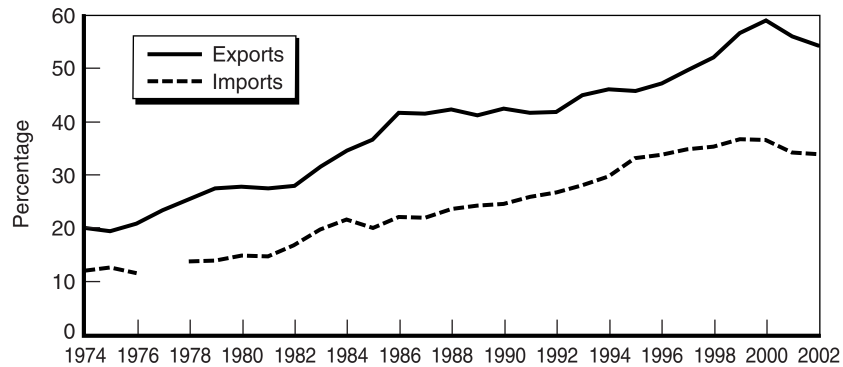
move goods through the West Coast; countries bordering the Atlantic will use either the East or Gulf Coasts; Mexico and Canada route land trade through bordering states. Of course, air cargo can overfly coasts; in Table 4.2 we see that the majority of air cargo enters through the nearest coast, but the share of the nearest coast is much smaller than that for ocean-shipping. As air cargo grows in importance, the grip of geography begins to loosen. As we discuss below, flights originating in Asia that overfly California have substantially grown in importance.

Finally, Table 4.2 also shows the value of U.S. trade with each region that flows through California. In much of the past 30 years, the natural linkage to Asia has been good news for West Coast ports in general and California in particular. Asian countries have enjoyed unparalleled economic dynamism, with growth spurred by an unusually high degree of trade orientation. Looking forward, output growth in China and India, combined with their enormous populations, promises to spur continued trade with West Coast gateways.

This high degree of regional dependence has two drawbacks. First, lacking geographic diversification, California's gateways can be hit hard by regional downturns. One prominent example is the East Asian crisis of the last 1990s. As Figure 4.1 showed, exports through California stagnated after 1997. Second, the recent trend in tariff liberalization has been toward regional rather than worldwide integration. North American Free Trade Agreement (NAFTA) tariff reductions in particular have caused a shift in U.S. trade toward North America, most of which enters through gateways outside California.

Modal Composition of U.S.Trade

Finally, we describe modal trends in how goods move. In our discussion, we address North American trade in addition to U.S. trade as a whole, as the former is dominated by ground-shipping and the latter by air and ocean modes. We have seen two important patterns outside North America in modal choice by value. The first is a tremendous shift toward air-shipping (Figure 4.3). Over a third of imports are shipped by air, a steady increase from 11 percent in 1974. More than 54 percent of exports were air-shipped, up from 20 percent in 1974. The second broad pattern is that the use of air-shipping differs substantially across

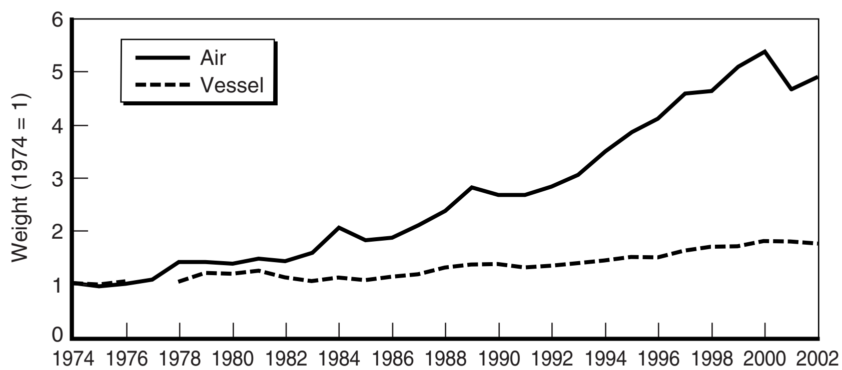


SOURCE: U.S. Census Bureau, *U.S. Exports/Imports of Merchandise*.

Figure 4.3—Share of Shipments by Air (World)

geographic origin and destination. Trade with Asia and Europe goes via air to a much greater extent than trade with Latin America, Africa, and the Middle East.

In terms of weight, ocean-shipping dominates. Considering all goods, 99.6 percent of trade by weight is ocean-shipped. Even excluding bulk commodities, 98 percent of trade by weight goes via ocean. Still, there have been significant trends. Figure 4.4 graphs trade by weight for ocean and air, normalizing the weights to equal 1 in 1974. Ocean trade



SOURCE: U.S. Census Bureau, *U.S. Exports/Imports of Merchandise*.

Figure 4.4—Growth of Trade, by Weight

by weight has increased 78 percent, whereas air trade by weight has increased roughly fivefold.

Table 4.3 describes North American trade by transport mode for 2002. Apart from very heavy goods, for which ocean-shipping is preferred, trucking dominates trade in and out of Mexico and exports to Canada. In contrast, ground-based U.S. imports from Canada are evenly distributed between rail, truck, and pipeline. This pattern reflects differences in transport infrastructure (in particular, the density of rail links across the northern border) and the bulk commodity structure of Canadian trade.

Table 4.3

Composition by Mode, 2002
(value in billion $, weight in billion kg)

	Mexico				Canada			
	U.S. Imports		U.S. Exports		U.S. Imports		U.S. Exports	
	Value	Weight	Value	Weight	Value	Weight	Value	Weight
Total	134.7	123.1	97.6		210.6	258.3	160.8	
By mode								
Ocean	17.1	93.6	6.3		7.0	61.1	2.4	
Air	3.2	0.1	6.1		8.8	0.1	12.0	
Land	114.4	29.4	85.2		194.8	197.1	146.4	
Of which								
Rail	20.8	7.8	10.1		47.0	63.0	14.3	
Truck	90.6	21.2	70.9		118.0	66.2	118.3	
Pipe	0.0	0.0	0.6		21.8	67.9	0.2	
Other	3.0	0.4	3.5		8.0	0.1	14.0	
Total (%)	100.0	100.0	100.0		100.0	100.0	100.0	
By mode (%)								
Ocean	12.7	76.0	6.5		3.3	23.7	1.5	
Air	2.4	0.1	6.3		4.2	0.0	7.5	
Land	84.9	23.9	87.3		92.5	76.3	91.0	
Of which (%)								
Rail	18.2	26.5	11.9		24.1	32.0	9.8	
Truck	79.2	72.1	83.2		60.6	33.6	80.8	
Pipe	0.0	0.0	0.7		11.2	34.4	0.1	
Other	2.6	1.4	4.1		4.1	0.1	9.6	

SOURCES: Data for ocean and air are from U.S. Census Bureau, *U.S. Imports/Exports of Merchandise* (2002). Land data are from U.S. Department of Transportation, *Transborder Surface Freight Database*.

NOTE: Weight data are not available for U.S. exports.

Summary and Discussion

U.S. trade has grown rapidly in the past three decades, and its composition has shifted considerably. Manufactures have grown relative to bulk commodities, leading to a marked rise in the value per kilogram shipped. Trade with Asia has grown relative to that with other partner countries, and air cargo has risen relative to ocean cargo. All of these trends in U.S. trade are even more pronounced for California's trade.

These trends have significant implications for infrastructure needs at California's gateways. In particular, the growth of trade flows through the state has required significant investments in technology and equipment simply to efficiently process the greater flow. As pointed out, increased flows can result in the employment of different, more efficient shipping technologies. Ships become larger, and more specialized vessels play a larger role in the movement of goods internationally. Such changes have implications for the ports. For the Ports of Los Angeles, Long Beach, and Oakland, it has meant increasing specialization in a smaller number of shipping technologies. In particular, each of these ports is now focused on containerized cargo. Neighboring ports, such as San Diego and Hueneme, have picked up the slack in handling "niche" cargos, such as automobiles, which arrive on ro-ro vessels.

The changing composition of international trade suggests an increasing reliance on airports relative to seaports. This change has several interesting implications. First, it suggests a reorientation of infrastructure funds toward California's airports. Second, it introduces the possibility that trade could bypass California altogether, and the next chapter introduces evidence that this is happening to a significant extent. Finally, as ocean-going trade becomes cheaper on a per-pound basis, the pricing power of ports and shippers declines.

Changes in modal preferences have similar implications. In particular, as U.S. trade relationships become stronger with Canada and Mexico, there is a trend away from both air and seaports toward trucking and rail. This trend implies an increased relative burden on California's land ports and a shift in trade away from California's gateways more generally.

5. Are California's Gateways Keeping Up?

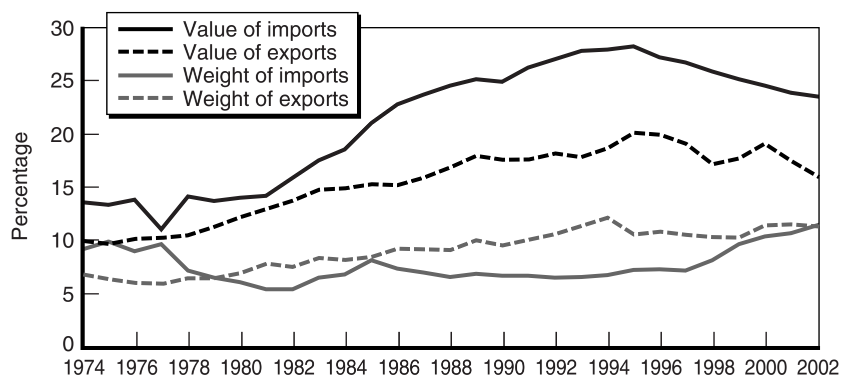
California's position on the West Coast makes it a natural gateway for U.S. trade with Asia and other nations along the Pacific Rim. However, this natural advantage could erode over time. Congestion near California's gateways combined with the falling costs of air cargo may lead shippers to use other means to reach both other nations and inland destinations. Meanwhile, other states may improve their trade infrastructure to lure international traffic through their gateways. In this chapter, we investigate the extent to which California's gateways are keeping up with the competition for international trade traffic.

To address this question, we could use an approach that emphasizes transport infrastructure as an input into moving cargo, by calculating expenditures on roads, rail, ports, and multimodal facilities to see if California is investing at the rate of other competitors. But expenditures by themselves are poor indicators. Building a ten-mile corridor through a crowded metropolis could be much more expensive, but no more effective from a logistical standpoint, than building the same corridor through unpopulated land. A better approach would be to directly measure the quantity and quality of the infrastructure itself, counting miles of paved highway, density of rail coverage, container cranes and terminals, and so on. Unfortunately, the data for this approach either omit assessments of quality or are difficult to obtain. An ocean port may have many container cranes, but if they are idled by a poorly arranged terminal or inland congestion, they are less valuable than fewer cranes operating at high efficiency.

These problems suggest an alternative approach. Rather than examining the inputs into moving cargo, we look at movements of the cargo itself. The rationale is simple: Shippers vote with their feet. If trade infrastructure is inadequate, management is poor, traffic is congested, or fees are too high, shippers will take their cargo elsewhere. In this sense, an analysis of trade flows offers a kind of referendum on the cost and quality of trade infrastructure. Even this straightforward approach, however, must consider other factors, including changes in the country and commodity patterns of U.S. trade.

In Figure 4.1, we showed a steady rise in the flow of goods through California's gateways. However, since U.S. trade as a whole rose rapidly in this period, growth in trade through California tells us little about the competitiveness of or relative demand for services at California's gateways. To better understand relative demand, we examine the *share* of California's gateways in total U.S. trade flows. These shares are depicted in Figure 5.1 and provide a direct indication of the flow of goods through California relative to the total amount of U.S. trade. Expanding shares imply that California's gateways are becoming more attractive, whereas declining shares indicate an erosion in the demand for their services relative to that for other gateways.

In value terms, the share of U.S. trade handled by California's gateways doubled between 1974 and 1995. The share of imports increased from just 13.5 percent to just over 28 percent, and the share of exports passing through California increased from 9.9 percent to 20



SOURCE: U.S. Census Bureau, *U.S. Exports/Imports of Merchandise*.
NOTES: Weight share includes only air and vessel shipments. Value share also includes shipments by land.

Figure 5.1—California's Share of U.S. Trade Flows

percent. These shares have fallen significantly, however, to 23.4 and 16.1 for imports and exports, respectively. In weight terms, California's share of U.S. exports exhibits a similar pattern, doubling between 1974 and 1994 and then tailing off. The outlier is California's share of U.S. imports by weight. This series declined by almost half from 1974 to 1982 and then increased sharply in the late 1990s.

To illustrate the sharp changes in California's trade share in the 1990s, we break out changes by mode in Table 5.1. California's rising share of trade before 1995 is attributable to an increased flow through all three types of gateways: air, ocean, and land. This holds true for imports and exports as well as for trade measured in both value and weight terms. California's share of air-based trade grew especially quickly and, as with other modes, the import share grew faster than the export share.

What explains the evolution in California's trade share and, in particular, the sharp reversal in shares that occurred during the mid-1990s? As discussed in the previous chapter, gateway shares can evolve for a number of reasons, the majority of which lie outside the influence of the gateways themselves. Three such reasons are the country composition, commodity composition, and modal composition of trade.

Table 5.1

California's Trade Shares

	Imports Share (%)		Exports Share (%)	
	Value	Weight	Value	Weight
		Air		
1990	29.9	19.1	29.2	20.5
1995	37.5	20.7	33.1	20.7
2002	20.8	18.5	25.7	19.5
		Ocean		
1990	32.2	6.6	20.6	9.3
1995	37.6	7.0	22.5	10.4
2002	36.6	11.2	20.5	11.2
		Land		
1990	3.8	—	4.1	—
1995	4.5	—	4.5	—
2002	5.3	—	5.2	—

SOURCE: U.S. Census Bureau, *U.S. Exports/Imports of Merchandise.*

In Table 4.2, we showed a basic geographic relationship: Pacific Rim countries trade with the U.S. West Coast; Europe and much of Latin America with the East and Gulf Coasts. Apart from a few minor fluctuations, this relationship remains fairly constant over time. As trade with Asia rises and falls, the share of West Coast gateways will rise and fall. For example, most of California's rising share of air trade from 1974 through the early 1990s is attributable to expansions of U.S. trade with Asian countries, especially Malaysia, South Korea, Singapore, and Japan. By ocean, increased imports and exports with China were instrumental in driving up California's shares.

Similarly, particular ports may be well suited for trade in particular commodities. Ports on the Gulf Coast are specially equipped to handle large shipments of bulks—iron ore, grains, and crude oil—whereas California's ports are oriented toward containerized goods. As the share of bulk commodities in trade rises, the share of Gulf Coast gateways rises. From 1974 through the early 1990s, there was a dramatic increase in U.S. imports and exports of technology products, computer and office equipment, and other electronic equipment, in particular. These goods have long had a significant presence in California's gateways. Similarly, increases in U.S. imports of motor vehicles and equipment, and increased exports of computer and office equipment drove up California's share.

Finally, changes in the price of air versus ocean transport will shift trade between these modes in a way that the gateways involved cannot easily affect. If air cargo becomes cheaper, more shipments will over fly the coast, and the Port of Los Angeles will see vessel shipments drop.

In this section, we use a technique known as a "shift-share decomposition" to explain the evolution of California's market share. The technical details of this decomposition are reported in Appendix C, but the idea behind it is simple. We take changes in the trade share of California's gateways and separate them into two "control" bins: changes in trade composition by country and by commodity. [1] Conceptually, this technique poses the question: Suppose U.S. trade with Asia rose, but

[1]The figures presented here represent share changes within a category and are abstracting away from mode changes during this period. Changes in the demand for various modes were very small between 1995 and 2002.

there were no other changes in trade. In which direction, and by how much, would California's trade share change? We then repeat the exercise, examining changes in commodity composition, holding all else constant. At the end, we are left with changes in California's trade share that cannot be explained by changes in trade composition. We think of this as shifts in demand that are specific to individual gateways.

Table 5.2 reports changes in California's value share of U.S. trade from 1995 to 2002, separating imports from exports, and examining changes by mode. The first column of numbers reports the total change in shares. The next three columns use the shift-share decomposition to attribute changes in total gateway shares to commodity composition, country composition, and gateway-specific demand factors.

The changes in California's share of ocean- and land-based-shipping have been quite modest. The small reductions in ocean share and small increases in land share are largely explained by country composition factors. The change in land share reflects the continued growth of land-based trade through Mexico in the wake of NAFTA.

Most of the decline in California's value share comes from changes in the use of California's airports, primarily resulting from reduced imports. Shifts in country and commodity composition are important. They explain just under half the change in California's air share of

Table 5.2

Explaining California's Changing Percentage Share of Trade, by Value, 1995 to 2002

	Share Changes	Commodity Changes	Country Changes	Demand Changes
	Imports			
Air	–16.4	–3.6	–4.2	–8.6
Ocean	–1.3	–0.4	–1.5	0.6
Land	0.8	0.1	1.2	–0.5
	Exports			
Air	–7.3	–1.3	–0.5	–5.6
Ocean	–1.9	1.2	–2.6	–0.5
Land	0.9	0.1	1.0	–0.1

SOURCE: Authors' estimates from U.S. Census Bureau, *U.S. Exports/Imports of Merchandise* (1995, 2002).

imports and about a quarter of the change in California's air share of exports. Imports and exports of computer and office equipment and imports of electronic components and accessories each contribute significantly to the commodity composition change. By country, declines in U.S. imports from and exports to Japan and imports from Singapore explain most of the changing share of airfreight handled by California's airports.

Still, most of the post-1995 drop in California's air share of trade cannot be explained by compositional shifts in trade. They instead reflect reductions in demand, which should be thought of as indicating changes in the desirability of California's gateways generally. One component of desirability is the financial and logistical ease with which goods flow through these gateways. A second component relates to the location of production (for exports) and consumption (for imports). If manufacturing facilities shift to inland locations, and falling air costs make it easier to fly over California, these factors combine to reduce the desirability of California's global gateways.

To further explain demand shifts, we looked for cases where trade with a particular partner and commodity through California has fallen while rising elsewhere. There was a significant decline in imports of electronic components and accessories from Japan through California. At the same time, Savannah and New York experienced significant increases in imports of these same products. Their expansion explains roughly 56 percent of California's decline. Looking further, we find that New York picked up about three-fifths of California's decline in computer peripherals and hard drives, particularly from Singapore. Similarly, a decline in imports of integrated circuits through California's airports occurred during this time. This was coincident with a dramatic increase, equal to about half of the California decline, in their flow into the Savannah airport.

Similar changes occurred in computer and office equipment trade with Japan. In particular, imports of hard drives and laptops have shifted dramatically from California's airports to those in Chicago and New York. This decline in imports through California goes above and beyond the general decline in U.S. imports of hard drives. In 2002, overall U.S. imports of hard drives had fallen to about 30 percent of their 1995 level.

Despite this overall decline, imports into Chicago more than doubled, whereas imports through California fell to about 15 percent of their 1995 level.

Although imports of Japanese hard drives have been diverted, particularly to Chicago, imports of laptops from Japan are now more likely to arrive in New York. This decline is, however, just the tip of the iceberg. Many laptops from Malaysia, Taiwan, and Singapore that would have come through California in 1995 are now rerouted through Anchorage, New Orleans, and Savannah. Anchorage, in particular, appears to be growing in popularity as a distribution point for laptops entering the United States.

What explains these shifts? During this period, both Northwest Airlines and Federal Express developed and expanded their cargo distribution centers in Anchorage. This seems to be a case where California's competitive advantage is eroding. Anchorage is a more cost-effective location than California because it lies closer to the most direct path between Asia and the U.S. East Coast. Between 1995 and 2002, international freight flows through Anchorage airport increased by 95 percent, whereas SFO showed no increase and LAX increased by only 13 percent.[2] In 2002, Anchorage airport handled more freight than did any other U.S. airport with the exception of Memphis, home to the main FedEx distribution center.[3] (Although Oakland possesses a major regional Federal Express distribution center, making Oakland the 12th largest freight-handling airport in the country, nearly all of its throughput is domestic in origin and destination.)

By some accounts, this shift away from California's airports could be the result of increased congestion in and around SFO and LAX. Although much of this congestion is external to the airports, it affects the efficiency with which distribution operations at the airports function. Affected industries have voiced concerns about congestion in California

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[2]In 2002, LAX and Anchorage airport (ANC) handled comparable amounts of total freight, domestic and international, and were the fourth and fifth busiest airports in the world in terms of freight-handling, behind Memphis, Hong Kong, and Tokyo.

[3]This is true when considering all freight through the airports, including transit freight. Table 4.1 excludes transit freight, which explains the rank of the Anchorage airport presented there.

for more than a decade, but congestion levels may have reached a tipping point in 1995, when carriers such as Northwest Airlines and Federal Express enabled the movement of trade out of the state.

On the export side, the reduction in demand shares for California airport services largely reflects a change in the export origin point for integrated circuits bound for the Philippines, Malaysia, Singapore, and Japan. Many exports now originate in Dallas, Boston, New Orleans, and New York rather than California. Although the decline is common to California airports, the San Francisco district experienced the largest decline in share. Exports out of the San Francisco area to the Philippines have largely been rerouted to Dallas, the site of a major Federal Express distribution center.

In general, Los Angeles and San Francisco share responsibility for the declining shares, although San Francisco has suffered a larger loss of demand than has Los Angeles. San Francisco has experienced a drop in its exports of electronic components and accessories to Philippines, Malaysia, and Singapore, and Los Angeles has exported fewer electronic components and accessories to Japan, Korea, and Hong Kong. On the import side, shipments of computer and office equipment from Japan, Singapore, and South Korea through San Francisco have dropped, and shipments of the same from Malaysia and Singapore through Los Angeles also declined.

Although the value share of trade through California fell in the late 1990s, the weight share of trade continued to increase. These changes are decomposed in Table 5.3. Changes in air weight were driven by changes in demand; shifts in country composition actually pulled California's share up. The causes of the decline in air weight share closely mirror the causes of the decline in air value. Changes in ocean weight share are influenced heavily by changes in demand, but in the case of exports, the commodity composition of U.S. exports by ocean explains the bulk of the changes.

Between 1995 and 2002, California's share of the weight of all U.S. imports by ocean increased by more than three points. This growth was driven by a favorable shift in the countries with which the United States trades, most notably, China, and a favorable shift in the demand for entry into the country through California's ports relative to other

Table 5.3

Explaining California's Changing Percentage Share of Trade, by Weight, 1995 to 2002

	Share Changes	Commodity Changes	Country Changes	Residual Demand Changes
		Imports		
Air	–2.3	–0.3	2.1	–4.1
Ocean	3.1	0.3	1.0	1.5
		Exports		
Air	–1.2	–0.2	0.7	–1.7
Ocean	0.9	1.1	–0.5	0.4

SOURCE: Authors' estimates from U.S. Census Bureau, *U.S. Exports/ Imports of Merchandise* (1995, 2002).

U.S. ports. In particular, crude petroleum and natural gas imports from Saudi Arabia, Ecuador, and Argentina increasingly entered through California. Argentine increases all went into the Los Angeles customs district, whereas shifts in imports from Ecuador and Saudi Arabia were split between San Francisco and Los Angeles. We also can identify the ports from which imports were diverted. Saudi Arabian crude shifted away from Mobile, Alabama, and the U.S. Virgin Islands, Ecuadoran crude shifted away from Houston and Port Arthur, and Argentina's crude shifted away from New Orleans.

California's share of the U.S. export volume also increased, but by only 0.9 points. This increase was largely driven by U.S. exports of scrap and waste and refined petroleum. As for demand, the 0.4 increase in share was driven entirely by a reorientation of bituminous coal exports to Japan through California ports, and Los Angeles and Long Beach specifically. These exports had previously originated primarily in Savannah, Georgia, but also in Mobile, Alabama.

In contrast with the changes by value, the change in weight shares are not evenly distributed across ports in the state. In fact, the state's gains in share accrue entirely to ports in the Los Angeles customs district. Ports in the San Francisco area lost share during this period. These losses amount to about two-thirds of the gain in share that was experienced by the Los Angeles ports for exports. On the import side, however, ports in the San Francisco customs district roughly maintained their 1995 share.

Finally, California's trade share by weight continues to grow, although its trade share by value fell in the latter half of the 1990s. What explains this result? Consider a manufacturer who wants to ship a product from the U.S. Midwest to Asia, or the reverse. If the product is heavy relative to its value, ocean-shipping is the only cost-effective option. If the product is light relative to its value, air-shipping dramatically cuts time, avoids congestion delays in California, and costs a small additional premium relative to ocean-shipping. The data show a clear shift away from California's gateways for these light products, especially electronics, and a shift toward California's gateways for heavy products. In particular, the Los Angeles region experienced a significant increase in its handling of bulk commodities, including petroleum and natural gas imports and bituminous coal exports. All of these are very heavy and have a low price per pound.

The implications of this shift are twofold, and neither bodes well for California. Port operators tend to be focused on quantities moved, weight, number of containers, and number of flights. However, the pricing power of gateways and inland transport network fees depends on the value of the item shipped. Shipping costs are a small fraction of the delivered price for light products, meaning that consumers are less sensitive to changes in shipping costs. In contrast, the shipping costs for bulk items make up a much larger fraction of the delivered price, making consumers much more sensitive to changes in shipping costs. Our finding suggests that these changes in U.S. trade patterns and overall competitiveness are compromising the ability of California's gateways to raise revenues through fee increases. If these trends persist, they may result in a real decrease in the level of charges these ports can collect.

The second unfortunate implication relates to the value-added embodied in traded goods. Local ports may generate positive benefits to local manufacturers by reducing their overland shipping costs and travel times and creating ancillary industries. Manufacturers, in turn, benefit local governments by providing a taxable base of value-added: land rent, returns on capital, and wages. But our data show that high-value-added goods such as electronics are being crowded out of California's ports in favor of low-value-added goods such as coal, scrap iron, and petroleum. Why should an electronics manufacturer fight congestion in and around California's ports when it can relocate to an uncongested location farther inland? The danger in the trends we have identified is that they reduce the benefits ports generate in their regions while leaving in place the burdens of congestion and pollution. These trends may be temporary, but they are worth watching.

6. Vulnerability of California's Goods Movement: Labor Relations and Security

NAFTA and the growth of Asian trade have increased the demand for international freight shipping services in California. At the same time, competitors are increasingly able to divert traffic from California's gateways, especially its airports. This chapter discusses several recent events and issues—including the West Coast port lockout and security concerns following the terrorist attacks of September 11, 2001—that also have the potential to alter demand for California's gateway services.

Both labor disputes and terrorist attacks can permanently alter the direction of trade flows. The former can affect the use of West Coast ports by reducing their attractiveness compared to other seaports or to air shipment. The effects of terrorist activity could lead to a general reduction of maritime trade, substantially affecting flows through California's ports as they currently handle a large amount of total trade. How California's ports and policymakers respond to these events can be crucial to managing the flow of traded goods through the state.

West Coast Port Lockout

For ten days beginning September 27, 2002, all 29 seaports on the West Coast of the United States closed their doors. These ports handled approximately 42 percent of all U.S. waterborne trade in 2001 and were responsible for more than half of all U.S. containerized imports and exports. During the lockout, an estimated $6.2 billion in imports were disrupted in the Ports of Los Angeles and Long Beach alone. Yet the effects of these disruptions were not limited to West Coast states. According to the ports, 60 percent of imports used in the Chicago area come through the Ports of Los Angeles and Long Beach.[1] Even after the ports reopened in early October, the backlog of ships sitting off the West Coast did not clear until December.[2]

This closure was precipitated by a lack of progress in contract negotiations between the Pacific Maritime Association (PMA) and the International Longshore and Warehouse Union (ILWU). The longshoremen had been working since July 1, 2002, without a contract. The reason for the shutdown is a matter of some dispute. The port owners claimed that the longshoreman had engaged in a work-to-rules slowdown of activity, thereby forcing the shutdown as a disciplinary mechanism.[3] The longshoremen claimed that evidence of the slowdown was manufactured to invite federal intervention that would strengthen the PMA's negotiating position. The Bush administration invoked the Taft-Hartley Act of 1947, forcing the ports to reopen and the longshoremen to return to work. This was the first time since 1978 that this law was invoked, and the first time ever that it was used to end an employer-initiated work stoppage. The ports resumed operations on October 7, 2002. A new contract was negotiated during the ensuing cooling-off period, and traffic has been flowing fluidly through the ports since the backlog of ships was cleared.

Regardless of its cause, the shutdown imposed large costs on the U.S. economy. A study by Martin Associates (2002) arrived at a figure of $2 billion per day. Although this figure seems too high, it is widely cited and formed the basis for federal intervention. Where does it come from? In 2001, West Coast ports handled $302 billion in goods, around $827 million per day. Were the cargo to be dumped in the ocean, the direct cost would be less than half the claimed $2 billion figure. Involved workers, including 16,000 longshoremen and workers in related trucking

[1]State of California (2002, p. 10).

[2]It is estimated that one week is necessary to clear a backlog created by a one-day port closure. For some ports, this process took much less time. Port Hueneme cleared its backlog in about a week.

[3]Such a slowdown occurs when the workers adhere strictly to the letter of the rules and regulations governing their on-the-job behavior. Evidently, many rules and regulations are not followed strictly during the course of normal business, allowing for a more expeditious processing of containers.

sectors, suffered a loss of earnings, estimated as no more than $43 million per day.[4] Thus, the major contributor to the costs identified in the Martin study clearly is the hampering of economic activity beyond the port.

Consider the following scenario: U.S. manufacturers have become increasingly reliant on parts and supplies sourced from Asian nations. If those supplies are suddenly cut off, factories cannot run, workers are laid off, and output grinds to a halt. Similarly, retailers taking orders for the holiday buying season find their shelves bare and sales lost. And because the shutdown closes off cargo flows in both directions, exporters can not ship their items out to Asian destinations. Were all this to occur, the cost of the shutdown could easily reach $2 billion a day. This is the essence of the method underlying the results published by Martin Associates.

The problem is that the Martin analysis essentially assumes that the involved parties have no option but to wait out the reopening of the ports. This is clearly not the case. There is evidence that "many shippers rushed to get goods in the country ahead of the deadline for resolving the labor dispute with dockworkers."[5] There are also anecdotes that many enterprises negotiated contingent contracts with the airlines in the event that their goods were not able to arrive by sea.[6] That a shutdown or a strike was possible would have been clear to firms working with the PMA and the ILWU. Strikes had occurred in 1948, 1951, and 1971, and the ILWU had conducted work-to-rule slowdowns as recently as 1999, when the previous contract was being negotiated.

Once the shutdown occurred, there were other actions available to firms on the receiving end of imports. Some enterprises engaged in maintenance and training exercises, exploiting the free time of their workers for necessary activities. Others obtained their inputs from alternative sources, including domestic suppliers, or brought goods in via

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[4]Hall (2003).

[5]*New York Times* (2002).

[6]Port of Oakland officials have informed us that managers at the NUMMI plant made efforts, and succeeded in some measure, to have containers put on airplanes and delivered to the Oakland International Airport.

air cargo. Rising air freight prices during this period suggest that modal substitution occurred.

Studies that incorporate these substitution responses estimate much lower per day costs. Anderson (2002) suggests that the costs start small, as firms rely on buffer stock inventories to wait out the shutdown, but could grow rapidly as those inventories run out. At the time, his estimate was that a four-week shutdown would cost approximately $4.7 billion. He views the "figure of $1 billion or $2 billion per day as closer to the economic impact of *sinking* the ships than delaying them."

Although the shutdown ended and the resulting backlog was cleared, its occurrence may have a lasting effect on shipments through West Coast seaports. In particular, firms bringing goods through West Coast ports are now more acutely aware of the costs of a disruption such as the port closure. These firms may, as a result, seek to diversify this risk by using other modes or entry points. Whether by altering mode or entry point, diversification would have the effect of reducing the future flow of products through West Coast ports generally and California's ports in particular.

An entirely unforeseen consequence of the shutdown was the traffic holiday it provided to commuters. In particular, traffic on the I-710 highway in the region was greatly diminished and the flow of passenger vehicles along this route was both faster and safer.[7] Southern Californians were provided with an unusually stark demonstration of the negative effects that shipping enormous volumes of goods through Los Angeles and Long Beach has on their lives.

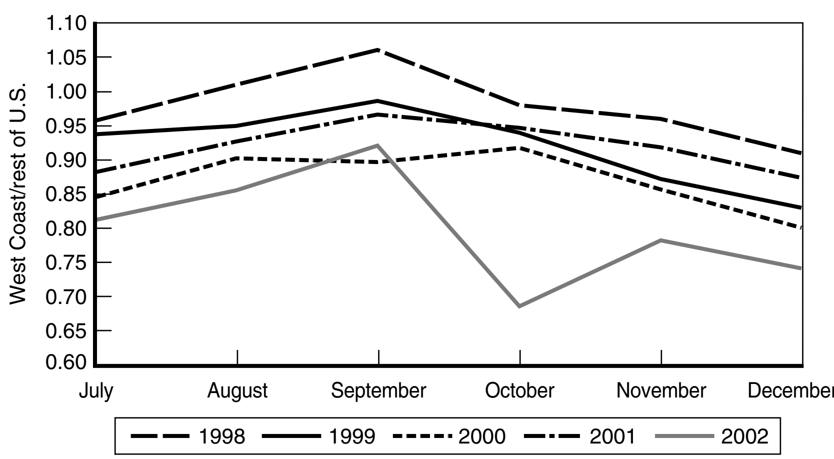
Port Closure and International Trade

We argue above that the costs of the port crisis would have been mitigated if firms had anticipated it or diverted traffic around it. We provide some simple calculations designed to identify whether this anticipation and diversion took place. We look for three effects. First, did shipments through West Coast ports accelerate before the shutdown? Second, were alternative modes of transportation employed during the

[7]Research by SCAG indicates that average traffic speeds along the I-710 Corridor increased by 67 percent during the shutdown.

shutdown? Third, did firms shift entry points and modes away from West Coast ports after the shutdown to diversify their shipping portfolio and minimize the risk of another disruption?

Figure 6.1 provides some suggestive evidence on the first set of these questions. The chart plots the monthly value of imports flowing through West Coast ports relative to the value of imports flowing into the United States. For comparison, 2002 is charted alongside each of the previous five years. Three observations can be made from this chart. First, the share of trade through West Coast ports was lower in 2002 than in each of the previous five years. This decline could be related to the port crisis, but it could also be due to business cycle downturns that have hit high-technology trade, and hence trade through California, especially hard. Second, the West Coast share of imports rose from June through September in four of the five years, but the rate of increase in September was higher for 2002 than for other years. This could reflect anticipation of the port lockout and an inventory stocking effect. Third, although the West Coast share declined in October in four of the five years, the decline was dramatic in 2002. The decline clearly reflects the period of the port closure and the failure to clear the backlog of goods until November or December.



SOURCE: U.S. Census Bureau, *U.S. Exports/Imports of Merchandise*.

Figure 6.1—Monthly Ratio of Vessel Imports

Whereas the decline of import flows in October is not surprising, the low levels of import flows in November and December are. During November and December, these ports were handling the normal flow of goods, plus clearing the backlog created during the port shutdown. This dual tasking should have caused a rising share in these months. The only explanation is that goods were diverted around the West Coast, either by rerouting sea traffic to the East Coast or by shifts to air freight. The latter diversion could reduce the value of imports through the West Coast ports significantly as it would likely be goods with high value-to-weight ratios that would be diverted to the air.

The third implication of the port shutdown is that freight may well be diverted away from West Coast ports toward other U.S. ports on a more permanent basis. Although it is too soon after the event to be certain that much permanent diversion has taken place, data from the first five months of 2003 are suggestive. For comparison, we consider January through June 2003 alongside the same months in five previous years. In each of the five previous years, between 77 and 78 percent of U.S. imports from Asia entered through West Coast ports. In the first six months of 2003, however, imports from Asia entering through West Coast ports had dropped to 73.9 percent. It is unclear whether this decline represents a temporary blip or a significant permanent diversion away from the West Coast, but the trend bears watching.

In summary, shipments into the West Coast accelerated in September 2002 in apparent anticipation of the lockout, diversion toward other modes and entry points occurred during the lockout, and those diversions continued for months after the lockout ended. The apparent willingness of importers to divert goods in the short run has implications for their willingness to do so in the longer term. In particular, it suggests that events such as the lockout may well encourage future diversification of shipping away from West Coast ports. This diversification implies a longer-term reduction of traffic through California's ports.

It should be emphasized that the foregoing remarks do not represent a rigorous statistical analysis of the anticipation and diversion hypotheses. Moreover, it would be necessary to evaluate many additional months of data to determine whether diversion was temporary or permanent.

However, the basic trends indicate the need for careful study beyond the scope of the current work.

Port Security Issues and Initiatives

Since the terrorist attacks on the World Trade Center in New York City and the Pentagon in Washington, D.C., concerns over safety and the prevention of similar attacks have became paramount both on the national political scene and in the daily lives of Americans. The initial security focus was on air passenger traffic, including increased passenger screening and restricting cockpit access. As the debate broadened, however, the issue of goods movement moved to the fore. U.S. ports, and seaports in particular, are vulnerable to two sorts of attacks. The first aims to disrupt economic activity. A tremendous volume of goods flows through U.S. ports. In 2001, the Port of Los Angeles alone handled more than $104 billion in goods. The detonation of an explosive device within its confines would have a devastating effect on economic activity not only in Los Angeles but, arguably, throughout the entire country.

In the aftermath of 9/11, the immediate response was to close down the nation's aviation system until the scope of the threat could be assessed. It seems likely that the effect of a waterborne attack would similarly result in the closing of all ports around the country. During the height of the West Coast port lockout in the fall of 2002, estimates of the daily cost of the disrupted flow of goods ranged from the hundreds of millions to $2 billion per day. Even if the costs were in the lower end of that range, they represent a significant disruption of economic activity.

The short-run costs of a terrorist attack on a U.S. port would likely be higher, precisely because a broad shutdown would preclude the diversion of cargo that minimized costs of the port lockout. Not only would the other U.S. waterborne traffic be disrupted while the ports were closed, all cargo loaded before the attack would probably be subjected to intense scrutiny before docking at a U.S. port. Therefore, not only would there be significant costs while the ports were closed, but the costs would continue as cargo destined for U.S. shores was slowed for some time thereafter.

A second vulnerability presented by the ports is the possibility that an explosive device could arrive on U.S. shores in a container and be successfully transported inland. Containers, once loaded, are rarely opened or otherwise inspected before their arrival in the United States. A container can be loaded onto the back of a truck and make its way inland to a target quite independent of the port. The task of inspecting all containers is currently infeasible, and the current inspection rate is startlingly low. As late as May 2002, only 2 percent of all containers unloaded at U.S. ports were subject to any sort of inspection.[8]

These vulnerabilities pose the following challenge: How does the United States realize the gains of international trade when opening its ports to foreign goods poses substantial security risks? As Flynn (2002) notes, "Ultimately, getting homeland security right is not about constructing barricades to fend off terrorists. It is, or should be, about identifying and taking the steps necessary to allow the United States to remain an open, prosperous, free, and globally engaged society." Just how to strike a balance between the provision of protection from an attack and the normal pursuit of economic activity is a puzzle that will plague policymakers for some time. Despite this unresolved challenge, policies are being implemented that are likely to enhance the safety of maritime activities.

Federal Initiatives and Port Security

Current federal policy initiatives are designed to strike a balance between safety and commercial efficiency. The Container Security Initiative (CSI) is a cooperative agreement that places U.S. customs officials at foreign ports and places reporting requirements on shippers loading cargo onto a ship bound for the United States. It is intended to interdict explosive devices before they arrive at U.S. ports. The Customs-Trade Partnership Against Terrorism (C-TPAT) is designed to more closely control the movement of goods between their foreign source and final U.S. destination. The goal of the program is to essentially limit the cargo flowing through the system that might require inspection. Goods flowing under the control of shippers certified under the C-TPAT program will be presumed to be secure and safe.

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[8]Nacht (2002).

Under the CSI, an invoice for all containers through partner ports will be filed with the appropriate authorities 24 hours in advance of that container's arrival at the port. Upon receipt of the invoice, U.S. customs officials at the foreign port will screen the manifest submitted for each container, assessing the potential threat that is implied by the contents or the identity of the shipper. Threatening containers will be inspected at the foreign port and will not reach U.S. shores unless they pass muster.

CSI consists of four core elements:

- Using intelligence and automated information to identify and target high-risk containers,
- Pre-screening containers identified as high risk, at the point of departure,
- Using detection technology to quickly pre-screen high-risk containers, and
- Using smarter, tamper-evident containers.

The CSI has been implemented in two stages. In the first stage, arrangements were made with 23 ports in 19 countries to implement the inspection process. These ports, listed in the first column of Table 6.1, are the source of 68 percent of all container traffic into U.S. ports.[9] A second phase of negotiations resulted in the addition of the ports in the second column. Between phase one and phase two, approximately 80 percent of all container traffic into U.S. ports is covered by the CSI.

The eligibility of entry into the CSI program for foreign ports is subject to the following criteria:[10]

- A country's customs administration must be able to inspect cargo originating in or being transshipped through a country,
- The seaport must have or be in the process of acquiring nonintrusive inspection equipment—large x-ray-type systems—and radiation detection equipment to conduct security, and

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[9]U.S. Department of Homeland Security (2003).

[10]See U.S. Customs website at http://www.customs.ustreas.gov/xp/cgov/import/cargo_control/csi/.

Table 6.1

Foreign Ports Participating in the CSI

Phase I Ports	Phase II Ports
Hong Kong	Port Kelang, Malaysia
Shanghai, China	Tanjung Pelepas, Malaysia
Singapore	Göteborg, Sweden
Kaohsiung, Taiwan	Marseilles/Fos, France
Rotterdam, The Netherlands	Livorno, Italy
Pusan, Korea	Gioia Tauro, Italy
Bremerhaven, Germany	Naples, Italy
Tokyo, Japan	Barcelona, Spain
Genoa, Italy	Valencia , Spain
Shenzhen, China	Southampton, United Kingdom
Antwerp, Belgium	Thamesport/Tilbury, United Kingdom
Nagoya, Japan	Liverpool, United Kingdom
Le Havre, France	Zeebrugge, Belgium
Hamburg, Germany	Osaka, Japan
La Spezia, Italy	Colombo, Sri Lanka
Felixstowe, United Kingdom	
Algeciras, Spain	
Kobe, Japan	
Yokohama, Japan	
Laem Chabang, Thailand	
Montreal, Canada	
Vancouver, Canada	
Halifax, Canada	

SOURCE: http://www.customs.ustreas.gov/ImageCache/cgov/content/import/cargo_5fcontrol/csi/ports_5fcsi_5flandscape_2eppt/v3/ports_5fcsi_5flandscape.ppt (accessed July 15, 2003).

- The seaport must have regular, direct, and substantial container traffic to ports in the United States.

These are fairly onerous conditions, making it unlikely that complete coverage of all sources of containers is achievable. In fact, the third point appears to rule out the notion of complete coverage altogether. Of the 2,600 commercial ports in the world, 575 handle significant numbers of containers.[11]

C-TPAT is a joint government-business initiative to build cooperative relationships that strengthen overall supply chain and border

[11]See http://www.lloydsports.com.

security. Through this partnership, the U.S. government is asking businesses to develop security procedures designed to maintain the integrity of their shipments and to have these procedures certified by the government. Businesses must apply to participate in C-TPAT and, in so doing, commit to the following actions:

- Conduct a comprehensive self-assessment of supply chain security using the C-TPAT security guidelines jointly developed by Customs and the trade community. These guidelines, which are available for review on the Customs website, encompass the following areas: procedural security, physical security, personnel security, education and training, access controls, manifest procedures, and conveyance security;
- Submit a supply chain security profile questionnaire to Customs;
- Develop and implement a program to enhance security throughout the supply chain in accordance with C-TPAT guidelines; and
- Communicate C-TPAT guidelines to other companies in the supply chain and work toward building the guidelines into relationships with these companies.

C-TPAT is currently open to all importers and carriers (air, rail, and sea), with the intention of opening enrollment to the broader trade community in the near future, including all sectors of the supply chain.

Participation in C-TPAT produces positive spillovers primarily associated with the better tracking of containers. Shippers acknowledge that this will reduce theft and other losses of containers, thereby lowering costs. It has been reported that from 6 to 10 percent of the containers in yards of some West Coast terminals are in the "unable to locate" category.[12] Presumably, the closer supervision over the loading, unloading, and transporting of individual containers by shippers will serve to reduce this figure, reducing costs.

In addition to initiating these programs, the United States passed the Maritime Transportation Security Act in November 2002.   This act imposes many security responsibilities on U.S. ports and vessels traveling

[12]Nacht (2002).

in U.S. waters. The overall thrust of the law is to reduce the probability of a transportation security incident, whether terrorist-related or otherwise. It mandates the assessment of all vessels and facilities on or near the water to identify those at high risk of being involved in an incident that produces significant loss of life, environmental damage, transportation system disruption, or economic disruption. For vulnerable infrastructure, additional security measures are to be adopted. For all ports, facilities, and vessels, a comprehensive security plan and incident response plan are to be devised. It also mandates identification cards for crew members and select employees at domestic ports.

A rough evaluation of the costs of this act for California has been undertaken.[13] The following are major upgrades needed at some of California's busiest ports: worker ID systems, terminal traffic controls, surveillance and monitoring equipment, and utility upgrades. The costs associated with installing this equipment at Oakland, San Francisco, Hueneme, Los Angeles, and Long Beach run in excess of $205 million.[14] According to a survey of U.S. ports, the implementation of the security measures mandated by the Department of Homeland Security will take 20 years at current funding levels.[15]

The Container Security Initiative and California Ports

In 2001, California ports handled more than 7.5 million TEUs.[16] Container imports were handled by 13 of California's 20 seaports and originated in some 925 foreign ports, only 3.9 percent of which participate in the CSI. Although the vast majority of source ports for imports into California do not participate in the CSI, more than 64 percent, by value, of waterborne containerized imports into California

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[13]According to Armstrong (2003), new Department of Homeland Security regulations for shipping at the nation's 361 seaports will cost an estimated $7.3 billion during the next ten years.

[14]Respectively, Oakland, $55 million; San Francisco, $70 million; Hueneme, $660,000; Los Angeles and Long Beach, $79 million each (California Marine and Intermodal Transportation System Advisory Council, 2003).

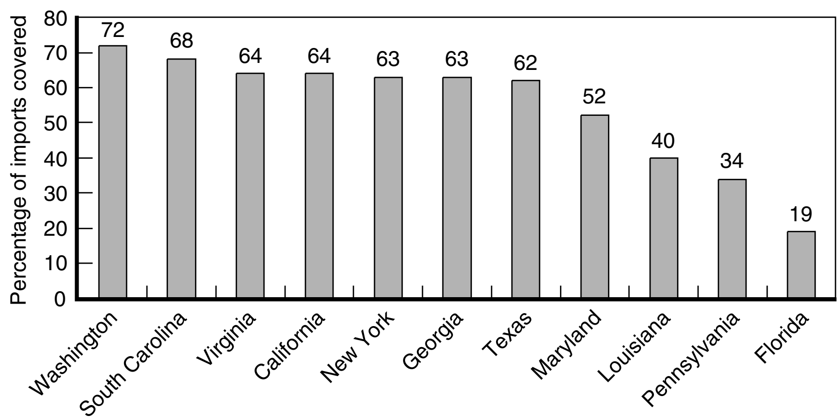
[15]Rosen Lum (2003).

[16]This includes imports, exports, and transshipments. Transshipments pass through the United States on a journey from one foreign country to another.

are covered by it. This coverage ranges from a high of 100 percent of containerized imports arriving at the San Joaquin River Port to a low of 11 percent of containerized imports arriving in San Diego. The state's major ports—Los Angeles, Long Beach, and Oakland—each have coverage ranging between 60 and 70 percent.

By national standards, these coverage figures are relatively high. Among states receiving more than $10 billion in imports, only one state, Washington, at just under 72 percent, has a higher coverage rate than does California. This contrasts sharply with major East Coast states such as Florida, Pennsylvania, Maryland, and New York (Figure 6.2). Container imports arriving on the Eastern Seaboard tend to arrive from smaller ports, many of which are in Latin America and not yet covered by the CSI.

Yet the number of source ports covered by CSI is perhaps a more relevant number than the value covered, if only because it takes only a single container to wreak local physical and broader economic havoc. As the final column of Table 6.2 indicates, there is substantial variation in the extent of port coverage among California's gateways. More than two-thirds of all ports of origin are outside the CSI for nine of the 13



SOURCE: Author's estimates from U.S. Department of Transportation, *Waterborne Databank*.

Figure 6.2—Coverage of Imports by the Container Security Initiative

Table 6.2

Containerized Import Flows Through California Ports, 2001

Name	Imports (billion $)	Containerized Imports: Total Value (billion $)	CSI Coverage (%)	Covered Source Ports (%)
Los Angeles	86.8	77.1	59.7	4.8
Long Beach	78.0	69.3	67.8	5.0
Oakland	17.3	15.9	65.5	6.6
Port Hueneme	4.7	0.2	34.3	33.3
San Diego	4.0	0.0	11.4	23.1
El Segundo	1.5	0.0	9.0	14.3
San Francisco	1.3	0.7	55.0	15.2
Richmond	0.6	0.0	53.0	42.9
Stockton	0.1	0.0	86.8	62.5
San Pablo Bay	0.1	0.0	50.5	30.0
San Joaquin River	0.1	0.0	100.0	100.0
Sacramento	0.0	0.0	0.0	0.0
Eureka	0.0	0.0	51.7	62.5

SOURCE: U.S. Department of Transportation, *Waterborne Databank.*

NOTE: Percentages represent authors' estimates.

ports receiving containers. The numbers are especially low for California's largest ports, for which less than 7 percent of all ports of origin are covered by the CSI.

Although California appears to receive better coverage from the Container Security Initiative than do many other states with port facilities, this is not true of all ports in California. In particular, San Diego is left vulnerable, with only 11.4 percent of its containers originating in CSI ports. Furthermore, California's largest ports continue to receive containers from many foreign ports that are not participating in the CSI. It remains an open question as to just how much security is being provided by the Container Security Initiative.

Summary and Discussion

Although the 9/11 attacks and the port lockout are very different in nature, they are closely related in their implications for the flow of internationally trade goods through California. Uncertainty with regard to both the labor environment and the costs of port security can result in a diversion of international trade away from California's seaports. In either case, the efficiency with which goods move through California is eroded. The uncertainty arising from the labor dispute increases the implicit cost of goods through West Coast ports. The labor agreements are also restrictive in the use of technology at California's ports. In comparison to some foreign ports, or even ports on the East Coast, California's ports are considered much less efficient in their ability to move goods smoothly and quickly to land-based modes of transportation.[17] The labor environment on the West Coast leads to the possibility of both a diversion of trade to East Coast ports and shipment by air. Although it is not practical or possible to ship all traded goods by air, increases in shipping costs are likely to be met with a shift of goods with high values relative to weight from sea to air.

The recently imposed security measures also bring increased costs and uncertainty. Should cargo require inspection, ships departures and arrivals may be delayed. Given just-in-time inventory techniques, these delays are very costly to firms importing inputs to their production process. Yet the failure to implement security measures comes with an abstract cost of uncertainty because of the higher likelihood of a terror-related event at any given port. The imposition of security measures, including efforts to track individual containers, may increase costs, but they also come with associated cost savings. The incidence of container loss and theft will surely decline, producing direct savings to all shippers.

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[17]The Rotterdam port is hailed as a model of efficiency, operating 24 hours per day with far fewer workers than are necessary at West Coast ports.

7. Forecasting Trade and Transport

Transporting merchandise globally requires investing in infrastructure locally. The construction of highways, railways, ports, and intermodal facilities all demand significant financial resources for their completion. These investments also tend to have a long shelf life—few governments can afford to scrap ill-considered infrastructure. Moreover, private market activity is shaped by these projects, as firms make decisions based on the provision of public goods. As a result, infrastructure decisions made today can influence economic activity for decades.

A critical component in the infrastructure planning and development process is forecasting growth. In this chapter, we provide estimates on the growth of international trade through 2020.[1] In particular, we combine the results of a long-horizon world trade forecast with our current data on freight demands to provide a picture of transportation needs, by mode, for California and the United States as a whole for the next 20 years. The forecasts for California are further broken out into customs districts for air-based trade and major ports for ocean shipments.

Method

The forecasts presented in this chapter are based on results from the GTAP.[2] GTAP was established in 1992 to facilitate quantitative analyses of international economic issues. At the heart of this widely consulted project is a standard general equilibrium model of international output

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[1]These estimates draw on work done by GTAP, the Global Trade Analysis Project. GTAP is the pre-eminent tool used by academics and government agencies alike to predict how changes in trade policy will affect trade patterns.

[2]See Hertel (1997), Dimaranan and McDougall (2002), or http://www.gtap.agecon.purdue.edu, for more information on GTAP.

and trade. It is designed to examine how changes in economic fundamentals, including investment rates, population growth, and tariff rates, would affect patterns of specialization and trade worldwide.

The forecasts presented here are derived from an extension of the basic GTAP model that incorporates dynamic aspects of the world's economies.[3] The model draws on World Bank forecasts of growth rates in gross domestic product, gross domestic investment, capital stocks, population, skilled labor and unskilled labor for each country. The model further assumes a set of trade policy changes, including the full implementation of Uruguay Round commitments, the implementation of China's accession to the World Trade Organization, and the implementation of the agreement on textiles and clothing. It further assumes that, after the full implementation of the Uruguay Round commitments, there will be gradual tariff reductions commensurate with the rate of liberalization that has occurred in recent decades.

The model is highly disaggregated, allowing analysis of 66 countries that generate the vast majority of world output and trade, with results for 37 sectors in the economy, including agriculture, mining, services, and multiple manufacturing activities. The results from the GTAP simulations forecast changes in the composition of U.S. trade flows by country of origin or destination and also by commodity.

This disaggregation is critical to our exercise. As Chapter 3 indicates, the sectoral composition of trade and its eastward or westward orientation have important implications for the quantity that must be transported and which modes and international gateways are employed. For example, were the model to predict significant growth in imports of iron ore from Africa, that outcome would likely entail substantial weight to be moved via ocean into the Gulf Coast. Suppose, however, that the model predicted the same dollar value in import growth, but in Taiwanese microchips. This would entail less weight and perhaps air shipment to California.

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[3]See Walmsley et al. (2000) for a description of the macroeconomic and policy scenario under which these forecasts were generated. See Ianchovichina (1998) and Ianchovichina et al. (1999) for details on the dynamic version of the GTAP model.

To complete the exercise, we translate GTAP's forecasted trade values into freight demands for each mode and international gateway (customs district). For each commodity and trade partner combination, we assume that trade will be distributed across modes and gateways in a manner that reflects trends in trade flows and gateway use between 1990 and 2002.

Caveats

Forecasting trade growth 20 years out, like forecasting anything 20 years out, is fairly ambitious. What are the weak links in our process? The first is the reliance on World Bank estimates of GDP and factor supply growth for each country. They are the best available, but their ultimate accuracy is unknown. Second, the model assumes that trade relations worldwide continue on their present trajectory toward liberalization. That may be a reasonable extrapolation from the last 50 years, but is by no means assured. Many experts see successive failures of WTO negotiations and increasingly hostile disputes between the United States, Europe, and China as indicators of a rising trade war or protectionism. Third, the model cannot foresee any sort of sudden technological change. A similar exercise conducted 25 years ago would have no doubt focused heavily on trade in petroleum and largely ignored computing machinery, with the attendant overestimate of the need for supertankers and underestimate of the need for air cargo. Fourth, the model cannot foresee changes in modal demand that would be occasioned either by technological changes or by increases in exporters' demands for time savings.

Most important, our analysis assumes that ports are capable of absorbing an ever-rising volume of trade. Considering that many of California's ports are already near capacity, and local highways are groaning under the weight of the congestion they create, tripling volumes seems implausible. Accordingly, the forecasts should not be read in terms of the volumes of trade that shippers *will* move through California, but rather as a projection of the volumes that shippers *would like* to move through California. Given constraints on expansion, this volume may be moved through other ports, by some other mode, or not at all. This last possibility suggests that increased port congestion may raise shipping costs and result in less trade.

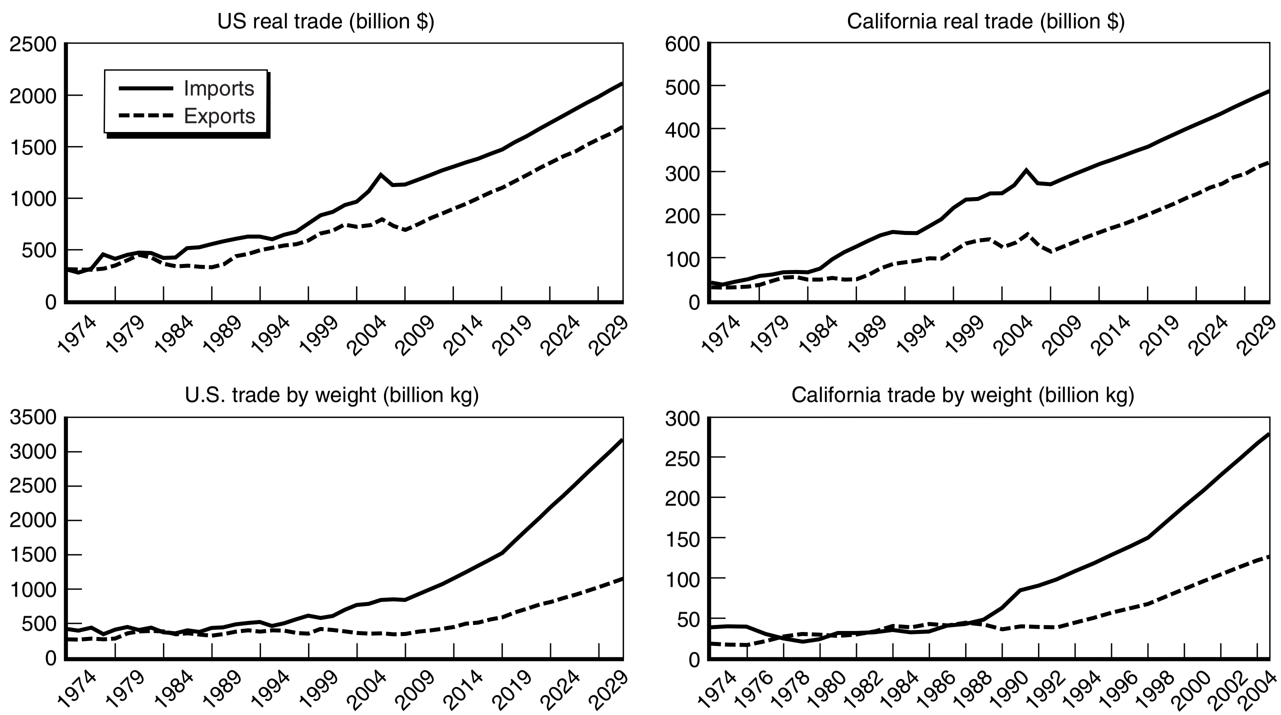
Main Results

Figure 7.1 shows forecast trade growth, by value, for imports and exports. Between 1974 and 2000, the real value of all U.S. imports increased more than fourfold. Our forecast exercise predicts roughly an 87 percent increase in imports and a 148 percent increase in exports between 2002 and 2020 for the United States as a whole. Import growth through California is predicted to rise 81 percent and export growth through California to rise 187 percent.

The source of this trade growth is twofold. First, output growth is predicted to be higher outside the United States, meaning a relative expansion of foreign markets to buy from and sell to. Second, the scenario assumes a gradual reduction of tariff barriers by all countries during this period. Although the United States currently has low tariffs, this reduction of barriers implies more significant liberalization in foreign markets than in the United States.

The second panel of Figure 7.1 shows trade growth by weight. For both California and the United States as a whole, we see an extremely rapid growth in the weight of imports and a widening gap between imports and exports. Here, the commodity composition of trade comes to the fore. As the United States continues to specialize in and export lighter manufactured goods, it will import more and more heavy goods from abroad.

A chronic problem faced by ports and shippers, particularly in the San Pedro Bay, is the dramatic imbalance in container volume through the port. Containers arrive full and depart empty. Figure 7.1 suggests that this problem will only worsen. In 2002, the volume of imports exceeded the volume of exports by almost 55 billion kilograms. By 2020, this imbalance is projected to reach something in excess of 150 billion kilograms. Nationwide, this imbalance grows from nearly 500 billion kilograms in 2002 to almost 2050 billion kilograms in 2020. This contrasts sharply with the top panels in Figure 7.1; by value, the U.S. trade balance is projected to remain fairly constant between 2002 and 2020.



SOURCE: 1974–2002 data are from U.S. Census Bureau, *U.S. Exports/Imports of Merchandise*.
NOTE: Actual trade for 1974–2002 and projected figures for 2005, 2010, and 2020.

As we highlighted in Chapter 5, the growth of heavy trade through California has several unfortunate implications. First, the ad valorem incidence of shipping costs is much higher for goods with high weight-to-value ratios. This means that final demand for these goods is much more sensitive to transportation costs, limiting the ability of ports to increase fees. Second, the effect of shipping on local infrastructure depends on the weight of trade, whereas the potential benefits to ancillary industries depend on value. So a rising weight-to-value ratio implies rising costs without corresponding benefits. Our forecasts indicate that this problem will not improve much for exports and will worsen for imports.

In Table 7.1, we separate growth in the value of trade by mode. On the export side, the simulation predicts similar growth rates for air and

Table 7.1

Projected Growth in the Value of U.S. Trade Through 2020

	Exports			Imports		
	2002	2010	2020	2002	2010	2020
U.S. Total (billion $)						
Total	671	1,080	1,665	1,115	1,451	2,089
Air	223	384	591	254	306	397
Vessel	190	314	500	536	733	1,131
Other	258	381	574	325	411	561
Percent Increase over 2002						
Total		61	148		30	87
Air		72	165		20	56
Vessel		65	163		37	111
Other		48	122		26	73
California Total (billion $)						
Total	110	196	316	267	354	482
Air	58	106	167	53	63	74
Vessel	39	68	112	196	266	368
Other	14	22	37	18	25	39
Percent Increase over 2002						
Total		78	187		33	81
Air		83	188		19	40
Vessel		74	187		36	88
Other		57	164		39	117

SOURCES: Authors' estimates. 2002 data are from U.S. Census Bureau, *U.S. Exports/Imports of Merchandise* (2002).

ocean modes and slightly lower rates for other (land) modes. This is true for California and the United States as a whole. The numbers on the import side are quite different, showing much higher growth in ocean than in air or land usage. Table 7.2 shows modal growth by weight and tells a similar story: high growth rates on the export side and growth favoring ocean transport on the import side.

To better understand how these changes affect the importance of California in U.S. trade, we perform a shift-share analysis similar to that presented in Chapter 5. The analysis here is limited to the effect of changes in country and commodity composition, as mode and port shares are predetermined by the assumptions of our forecast model.

Table 7.3 indicates that California is expected to handle an increasing share of both air and ocean exports but a declining share of both air and ocean imports. From Column 4 of Table 7.3, we find that this trend is driven largely by changes in the country mix of U.S. trading partners. The destinations for U.S. exports tend to require the use of

Table 7.2

Projected Growth in the Volume of U.S. Trade Through 2020

	Exports			Imports		
	2002	2010	2020	2002	2010	2020
U.S. Total (billion kg)						
Total	319.5	566.9	1,113.10	816.8	1,499.50	3,155.20
Air	2.3	3.7	5.8	3.5	4.3	5.5
Vessel	317.2	563.2	1,107.40	813.3	1,495.20	3,149.70
Percent Increase over 2002						
Total		77	248		84	286
Air		61	152		23	57
Vessel		78	249		84	287
California Total (billion kg)						
Total	35.9	65.3	125.8	92.0	147.8	276.7
Air	0.4	0.7	1.2	0.6	0.8	1.1
Vessel	35.4	64.6	124.7	91.3	147.0	275.6
Percent Increase over 2002						
Total		82	250		61	201
Air		75	200		33	83
Vessel		82	252		61	202

SOURCES: Authors' estimates. 2002 data are from U.S. Census Bureau, *U.S. Exports/Imports of Merchandise* (2002).

Table 7.3

California's Changing Percentage Share of Trade, by Value, 2002 to 2020

	Share Changes	Commodity Changes	Country Changes
	Exports		
Air	2.1	–0.3	2.3
Ocean	1.9	–0.2	2.1
Land	1.0	–0.2	1.1
	Imports		
Air	–2.7	–1.5	–1.2
Ocean	–5.0	–1.2	–3.9
Land	1.2	0.3	0.9

SOURCES: Authors' estimates from GTAP projections and U.S. Census Bureau, *U.S. Exports/Imports of Merchandise* (2002).

NOTE: Columns 2 and 3 may not add to the first column because of rounding.

California as a gateway, whereas imports are increasingly from countries that do not. Much of Central and South America, Europe, and Africa fall in this category.

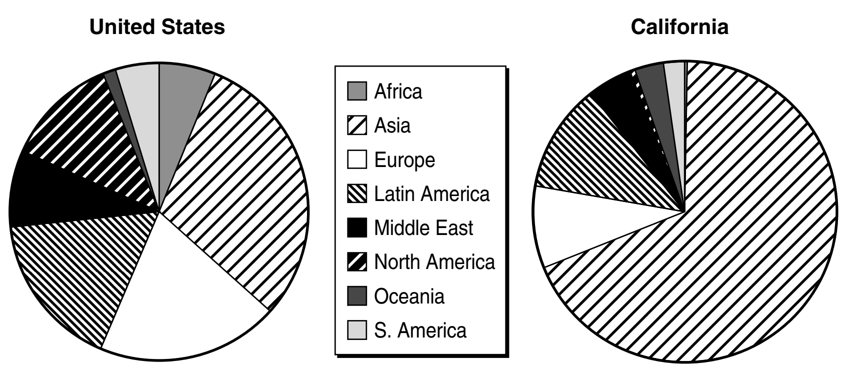
The effect of the changes in country mix is largely driven by developments in trade with China and Japan, two countries that figure prominently in trade through California. Japanese trade is expected to stagnate, reflecting a shrinking population and lower overall GDP growth. Chinese trade is expected to make great strides as a result of both rapid GDP growth and trade liberalization. Finally, California's share of other (land-based) trade is projected to increase as trade with Mexico rises.

The forecast change in the commodity mix of U.S. imports implies a rise in the absolute value of, but a fall in the *share* of, trade moving through California's air and ocean gateways. The change in air imports reflects a reduced role of computer, office, and other electronic equipment in overall U.S. air imports. The fall in ocean imports reflects a declining presence of toys and computer equipment in U.S. imports.

Another observation from Table 7.1 is that trade flows (imports plus exports) through California will grow more quickly than aggregate U.S.

trade. This is largely the result of the important role that Asia plays in expanding U.S. trade. From Figure 7.2, it is immediately apparent that Asia is the largest driver of U.S. trade growth for the next 20 years. This is a result of generally faster growth predicted for these countries than for much of the rest of the world. As Asia-oriented trade plays such a large role in shipments through California, it is inevitable that California will be affected to a larger extent than will other gateway states.

In the coming years, Asian countries are likely to experience significant growth and to be sources of significant trade liberalization. Accordingly, they are predicted to play an important role in the pattern of growth of U.S. trade, as shown in Figure 7.2. Growth in trade with Asia is only a moderate force in overall U.S. trade growth. However, the growth in trade with Asia, and China in particular, drives most of the rise in shipments through California. This is consistent with the findings of Haveman (2003a), who describes the effect of foreign trade liberalization on exports by California firms. In particular, Haveman predicts that the elimination of all tariffs in the world would lead to a 24 percent increase in California's exports, 72 percent of which would be accounted for by an increase in exports to countries in Asia and the South Pacific. These results appear to apply equally well to the flow of trade through California's gateways.

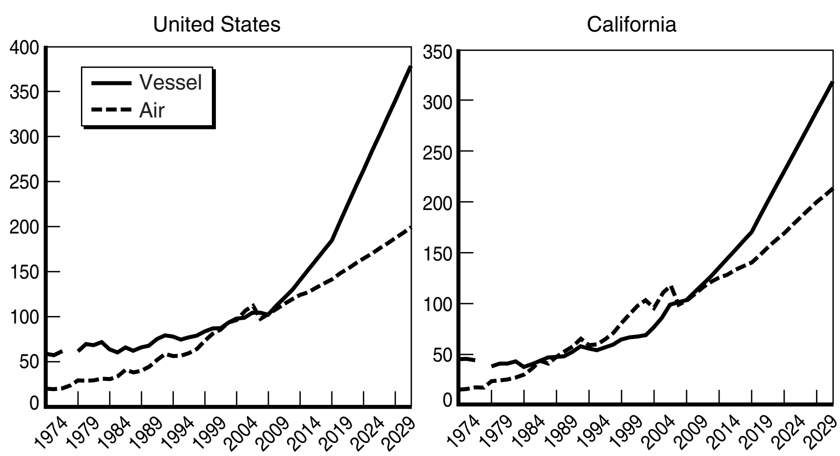


SOURCES: Authors' estimates from GTAP projections and U.S. Census Bureau, *U.S. Exports/ Imports of Merchandise* (2002).

Figure 7.2—Regional Contributions to U.S. and California Trade Growth

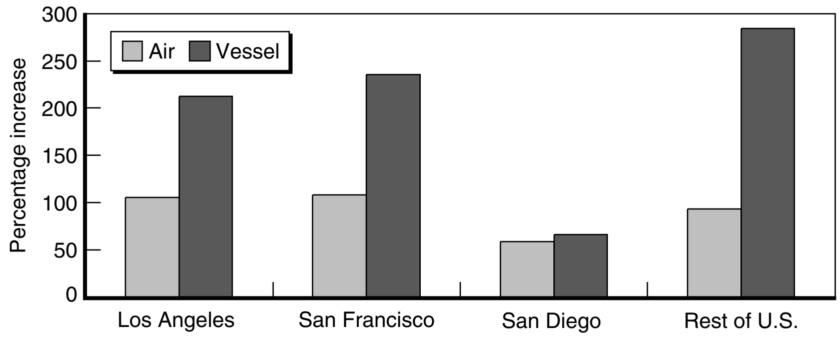
Hidden in the message of Tables 7.1 and 7.2 is the fact that ocean trade through California is expected to grow more quickly than air trade. The gap between the increased value of goods flowing by ocean through California relative to that by air nearly doubles by 2020. The same comparison by weight is not relevant as the weight of trade by ocean overwhelms the weight of air-based trade in any case. However, by scaling the weight of both air and ocean trade in 2002 to be equal to 1, we can compare their trajectories, as is done in Figure 7.3. Although both increase significantly, the increase in the weight of ocean flows is quite dramatic.

Our projections also permit a breakout of trade increases by California customs district (Figure 7.4). The volume of ocean-going trade through California's gateways is projected to increase significantly faster than is the volume of air trade in all three customs districts, although the gap is much smaller for San Diego. This breakdown by customs district helps to put in perspective the dramatic increases that are coming to California gateways. It is difficult to fathom a tripling of shipments through the San Pedro ports, and a volume through San



SOURCE: 1974–2002 data are from U.S. Census Bureau, *U.S. Exports/Imports of Merchandise*.
NOTE: Actual trade for 1974–2002 and projected figures for 2005, 2010, and 2020.

Figure 7.3—Growth in U.S. and California Trade Volume, by Mode (2002 = 100)



SOURCE: Authors' estimates.

Figure 7.4—Growth in California Trade Volume, by Customs District

Francisco that is three and a half times the current level. Congestion in the vicinity of these ports is already burdensome. In the absence of either dramatic changes in the orientation of trade flows or investments in infrastructure at these ports, conditions may well not be conducive to the handling of this increase in trade flows.

By 2020, the value of trade flows through California is expected to triple. This increase will also have significant consequences for the volume of trade the state will be expected to handle. There is a bias toward increased ocean traffic, so the weight California's ports will be expected to handle is almost four times what it was in 2002. The implications for California's ports are therefore enormous. In particular, the Los Angeles–Long Beach region is already straining to move goods from its port facilities to the interior. Clearly, there is much to be done in preparation for the coming flow of goods. To some extent, however, infrastructure constraints may prevent the realization of these forecasts. Current patterns of flow are not written into stone, and goods will flow through the path of least resistance, which may not ultimately be through California, but possibly Mexico, Canada, or even an upgraded Panama Canal.

8. Some Remaining Policy Issues

The analysis and discussion in previous chapters suggest a great many specific policy questions, but most can be subsumed under one large and overarching question. *Does California want to see more international cargo moving through it, or not?* The volume of cargo moved through California has nearly tripled over the past three decades. The state's existing seaports and airports are already approaching capacity constraints and generating significant traffic congestion and pollution. Yet forecasts of future trade growth—predicated largely on the continued expansion of China as a world trade power and its natural geographic tendency to ship to the United States through California—indicate that the demand for California's cargo services could triple again in the next 20 years. Should California invest in the infrastructure necessary to handle this surging demand? Or should it be content to let ports in less congested areas meet that increased demand?

The argument for investing in infrastructure is that California's status as an entrepôt and international transport hub generates significant benefits, which come in three forms. First, ports and transportation services directly employ many workers, and expansion presumably means more jobs.[1] Second, manufacturing firms whose products are especially difficult to move because of weight or bulk benefit from proximity to efficient seaports. Similarly, manufacturers whose products are especially time-sensitive benefit from proximity to efficient airports. Continuous improvement in port infrastructure therefore aids in the maintenance of the manufacturing base. Third, the combination of port services and the manufacturing activity they attract generates ancillary industries that support each.

[1]This connection has been made and assessed in a number of publications. Recently, OnTrac (2002, 2003) and Los Angeles County Economic Development Corporation (2003) have been actively involved in evaluating the benefits of trade through Los Angeles for the surrounding areas and the rest of the country.

The best example of these benefits can be seen in the Asian city-states of Hong Kong and Singapore. Together, these entrepôts have the population of Los Angeles but have become economic dynamos and giants in international trade by leveraging the geographic advantage of sitting astride important trade routes. Trade and logistics services employ many citizens of Hong Kong and Singapore, as does manufacturing that takes advantage of their hub status. Most intriguing, though, is how ancillary services such as international finance, insurance, and consulting sprang up in the shadow of their ports. Ultimately, these countries did not become rich because a few hundred thousand workers were employed in their ports, but because the existence of the ports and the trade that flows through them enabled the creation of millions of high-value-added jobs in manufacturing industries.

Still, it is not entirely clear that the examples of Hong Kong and Singapore apply directly to California. The transportation and logistics industry employs 11.2 percent of the overall U.S. workforce, and 22 states have a higher proportion of their workforce in this sector than does California. Furthermore, Los Angeles and Alameda Counties, home to California's major ports, have a smaller percentage of workers in this sector than do many other U.S. counties housing large cities. Inland locations such as Atlanta, Salt Lake City, Denver, and Lincoln, Nebraska, have a higher proportion of employment in transport and logistics than do Los Angeles and Alameda. It is therefore unclear that employment in these sectors receives a tremendous boost because of the ports.

Regarding the dependence of manufacturing on proximate ports, this is an interesting hypothesis, but we are unaware of any direct evidence to support it. Indeed, evidence linking any infrastructure investment to the creation of competitive advantage in manufacturing is scarce. California has a disproportionate share of employment in manufacturing, but without a careful investigation into why this is true, the link to infrastructure remains speculative.

In any case, much of California's natural advantage stems from its access to coastal waters and proximity to Asia. But as we have shown in Chapter 5, these advantages can be overcome by air transport. Alaska, not California, sits astride the shortest-distance air route between Asia and most of the United States. As products become lighter, it becomes easier to rely on air-shipping directly to inland locations and avoid coastal bottlenecks. Airports can operate on a small scale and, indeed, some manufacturers in the Southern states have built essentially private airstrips for moving air cargo in and out of their production facilities. All of these developments combine to create a steady erosion of California's geographic advantage for some goods. Light, high-value goods fly inland and heavy, low-value goods continue to use California's ports.

This compositional shift is a matter of significant concern. The spillover benefits of ports to manufacturing and ancillary services depend on the value moved through them, whereas only the direct benefits of port employment depend on quantities moved. That is to say, a container-load of microchips weighs about the same as a container-load of scrap metal and requires about the same amount of dock labor to move. However, the revenues to ports and local ancillary industries from handling scrap metal are likely to be less than revenues to ports for handling exclusively high-value goods such as microchips.

Further, the costs of hosting gateway ports are also rising in the quantities moved. Chapter 2 emphasized the growing congestion problems near these ports. The Los Angeles area is already severely burdened by the flow of traded goods through the area. On some major routes, SCAG has found that the shipments of goods reduce average highway speeds in excess of 65 percent. To facilitate the increased quantities that our forecast suggests are coming would require dramatic investments in infrastructure—SCAG is currently proposing a 120-mile truck route to be constructed on top of existing highways. Failing this, a significant diversion of traffic away from the Los Angeles region would take place. But other California port facilities and, indeed, each of the other major U.S. ports on the West Coast suffers from significant congestion issues.

The congestion costs are not limited to traffic slowdowns around ports.[2] Trucks moving containers in and out of ports produce significant air pollution, as do the passenger cars idled in the traffic delays caused by

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[2]Don Breazeale and Associates, Inc. (2003) has recently concluded a study that details the costs as well as the benefits of freight movement activity in California. Although thorough, the study does not include a formal accounting. We are unaware of a formal accounting of the benefits and costs of entrepôt status for California.

these trucks. Oceanfront property is also expensive, and reserving a large and growing share of it for shipping crowds out other productive uses of this land. And if transport-intensive manufacturing is attracted to ports, manufacturing that does not require port access is repelled by them. Why would an electronics manufacturer that can easily airlift its product out of any small airport in America fight the higher land prices, labor costs, and highway crowding that ports generate?

Part of the dilemma inherent in our fundamental question is that the relevant economic and political issues cross over obvious jurisdictional boundaries. Put another way, should we think about the expansion of the Port of Los Angeles and associated transport nodes as an issue to be resolved by the port itself, the city and county of Los Angeles, the state of California, or indeed, the United States as a whole? Clearly, the port would like to expand to meet the coming demand, but should Los Angeles assist in this effort given the attendant congestion issues? As congestion is highly localized in the areas around the ports, is congestion an appropriate concern of the state of California? If high traffic through the Port of Los Angeles aids manufacturers throughout California, policymakers at the state level might prefer policies that generate greater congestion for Los Angeles. Similarly, the state could play an active role in expanding facilities at the port, but if this merely diverts port traffic from the Bay Area, is this a good use of resources?

Finally, if the U.S. government finds it worthwhile to facilitate trade, should other states be involved in subsidizing investment in bottleneck areas in California? This last question is noteworthy for two reasons. First, California is a major provider of transport services to other states, and not all the costs of this provision are fully shared. Second, the next round of world trade negotiations are likely to focus on trade facilitation as a key issue. The argument is that, with explicit barriers to trade such as tariffs fading away, further liberalization turns on the ability to remove implicit barriers to trade such as those caused by inefficient transport networks. The U.S. government has been a leader in demanding improved trade facilitation from its trading partners. Can it continue to do so if the major entry points into the United States become bottlenecks?

We raise these questions, rather than answer them, because they are extraordinarily complex. But some effort must be made to determine at what level these infrastructure questions are decided and what mixture of local, state, and federal cooperation is appropriate. State policymakers, both in Sacramento and in Washington, D.C., have recognized the need for such an effort and have begun initiatives designed to improve the transportation infrastructure situation in the state. This effort requires both the identification of infrastructure trouble spots and the generation of resources with which to make the necessary improvements. It also requires the assumption that facilitating an expansion of trade flows through the state is important. As we have suggested above, this assumption is not necessarily correct, although it is an appropriate position to take in the absence of evidence to the contrary.

At the heart of this effort is a program to identify important areas for infrastructure improvement. In 2000, State Senator Betty Karnette began this effort with Senate Concurrent Resolution 96, which initiated California's Global Gateways Development Program and resulted in a report that outlined infrastructure trouble spots and steps needed to improve them.[3] The report recommended specific implementation steps, including the initiation of a Goods Movement Investment Program, the active involvement by the state in improving the operating efficiency of the state's major gateways, greater flexibility in the use of state funds, and the development of coalitions of goods movement advocates to develop greater federal support for the goods movement efforts on the West Coast.

With the exception of a greater funding burden placed on state coffers, which the current budget situation renders all but impossible, much of this call to action is feasible and crucial to improving the flow of goods through the state. There is significant scope for improving the efficiency of the state's major gateways, and coalitions have proven successful at drawing the attention of those in control of significant purse strings. In particular, the I-95 Corridor Coalition, representing the 12

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[3]State of California (2002). An additional publication by the California Marine and Intermodal Transportation System Advisory Council (2003) details specific needs for California's Marine Transportation System.

states from Virginia to Maine and the I-69 Mid-Continent Highway Coalition, a seven-state contingent including Michigan, Texas, and the states in between, have been active for years and have drawn the attention of lawmakers to important infrastructure issues in their regions.

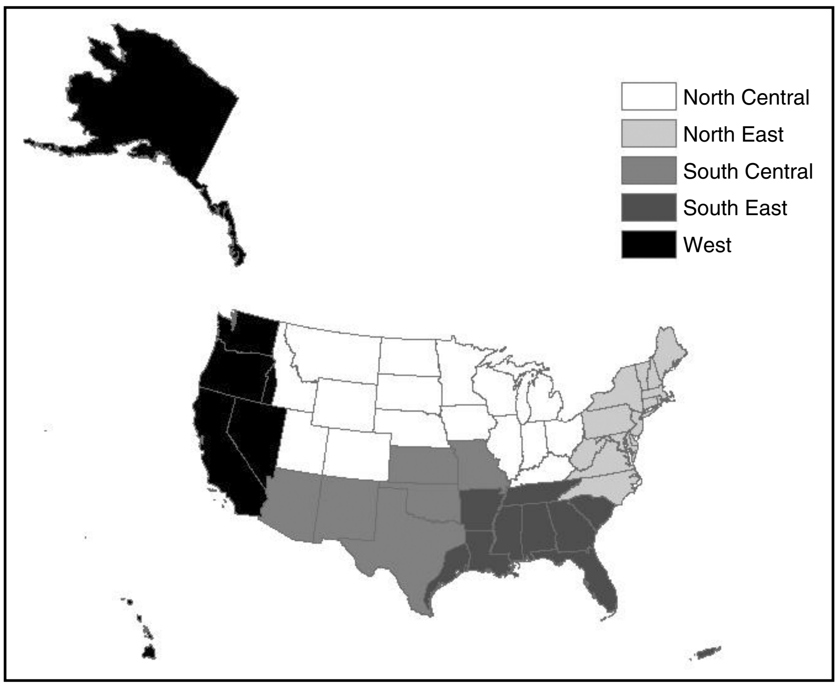
After State Senator Karnette's call to action, several coalitional initiatives have developed that could increase the attention given to California's gateways and the important role that they play in the U.S. economy. In particular, Congresswoman Millender-McDonald has both formed the House Goods Movement Caucus and introduced "Goods Movement" legislation that would allocate additional federal funds for transportation infrastructure projects around the country. This legislation is in addition to efforts by the caucus to increase the attention given to goods movement in the federal transportation infrastructure legislation, currently TEA-21. This legislation has expired and congressional action on reauthorization is scheduled for sometime in 2004.

In addition to the federal caucus, Washington, Oregon, and California have joined forces to form the West Coast Corridor Coalition (WCCC). This coalition has goods movement generally rather than international trade as its focus. This effort, although probably too late to influence the TEA-21 reauthorization in any significant way, may help draw national attention to the needs of important goods movement corridors on the West Coast, including California's global gateways.

This report has surveyed California's global gateways, showing where trade has been and where it is likely to go. Although California's initiatives designed to accommodate this trade are appropriate, it remains an open question as to whether this accommodation is truly in the state's best interests. Whatever uncertainties remain, one thing is clear: The demands of international commerce on California's ports and its people will only grow.

Appendix A

U.S. Customs Districts, by Region



NOTES: Boise, Idaho, is part of the West and the remainder of the state is North Central. Port Arthur and Houston, Texas, are part of the South East and the remainder of the state is South Central.

Figure A.1—U.S. Customs Districts, by Region

Table A.1

U.S. Customs Districts

No.	Name	Region
01	Portland, Maine	North East
02	St. Albans, Vermont	North East
04	Boston, Massachusetts	North East
05	Providence, Rhode Island	North East
07	Ogdensburg, New York	North East
09	Buffalo, New York	North East
10	New York City, New York	North East
11	Philadelphia, Pennsylvania	North East
13	Baltimore, Maryland	North East
14	Norfolk, Virginia	North East
15	Wilmington, North Carolina	North East
16	Charleston, South Carolina	South East
17	Savannah, Georgia	South East
18	Tampa, Florida	South East
19	Mobile, Alabama	South East
20	New Orleans, Louisiana	South East
21	Port Arthur, Texas	South East
23	Laredo, Texas	South Central
24	El Paso, Texas	South Central
25	San Diego, California	West
26	Nogales, Arizona	South Central
27	Los Angeles, California	West
28	San Francisco, California	West
29	Columbia-Snake, Oregon	West
30	Seattle, Washington	West
31	Anchorage, Alaska	West
32	Honolulu, Hawaii	West
33	Great Falls, Montana	North Central
34	Pembina, North Dakota	North Central
35	Minneapolis, Minnesota	North Central
36	Duluth, Minnesota	North Central
37	Milwaukee, Wisconsin	North Central
38	Detroit, Michigan	North Central
39	Chicago, Illinois	North Central
41	Cleveland, Ohio	North Central
45	St. Louis, Missouri	South Central
49	San Juan, Puerto Rico	South East
51	Virgin Islands	South East
52	Miami, Florida	South East
53	Houston, Texas	South East
54	Washington, D.C.	North East
55	Dallas/Fort Worth, Texas	South Central

Appendix B

World Countries, by Region

Africa

Algeria	Eritrea	Namibia
Angola	Ethiopia	Niger
Benin	Gabon	Nigeria
Botswana	Gambia, The	Reunion
Burkina Faso	Ghana	Rwanda
Burundi	Guinea	Sao Tome and Principe
Cameroon	Guinea-Bissau	Senegal
Cape Verde	Heard Island and McDonald Islands	Seychelles
Central African Republic	Kenya	Sierra Leone
Chad	Lesotho	Somalia
Comoros	Liberia	South Africa
Congo, Democratic Republic of the	Libya	Sudan
Congo, Republic of the	Madagascar	Swaziland
Cote d'Ivoire	Malawi	Tanzania
Djibouti	Mali	Togo
Egypt	Mauritania	Tunisia
Equatorial Guinea	Mauritius	Uganda
	Morocco	Western Sahara
	Mozambique	Zambia
		Zimbabwe

Asia

Afghanistan	Georgia	Nepal
Armenia	Hong Kong	Pakistan
Azerbaijan	India	Papua New Guinea
Bangladesh	Indonesia	Philippines
Bhutan	Japan	Russia
British Indian Ocean Territory	Kazakhstan	Singapore
Brunei	Korea North	Sri Lanka
	Korea South	Taiwan

Burma
Cambodia
China
Christmas Island
Cocos (Keeling) Islands
East Timor
Kyrgyzstan
Laos
Macau
Malaysia
Maldives
Mongolia
Tajikistan
Thailand
Turkmenistan
Uzbekistan
Vietnam

Europe

Albania
Andorra
Austria
Belarus
Belgium
Bosnia and Herzegovina
Bulgaria
Croatia
Czech Republic
Denmark
Estonia
Faroe Islands
Finland
France
Germany
Gibraltar
Greece
Holy See (Vatican City)
Hungary
Iceland
Ireland
Italy
Latvia
Liechtenstein
Lithuania
Luxembourg
Macedonia
Malta
Moldova
Monaco
Netherlands
Norway
Poland
Portugal
Romania
San Marino
Slovakia
Slovenia
Spain
Svalbard
Sweden
Switzerland
Turkey
Ukraine
United Kingdom
Yugoslavia

Latin America

Anguilla
Antigua and Barbuda
Aruba
Bahamas, The
Barbados
Belize
British Virgin Islands
Cayman Islands
Costa Rica
Cuba
Dominica
Dominican Republic
El Salvador
Grenada
Guadeloupe
Guatemala
Haiti
Honduras
Jamaica
Martinique
Montserrat
Netherlands Antilles
Nicaragua
Panama
Saint Kitts and Nevis
Saint Lucia
Saint Vincent and the Grenadines
Trinidad and Tobago
Turks and Caicos Islands

Middle East

Bahrain	Jordan	Saudi Arabia
Cyprus	Kuwait	Syria
Gaza Strip	Lebanon	United Arab Emirates
Iran	Oman	West Bank
Iraq	Qatar	Yemen
Israel		

North America

Bermuda	Greenland	Saint Pierre and Miquelon
Canada	Mexico	

Oceania

Australia	Micronesia, Federated States of	Pitcairn Islands
Cook Islands	Nauru	Solomon Islands
Fiji	New Caledonia	Tokelau
French Polynesia	New Zealand	Tonga
French Southern and Antarctic Lands	Niue	Tuvalu
Kiribati	Norfolk Island	Vanuatu
Marshall Islands	Palau	Wallis and Futuna
		Western Samoa

Other

Canada for Unknown Final Destination

South America

Argentina	Ecuador	Peru
Bolivia	Falkland Islands (Islas Malvinas)	Saint Helena
Brazil	French Guiana	Suriname
Chile	Guyana	Uruguay
Colombia	Paraguay	Venezuela

Appendix C

Understanding Shift-Share Analysis

In Chapter 5, we used a shift-share analysis to distinguish between likely causes of changes in California's share of U.S. trade. In this appendix, we provide some background on the calculations underlying the analysis.

Shift-share analysis begins with the observation that California's share of U.S. trade flows into a particular customs district, by a particular mode of transportation, of a particular commodity, from a particular country, can be computationally calculated as follows:

$$T_{ijk}^{l} = S_{ijk}^{l} \times W_{ijk} \times K_{jk} \times C_{k}$$

where l indexes U.S. customs districts, i indexes mode, j indexes commodities, and k indexes countries. If V indicates either the value or the weight of trade flows, the terms on the right-hand side of the equation are then defined as:

$$S_{ijk}^{l} = \frac{V_{ijk}^{l}}{V_{ijk}},$$

and is district l's share of U.S. imports or exports of goods shipped by mode i, commodity j, from or to country k,

$$W_{ijk} = \frac{V_{ijk}}{V_{jk}},$$

and is mode i's share of U.S. imports or exports of commodity j, from or to country k,

$$K_{jk} = \frac{V_{jk}}{V_{k}},$$

and is commodity *j*'s share of U.S. imports or exports from or to country *k*,

$$C_k = \frac{V_k}{V},$$

and is country *k*'s share of all U.S. imports or exports.

Any change in one of California's trade shares, T^l_{ijk} can then be broken down into the portion attributable to changes in flows into California's customs districts, changes in the modal choice of shippers, changes in the commodity composition of U.S. trade flows, or changes in the country composition of those trading with the United States. Although changes in flows through California's customs districts may result from changes in modal choice, or country or commodity composition of U.S. trade, this analysis removes these factors before ascribing any change in share to elements fundamental to the demand for port services; these changes may result from technological change (bigger ships need deeper ports, or airplanes are able to fly greater distances), relocation of internal markets, or some other change in the demand for port services in California, for instance, relative user fees or costs associated with congestion.

The decomposition is with respect to changes in trade flows between two time periods and is calculated as follows:

$$\Delta T^l_{ijk} = \Delta S^l_{ijk} \times (\overline{W}_{ijk}\overline{K}_{jk}\overline{C}_k) + \Delta W_{ijk} \times (\overline{S}^l_{ijk}\overline{K}_{jk}\overline{C}_k)$$
$$+ \Delta K_{ij} \times (\overline{S}^l_{ijk}\overline{W}_{ijk}\overline{C}_k) + \Delta C_k(\overline{S}^l_{ijk}\overline{W}_{ijk}\overline{K}_{jk})$$

where Δ indicates the change in the share over time and $\overline{X}$ indicates the average of the share in the two time periods. As a shorthand, we can write:

$$\Delta T^l_{ijk} = S_{ijk} + W_{ijk} + K_{jk} + C_k$$

By adding up these changes in different ways, we are able to discern the proximate sources of the total changes in California's share, *T*. For instance,

$$\sum_{ijk} S_{ijk}$$

indicates the contribution of changes in the pattern of port demand to changes in customs district *l*'s share of U.S. trade. This can be more or less than the district's actual change in share depending on the influence of changes in modal choice or the commodity and country composition of trade.

Bibliography

Alameda Corridor Transportation Authority, *The Alameda Corridor Backgrounder,* available at http://www.acta.org/newsroom_factsheet.htm (accessed November 13, 2003).

Alameda Corridor Transportation Authority, *Alameda Corridor Board Authorizes Bond Sale to Complete Funding Package,* News Release, December 17, 1998, available at http://www.acta.org/Releases/releases_11.html (accessed November 13, 2003).

Anderson, Patrick L., "Lost Earnings Due to the West Coast Port Shutdown-Preliminary Estimate," Anderson Economic Group, LLC, working paper 2002-10, Lansing, Michigan, October 7, 2002.

Armstrong, David, "High Price of Security: Shippers, Ports Scramble to Find Ways to Pay for Anti-Terrorism Upgrades," *San Francisco Chronicle*, *Business*, July 24, 2003, p. 1.

California Marine and Intermodal Transportation System Advisory Council, "California Marine Transportation System Infrastructure Needs," March 11, 2003.

Council of Economic Advisers, *2003 Economic Report of the President*, U.S. Government Printing Office, Washington, D.C., 2003.

Dimaranan, Betina V., and Robert A. McDougall, *Global Trade, Assistance, and Production: The GTAP 5 Data Base*, Center for Global Trade Analysis, Purdue University, W. Lafayette, Indiana, 2002.

Don Breazeale and Associates, Inc., *California Freight Movement Cost Benefit Study: Final Report,* Rancho Santa Fe, California, March 2003.

Fink, Carsten, "Transport Services: Reducing Barriers to Trade," in *World Bank, Global Economic Prospects,* Washington, D.C., 2002.

Fink, Carsten, Aaditya Mattoo, and Ileana Cristin Neagu, "Trade in International Maritime Services: How Much Does Policy Matter?" *World Bank Economic Review*, No. 16, 2002, pp. 81–108.

Flynn, Stephen E., "America the Vulnerable," *Foreign Affairs,* Vol. 81, No. 1, January/February 2002.

Hall, Peter V., " 'We'd Have to Sink the Ships': Impact Studies and the 2002 West Coast Port Lockout," unpublished manuscript, University of California, Berkeley, 2003.

Hankla, James C., "Alameda Corridor Meets Goals and Expectations But Freight Rail Expressway Is Only Part of Goods Movement Solution," The Cunningham Report, Open Editorial, n.d., available at http://www.cunninghamreport.com/HanklaOpEd.htm as of November 10, 2003.

Haveman, Jon D., *Foreign Tariff Barriers and California Exports*, Public Policy Institute of California, San Francisco, California, 2003a.

Haveman, Jon D., "Imports, Exports, and Shipping Services: The Balance Between California and Other States," Public Policy Institute of California, San Francisco, California, 2003b.

Hertel, Thomas W., *Global Trade Analysis Using the GTAP Model*, Cambridge University Press, New York, 1997.

Ianchovichina, E. L., "International Capital Linkages: Theory and Applications in a Dynamic Computable General Equilibrium Model," Ph.D. Dissertation, Purdue University, W. Lafayette, Indiana, 1998.

Ianchovichina, E. L., Robert A. McDougall, and Thomas W. Hertel, "A Disequilibrium Model of International Capital Mobility," paper presented at the Second Annual Conference on Global Economics Analysis, Denmark, June 1999.

Los Angeles County Economic Development Corporation, "International Trade Trends & Impacts: The Los Angeles Region, 2002 Results and 2003 Outlook," Los Angeles, California, May 2003.

Martin Associates, "An Assessment of the Potential Impacts of a Work Slowdown at West Coast Container Ports," prepared for the Pacific Maritime Association, Lancaster, Pennsylvania, January 25, 2002.

Massachusetts Institute for Social and Economic Research (MISER), Foreign Trade Database, Amherst, Massachusetts, available at http://www.misertrade.org.

Melendres, Maria M., email correspondence with Maria Melendres, ACTA Public Affairs Officer, November 15, 2003.

Nacht, Michael, "A Call for Closer Guarding of Coasts," *The Mercury News,* May 5, 2002.

New York Times, "Port Lockouts Narrowed Trade Deficit in October," December 19, 2002, p. C2.

OnTrac, "OnTrac Trade Impact Study," Los Angeles, California, December 2002.

OnTrac, "OnTrac Trade Impact Study: National Economic Significance of Rail Capacity and Homeland Security on the Alameda Corridor East," Los Angeles, California, September 2003.

Ransdell, Timothy, and Shervin Boloorian, *Federal Formula Grants: Federal Highway Programs*, Public Policy Institute of California, San Francisco, California, 2003.

Rosen Lum, Rebecca, "Ports Have No Money, But a Wealth of New Security Rules," *Contra Costa Times*, October 28, 2003.

State of California, *Global Gateways Development Program: Stakeholder Perspectives on Options to Facilitate the Movement of Goods in California*, Sacramento, California, January 2002.

U.S. Census Bureau, *2001 County Business Patterns,* Washington D.C., available at http://www.census.gov/epcd/cbp/view/cbpview.html as of November 12, 2003.

U.S. Census Bureau, Foreign Trade Division, *U.S. Exports/Imports of Merchandise,* Washington, D.C., various years.

U.S. Coast Guard, "Maritime Strategy for Homeland Security," Washington, D.C., December 2002.

U.S. Department of Commerce, Bureau of Economic Analysis, *Current-Dollar and "Real" GDP,* Washington, D.C., December 23, 2003.

U.S. Department of Homeland Security, "Secretary Ridge Announces New Initiatives for Port Security," Washington, D.C., June 12, 2003.

U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics 2001*, Washington, D.C., 2001.

U.S. Department of Transportation, Maritime Administration, *Intermodal Access to US Ports: Report on Survey Findings,* Washington, D.C., August 2002a.

U.S. Department of Transportation, Bureau of Transportation Statistics, *California Transportation Profile*, Washington, D.C., 2002b.

U.S. Department of Transportation, Bureau of Transportation Statistics, *U.S. International Trade and Freight Transportation Trends,* Washington, D.C., 2003.

U.S. Department of Transportation, Bureau of Transportation Statistics, *Transborder Surface Freight Database,* various years, available at http://www.bts.gov/ntda/tbscd/.

U.S. Department of Transportation, Bureau of Transportation Statistics, *Border Crossings Data*, various years, available at http://www.transtats.bts.gov.

U.S. Department of Transportation, Maritime Administration, *Waterborne Databank,* Washington, D.C., various years.

Walmsley, Terri L., Betina V. Dimaranan, and Robert A. McDougall, "A Base Case Scenario for the Dynamic GTAP Model," unpublished monograph, Purdue University, W. Lafayette, Indiana, July 2000.

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