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Recent Trends in Exports of California's Information Technology Products

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SUMMARY

California's information technology industry is both the state's leading manufacturing sector and its leading export sector. Exports from this sector grew rapidly between 1997 and 2000 but then declined dramatically for both the state and the United States through 2003—in California's case, a decline of more than $25 billion, or 42 percent, from the 2000 peak. Perhaps more important, California exports declined far more, proportionately, than those of the United States. Between 2000 and 2003, California's share of U.S. manufactured information technology exports dropped from 31 percent to 24.5 percent.

This issue of *California Economic Policy* documents the changing pattern of California's manufactured information technology exports during the recent boom and bust period. Much of the drop in the total value of exports between 2000 and 2003 stemmed from lower purchases of California commodities worldwide, but declining prices for commodities exported from California also contributed. The vast majority of the steep dropoff in California's share of the U.S. total stemmed from a redirection of purchases away from California to other states. The increase in exports from other states relative to those from California appears to be related to changing production patterns. Although specific causes for these changing production patterns are not identified, three possible explanations are discussed—efforts by technology firms to cut costs by producing in lower-cost areas, incentives offered by other states to attract these firms, and opportunities to engage in joint production with Mexico in Texas or other border states.

In recent months, California's share of U.S. manufactured information technology exports has regained some of its lost ground, but these developments are too recent to suggest conclusions about the likely trend. If the export share loss is permanent, this sector and the high wages it pays may decline in importance in California. If transitory, then going forward, California could face higher volatility than that faced by the rest of the United States in this important export sector. These export patterns therefore merit attention and further investigation by the state's policymakers.

California Economic Policy *is a quarterly series analyzing and discussing policy issues affecting the California economy.*

Recent Trends in Exports of California's Information Technology Products

Introduction

California is the nation's premier producer and exporter of U.S. manufactured information technology products.[1] Its exports of these products marched upward throughout the late 1990s to $61 billion in 2000, and in that year they constituted more than half of all California's goods exports and almost 44 percent of the output of California information technology manufacturers. This export increase, from $46 billion only two years earlier, occurred as part of a great technology expansion throughout the United States. Just as California's exports rose dramatically, so did those from the rest of the United States. And when the technology bubble burst in 2001, exports of these products from both California and the rest of the United States fell dramatically.

Not only did exports of technology products from both California and the rest of the United States collapse, but they fell far more on a relative basis in California.

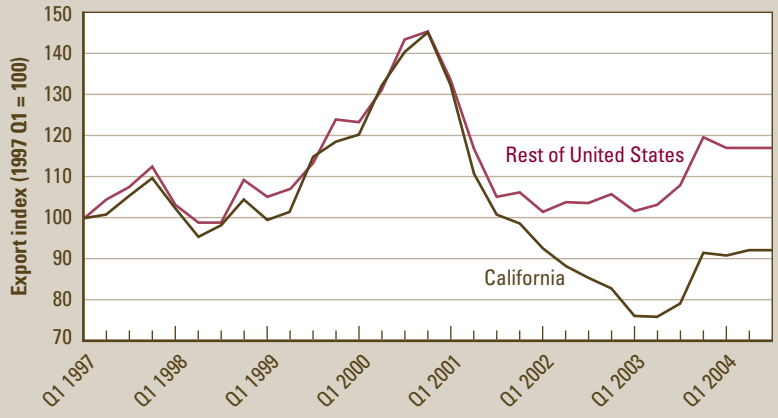
For California, however, the fall had an extra dimension. Not only did exports of technology products from both California and the rest of the United States collapse, but they fell far more on a relative basis in California (Figure 1). From the beginning of 1997 to nearly the end of 2001, the rise and fall of California's exports closely tracked those of the rest of the country. In fact, the state maintained a constant 30–31 percent share of all U.S. exports of these products during that period. However, at the end of 2001, when these exports from the rest of the United States started leveling off, those from California continued to fall into the middle of 2003. In 2003, California's exports constituted less than 25 percent of all U.S. exports in this industry.

This report documents changes in the importance and pattern of manufactured information technology exports for California during the recent boom and bust period, 1997–2003, including changes in the level of California's exports and the more puzzling change in California's share of U.S. exports. It explores the causes of these dramatic shifts by analyzing the effects of reduced global demand for U.S. technology exports, the effects of changes in technology-goods prices, and the effects of shifts away from California to other states as sources for information technology exports. It then discusses possible causes and implications of these trends.

The issue is important for three reasons. First, the industry as a whole is a large part of California's manufacturing economy. Second, exports constitute a large portion of the industry's sales. And third, exports may be important to an industry's long-term health. Research in a number of countries within the past decade has shown that firms that export tend to pay higher wages, have higher productivity, expand employment more, and survive longer.[2]

California has recently seen an increase in its exports of these products. However, even with recent gains in 2004, the state still exported less than 26 percent of all U.S. exports in these goods, well below its share in the late 1990s. And although comparable data are not available for the period before 1997, our estimates stretching back to 1988 indicate that such a share drop has not occurred before, despite the volatility of the industry.[3] For a background in understanding the puzzling drop of

Figure 1. Information Technology Exports from California and the Rest of the United States



Source: World Institute for Strategic Economic Research (2004).

the last few years, we provide in the next section a brief profile of California's manufactured information technology sector, and California's manufactured exports generally.

California Technology Production and Exports

California is remarkably diverse in its production of technology-based goods and services. In manufacturing, it produces semiconductors, computers, communications equipment, pharmaceuticals, aerospace equipment, and medical devices. In services, it produces software, performs data processing, carries out scientific research and development, and provides medical and diagnostic laboratory services.

Among all these sectors, the leading one in terms of employment and exports is the computer and electronic products manufacturing sector—or information technology sector—the focus of this report. In 2001, the latest year of comprehensive employment and production data, this industry employed 22 percent of all California manufacturing workers, paid 31 percent of all California manufacturing payroll, and produced 29 percent of all California manufacturing output.[4]

California's computer and electronic products industry is the largest in the nation. Output in 2001 measured $122 billion, with $68 billion of that representing value added in California after accounting for intermediate inputs. The industry's employment of 395,000 constituted almost 25 percent of all workers in the computer and electronic products industry in the United States. For comparison, California's share of total U.S. nonfarm employment was only 11.1 percent in 2001.[5] Texas hosted the second-largest computer and electronic products sector, with output of $49 billion, less than half that of California's, and employment of 136,000.

The importance of the technology sector to California's economy stems not just from its size but from its high wages. In 2001, manufacturing employees in California earned on average $40,279, and all employees in the state earned on average $41,327. In contrast, workers in the computer and electronic products industry earned on average $56,282.[6]

The importance of the technology sector to California's economy stems not just from its size but from its high wages.

Exports absorb a large proportion of output in this industry in California. Between 1997 and 2001, exports amounted to more than 40 percent of the output of the California information technology industry. In the United States as a whole, they amounted to 36 percent.[7] In 2001, the California industry exported almost 41.2 percent of its output, the third-highest export ratio among all California manufacturing industries that year. The average for all industries was 24 percent. The machinery industry and the leather and allied products industry each exported 56 percent of their output, but both these industries were small compared to the information technology industry—machinery output totaled only 16 percent of information technology output, and leather output totaled only 0.4 percent.

Within this industry, both California and total U.S. exports are concentrated in five commodities:

- integrated circuits;
- computers and peripheral devices;
- computer parts and accessories;
- telecommunications equipment; and
- semiconductor devices.[8]

Integrated circuits, often referred to simply as chips, are used for a variety of devices, including electronic memory, microprocessors, and audio and video equipment. Computers and peripheral devices include desktop and laptop computers in addition to various input and output devices, such as keyboards, monitors, printers, and other similar hardware. The third category—computer parts and accessories—includes such components as printed circuit assemblies (for example, motherboards, video adapters, or network interface cards) and memory modules for computers and certain

other machinery. Telecommunications equipment includes telephones and facsimile machines in addition to more sophisticated telephonic apparatuses, such as switching equipment. Semiconductor devices include diodes, transistors, and certain photosensitive devices.

Throughout 1997 to 2003, California's exports were actually more concentrated in these five commodities than were those of the United States. As of 2003, 67 percent of California's information technology exports were in these categories, down from 71 percent in 1997, whereas only 62 percent of overall U.S. information technology exports were in these categories, unchanged from 1997.

Between the fourth quarter of 2000, the peak of California's technology exports, and the second quarter of 2003, the trough, the state's quarterly technology exports dropped by $7.9 billion, or 48 percent.

Among destinations, both California and overall U.S. exports of these products were heavily concentrated in Mexico, Canada, and Japan—the top three destinations, in order, for both the state and the nation in 2003. China and Hong Kong rounded out the top five markets, which together absorbed nearly half of all California information technology exports by 2003. The most significant change in this ordering is the movement of Mexico from the number three spot in 1997 to number one in 2003 in both the California and overall U.S. rankings.

As discussed in the introduction, the value of technology products exported from California rose and fell dramatically between 1997 and 2003. In 1997, at the beginning of the technology boom, California exported $47 billion worth of technology products—48 percent of all of California goods exports. The next three years brought a dramatic growth of technology exports from the state. By 2000, California's technology exports had grown to $61 billion, or 51.4 percent of all California exports. This subsequently gave way to a precipitous decline through 2003, when exports of these products amounted to only $37 billion, just 39 percent of all exports from the state.

Exports of technology products from other states exhibit a similar up-and-down pattern—but not quite as down. Through the third quarter of 2001, the percentage change in technology exports from California was comparable to that from other states, and California's share of all U.S. information technology exports held steady at 31 percent. In the period through 2003, however, California's exports fell relative to those of other states, ending with a 24.5 percent share, its lowest level on record.

The absolute decline in California's technology exports was more severe than in any other exporting state. More tellingly, California's peak to trough proportional decline of 48 percent was among the highest of any major exporting state. Among states that had more than $1 billion worth of exports at their quarterly peak, only Minnesota and New Jersey experienced larger proportional declines.[9]

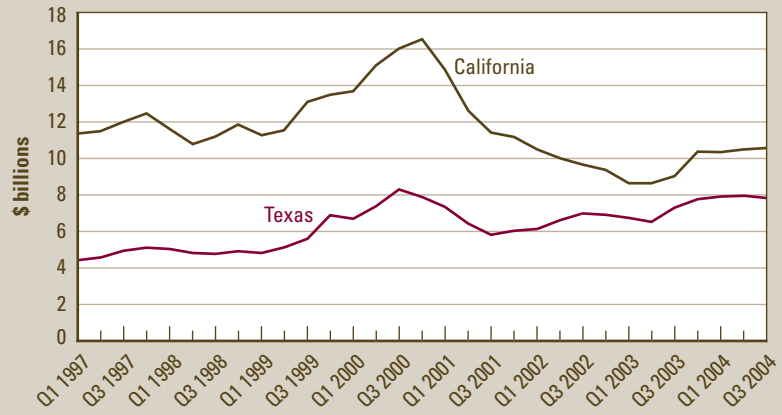
California and Texas have historically dominated U.S. technology exports, and a comparison of their technology exports between 1997 and 2003 highlights California's decline (Figure 2). Between the fourth quarter of 2000, the peak of California's technology exports, and the second quarter of 2003, the trough, the state's quarterly technology exports dropped by $7.9 billion, or 48 percent, from slightly less than $16.6 billion to slightly more than $8.6 billion. Texas, the second-largest source of U.S. technology exports, experienced a similar decline after 2000, but one that was less severe in both absolute and proportional terms. Texas peaked in the third quarter of 2000 at $8.3 billion and troughed in the third quarter of 2001 at $5.8 billion, a proportional drop of only 30 percent. The narrowing of the gap is even more dramatic when looking at annual totals. Between 2000 and 2003, the gap in annual technology exports between California and Texas fell from $31 billion to just over $8 billion.

This differential decline meant that the contribution of California and Texas to overall U.S. technology exports also changed during the period. In both 1997 and 2003, California and Texas pro-

vided more than 43 percent of total U.S. technology exports (Figure 3). This share increased to almost 47 percent in 2000. Most of the share gain came from proportionately more rapid growth of exports from Texas, with that state's share of the U.S. total rising from 12 to 15 percent. Between 2000 and 2003, Texas's share of the total continued to increase, to 19 percent, whereas California's shrank.

In sum, two significant patterns emerged regarding California's information technology exports after 2000. First, they suffered a dramatic absolute drop in their level. Second, they fell proportionately more than did exports in the same industry from other states, resulting in a reduced share of U.S. exports. We now turn to a formal analysis of the causes of these two phenomena.

Figure 2. Trends in Technology Exports, California and Texas



Source: World Institute for Strategic Economic Research (2004).

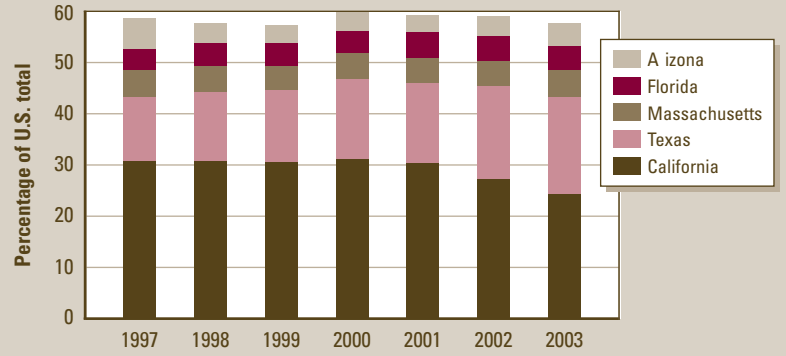
The Changing Value of California's Technology Exports

The value of California's quarterly information technology exports between January 1997 and December 2003 peaked in the fourth quarter of 2000 and bottomed in the second quarter of 2003, mirroring the global collapse of the technology industry after its run-up of the late 1990s. These export trends were remarkably stable, with every quarter's exports larger than those before it between 1997 and 2000 and every quarter's exports smaller than those of the previous quarter from 2000 through early 2003.

This section describes multiple causes of the changes in total export values to help audiences better understand California's export patterns in the boom period of 1997 through 2000 and the bust period of 2000 through 2003. It does so by using trade data at the most disaggregated level possible, basing the analysis on trade patterns for almost 300 commodities manufactured by the computer and electronic products industry.[10]

The value of exports can be influenced by changes in the prices of commodities, changes in the quantities purchased—more units or fewer units[11]—and changes in the composition of commodities—shifts away from one type of commodity to another. A general increase in the price of technology products exported from California will raise their total value, just as an increase in quantities will. Furthermore, a shift of worldwide demand toward higher-value commodities could raise total export values.

Figure 3. State Distribution of U.S. Technology Exports, Top Exporters



Source: World Institute for Strategic Economic Research (2004).
Notes: The figure shows the share of U.S. information technology exports for the 2003 top five states. Six states actually stand well above the rest in terms of technology exports. New York was number six in 2003 but number five between 2000 and 2002.

Recent Trends in Exports of California's Information Technology Products

In the 1997 to 2000 period, an increase in quantities purchased was the dominant cause for the rise in California export values (Table 1). More specifically, the analysis shows that if only the quantity of base-year information technology exports had risen, holding prices the same and not allowing for changes in the types of commodities sold, California's exports would have risen by $10.5 billion, accounting for 74.8 percent of the total increase in export values. The next contributor to the export increase was commodity composition. If quantities and prices had remained the same and only the types of commodities sold had changed, then California's exports would have risen by $4.1 billion. Price changes actually had a negative influence on the value of California's information technology exports. If quantities and commodity composition had remained the same, then price changes between 1997 and 2000 would have caused California's exports to fall by $0.6 billion.[12]

This decomposition of the sources of the rise of California's technology exports differs from that of other states. The greatest gains for exports from the rest of the United States stemmed from changes in the types of commodities that foreigners purchased from them. The rise in quantities purchased played the second-largest role, and price changes played a positive, albeit small, role.

Between 2000 and 2003, California's exports fell by almost $25 billion. Just as changes in quantities were responsible for most of California's export gains, they were also responsible for most of California's export declines. The decline in the quantity of exports alone reduced the value of California's technology exports by almost $18 billion, accounting for 72 percent of the total decline in the state's technology exports.

Declining prices of technology products further reduced the value of California's exports by an additional $5.5 billion. In fact, changing world prices is the only factor that reduced the value of California's exports during both periods. This is not surprising, as the decline in technology prices over time is well documented.[13] A shift in the composition of exports toward lower-priced products augmented these declines, perhaps reflecting a retrenchment of California's technology exports back into its core products. The products that fell relatively faster between 2000 and 2003 were generally the same products that had risen relatively faster in the earlier period, and they were generally the higher-priced goods, in particular computers and integrated circuits.

For the rest of the United States, declines in quantity also played a significant role in the decline of total export values. Had there been no changes

Table 1. Changes in the Value of Technology Product Exports

	California				Rest of the United States			
	1997–2000		2000–2003		1997–2000		2000–2003	
Source of Change	$ billions	%	$ billions	%	$ billions	%	$ billions	%
Prices	–0.6	–4.1	–5.5	–22.3	2.0	6.9	–10.3	–47.8
Commodity composition	4.1	29.3	–1.4	–5.8	16.9	57.7	9.3	43.1
Quantity	10.5	74.8	–17.8	–71.9	10.3	35.3	–20.5	–95.3
Actual change in value	14.1		–24.7		29.3		–21.5	

Sources: Global Trade Information Services (1997–2001), World Institute for Strategic Economic Research (2002–2004), and authors' computations.
Notes: Export values are in nominal terms. The formulas behind this decomposition are derived from the discussion of price indices in Diewert (2004).

in commodity composition or prices, the quantity declines would have generated about 95 percent of the total decline. Substantial changes in prices (downward) and commodity composition (toward higher-value products) largely offset each other.

The Changing California Share of U.S. Information Technology Exports

The preceding section showed how changes in prices, quantities, and commodity composition contributed to the change in the overall *level* of California's information technology exports. We now move to an analysis of the sources of California's proportionately greater drop in exports than that experienced by the rest of the United States. This section focuses on a decomposition of how changes in commodity composition, foreign markets, and domestic U.S. sources contributed to the deep drop in California's share of U.S. manufactured information technology exports.

Between 1997 and 2000, California's share of U.S. technology exports remained almost constant at 31 percent. In 2001, the share dropped slightly to 30.4 percent and then continued to fall, ending at 24.5 percent in 2003. Evidence indicates that a share decline of this magnitude had not occurred before—in other words, that this was not a simple, cyclical event. Unfortunately, data for exports by the computer and electronic products industry are not available on a comparable basis before 1997. However, we estimated these exports for California and the United States in two ways, going back to 1988, and found no comparable share decrease before that experienced between 2000 and 2003. In particular, in the late 1990s, when the Asian economic crisis depressed U.S. exports of technology products, California's exports declined proportionately, maintaining their overall share.

As discussed in the previous section, changes in values can be determined by changes in both prices and quantities. In the event that price changes are biased toward reducing the value of California's exports, they could also be responsible for the observed decline in California's share of overall U.S. exports of these products. However, our examination in the previous section makes it clear that the declining value of California's exports was overwhelmingly due to changes in quantities. That this change in quantity should result in a decline in California's share indicates that one of three changes might have occurred. First, the decline in California's share could reflect a greater reduction of imports by countries that traditionally purchase these products from California producers. Second, it could reflect a greater reduction in world demand for the specific technology products most commonly produced in California. Third, it could reflect continued purchases of those products by traditional U.S. export partners, but from states other than California.

Evidence indicates that a share decline of this magnitude had not occurred before—in other words, that this was not a simple, cyclical event.

This section provides a detailed analysis that identifies the sources of California's declining share by using a methodological technique known as "shift-share decomposition." As with the analysis in the previous section, this decomposition is carried out at the detailed commodity level. This time, we also include the country level, so the analysis includes individual country-commodity cells.

The technical details of this decomposition are reported elsewhere, but the idea behind it is simple.[14] It separates changes in California's share of U.S. technology exports into three types—changes by commodity, changes by country, and changes by source state. Regarding changes by commodity, this technique asks the following question: Suppose U.S. exports of a commodity rose, but there were no other changes in exports. Given California's starting share of exports in this commodity, in which direction, and by how much, would California's share of U.S. exports change? The question for country changes is similar: Suppose U.S. exports to a country rose, but there were no other changes in exports. Given California's starting share of exports to this country, in which direc-

Between 2000 and 2003, California's share of U.S. technology exports declined by 6.8 percentage points. If California had kept pace with exports from other states, its exports of technology products would have been in excess of $10 billion higher than was actually observed.

tion, and by how much, would California's share of exports change? Finally, the question for source state changes is as follows: Suppose U.S. exports in a particular commodity and to a particular country changed. Did California's exports of that commodity to that country change as much? If not, then the change is credited to other states.

Between 2000 and 2003, California's share of U.S. technology exports declined by 6.8 percentage points (Table 2). If California had kept pace with exports from other states, its exports of technology products would have been in excess of $10 billion higher than was actually observed, and it would have maintained its constant share of 31 percent of U.S. manufactured information technology exports. In other words, California's changing share accounts for more than 40 percent of the almost $25 billion total decline in California's technology exports between 2000 and 2003.

Table 2. Contributions to Changes in California's Share of U.S. Technology Exports, 2000–2003

	Contribution to Changing Share	Value of Lost Trade
Source of Change	**(percentage points)**	**($ billions)**
Commodity composition	–1.1	1.7
Country composition	–0.1	0.2
State shift	–5.7	8.6
Total change in California share	–6.8	10.3

Sources: Global Trade Information Services (1997–2001), World Institute for Strategic Economic Research (2002–2004), and authors' computations.
Notes: The first three rows use the shift-share decomposition to attribute changes in California's share of U.S. exports to commodity composition, country composition, and state-specific factors. The final row reports the total change in California's share of U.S. technology exports. Numbers may not sum exactly because of rounding.

Of this share decline, it is possible to attribute just under one-sixth, or 1.1 percentage points, to changes in the commodity structure of U.S. exports. That is, U.S. exports shifted away slightly from commodities that California produces. In particular, there was a dramatic decline in U.S. exports of integrated circuits and computers. These two categories were, respectively, the top two export categories for California producers of information technology products. Although U.S. exports of all information technology products fell by 7 percent, U.S. exports of computers fell by more than 22 percent and exports of integrated circuits fell by 29 percent. California's exports of both categories fell by just over 48 percent. Because California accounted for more than 37 percent of all U.S. exports of these products in 2000, the decline in world demand for these U.S. products disproportionately affected California. However, this was not the main contributor to California's share decline.

A slightly different message could be inferred from Table 1, which suggests that changes in commodity composition are responsible for a $10.7 billion relative increase in exports by other states between 2000 and 2003, because of a decline of $1.4 billion in California and an increase of $9.3 billion elsewhere. However, the two decompositions measure different types of changes, so there is no contradiction. Table 1 indicates an increased relative presence of lower-priced commodities in California's actual export bundle, both lowering the value of California's exports and raising the value of exports from other states. The decomposition of this section, featured in Table 2, instead focuses on total U.S. exports and indicates that the changes in U.S. exports across commodities during this same period did not significantly compromise California's exports of these products. Changes in aggregate world demand for U.S. exports across commodities lowered California's exports by only $1.7 billion. The changes attributable to commodity composition in Table 1 are reflected here in the "state shift" row as the U.S. exports of relatively higher-priced manufactured information technol-

ogy products are increasingly produced in states other than California. We explore this further below, after discussing country effects.

A second source of California's changing share, changes in the pattern of U.S. exports across countries, contributed one-tenth of one percentage point to the decline in California's export share. This is not to say that the pattern of U.S. exports across countries was unchanged between 2000 and 2003 but rather that, on the whole, the shift was not meaningfully biased in one way or another with respect to California's exports.

Reductions in aggregate U.S. technology exports to Japan, Canada, and the United Kingdom did result in downward pressure on California's share of U.S. technology product exports. These were three of the seven largest markets for California's technology products in 2000. During this period, however, an expansion in U.S. technology exports to China, Malaysia, and Hong Kong offset much of the decline in exports to Japan, Canada, and the United Kingdom. Overall, the reorientation of U.S. technology exports on a country basis had a negligible effect on California's exports.

With country-change and commodity-change contributions small, a shift of sourcing away from California to other states accounts for most of the drop in California's share of U.S. information technology exports. This shift accounts for 5.7 percentage points—more than 83 percent—of the reduction in California's share of the U.S. total. In dollar terms, the state shift represents $8.6 billion of exports that might have been sold from California, all else equal, but that in 2003 were sold from other states.

These changes are calculated on a disaggregated country-by-commodity basis. That is, we are able to discern, for example, how much of the decline in California's exports of integrated circuits to Malaysia can be attributed to increased exports from another state. To understand the details of California's share loss, we next analyze changes by commodity, aggregated over countries, and changes by country, aggregated over commodities, and then conclude with individual country-commodity combinations.

By far the largest single category of products in which California has been losing share to other states is integrated circuits (Figure 4). Had California's share of U.S. exports of these products remained constant between 2000 and 2003, its exports of technology products would have been almost $4 billion higher. California also suffered a significant decline in export market share of computers, peripheral devices, and their parts and accessories. Losses in these two product categories resulted in a further decline of more than $4.5 billion in California's technology exports. Integrated circuits, computers, and computer parts together account for more than 5.6 of the 5.7 share point loss attributable to the change of states serving as sources of U.S. exports. California experienced small share losses in a number of other products, but similarly small share gains elsewhere somewhat offset these declines.

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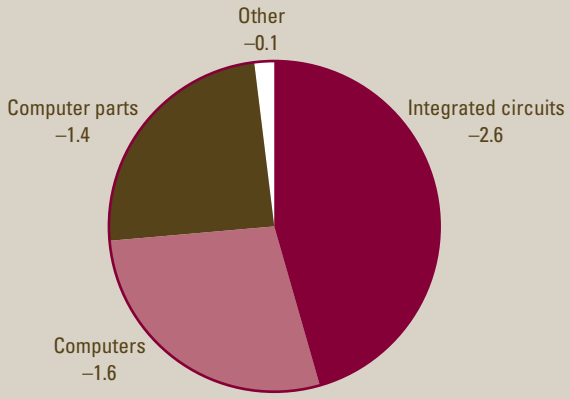
California gave up market share to other states in trade

Figure 4. Commodity Export Shifts to Other States and Their Contribution to California's Market Share Decline, 2000–2003



Source: Global Trade Information Services (1997–2001), World Institute for Strategic Economic Research (2002–2004), and authors' computations.

California gave up market share to other states in trade with particular countries, especially Mexico and Canada.

with particular countries, especially Mexico and Canada (Figure 5). Combined, these two countries account for more than one-third of the 5.7 share points ceded to other states, or $2.9 billion worth of exports. Other important countries that switched their supplier of U.S. information technology products from California to other states included Malaysia and South Korea, followed by the Philippines, Japan, and the Netherlands. Hong Kong is the only economy for which California picked up significant market share. The losses to Canada and Mexico were concentrated in the computer and computer parts sectors, with additional significant losses in exports of integrated circuits to Mexico. Texas captured the preponderance of this trade.

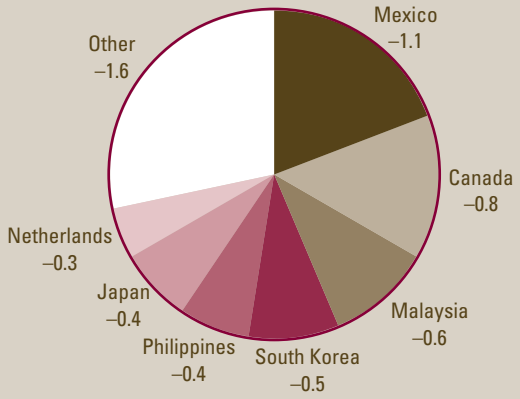
At the same time that exports of computers and computer parts from California to Mexico were declining, overall U.S. exports of these products to Mexico grew. U.S. exports of these products to Canada fell, and California accounted for most of the decline. Declines in California's share of trade to Canada were largely offset by an increase in Texas's share of U.S. trade with Canada; Tennessee and Colorado also experienced gains in the share of U.S. trade with Canada in these products during this period. Considering other declines in California's share of particular commodity-country flows, Arizona, Oregon, Massachusetts, Florida, and Utah also absorbed some of the decline in California's share.

In addition to looking at specific countries and commodities, we can also examine particular commodity-country pairs. The largest pair in which California lost market share relative to the United States as a whole was of exports of integrated circuits to Malaysia (Table 3). Declines in exports of integrated circuits to five other economies—South Korea, the Philippines, Taiwan, Mexico, and Thailand—also proved important in California's loss of share to other states. Curiously, California gained share through an expansion of these very same products to Hong Kong. Despite an overall decline in U.S. exports to Hong Kong, California's exports increased by $400 million; states losing share in this bilateral relationship included Texas and Oregon.

One additional aspect of California's changing share of U.S. manufactured information technology exports is highlighted in Table 3. The changes are relatively concentrated in a small number of countries and commodities. The table lists the top 10 country-commodity pairs that are responsible for reducing California's share of U.S. technology exports. These pairs account for 3.7 points of California's 5.7 point share decline and reflect a reduction of $7.7 billion in California's exports. The largest influence on California's share change is the reduction of integrated circuits exports to Malaysia, replaced by exports from other states, contributing more than half a percentage point to the overall share decline. This list of 10 pairs includes only seven countries and three goods sectors, further reflecting the high concentration of country-commodity pairs that contributed to the decline of California's share of U.S. information technology exports.

Many of these countries were also leading export destinations for California goods but to a lesser degree

Figure 5. Country Export Shifts to Other States and Their Contribution to California's Market Share Decline, 2000–2003



Source: Global Trade Information Services (1997–2001), World Institute for Strategic Economic Research (2002–2004), and authors' computations.

Table 3. Top 10 Information Technology Export Shifts from California to Other States, 2000–2003

Country	Product	Change in California Share	Change in California Exports		Change in Rest of U.S. Exports		States Gaining Share
			($ billions)	%	($ billions)	%	
Malaysia	Integrated circuits	–0.57	–0.8	–60	1.9	54	Texas, Arizona
Mexico	Computer parts and accessories	–0.48	–0.1	–17	2.3	233	Texas
Canada	Computers	–0.45	–1.1	–46	0.1	2	Texas, Tennessee
South Korea	Integrated circuits	–0.41	–1.0	–57	–0.3	–7	Oregon
Philippines	Integrated circuits	–0.40	–0.6	–58	1.1	31	Texas, Massachusetts, Arizona
Taiwan	Integrated circuits	–0.37	–0.8	–51	0.0	1	Texas, Utah
Mexico	Integrated circuits	–0.34	–1.3	–54	–0.8	–21	Texas
Mexico	Computers	–0.29	–0.5	–38	0.5	39	Texas, Florida
Thailand	Integrated circuits	–0.21	–0.8	–86	–0.5	–42	Arizona, Texas
Canada	Computer parts and accessories	–0.20	–0.7	–60	–0.3	–19	Texas, Colorado
Total		–3.72	–7.7	–53	4.1	15	
Hong Kong	Integrated circuits	0.23	0.4	28	–0.4	–31	Texas, Oregon (lost share)

Sources: Global Trade Information Services (1997–2001), World Institute for Strategic Economic Research (2002–2004), and authors' computations.
Note: Total is an aggregate for the 10 country-commodity rows listed above and not a total for all country-commodity pairs.

than their contribution to California's share decline. The 10 country-commodity pairs shown in the table accounted for about two-thirds of the state's total share decline, and the seven countries listed in the table bought 46 percent of California's information technology exports in 2000. Likewise, the seven countries listed in Figure 5 bought 54 percent of California's information technology exports in 2000, again not quite as concentrated as the contribution of the 10 leading country-commodity pairs in Table 3.

Discussion of Findings

Much of the decline of California's technology exports stemmed from a general collapse of demand for technology products worldwide. However, a large portion of the drop in level also occurred because of a drop in share—U.S. trade partners bought more of these goods from other states. Available evidence indicates that one reason exports shifted is that after

2001, companies scaled back their production of information technology goods more in California relative to production in other states. Between 2001 and 2002, when California's share of U.S. exports of information technology products dropped from 30.4 to 27.2 percent, the state's share of U.S. production of information technology products fell from 28.4 to 25.6 percent, and the state's share of U.S. value added in information technology products fell from 30.4 to 25.7 percent. This suggests that what occurred between 2000 and 2003 was a change in production patterns, not just a change in export patterns. Interestingly, these decreases were not accompanied by proportionate decreases in employment—California's share of U.S. industry employment has stayed steady at around 23 to 24 percent.

What occurred between 2000 and 2003 was a change in production patterns, not just a change in export patterns.

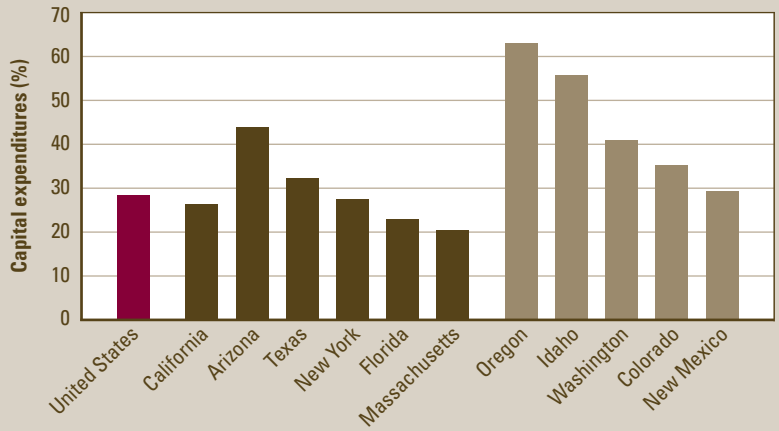
Other evidence for the expansion of production in other states rather than California is provided by news articles and press releases. Events included the opening of two Intel plants in Arizona and Colorado in 2001 and the opening of a Samsung chip plant in Austin, Texas, in 1997 and its expansion in 1999. By late 2004, California hosted very little semiconductor production capacity among major semiconductor companies compared to the rest of the United States.[15]

Several different factors may explain the scaling back of production and export sourcing in California and their expansion in other states. None are definitive, although all are possible. These include industry efforts to cut costs by increasing production in lower-cost areas, incentives or other "pull" factors offered by other states, and better opportunities to engage in joint production with Mexico in Texas or other border states.

Information technology manufacturing has shown a tendency to have firm headquarters in specialized information technology centers but to locate production in lower-cost areas. This buildup of production in lower cost locations has occurred over the past decade, but it received an extra boost after the technology collapse of 2001 when manufacturers increased their attention to low-cost production opportunities.[16]

The expansion of production facilities in other states can be seen in the investment data. Between 1997 and 2001, a number of other major exporting states gained far more capital investment in technology manufacturing relative to their 1997 output than did California (Figure 6). For the United States as a whole, capital expenditures in those four years totaled 28 percent of the value of 1997 output. California's figure was slightly below that, 26 percent. However, of the other top five exporting states, capital expenditures in Arizona totaled 43 percent of initial output, and those in Texas totaled 32 percent. Other states that exhibited large gains in investment included Oregon (63% of initial output), Idaho (56%), Washington (41%), Colorado (35%), and New Mexico (29%). Many of these states took export share from California between 2000 and 2003. It should be noted that some states that exhibited strong gains in export share did not also have large gains in investment, and vice versa, so investment patterns cannot provide a complete explanation.

Figure 6. Capital Expenditures Relative to Initial Output, 1997–2001



Source: U.S. Census Bureau (2004).
Notes: The figure shows the United States and two groups of states: (1) California and other top exporters, and (2) emerging exporters. Each bar shows cumulative capital expenditures between 1997 and 2001 as a percentage of 1997 output.

Recent Trends in Exports of California's Information Technology Products

Knowing that the technology industry was expanding its production capacity throughout the 1990s and that the industry paid higher than average wages, other states set out to attract this investment through incentives. Evidence is mixed as to whether incentives improve a state's overall prosperity or whether they are cost-effective.[17] Nonetheless, they have helped bring a number of high-profile investments to specific locations.

In 1993, Oregon started its Strategic Investment Program under which major investments could gain more favorable property tax arrangements. In 1999, Washington County and the city of Hillsboro in Oregon took steps under this program as part of an agreement by Intel to invest $12.5 billion there during the next 15 years. Even earlier, in 1987, Texas provided $62 million in incentives to land Sematech, a nonprofit consortium of chipmakers. The Austin-based consortium has formed the core of a Texas technology cluster. Texas added to its state programs in 1999 and also gets mileage out of incentives at the local level, according to some specialists on corporate location.[18] More recently, in 2003, the state created a $295 million Texas Enterprise Fund that the governor uses to court companies thinking of building in Texas, and the state credits this fund with helping land a $3 billion expansion of a Texas Instruments wafer fabrication plant.[19]

A third factor that may have helped Texas, in particular, gain export share between 2000 and 2003 is that state's opportunities for binational production with Mexico. Both Texas and California share a border with Mexico. However, the California-Mexico border is quite far from the center of California's technology industry, Santa Clara County, whereas the Texas-Mexico border is about half as far to the Austin technology cluster.[20] The proximity of Mexico to the industry in Texas may add to the attractiveness of Texas if the importance of cost-cutting increases, as it may have done after the technology collapse.

Indeed, rather than considering the technology industry in the United States, it may be more valuable to consider the industry as a binational entity, with significant cross-border production taking place in maquiladoras, or Mexican assembly and production plants that make high use of imported inputs.

Knowing that the technology industry was expanding its production capacity throughout the 1990s and that the industry paid higher than average wages, other states set out to attract this investment through incentives.

In 2000, Baja California, the one Mexican state bordering California, had 159,400 workers in the broad maquiladora industry that includes information technology manufacturing.[21] The four states bordering Texas had 446,300.[22] The Baja California industry's employment shrunk by almost 24 percent between 2000 and 2002, whereas the Mexican industry bordering Texas shrunk by less than 14 percent. This means that even though California's share of U.S. employment in the industry stayed fairly constant, California's share of U.S.-plus-border-employment actually shrank.

Another difference between the maquiladoras in Baja California and those bordering Texas is that those in Texas grew far more rapidly in both output and the use of imported inputs between 1997 and 2000 and then fell less rapidly in the years after 2000. The nominal value of production in this broad industry in Baja California grew about 75 percent between 1997 and 2000, and the use of imported inputs grew about 64 percent. In contrast, production in the industry bordering Texas grew 114 percent, and the use of imported inputs grew just as fast, 112 percent. Between 2000 and 2002, the use of imported inputs in Baja California fell by 13 percent, but it held steady in the Mexican states bordering Texas.

It is highly likely that a large portion of the imported inputs used by border-state maquiladoras comes from the particular U.S. state that they border. For example, between two-thirds and three-quarters of California exports to Mexico go to an importer in Baja California.[23] They do not necessarily remain in Baja California, but given that state's relative isolation from the rest of Mexico, a large portion probably does. This means that the more rapid growth of the use of imported inputs in maquila-

doras bordering Texas than in those bordering California, through 2000, and the less rapid fall afterward may have contributed to gains in U.S. information technology export share by Texas after 2000.

Looking to the Future

At this point, it is impossible to reach definitive conclusions about the future of the information technology manufacturing industry in California. The decline in production and exports may be part of a natural evolution of industries in California, in which California serves as an incubator for new industries and then sees production grow elsewhere as manufacturing processes become more routine and companies seek cost savings.[24] New industries then arise in California, taking advantage of the state's stock of financiers, scientists, and highly educated workers. Although this is certainly a plausible explanation, the available data do not permit either its validation or refutation. In addition, if exports serve as a signal for this type of evolution, there is a question as to why California dramatically lost share after 2000 rather than seeing a steady erosion as the industry grew throughout the 1990s.

If California's manufactured information technology sector has evolved in such a way as to be especially sensitive to changes in the demand for overall U.S. exports of these products, then the industry's performance in the state may experience high volatility going forward.

California is certainly not out of the technology export game. In 2003, it accounted for 24.5 percent of all such U.S. exports. In 2004, it accounted for 25.7 percent of all U.S. technology exports. In addition, it had small quarter-on-quarter share increases in each of the last three quarters of 2004. These increases were sufficient to offset the decline in share experienced between the third quarter of 2002 and the third quarter of 2003, when it reached its lowest level. It may be that the industry is marshalling its research and development capacity for a new technological development to be built in California and that California will fully—if perhaps, again, temporarily—recover its share of U.S. exports of these products. However, it is much too soon to make this prediction.

Even if California's exports of these products do recover fully, this unprecedented drop in California's export share presents a puzzling development. If California's manufactured information technology sector has evolved in such a way as to be especially sensitive to changes in the demand for overall U.S. exports of these products, then the industry's performance in the state may experience high volatility going forward. Given the industry's importance to California manufacturing and manufactured exports, California policymakers would do well to monitor the situation and learn more about why California's exports were disproportionately affected by the global technology slowdown. ❖

Appendix

Top Exporting States for Information Technology Products, 1997–2004

State	1997	1998	1999	2000	2001	2002	2003	2004
	($ billions)							
California	47.4	45.6	49.5	61.5	50.3	39.7	36.7	42.2
Texas	19.1	19.6	22.5	30.4	25.7	26.7	28.4	31.7
Florida	6.4	6.7	7.1	8.4	8.4	7.2	7.3	8.5
Massachusetts	7.9	7.5	8.1	10.2	8.1	7.0	7.7	7.5
New York	6.2	5.8	6.0	7.4	6.5	6.3	6.3	6.9
Arizona	9.0	5.9	5.8	6.9	5.5	5.5	6.7	5.6
Oregon	3.8	4.1	5.0	5.6	3.8	4.7	4.6	4.2
Illinois	6.2	5.9	5.4	5.1	4.4	3.9	3.7	4.2
Colorado	2.7	3.0	3.5	3.9	3.4	3.0	3.5	3.9
Minnesota	2.9	2.9	3.2	3.9	3.9	3.3	3.4	3.5
Total all states	152.9	147.5	161.5	196.2	165.3	145.9	150.0	164.2

Source: World Institute for Strategic Economic Research (2004).
Notes: Information technology products include goods from NAICS industry 334, computer and electronic products. States are ranked in terms of value of 2004 exports.

California's Top Information Technology Product Markets, 1997–2004

Country	1997	1998	1999	2000	2001	2002	2003	2004
	($ billions)							
Mexico	4.6	4.9	5.7	8.0	6.8	6.3	4.8	5.9
Canada	5.2	5.9	6.4	7.7	5.4	3.8	4.0	4.5
Japan	6.3	5.1	5.0	6.4	5.3	3.5	3.3	4.0
Hong Kong	1.9	1.9	2.4	2.8	2.6	2.4	2.8	3.7
China	0.7	1.0	1.2	1.9	2.6	2.2	2.2	2.6
United Kingdom	2.8	2.8	2.7	3.4	3.0	2.0	1.8	2.3
South Korea	3.0	1.9	3.4	4.1	2.2	2.0	1.8	2.2
Singapore	3.6	3.0	2.9	3.0	2.5	1.7	1.9	2.2
Taiwan	2.4	2.5	2.7	3.5	2.5	2.4	1.9	2.1
Germany	2.0	2.1	2.0	2.4	2.0	1.7	1.7	1.7
Total all countries	47.4	45.6	49.5	61.4	50.3	39.7	36.7	42.2

Source: World Institute for Strategic Economic Research (2004).
Notes: Information technology products include goods from NAICS industry 334, computer and electronic products. Markets are ranked in terms of value of 2004 California exports.

Notes

[1] This is industry 334 of the North American Industry Classification System (NAICS). Please see the appendix for detailed industry export data.

[2] Lewis and Richardson (2001). One key paper among this research has shown that, in general, strong companies become exporters but that exporting leads to employment growth and an increased probability of survival (Bernard and Jensen, 1999).

[3] The U.S. government introduced NAICS in 1997, supplanting the U.S. Standard Industrial Classification (SIC), a system of industrial classification that had been used in one form or another since before World War II. California exports are available in SIC format from 1988 to 2000 and in NAICS format from 1997 to the present. In our first estimate, we aggregated the different SIC industries that went into the NAICS manufactured information technology industry (NAICS 334) and looked at export patterns for this aggregation. In our second estimate, we divided these SIC industries into portions that went into NAICS 334 and those that did not and looked at export patterns for only the portions that went into NAICS 334.

[4] It also produced 31 percent of all California manufacturing value added. Output is the total value of an industry's production. Value added is the value of the industry's production after subtracting the cost of intermediate inputs. It includes primarily wages, profits, and certain business taxes. Data on employment, payroll, output, and value added are from U.S. Census Bureau (2004).

[5] U.S. Department of Labor (n.d.a). Data are not seasonally adjusted.

[6] Manufacturing and technology manufacturing pay is from U.S. Census Bureau (2004). Pay for all employees statewide is from U.S. Department of Labor (n.d.b).

[7] The export figures are transaction values rather than value added and include materials costs. Therefore, the appropriate comparison is to industry output rather than value added. Export data are collected by the U.S. Census Bureau and allocated to states according to the locations designated by the exporter as the "origin of movement." This may be the location of production, but it also could be a warehouse or the location of a logistics company. The match between origin of movement and location of production for manufactured items has been judged to be imperfect but not egregiously so and, regardless, is the only credible and the most widely used source of state-level export data. The data are distributed by private data providers, of which our main source is the World Institute for Strategic Economic Research, formerly the Massachusetts Institute for Social and Economic Research. For more information, see Haveman, Shatz, and Vilchis ("Box 1. What Do State Export Data Tell Us?" p. 8, 2002).

[8] These categories are commodities at the four-digit level as classified under the Harmonized Tariff System (HS). NAICS 334 produces products in 66 four-digit HS commodity categories.

[9] These states included California, Texas, Massachusetts, Arizona, Florida, New York, Illinois, Oregon, Minnesota, Colorado, and New Jersey. The peaks for each state did not necessarily occur in the same quarter.

[10] Technically, these are commodities classified at the six-digit level of the HS.

[11] Quantities are measured mostly in terms of weight, so we are implicitly equating changes in weight with changes in the number of units.

[12] The algorithm used to produce these figures is somewhat more complicated, but thinking about it in these terms does not distort one's understanding of the explanation of changes in California's exports.

[13] For example, the producer price index for personal computers and workstations fell from 262.1 in January 1997 to 30.4 in December 2003, a drop of 88 percent, and the producer price index for computer storage devices fell from 129.1 to 55.4 during the same period, a drop of 57 percent (U.S. Department of Labor, 2004).

[14] Haveman and Hummels (2004).

[15] Plant data for Intel, National Semiconductor, Philips, AMD, Texas Instruments, and IBM were accessed at www.semizone.com.

[16] Daly and Valletta (2004). The pattern of innovating and beginning to manufacture in a high-cost location and then eventually expanding manufacturing in lower-cost locations is known as the product cycle and was identified as early as the 1960s for many industries (Vernon, 1966).

[17] Buss (2001) provides a comprehensive review of the findings on the relationship between taxation, incentives, economic growth, and business location.

[18] Heath (1999).

[19] Office of Texas Governor Rick Perry (2004).

[20] Yahoo! mapping shows a driving distance of 473 miles and a driving time of seven hours and 16 minutes from San Jose to the Otay Mesa border crossing. In contrast, it shows a driving distance of 239 miles and a driving time of four hours and 25 minutes from Austin to the Laredo border crossing (Yahoo! 2004).

[21] This is industry 38 in the 1994 version of the Mexican Classification of Activities and Products (CMAP—Clasificación Mexicana de Actividades y Productos). All maquiladora data are from Instituto Nacional de Estadística, Geografía y Informática (n.d. and 2003).

[22] These states include Chihuahua, Coahuila, Nuevo León, and Tamaulipas.

[23] Shatz and López-Calva (2004).

[24] California lost U.S. export share in a number of other industries between 2000 and 2003, including machinery, electrical equipment, and furniture, but none of these drops were as large proportionately as that of exports from the computer and electronic products industry.

References

Bernard, Andrew B., and J. Bradford Jensen, "Exceptional Exporter Performance: Cause, Effect, or Both?" *Journal of International Economics*, Vol. 47, No. 1, 1999, pp. 1–25.

Buss, Terry F., "The Effect of State Tax Incentives on Economic Growth and Firm Location Decisions: An Overview of the Literature," *Economic Development Quarterly*, Vol. 15, No. 1, February 2001, pp. 90–105.

Daly, Mary C., and Robert G. Valletta, "Performance of Urban Information Technology Centers: The Boom, the Bust, and the Future," *Federal Reserve Bank of San Francisco Economic Review,* 2004, pp. 1–18.

Diewert, Erwin, "Basic Index Number Theory," Chapter 15 of *The Consumer Price Index Manual: Theory and Practice*, International Labour Organization, Geneva, Switzerland, 2004.

Global Trade Information Services, Inc., *Annual Summary of the World Trade Atlas—State Export Edition 1996–2000*, Columbia, South Carolina, 1997–2001.

Haveman, Jon D., and David Hummels, *California's Global Gateways: Trends and Issues*, Public Policy Institute of California, San Francisco, California, 2004.

Haveman, Jon D., Howard J. Shatz, and Ernesto Vilchis, *California and the World Economy: Exports, Foreign Direct Investment and U.S. Trade Policy*, Occasional Paper, Public Policy Institute of California, San Francisco, California, December 2002.

Heath, Tracy, "Texas: Big on Business," *Site Selection*, November 1999.

Instituto Nacional de Estadística, Geografía y Informática, *Maquiladora Database*, Aguascalientes, Aguascalientes, Mexico, n.d.

Instituto Nacional de Estadística, Geografía y Informática, unpublished maquiladora data, Aguascalientes, Aguascalientes, Mexico, 2003.

Lewis III, Howard, and J. David Richardson, *Why Global Commitment Really Matters!* Institute for International Economics, Washington, D.C., 2001.

Office of Texas Governor Rick Perry, "One Year Later Enterprise Fund Has Given Texas a Competitive Advantage," Press Release, October 6, 2004.

Shatz, Howard J., and Luis Felipe López-Calva, *The Emerging Integration of the California-Mexico Economies*, Public Policy Institute of California, San Francisco, California, 2004.

U.S. Census Bureau, *Annual Survey of Manufactures and Census of Manufactures*, electronic database, Washington, D.C., 2004.

U.S. Department of Labor, Bureau of Labor Statistics, *Current Employment Survey*, Washington, D.C., n.d.a.

U.S. Department of Labor, Bureau of Labor Statistics, *Quarterly Census of Employment and Wages*, Washington, D.C., n.d.b.

U.S. Department of Labor, Bureau of Labor Statistics, *Producer Price Index Industry Data*, Washington, D.C., downloaded September 22, 2004. www.bls.gov/ppi/home.htm.

Vernon, Raymond, "International Investment and International Trade in the Product Cycle," *Quarterly Journal of Economics*, Vol. 80, No. 2, May 1966, pp. 190–207.

World Institute for Strategic Economic Research, *Special Data Extract of California Exports by Country at the Six-Digit Schedule B Level*, Amherst, Massachusetts, 2002–2004.

World Institute for Strategic Economic Research, *Foreign Trade Database*, Amherst, Massachusetts, 2004, available at www.wisertrade.org.

Yahoo! Maps, Driving Distances, accessed October 21, 2004, available at www.yahoo.com.

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