Transportation and Economic Development of Coastal Areas in the Pacific Northwest

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The role of improved transportation infrastructure in the economic development of coastal areas in the U.S. Pacific Northwest was examined. A quantitative analysis that addressed how future economic development of this region could be stimulated by improved interregional transportation was undertaken. The research sought to understand the economic development potential of the various communities in the study area by identifying the types of businesses that appeared best suited to prosper in these locations. It then examined in detail the specific transportation and environmental needs of the selected target industries, while matching these needs to the infrastructure and quality of transportation services available. A "what-if" analysis was performed to explore whether proposed transportation infrastructure and service improvements would be justified in terms of their resulting direct user benefits and indirect economic benefits, the latter being addressed using input-output modeling. It was concluded that there are substantial economic benefits that would result from improved transportation. However, it is clear that the transportation system provides no magic for generating economic benefits in rural areas of a magnitude needed to offset the costs of a large-scale infrastructure improvement program. On the other hand, many selective infrastructure improvements and generally increased investment in the transportation system are clearly justified economically. The study also concluded that increased spending on transportation infrastructure in rural areas is only a contributing element in permitting these areas to gain the benefits of a vigorous economy and an improved quality of life.

This paper describes a study that examined the role of improved transportation infrastructure in the economic development of coastal areas of the U.S. Pacific Northwest. The study area extends from Mendocino County, north of San Francisco, to the Canadian border (Figure 1). The paper summarizes a quantitative analysis undertaken to address how future regional economic development could be stimulated by improved transportation infrastructure. The paper also reviews the major study conclusions and recommendations. The selected study area is widely perceived as transportation disadvantaged compared with nearby inland areas because it was bypassed by the interstate highway system and has poor or nonexistent rail service, limited or nonexistent air service, and declining intercity bus and domestic marine transportation services. Historically, the local economies of the area have been based on resource extraction—principally timber and fishing. These economies recently have undergone considerable restructuring, because of both production changes in the traditional industries and changes in the character of the local work force and population.

The communities of the study area are also being affected by broader social and economic trends that include the increasing importance of information processing and management technique as factors of production, increased leisure time and discretionary income, the increasingly footloose character of labor, increased networking among far-flung peer groups, emergence of a unified world economy, and accelerating specialization in economic activities.

The study sought to understand the economic development potential of the various communities in the study area by identifying the types of businesses that appeared best suited to prosper in these locations. It then examined in detail the specific transportation and environmental needs of the selected target industries, while matching these needs to the infrastructure and quality of transportation services available. A "what-if" analysis was performed to explore whether pro-

FIGURE 1 Coastal study area.

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posed transportation infrastructure and service improvements are justified in terms of their resulting direct user benefits and indirect economic benefits. The indirect economic benefits were addressed by using input-output modeling to estimate the impact of transportation system improvements on local income and employment.

The study concluded that there are substantial economic benefits, as well as other types of benefits, that would result from improved transportation. However, it is clear that the transportation system provides no magic wand for generating economic benefits in rural areas of a magnitude needed to offset the costs of large-scale infrastructure improvement programs, such as an expanded interstate freeway system. On the other hand, many selective transportation infrastructure improvements clearly are economically justified. Unfortunately, such improvements are not being made at a sufficient rate to match growing needs because of prevailing financial constraints.

The study also concluded that increased spending on transportation infrastructure in rural areas is only a contributing element to permit these areas to gain the advantages of a vigorous economy and an improved quality of life. In today's world, access to information, ability to participate in peer networks, exchange of new ideas, and increased specialization are the most important factors for economic success. In this regard, infrastructure improvement can play an important role in reducing the sense of remoteness that may discourage innovators and knowledge-sharers from participating in the development of rural areas. Whereas better infrastructure by itself can accomplish little, the role that transportation infrastructure can play in contributing to a balanced program of economic development in rural communities deserves careful attention.

The remainder of the paper contains three sections. The first discusses in greater detail the overall study approach. The second describes how the effects of hypothesized highway system improvements were traced through to their possible economic consequences, measured by direct costs and user benefits, income, and jobs. The last section reviews the principal conclusions and recommendations. The full documentation of the study is found in a three-volume final report (*1–3*).

OVERVIEW OF THE APPROACH

The study work plan included the following tasks:

1. Assemble information on past research dealing with relationships between transportation improvements and economic development.
2. Characterize the current economic and transportation conditions within the study area.
3. Attempt to understand the economic development potential of the various communities in the study area by identifying the types of businesses that seem best suited to prosper in these locations. (This task was aided greatly by the availability of previous target-industry studies performed by several state and local authorities.) Industry selection criteria from previous studies were reviewed, leading to the use of the following criteria by the study:
   - The selected industry offers opportunities to use the skills of displaced timber industry workers.
   - The selected industry can be established in the area through logical expansion of the product lines of businesses already in the area.
   - The selected industry is similar to industries already in the area, offering potential agglomeration economies.
   - The selected industry provides needed input that local businesses now import from outside the area.
   - The selected industry has some special environmental or location advantage, such as tourism and offshore mining.
   - The selected industry increases the value added in the production of goods for sale outside the area.

   These criteria led to the development of a "short list" of industry types, which formed the basis for the subsequent transportation needs analysis.
4. Examine in detail the specific transportation and environmental needs of the selected target industries, and match those needs to the infrastructure and quality of transportation services available.
5. Analyze the strengths and weaknesses of the existing transportation system serving the study area, considering pertinent trends. Whereas all transportation modes were considered, the study focused principally on highways (including trucking and intercity bus) and air. The analysis did not consider rail or coastal maritime transportation in depth, because of both limited resources and the fact that there are several recent, well-founded studies that dealt with these modes in considerable detail (*4–7*).
6. Conduct a "what-if" style of analysis to explore whether alternative transportation infrastructure and service improvements appear justified in light of their associated benefits. Generally, the hypothesized transportation system improvements are similar to those considered in previous studies. However, this analysis tried to explore the frontiers of what could be achieved through better transportation, while attempting to hold capital expenditures to a feasible level. Consequently, many of the infrastructure alternatives are selective spot improvements, implemented on a widespread basis to eliminate delays and other traffic conflicts evident in the existing system.
7. Complete the evaluation of alternatives by estimating the full economic consequences of the hypothesized transportation improvements. This step used conventional engineering economic analysis to estimate on-system costs and benefits and simple input-output modeling to estimate the indirect impact on the local economies and to calculate the associated multipliers.

The last two tasks are discussed in greater detail in the sections that follow.

ANALYSIS OF THE ECONOMIC EFFECTS OF AN IMPROVED HIGHWAY SYSTEM

This section describes the analysis of numerous alternative highway improvements to serve the coastal study area. The consequences of these alternatives are addressed from the

perspectives of direct transportation costs and user benefits and indirect benefits to the local economies.

Alternatives

The alternatives that were considered are not all practical proposals to be implemented in the near future. Rather, they are idealized improvements, devised to explore the boundaries of what could be accomplished if financial and political constraints on transportation improvements were relaxed. There is no way that such an ambitious package of improvements could be implemented under today's funding mechanisms. Also, the physical characteristics and effects of the alternatives are quite crudely specified. More in-depth feasibility analysis would be needed before reaching the "go" or "no-go" decisions for any of these proposals or portions thereof.

The transportation alternatives considered in this study are mostly spot improvements to two-lane sections of U.S. Highway 101 and all east-west highways between U.S. 101 and Interstate 5 throughout Oregon, Washington, and Northern California. These improvements are sufficient to provide Level of Service (LOS) B for projected 1990 traffic. Where necessary to achieve LOS B, some sections of U.S. 101 and some east-west highways are proposed for upgrading to four lanes, and U.S. 101 in California is shown as upgraded to a full freeway, as per current state plans. Finally, two new highways were evaluated: a new east-west highway to Gold Beach, Oreg., and a new north-south coastal link through the Quinault Indian Reservation, Wash.

It should be noted that these transportation alternatives do not address long-range opportunities for sweeping technological changes that could substantially change levels of accessibility to the coastal communities, as well as elsewhere in the nation. For example, if highways were automated and electrified employing fusion power, safe vehicle operation at speeds far greater than 55 mph could be achieved along selected access-controlled corridors. However, such possibilities, although important, were beyond the scope of the investigation.

Estimation of Direct User Benefits

Crude estimates were made of the travel time and accessibility consequences of the hypothesized improvements. It was assumed that the improvements would raise most average travel speeds from current levels, between 40 and 50 mph, to a uniform 55 mph. Target speeds were taken as 50 mph through areas with extensive roadside activities.

The fundamental conclusion from the accessibility analysis is that the effects of the improvements are in most locations not very dramatic. Table 1 summarizes the travel time changes between all coastal counties in California, Oregon, and Washington and the nearby major metropolitan areas. As can be seen, most relative improvements are less than 10 percent, and over half are less than 5 percent. The biggest improvements are in the two northernmost California counties, Humboldt and Del Norte, where travel times to San Francisco and the Central Valley improve 14 to 18 percent.

Although not very dramatic in percentage terms, because of the long trip lengths involved, the time savings in Table 1 constitute a significant direct benefit to the traveling public. This benefit is quantified in Table 2. However, this does not alter the fundamental fact that the coastal communities will continue to be physically remote from major metropolitan markets even after substantial improvements in the regional highway infrastructure.

Table 2 presents the full direct and indirect costs and benefits estimated for the highway improvements described above, grouped by highway and geographic area. The direct costs are crude construction cost estimates. User benefits include time savings, at $10 per vehicle-hour, and accident savings, using Caltrans 1987 average value of $28,500 per rural accident avoided, all discounted at 10 percent over a 20-year period (*8*). User benefits for new construction also include vehicle operating cost savings from the next best alternative route, minus annual facility maintenance costs (counted as a negative user benefit for convenience). Vehicle operating costs are not included as benefits on existing highways since the hypothesized improvements would not reduce travel distances significantly, and any operating benefits from reduced delays would be offset largely by increased operating costs from higher speeds. The analysis leading to Table 2 involves many additional assumptions and simplifications, too involved to address here; these are fully documented in the study final report.

Although Table 2 is complex, it provides one fairly simple conclusion. For a substantial portion of the hypothesized highway improvements—about half of the total mileage considered—selective upgrading is economically justified on the basis of direct highway user benefits alone. That is, expected safety benefits combined with estimated travel time savings are sufficient, over a 20-year period, to offset the capital costs of facility upgrading. This is especially true for low-cost spot improvements to mitigate inadequate geometry and improve passing opportunities, but it also applies to some upgrades from two lanes to four lanes, and for one case of new highway construction (the Quinault Tribal Highway in Washington).

In some cases in which the direct user benefits do not cover the costs, the shortfalls are made up through indirect benefits to the local economies.

Estimation of Indirect Benefits to the Local Economies

There are two categories of economic impacts of transportation projects on the affected communities. The first is the short-term consequences of the capital investments themselves, in the form of employment on construction activities and the streams of expenditures for needed materials, supplies, and equipment. (Because of the mobility of construction companies and labor, only a portion of this effect is felt locally.) The second is the permanent improvement to the local economy in the sense that improved transportation reduces some costs of doing business and increases access to customers, thereby increasing local competitiveness and raising the overall amount of economic activity, income, and jobs.

In this study, the full effects of both categories of effects were traced through the economy of each of six county groupings by means of a simple 30-industry input-output model. To drive the input-output model, it first was necessary to make estimates of the immediate (or "first-round") expansion in

TABLE 1 Travel Time Savings from Highway Infrastructure Improvements

	Principal Market Area														
	San Francisco Area			No. Sacramento Valley			Eugene			Portland			Seattle-Tacoma		
County of Production	Current Trip Time (min.)	New Trip Time (min.)	% Gain	Current Trip Time (min.)	New Trip Time (min.)	% Gain	Current Trip Time (min.)	New Trip Time (min.)	% Gain	Current Trip Time (min.)	New Trip Time (min.)	% Gain	Current Trip Time (min.)	New Trip Time (min.)	% Gain
Mendocino	215	195	9%	205	195	5%	530	520	2%	-	-	-	-	-	-
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Humboldt	400	330	18%	370	310	16%	400	390	3%	540	520	4%	-	-	-
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Del Norte	480	410	15%	430	370	14%	300	300	0%	430	430	0%	620	620	-
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Curry	570	480	16%	520	440	15%	275	250	9%	405	385	5%	593	573	3%
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Coos	595	560	6%	505	505	0%	190	170	11%	320	310	3%	508	490	3%
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
West Douglas	600	590	2%	510	500	2%	150	140	7%	290	280	3%	470	460	2%
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
West Lane	620	610	2%	530	530	0%	130	120	8%	250	250	0%	435	430	1%
	0		0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Lincoln	-	-	-	591	581	2%	191	185	3%	201	182	10%	388	372	4%
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Tillamook	-	-	-	-	-	-	261	254	3%	162	155	4%	332	323	3%
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Clatsup	-	-	-	-	-	-	300	285	5%	160	155	3%	288	270	6%
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Wahkiakum	-	-	-	-	-	-	290	290	0%	160	160	0%	230	225	2%
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Pacific	-	-	-	-	-	-	320	320	0%	190	180	5%	195	190	3%
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Grays Harbor	-	-	-	-	-	-	380	340	10%	251	244	3%	192	180	6%
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
West Jefferson	-	-	-	-	-	-	450	440	2%	320	300	6%	255	235	8%
	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%
Clallam	-	-	-	-	-	-	500	490	2%	370	360	3%	265	250	6%

each local economy stimulated by the transportation improvements. This is a difficult undertaking.

In theory, for a particular basic industry, it should be possible to relate transportation improvements to reductions in the costs of doing business and then trace those reductions through to their significance for local industry competitiveness, market share, and growth in output. Unfortunately, at least for this study area, it seems the real world does not subscribe to this theory. A cross-sectional investigation of freight transportation rates in the region showed that, for most target industries, freight rates are not affected significantly by highway infrastructure quality. This is because rates are largely distance and market based, rather than cost based. Oversupply and competition for back-hauls keep actual rural trucking charges lower than would appear justified by the costs of providing these services. Also, although travel times and reliability obviously improve with better highways, the dominant service parameters of frequency and flexibility are determined largely by market factors, rather than by the quality of transportation infrastructure.

Despite the tenuous link between transportation infrastructure and economic growth when considered at one point in time, some empirical evidence suggests that, over time, there are connections between improved transportation infrastructure and increased local economic activity (*9–11*). So, what is to be done?

This study adopted and elasticity-based method to estimate the immediate (first-round) permanent economic effects of transportation improvements. The analysis was highly judgmental; however, the judgments in all cases were based on transparent assumptions and were constrained by the findings of the transportation alternatives analysis and by empirical results from other locations.

In the case of target industries in the manufacturing sector, the estimation method was as follows:

1. For each coastal county, determine the improvement in accessibility (travel time) resulting from the hypothesized transportation improvements.
2. In light of the transportation needs of particular target industries, categorize each industry as highly sensitive, moderately sensitive, or fairly insensitive to the accessibility improvement. This characterization was based in part on the results of a survey of local industries and in part on the re-

TABLE 2 Benefit-Cost Summary for Highway Infrastructure Improvement Alternatives

Route	Length of Hgwy. Upgrade (mi.)	Upgrade Type	Total Upgrade Capital Cost(1) ($ mill.)	Total User Benefit(2) (20 yr./10%) ($ mill.)	Local Economic Impact of Capital Spending (1st Five Years Only) Total Sales ($ mill.)	Total Jobs (thous.)	Total Income ($ mill.)	Total Taxes ($ mill.)	Total Sales ($ mill.)	Other Local Increases in Economic Activity (After Five Years) Total Jobs (thous.)	Total Income ($ mill.)	Total Taxes ($ mill.)	Total Local Economic Benefit(3) (20 yr./10%) ($ mill.)
NORTHERN CALIFORNIA COASTAL COUNTIES													
CA 101	99	Freeway (4)	$599.0	$288.5									
CA 299	85	Major imp.	$63.8	$52.7									
	42	Major imp.	$125.7	$17.7									
CALIFORNIA STATE TOTALS			$788.5	$358.9	$143.9	2,046	$21.3	$3.6	$187.3	4,286	$60.2	$7.7	$364.9
SOUTHERN OREGON COASTAL COUNTIES													
OR 101	44	4-lanes	$55.0	$134.3									
(5)	8	4-lanes	$40.0	$29.8									
	55	Major imp.	$41.3	$41.3									
	38	Major imp.	$114.8	$32.5									
	110	Minor imp.	$27.5	$93.4									
	50	Minor imp.	$50.0	$19.8									
OR GB	45	New 2-lanes	$360.0	$76.8									
(6)	30	New 2-lanes	$60.0	$55.4									
OR 42	19	Major imp.	$14.3	$8.8									
	42	Minor imp.	$10.5	$16.5									
SOUTHERN OREGON SUBTOTALS			$554.3	$274.6	$101.6	1,723	$14.3	$2.0	$43.3	1,019	$13.6	$1.6	$118.6
CENTRAL OREGON COASTAL COUNTIES													
OR 38	40	Major imp.	$30.0	$27.9									
	14	Minor imp.	$3.5	$4.4									
OR 126	6	4-lanes	$7.5	$10.2									
	33	Major imp.	$24.8	$23.5									
	14	Minor imp.	$3.5	$8.0									
OR 20	6	4-lanes	$7.5	$10.7									
	15	Major imp.	$45.0	$16.7									
	33	Major imp.	$24.8	$15.5									
OR 18	19	4-lanes	$23.8	$30.1									
	21	Major imp.	$15.8	$29.1									
CENTRAL OREGON SUBTOTALS			$295.5	$293.0	$53.8	901	$7.4	$1.0	$33.5	952	$10.9	$1.3	$79.3
NORTHERN OREGON COASTAL COUNTIES													
OR 6	10	Major imp.	$7.5	$6.6									
	41	Major imp.	$123.0	$29.3									
OR 26	19	Major imp.	$57.0	$9.0									
	27	Major imp.	$20.3	$21.8									
	8	Minor imp.	$2.0	$8.6									
OR 30	4	4-lanes	$5.0	$7.9									
	7	Major imp.	$21.0	$20.2									
	27	Major imp.	$20.3	$35.8									
	6	Minor imp.	$1.5	$5.5									
NORTHERN OREGON SUBTOTAL			$367.0	$261.7	$62.4	1,130	$8.4	$1.2	$18.2	341	$4.4	$0.5	$52.9
OREGON STATE TOTALS			$1,216.8	$829.3	$217.8	3,754	$30.1	$4.2	$95.0	2,312	$28.9	$3.4	$250.8
SOUTHERN WASHINGTON COASTAL COUNTIES													
WA 101	14	4-lanes	$17.3	$54.5									
	123	Major imp.	$92.3	$101.3									
	125	Minor imp.	$31.3	$37.0									
WA 4	11	Major imp.	$33.0	$7.7									
	11	Major imp.	$8.3	$4.8									
	29	Minor imp.	$7.3	$5.0									
WA 6	9	Major imp.	$6.8	$5.2									
	42	Minor imp.	$10.5	$9.3									
WA 109	14	New 2-lanes	$28.0	$60.0									
	14	Major imp.	$10.5	$6.8									
	13	Minor imp.	$13.0	$9.0									
	7	Minor imp.	$1.8	$1.7									
SOUTHERN WASHINGTON SUBTOTALS			$212.8	$238.5	$37.8	560	$5.2	$0.6	$33.5	675	$9.4	$0.9	$64.0

(continued on next page)

TABLE 2 (*continued*)

NORTHERN WASHINGTON COASTAL COUNTIES (7)											
WA 104	19 4-lanes	$23.8	$29.0								
	5 Major imp.	$3.8	$3.8								
NORTHERN WASHINGTON SUBTOTALS		$74.4	$97.3	$12.7	193	$1.7	$0.2	$18.5	388	$5.1	$0.5	$30.3
WASHINGTON STATE TOTALS		$287.3	$335.9	$50.5	753	$6.9	$0.8	$52.0	1,063	$14.5	$1.4	$94.2
GRAND TOTALS FOR 3-STATE AREA		$2,292.5	$1,524.0	$412.2	6,553	$58.3	$8.6	$334.3	7,661	$103.5	$12.5	$709.9

* The six county groups are the following:

Northern California: Mendocino, Humboldt, and Del Norte
Southern Oregon: Curry and Coos
Central Oregon: The western portions of Douglas and Lane, plus Lincoln
Northern Oregon: Tillamook and Clatsop
Southern Washington: Wahkiakum, Pacific, and Grays Harbor
Northern Washington: The western portion of Jefferson, plus Clallam

Notes:
1. All estimates are in 1986 dollars.
2. User benefits include annual travel time savings and accident reduction benefits for twenty years discounted at 10%. For new highways, the benefits include vehicle operating costs and added road maintenance costs (as a negative user benefit).
3. Total local economic benefits are the sum of the annual increases in local income from capital spending for the first five years plus the additional income from increased permanent economic activity for years 6 through 20, discounted at 10%.
4. Includes the remaining rural non-freeway gaps not already programmed for improvement (except the proposed Eureka and Crescent City freeways).
5. The costs and benefits for Hwy. 101 in Or. are split equally among the three county groups in the state. In Wa., the costs are split 2/3-1/3 between the southern and northern groups.
6. Proposed new state highway between Gold Beach and Grants Pass.
7. Cost-benefit analyses of a new Puget Sound crossing and widening the Hood Canal Bridge were beyond the scope of this study.

ported shares of transportation in each industry's cost structure, from census data (*12*).

3. On the premise that, in the long run, transportation costs should track changes in accessibility, use the percentage change in accessibility to estimate the extent to which each industry should increase its future consumption of transportation and, hence, future output and employment. Based on past experience with transportation cost and time elasticities, it seemed reasonable to assume that highly transportation-sensitive industries would have elasticities ($\ddot{Y}$) of about -1.0, that transportation-insensitive industries would have $\ddot{Y} = -0.15$, and that moderately transportation-sensitive industries would have $\ddot{Y} = -0.5$.

Besides numerous empirical studies that give remarkably consistent values for transportation elasticities, in the range suggested here, these assumptions are consistent with the findings of a recent interregional input-output modeling study for a Midwest navigation project. This project found an elasticity between transportation costs and economic output on the order of -0.5 (*13*).

Table 3 shows how this approach is applied in the case of a particular California county. The percentage travel time improvements from Table 1 are weighted by the expected destination market shares for each group of similar industries, and a weighted average accessibility increase is determined. The accessibility increase and the transportation elasticity for each target industry group are multiplied together to develop an industry group growth index. The growth indexes are then averaged in proportion to each industry group's weight for the county to produce an overall estimate of the percent employment increase in the particular manufacturing sector (durable or nondurable goods). The sector employment increases are then distributed back to the groups of target industries in proportion to the products of their growth indexes and "industry weights." The industry weight that reflects each industry group's importance to the local economy is the product of the industry size, measured by 1984 employment, and the proportion of county manufacturing growth expected to come from each industry group, determined by judgment on the basis of target industry considerations.

An important point about this approach is that all growth stimulated by transportation improvements is confined to the target manufacturing industries identified for the study area. This point probably understates the impact somewhat. This was done for convenience and with the understanding that the objective is not really prediction but rather to provide a systematic accounting of the consequences of reasonable assumptions. Because the economic growth that actually occurs will be shaped mostly by nontransportation factors, this simplification seemed appropriate.

The overall results of the analysis showed immediate employment increases in the manufacturing sectors varying from about 1 percent in counties near the Columbia River to around 6 percent in Northern California, where transportation improvements have the greatest relative impact. Through the three-state area, about 1,400 new manufacturing jobs would be created, with over 1,000 in the durable manufacturing sector. This growth is because the counties that enjoy the greatest accessibility increases happen to be those in which durable manufacturing is dominant. The industries showing the greatest immediate employment increases are manufacturers of small metal and mineral products, furniture and fixtures, and packaged food products.

A similar approach was taken in the case of increases in trade and services related to tourism and activities related to

TABLE 3 Sample Estimation of First-Round Employment Increases in the Manufacturing Sectors

	SIC Codes						SIC Codes				
	2541 2599	3441 3533 3535	3299 3499 3544 3549	3732	394	ALL DURABLE MANUF.	2022 2032	2091 2092	275	2851 3079	ALL NON-DUR. MANUF.
Relative Ind. Size	.7	1.6	1.9	.7	.4		2.6	2.6	2.9	.6	
HUMBOLDT, CA											
% Access. Increase	14.5	18.0	18.0	12.2	12.2		18.0	14.5	18.0	18.0	
Elasticity	1	.15	.5	.15	.5		.5	.5	.15	1	
Ind. Growth Index	14.5	2.7	9	1.832	6.105		9	7.25	2.7	18	
Industry Weight	.13	.31	.39	.15	.09		.65	.65	.72	.15	
1986 Employment						4,983					1,592
% Empl. Increase						6.6					7.0
Empl. Increase	90	39	162	13	25	329	43	35	14	20	112

retirement communities. Both of these industries are transportation sensitive, and new output directly stimulated by improved accessibility was therefore assumed to have an elasticity of $\ddot{Y} = -1.0$. Since the outputs in retail trade and services related to tourism and retirees are impossible to distinguish in the available data from outputs consumed by other local residents, it was assumed that 100 percent of the outputs of hotels, motels, eating and drinking establishments, and recreational services are related to tourism, and that 50 percent of the outputs in health services and membership organizations are related to retirees. Although these assumptions probably overestimate the effects involved, this overestimation is balanced by not considering the effects of tourism and retirees in other sectors and in other retail trade and service industries (e.g., purchases at stores and gas stations). The results of the analysis for retail trade and services show immediate employment increases varying between 1 percent and 7 percent, with a similar geographic pattern as manufacturing. Through the three-state area, the estimate is that about 3,800 new retail and service jobs would be created.

Since the permanent employment increases described above are seen as occurring as the result of transportation infrastructure improvements, the analysis assumed a lag of 5 years before any such increases would be realized. Thus, the associated benefits occur only in years 6 through 20 of the analysis period.

In addition to the immediate employment increases in the manufacturing, retail, and service sectors, there are also the short- term employment increases caused by the highway construction itself. It was assumed that 33 percent of the construction labor for these projects would come from the local area and that these effects would occur only during the first 5 years of the analysis period. Also, a share of the direct expenditures on highway capital improvements enters each local economy in the form of local expenditures on materials, supplies, and related items. Construction expenditures were assumed to be 43 percent on structures (bridges, retaining walls, etc.), 36 percent on paving, and 21 percent on earth moving, as assumed by the Federal Highway Administration in developing its national highway construction cost index (*14*).

All of the above immediate (first-round) effects of transportation infrastructure improvements were used as input to the input-output model, customized for each of the six groups of counties within the coastal study area. The particular software used is the Port Economic Impact Kit (PORTKIT), developed for the U.S. Maritime Administration. A detailed description of input-output models in general and the PORTKIT model in particular are available in the associated report (*15*). The full economic effects shown in Table 2 incorporate the effects of the local area economic multipliers, which account for the second, third, and subsequent rounds of growth stimulated by the transportation infrastructure improvements. As expected, the multipliers derived for the six county groupings are small compared with those of most input-output studies, because the small size and relative homogeneity of these economies result in considerable income leakage outside the local areas. All of the multipliers are less than 2.0 and most fall between 1.0 and 1.5.

CONCLUSIONS AND RECOMMENDATIONS

The following are selected conclusions and recommendations reached by this study. Each is discussed in more detail in the study's final report.

1. The greatest potential for growth among the basic industries of the coastal study area lies in presently existing small enterprises and new small businesses started either by current residents or by persons who will move into the region. Adequate transportation is an important, but not a controlling, factor in fulfilling this potential. On the other hand, improved transportation is one of the few points of leverage in local economic development that is controlled primarily by state and federal authorities outside the communities directly affected.

2. A fundamental business problem in the study area—remoteness to large markets—will not be eliminated in the foreseeable future by new highway infrastructure. Fortunately, many basic industries can prosper in the coastal communities, despite their remoteness to major markets, pro-

vided that necessary conditions exist. Among these is access to good-quality air transportation.

3. Transportation infrastructure improvements can provide large user benefits and significant economic development benefits, although the magnitude of these benefits is not large enough to justify massive rural transportation infrastructure development on the scale of interstate freeway extensions.

4. Aggressive local and state efforts are needed to help build a national coalition for national post-interstate highway and bridge infrastructure programs, as well as for complementary state infrastructure programs with the flexibility to address variable local needs and with a greater commitment of resources than is available in current highway programs. It is important for rural political leaders to play an aggressive role to ensure that rural infrastructure receives an adequate share of future funding.

5. Transportation agencies should devote more attention and resources to the need to compete for public resources and support, and they should assemble personnel skills and an organization reflecting market-oriented rather than traditional engineering-oriented strategies. In other words, transportation agencies should learn to sell more effectively the benefits of their products.

6. The potential for dramatic technological change in the interregional transportation system is important to consider in addressing the nation's long-term transportation goals.

7. Finally, there is a critical need for additional basic research, to develop a better quantitative understanding of the relationship between transportation improvements and rural economic development.

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