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Sources of structural change in the Washington economy

An input-output perspective*

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Abstract. This paper analyzes changes in the structure of the Washington economy from 1963 to 1982. The empirical model utilizes data from the Washington state input-output tables for 1963 and for 1982. The model accounts for output change from a demand side perspective. Special attention is given to market diversification and the role of markets at the state, national and international levels in explaining real growth in given sector. Taking the service-producing sectors in Washington as an example, 48% of the real output change in the service sectors was associated with demand change from foreign and rest of the US sources, while 52% of service output change was associated with Washington intermediate and final demand variables. The implication is that important elements of Washington service-producing sectors are driven by demand exogenous to Washington and should properly be considered a part of Washington's economic base.

Introduction

This paper examines structural changes in the Washington state economy between 1963 and 1982. Washington state is especially well-suited for a study of this kind because of the wealth of survey-based input-output models that have been constructed for the state's economy dating back to the early 1960's. The 1963 model was the first of the Washington input-output models, while the 1982 model is the most recent (Bourque and Weeks 1969; Bourque 1987).

Better understanding of the sources of change in an economy's output of goods and services enables future economic restructuring to be better anticipated,

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and perhaps even managed. At the very least, economic development strategies can be considered in a context of historical tendencies. For example, in discussions of state economic policy the indispensability of foreign exports for future economic growth in Washington state has virtually become a conventional wisdom (Conway (1987). In this paper, the past contribution of foreign exports to output growth is examined and the sectors where foreign exports have been especially strong are noted.

Regarding the role of services in the economy, it is now widely recognized that growth in service employment has out-distanced employment growth in the goods-producing sectors of the economy. However, there is very mixed opinion on the sources generating service growth, on the likelihood that this trend will continue and on its implications for the overall well-being of the economy. In particular, it is often presumed that goods rather than services are the primary source of exports to the rest of the world (Chenery et al. 1986). Our analysis examines this presumption and, indeed, shows that key elements of the Washington service economy are driven by export markets to the same degree as some goods-producing sectors.

The paper is organized as follows. It begins with a review of the structural change characterizing the Washington economy and a review of the application of input-output techniques to the analysis of structural change. Next, the results of the empirical analysis are presented. Special attention is given to findings for emerging and declining sectors. Findings are contrasted for goods-producing as opposed to service-producing sectors. The importance of exports, especially foreign exports, in the Washington picture is revealed. The paper concludes with a discussion of some of the implications of the findings for understanding structural change in Washington.

Trends in sector shares

The information summarized in Table 1 provides a sketch of the changes that occurred in the Washington economy over the 1963 to 1982 period. The details of the sector classification scheme are summarized in Appendix A. Annualized sector real growth rates, as well as changes in sector share of real output between 1963 and 1982, are presented for each sector in the Washington input-output model. All sectors growing faster than the mean state real growth rate of 4.0% increased their share of state output over the study period. Wholesale and retail trade experienced the greatest share expansion, followed by other services, transportation services, and communications. It may be noted that all of the top four sectors in terms of increasing sector share from real output growth were service related. Services and trade sectors had a net expansion of their share of the Washington total output of eleven percentage points. Thus, the 1963 to 1982 period provides clear evidence of the growing importance of the service component of the Washington economy.

Major losers of output share in Washington between 1963 and 1982 were construction and industries processing wood products such as sawmills, and paper

mills.[1] Most of the goods-producing sectors experienced a net decline in their share of the economy as a result of real rates of growth below the state mean. Major exceptions were those emerging goods sectors involved in the production of electronic and electrical equipment, such as measuring instruments and computers. Some "heavy" industries also performed well. Gas utilities, shipbuilding, and petroleum refining were all in the top ten sectors in real growth rate and increased their share of total output.

Input-output techniques for the analysis of structural change

The use of input-output models to study the structure of an economy dates back to Leontief's development of the analytical framework to examine the American economy (Leontief 1986). A common approach to depicting economic structure of a region utilizes the ideas of forward and backward linkage as a measure of economic dependence and involves table rearrangement on these criteria-triangularization (Miernyk 1965). Individual sectors are ordered in the flow table according to a linkage criterion and the pattern of interaction is analyzed. This approach has been criticized for implying that the ordering of sectors between tables can vary without confusion in economic interpretation. An alternative approach is to assume that there is a natural order of sectors in any economy represented by an input-output table. The ordering is defined on some appeal to economic theory, and the analysis of economic structure is oriented to this given order. The ordering begins with natural resource based sectors on one end of the continuum and extends through secondary manufacturing and finally tertiary service-producing sectors. A study of regional economic structure in Queensland, Australia, based on this approach examined the relationship between the size of the economy and the magnitude of individual cells in the input-output tables (Jensen et al. 1988).

Until the 1988 analysis by the Office of Technology Assessment, the most comprehensive study of structural change in the United States economy dealt with the period between 1947 and 1961 and extensively used the input-output framework to examine the impact of technological change on intermediate and primary input requirements (Office of Technology Assessment 1988; Carter 1970). The use of a multisector comparative statics framework to identify alternative sources of economic growth dates to Chenery's work on the United States economy first published in 1960 (Chenery 1960).

More recently, structural changes characterizing the United States economy between 1963 and 1978 were analyzed using a multisectoral comparative statics approach (Feldman et al. 1987). From an input-output perspective, the output change observed for any sector is explained as a function of the portion of change attributable to changes in the level and composition of final demand and the portion attributable to changes in the input-output coefficients. Feldman's work in-

[1] The relatively poor showing of construction and wood products sectors is partially due to the cyclical downturn in these industries in 1982. This carries over into mining since a major buyer of mining output is construction.

Table 1. Annual growth rate by sector in the Washington economy, 1963 to 1982

Sector Number	Sector Classification	Total Output (Millions 82 $) 1963	1982	Annual Percent Growth	Rank of Sector Growth	Percent Share of Total Output 1963	1982	Change of % Share, 1963-82
37.	Industrial Machinery Including Computers	47	606	12.8%	1	0.12%	0.68%	0.57%
38.	Electronic and Electrical Equipment	94	907	11.3%	2	0.24%	1.02%	0.78%
42.	Other Manufacturing	121	1132	11.2%	3	0.31%	1.28%	0.97%
47.	Communications	366	1912	8.3%	4	0.93%	2.16%	1.23%
43.	Transportation Services	1576	5517	6.3%	5	4.00%	6.23%	2.23%
51.	Services	3283	10736	5.9%	6	8.33%	12.13%	3.79%
49.	Wholesale and Retail Trade	4827	15000	5.7%	7	12.25%	16.94%	4.69%
45.	Gas Companies	403	1144	5.2%	8	1.02%	1.29%	0.27%
41.	Ship and Boat Building	684	1890	5.1%	9	1.74%	2.13%	0.40%
27.	Petroleum	1849	4629	4.6%	10	4.69%	5.23%	0.54%
34.	Other Fabricated Metal Products	210	520	4.5%	11	0.53%	0.59%	0.06%
24.	Printing and Publishing	366	865	4.3%	12	0.93%	0.98%	0.05%
44.	Electric Companies	1123	2564	4.1%	13	2.85%	2.90%	0.04%
33.	Structural Metal Products	274	582	3.8%	14	0.70%	0.66%	-0.04%
39.	Aerospace	4267	8936	3.7%	15	10.83%	10.09%	-0.74%
40.	Transportation Equip. Exc. Air & Ship	240	502	3.7%	16	0.61%	0.57%	-0.04%
50.	Finance, Insurance, and Real Estate	1833	3800	3.6%	17	4.65%	4.29%	-0.36%
10.	Beverages	342	694	3.5%	18	0.87%	0.78%	-0.08%
35.	Nonelectrical Motive Equipment	200	406	3.5%	19	0.51%	0.46%	-0.05%
8.	Canning and Preserving	796	1594	3.5%	20	2.02%	1.80%	-0.22%
16.	Logging	886	1738	3.4%	21	2.25%	1.96%	-0.29%
4.	Other Agriculture	71	136	3.2%	22	0.18%	0.15%	-0.03%
2.	Vegetables and Fruits	401	759	3.2%	23	1.02%	0.86%	-0.16%
12.	Textiles	27	50	3.0%	24	0.07%	0.06%	-0.01%
6.	Meat Products	603	1091	3.0%	25	1.53%	1.23%	-0.30%
32.	Aluminum	1152	2050	2.9%	26	2.92%	2.32%	-0.61%
1.	Field and Seed Crops	661	1158	2.8%	27	1.68%	1.31%	-0.37%
36.	Machine Tools and Shops	113	197	2.8%	28	0.29%	0.22%	-0.06%
31.	Other Nonferrous Metals	148	257	2.7%	29	0.38%	0.29%	-0.09%
48.	Construction	3800	6532	2.7%	30	9.65%	7.38%	-2.27%
15.	Forestry	352	603	2.7%	31	0.89%	0.68%	-0.21%
7.	Dairy Products	475	780	2.5%	32	1.21%	0.88%	-0.33%
46.	Other Utilities	204	327	2.4%	33	0.52%	0.37%	-0.15%
20.	Furniture and Fixtures	104	164	2.3%	34	0.26%	0.19%	-0.08%
13.	Apparel	121	189	2.2%	35	0.31%	0.21%	-0.09%
28.	Glass Products	75	116	2.2%	36	0.19%	0.13%	-0.06%
23.	Paperboard, Other Paper	678	1041	2.1%	37	1.72%	1.18%	-0.55%
26.	Other Chemicals	139	185	1.4%	38	0.35%	0.21%	-0.14%
3.	Livestock and Products	690	916	1.4%	39	1.75%	1.03%	-0.72%
11.	Other Foods	456	598	1.4%	40	1.16%	0.68%	-0.48%
21.	Pulp Mills	278	355	1.2%	41	0.71%	0.40%	-0.31%
19.	Other Wood Products	395	499	1.2%	42	1.00%	0.56%	-0.44%
30.	Iron and Steel	248	306	1.0%	43	0.63%	0.35%	-0.28%
22.	Paper Mills	1030	1253	1.0%	44	2.62%	1.42%	-1.20%
29.	Cement, Stone, and Clay	342	413	0.9%	45	0.87%	0.47%	-0.40%
5.	Fisheries	80	94	0.8%	46	0.20%	0.11%	-0.10%
9.	Grain Mill Products	284	305	0.4%	47	0.72%	0.34%	-0.38%
25.	Industrial Chemicals	807	857	0.3%	48	2.05%	0.97%	-1.08%
17.	Sawmills	1069	1081	0.1%	49	2.71%	1.22%	-1.49%
18.	Plywood	444	305	-1.9%	50	1.13%	0.34%	-0.78%
14.	Mining	354	238	-2.0%	51	0.90%	0.27%	-0.63%
Total Growth in State Economy		39390.00	88529	4.0%		100.00%	100.00%	

dicated that, in a majority of sectors, a larger fraction of output change was associated with changes in final demand rather than with changes in input-output coefficients (Feldman et al. 1987). The exceptions were the most rapidly growing and rapidly declining sectors. In these sectors, changes in input-output coefficients accounted for a greater portion of output change than did changes in final demand.

The algebra of decomposition

The input-output model of the Washington economy can be represented in matrix form as:

$$X = AX + F \ , \tag{1}$$

where X = a 51×1 vector of industry total output, A = a 51×51 matrix of regional technical coefficients, F = a 51×6 vector of final demand, I = a 51×51 identity matrix.

The solution (Miller and Blair 1985) to this model is:

$$X = (I - A)^{-1} F \ . \tag{2}$$

Equation (2) suggests that industry output levels can change either because of changes in F, the vector of final demands, or in the elements of $(I-A)^{-1}$, the Leontief inverse. Changes in coefficients of the Leontief inverse derive from underlying changes in the matrix of technical coefficients. Technical coefficients will change due to changes in production technology, from factor-factor substitution arising from regional price changes or from import-substitution.

To determine the relative contribution of changing final demand and changing technical coefficients, the following decomposition methodology is used. Time subscripts indicate starting points and ending points for the analysis. Using these subscripts, the Leontief equations for 1963 and 1982 may be written:

$$\begin{aligned} X_{63R} &= (I - PA_{63}P^{-1})PF_{63} \ , \quad \text{and} \\ X_{82} \ &= (I - A_{82})^{-1} F_{82} \ , \end{aligned} \tag{3}$$

where X_{63R} = 1963 total output in 1982 prices, $(I - PA_{63}P^{-1})$ = the 1963 Leontief inverse in 1982 prices, PF_{63} = 1963 final demand in 1982 prices, P = a 51×51 diagonal matrix whose (i, i) element is P_i, the producer price index for the ith sector.[2] The index was constructed by dividing 1982 price by 1963 price for each sector.

The difference in real output for the two periods may be expressed as:

$$X_{82} - X_{63R} = (I - A_{82})^{-1} F_{82} - (I - PA_{63}P^{-1})PF_{63} \ . \tag{4}$$

Using this relationship, (4) may be rewritten as:

$$\begin{aligned} X_{82} - X_{63R} = {} & [(I - A_{82})^{-1} - (I - PA_{63}P^{-1})]PF_{63} \\ & + (I - A_{82})^{-1}(F_{82} - PF_{63}) \ . \end{aligned} \tag{5}$$

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[2] Producer price indices were generated from an aggregation of IMPLAN producer price data to the Washington input-output model sectoring scheme. The IMPLAN data are based on the 226 sector producer price data collected by the Bureau of Labor Statistics.

The left-hand side of (5) represents changes in sector output between 1963 and 1982 in real terms. The first term on the right-hand side of (5) represents the portion of output change attributable to changing input-output coefficients weighted by real 1963 levels of final demand. This is referred to as the technical change component (Kubo 1980; Syrquin 1976). The second term represents the portion of output change attributable to changes in real final demand weighted by the 1982 Leontief inverse. The sum of these two terms exhausts the total change in real industry output. Data for the analysis were obtained from the 1963 and 1982 flow tables of the Washington economy (Bourque and Weeks 1969; Bourque 1987).

Sources of output change in the Washington economy

Table 2 presents, for each sector in the Washington economy, the change in real output between 1963 and 1982 and the associated final demand component and technical change component. Final demand variables were grouped into two categories: those associated specifically with the Washington economy (household consumption expenditures, investment expenditures, and state government expenditures) and those variables determined largely outside the Washington economy (federal government expenditures, exports to the rest of the United States, and exports to foreign countries).

Technical change

The contribution of technical change to the overall growth of the Washington economy was small but positive. While some 4.8% of the growth in total output was accounted for by technical change in the 1963 to 1982 period, the output of many sectors actually declined due to technical change. Sectors that experience a decline in output due to technical change, as it is represented in the model are sectors that became less important as input suppliers to other Washington firms over the period from 1963 to 1982. Sectors experiencing such output declines are characterized by negative numbers in the row for that sector in the difference of Leontief matrices from the first term of (5). Although interpretation is complicated by the general equilibrium nature of the Leontief coefficients, in a rough sense, this means that the output of such industries became less important as an input to other Washington industries as the economy moved from 1963 to 1982. In our model, this could occur either as the result of changes in the production processes of downstream industries, such as the substitution of plastic for metal in automobile manufacture, or as the result of the substitution of an imported input for a state-produced input.[3]

[3] Technical change, as it is defined in this paper, embodies two components that, given the limitations of the data, are impossible to separate. It includes both pure technical change in the given production functions as well as changes in the use of state-produced versus imported inputs. It should be noted that the term technical change as it relates to the decomposition model refers not to a single sector but to the changing regional input coefficients in downstream industries weighted by initial period final demand.

Table 2. Output change due to demand change and technical change

Sector Number	Sector Classification	Demand Change: Washington 1	Demand Change: U.S. and Rest of the World 2	Technical Change 3	Total Change 4
1.	Field & Seed Crops	147.22	198.04	151.57	496.84
2.	Vegetables and Fruits	81.76	262.78	13.01	357.55
3.	Livestock and Products	-0.72	272.54	-46.10	225.72
4.	Other Agriculture	95.12	-37.45	7.06	64.73
5.	Fisheries	5.81	41.47	-32.88	14.40
6.	Meat Products	106.66	401.59	-20.23	488.02
7.	Dairy Products	45.27	218.35	40.88	304.50
8.	Canning and Preserving	40.80	755.78	1.69	798.26
9.	Grain Mill Products	25.01	17.95	-21.61	21.35
10.	Beverages	167.92	195.29	-11.13	352.08
11.	Other Foods	144.42	8.76	-10.70	142.49
12.	Textiles	0.00	22.88	-0.29	22.59
13.	Apparel	26.46	45.89	-4.70	67.65
14.	Mining	94.15	-20.94	-189.56	-116.36
15.	Forestry	31.29	116.18	103.36	250.83
16.	Logging	56.51	438.12	357.51	852.14
17.	Sawmills	65.21	-293.50	240.02	11.73
18.	Plywood	16.05	-179.97	25.24	-138.68
19.	Other Wood Products	40.45	94.31	-30.55	104.20
20.	Furniture and Fixtures	32.44	26.48	0.74	59.66
21.	Pulp Mills	1.26	158.76	-83.13	76.89
22.	Paper Mills	53.85	98.67	70.21	222.73
23.	Paperboard, Other Paper	123.31	212.65	27.13	363.08
24.	Printing and Publishing	315.50	244.67	-61.34	498.83
25.	Industrial Chemicals	38.63	-112.25	123.44	49.83
26.	Other Chemicals	37.47	21.85	-13.56	45.75
27.	Petroleum	807.96	1928.26	43.89	2780.11
28.	Glass Products	14.29	28.02	-1.25	41.05
29.	Cement, Stone, and Clay	106.52	67.37	-102.67	71.22
30.	Iron and Steel	34.21	101.22	-77.61	57.82
31.	Other Nonferrous Metals	5.65	135.87	-32.92	108.61
32.	Aluminum	10.76	566.23	321.05	898.03
33.	Structural Metal Products	150.47	152.93	4.27	307.67
34.	Other Fabricated Metal Products	91.72	240.67	-22.11	310.28
35.	Nonelectrical Motive Equipment	-36.54	236.16	6.02	205.64
36.	Machine Tools and Shops	19.29	68.41	-3.70	84.00
37.	Industrial Machinery Including Computers	12.12	531.51	15.81	559.44
38.	Electronic and Electrical Equipment	25.07	765.27	22.24	812.58
39.	Aerospace	20.55	4588.63	59.88	4669.06
40.	Trans. Equip. Exc. Aircraft & Ships	45.88	216.03	-0.11	261.81
41.	Ship and Boat Building	45.17	1152.80	8.45	1206.42
42.	Other Manufacturing	80.84	862.60	67.33	1010.78
43.	Transportation Services	771.23	3042.29	127.86	3941.38
44.	Electric Companies	772.14	376.40	292.00	1440.54
45.	Gas Companies	263.80	164.58	312.76	741.14
46.	Other Utilities	76.92	42.55	3.18	122.65
47.	Communications	1046.40	391.37	108.03	1545.79
48.	Construction	2538.71	306.44	-112.74	2732.42
49.	Wholesale and Retail Trade	4693.73	5176.05	303.10	10172.87
50.	Finance, Insurance, and Real Estate	787.17	1404.58	-224.31	1967.44
51.	Services	4904.94	1949.42	599.06	7453.42
TOTAL		19080.83	27704.55	2352.62	49138.98
PERCENT		38.8%	56.4%	4.8%	100.0%

Twenty-two of the 51 sectors in the Washington model exhibited output declines due to technical change. Mining, cement and stone, and iron and steel all experienced large output declines due to technical change. In the case of all of these sectors, it is likely that other inputs were substituted for these products in the production processes of downstream Washington firms. In contrast, Aluminum was one sector that experienced a large output increase due to favorable technical change in the Washington economy (Table 2).[4]

[4] (See page 162).

Rapidly expanding and declining sectors

Previous work for the United States economy has indicated that the those sectors on either end of the growth scale tended to be those in which a relatively large share of growth was due to technical change (Feldman et al. 1987). The results from our analysis of the Washington state economy, however, do not corroborate these findings. The ten fastest growing sectors and the ten slowest, or fastest declining, sectors of the Washington economy are displayed in Table 3. In none of the ten fastest growing sectors did the importance of technical change approach the relative importance of final demand-driven change. In fact, six of the top ten sectors fit nicely into an export-base theory of growth. For these six, the factor of major importance in each case was sales to buyers outside Washington. The other four sectors were affected mainly by final demand sources within Washington. The declining sectors did tend to exhibit growth declines due to technical change, but only in the case of mining did the technical change component dominate the final and demand component (Table 3).

That these findings differ from the analysis conducted on the national economy is not surprising. The Washington economy represents a much smaller

Table 3. Fastest growing and slowest growing sectors, 1963–1982 (Millions of dollars)

Sectors	Washington Demand	U.S. & Rest of the World Demand	Technical Change	Annual Growth	Sector Growth Rank
Fastest Growing Sectors					
37. Industrial Machinery Including Computers	12.12	531.51	15.81	12.8%	1
38. Electronic and Electrical Equipment	25.07	765.27	22.24	11.3%	2
42. Other Manufacturing	80.84	862.60	67.33	11.2%	3
47. Communications	1046.40	391.37	108.03	8.3%	4
43. Transportation Services	771.23	3042.29	127.86	6.3%	5
51. Services	4904.94	1949.42	599.06	5.9%	6
49. Wholesale and Retail Trade	4693.73	5176.05	303.10	5.7%	7
45. Gas Companies	263.80	164.58	312.76	5.2%	8
41. Ship and Boat Building	45.17	1152.80	8.45	5.1%	9
27. Petroleum	807.96	1928.26	43.89	4.6%	10
Slowest Growing Sectors					
14. Mining	94.15	-20.94	-189.56	-2.0%	51
18. Plywood	16.05	-179.97	25.24	-1.9%	50
17. Sawmills	65.21	-293.50	240.02	0.1%	49
25. Industrial Chemicals	38.63	-112.25	123.44	0.3%	48
9. Grain Mill Products	25.01	17.95	-21.61	0.4%	47
5. Fisheries	5.81	41.47	-32.88	0.8%	46
29. Cement, Stone, and Clay	106.52	67.37	-102.67	0.9%	45
22. Paper Mills	53.85	98.67	70.21	1.0%	44
30. Iron and Steel	34.21	101.22	-77.61	1.0%	43
19. Other Wood Products	40.45	94.31	-30.55	1.2%	42

[4] The 1963 Washington input-output table apparently failed to value the intraindustry sales of the aluminum industry, so the large technical change attributed to the industry is somewhat overstated by that omission from the 1963 table.

market than does the United States economy. That is, intermediate sales to regional industries as a proportion of total supply is less in a regional economy such as Washington than is the corresponding proportion in a large national economy. Thus, the relative importance of technical change would be expected to be a smaller consideration in regional economies than in large national economies. Even so, a number of the slowest growing sectors experienced significant loss in real output due to the loss of sales to downstream Washington firms.

Change in the economy by major function: primary, secondary and tertiary sectors

Table 4 summarizes the structural change in the Washington economy according to a relatively primitive interpretation of the 'natural ordering' of the sectors. Following previous work, the continuum is the conventional primary-secondary-tertiary scheme (Jensen et al. 1988). Economic activity is considered to be more primary in agriculture, forestry and mining, which directly involve the state's physical resources, and more tertiary in service sectors where fewer physical resources are involved.

Table 4. Output change due to demand change and technical change

Sectors	Washington Demand 1	U.S. & ROW Demand 2	Tech Change 3	Total Change 4
Goods Producing Sectors	**6877.38**	**15740.84**	**1439.87**	**24058.09**
Primary Natural Resource Commodities	511.15	1270.73	363.97	2145.85
Agriculture	323.38	695.91	125.54	1144.83
Forestry and Logging	87.80	554.29	460.88	1102.97
Fishing and Mining	99.97	20.52	-222.44	-101.95
Secondary Processing of Natural Resource Commodities	830.20	1688.64	227.83	2746.67
Food Processing	530.07	1597.72	-21.09	2106.70
Wood and Paper Processing	300.13	90.92	248.92	639.97
Manufacturing	1884.46	11891.51	352.85	14128.82
Petroleum Refining	807.96	1928.26	43.89	2780.11
Aluminum	10.76	566.23	321.05	898.03
Aerospace	20.55	4588.63	59.88	4669.06
Shipbuilding	45.17	1152.80	8.45	1206.42
Industrial Machinery Including Computers	12.12	531.51	15.81	559.44
Electrical and Electronic Equipment	25.07	765.27	22.24	812.58
Other Manufacturing	962.84	2358.81	-118.46	3203.18
Utilities and Construction	3651.57	889.97	495.21	5036.75
Utilities	1112.86	583.52	607.95	2304.33
Construction	2538.71	306.44	-112.74	2732.42
Service Producing Sectors	**12203.45**	**11963.70**	**913.74**	**25080.89**
Wholesale and Retail Trade	4693.73	5176.05	303.10	10172.87
Transportation Services	771.23	3042.29	127.86	3941.38
Communication Services	1046.40	391.37	108.03	1545.79
Financial Services	787.17	1404.58	-224.31	1967.44
Other Services	4904.94	1949.42	599.06	7453.42

Service-producing sectors

As discussed previously, the service sectors grew very rapidly between 1963 and 1982 and, as a group, accounted for more output change in Washington than did the goods-producing sectors (Table 4). The question addressed here is, what are the economic components that explain the service growth? In contrast to the conventional wisdom, which has been that services are sold mainly to consumers in the local economy, the evidence in Table 4 shows the selected components of the service economy were driven mainly by demand outside the Washington state economy. The output growth in transportation services is explained mainly by external demand, as is also the case in financial services and in margins earned or wholesale and retail trade.

The growth of output from wholesale and retail services is remarkable in that it was the largest in real terms of any of the 51 sectors identified in the model and was the seventh most rapidly growing sector (Table 2). The expanding role of the trade component of the economy illustrates, in our view, the increasing internationalization of the economy and the growing importance of specialized market niches now characterizing so many commodities. The increasing importance of trade has been accompanied by growth in transportation and marketing services necessary to deliver products to the customer. Also along with the increasing importance of specialty stores has come higher margins to pay for the higher levels of service and convenience such stores provide.

Utilities and construction

As Table 4 shows, the utilities and construction components of the Washington economy were very dependent upon demand generated within the Washington economy. In fact, construction had a higher percentage of its output growth explained by increases in Washington final demand than any other sector. However, the experiences of utilities and of construction regarding technical change were very different. Nearly 25% of the increase in utility output was associated with technical change. In particular, gas utilities experienced a huge increase in real sales to Washington firms over the 1963 to 1982 period.[5]

Experience in construction was quite the opposite; technical change was large and negative for this sector. Since construction as it is reflected in the interindustry accounts reflects maintenance and repair, several different interpretations of the negative technical change component for this sector are possible. Perhaps the capital stock in place in 1982 was of a higher quality and more durable, thus requiring relatively less repair and maintenance than was the case in 1963. A more likely explanation relates to the economy's position in the business cycle. Both national and Washington state economies were in a deep recession in 1982. In such times a ready candidate for cost saving is the category of maintenance expenditures. It seems likely that the negative component for technical change in construction is not a substitution away from maintenance and repair services by

[5] The nature of the gas industry changed very much over the 1963 to 1982 period with natural gas becoming much more widely available and used than in 1963.

Washington firms, but is a function more of the economic recession in 1982 and the associated temporary reduction in maintenance and repair expenses.

Manufacturing

The determining component of output change for most major manufacturing sectors in Washington was external final demand. In only two cases, aluminum and refined petroleum, did in-state markets play even a minor role. For aluminum an important component of this sector's growth was associated with technical change.

Aluminum was substituted to a significant extent for other materials in the production processes of Washington industries. In the case of petroleum refining, in-state sales resulting from domestic demand change accounted for nearly one-fourth of the output change. Petroleum refining in Washington expanded greatly when North Slope oil from Alaska came on stream.

The natural resource sectors

As noted previously, the natural resource sectors and resource-processing sectors were disproportionately represented in the list of the ten slowest growing sectors (Table 3). While the growth performance of the group as a whole is poor, certain individual sectors stand out as doing relatively well. Fruits and vegetables, for instance, were a fast growing component of the agricultural sector. Logging (harvesting and sales of timber) also experienced a high rate of growth.

Again, most of the output change in this group was associated with external demand change. However, in contrast to most manufacturing and service sectors technical change played a significant negative role for selected natural resource sectors. Mining was devastated by the loss of industrial in-state markets and many of the food processing sectors were likewise hurt by negative technical change.

Output change related to final demand change

In contrast to the Table 4 which treats both technical and demand components, Table 5 shows the contribution of final demand disaggregated into its major internal and external components. The internal component consists of demand generated largely within the Washington economy, including sales to Washington households, sales to state and local governments and sales of capital goods to private Washington firms. The external component of demand change was defined as sales to the federal government, sales to the rest of the Unites States, and sales to the rest of the world.

Washington economy demand change

The growth of Washington state final demand was strongly oriented toward the service-producing sectors and utilities and construction (Fig. 1). Services, utilities and construction sectors accounted for a remarkable 83% of the in-state final de-

Table 5. Output change due to change in final demand (Millions of 1982 dollars)

Sectors	Demand Categories: Washington Households 1	Washington Government 2	Washington Investment 3	Federal Government 4	Exports To U.S. 5	Exports To R.O.W. 6
Goods Producing Sectors	**2865.81**	**2829.35**	**1182.22**	**-534.02**	**9178.37**	**7096.50**
Primary Natural Resource Commodities	191.36	90.20	229.59	15.03	-63.96	1319.67
Agriculture	132.31	30.61	160.45	26.78	459.38	209.75
Forestry and Logging	37.59	37.67	12.55	-0.67	-547.30	1102.27
Fishing and Mining	21.46	21.92	56.59	-11.08	23.96	7.65
Secondary Processing of Resource Commodities	639.41	151.41	39.38	51.58	685.10	951.96
Food Processing	481.40	48.17	0.51	51.17	1245.83	300.71
Wood and Paper Processing	158.01	103.24	38.88	0.40	-560.74	651.25
Manufacturing	1103.58	492.26	288.61	-762.88	8065.04	4589.35
Petroleum Refining	642.03	124.92	41.01	59.69	1570.72	297.85
Aluminum	6.72	5.32	-1.28	-0.82	549.76	17.28
Aerospace	1.94	0.15	18.45	-1567.86	2873.87	3282.61
Shipbuilding	27.55	-0.36	17.97	966.45	162.36	23.99
Industrial Machinery Including Computers	4.58	3.06	4.48	-3.05	388.69	145.88
Electrical and Electronic Equipment	5.82	6.23	13.02	-11.30	699.59	76.98
Other Manufacturing	414.94	352.93	194.96	-206.00	1820.05	744.75
Utilities and Construction	931.46	2095.48	624.63	162.26	492.20	235.51
Utilities	948.46	143.08	21.32	-36.51	445.09	174.95
Construction	-17.00	1952.40	603.31	198.76	47.11	60.56
Service Producing Sectors	**10584.26**	**1241.97**	**377.22**	**247.75**	**9019.52**	**2696.43**
Wholesale and Retail Trade	4240.41	190.66	262.65	103.16	3491.17	1581.71
Transportation Services	603.40	141.77	26.06	41.94	2406.84	593.50
Communication Services	922.62	94.85	28.93	20.43	298.72	72.21
Finance, Insurance, and Real Estate	651.35	134.14	1.68	-63.32	1405.63	62.27
Other Services	4166.48	680.55	57.90	145.54	1417.15	386.73
Mean Growth Rate	**3.5%**	**6.4%**	**2.2%**	**-0.4%**	**5.1%**	**9.7%**

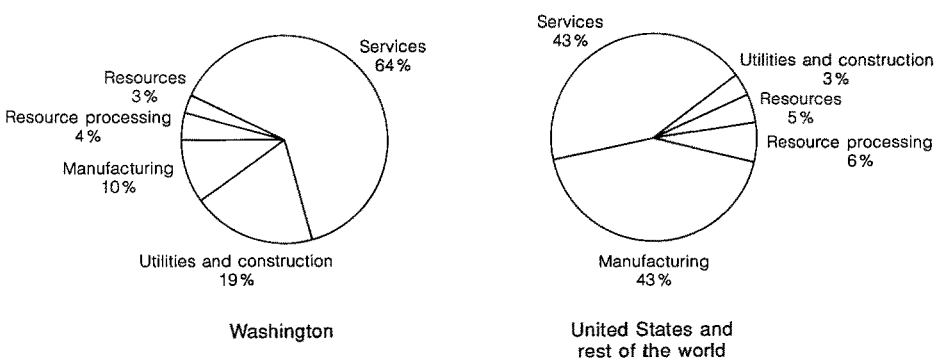

Fig. 1. Change in Washington final demand decomposition 1963–1982

mand driven growth over the study period (Fig. 1). Growth in demand generated by state and local government was by far the most important component in the expansion of the construction sector. Expenditures from state government grew at a real annual rate of 6.4% from 1963 to 1983 and were a major source of output expansion for the Washington economy (Table 5). The real rate of growth in state and local government spending far surpassed that of federal spending. In fact, the

real rate of growth of federal spending over the study period was negative. Only the annual real growth rate of output generated by changes in foreign demand at 9.7% was greater then the real output growth rate generated by changes in state and local government spending.

Growth in sales to Washington households was responsible for most of the utilities expansion and likewise most of expansion of the communication and other services sectors. Other sectors where expansion of household expenditures generated a large portion of total output change were the previously noted petroleum refining and food processing sectors.

Federal government demand change

The impact of changes in federal government spending was, on balance, negative for goods-producing sectors and positive for service-producing sectors, with the overall impact being negative. The growth in the shipbuilding sector was almost entirely related to increased federal demand in the form of military spending. Construction also experienced increased output in the form of sales to the federal government. Aerospace was a major loser due to reduction of real military purchases from this sector.

National versus international demand change

The successes and failures of Washington firms in national and international markets are revealed clearly in Table 5. Aerospace as unusual in that it was a major gainer from real growth generated by growth in both United States and foreign demand. Other major sectors tended to have their output changes driven by changes in either national or international markets but not both.

For example, agriculture and food processing sectors experienced large output driven by sales increases in the national market, but relatively small increases in the international market. Forestry and logging and wood and paper processing had just the opposite experience. These sectors experienced huge losses of real output resulting from declines in sales to the national market, that were more than offset by large increases in sales to international markets.

The export of raw logs is very controversial in Washington because of the low jobs to sales ratio. Table 5 shows the relative significance of these exports from the logging sector and the difficulty with what has been suggested as an alternative marketing approach. It is often argued that the now exported logs should be sold instead to the Washington wood and paper processing sectors for additional processing, thereby creating more jobs. The problem with this argument is that Washington wood and paper processing sectors were having marketing problems of their own (Table 5). They were losing their domestic markets and becoming increasingly dependent on international sales as was the logging sector. It seems unlikely that wood and paper processors would have been capable of absorbing additional input (logs) from the forestry and logging sectors and profitably marketing the resulting increased output in view of their declining real sales to domestic markets.

The importance of exports to the rest of the world for Washington is revealed clearly in Table 5. Over the 1963 to 1982 period, expansion of export demand became a large and very fast-growing source of output expansion for Washington firms. In 8 of the 51 sectors, outputs based on increasing international demand grew at a real rate of over 15% per year. For the goods-producing sectors, only output increases attributed to national demand exceeded output increases based on sales to the international economy (Table 5).

For the service sectors, Table 5 shows that domestic demand was more important than foreign demand. Nonetheless, both demand components were an important part of the total demand picture. For example, 43% of the output change due to changes in United States and foreign demand was in the service sector (Fig. 1). Among the service sectors, transportation services and wholesale and retail trade experienced the greatest growth in demand for their services as a result of foreign demand.

Conclusions

A somewhat surprising finding of this analysis is that technical change as defined in the decomposition model contributed to positive growth in the 1963 to 1982 period. Both substitution of imports for state produced inputs and pure technical progress would lead one to look for declining regional input coefficients over time. This did not happen, however, to the Washington economy over the period 1963 to 1982. On balance, the change in output due to changes in the intermediate demand for Washington-produced goods and services was positive.

If the Washington economy increases its substitution of imports for state-produced inputs as seems likely in a more internationalized economy, more sectors will show decreases in output due to diminished sales to intermediate demand. Then technical change will be negative for more sectors in the future as these sectors experience a substitution of imported inputs for state-produced inputs. If more industries fall into the negative technical change category, the percentage of growth accounted for by technical change will fall toward zero and perhaps on balance become negative. Another way to think of this is that the State's economy becomes "hollowed out" in terms of the role of intermediate demand as it becomes more internationalized.

Perhaps the major theme to emerge from this work relates to the idea of diversification as an economic development strategy. The notion of lessening a regional economy's sensitivity to economic shocks by making that economy less dependent upon a few basic industries is an important idea in the development literature. The strategy of diversification often seems to have special relevance to Washington given the dominance of the aircraft industry in the Washington economy.

What this analysis shows is that the idea of economic diversification should be thought of in terms of the markets that a given sector serves as well as the number of sectors in the economy. Three major market groups for any given sector in Washington are the market of downstream intermediate users, the Washington based final users markets, and the final users markets that are external to Washington.

In a very real sense, the Washington economy became more diversified in the case of aerospace not as a result of the relative expansion of other sectors but as the result of the successful expansion of the Washington aerospace sector into the domestic and international markets for aircraft. As a result, the sector was able to overcome a dependence on military markets and survive what would have been a disastrous decline in military sales over the 1963 to 1982 period.

Sectors that stand out in need of market diversification are sectors where nearly all the market is concentrated on one final demand component. In shipbuilding, for example, almost all of the output change between 1963 and 1982 was driven by changes in final demand from the federal sector. In recent years, shipbuilding sales to the military have declined and Washington has experienced the resulting output and employment declines. Another sector with a demand structure similar to shipbuilding is industrial chemicals. This sector is dominated by the production of fissionable materials and thus is very vulnerable to declines in military demand.

The final point relates to the encouraging finding relating to the expansion of the service-producing sectors. Large portions of the output expansion of these sectors were associated with increased export demand outside the state economy. In other words, for the Washington economy at least, selected services are very sensitive to the overall structure of export demand and as a result may be able to expect continued output expansion from growth of export demand in the future.

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Appendix A

Washington input-output definitions, 1982

Sector No.	Sector Name	Standard Industrial Classification (SIC) System Codes
1	Field & Seed Crops	011, 013, (exc. 0134), pt. 019
2	Vegetables & Fruits	0134, 016, 107, pt. 019
3	Livestock & Products	02
4	Other Agriculture	018
5	Fisheries	09 (exc. 097)
6	Meat Products	201
7	Dairy Products	202
8	Canning & Preserving	203, 2091, 2092
9	Grain Mill Products	204
10	Beverages	208
11	Other Foods	205-207, 2095-2099
12	Textiles	22
13	Apparel	23
14	Mining	10-14
15	Forestry	08 (inc. national & state forests, christmas tree farms)
16	Logging	241
17	Sawmills	242
18	Plywood	2435, 2436
19	Other Wood Products	2431, 2434, 2439, 244, 245, 249
20	Furniture & Fixtures	25
21	Pulp Mills	261
22	Paper Mills	262
23	Paperboard, Other Paper	263-266
24	Printing & Publishing	27
25	Industrial Chemicals	281, 286, 287, 289
26	Other Chemicals	282-285
27	Petroleum	29
28	Glass Products	321-323
29	Cement, Stone & Clay	324-329
30	Iron & Steel	331, 332, 339
31	Other Nonferrous Metals	3331-3333, 3339, 334, 3351, 3356, 3357, 3362, 3369
32	Aluminum	3334, 3353-3355, 3361
33	Structural Metal Products	344
34	Other Fabricated Metal Products	341-343, 345-349
35	Nonelectrical Motive Equip.	351-353
36	Machine Tools & Shops	354, 359
37	Industrial Machinery Including Computers	355-358
38	Electronic and Electrical Equipment	36
39	Aerospace	372, 376
40	Trans. Equipment Exc. Aircraft & Ships	371, 374, 375, 379
41	Ship & Boat Building	373 (inc. Puget Sound Naval Shipyard)
42	Other Manufacturing	30, 31, 38, 39
43	Transportation Services	40-47 (inc. Postal Service, state ferries, ports & public transit)
44	Electric Companies	491, pt. 493 (inc. BPA, PUDs & municipal electric utilities)
45	Gas Companies	492, pt. 493 (inc. municipal gas companies)
46	Other Utilities	Pt. 493, 494-497 (inc. public water, sewage, sanitary & irrig. systems)
47	Communications	48
48	Construction	15-17
49	Wholesale and Retail Trade	50-59 (inc. state liquor stores)
50	Finance, Ins. & Real Estate	60-67
51	Services	07, 097, 70-89 (exc. public hospitals & schools)