Impacts of Aluminum Industry Closings on the Pacific Northwest

Prepared for:

The Aluminum Industry Study Group

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Executive Summary and Highlights of Results

Introduction

This study identifies and evaluates the economic impacts of closing the aluminum smelters in the Pacific Northwest (PNW) on a plant by plant and county by county basis. The analysis includes the interacting macroeconomic and energy impacts at the county, state, and regional level. Results indicate that while impacts at the county level will be significant, they are minor at the both the state and the regional level.

This analysis focuses primarily on the aluminum industry because the aluminum smelting industry is so energy intensive and its product is an international commodity. It is the industry in the PNW most sensitive rising electricity prices. Other energy-intensive industries in the PNW such as Clor-Alkali, Groundwood Pulp, Steel Arc-Mills, and Liquefied Gases dominantly serve local markets and are less affected by the costs – which can be partially passed on to consumers of their products. Nonetheless, this work did also test macroeconomic and energy impacts if these industries were to close. That work, which is not discussed here, simply showed that the aluminum industry impacts are far larger and need to be the focus of the assessment.

The aluminum smelting industry appears to be an industry almost separate from the rest of the PNW. The aluminum ingots are a world-commodity and it appears that the mills and downstream industry are relatively unaffected by the lost of the smelters. The loss of the smelter employees does have a temporary impact on local business supporting those employees. This economic impact is dominantly characterized by an out-migration (or reduction of in-migration). The remaining economy recovers in approximately five years with a more diversified and robust economy. This phenomenon is similar to the experiences related to the decline of the timber industry in the PNW during the last decade.

The region does have a statistically insignificant permanent offset due to the loss of the aluminum smelter industry, but the underlying regional economy is unaffected by the loss. This offset is on the order of 0.4% of the regional economy or the equivalent of 0.02%/year over the 20 year analysis period. A 0.02% change is almost within the noise limits of the economic behavior.

Nonetheless, the aluminum industry represents over 3000 aMW of energy at a time when the PNW is short on regional generation capacity.[1] New sources of energy at the time of this writing were priced at $60/MWh.[2] The expectation is for price to go much higher. The BPA augmentation process will need to contract for over 3000 additional aMW. Roughly, 40,000 aMW are produced in the region at a cost of $30/MWh. Assuming these simple averages, this means that if the 3000 MW of the aluminum industry were absent, regional electricity costs, in the mid to short term would be -5.4% lower than they might otherwise be. The actually calculated price benefit is slightly less than this value --

[1] "Northwest Utilities Prepare for Possible Power Shortage," *The Oregonian*, Portland, OR, November 21, 2000.
[2] "SDG&E: Duke Never Sent Proposal for Fixed Rate Deal," *Dow Jones Newswire*, November 30, 2000.

less in winter but more in summer when the California market make the market tight and strongly influenced by changes in load. The price reduction stimulates the economic growth in other energy intensive industries and reduces the impact of the aluminum industry closure to approximately 50% of what might be expected in the absence of electric-market price effects. Electricity prices are, however, a small component of the overall economy and have a relatively modest impact except for energy-price sensitive industries. The impact of the aluminum smelter closures is comparable to the impacts of electricity price but in the opposite direction because of the beneficial affect on energy prices of the aluminum smelter closures.

Basic Methodology

The macroeconomic portion of the analysis was performed using the REMI model. This model has been used extensively for similar work[3] and is well documented.[4] It contains detailed inter-industry responses, consumer responses, and migration dynamics. The model was configured to include the explicit macroeconomic interactions of CA, OR, WA, ID, MT, and the rest of the west (UT, CO, WY, NM, AZ, NV as an aggregate) along with the counties containing the smelters: Chelan, Klickitat, Whatcom, Spokane, Cowlitz and Clark, all in Washington; Wasco and Multnomah in Oregon; and Flathead in Montana.[5] These entities additionally interact with a rest-of-nation region that contains basic rest-of-world interactions in it as well.

The energy dynamics are integrated with the macroeconomic analysis using the ENERGY 2020 model. ENERGY 2020 has been extensively used for price[6], resource[7], and demand forecasting.[8] The REMI and ENERGY 2020 models are often combined for scenario analyses that contain significant expected energy price responses.[9] Different price responses are simulated for residential, commercial and industrial customers. In this analysis, the ENERGY 2020 portion simulated the entire WSCC (Western System Coordinating Council - all the western states) including the Canadian portion at the state and provincial level for demands, and at the company level for energy. Transmission constraints and wholesale markets, including the deregulated California market, are explicitly simulated. Both wholesale and retail prices by class are detailed and the price changes from the smelter closings are explicitly calculated and fed back in REMI.

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[3] Fulton, G.A. and D.R. Grimes. 1993. The Economic Impact of the Domestic Automotive Industry on the United States and Its Major Regions. Mimeograph, Institute of Labor and Industrial Relations, University of Michigan.

[4] Treyz, G.I. 1993. *Regional Economic Modeling: A Systematic Approach to Economic Forecasting and Policy Analysis.* Boston: Kluwer Academic Publishers.

[5] The small Tacoma smelter (Pierce county) is include in the "rest of Washington" region because of its integration with the greater Seattle economy.

[6] Kleemann, Sue, "Trends in Electricity Prices", *Area Development*, February 1999.

[7] Jensen, Val R., et. al., *The Illinois Statewide Gas Utility Plan*, Illinois Department of Energy and Natural Resources, Report ILENR/RE-SP-90/03 (2 Volumes), Springfield, Illinois, February 1990.

[8] *New York Times*, "Vermont's Broad New Plan on Energy", New York, January 6, 1991.

[9] Backus, G. and Michael Alexander, "The Effect of Green Taxes and Carbon Tax Shifting on the State of Minnesota," *International Journal of Public Administration*, Vol. 22, No. 6, 1999

Overview of the Impacts on the Pacific Northwest: State Employment, Population, Personal Income and GRP

This analysis did not attempt to determine which smelter would close when. It merely arranged the smelters based on their understood cost structure and tested the impacts of closing groups of smelters. Three closing scenarios were tested: Worse Plants, Most Plants, and All Plants. One of the most costly plants, Troutdale was already closed when this work was commissioned. That permanent closure is already assumed in the based case use for comparison to all the scenarios. The discussion here will focus on the all-plants closed scenario to illustrate the maximum impacts that could be envisioned. In the technical appendix, all three scenarios will be summarized for PNW.

Employment

Closing the aluminum smelter industry initially results in the direct loss of 6069 jobs in that industry alone. However, the job loss is not evenly distributed among the states in the Pacific Northwest. Seventy-five percent of the jobs are lost in Washington, seventeen percent in Oregon and only five percent in Montana. No smelting jobs are lost in Idaho. The number of jobs lost can give a misleading impression of the impact on the states. While only five percent of the jobs are lost in Montana, because Montana's employment is so much lower than Washington, the impact on both states is about the same.

As you look at Figure 1 through Figure 3, you will notice that far more jobs than 6800 are "missing" when the aluminum industry is shut down. The additional job loss is due to a multiplier effect whereby the loss of a single high-paying industrial job causes further employment reductions in industries that sell to the industry that has been closed and in full and part-time service positions that feel the loss of disposable income from its employees. Initially in 2001, the multiplier effect for the region is about (-2.9) – for every smelting job lost roughly two other jobs are eliminated as well. The average value in the mid- and long-term drops to 2.3 as the economy adjusts and recovers.

The economic model used for these simulations, REMI, calculates the impacts of layoffs at the regional (interacting state and county) level. In many analyses, the multiplier effects are often just determined in isolation for a single state. We believe that the composite impacts are valid, however, while the individual state impacts have little significance due to these real-world dynamics. Nonetheless, we have attempted to estimate the multiplier at a state level to "match" other studies for comparison purposes.

The state multipliers vary significantly from the regional multipliers. Smelting job layoffs in Washington affect both the durable goods and service industries in Oregon and Montana. These can be more easily illustrated in other simulations where plants are closed in Washington but nowhere else and will be discussed later. There are also secondary impacts, such as changing electricity prices, from closing the aluminum smelting industry that affect total jobs lost. These impacts also will be discussed later.

While the loss of high paying jobs is certainly difficult for those that lose them, closing the aluminum smelting industry does not cause cataclysmic impacts in any state or the Pacific Northwest in general. Washington, with the greatest job loss and Montana with the smallest loss, both have about the same small statewide percent impact from 0.30% to 0.40%. These are the largest impacts experienced. Oregon and Idaho experience job-loss impacts of from one-tenth to one-fourth of Washington and Montana's impact.

Figure 1: Total Employment By State (in thousands)

	2001	2005	2010	2015	2020
Washington	3493.84	3591.46	3724.28	3862.40	3966.03
Oregon	2060.79	2142.73	2233.61	2299.86	2341.57
Montana	560.16	583.50	606.11	624.05	637.18
Idaho	752.16	793.77	833.70	860.26	877.56
PNW	6866.95	7111.46	7397.70	7646.57	7822.34

Figure 2: Employment Losses by State (in thousands)

	2001	2005	2010	2015	2020
Washington	-12.57	-10.41	-10.88	-11.48	-12.15
Oregon	-2.12	-0.90	-0.93	-1.03	-1.37
Montana	-2.23	-1.80	-1.81	-1.84	-1.95
Idaho	-0.67	0.00	0.00	-0.26	-0.46
PNW	-17.60	-13.11	-13.61	-14.62	-15.94

Figure 3: Employment Impact Multipliers in 2001

	Aluminum Layoffs	Total Lost Employment	Multiplier Effect
Washington	5.119	-12.57	-2.46
Oregon	0.400	-2.12	-5.30
Montana	0.550	-2.23	-4.05
Idaho		-0.67	
PNW	6.069	-17.6	-2.90

Figure 4: Percent of Employment Lost by State

	2001	2005	2010	2015	2020
Washington	-0.36%	-0.29%	-0.29%	-0.30%	-0.31%
Oregon	-0.10%	-0.04%	-0.04%	-0.04%	-0.06%
Montana	-0.40%	-0.31%	-0.30%	-0.30%	-0.31%
Idaho	-0.09%	0.00%	0.00%	-0.03%	-0.05%
PNW	-0.26%	-0.18%	-0.18%	-0.19%	-0.20%

Population

Population increases because of births and in-migration (generally due to favorable economic conditions.) When people lose their jobs, some of them must move out of the region to find new employment. Furthermore, states that have high unemployment rates do not attract new workers. The net impact of increased regional unemployment on population is negative.

There is a second impact on population. The people who are leaving are relatively young compared to the rest of the population and are taking with them future children. This additional population loss is carried through the simulation period resulting in overall lower population levels.

Figures 4 through 6 illustrate the change in population by state that occurs when the aluminum smelters shut down. While the largest numerical decline is in Washington, the largest percentage decline is in Montana. This corresponds to the number and percentage of employment losses in each state. Oregon and Idaho had relatively few employment losses in percentage terms (Idaho had no plant closings); they have corresponding small population losses as well.

Figure 5: Total Population By State (in thousands)

	2001	2005	2010	2015	2020
Washington	5855.00	6001.40	6223.31	6540.58	6897.10
Oregon	3351.75	3445.71	3599.94	3776.97	3950.96
Montana	901.81	921.45	950.77	987.89	1024.15
Idaho	1262.28	1312.17	1381.40	1447.86	1502.15
PNW	11370.84	11680.72	12155.41	12753.29	13374.35

Figure 6: Population Losses by State (in thousands)

	2001	2005	2010	2015	2020
Washington	-4.087	-15.306	-21.262	-24.129	-25.510
Oregon	-0.762	-1.973	-2.089	-2.385	-3.292
Montana	-0.714	-2.412	-3.152	-3.522	-3.751
Idaho	-0.035	-0.005	-0.004	-0.019	-0.033
PNW	-5.598	-19.696	-26.507	-30.055	-32.586

Figure 7: Percent of Population Lost by State

	2001	2005	2010	2015	2020
Washington	-0.07%	-0.26%	-0.34%	-0.37%	-0.37%
Oregon	-0.02%	-0.06%	-0.06%	-0.06%	-0.08%
Montana	-0.08%	-0.26%	-0.33%	-0.36%	-0.37%
Idaho	0.00%	0.00%	0.00%	0.00%	0.00%
PNW	-0.05%	-0.17%	-0.22%	-0.24%	-0.24%

GRP and Personal Income (PI)

As shown in Figures 7, 10, and 12, a pattern similar to the employment pattern can be seen in the changes to GRP. The percent change ranges from –0.56% in Washington where the most job loss occurred to -0.10% in Idaho where no direct job loss occurred from the closure of smelting plants. The GRP percentage changes were slightly higher than the employment changes, indicating in part the higher than average wage paid to these workers.

Contrast the GRP changes with changes to Personal Income (Figures 8, 10, 12). Personal Income includes transfer payments such as social security. While the impact on Personal Income is about the same as the impact on GRP in the states least affected by the smelter closings (Oregon and Idaho), the states most affected by the smelter closings (Washington and Montana) see their impact mitigated somewhat by the transfer payment component in Personal Income. For the region as a whole, the impact of smelter closings on PI is only a little more than half the impact on GRP.

Figure 8: GRP by State in $B92

	2001	2005	2010	2015	2020
Washington	171.08	181.27	197.84	215.81	232.38
Oregon	95.42	105.54	119.25	131.57	142.25
Montana	22.56	24.14	26.45	28.66	30.70
Idaho	34.20	39.37	45.57	50.79	55.27
PNW	323.26	350.32	389.12	426.83	460.60

Figure 9: Personal Income by State in $B92

	2001	2005	2010	2015	2020
Washington	163.05	189.82	231.30	281.26	338.69
Oregon	83.72	98.19	120.18	144.70	172.06
Montana	18.76	22.03	26.74	32.04	38.09
Idaho	27.21	32.40	39.91	47.83	56.61
PNW	292.74	342.43	418.13	505.84	605.44

Figure 10: Change in GRP by State in $B92

	2001	2005	2010	2015	2020
Washington	-0.95	-0.93	-1.06	-1.20	-1.34
Oregon	-0.13	-0.08	-0.08	-0.09	-0.11
Montana	-0.19	-0.18	-0.19	-0.19	-0.21
Idaho	-0.04	-0.01	0.00	-0.02	-0.03
PNW	-1.31	-1.19	-1.33	-1.50	-1.70

Figure 11: Change in PI by State in $B92

	2001	2005	2010	2015	2020
Washington	-0.45	-0.49	-0.61	-0.72	-0.85
Oregon	-0.09	-0.07	-0.09	-0.11	-0.14
Montana	-0.07	-0.07	-0.09	-0.10	-0.12
Idaho	-0.04	-0.01	0.00	-0.02	-0.03
PNW	-0.64	-0.65	-0.79	-0.96	-1.15

Figure 12: Percent Change in GRP by State

	2001	2005	2010	2015	2020
Washington	-0.56%	-0.51%	-0.54%	-0.56%	-0.58%
Oregon	-0.14%	-0.07%	-0.07%	-0.07%	-0.08%
Montana	-0.84%	-0.73%	-0.70%	-0.67%	-0.67%
Idaho	-0.10%	-0.01%	-0.01%	-0.04%	-0.06%
PNW	-0.41%	-0.34%	-0.34%	-0.35%	-0.37%

Figure 13: Percent Change in PI by State

	2001	2005	2010	2015	2020
Washington	-0.28%	-0.26%	-0.26%	-0.26%	-0.25%
Oregon	-0.11%	-0.08%	-0.08%	-0.07%	-0.08%
Montana	-0.36%	-0.35%	-0.35%	-0.33%	-0.32%
Idaho	-0.12%	-0.01%	-0.01%	-0.04%	-0.05%
PNW	-0.22%	-0.19%	-0.19%	-0.19%	-0.19%

Additional impacts in the region are captured by the "per capita" measures for GRP and PI (Figures 14 to 19). Washington has the highest per capita GRP and Montana the lowest. The loss of the smelting industry with its high wages has a greater impact on Montana with its lower-than-the-regional average GRP per capita. Montana loses 0.76% of its GRP during the shut down; Washington loses only two-thirds of that. Idaho and Oregon experience very small changes in GRP.

However, by the end of the simulation period both Washington and Montana appear to recover over half the loss of their GRP. Montana's impact is less than one percent initially and quickly declines to about a third of one percent. Washington's drop is equally dramatic. However, it should be noted that all changes to GRP are small, even before recovery. At most, the average loss in per capita annual GRP is $191; the least, a paltry $1. On average, the Pacific Northwest would see GRP per capita decline by $101 initially but by 2005 the loss is only $51 on an average per capita GRP of over $32,000.

Personal Income recovers even more quickly. Virtually all the reduction in per capita PI is recovered by Washington, Oregon and Idaho by 2005 and by Montana in 2010. The range on the change of PI ranges from a $58 loss to $58 gain on an average PI for the region of slightly over $28,000. The loss occurs in the short-term while the gains occur in the long-terms as the economy recovers and the population dynamics adjust to the new

conditions. PI per capita is probably a better measure of population well-being than GRP because it reflects all the sources of income. Transfer payments tend to be a larger component of county incomes than does the specified business activity noted in the GRP.

However there is one more major factor at work that "masks" some of the hardship associated with the smelter closings. There is an apparent inconsistency in the rapid recovery of "per capita" variables GRP and PI when compared to the total variables GRP and PI that do not recover as much or as fast through the simulation period. This inconsistency can be explained in terms of population changes.

The reduction in population in the states with the loss of smelter employment reduces the impact on the per capita variables. GRP and PI may be less but since population is also reduced, the impact is minimized. This does not necessarily reflect an understatement of the hardship involved in closing the plants; many of whom leave to seek other work will find it and many of those that do not in-migrate are already employed elsewhere.

Figure 14: GRP per Capita by State in $B92

	2001	2005	2010	2015	2020
Washington	29,220	30,205	31,791	32,996	33,693
Oregon	28,467	30,629	33,126	34,834	36,004
Montana	25,015	26,196	27,820	29,012	29,971
Idaho	27,093	30,006	32,990	35,082	36,792
PNW	28,429	29,990	32,002	33,453	34,423

Figure 15: Personal Income per Capita by State in $B92

	2001	2005	2010	2015	2020
Washington	27,848	31,629	37,166	43,003	49,106
Oregon	24,976	28,496	33,383	38,312	43,547
Montana	20,808	23,902	28,132	32,433	37,190
Idaho	25,226	28,017	30,774	32,604	34,067
PNW	26,153	29,693	34,626	39,629	44,855

Figure 16: Change in GRP per Capita by State in $

	2001	2005	2010	2015	2020
Washington	-142.10	-77.07	-61.82	-62.28	-69.84
Oregon	-33.50	-5.10	-2.72	-1.04	1.40
Montana	-190.73	-123.20	-102.01	-91.61	-92.01
Idaho	-22.98	0.95	-3.40	-6.94	1.35
PNW	-100.74	-50.86	-41.11	-40.42	-42.71

Figure 17: Change in PI per Capita by State in $

	2001	2005	2010	2015	2020
Washington	-57.33	-2.25	28.85	47.78	57.64
Oregon	-22.09	-6.17	-5.76	-4.10	1.36
Montana	-57.82	-21.48	-3.86	9.28	17.71
Idaho	-21.40	0.89	-3.17	-6.45	1.25
PNW	-43.00	-4.58	12.51	23.42	31.63

Figure 18: Percent Change in GRP per Capita by State

	2001	2005	2010	2015	2020
Washington	-0.49%	-0.26%	-0.19%	-0.19%	-0.21%
Oregon	-0.12%	-0.02%	-0.01%	0.00%	0.00%
Montana	-0.76%	-0.47%	-0.37%	-0.32%	-0.31%
Idaho	-0.08%	0.00%	-0.01%	-0.02%	0.00%
PNW	-0.35%	-0.17%	-0.13%	-0.12%	-0.12%

Figure 19: Percent Change in PI per Capita by State

	2001	2005	2010	2015	2020
Washington	-0.21%	-0.01%	0.08%	0.11%	0.12%
Oregon	-0.09%	-0.02%	-0.02%	-0.01%	0.00%
Montana	-0.28%	-0.09%	-0.01%	0.03%	0.05%
Idaho	-0.08%	0.00%	-0.01%	-0.02%	0.00%
PNW	-0.16%	-0.02%	0.04%	0.06%	0.07%

Overview of the Impacts on the Pacific Northwest: County Employment, Population, Personal Income and GRP

The discussion above illustrated the different impacts of the smelting closures on the individual states. While there were some differences, the total impact both for each state and the Pacific Northwest region as a whole was very small. However, these aggregate numbers do mask some county differences that are problematic and should be considered.

Population

Just as the impacts of closing the smelters is not felt evenly among the states, there are differences in the impacts between counties as well. County population changes more dramatically in response to employment opportunities than does the state population. Klickitat, Washington and Wasco, Oregon experience the greatest drops in population, with Klickitat losing almost 18 percent of its population by 2020 (Figures 20-22). Wasco's drop in population was a little less than half that – about 8.5 percent by 2020. This is not surprising given that these two counties are the smallest in size and heavily dependent on the smelter for employment. [10] If the smelters close there is no diversified

[10] The smaller the population, the more difficult is the statistical interpretation and the greater the potential difference between what is reported here and the actual outcome.

economy to absorb the laid-off workers. Unemployment rises (as discussed in the next section) and out-migration begins. High unemployment rates do not encourage economic in-migration and the net result is a loss of county population.

Figure 20: County Population in thousands

	2001	2005	2010	2015	2020
Klickitat	20.624	20.324	20.672	21.395	22.252
Cowlitz	88.997	86.417	86.464	89.003	92.307
Chelan	60.546	60.512	61.291	63.424	66.375
Clark	346.162	365.234	390.387	416.564	442.021
Whatcom	157.835	158.502	163.220	171.420	180.974
Spokane	416.014	422.930	437.144	456.791	478.619
Rest of WA	4764.820	4887.476	5064.129	5321.981	5614.548
Total WA	5854.998	6001.395	6223.307	6540.578	6897.097

	2001	2005	2010	2015	2020
Wasco	22.958	22.237	22.251	22.960	23.939
Multnomah	630.231	632.588	646.343	668.777	697.393
Rest of OR	2698.563	2790.881	2931.343	3085.230	3229.623
Total OR	3351.752	3445.706	3599.937	3776.967	3950.955
Flathead	74.815	76.200	79.743	84.444	89.070
Rest of MT	826.997	845.247	871.028	903.448	935.075
Total MT	901.813	921.447	950.771	987.893	1024.145

Figure 21: Change in County Population in thousands

	2001	2005	2010	2015	2020
Klickitat	-0.613	-2.637	-3.985	-4.677	-4.866
Cowlitz	-0.517	-2.172	-3.152	-3.624	-3.737
Chelan	-0.286	-1.146	-1.662	-1.917	-1.973
Clark	-0.412	-1.782	-2.658	-3.118	-3.291
Whatcom	-0.890	-3.580	-5.035	-5.645	-5.695
Spokane	-0.856	-3.338	-4.542	-4.985	-5.002
Rest of WA	-0.513	-0.650	-0.228	-0.163	-0.948
Total WA	-4.087	-15.306	-21.262	-24.129	-25.510

	2001	2005	2010	2015	2020
Wasco	-0.33	-1.30	-1.86	-2.15	-2.20
Multnomah	-0.11	-0.23	-0.17	-0.18	-0.33
Rest of OR	-0.32	-0.45	-0.06	-0.06	-0.77
Total OR	-0.76	-1.97	-2.09	-2.38	-3.29
Flathead	-0.57	-2.23	-3.09	-3.41	-3.42
Rest of MT	-0.15	-0.18	-0.07	-0.11	-0.34
Total MT	-0.71	-2.41	-3.15	-3.52	-3.75

Figure 22: Percent Change in County Population

	2001	2005	2010	2015	2020
Klickitat	-2.89%	-11.48%	-16.16%	-17.94%	-17.94%
Cowlitz	-0.58%	-2.45%	-3.52%	-3.91%	-3.89%
Chelan	-0.47%	-1.86%	-2.64%	-2.93%	-2.89%
Clark	-0.12%	-0.49%	-0.68%	-0.74%	-0.74%
Whatcom	-0.56%	-2.21%	-2.99%	-3.19%	-3.05%
Spokane	-0.21%	-0.78%	-1.03%	-1.08%	-1.03%
Rest of WA	-0.01%	-0.01%	0.00%	0.00%	-0.02%
Total WA	-0.07%	-0.25%	-0.34%	-0.37%	-0.37%

	2001	2005	2010	2015	2020
Wasco	-1.43%	-5.51%	-7.73%	-8.55%	-8.41%
Multnomah	-0.02%	-0.04%	-0.03%	-0.03%	-0.05%
Rest of OR	-0.01%	-0.02%	0.00%	0.00%	-0.02%
Total OR	-0.02%	-0.06%	-0.06%	-0.06%	-0.08%
Flathead	-0.75%	-2.85%	-3.73%	-3.88%	-3.69%
Rest of MT	-0.02%	-0.02%	-0.01%	-0.01%	-0.04%
Total MT	-0.08%	-0.26%	-0.33%	-0.36%	-0.36%

Employment

The largest absolute reductions in employment are found in Whatcom, Spokane, both in Washington, and Flathead, Montana (Figures 23-25). In terms of percentage impacts, however, Klickitat, with an 11 percent loss of employment tops the list by a wide margin, followed by Wasco with nearly a six percent reduction. Flathead is third, with a little over 3.5 percent reduction, followed by Cowlitz with a little less than 3.5 percent reduction. So the pain is not spread evenly over the counties and an 11 percent reduction in employment that increases over the simulation period to nearly 14 percent requires significant changes within the county over what would have otherwise occurred.
The rest of Washington (which includes Pierce county that has the Tacoma plant), loses the jobs associated with the plant but rebounds and even gains employment during the later years of the simulation. Counties that experience job loss because of plant closings and secondary employment loss also lose employees who leave to seek work elsewhere. One place they go is the "rest of" the state where they seek and often find new employment. Plant closings cause hardship in some areas of each state but can actually have a positive impact on other areas.

Figure 23: Total Employment By County (in thousands)

	2001	2005	2010	2015	2020
Klickitat	8.54	8.86	9.19	9.43	9.57
Cowlitz	46.26	47.50	48.85	49.71	50.06

Chelan	43.66	44.90	46.34	47.54	48.36
Clark	151.13	159.65	170.30	178.58	184.70
Whatcom	89.69	93.34	97.34	100.60	103.27
Spokane	250.33	261.30	273.98	283.63	291.10
Rest of WA	2904.24	2975.91	3078.29	3192.92	3278.97
Total WA	3493.84	3591.46	3724.28	3862.40	3966.03

	2001	2005	2010	2015	2020
Wasco	11.56	11.88	12.21	12.47	12.64
Multnomah	555.93	571.58	592.00	610.39	622.17
Rest of OR	1493.30	1559.26	1629.40	1677.00	1706.76
Total OR	2060.79	2142.73	2233.61	2299.86	2341.57
Flathead	46.47	48.75	51.43	53.43	54.94
Rest of MT	513.69	534.75	554.67	570.63	582.24
Total MT	560.16	583.50	606.11	624.05	637.18

Figure 24: Employment Changes by County (in thousands)

	2001	2005	2010	2015	2020
Klickitat	-1.05	-1.21	-1.40	-1.51	-1.54
Cowlitz	-1.63	-1.60	-1.70	-1.79	-1.85
Chelan	-1.18	-1.20	-1.27	-1.32	-1.33
Clark	-1.24	-1.18	-1.25	-1.30	-1.34
Whatcom	-2.53	-2.46	-2.57	-2.66	-2.70
Spokane	-3.43	-3.07	-3.03	-3.05	-3.04
Rest of WA	-1.52	0.31	0.33	0.15	-0.35
Total WA	-12.57	-10.41	-10.88	-11.48	-12.15

	2001	2005	2010	2015	2020
Wasco	-0.71	-0.73	-0.79	-0.85	-0.88
Multnomah	-0.54	-0.16	-0.13	-0.15	-0.24
Rest of OR	-0.87	-0.02	0.00	-0.03	-0.26
Total OR	-2.12	-0.90	-0.93	-1.03	-1.37
Flathead	-2.12	-1.66	-1.66	-1.68	-1.70
Rest of MT	-0.51	-0.15	-0.15	-0.16	-0.25
Total MT	-2.23	-1.80	-1.81	-1.84	-1.95

Figure 25: Percent of Employment Lost by County

	2001	2005	2010	2015	2020
Klickitat	-10.92%	-12.01%	-13.17%	-13.78%	-13.88%
Cowlitz	-3.40%	-3.26%	-3.36%	-3.48%	-3.56%
Chelan	-2.64%	-2.59%	-2.67%	-2.70%	-2.67%

Clark	-0.81%	-0.73%	-0.73%	-0.72%	-0.72%
Whatcom	-2.74%	-2.57%	-2.57%	-2.58%	-2.55%
Spokane	-1.35%	-1.16%	-1.09%	-1.06%	-1.03%
Rest of WA	-0.05%	0.01%	0.01%	0.00%	-0.01%
Total WA	-0.36%	-0.29%	-0.29%	-0.30%	-0.31%

	2001	2005	2010	2015	2020
Wasco	-5.80%	-5.79%	-6.10%	-6.36%	-6.48%
Multnomah	-0.10%	-0.03%	-0.02%	-0.02%	-0.04%
Rest of OR	-0.06%	0.00%	0.00%	0.00%	-0.02%
Total OR	-0.10%	-0.04%	-0.04%	-0.04%	-0.06%
Flathead	-3.58%	-3.28%	-3.12%	-3.05%	-3.00%
Rest of MT	-0.10%	-0.03%	-0.03%	-0.03%	-0.04%
Total MT	-0.40%	-0.31%	-0.30%	-0.29%	-0.30%

GRP and Personal Income

At the county level, the impacts on GRP are often twice that of employment in percentage terms (Figures 26,28,30). As with employment, the county impacts vary. Klickitat, with an initial GRP of $340M, loses over 20 percent of its GRP initially and never recovers – its GRP is 25 percent lower at the end of the simulation period. Cowlitz and Chelan lose slightly more of their GRP but the impact is only about one quarter that of Klickitat.

Wasco, in Oregon, is another county hard hit. Like Klickitat, its initial GRP is small, about $390M, and it loses about 13.5 percent of its GRP when the smelter closes. Also, like Klickitat, it is unable to recover from the initial loss; however, the new employment path stablizes at the initial level loss and does not increase as it does in Klickitat. Flathead, MT loses eight percent of its GRP and Whatcom, over four percent, both significant losses that are generally maintained through the simulation period.

The transfer payments in Personal Income cushion these reductions somewhat (Figures 27,29,31). In general, Personal Income loss is half that of GRP. The biggest differences occur in the counties with the greatest losses. Transfer payments insulate Personal Income to some extent from the full impact of the lay-offs.

Figure 26: GRP ($B92)

	2001	2005	2010	2015	2020
Klickitat	0.34	0.36	0.40	0.43	0.45
Cowlitz	2.32	2.46	2.68	2.88	3.06
Chelan	1.92	2.04	2.23	2.42	2.59
Clark	7.79	8.88	10.29	11.52	12.62
Whatcom	3.94	4.23	4.66	5.06	5.44

Spokane	11.78	12.80	14.26	15.61	16.84
Rest of WA	142.99	150.51	163.34	177.89	191.37
Total WA	171.08	181.27	197.84	215.81	232.38

	2001	2005	2010	2015	2020
Wasco	0.39	0.41	0.45	0.48	0.51
Multnomah	27.07	28.77	31.56	34.36	36.85
Rest of OR	67.96	76.35	87.24	96.73	104.89
Total OR	95.42	105.54	119.25	131.57	142.25
Flathead	1.73	1.85	2.05	2.23	2.40
Rest of MT	20.83	22.28	24.40	26.43	28.29
Total MT	22.56	24.14	26.45	28.66	30.70

Figure 27: Personal Income by County ($B92)

	2001	2005	2010	2015	2020
Klickitat	0.34	0.39	0.47	0.56	0.66
Cowlitz	1.93	2.20	2.65	3.15	3.70
Chelan	1.41	1.61	1.91	2.27	2.68
Clark	8.89	10.53	13.13	16.11	19.47
Whatcom	3.46	4.03	4.93	5.98	7.21
Spokane	9.79	11.45	14.02	16.88	20.22
Rest of WA	137.23	159.62	194.18	236.35	284.76
Total WA	163.05	189.82	231.30	281.26	338.69

	2001	2005	2010	2015	2020
Wasco	0.47	0.54	0.64	0.76	0.91
Multnomah	19.08	21.99	26.50	31.82	37.86
Rest of OR	64.16	75.66	93.03	112.12	133.29
Total OR	83.72	98.19	120.18	144.70	172.06
Flathead	1.55	1.82	2.27	2.76	3.33
Rest of MT	17.22	20.20	24.48	29.28	34.75
Total MT	18.76	22.03	26.74	32.04	38.09

Figure 28: Change in GRP ($92)

	2001	2005	2010	2015	2020
Klickitat	-0.09	-0.10	-0.12	-0.14	-0.16
Cowlitz	-0.13	-0.13	-0.16	-0.18	-0.20
Chelan	-0.12	-0.13	-0.15	-0.17	-0.19
Clark	-0.08	-0.08	-0.09	-0.11	-0.12
Whatcom	-0.19	-0.20	-0.23	-0.26	-0.28
Spokane	-0.29	-0.29	-0.32	-0.36	-0.38

Rest of WA	-0.07	0.01	0.01	0.01	-0.02
Total WA	-0.95	-0.93	-1.06	-1.20	-1.34

	2001	2005	2010	2015	2020
Wasco	-0.06	-0.06	-0.07	-0.07	-0.08
Multnomah	-0.03	-0.01	-0.01	-0.01	-0.02
Rest of OR	-0.04	0.00	0.00	0.00	-0.02
Total OR	-0.13	-0.08	-0.08	-0.09	-0.11
Flathead	-0.15	-0.16	-0.16	-0.17	-0.17
Rest of MT	-0.04	-0.02	-0.03	-0.03	-0.04
Total MT	-0.19	-0.18	-0.19	-0.19	-0.21

Figure 29: Change in Personal Income ($B92)

	2001	2005	2010	2015	2020
Klickitat	-0.04	-0.06	-0.07	-0.09	-0.10
Cowlitz	-0.06	-0.07	-0.09	-0.11	-0.12
Chelan	-0.03	-0.04	-0.05	-0.06	-0.06
Clark	-0.05	-0.06	-0.07	-0.08	-0.10
Whatcom	-0.08	-0.11	-0.14	-0.17	-0.19
Spokane	-0.11	-0.13	-0.16	-0.18	-0.19
Rest of WA	-0.08	-0.03	-0.03	-0.04	-0.08
Total WA	-0.45	-0.49	-0.61	-0.72	-0.85

	2001	2005	2010	2015	2020
Wasco	-0.03	-0.04	-0.05	-0.06	-0.06
Multnomah	-0.02	-0.02	-0.02	-0.02	-0.03
Rest of OR	-0.05	-0.03	-0.03	-0.03	-0.05
Total OR	-0.09	-0.07	-0.09	-0.11	-0.14
	0.00	0.00	0.00	0.00	0.00
Flathead	-0.06	-0.07	-0.08	-0.09	-0.10
Rest of MT	-0.02	-0.01	-0.01	-0.02	-0.02
Total MT	-0.07	-0.07	-0.09	-0.10	-0.12

Figure 30: Percent Change in GRP

	2001	2005	2010	2015	2020
Klickitat	-20.70%	-22.15%	-23.89%	-25.00%	-25.62%
Cowlitz	-5.12%	-5.14%	-5.51%	-5.82%	-6.04%
Chelan	-5.89%	-5.96%	-6.34%	-6.56%	-6.69%
Clark	-1.02%	-0.90%	-0.91%	-0.92%	-0.94%
Whatcom	-4.48%	-4.45%	-4.66%	-4.83%	-4.91%
Spokane	-2.38%	-2.22%	-2.21%	-2.24%	-2.22%
Rest of WA	-0.05%	0.01%	0.01%	0.00%	-0.01%

Total WA	-0.55%	-0.51%	-0.53%	-0.56%	-0.57%

	2001	2005	2010	2015	2020
Wasco	-13.41%	-13.39%	-13.32%	-13.29%	-13.32%
Multnomah	-0.11%	-0.04%	-0.04%	-0.04%	-0.06%
Rest of OR	-0.06%	0.00%	0.00%	0.00%	-0.01%
Total OR	-0.14%	-0.07%	-0.07%	-0.07%	-0.08%
Flathead	-8.09%	-7.72%	-7.19%	-6.88%	-6.64%
Rest of MT	-0.18%	-0.10%	-0.11%	-0.11%	-0.13%
Total MT	-0.84%	-0.73%	-0.69%	-0.67%	-0.67%

Figure 31: Percent Change in Personal Income by County

	2001	2005	2010	2015	2020
Klickitat	-9.58%	-12.61%	-13.89%	-14.31%	-13.61%
Cowlitz	-2.82%	-3.20%	-3.31%	-3.29%	-3.17%
Chelan	-2.02%	-2.33%	-2.47%	-2.48%	-2.37%
Clark	-0.52%	-0.55%	-0.56%	-0.55%	-0.52%
Whatcom	-2.44%	-2.72%	-2.78%	-2.68%	-2.49%
Spokane	-1.09%	-1.15%	-1.10%	-1.04%	-0.97%
Rest of WA	-0.06%	-0.02%	-0.01%	-0.02%	-0.03%
Total WA	-0.28%	-0.26%	-0.26%	-0.26%	-0.25%

	2001	2005	2010	2015	2020
Wasco	-5.72%	-6.61%	-6.98%	-7.00%	-6.69%
Multnomah	-0.10%	-0.07%	-0.06%	-0.06%	-0.07%
Rest of OR	-0.07%	-0.03%	-0.03%	-0.03%	-0.04%
Total OR	-0.11%	-0.08%	-0.08%	-0.07%	-0.08%
Flathead	-3.21%	-3.51%	-3.42%	-3.19%	-2.94%
Rest of MT	-0.09%	-0.06%	-0.05%	-0.05%	-0.06%
Total MT	-0.36%	-0.35%	-0.34%	-0.33%	-0.32%

Figures 32,34,36 show that GRP per capita has wider spread among the counties than among the states in the region; values range from a low of $16,534 in the small county of Klickitat to a high of $42,946 in Multnomah. The spread on Personal Income is considerably less, from $17,843 in Klickitat to $32,506 in Multinomah. State averages range only from about $25,000 to $29,000. Klickitat loses over 18 percent of its GRP per capita as a result of the plant closing, and with the lowest GRP per capita initially, the disparity is increased. However, it only loses 6.53 percent of its Personal Income (Figures 33,35,37). The county appears to recover as the simulation period ends, losing "only" nine percent of GRP per capita by 2020 and actually gaining 7 percent in PI per capita . This improvement is not due to increased GRP or PI (see Figures 25 to 30) but because of economic out-migration. People lose their jobs and leave the county seeking new employment. Wasco, also hard hit by the plant closing, loses over 12 percent of its

GRP per capita and recovers to within 5.5% of the baseline by 2020, again principally because of out-migration. Both Klickitat and Wasco are small counties and do not have sufficiently diversified economies to absorb the loss of a major industry.

Figure 32: GRP per Capita ($92)

	2001	2005	2010	2015	2020
Klickitat	16,534	17,811	19,108	19,911	20,358
Cowlitz	26,035	28,420	30,938	32,381	33,194
Chelan	31,645	33,663	36,384	38,156	39,066
Clark	22,513	24,321	26,346	27,664	28,544
Whatcom	24,982	26,706	28,550	29,536	30,071
Spokane	28,324	30,258	32,621	34,167	35,182
Rest of WA	30,010	30,794	32,254	33,425	34,085
Total WA	29,220	30,205	31,791	32,996	33,693

	2001	2005	2010	2015	2020
Wasco	17,162	18,618	20,179	21,037	21,471
Multnomah	42,946	45,486	48,833	51,371	52,832
Rest of OR	25,182	27,357	29,760	31,352	32,478
Total OR	28,467	30,629	33,126	34,834	36,004
Flathead	23,084	24,331	25,733	26,455	26,979
Rest of MT	25,189	26,364	28,011	29,250	30,255
Total MT	25,015	26,196	27,820	29,012	29,971

Figure 33: Personal Income per capita ($92) by County

	2001	2005	2010	2015	2020
Klickitat	16,614	19,111	22,653	26,020	29,585
Cowlitz	21,656	25,456	30,607	35,346	40,073
Chelan	23,175	26,509	31,246	35,695	40,259
Clark	25,696	28,829	33,651	38,657	44,053
Whatcom	21,963	25,448	30,193	34,834	39,846
Spokane	23,523	27,071	32,076	36,945	42,242
Rest of WA	28,802	32,657	38,344	44,410	50,719
Total WA	27,848	31,629	37,166	43,003	49,106

	2001	2005	2010	2015	2020
Wasco	20,724	24,312	29,053	33,354	37,789
Multnomah	30,266	34,766	40,997	47,585	54,282
Rest of OR	23,777	27,108	31,737	36,339	41,271
Total OR	24,976	28,496	33,383	38,312	43,547
Flathead	20,659	23,943	28,450	32,731	37,444
Rest of MT	20,822	23,898	28,101	32,405	37,166
Total MT	20,808	23,902	28,132	32,433	37,190

Figure 34: Change in GRP per capita ($) by County

	2001	2005	2010	2015	2020
Klickitat	-3714	-2440	-1941	-1875	-2100
Cowlitz	-1246	-805	-653	-655	-760
Chelan	-1824	-1467	-1438	-1482	-1594
Clark	-204	-103	-61	-49	-59
Whatcom	-1025	-626	-501	-510	-588
Spokane	-630	-443	-396	-404	-428
Rest of WA	-11	6	4	2	2
Total WA	-142	-77	-62	-62	-70

	2001	2005	2010	2015	2020
Wasco	-2375	-1693	-1302	-1148	-1217
Multnomah	-38	-2	-6	-6	-5
Rest of OR	-13	4	1	0	3
Total OR	-33	-5	-3	-1	1
Flathead	-1842	-1284	-961	-851	-853
Rest of MT	-41	-20	-28	-28	-29
Total MT	-191	-123	-102	-92	-92

Figure 35: Change in Personal Income per capita ($92) by County

	2001	2005	2010	2015	2020
Klickitat	-1230	-245	597	1103	1484
Cowlitz	-499	-198	67	229	296
Chelan	-366	-128	54	165	214
Clark	-103	-18	40	77	97
Whatcom	-423	-135	66	181	229
Spokane	-210	-101	-23	15	29
Rest of WA	-15	-1	-3	-6	-6
Total WA	-58	-2	29	47	57

	2001	2005	2010	2015	2020
Wasco	-944	-287	233	558	698
Multnomah	-25	-11	-12	-15	-10
Rest of OR	-13	-5	-8	-9	-6
Total OR	-22	-7	-6	-4	1
	0	0	0	0	0
Flathead	-523	-163	91	234	292
Rest of MT	-16	-8	-13	-12	-8
Total MT	-58	-21	-4	9	18

Figure 36: Percent Change in GRP per capita by County

	2001	2005	2010	2015	2020
Klickitat	-18.34%	-12.05%	-9.22%	-8.60%	-9.35%

Cowlitz	-4.57%	-2.75%	-2.07%	-1.98%	-2.24%
Chelan	-5.45%	-4.17%	-3.80%	-3.74%	-3.92%
Clark	-0.90%	-0.42%	-0.23%	-0.18%	-0.20%
Whatcom	-3.94%	-2.29%	-1.72%	-1.70%	-1.92%
Spokane	-2.18%	-1.44%	-1.20%	-1.17%	-1.20%
Rest of WA	-0.04%	0.02%	0.01%	0.01%	0.01%
Total WA	-0.48%	-0.25%	-0.19%	-0.19%	-0.21%

	2001	2005	2010	2015	2020
Wasco	-12.15%	-8.34%	-6.06%	-5.18%	-5.36%
Multnomah	-0.09%	-0.01%	-0.01%	-0.01%	-0.01%
Rest of OR	-0.05%	0.01%	0.00%	0.00%	0.01%
Total OR	-0.12%	-0.02%	-0.01%	0.00%	0.00%
Flathead	-7.39%	-5.01%	-3.60%	-3.12%	-3.06%
Rest of MT	-0.16%	-0.08%	-0.10%	-0.10%	-0.09%
Total MT	-0.76%	-0.47%	-0.37%	-0.31%	-0.31%

Figure 37: Percent Change in Personal Income per capita by County

	2001	2005	2010	2015	2020
Klickitat	-6.53%	-1.30%	3.04%	5.45%	7.14%
Cowlitz	-1.96%	-0.73%	0.23%	0.75%	0.94%
Chelan	-1.17%	-0.39%	0.15%	0.45%	0.57%
Clark	-0.49%	-0.08%	0.16%	0.30%	0.37%
Whatcom	-1.74%	-0.53%	0.24%	0.65%	0.81%
Spokane	-0.78%	-0.35%	-0.07%	0.04%	0.09%
Rest of WA	-0.05%	0.00%	-0.01%	-0.02%	-0.02%
Total WA	-0.21%	-0.01%	0.10%	0.16%	0.18%

	2001	2005	2010	2015	2020
Wasco	-5.19%	-1.51%	1.16%	2.70%	3.32%
Multnomah	-0.06%	-0.03%	-0.03%	-0.03%	-0.02%
Rest of OR	-0.06%	-0.02%	-0.03%	-0.03%	-0.02%
Total OR	-0.08%	-0.02%	-0.02%	-0.01%	0.00%
Flathead	-2.26%	-0.69%	0.37%	0.92%	1.13%
Rest of MT	-0.07%	-0.03%	-0.05%	-0.05%	-0.03%
Total MT	-0.25%	-0.09%	-0.01%	0.03%	0.06%

The GRP per capital is permanently different than it would have otherwise have been for badly affected counties because many former employees leave the area with a resulting increase in the retired fraction of the population. Because the retired population does not depend on the aluminum industry employment, they are relatively unaffected by the closures. As the county initially declines, real-estate prices and wages fall. This makes the area attractive to new business. In the long-term, the hardest hit counties appear to

benefit the most.[11] This may run contrary to intuition, but Appendix 3 verifies that this result is consistent with the impacts experienced for the timber industry decline. All forecast have a degree of uncertainty. With all things equal, the accuracy is greater for large populations where individual conditions blend to produce the estimated average. In a small county, unique situations may overwhelm these estimated averages and cause results different from those shown here.

Relationship between Smelter Closures and Electricity Price and Availability

This brings up the last point of the analysis. The PNW smelters use nearly 3500 average MW of electricity. This amount of energy is comparable to what the region is short. When the ENERGY 2020 model is combined with the REMI model for the analysis, simulation results indicate regional average electric prices rising in the $50 to $60/MWh range for a sustained period -- despite the continued Bonneville Power Administration (BPA) efforts to limit market prices.

Closing the plants has a positive impact on prices, particularly summer prices (Figures 38 and 39). As shown in Figure 39, closing all plants results in an immediate reduction in summer average wholesale prices of nearly 10%. Reducing load reduces prices three ways: by reducing purchases of expensive power, by readjusting the load shape, and by deferring new plant construction. In ENERGY 2020, "tight" prices are a signal to build, so prices tend to run up shortly before new construction comes on-line which is consistent with what actually happens. Reducing demand alters the building pattern as well as the amount of building. This can cause different electricity price "patterns" in the various simulations that can intersect each other. That these intersections do not happen in this case, that the APC simulation consistently generates much lower prices than the RTC simulation, is a further indication that real energy cost savings are achieved if the plants are closed.

Figure 38: Winter Average Wholesale Prices

$/MWh	2001	2002	2005	2010	2019
RTC	$ 31.41	$ 32.91	$ 41.20	$ 48.99	$ 65.06
WPC	-0.02%	-0.18%	-0.02%	-0.50%	-0.05%
MPC	-0.74%	-0.74%	-0.02%	-0.50%	-0.09%
APC	-0.81%	-0.77%	-0.25%	-0.50%	-0.14%

Figure 39: Summer Average Wholesale Prices

$/MWh	2001	2002	2005	2010	2019
RTC	$ 29.09	$ 31.65	$ 37.38	$ 48.25	$ 52.70
WPC	-1.85%	-0.44%	-1.26%	-0.01%	-5.00%
MPC	-7.51%	-4.93%	-1.74%	-1.73%	-5.02%
APC	-9.97%	-7.50%	-3.16%	-1.74%	-5.04%

[11] See Appendix 2 for more discussion on this phenomenon.

The analyses reported here did not assume the recent ramp-up in gas prices as permanent or that the generators would take advantage of the market conditions, as is so evident elsewhere in all other electric markets. Including these two considerations would have led to price estimates with peak values much higher than those developed here. Current long-term purchases of power are in the $60/MWh range as noted earlier.[12] With "normal" gas prices, the cost of energy from new combined cycle gas turbine generation is below $40/MWh and possibly below $30/MWh. This analysis indicates that the closure of the smelters would reduce the price of electricity from 7% to nearly10% during summer months and slightly under 1% during the winter months, in the near and mid-term.[13] California conditions, PNW demand growth, and the construction delays for new PNW generation capacity prevent the full 30+% price reduction implied by new plant costs from being fully realized.

If anything, the ENERGY2020/REMI analysis underestimates the price benefits form the reduction of the smelter load in the currently tight PNW energy markets. Nonetheless, the economic benefits of the reduced energy prices are comparable in size to the economic impacts reported here for the smelter closures.[14] That is, the modest impacts reported here at the regional level, would be nearly twice as large if it were not for the electric price reduction "benefits." The other energy intensive industries such as groundwood pulp, clor-alkali, liquefied gases, and steel arc-mills benefit noticeably from these modest price reductions.

As a secondary dynamic associated with the energy price response, it must be noted that the analysis assumed normal water conditions for BPA and that BPA continued its efforts to minimize regional energy costs. Both of these considerations subdue the building of new capacity in the region. When the smelter closures occur, the reduction in both forecasted load and prices cause the simulated new capacity additions in the region to be reduced. A large part of the long-term economic impacts reported for the region are due to the increased long-term energy prices caused by the region maintaining its historical "tradition" of under-building. In essence, the simulation moves the currently anticipated "generation crises" into the future. The analysis suggests that the breathing room the smelter closures could provide to the region for adding new generation capacity will be underutilized. PNW planning actions to ensure that adequate generation capacity is developed in the region would mitigate the long-term economic effects indicated in this analysis.

Conclusion

The analysis presented here simply considers the impacts of smelter closures without regard to whether the smelters really have an economic incentive to shutdown. Other

[12] Ibid., *Dow Jones newswire*

[13] Peak rates are reduced by a much large extent but these represent a small amount of energy. Nonetheless, the high peak rates often cause the political responses experienced elsewhere in the country.

[14] Because the Troutdale plants is already assumed permanent closed in thee base case, the analyses under-reports the total difference in economic benefits caused from energy price reductions due to the closing of all the smelters.

analyses are left to determine the viability of the smelters under varying economic and electric price conditions.[15] This analysis included all the significant macroeconomic dynamics among the interacting counties and states as well as the energy market impacts from changes in electricity demands due to the smelter closures.

The impacts at the regional level are minimal. If the impacts are averaged over the 20 year analysis, they blend in to the background noise of the other business shutdowns and start-ups that naturally occur in a vibrant economy. All impacts are at the tenths of percent values at the regional level. While county level impacts are more significant, long-term recovery looks promising -- or the long-term viability of the county is comparable to what it would be under normal expected conditions. Energy price impacts are small but of the same magnitude to the aluminum smelter closure impacts. The reduced electric demands from the closure cause reduced energy prices that benefit the region in the short and mid-term.

Because the smelters obtain much of their input material from outside the region and the output is an internationally-traded commodity, the impacts the smelters closures have on the PNW economy in much less than that which might be associated with other local, high-value added industries.

[15] Moison, David, PNW Aluminum Industry Survivability Study, Metal Strategies, International, LLC. Prepared for the Aluminum Industry Study Group, October 6, 2000

Appendix 1: Detailed Analysis of Plant Closures and a Look at Other Simulations

Feedback and Secondary Effects

The impact of the smelter closures is more than just the loss of the smelter output and the loss of its employees. The smelters require goods and services from other businesses and those businesses experience reduced activities and consequently reduce employment as well. In the context of economic-modeling, these effects are called Type I responses. Additionally, the laid-off employees no longer have the income to make the purchases they would normally make, those businesses associated with those purchases then additionally suffer. When these affects are added to the Type I responses, the total is called Type II responses. Finally, affected businesses and laid-off works may decide to migrate out of the region and local wages may decline. The combination of these effects plus the Type II effects are called Type III responses. The REMI model includes all the Type III responses.

The ratio of direct employment impacts due the closure of the smelters and the total impacts on county is called the employment multiplier. Except for Montana, the analysis here shows multipliers on the order of 2.0 to 3.0. There is some secondary spillover loss across county lines but these are relatively subdued. The multiplier does vary among the counties with values modestly above and below 2.0. A multiplier of 2.0 is relatively low. Previous analyses by Dick Conway and Associates for Washington,[16] Oregon,[17] and Montana[18] indicate employment multipliers as high as 3.9. The Conway efforts use a 2-digit SIC input-output model with some rudimentary equations describing migration and consumption. It is a static picture that assumes no counter responses by businesses or the labor force. The Conway analysis primarily considers Type I responses but does have some Type II and Type III features. It contains no price response or the consequent impacts. These impacts remain unmitigated in Montana because of the rural nature of Montana in general and because of the limited interaction of the aluminum industry-dependant Flathead County with the rest of the economy. The size of the energy-induced response then indicates that underlying impacts of the REMI analysis without any energy response would be in between those reported by Conway and the IMPLAN studies.

[16] Conway, R. S. Jr., "The Washington State Aluminum Industry Economic Impact Study, Prepared for the Pacifica Northwest Aluminum Industry," Dick Conway and Associates, Seattle, Washington, August 2000.
[17] Conway, R. S. Jr., "The Oregon State Aluminum Industry Economic Impact Study, Prepared for the Pacifica Northwest Aluminum Industry," Dick Conway and Associates, Seattle, Washington, November 2000.
[18] Conway, R. S. Jr., "The Montana State Aluminum Industry Economic Impact Study, Prepared for the Pacifica Northwest Aluminum Industry," Dick Conway and Associates, Seattle, Washington, November 2000.

As discussed before, the REMI simulations in this analysis generate regional multipliers that contain interactions between counties and states. We believe that these multipliers capture more of the real-world impacts than the static, isolated multipliers. For Montana, which has a relatively isolated economy, REMI does show a multiplier in excess of 4.0. This verifies that REMI is capturing the full extent of secondary impacts.

Multiplier differences between this study and other studies

The REMI model provides a sophisticated framework at the 3-digit SIC level to address the dynamics that the Conway model misses. The smelters produce a low value added commodity with much of the process depending on imports of alumina from outside the region. The smelter output of aluminum ingots is an international commodity that with minor additional transportation costs, can be readily obtained on the world markets. A fundamental assumption difference between this study and the Conway study is while the Conway study additionally assumed the loss of the downstream aluminum industry (e.g. mills and foundries), the REMI work here simply forces the downstream industries to look to the markets for the supply of aluminum ingots. If these businesses can obtain the aluminum for economically viable prices, their business continues, albeit with some degradation, if any added costs affect profits. The downstream industries produce greater economic value added than do the smelters. Because they are included in the Conway analysis, the multiplier impacts derived from that work are naturally larger than those found in the REMI analysis

Because the REMI model assumes the existence of and simulates the interaction with the economy outside the region explicitly modeled, the loss of employee purchases has smaller effects on the region than studies without this feature because many of the products, such as automobiles and TVs, are produced outside the region. In the scope of the large national or international markets, these changes in purchases are lost in the noise.
Other studies[19] looking at the closure of the Klickitat and Wasco smelters also produce employment multipliers closely approximating 2.0. The IMPLAN model used for the work is 4-digit input-output model and it primarily captures Type II responses. That it produces similar impacts to the REMI work, indicates much of the differences in response among the models are due to the detail of the IMPLAN and REMI models compared to the Conway model. Note the all three models use the same underlying government-produced economic data. Additionally, IMPLAN has been used with the REMI model to provide added 4-digit level detail with time-dependent dynamics.

Whereas the other noted studies only take a static view of the closures, the REMI analysis takes a dynamic view that extends to 2020. REMI internally determines the substitution effects among labor, capital, and energy. Changes in labor productivity, indicate that the continuing trend in reducing the amount of labor per ton of aluminum will continue. Even without the assumptions of smelter closure, employment in the smelters declines by

[19] Mid-Columbia Economic Development District , "An Assessment of the Employment and Income Impacts of the Primary Metals Industry in Wasco and Klickitat Counties," Prepared for Northern Wasco County People's Utility District, February 10, 2000

almost 25% over the 20-year analysis and by almost 45% from its 1980 peak levels. Consequently, the importance of the smelter industry to the PNW economy already declines overtime even without assuming closures.

A recent study by CRU International of the UK indicates that if a significant portion of the aluminum smelting capacity PNW shuts down, then world aluminum prices may double.[20] While the REMI analysis does include the dynamics economic interactions with the rest of the US West and can include economic interplay with the rest of the US,[21] the interactions with the Rest-of-the-World assume that the world conditions are unaffected by the regional changes within the analysis. That is, this REMI analysis does not include the dynamics of international markets. Nonetheless, the concerns of the CRU study can be addressed.

First, if the price of aluminum did double, demand would decline, thereby bringing supply and demand more into balance with a lower price. Prices would not remain at those levels other than momentarily on some future's market. Second, the higher prices would stimulate new capacity or additional production from existing plants. The PNW plants are relatively inefficient (expensive) by world standards. The new capacity would have costs below those of the PNW plants and these new plants would place additional strain on the PNW plants to close (or stay closed) for economic reasons. In fact, the high cost of the existing PNW smelters has caused others to look toward adding efficient aluminum smelting capacity in Canada to profitably snatch business away from the existing PNW smelters.[22] Lastly, if aluminum prices do double, most of the PNW smelters could pay $120/MWH for energy and remain profitable. Average energy costs of $120/MWh are unlikely over any meaningful period of time – even given the tight energy markets in the PNW. The CRU study does not adequately reflect the realities of the PNW smelter situation.

Overview of the impacts from the REMI model analysis

The REMI baseline forecast of each region is based on the US Department of Commerce BEA forecast. This analysis focused on the differences in the impacts caused by the separate smelter closure scenarios and is relatively insensitive to the underlying forecast. The analysis automatically simulates the multiplier affects of smelter job losses and the loss of economic output on other industries and business for both the employees and the smelters. REMI thoroughly captures the import, export, commuter, and the migration dynamics (of both firms and people) from the closures. The simulation of the down stream impacts of the smelter closures does not have an assumed rigid relationship between supplier and user. REMI explicitly models regional purchase decisions and, in this analysis, the users of the aluminum smelter output simply lost their local supply. If the economics allowed for alternative (domestic or international) supply, then the down-

[20] O'Connor, Gillian, "Aluminum smelters buckle under rising cost of power," *Financial Times*, December 4, 2000

[21] Test along these lines, indicated that the impacts were insignificant, and subsequent analyses limited themselves to the dynamics within the western region of the US.

[22] Stucke, John, " Spokane group eyes aluminum venture," *The Spokesman Review*, November 16, 2000

stream mills would continue to operate. Any increased costs impacts might affect profitability and the output of those mills or of related aluminum-finishing industries.[23]

While some of the industry distinction is at the 4-digit level, the (4-digit) aluminum smelter in each county usually represents the entire 3-digit industry (e.g. non-ferrous metals) in that county. Therefore, the 3-digit level REMI model is adequate for the 4-digit analysis here. National data readily exists at the 3-digit SIC level. Adequate data exists at the state level, but county level data is very sparse. For county level estimation, the REMI model assumes the state or national data (which ever is more appropriate) and then scales it to match the data that is known about the county, such as employment or facility output. This approach produces robust results that are as accurate as possible given the data limitations. Analyses performed many years ago with the REMI model have been shown to be quite accurate; 0.1% changes have meaningful implications.[24]

Impacts of Closing Some Plants:Regional and State Impacts

While even a simple, static input-output model would produce regional impacts comparable to those reports here, the county impacts show responses that may at first appear counter-intuitive. When a factory closes at the county level, there is a decline in the demand of secondary businesses, such as accountants, mechanics, and many others that depended on the spending from the former smelter employees. Unemployed workers may be willing to work for less at other jobs or they may migrate out of the area to resume work in their career elsewhere. They may maintain their residence but find work in the next county. They may take multiple lower paying jobs or previously underemployed spouses may find work to provide supplemental income.

Even though both the short and long-term impacts of aluminum smelter closure are minimal at the regional level, the short-term impacts at the county level are significant. In many cases, the aluminum smelters represent a major source of employment. This analysis indicates that the county may be better off in the long term if it is forced to find a more diversified economic base that releases the county economy from the tenuous dependence it has on the smelter industry. Unique circumstances may indicate that a county really does have marginal economic viability, in which case, the departure of the smelters is just changing the timing of the county's inevitable decline. History and analysis indicates that after a difficult transition period, the remaining citizens of the affected counties may be better off than they currently are. This dynamic is historically evident in the PNW experiences associated with the timber industry. A discussion on the economic history of the "timber counties" is presented in Appendix 3 of this paper to allow comparison the present situation.

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[23] The analysis does assume that the requirement for liquid metal input at the Trentwood plant could be circumvented by the investment in a melting facility or the transport of melted metal from some other facility within physical proximity.

[24] The Massachusetts Economic Policy Analysis Model Track Record 1977-1983; J. Lanzillo, M. Larson, G. Treyz, and R. Williams; Massachusetts Business and Economic Report 13(1), Winter 1985.

The loss of the smelters does lead to both migration out of the county and the reduction in local wage rates. Data indicate that the reduced land and labors costs make the area more attractive to new business. The out-migration of smelter labor ensures that the local labor markets can tighten as the new businesses grow. The end result, on average, is per capita income improvements over the base case. Certainly, the analysis necessarily treats the sparse data as representative and amenable to statistical analysis. This means that the all the counties are simulated assuming the smooth trends implied by the econometric equations. This further implies that some counties will fare worse then noted and some will fare better. However, on average, the response should be what is portrayed here as the "expected" response. These results do depend on the ability of the REMI model to capture wage, labor, and migration dynamics. REMI has an excellent track record in the regard[25] and "REMI … is more sophisticated, less expensive, and has become the standard model for population forecasts."[26]

The analysis provided in Part I of this report concentrated on the "All Plants Closed" Scenario. Below, two other scenarios are evaluated, the "Worst Plants Closed" and the "Major Plant Closing" scenarios. Plants were ranked from best to worst based solely on the cost of production.

Worst Plants Closed Scenario

In the worst plants closed scenario, the following closures were made: Kaiser Tacoma (Rest of Washington); Kaiser Spokane (Spokane, WA)), Reynolds Longview (Cowlitz, WA); Vanalco Vancouver (Clark, WA). Reynolds Troutdale (Multnomah, OR) remains closed. In this simulation Washington has four plants closed; Oregon, one plant closed; and no plants closed in Montana.

Employment

A total of 2830 jobs were eliminated in Washington in this simulation in addition to the 760 jobs already lost from the plant closure in Multnomah, Oregon (Figures 40, 41, 42) Oregon, Montana and Idaho are experiencing only the secondary employment impacts during this simulation. The lost employment is the deviation from the baseline that already had the Multnomah plant closed. The 74 lost jobs in Oregon is a secondary impact to the four plant closures in Washington as is the 22 and 67 lost jobs in Montana and Idaho, respectively.

As discussed before, there is a multiplier effect when plants are closed and high paying jobs are eliminated. In addition to reduced demand for the intermediate goods the plants required to produce their products, the income received by the employees paid service worker salaries. When this income is gone, the service jobs depart as well. The initial multiplier impacts (total jobs lost divided by aluminum smelting jobs lost) for this

[25] Treyz, G.I, C.G. Christopher Jr., and C. Lou. 1996. Regional Labor Force Participation Rates. Mimeograph for Regional Economic Models, Inc.

[26] Public Utilities Fortnightly, May 15, 2000 pg. 18, Report on the Nevada Power Co FERC Docket No. 00-2016

simulation are calculated for Washington to be at -2.45 (about two and one half other jobs are lost for every smelter job). But notice that there are other jobs lost in Oregon (740 jobs), Idaho (670 jobs) and Montana (222). These jobs are lost because of plant closures in Washington and should be included in the tally. Including those jobs in the calculation raises the multiplier to –3.02. A closer look at the REMI outputs reveals about 80 percent of jobs lost in the neighboring states are in services, retail trade, construction (and lumber). The job reductions do not amount to a significant percentage in any SIC and are quickly regained as the economies adjust and energy prices change. Much of the impact disappears by 2005.

Figure 40: Total Employment (1,000)

WPC	2001	2005	2010	2015	2020
Washington	3499.48	3596.65	3729.71	3868.29	3972.34
Oregon	2062.18	2143.52	2234.41	2300.91	2342.91
Montana	562.17	585.29	607.86	625.88	639.08
Idaho	752.16	793.77	833.70	860.26	877.56
PNW	6875.99	7119.23	7405.67	7655.34	7831.89

Figure 41: Reductions in Employment (1,000)

WPC	2001	2005	2010	2015	2020
Washington	-6.94	-5.22	-5.45	-5.59	-5.85
Oregon	-0.74	-0.11	-0.14	0.02	-0.03
Montana	-0.22	-0.01	-0.05	-0.02	-0.05
Idaho	-0.67	0.00	0.00	-0.26	-0.46
PNW	-8.56	-5.34	-5.64	-5.85	-6.39

Figure 42: Percent of Employment Lost

WPC	2001	2005	2010	2015	2020
Washington	-0.20%	-0.14%	-0.15%	-0.14%	-0.15%
Oregon	-0.04%	-0.01%	-0.01%	0.00%	0.00%
Montana	-0.04%	0.00%	-0.01%	0.00%	-0.01%
Idaho	-0.09%	0.00%	0.00%	-0.03%	-0.05%
PNW	-0.12%	-0.07%	-0.08%	-0.08%	-0.08%

GRP and Personal Income

As shown in Figures 43, 44,45, GRP shows a similar pattern. Because of the high value of the lost aluminum jobs the impact on GRP is somewhat greater than the impact on jobs in percentage terms. The transfer payment component of personal income helps to maintain the PI per capita levels (Figures 46, 47, 48). The "per capita" component also changes as workers (of child-bearing age) move out of the region seeking employment the remaining population is older. Older people get more of the transfer payments and this too helps maintain the PI levels.

Figure 43: GRP ($B92)

WPC	2001	2005	2010	2015	2020
Washington	171.52	181.72	198.36	216.40	233.05
Oregon	95.51	105.61	119.32	131.65	142.36
Montana	22.73	24.31	26.63	28.85	30.89
Idaho	34.20	39.37	45.57	50.79	55.27
PNW	323.97	351.01	389.88	427.70	461.57

The major reduction in GRP occurs in Washington because this is the only state with plant closings in this scenario (Troutdale in Oregon is already closed in the baseline).

Figure 44: GRP Reductions ($B92)

WPC	2001	2005	2010	2015	2020
Washington	-0.51	-0.48	-0.55	-0.61	-0.68
Oregon	-0.04	-0.01	-0.01	0.00	0.00
Montana	-0.02	0.00	-0.01	-0.01	-0.01
Idaho	-0.04	-0.01	0.00	-0.02	-0.03
PNW	-0.60	-0.50	-0.57	-0.64	-0.72

Figure 45: Percent of GRP Lost

WPC	2001	2005	2010	2015	2020
Washington	-0.30%	-0.26%	-0.28%	-0.28%	-0.29%
Oregon	-0.04%	-0.01%	-0.01%	0.00%	0.00%
Montana	-0.07%	-0.02%	-0.03%	-0.02%	-0.03%
Idaho	-0.10%	-0.01%	-0.01%	-0.04%	-0.06%
PNW	-0.19%	-0.14%	-0.15%	-0.15%	-0.16%

In spite of the plant closings, Washington still leads the region in GRP per capita. However, Washington's position changes by 2005 when Oregon's GRP per capita exceeds Montana. Idaho also overtakes Washington by 2010. As shown in Figure 46, the changes from closing the plants only exacerbates the change in relative position; the dollars lost are not alone sufficient to cause Washington to fall to third position by 2010.

Figure 46: GRP per capita ($92)

WPC	2001	2005	2010	2015	2020
Washington	29,284	30,238	31,814	33,020	33,720
Oregon	28,492	30,637	33,130	34,839	36,005
Montana	25,190	26,316	27,914	29,097	30,055
Idaho	27,093	30,006	32,990	35,082	36,792
PNW	28,483	30,019	32,023	33,474	34,444

Figure 47: Change in GRP per capita ($)

WPC	2001	2005	2010	2015	2020
Washington	-77.93	-44.09	-38.16	-37.98	-42.40
Oregon	-8.94	2.61	1.69	3.75	2.58

Montana	-16.08	-3.42	-7.19	-6.39	-8.21
Idaho	-22.98	0.95	-3.40	-6.94	1.35
PNW	-46.60	-22.11	-20.11	-19.74	-21.58

Figure 48: Percent Change in GRP per capita

WPC	2001	2005	2010	2015	2020
Washington	-0.27%	-0.15%	-0.12%	-0.12%	-0.13%
Oregon	-0.03%	0.01%	0.01%	0.01%	0.01%
Montana	-0.06%	-0.01%	-0.03%	-0.02%	-0.03%
Idaho	-0.08%	0.00%	-0.01%	-0.02%	0.00%
PNW	-0.16%	-0.07%	-0.06%	-0.06%	-0.06%

Figure 49: Total Personal Income (PI) $B92

WPC	2001	2005	2010	2015	2020
Washington	163.26	190.07	231.61	281.64	339.14
Oregon	83.77	98.24	120.24	144.79	172.16
Montana	18.83	22.10	26.84	32.15	38.20
Idaho	27.21	32.40	39.91	47.83	56.61
PNW	293.06	342.82	418.59	506.40	606.12

Figure 50: Change in PI $B92

WPC	2001	2005	2010	2015	2020
Washington	-0.24	-0.24	-0.30	-0.34	-0.41
Oregon	-0.04	-0.03	-0.03	-0.03	-0.03
Montana	-0.01	0.00	0.00	0.00	0.00
Idaho	-0.04	-0.01	0.00	-0.02	-0.03
PNW	-0.32	-0.27	-0.33	-0.39	-0.47

Figure 51: Percent Change in PI

WPC	2001	2005	2010	2015	2020
Washington	-0.15%	-0.13%	-0.13%	-0.12%	-0.12%
Oregon	-0.04%	-0.02%	-0.02%	-0.02%	-0.02%
Montana	-0.03%	-0.01%	-0.01%	-0.01%	-0.01%
Idaho	-0.12%	-0.01%	-0.01%	-0.04%	-0.05%
PNW	-0.11%	-0.08%	-0.08%	-0.08%	-0.08%

Figure 52: PI per capita ($92)

WPC	2001	2005	2010	2015	2020
Washington	27,874	31,628	37,148	42,975	49,071
Oregon	24,989	28,500	33,385	38,314	43,542
Montana	20,860	23,923	28,132	32,422	37,169
Idaho	25,226	28,017	30,774	32,604	34,067

PNW	26,174	29,695	34,618	39,614	44,833

Figure 53: Change in PI per capita ($92)

WPC	2001	2005	2010	2015	2020
Washington	-31.83	-2.89	10.60	19.97	22.25
Oregon	-9.26	-2.46	-3.85	-1.98	-3.62
Montana	-5.86	-1.20	-2.79	-1.12	-2.62
Idaho	-21.40	0.89	-3.17	-6.45	1.25
PNW	-21.96	-2.20	3.75	8.89	10.32

Figure 54: Percent Change in PI per capita

WPC	2001	2005	2010	2015	2020
Washington	-0.11%	-0.01%	0.03%	0.05%	0.05%
Oregon	-0.04%	-0.01%	-0.01%	-0.01%	-0.01%
Montana	-0.03%	0.00%	-0.01%	0.00%	-0.01%
Idaho	-0.08%	0.00%	-0.01%	-0.02%	0.00%
PNW	-0.08%	-0.01%	0.01%	0.02%	0.02%

Population

Closing plants in Washington only does not cause out-migration to other parts of the PNW (Figures 55, 56, 57). The rest of the PNW cannot absorb laid off aluminum smelter workers since their own smelting industries are not increasing production. As jobs become less plentiful, people are moving out of the PNW region and in-migration is reduced. The biggest changes in population occur within the first five years after the closure. The people moving out of the region are workers, many who have or will have children. This changes the demographics of the region, and results in fewer children and reduced population levels throughout the simulation period.

Figure 55: Population (1,000)

WPC	2001	2005	2010	2015	2020
Washington	5857.13	6009.63	6234.80	6553.63	6911.20
Oregon	3352.27	3447.12	3601.63	3778.92	3953.85
Montana	902.47	923.83	953.92	991.39	1027.84
Idaho	1262.28	1312.17	1381.40	1447.86	1502.15
PNW	11374.14	11692.76	12171.75	12771.80	13395.05

Figure 56: Change in Population (1,000)

WPC	2001	2005	2010	2015	2020
Washington	-1.960	-7.067	-9.766	-11.074	-11.403
Oregon	-0.247	-0.555	-0.395	-0.435	-0.394
Montana	-0.059	-0.032	-0.005	-0.023	-0.052
Idaho	-0.035	-0.005	-0.004	-0.019	-0.033

PNW	-2.301	-7.659	-10.170	-11.551	-11.882

Figure 57: Percent Change in Population (1,000)

WPC	2001	2005	2010	2015	2020
Washington	-0.03%	-0.12%	-0.16%	-0.17%	-0.16%
Oregon	-0.01%	-0.02%	-0.01%	-0.01%	-0.01%
Montana	-0.01%	0.00%	0.00%	0.00%	-0.01%
Idaho	0.00%	0.00%	0.00%	0.00%	0.00%
PNW	-0.02%	-0.07%	-0.08%	-0.09%	-0.09%

Major Plant Closing Scenario

In this scenario Goldendale Aluminum (Klickitat, WA), Columbia Falls (Flathead, MT) and Northwest Aluminum, The Dalles (Wasco, OR) are closed in addition to those plants closed under the worst plants closed scenario (Kaiser Tacoma (Rest of Washington); Kaiser Spokane (Spokane, WA)), Reynolds Longview (Cowlitz, WA); Vanalco Vancouver (Clark, WA).) Reynolds Troutdale (Multnomah, OR) remains closed. In this simulation Washington now has five plants closed; Oregon, two plants are closed; and the only plant in Montana is shut down.

Employment

Washington, Oregon and Montana are each experiencing additional employment losses from one new plant shut-down; Idaho has no closures but experiences job loss from secondary impacts (Figures 61, 62, 63). The total number of additional jobs lost in this scenario is 1650 and they are split this time among three states. The initial aluminum jobs lost as the result of an additional plant closure for Washington is 700; for Montana, 550 and for Oregon, 400. The total number of primary jobs lost is 5240.

Initial multiplier impacts for this round are:

Washington	-2.83
Oregon	-2.73 (the Troutdale plant was already closed)
Montana	-3.42
PNW	-2.90

Notice that only in Idaho where no plants are closed do the employment reductions rebound quickly in 2005. The loss of the smelter jobs has a longer lasting impact on the local economies. The difference between the jobs lost in 2001 and 2005 for Oregon, Montana and Idaho is about the same as the job loss in the WPC scenario where no smelter related jobs were lost in these states. "Reassigning" these job losses to Washington, we can recalculate a purer state-only multiplier (Figure 58, MPC (adj)):

Figure 58: Calculating Multipliers for MPC

MPC	Total	Adj. Job	Adj. Total	MPC (adj)

	Job Loss	Loss from WA closure	Job Loss	
Washington	-8.36	-1.63	-9.99	-2.83
Oregon	-1.83	0.74	-1.09	-2.73
Montana	-2.10	0.22	-1.88	-3.42
Idaho	-0.67	0.67		
PNW	-12.97			-2.90

In a similar fashion, we can adjust the multipliers for the APC simulation. In this case, the difference between the total job loss for Oregon and Montana in the MPC and APC scenarios reflects jobs lost because two more plants closed in Washington (the only difference between the Major Plant Closing (MPC) and All Plants Closing (APC)).

Figure 59: Calculating Multipliers for APC

APC	Total Job Loss	Adj. Job Loss from WA closure	Adj. Total Job Loss	APC(adj)
Washington	-12.57	-2.05	-14.62	-2.86
Oregon	-2.12	1.03	-1.09	-2.73
Montana	-2.23	0.35	-1.88	-3.42
Idaho	-0.67	0.67		
PNW	-17.60			-2.90

The initial multiplier impacts across the three scenarios can be summarized as follows:

Figure 60: Summary of Multipliers Across Simulations

	APC	APC (adj)	MPC	MPC(adj)	WPC
Washington	-2.46	-2.86	-2.37	-2.83	-2.45
Oregon	-5.30	-2.73	-4.58	-2.73	
Montana	-4.05	-3.42	-3.82	-3.42	
Idaho					
PNW	-2.90	-2.90	-2.48	-2.90	-3.02

The PNW region multipliers range from about 2.5 to 3.0, with variations among the states due to spill-over impacts. Removing the spillover impacts brings the state multipliers into a narrower range: from 2.45 to 3.42.

Figure 61: Total Employment (1,000)

MPC	2001	2005	2010	2015	2020
Washington	3498.05	3594.99	3727.92	3866.27	3970.20
Oregon	2061.08	2142.28	2233.17	2299.41	2341.35
Montana	560.29	583.41	606.03	623.98	637.17

Idaho	752.16	793.77	833.70	860.26	877.56
PNW	6871.59	7114.46	7400.82	7649.92	7826.29

Figure 62: Reductions in Employment (1,000)

MPC	2001	2005	2010	2015	2020
Washington	-8.36	-6.88	-7.24	-7.61	-7.98
Oregon	-1.83	-1.35	-1.37	-1.48	-1.59
Montana	-2.10	-1.89	-1.88	-1.91	-1.95
Idaho	-0.67	0.00	0.00	-0.26	-0.46
PNW	-12.97	-10.11	-10.49	-11.27	-11.98

Figure 63: Percent Employment Lost

MPC	2001	2005	2010	2015	2020
Washington	-0.24%	-0.19%	-0.19%	-0.20%	-0.20%
Oregon	-0.09%	-0.06%	-0.06%	-0.06%	-0.07%
Montana	-0.37%	-0.32%	-0.31%	-0.31%	-0.31%
Idaho	-0.09%	0.00%	0.00%	-0.03%	-0.05%
PNW	-0.19%	-0.14%	-0.14%	-0.15%	-0.15%

GRP and Personal Income

Again, because of the high value of the positions lost, the impact on GRP is larger than the impact on employment (Figures 64 – 75). As shown before, the impact on PI is less than GRP because of transfer payments that are unaffected or increase as a result of the layoffs. As described in the next section, population also changes, with more worker-aged people moving leaving behind a higher concentration of those receiving transfer payments, which also helps to maintain the PI per capita number.

Figure 64: Total GRP ($B92)

MPC	2001	2005	2010	2015	2020
Washington	171.41	181.60	198.21	216.23	232.85
Oregon	95.43	105.52	119.23	131.54	142.24
Montana	22.57	24.14	26.46	28.67	30.70
Idaho	34.20	39.37	45.57	50.79	55.27
PNW	323.61	350.63	389.46	427.23	461.07

Figure 65: Reduction in GRP ($B92)

MPC	2001	2005	2010	2015	2020
Washington	-0.62	-0.60	-0.70	-0.79	-0.87
Oregon	-0.12	-0.10	-0.10	-0.11	-0.12
Montana	-0.18	-0.17	-0.18	-0.19	-0.20
Idaho	-0.04	-0.01	0.00	-0.02	-0.03
PNW	-0.95	-0.88	-0.98	-1.11	-1.23

Figure 66: Percent of GRP Lost

MPC	2001	2005	2010	2015	2020
Washington	-0.36%	-0.33%	-0.35%	-0.36%	-0.37%
Oregon	-0.12%	-0.09%	-0.09%	-0.09%	-0.09%
Montana	-0.79%	-0.72%	-0.68%	-0.66%	-0.64%
Idaho	-0.10%	-0.01%	-0.01%	-0.04%	-0.06%
PNW	-0.30%	-0.25%	-0.25%	-0.26%	-0.27%

Figure 67: GRP per capita

MPC	2001	2005	2010	2015	2020
Washington	29,269	30,233	31,816	33,022	33,720
Oregon	28,472	30,628	33,130	34,839	36,005
Montana	25,027	26,203	27,835	29,027	29,982
Idaho	27,093	30,006	32,990	35,082	36,792
PNW	28,456	30,005	32,018	33,469	34,438

Figure 68: Change in GRP per capita

MPC	2001	2005	2010	2015	2020
Washington	-92.89	-48.96	-36.81	-36.23	-42.21
Oregon	-29.25	-6.38	1.76	3.86	2.14
Montana	-179.34	-115.48	-86.16	-77.23	-81.00
Idaho	-22.98	0.95	-3.40	-6.94	1.35
PNW	-73.23	-36.15	-25.65	-24.42	-27.38

Figure 69: Percent Change in GRP per capita

MPC	2001	2005	2010	2015	2020
Washington	-0.32%	-0.16%	-0.12%	-0.11%	-0.13%
Oregon	-0.10%	-0.02%	0.01%	0.01%	0.01%
Montana	-0.72%	-0.44%	-0.31%	-0.27%	-0.27%
Idaho	-0.08%	0.00%	-0.01%	-0.02%	0.00%
PNW	-0.26%	-0.12%	-0.08%	-0.07%	-0.08%

Figure 70: Personal Income (PI) $B92

MPC	2001	2005	2010	2015	2020
Washington	163.20	189.99	231.50	281.51	338.99
Oregon	83.72	98.18	120.17	144.68	172.05
Montana	18.77	22.03	26.74	32.04	38.09
Idaho	27.21	32.40	39.91	47.83	56.61
PNW	292.91	342.60	418.32	506.07	605.74

Figure 71: Change in PI $B92

MPC	2001	2005	2010	2015	2020
Washington	-0.30	-0.33	-0.40	-0.47	-0.56
Oregon	-0.08	-0.09	-0.10	-0.12	-0.14
Montana	-0.07	-0.07	-0.09	-0.10	-0.12
Idaho	-0.04	-0.01	0.00	-0.02	-0.03
PNW	-0.47	-0.49	-0.61	-0.72	-0.84

Figure 72: Percent Change in PI

MPC	2001	2005	2010	2015	2020
Washington	-0.18%	-0.17%	-0.17%	-0.17%	-0.16%
Oregon	-0.10%	-0.09%	-0.09%	-0.08%	-0.08%
Montana	-0.34%	-0.35%	-0.35%	-0.33%	-0.31%
Idaho	-0.12%	-0.01%	-0.01%	-0.04%	-0.05%
PNW	-0.16%	-0.14%	-0.14%	-0.14%	-0.14%

Figure 73: PI per capita ($92)

MPC	2001	2005	2010	2015	2020
Washington	27,868	31,631	37,160	42,992	49,091
Oregon	24,979	28,497	33,391	38,321	43,550
Montana	20,812	23,906	28,142	32,443	37,196
Idaho	25,226	28,017	30,774	32,604	34,067
PNW	26,164	29,694	34,626	39,626	44,848

Figure 74: Change in PI per capita ($92)

MPC	2001	2005	2010	2015	2020
Washington	-37.90	0.13	22.99	36.43	41.33
Oregon	-19.78	-5.48	1.59	4.38	4.69
Montana	-54.36	-17.40	6.86	19.70	24.08
Idaho	-21.40	0.89	-3.17	-6.45	1.25
PNW	-32.03	-2.83	12.50	20.90	24.72

Figure 75: Percent Change in PI per capita

MPC	2001	2005	2010	2015	2020
Washington	-0.14%	0.00%	0.06%	0.08%	0.08%
Oregon	-0.08%	-0.02%	0.00%	0.01%	0.01%
Montana	-0.26%	-0.07%	0.02%	0.06%	0.06%
Idaho	-0.08%	0.00%	-0.01%	-0.02%	0.00%
PNW	-0.12%	-0.01%	0.04%	0.05%	0.06%

Population

Out-migration from the entire region continues as the situation worsens in the aluminum industry (Figures 76, 77, 78). As shown before with worst plant closure simulation, the biggest changes in population occur within the first five years after the closure in the states that have plant closures. As younger people move out seeking employment, the demographics of the region change, and this means there are fewer children and reduced population levels throughout the simulation period.

Montana experiences the greatest change in population. The impact of the single plant closure is significant relative to its comparatively small population and Montana's less diversified economy does not allow for the same level of absorption that the larger states have.

Figure 76: Population (thousands)

MPC	2001	2005	2010	2015	2020
Washington	5856.39	6006.43	6229.89	6548.08	6905.44
Oregon	3351.81	3445.20	3598.73	3775.72	3950.57
Montana	901.84	921.29	950.41	987.58	1024.07
Idaho	1262.28	1312.17	1381.40	1447.86	1502.15
PNW	11372.33	11685.09	12160.42	12759.23	13382.23

Figure 77: Change in Population (1,000)

MPC	2001	2005	2010	2015	2020
Washington	-2.691	-10.268	-14.683	-16.631	-17.165
Oregon	-0.700	-2.482	-3.300	-3.633	-3.679
Montana	-0.685	-2.569	-3.514	-3.839	-3.827
Idaho	-0.035	-0.005	-0.004	-0.019	-0.033
PNW	-4.111	-15.324	-21.501	-24.122	-24.704

Figure 78: Percent Change in Population (1,000)

MPC	2001	2005	2010	2015	2020
Washington	-0.05%	-0.17%	-0.24%	-0.25%	-0.25%
Oregon	-0.02%	-0.07%	-0.09%	-0.10%	-0.09%
Montana	-0.08%	-0.28%	-0.37%	-0.39%	-0.37%
Idaho	0.00%	0.00%	0.00%	0.00%	0.00%
PNW	-0.04%	-0.13%	-0.18%	-0.19%	-0.18%

GRP, Personal Income, Employment and Population variables all behave in the same fashion in the WPC and MPC simulations as they do in the APC. The differences are simply a matter of degree. In each simulation the same set of dynamics apply: layoffs from the smelting industry induce secondary unemployment increases and population reductions. The combined primary and secondary unemployment lower GRP and Personal Income, although the transfer payments in PI reduce the impact on this variable. At the same time outmigration is occurring of unemployed workers. Since these tend to be younger people who have and will have more children, population is reduced during the out-migration period and continues throughout the simulation period as fewer children are born. While GRP and PI decline, this decline is mitigated somewhat in the per-capita measures because population declines as well.

Appendix 2: Brief Overview of the ENERGY 2020 and REMI Models Used for This Analysis

REMI Policy Insight (Regional Economic Models, Inc.)

REMI Policy Insight includes a REMI model that has been built especially for the geographic area(s) in BPA's customized version of the model. REMI's model-building system uses hundreds of programs developed over the past two decades to build customized models for each area using data from the Bureau of Economic Analysis, the Bureau of Labor Statistics, the Department of Energy, the Census Bureau and other public sources.

Beginnings of the REMI Macroeconomic Model[27]

Founded in 1980, Regional Economic Models, Inc. (REMI) constructs models that reveal the economic and demographic effects that policy initiatives or external events may cause on a local economy. REMI model users include national, regional, state and city governments, as well as universities, nonprofit organizations, public utilities and private consulting firms.

The REMI model is a structural model, meaning that it clearly includes cause-and-effect relationships. The model shares two key underlying assumptions with mainstream economic theory: households maximize utility and producers maximize profits. Since these assumptions make sense to most people, the model can be understood by intelligent lay people as well as trained economists.

In the model, businesses produce goods to sell to other firms, consumers, investors, governments and purchasers outside the region. The output is produced using labor, capital, fuel and intermediate inputs. The demand for labor, capital and fuel per unit of output depends on their relative costs, since an increase in the price of any one of these inputs leads to substitution away from that input to other inputs. The supply of labor in the model depends on the number of people in the population and the proportion of those people who participate in the labor force. Economic migration affects the population size. People will move into an area if the real after-tax wage rates or the likelihood of being employed increases in a region.

Supply and demand for labor in the model determine the wage rates. These wage rates, along with other prices and productivity, determine the cost of doing business for every industry in the model. An increase in the cost of doing business causes either an increase in price or a cut in profits, depending on the market for the product. In either case, an increase in cost would decrease the share of the local and U.S. market supplied by local

[27] The REMI homepage is www.remi.com. Articles can be found at: http://www.remi.com/Analysis_Areas/Article_List/article_list.html Publications and documentation can be found by clicking the SUPPORT button on the homepage.

firms. This market share combined with the demand described above determines the amount of local output. Of course, the model has many other feedbacks. For example, changes in wages and employment impact income and consumption, while economic expansion changes investment and population growth impacts government spending.

REMI Model Structure

The structure of REMI models of economies incorporates inter-industry transactions and endogenous final demand feedback. In addition, the model includes: substitution among factors of production in response to changes in relative factor costs, migration in response to changes in expected income, wage responses to changes in labor market conditions, and changes in the share of local and export markets in response to changes in regional profitability and production costs.

The power of the REMI model lies in its use of theoretical structural restrictions instead of individual econometric estimates based on single time-series observations for each region. The explicit structure of the model facilitates the use of policy variables that represent a wide range of policy options and the tracking of the policy effects on all the variables in the model.

The inclusion of price responsive product and factor demands and supplies give the REMI model much in common with Computable General Equilibrium (CGE) models. CGE models have been widely used in economic development, public finance and international trade, and have been more recently applied in regional settings. Static CGE models usually invoke market clearing in all product and factor markets. Dynamic CGE models typically assume perfect foresight intertemporal clearing of markets, or temporary market clearing if expectations are imperfect. The REMI EDFS model differs, however, because product and factor markets do not clear continuously. The model replicates the time paths of responses between variables by combining *a priori* model structure with econometrically estimated parameters.

REMI models generate forecasts by solving a large number of simultaneous equations, organized in five blocks as shown in Figure 79, which describes the underlying structure of the model. Each block contains several components that are shown in rectangular boxes. The lines and arrows represent the interaction of key components both within and between blocks. Most interactions flow both ways indicating a highly simultaneous structure. Block 1, labeled output linkages, forms the core of the model. An input-output structure represents the inter-industry and final demand linkages by industry. The interaction between block 1 and the rest of the model is extensive. Predicted outputs from block 1 drive labor demand in block 2. Labor demand interacts with labor supply from block 3 to determine wages. Combined with other factor costs, wages determine relative production costs and relative profitability in block 4 affecting the market shares in block 5. The market shares are the proportions of local demand in the region in block 1 and exogenous export demand that local production fulfills.

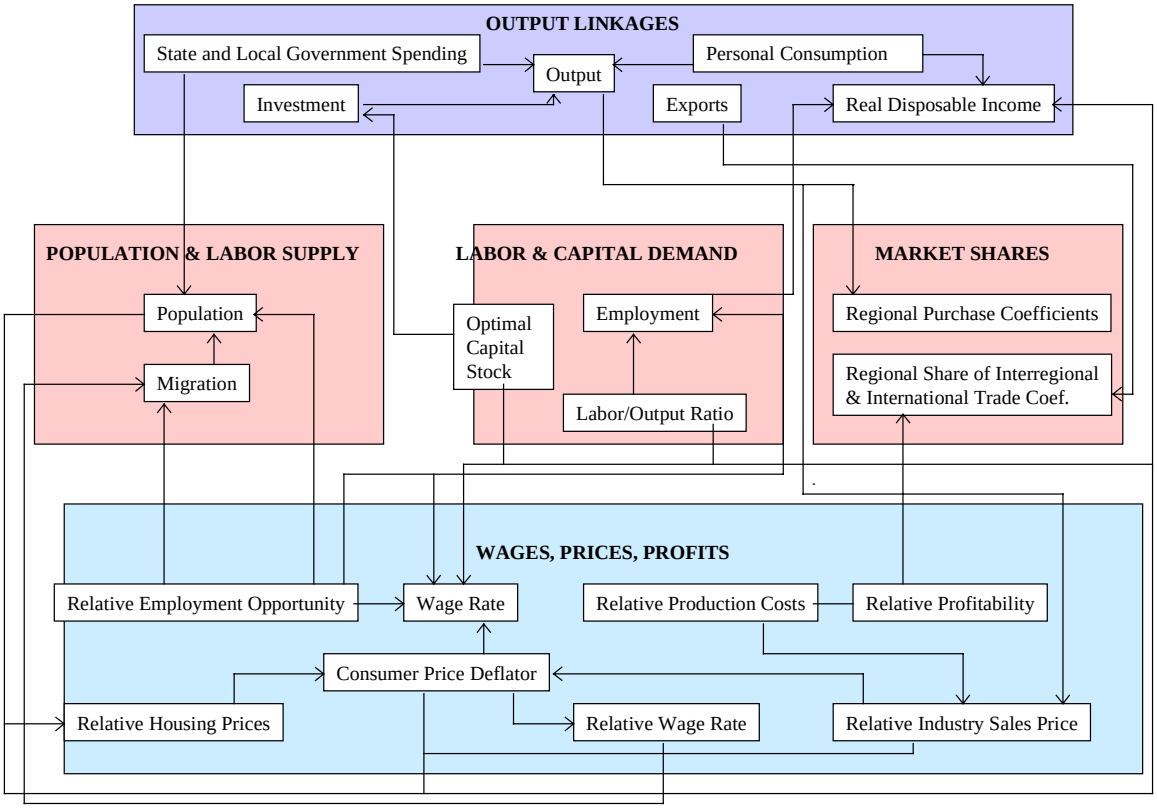

Figure 79: REMI Overview

The endogenous final demands include consumption, investment, and state and local government demand. Real disposable income drives consumption demands. An accounting identity defines nominal disposable income as wage income from blocks 2 and 4, plus property income related to population and the cohort distribution of population calculated in block 3, plus transfer income related to population less employment and retirement population, minus taxes. Nominal disposable income deflated by the regional consumer price deflator from block 4 gives real disposable income. Optimal capital stock calculated in block 2 drives stock adjustment investment equations. Population in block 3 drives state and local government final demand. The endogenous final demands combined with exports drive the output block.

ENERGY 2020 Energy Market Simulation Model[28]

The ENERGY 2020 model is an integrated multi-region energy model that provides complete and detailed, all-fuel demand and supply sector simulations. These simulations can additionally include macroeconomic interactions to determine the benefits or costs to

[28] See more information at www.energy2020.com.

the local economy of new facilities or changing energy prices. The model can be used in regulated as well as deregulated and transitioning environments. It portrays the interaction of market competitors in a realistic, as opposed to an idealized, fashion, including transmission-system market-dynamics. It focuses on the imperfections of the market, including market gaming, and therefore, is extremely useful for M&A and asset evaluation. Pollution emissions and costs, including allowance and trading, are endogenously determined, thereby, allowing assessment of environmental business-risks.

History

ENERGY 2020 is an outgrowth of the FOSSIL2/IDEAS model developed for the US Department of Energy (DOE) and used for all national energy policy since the Carter administration.[29] This early version of the ENERGY 2020 model was developed in 1978 at Dartmouth College for the DOE's Office of Policy Planning and Analysis.

In 1985, A breakthrough in uncertainty, sensitivity and confidence analysis capability was incorporated into ENERGY 2020 through the combined efforts of Los Alamos National Laboratory and the Control Data Corporation. The new package, called HYPERSENS, can quantify uncertainty and determine the data and assumptions that contribute to the uncertainty in a minimal number of simulations.

Over its history, a large number of professionals at various institutions have contributed to the development of the ENERGY 2020 system, including individuals from Dartmouth College, Purdue University, Los Alamos National Laboratory, Control Data Corp., PROMULA Development Corp., Policy Assessment Corp., and Systematic Solutions, Inc. ENERGY 2020 represents over 250 experience-years of model use and development at the federal, state, and company level. Over fifteen million dollars have been spent on development and testing of ENERGY 2020 and its predecessors. The model has been widely disseminated to research organizations, universities, electric utilities, as well as state and federal energy agencies and public utility commissions.

Overview

The basic implementation of ENERGY 2020 for North America now contains the user-defined level of aggregation down to the 12 provincial and 50 state (and sub-state) level. ENERGY 2020 is historically parameterized to simulate all 3500 interacting energy suppliers in North America as needed. This historical validation captures limits to future actions that market players can pursue as market rules change. Current efforts are adding the South American and European databases to the model, and allowing holding companies to see the combined portfolios crossing the continents.

[29] FOSSIL2 was the original version but was renamed to IDEAS a few years ago to reflect its evolutionary development since its original construction

ENERGY 2020 is parameterized with local data for each region/state/province as well as the all the associated energy suppliers it simulates. Thus, it captures the unique characteristics (physical, institutional and cultural) that affect how people make choices and use energy. National models typically reproduce history from 1975 to partially validate structure and results. Collections of state and provincial models are currently validated from 1988 to the latest quarterly numbers because of limited historical data associated with electric utilities.[30]

ENERGY 2020 model can be linked to a detailed macroeconomic model to determine the economic impacts of energy/environmental policy and the energy/environmental impacts of national policy. For US regional and state level analyses, the REMI macroeconomic model is regularly linked in ENERGY 2020.[31] The macroeconomic model (that includes inter-state/provincial, US and world trade flows) simulates the real-time impact of energy and environmental concerns on the economy and vice versa.

The structure of the model is well tested and has been used to simulate not only US and the Canada energy and environmental dynamics but also those of several countries in Western, Central, and Eastern Europe. Current efforts include strategic and tactical analyses for South America deregulation. The US EPA uses ENERGY 2020 to perform the regional (energy, environmental and macroeconomic) impacts of proposed Kyoto initiatives at the 50-state level. Further, the model has been used successfully for deregulation analyses in over 50 energy suppliers and in all the US states and Canadian provinces. Many US and Canadian energy suppliers currently use the model for the analysis of combined electricity and gas deregulation dynamics.[32] The model contains confidence and validity packages that allow it to determine how to take maximal advantage of RTO rules. The ISO NE used the model to find "gaps" in its rules and to develop more efficient market conditions. The model was used for the CAPX/ISO to model to show, before-the-fact, many of the "games" played in the California market.

The default model simulates demand by three residential categories (single family, multi-family, and agriculture/rural), commercial, industrial by 2-digit SIC, and three transportation services (residential, commercial, industrial). There are approximately six end-uses per category and 6 technology/mode families per end-use.[33] Currently the technology families correspond to six fuels (oil[34], gas, coal, electric, solar and biomass). The transportation modes include automobile, truck, bus, train, plane, marine and electric

[30] Energy supplier data comes from Resources Data International, Inc., Boulder, Colorado. US and Canadian fuel and demand data come the US Department of Energy and Natural Resources Canada, respectively. US and Canadian pollution data comes from US EPA and Environment Canada, respectively.
[31] Regional Economic Models, Inc., Amherst, Massachusetts.
[32] ENERGY 2020 is the only model known to have simulated and predicted the dynamics that occurred in the UK electric deregulation. These include gaming, market consolidation and re-regulation dynamics.
[33] End-uses include Process Heat, Space Heating Water Heating, Other Substitutable, Refrigeration, Lighting, Air Conditioning, Motors, and Other Non-Substitutable (Miscellaneous). Detailed modes include: auto, light truck, medium weight truck, bus, train, airplane, and marine. Each mode type can be characterized by gasoline, diesel, electric, NG, propane, or hybrid vehicles.
[34] Different petroleum products are associated with specific end-uses and categories.

vehicles. Added end-uses, technologies, and modes can be added as data allow. (Added sectoral detail comparable to the 13 building-types in the national model's commercial sector can be added as well.) For all end-uses and fuels, the model is parameterized based on historical locale-specific data. The load duration curves are dynamically built up from the individual end-uses to capture changing condition under consumer choice and combined gas/electric programs.

Each energy demand sector includes cogeneration and distributed generation simulation including mobile-generation and fuel-cells. Retail wheeling and fuel-switching responses are rigorously determined. The technology families (which can be split, as an option, to portray specific technology dynamics) are aggregates that, within the model, change building shell, economic process and device efficiency and capital costs as price or other information that the decision makers see, changes. The ENERGY 2020 model utilizes that data the group develops for parameterizing and disaggregating the model. ENERGY 2020 provides feedback on the implications of future assumptions. Its demand and prices forecasts are impeccably accurate even under extreme market conditions

The supply portion model includes endogenous detailed electric supply simulation of capacity expansion/construction, rates/prices, financial/accounting, load shape variation due to weather, and changes in regulation.[35]

The electric sector can additionally simulate the full spectrum of deregulated markets, whether these include a power exchange, ISO, Poolco, Gridco, Transco, or any RTO configuration. The model dispatches plants according to the specified rules whether they are optimal or heuristic and recognizes transmission constraints as well as the associated costs.[36] A sophisticated dispatch routine selects critical hours along seasonal load duration curves as a way to provide a quick but accurate determination of system generation. Peak and base hydro usage is explicitly modeled to capture hydro-plant impacts on the electric system.

Where the model departs from conventional (idealized) approaches is in the overall behavior of the market players. Each utility (or energy provider, as appropriate) is represented in the model by four business units: distribution, transmission, marketing, and generation. The first two remain regulated but the last two can be deregulated to any degree. All market participants use the rules to their best self-interest. Many organizations do not have the financial or physical where with all to undertake or survive certain activities in the market. They can be (and maybe should be) easily victimized. Other players with locational, financial or generation advantages play them to the detriment of other competitors -- just as do the competitors in any other industry. New

[35] The ENERGY 2020 model does include a complete, but aggregate representation of the gas and electric transmission system. Gas transmission data are provided by CERI and electric transmission data provide by Resource Data, International via the National Electric Reliability Council. The dispatch technologies in the basic model include: Oil/Gas Combustion turbine, Oil/Gas Combined Cycle, Oil/Gas Steam Turbine, Coal Steam Turbine, Advanced Coal, Nuclear, Baseload Hydro, Peaking Hydro, Renewables, Baseload Purchase Power Contracts, Baseload Spot Market, Intermediate Purchase Power Contracts, Intermediate Spot Market, Peaking PP Contracts, Peaking Spot Market, and Emergency Purchases.

[36] A 60 node transmission system is used in the default model.

market entrants, asset sales/purchases, mergers, acquisitions, takeovers, and bankruptcy are explicitly modeled because that will be the realistic behavior of the market. Players may bid what economics predicts on average, but the deregulation transition is volatile and non-linear. There is no unique economic solution. This allows players to try multiple strategies that, while inconsistent with the long-term stability, are successful and therefore economically efficient in the local sense.

The process of deregulation requires a careful consideration of market power dynamics. The ENERGY 2020 model can examine how potential rules can be used to by market participants to take advantage of the market. It can then be used to help design rules that limit the potential for exercising market power. ENERGY 2020 does produce the Herfindahl-Hirschman Index of Concentration (HHI). It can also readily generate the indexes found in DOJ/FTC Merger Guidelines, FERC Order Nos. 592, 888 and other FERC reports.

The gas distribution utility dynamics are also simulated, but the generic state/provincial models does not contain oil or gas production; only a simplified simulation to determine delivered-product prices.

E2020 is written in a language called PROMULA (PROcessor of MUltiple LAnguages) that by its nature allows other client analytical or accounting systems to run under it.

ENERGY 2020 can include oil, gas and coal supply sectors (they exist in the FOSSIL2/IDEAS model) and it is an option (as is the alcohol supply simulation) not incorporated in the basic model implementation. Energy used in primary production and emissions associated with primary production and its distribution is included in the model.

The ENERGY 2020 model includes pollution accounting for both energy (by fuel, end-use and sector) and non-energy (by economic activity) for SO2, NO2, N2O, CO, CO2, CH4, TSP, VOC, CF4, C2F6, SF6, and HFC. Other (gaseous, liquid and solid) pollutants can be added as desired. Pollution is not determined directly by coefficients but rather by the accumulation of capital investments that result in pollution emission with usage. National and international Allowance trading is also included. Plant dispatch can consider emission restrictions.

The model uniquely captures the feedback among energy consumers, energy suppliers and the economy. For example, a change in price affects demand that then affects future supply and price. Increased economic activity increases demand; increased demand increases the investment in new supplies. The new investment affects the economy and energy prices. The energy prices also affect the economy. While this feedback makes for more self-consistent forecasts and characterization of policy impacts, it also adds increased complexity to the detriment of consensus building among stakeholders. As such, the model can be run without the feedback active.

The ENERGY 2020 user interface allows the user to arbitrarily specify output tables and graphics. All information in the model can be interrogated and modified interactively. A MS Windows menuing system allows automated policy analysis and scenario specification. These same capabilities allow the user to save multiple scenarios and analyses and then compare them with each other graphically or in tabular form.

Finally, the system includes confidence and validity testing software that places uncertainty bounds on simulation results, quantifies confidence intervals, and ranks the contributions to uncertainty in future conditions. This feature can be used to limit data efforts to information important to the analysis and to determine those strategies and tactics that will most likely result in the desired conditions.

ENERGY 2020 can simulate a technology-by technology, asset-by-asset modeling approach. Via menus, the user can define new technologies and determine their value and impacts in the marketplace. The ENERGY 2020 model is designed for scenario testing. The introduction of a new technology is associated with many market considerations that include market applicability, sub-market niche distinctions, marketing/advertising strategy and categorization of the technology as a new "family" or part of an existing family of technologies. Additionally, incentives such as rebates, tax breaks, and subsidies can be considered. The impact of potential changes in technical characteristics such as cost, lifetime, operating costs and efficiency can then be addressed.

Appendix 3 Economic Response to Timber Closures, a Survey of Data from Oregon Counties

Executive Summary

This appendix surveys data from 11 timber counties in Oregon to determine to what extent the economic data from counties with major job losses behaves in a manner similar with data from REMI for the aluminum closure analysis.

This survey revealed that despite job losses which occurred in the early 1990's, at the county level real income, and wages recover and grow by mid to late 1990's. Although wages and income continues to grow, it is generally at a slower rate then for Oregon overall. Factors contributing to this increase include growth in the overall Oregon and national economies, changes in the industrial mix including job formation as counties move away from resource dependent economies, transfer payments from federal and state governments and population migrations.

These effects are consistent with the REMI results for the aluminum study.

Background

This appendix was prepared to verify that the REMI employment and income effects under conditions of industry closure and job lose accurately portrays the long-run effects observed in regions where job losses have actually occurred. To this end the county level impacts due to timber closures in Oregon was selected as the counter-point because it its familiarity to study team participants.

The REMI model is a stylized representation of reality[37]. It assumes that all things being equal the effects of overall economic expansion will be shared among all the regions, including counties, represented in the model. Regions with larger economic bases including work force and distribution of labor across various industries do have an advantage over regions with a smaller economic base. However, regions with lower labor costs, in turn, have an advantage over regions with higher labor costs when it comes to attracting business expansion.

The fundamental premise in the REMI model is the flows of labor and capital between regions. Labor in those regions that are effected by plant closures will be free to migrate to regions where jobs are available. Further, labor is attracted to areas where wages are relatively high.

[37] See Appendix 2 of this study for a discussion of the REMI model.

Given these conditions in the model regions that experience economic dislocations will experience near-term out migrations, resulting in lower population levels. As presumed in the REMI model the unemployed will tend to dominate this group. Because the remaining labor force tends to employed, the income per capita rebounds quickly or reaches higher levels in part due to the out migration of non-income producing residents. This impact occurs on the top of business formation and in-migration into regions with lower labor costs. The US Department of Commerce, Census Bureau has documented this effect when looking at poverty levels across the U.S. and noting that rich counties gain people while poorer counties lose people.[38]

Unlike an economic model, measuring changes in the economic structure of a region can be a messy affair since cause and effect may not be directly traceable because of numerous simultaneous factors. With this caveat we will proceed with the survey. Given time constraints this survey screened for representative counties using the Oregon & California Railroad Counties and all counties that fall into the bottom quartile of Oregon Counties based on per capita income to screen for candidate counties to profile.

Context: Oregon's Changing Economy

Economic changes at the county level take place within the framework of economic growth and structural changes at the state and national level. Oregon's economy has undergone a significant structural change in recent years, from being heavily timber-dependent to relying more on the high tech industries[39]. Oregon is faced with the challenges of a diversifying economy. While high tech has been one of the fastest growing industries in the state, it was also the hardest hit by the Asian financial crisis of 1997.[40] The Asian crisis impacted Oregon hard because the state depends on Asian markets for a large share of foreign sales. The faltering sales to Asia from Oregon's manufacturing has lead to layoffs and to a much lower growth rate in the state's manufacturing sector overall. Generally the growth of Oregon's economy has been somewhat lower then the growth of the U.S. economy. Real per capita income growth over the past decade for Oregon was 2 percent per year while the growth for the U.S. was 2.9 percent per year. In 1998 Oregon's per capita income was 94 percent of the U.S. level.[41] In other measures too, Oregon has lagged behind the U.S. Oregon's unemployment rate is higher at 5.4 percent compared to the U.S. unemployment rate of 3.9 percent.[42] Overall Oregon's jobs have been growing at a rate of 2.5 percent per year. In the manufacturing sector over 24,000 jobs have been created over the past decade, a growth rate of only 1.2 percent per year. Non-manufacturing sector employment has expanded by 285,000 jobs, a growth rate of 2.8 percent. On a structural basis, the retail and service sectors have been the areas where the most rapid growth in job formation has been taking place.

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[38] Cardiff, Patrick; Profiles of Poor Counties, Some Empirical Evidence; U.S. Census Bureau, http://www.census.gov/hhes/www/saipe/asapaper/Cardiff99.pdf

[39] Volume: Oregon Statewide, 2000 Regional Economic Profile, page 4.

[40] Ibid, page 4.

[41] Ibid; page 73.

[42] Seasonally adjusted figures as of October 2000. See web site: http://olmis.emp.state.or.us/pubs/rolf/pdf/00/rolf1100.pdf

Figure 80
Comparison of Average Annual Growth Rate 1990-1998

Region	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufact-uring	Lumber & Wood Products	Real Average Covered Wage	Real Per Capita Income
Oregon	1.5%	2.5%	2.7%	2.5%	2.1%	1.2%	-2.6%	1.4%	1.7%
Baker	1.0%	0.7%	-1.0%	1.3%	2.5%	0.3%	-2.3%	NA	0.2%
Coos	0.2%	0.1%	-3.1%	0.8%	2.4%	-3.3%	-4.7%	0.5%	1.5%
Crook	1.9%	0.9%	-1.9%	1.5%	4.9%	-2.9%	-3.5%	0.2%	1.1%
Curry	1.4%	0.2%	-1.5%	0.8%	4.0%	-1.6%	-1.5%	0.4%	1.0%
Deschutes	3.7%	3.1%	-1.5%	3.9%	6.3%	0.0%	-4.8%	0.7%	0.6%
Douglas	0.6%	0.3%	-4.3%	1.1%	1.9%	-1.7%	-3.0%	0.4%	1.1%
Harney	0.7%	1.0%	-0.9%	1.6%	-1.1%	-0.4%	-9.0%	NA	0.6%
Lane	1.1%	1.2%	-4.4%	1.9%	-0.4%	0.8%	-3.9%	1.0%	1.8%
Lincoln	1.2%	0.7%	-5.3%	2.2%	3.9%	-2.7%	-10.1%	0.8%	1.2%
Jefferson	2.7%	2.8%	3.2%	2.6%	3.0%	0.5%	1.6%	0.6%	0.9%
Morrow	2.3%	1.0%	-4.0%	2.9%	2.6%	-0.5%	-2.0%	0.8%	-2.1%
Yamhill	1.4%	0.2%	-1.5%	0.8%	4.0%	-1.6%	-1.5%	0.9%	1.5%

According to Oregon's Employment Department's 2000 Regional Economic Profile [43] there were 50,300 lumber and wood products jobs in Oregon as of 1998. This is a loss of 13,700 positions since 1990. Logging accounted for 3,600 of these lost jobs and sawmills accounting for 7,800 lost jobs. The remainder of this reduction is spread among veneer and plywood, millwork and structural wood; and other wood products. The one category that saw a net increase in jobs was mobile home manufacture where jobs increased from 2,000 in 1990 to 3,400 in 1998. Jobs in this sector paid an average $32,500 per position in 1998. Employment in the forest industry declined in the early-1990s in the wake of the 1991-92 recession and the transition in government forest management due to environmental concerns. A series of court and administrative decisions were made mandating curtailment of timber harvests on federal property in order to protect the habitat of the Northern Spotted Owl and other Endangered Species and environmental restrictions. The reduction in the lumber and wood products sector followed a decade long decline due events such as the oil price shocks of the late 1970s, the recession of 1982 and a shifting of economic advantage from the wood products industry in the Pacific Northwest to that of the U.S.[44]

Because timber related jobs are more concentrated in rural counties the impacts from these job losses are more concentrated in those counties. The common wisdom is that because these counties have a smaller, less diversified economic base, the loss of good paying timber jobs well reduce overall county income and cause long-term economic dislocations. Restrictions on timber harvest means not only a reduction in employment, but also a reduction in federal payments to counties in lieu of property taxes which are made to support county programs. These payments made by both the Bureau of Land Management and the Forest Service are critical to local governments since they compensate in part for the lack of private property base in counties dominated by federal

[43] Volume Titled: Oregon Statewide, 2000 Regional Economic Profile, page 102

[44] The Oregon Employment Department tends to use the late 1970s as its reference benchmark in part due to the fact that total labor employment in this sector has at its peak in 1979 and because in real terms average wages in this sector was also at its peak in 1979.

lands. As a means to help transition the counties off relying on the timber payments, the federal government is continuing to make payments at lower levels through 2003.

For purposes of comparisons below, Figure 80 above provides side-by-side average annual change in population, employment, wages and income for with those counties surveyed for this appendix. Figure 103 at the end of this appendix contains the raw data taken from the 2000 Regional Economic Profile prepared by the Oregon Employment Department.

Oregon & California Railroad Counties

Figure 81

Change in Employment & Income

Oregon & California Railroad Counties

	Real 1997 Per Capita Income			Population			Lumber & Wood Products Employment		
	1987	1997	Change	1987	1997	Change	1987	1997	Change
Benton	$18,497	$24,374	32%	69,200	76,700	11%	1,510	1,070	-29%
Clackamas	$22,008	$28,149	28%	255,100	317,700	25%	2,200	1,662	-24%
Columbia	$17,342	$21,132	22%	36,100	41,500	15%	1,230	770	-37%
Coos	$17,180	$19,494	13%	57,500	61,400	7%	3,390	1,800	-47%
Curry	$18,045	$20,381	13%	17,200	22,200	29%	1,070	650	-39%
Douglas	$16,641	$19,056	15%	93,000	99,100	7%	8,790	6,310	-28%
Jackson	$17,907	$21,933	22%	141,700	169,300	19%	5,940	4,514	-24%
Josephine	$16,120	$18,574	15%	61,700	73,000	18%	2,320	1,440	-38%
Klamath	$16,280	$18,466	13%	56,900	61,600	8%	3,680	2,800	-24%
Lane	$17,984	$22,231	24%	267,700	308,800	15%	11,500	7,300	-37%
Lincoln	$17,857	$20,089	13%	37,600	42,500	13%	480	200	-58%
Linn	$16,414	$20,151	23%	87,000	100,700	16%	4,720	4,020	-15%
Marion	$17,716	$21,243	20%	214,500	267,700	25%	3,000	4,000	33%
Multnomah	$22,211	$28,466	28%	562,000	639,300	14%	2,500	1,990	-20%
Polk	$16,789	$19,533	16%	45,800	57,400	25%	2,848	3,657	28%
Tillamook	$15,847	$18,712	18%	21,000	23,800	13%	560	680	21%
Washington	$22,309	$28,490	28%	280,000	385,000	38%	1,500	1,970	31%
Yamhill	$17,460	$20,876	20%	58,400	79,200	36%	1,130	729	-35%

Source: Oregon Department of Employment

Oregon and California Railroad Counties[45] provides a convenient representative cross section of Western Oregon counties with timber related jobs which are dependent of federal timber sales that were curtailed during the early 1990s. Figure 81 provides a full

[45] . O & C forest lands are the remnants of a four-million acre land grant given to the Oregon & California Railroad Company by Congress in 1896 as a subsidy to encourage construction of a railroad from the Columbia River, south to the California border. In exchange for the land, the company agreed to construct the line and to sell what land it did not use to settlers. The railroad was completed, but due to the economic failure of the Oregon & California Railroad Company in the early 1900's, the line was sold to the Southern Pacific Railroad Company. The management of Southern Pacific Railroad decided to hold on to the land rather than sell it to settlers as Congress had directed in 1869. The Oregon Legislature balked, took its case to Congress, and Congress took the land back, re-affirming the intent of the 1869 legislation that the land be settled for the benefit of local business and industry. These forest lands have been managed on a sustained-yield basis by various agencies of the federal government since that time. Half of the revenues derived from the sale of timber from these lands is paid to the counties.

list of O&C counties. What is most insightful is that this list includes Oregon's metropolitan counties. Figure 81 also provides measures of change in population, lumber and wood products employment and per capita income between 1987 and 1997.

Out of these 16 counties all but 4 saw a significant drop in lumber and wood products employment between 1987 and 1997. Yet each of these counties have seen growth in both population and real per capita income. Coos, Curry, Douglas, Josephine, Klamath, Lincoln, Polk and Tillamook have seen real per capita income grow by less then 20 percent over the 10-year period. In terms of population growth, Coos, Douglas and Klamath have seen less then 10 percent population growth in the same period.

The underlying growth in per capita income and population growth despite significant curtailment in key local industries seems counter intuitive to common expectation (and a static view of the economy) but is a result predicted in REMI and observed in actual data. We will now look at some specific counties to understand why these local economies respond to these negative impacts in a dynamic and positive manner.

Douglas County[46], [47]:

The Oregon Employment Department web site[48] provides some reporting on how counties have responded to the curtailment of timber harvests. One such report documents how Douglas, Lane and Lincoln have progressed but for vary different reasons.[49] Figures 84 through 87, below, show the comparative levels of income, wages, population and employment for these three counties.

Between 1990 and 1998 Douglas County employment in lumber and wood products have declined by 3 percent per year (Figure 87). This is reflected in a 1.7 percent per year loss in manufacturing employment overall while non-farm employment grew by 1.1 percent per year (Figure 86). This non-farm employment change occurred with a population increase of 0.6 percent per year (Figure 85). Real covered wages have increased by 0.4 percent per year and real per capita income has increased by 1.1 per cent per year (Figure 84).

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[46] Volume titled: Region 6; 2000 Regional Economic Profile.

[47] See web page: http://www.olmis.org/olmisj/ArticleReader?itemid=00001417&segmentid=0002&tour=0&p_date=1&p_search=timber&searchtech=1

[48] http://www.olmis.org

[49] Brian Rooney; Tail of Three Counties, http://www.olmis.org/olmisj/ArticleReader?p_search=timber&searchtech=1&itemid=00001417

The loss of timber jobs was only one element in the change for the industrial mix for Douglas County. The county also saw manufacturing job losses with the closure of Glenbrook Nickel and the closure of the International Paper plant in Reedsport.[50]

On the positive side there was the expansion of Cow Creek Gaming Center, and increasing use of staffing services. Douglas County's remaining timber industry was able to benefit from increased efficiency that made the mills less labor intensive and therefore more competitive. Further, Douglas County has large stands of private timber which made it less dependant on the federal lands as a timber source.

Douglas County has benefited from a growth in population and although the county saw a slight reduction in the population in 1990 there has been steady population growth since. In fact, Douglas County experienced population growth even during 1991 and 1992 -- years of employment loss and unemployment rates in the 10 to 11 percent range when one would expect population to decrease. The population boom, with a net 5,600 increase, was lead by an influx in retirement age individuals. The increase in population in turn fueled the services and retail sectors', the job growth. The service industries with the most growth since 1990 are amusement and recreation, business services, social services, and health services. A key factor in attracting the retirement-aged people to the county is the abundance of health care facilities including a Veterans Administration hospital.

Lane County[51, 52]

Between 1990 and 1998 Lane County employment in lumber and wood products have declined by 3.9 percent per year while overall manufacturing employment has increased by 0.8 percent per year (Figure 87). Non-farm employment grew by 1.9 percent per year. This non-farm employment change came as the population increased at 1.1 percent per year (Figure 85). The net result is that real covered wages has increased by 1.0 percent per year and real per capita income has increased by 1.8 per cent per year (Figure 84).

The reasons for the drop in manufacturing's share of industry mix (Figure 85) are much the same for Lane County as they are for Douglas County, but the outcome is somewhat different. Since 1987 the total production in the lumber and wood products sector has fallen by 38 percent in Lane County. Total employment in this sector fell by 4000 jobs.[53] After the contraction in the lumber and wood products industry manufacturing was able to rebound to employment levels higher then in 1990 because of the introduction of high technology manufacturing firms and the expansion of motor home manufacturing in the county.

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[50] Volume: Region 6, 2000 Regional Economic Profile, page 12.
[51] Volume titled: Region 5, 2000 Regional Economic Profile.
[52] See web page:
http://www.olmis.org/olmisj/ArticleReader?itemid=00001417&segmentid=0003&tour=0&p_date=1&p_search=timber&searchtech=1
[53] Volume: Region 5, 2000 Regional Economic Profile, page 11.

Due largely to amenities such as transportation, communications, and a major university associated with the Eugene/Springfield Metro area[54], Lane County manufacturing has been able to diversify by attracting high tech firms such as Hyundai Semiconductor and Sony Disc Manufacturing. Other local high tech firms such as PSC Scanning expanded during this period. High tech manufacturing grew by 2,200 from 1990 to 1998 for a growth rate of 211 percent.

With manufacturing able to rebound to employment levels close to those of 20 years ago, the industry mix change in Lane County has more to do with rapid growth in the services sector during the 1990s. Again, following a national trend, business services increased rapidly during the 1990s as staffing agencies became more popular. Help supply companies added 1,928 jobs from 1990 to 1998 for a 98 percent increase. Another portion of business services, computer related services, also had a healthy increase of 927 – 13 times the number employed at the beginning of the decade. Responding to an aging population, residential care employment is up by 910 since 1990.

Lincoln County[55, 56]

Between 1990 and 1998 Lincoln County employment in lumber and wood products has declined by 10.1 percent per year (Figure 87). The net result has been a 2.7 percent per year loss in manufacturing employment overall while non-farm employment grew by 2.2 percent per year. This non-farm employment change came as the population increased at 1.2 percent per year (Figure 85). Real covered wages have increased by 0.8 percent per year and real per capita income has increased by 1.2 per cent per year (Figure 84).

Lincoln County has suffered the dual effects of the timber reductions and by the contraction in the fishing and fish processing industries. With the drop in resource extraction industry employment, Lincoln County became more dependent on tourism as the basis for its economy. Because of attractions like Oregon Coast Aquarium, and the Yaquina Head Interpretive Center more tourists have been drawing to Lincoln County. In turn, employment in the tourism-related restaurant and hotel industries increased, driving increases in the retail trade and services sectors. Another reason for the growth in retail trade and services is the popularity of Lincoln County as a place to retire.

South Coast; Coos & Curry Counties[57]

[54] Eugene-Springfield metropolitan statistical area is in the top half of the fastest growing areas of the country. See Volume: Region 5, 2000 Regional Economic Profile page 9

[55] Volume titled: Region 4, 2000 Regional Economic Profile

[56] See web site: http://www.olmis.org/olmisj/ArticleReader?itemid=00001417&segmentid=0004&tour=0&p_date=1&p_search=timber&searchtech=1

[57] Volume titled: Region 7, 2000 Regional Economic Profile.

The Counties of Coos and Curry represent a distinct case showing dramatically how the mix of industries changes. What makes these counties a good comparative case is that both counties begin with essentially much the same industry structure except the Coos County had three times the population of Curry County in 1987. Basic industries on the south coast includes agriculture, fishing, timber products as well as tourism based services. Which, in turn support secondary industries such as trade, services and government through household spending. Figures 88 through 91 below show population, employment and income data for Coos and Curry Counties.

Between 1990 and 1998 Coos County employment in lumber and wood products has declined by 4.7 percent per year. This has resulted in a 3.3 percent per year loss in manufacturing employment overall while non-farm employment grew by 0.8 percent per year. This non-farm employment change came with a population growth of 0.2 percent per year. Real covered wages have increased by 0.5 percent per year and real per capita income has increased by 1.5 per cent per year.

In comparison, between 1990 and 1998 Curry County employment in lumber and wood products declined by 1.5 percent per year. This has resulted in a 1.6 percent per year net loss in manufacturing employment overall with non-farm employment growing by 0.8 percent per year. This non-farm employment change came along with a population growth rate of 1.4 percent per year. Real covered wages have increased by 0.4 percent per year and real per capita income has increased by 1.0 per cent per year.

Non-farm employment on the South Oregon Coast rose by just 8 percent (total) over the past decade. Non-manufacturing grow at the fastest rate by nearly 22 percent through growth in the service and government sectors. In the manufacturing sector, 37 percent of the jobs (-2,010 net) were lost due mainly to mill closures and job losses in the timber industry.[58]

Real wages have responded differently between the two counties. In Coos County, where both the population is larger and the number of lost lumber and wood products jobs was larger then relative to Curry Counties the covered wage declined by 2.2 percent in real terms. In the case of Curry County the covered wage decreased by only 0.8 percent (Figure 102).

On the other hand the measure of per capita income shows a net increase in real terms over the course of the decade. Coos County's real per capita income grew 21.9 percent since 1987 but Curry County's per capita income only grew by 12.6 percent.

[58] Ibid, page 17.

Bottom Quartile Counties

The second screen applied was to the bottom quartile counties measured by per capita income. The presumption is that by looking at the bottom quartile counties we will identify those counties most devastated by the mill closures and who are less likely to see an increase in either wages or income. Figure 82 presents the bottom quartile of counties. It must be pointed out that of the 9 counties listed here only 5 had data for employment in lumber and wood products reported in the Oregon Employment Department study. The fact that lumber and wood products employment was not separated out of total manufacturing employment, suggests that this sector maybe an insignificant component of the county economy[59]. This conclusion is validated in part by the fact that manufacturing employment where reported consistently varied between 10 and 30 employees total for the counties in question.

Figure 82

Comparison of Employment, Per Capita Income and Lumber/Wood Employment in Bottom Quartile Counties

		Real Per Capital Income 1997 $			Population			Lumber/Wood Prod. Employment		
County	Rank in 1999	1987	1997	Change	1987	1997	Change	1987	1997	Change
Sherman	36	$24,689	$13,709	-44%	2,100	1,900	-10%	NA	NA	NA
Wheeler*	35	$14,633	$13,798	-6%	1,400	1,900	36%	NA	NA	NA
Gilliam*	34	$18,487	$14,455	-22%	1,850	1,960	6%	NA	NA	NA
Morrow	33	$16,188	$15,518	-4%	8,000	9,000	13%	220	200	-9%
Malheur*	32	$14,583	$17,106	17%	28,500	28,700	1%	NA	NA	NA
Jefferson	31	$15,333	$17,125	12%	11,800	17,100	45%	880	1,180	34%
Harney	30	$15,951	$17,479	10%	7,200	7,500	4%	610	210	-66%
Baker	29	$14,939	$17,847	19%	15,300	16,500	8%	440	560	27%
Crook	28	$15,713	$18,274	16%	13,500	16,250	20%	1,750	1,490	-15%

* Figures for Lumber & Wood products employment are NOT available and therefore are probably not a significant component of the economic base.

Sherman County[60] is something of a special case, along with Grant County, Sherman was one of only two counties in Oregon to suffer a net loss in population over the past decade. According to the Oregon Employment data, there are no manufacturing jobs in the county whatsoever. The steady erosion in per capita income is due to lower population offset by higher employment overall which suggests a general erosion in the wage base across all economic sectors. Approximately one-third of Sherman County's employment is in the farm sector so a high proportion of income is subject to commodity cycles in that sector.

Although we can conclude that lumber and wood products do not contribute to the economy of Sherman County the proximity to Hood River and Wasco Counties may allow workers to commute to jobs in these counties from Sherman County.

[59] The statistics reflect employment covered by workers compensation. These statistics do not pick up self employed or part time loggers who work as independent loggers.

[60] See Volume for Region 9, 2000 Regional Economic Profile.

Of the other counties lacking data on lumber and wood products employment the farm sector is the major economic driver in the same fashion as Sherman County. Although some minor timber related employment may exist it is not significant enough for consideration in this analysis.

Comparative data on changes in population, income, wages and manufacturing employment for Baker, Crook, Harney and Morrow counties is contained in figures 92 through 96 below.

Morrow County[61]

Between 1990 and 1998 Morrow County employment in lumber and wood products has declined by 2.6 percent per year (Figure 96). This has resulted in a 0.5 percent per year loss in manufacturing employment overall with non-farm employment growing by 2.9 percent per year (Figure 94). This non-farm employment change is on top of a population increase of 2.3 percent per year. Real covered wages have increased by 0.8 percent per year and real per capita income has decreased by 2.1 per cent per year (Figure 92).

Of the 5 counties in the bottom quartile that have a lumber and wood products sector Morrow County is the only county with a decline in per capita income in real terms (Figures 92 & 102). Yet in terms of total employment in the wood products sector the loss in jobs has been only 20 over the past decade. The decline in per capita income cannot be explained by changes in the wood products sector. The explanation for this is the significant and relatively high unemployment rate that has remained between 7% and 10% over the past decade. The overall expansion of the civilian labor force (6% over 11 years) in Morrow County has not kept pace with the growth in the overall population (17% over 11 years). As shown in Chart 12 lumber and wood products as a share of all non-farm employment has fallen. Actual employment in the lumber and wood product sector has fallen from a peak of 250 in 1989 to 200 in 1997.

Part of the explanation for the fall in per capita income can be attributed to the fall in farm income and the decrease in employment in the farm sector. In 1991 gross farm sales fell by $20 million from the year previously and did not recover to 1990 levels until 1994. A better measure of what is happening with income in Morrow County is real average covered wages (Figure102). Average covered wages actually increased with a jump in 1995 caused by hiring in the food-processing sector.[62] In 1996 with a reduction in employment in the non-manufacturing sector (food processing continues to expand employment) a fall off in average covered wages is felt. In conjunction with the expansion of employment the population increases by 400 people between 1994 and 1996. With the layoffs and immigration unemployment rises to 9.3%

[61] See Volume for Region 12, 2000 Regional Economic Profile.
[62] Volume: Region 12, 2000 Regional Economic Profile, page 63.

Harney County[63]

Between 1990 and 1998 Harney County employment in lumber and wood products has declined by 9.0 percent per year. This has resulted in a 0.4 percent per year loss in manufacturing employment overall with non-farm employment growing by 1.6 percent per year. This non-farm employment change occurred with a population increase of 0.7 percent per year. The net result is that real per capita income has increased by 3.3 per cent per year.

Over the past forty years Harney County has witnessed net out migration; but over the past decade, there has been a recovery in its population growth (Figure 93). From 1990 to 1998 the population has increased by 7.9 percent with four-fifths of the growth attributed to in migration.[64]

The lumber and wood products sector represents less then 50 percent of Harney County's manufacturing jobs (Figure96). From 1990 to 1998, this sector lost a total of 310 jobs or 50 percent of the total number. The trend in total manufacturing jobs has been negative represented by the net effect of job losses in the lumber and wood products sector. The level of timber harvests in Southeast Oregon where Harney County is located is off 18 percent from the record high in 1986.[65]

Harney is a case where new manufacturing jobs have been formed to offset the losses. To quote the OED study: "The local economy didn't just diversify in the most recent years, it grew rather strongly."[66] The diversification took place since 1996 with the addition of a motor coach and related manufacturing which "…means that on one industry seems to get all the credit or the blame for changing economic conditions in the county." A total of 290 new jobs were added to other manufacturing sectors.

Between 1996 and 1998 Harney County's non-farm job growth (at 17.1 Percent) was the highest in percentage terms then any other labor market in the state and better then 3 times the state average.[67]

Baker County[68]

Between 1990 and 1998 Baker County employment in lumber and wood products has declined by 2.3 percent per year. This has resulted in a 0.3 percent per year net increase in manufacturing employment overall with non-farm employment growing by 1.3 percent per year. This non-farm employment change came with a population increase of 0.6

[63] See Region 14, 2000 Regional Economic Profile.
[64] Ibid, page 9.
[65] Ibid, page 18.
[66] Ibid, page 29.
[67] Ibid, page 29.
[68] See: Region 13, 2000 Regional Economic Profile.

percent per year. The net result is that real per capita income has increased by 0.2 per cent per year.

Like Harney, Baker County has had limited population growth. Because of in migration between 1987 and 1998 the county added a total of 1,030 people which has brought the county population back to the historic highs of the 1950's.[69] The unemployment rate is higher then the state average with the rate declining from an historic high of 11.5 percent in 1996 to 9 percent today.

In 1998 Baker County had 380 lumber related jobs this is a net decrease of 90 jobs since 1990 but the county added 110 new manufacturing jobs for a net gain.[70] In total Baker County has netted 500 new jobs since 1990. Contributing the most has been the growth in the social services and health care components of the service sector[71].

Crook County

Between 1990 and 1998 Crook County employment in lumber and wood products have declined by 3.5 percent per year. This has resulted in a 2.9 percent per year net loss in manufacturing employment overall (Figure 94) with non-farm employment growing by 1.5 percent per year. This non-farm employment change came with a population increase of 1.9 percent per year. The net result is that real covered wages have increased by 0.2 percent per year and real per capita income has increased by 3.5 per cent per year.

Losses in manufacturing were gained in various non-manufacturing sectors. The non-manufacturing sector with the greatest gain was trade.[72]

Jefferson & Deschutes Counties[73]

Between 1990 and 1998 Jefferson County employment in lumber and wood products has increased by 1.6 percent per year (Figure 101). This has resulted in a 0.5 percent per year net increase in manufacturing employment overall with non-farm employment growing by 2.6 percent per year. This non-farm employment change came with a population increase of 2.7 percent per year (Figure 99). Real covered wages have increased by 0.6 percent per year and real per capita income has increased by 0.9 per cent per year (Figure 97).

Jefferson County (ranked 31 out of 36 in terms of per capita income) is one of the few rural counties where lumber and wood products employment has stayed stable, at 18 percent of the total employment, over the past decade. The total number of jobs in this

[69] Ibid, page 13.
[70] Ibid, page 25.
[71] Ibid, page 24.
[72] Volume: Region 10; 2000 Regional Economic Profile, page 19.
[73] Volume titled: Region 10, 2000 Regional Economic Profile

sector had increased to a high of 1,190 in 1993 only to fall off to 1,070 by 1998. Jefferson County was able to successfully buck the trend in the lumber and wood products sector because of the presence of a very efficient and successful secondary wood products plant.[74] The decline in jobs is due, in part, to two causes. The first is the Asia economic slowdown and the second is the reclassification of tribal establishments engaged in the lumber and wood products sector as government establishments.[75] In fact this reclassification contributed in part to the fall (-$3,209 per worker[76]) in lumber and wood products contribution to the county's income statistics. Besides the lumber and wood products sector the local tribes are the single most important source of employment in the county. More then 40 percent of the increase in personal income was influenced by transfer payments from the federal government to the tribes, as well as assistance to wage earners in the low-wage agricultural sector.[77]

Figure 83
Change in Personnal Income by Major Source 1987 to 1997
Comparison Deschutes and Jefferson Counties

Income Source	Deschutes	Jefferson
Dividends, Interest & Rent	64.9%	14.9%
Transfer Payments	77.3%	87.6%
Farm	-641.8%	-65.7%
Construction & Mining	128.3%	113.4%
Manufacturing	8.5%	30.8%
Transportation and Utlities	48.7%	45.9%
Trade	93.1%	56.5%
Finance, Insurance, Real Estate	297.1%	55.5%
Services	93.4%	54.8%
Federal Government	20.2%	16.3%
State & Local Government	53.6%	47.8%
Total Personal Income	71.1%	38.0%
Per Capital Income	12.6%	5.3%

Source: Oregon Employment Department 2000 Regional Economic Profile, Region 13, page

Jefferson County's population growth is one of the most rapid growth rates in percentage terms of any Oregon county with an increase of 27.2 percent between 1990 and 1998. This is caused in part by the "spillover effect" form the nearby Bend area. Jefferson County can boast a relatively low-priced real estate market coupled with a high degree of livability.[78]

Between 1990 and 1998 Deschutes County employment in lumber and wood products has declined by 4.8 percent per year. This has resulted in a net wash in manufacturing

[74] Volume: Region 10, 2000 Regional Economic Profile, page 17.
[75] Ibid, page 46
[76] Ibid, page 47.
[77] Ibid, page 41.
[78] Ibid, page 9

employment overall (Figure 100) while non-farm employment grew by 3.9 percent per year. This non-farm employment change came with a population increase of 3.7 percent per year. Real covered wages have increased by 0.7 percent per year and real per capita income has increased by 30.6 per cent per year.

By comparison, Deschutes County did suffer relatively heavy job losses in the lumber and wood products sector. Since 1990, Deschutes lost 1,240 lumber and wood products jobs (36 percent decline). On top of this downturn farm sales also declined by 29 percent compounding the income problem.

The overall economic base of the county continued to grow despite the downturns in lumber and agriculture. The population of the county grew at 39%[79] between 1990 and 1998 while the number of people employed grew by 32% during the same period. Although the total number of manufacturing jobs remained flat over this period, job formation in other areas of durable goods manufacturing was able to make up for losses in the lumber sector.

Unemployment increased from 5.5 percent to 8.2 percent by 1993, but unemployment has been trending lower over the past few years and is now at 7 percent. Historically, Deschutes has had higher unemployment rates then Oregon.[80] The primary cause for the recent high unemployment rates has been a rate of population growth that is higher then rate of job formation.[81] Dealing with this issue is a true challenge for the county.

In the arena of job growth in Deschutes the sectors with the greatest level of job formation has been finance, insurance, and real estate then the service sector; growing at 69 percent and 59 percent respectively. Employment in the trades sector has grown by a respectable 42 percent.

The overall effect is that both covered wages and real per capita income continued to rise despite job losses in the lumber sector.

Findings and Conclusions

A review to the economic data for the 11 counties surveyed shows that in the majority of cases, the employment data shows a real and significant decline in employment in the lumber and wood products manufacturing. Although wages and income may fall initially, by the end of the survey period (1990 to 1997) these economic measures have begun to recover in real terms.

Covered wages are wages paid to the workforce who is covered by unemployment insurance. Covered wages is considered by many labor economists as the best measure of payrolls available since the definition of covered payrolls is established by the U.S. Bureau of Economic Analysis and the Oregon Employment Department collects this data

[79] Livability is a draw for new residents, see Ibid page 9.
[80] Ibid, page 13.
[81] Ibid, page 14.

on a quarterly basis from employers directly. This statistic is used as a means to judge the ability of locality's workforce and households ability to pay for goods and services.

A more complete measure of a region's overall income is per capita income which reflects not only wages covered by unemployment insurance but also proprietor's income, income from rents and dividends, retirement payments and transfer payments from state and federal governments.

This survey showed that timber dependant counties as measured by employment in the lumber and wood products manufacturing sector did see changes in the underlying economic structure. Those counties with a higher population and more diverse economic base, such as Lane County, did better then counties with smaller populations and where the economic bases supported a resource based economy only.

If the county has both a large population base and inherent amenities that makes it attractive to in migration, such as Deschutes County, then the change in economic mix may be very dramatic as seen in Figure 83. The amenity factor (which can include low relative property values) does play a role in the change in other counties like Douglas and Lincoln where retirement communities and tourism now play a pivotal role in the economies of these counties. It should be noted that retirement incomes play an important role in moderating any erosion in local per capita income since retirement income is fixed so unlikely to decline.

The changes in population demographics in some of the counties we looked at, due in part to increasing retirement communities suggest that the growing economic sectors are the services and trade sectors. Although there are many questions about the comparability of wages with the manufacturing sector, the wages in the service arena like health care do not have to be low.

It is implicit from the population data and the changes in employment totals that labor is mobile and flexible and will move to where the opportunities exist as in the case of Morrow County. Shifting employment patterns occur because unemployed labor will seek work and employers will seek to higher labor where it is less expensive. This is seen in the change in manufacturing sector jobs in not only Lane and Deschutes Counties but also in counties such as Harney and Crook Counties.

A final observation concerns the role of transfer payments from the state and local governments. These payments do make a real and noticeable impact on the overall per capita income of the counties and do moderate the economic erosion of these communities. Some payments such as continuation of the federal harvest payments until 2003 are designed to help transition the local economies off dependency on the federal timber sales. In addition, state economic development programs contribute in this area. One element that has seemed to go unrecognized is the contribution the local tribal communities play. The largest area of growth in federal transfer payments has been to the local tribal communities. The local tribes do participate in the local economies and so these transfer payments play a role in supporting these counties.

This recovery does have a downside. As local economies improve in-migration does occur and if population grows faster then job formation unemployment will increase as in the case do Deschutes County. Further, the benefits of economic growth will not be evenly distributed throughout the county. Some communities will be left behind. This effect can be seen in Lane County where most of the manufacturing growth is located in the Eugene-Springfield area.

The economic data reviewed during this survey of timber dependent counties is consistent with the county level responses coming from REMI.

Figure 84
Real Wages & Per Capita Income

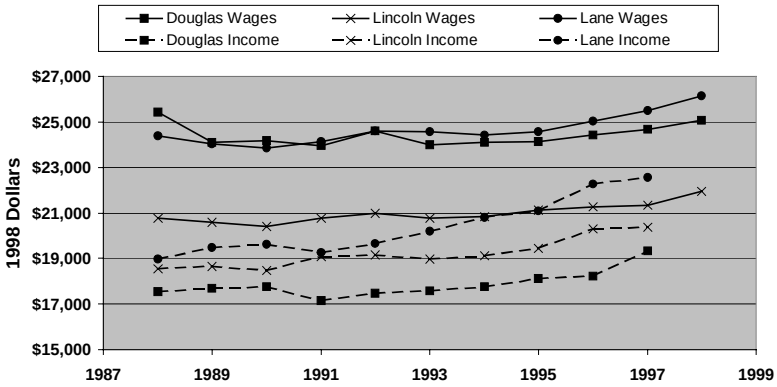

Figure 85
Change in Population

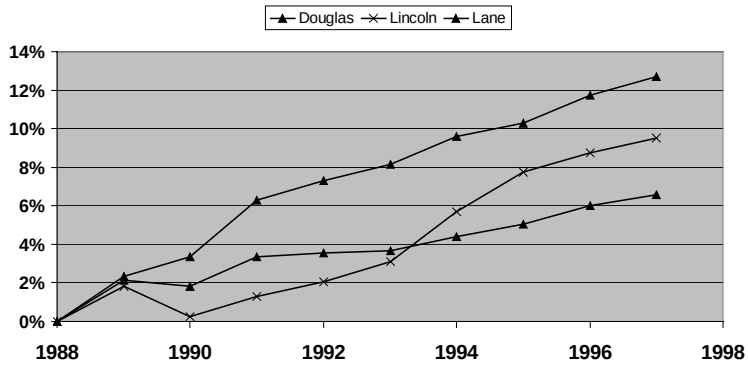

Figure 86
Change In Manufacturing Employment

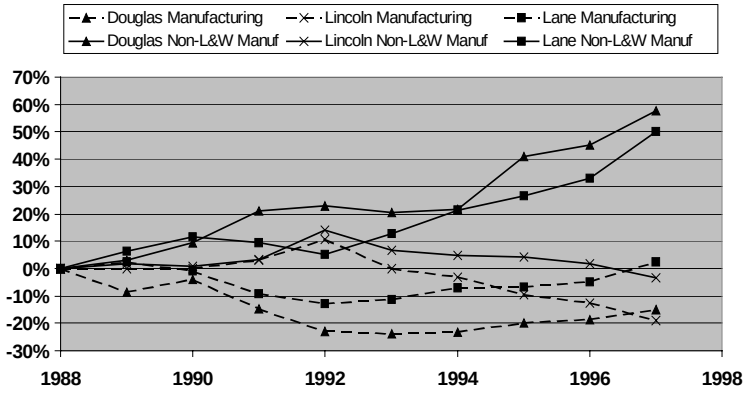

Figure 87
Manufacturing Share of Employment

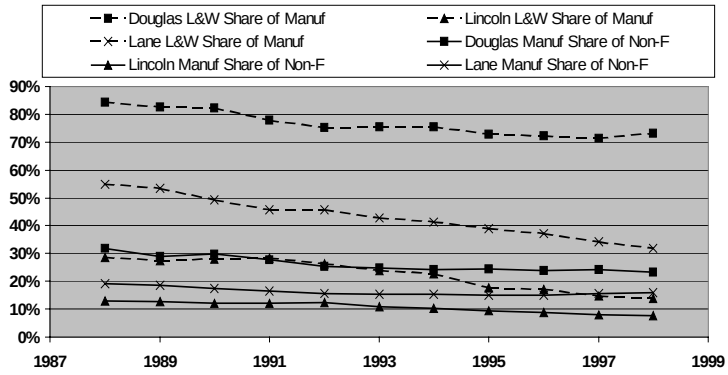

Figure 88
Real Wages & Per Capita Income

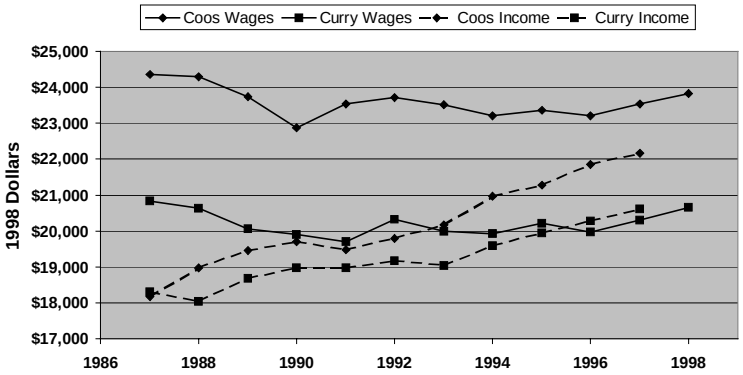

Figure 89
Change in Population

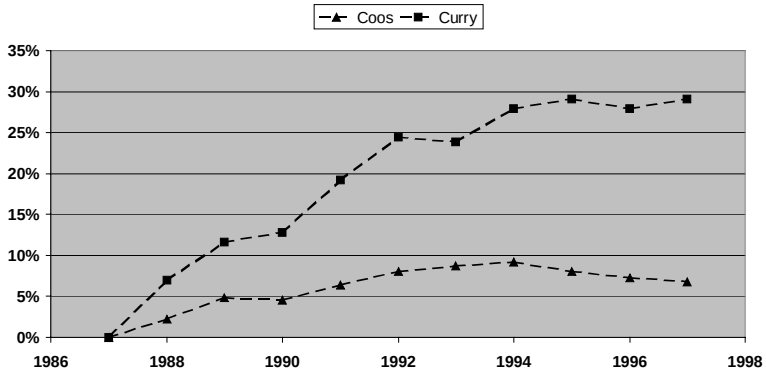

Figure 90
Change in Manufacturing Employment

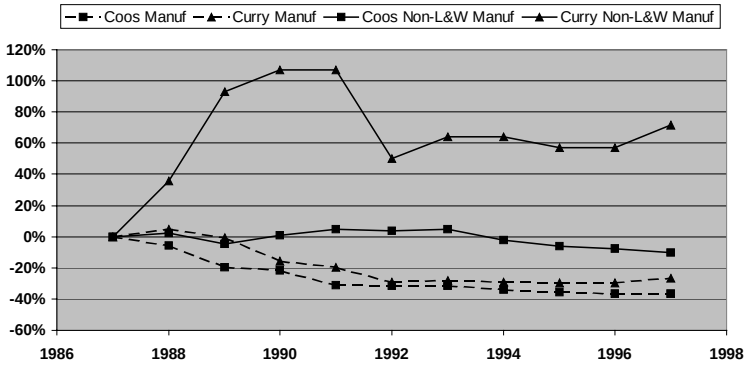

Figure 91
Manufacturing Share of Employment

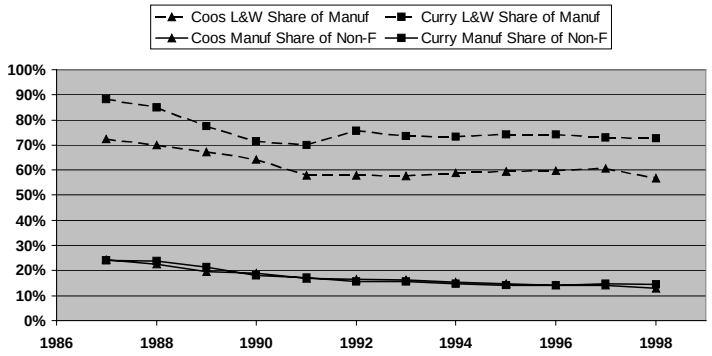

Figure 92
Real Per Capita Income

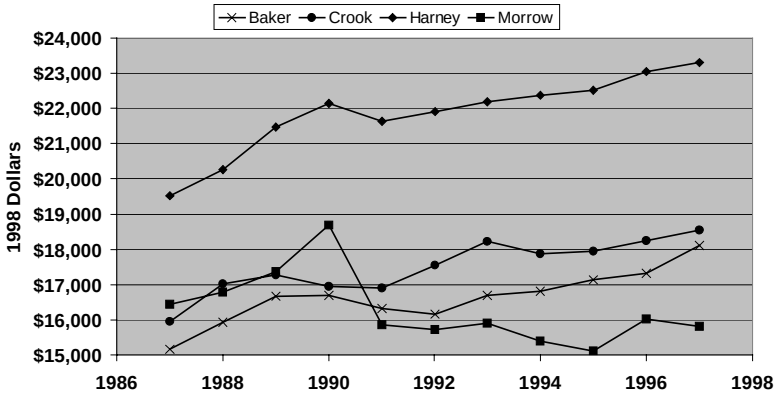

Figure 93
Change in Population

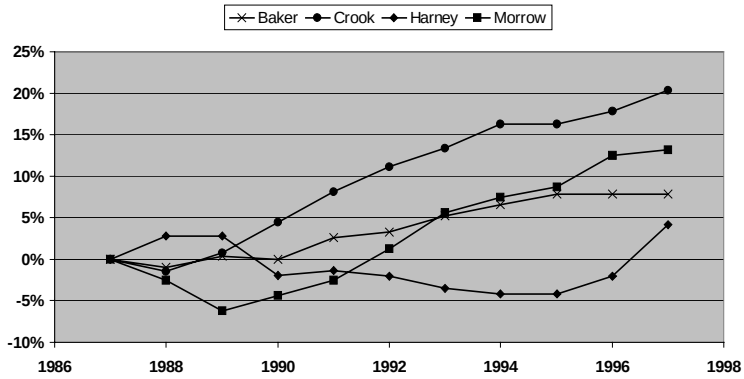

Figure 94
Change in Manufacturing Employment

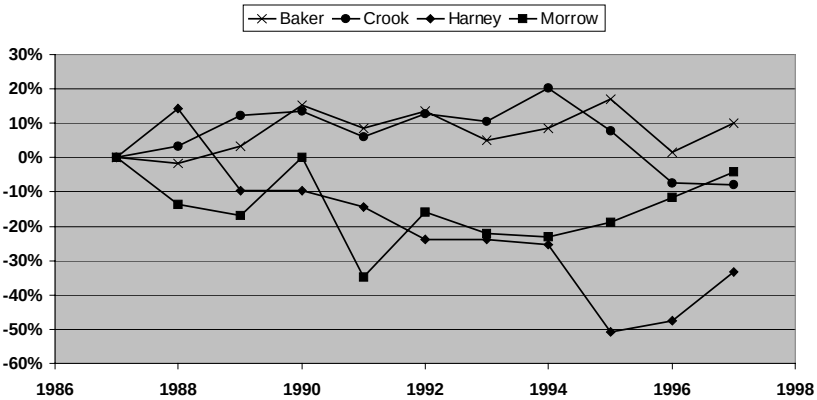

Figure 95
Change in Non-Lumber & Wood Manufacturing Employment

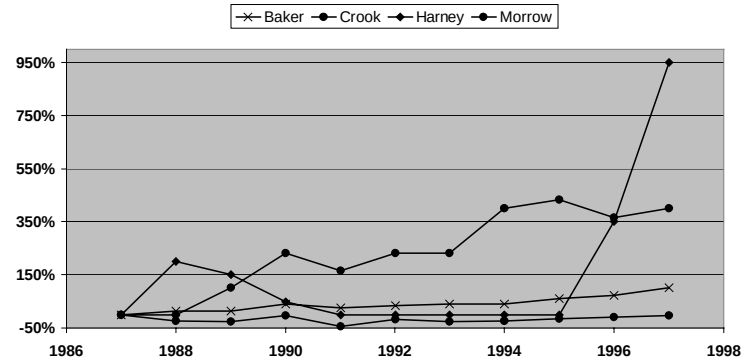

Figure 96
Manufacturing Share of Employment

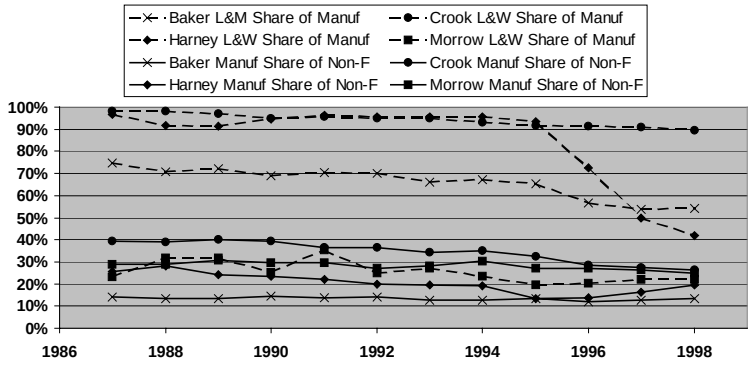

Figure 97
Real Wages & Per Capita Income

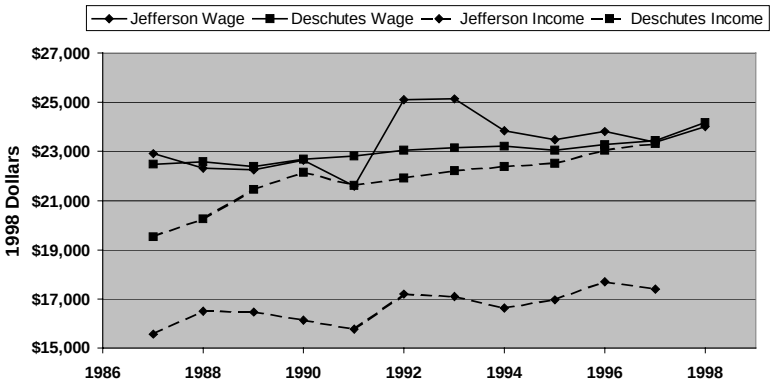

Figure 99
Change in Population

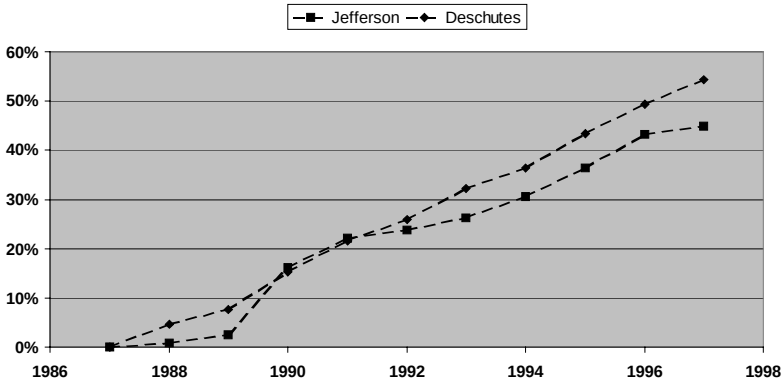

Figure 100
Change in Manufacturing Employment

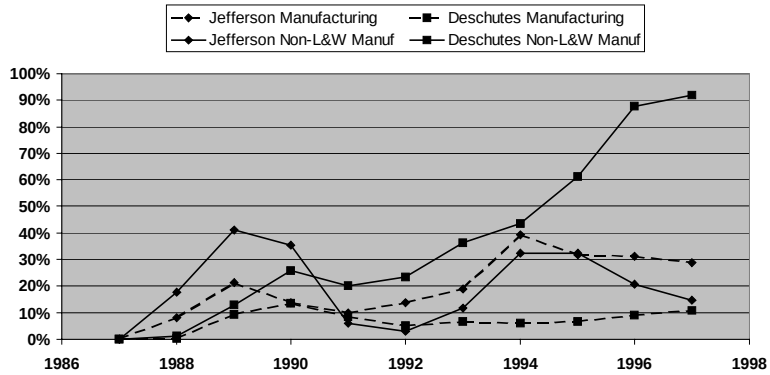

Figure 101
Manufacturing Shares

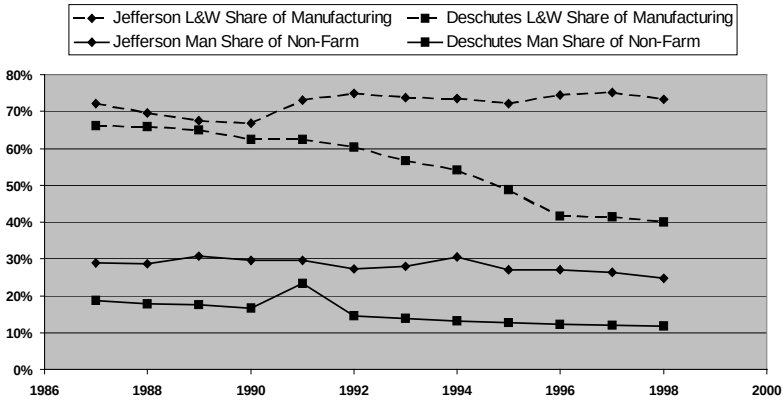

Figure 102
Real Covered Wages & Real Per Capita Income

	Oregon		Baker		Coos		Crook	
	Average Covered Wage	Per Capita Income	Average Covered Wage	Per Capita Income	Average Covered Wage	Per Capita Income	Average Covered Wage	Per Capita Income
1987	$25,938	$19,616		$15,162	$24,357	$18,178	$24,704	$15,947
1988	$26,020	$20,290		$15,928	$24,288	$18,981	$25,327	$17,021
1989	$25,797	$20,835		$16,662	$23,737	$19,463	$25,226	$17,282
1990	$25,980	$21,230		$16,693	$22,867	$19,707	$24,852	$16,948
1991	$26,199	$20,974		$16,328	$23,534	$19,483	$24,616	$16,904
1992	$26,822	$21,306		$16,165	$23,705	$19,782	$26,271	$17,562
1993	$26,774	$21,692		$16,703	$23,504	$20,174	$25,496	$18,235
1994	$26,908	$22,261		$16,809	$23,204	$20,968	$24,911	$17,888
1995	$27,349	$22,883		$17,138	$23,363	$21,286	$24,378	$17,942
1996	$27,993	$23,695		$17,331	$23,205	$21,859	$25,191	$18,249
1997	$28,830	$24,276		$18,113	$23,538	$22,158	$24,778	$18,546
1998	$29,548	$24,768	$21,978		$23,831		$25,296	
% Change	13.9%	26.3%	NA	19.5%	-2.2%	21.9%	2.4%	16.3%
Ave Ann Rate	1.1%	2.0%	NA	1.6%	-0.2%	1.8%	0.2%	1.4%

	Curry		Deschutes		Douglas		Harney	
	Average Covered Wage	Per Capita Income	Average Covered Wage	Per Capita Income	Average Covered Wage	Per Capita Income	Average Covered Wage	Per Capita Income
1987	$20,826	$18,314	$22,471	$19,518				$16,189
1988	$20,644	$18,034	$22,579	$20,268	$25,433	$17,542		$16,501
1989	$20,055	$18,677	$22,376	$21,462	$24,090	$17,680		$17,035
1990	$19,897	$18,971	$22,692	$22,148	$24,175	$17,762		$16,366
1991	$19,710	$18,974	$22,801	$21,623	$23,965	$17,154		$16,796
1992	$20,333	$19,171	$23,042	$21,911	$24,609	$17,480		$16,841
1993	$20,002	$19,044	$23,139	$22,202	$23,996	$17,562		$17,584
1994	$19,920	$19,598	$23,221	$22,369	$24,099	$17,752		$17,245
1995	$20,222	$19,958	$23,045	$22,525	$24,134	$18,129		$16,151
1996	$19,967	$20,279	$23,270	$23,059	$24,430	$18,216		$18,880
1997	$20,307	$20,620	$23,440	$23,303	$24,687	$19,340		$17,739
1998	$20,658		$24,160		$25,054		$21,895	
% Change	-0.8%	12.6%	7.5%	19.4%	-1.5%	10.2%	NA	9.6%
Ave Ann Rate	-0.1%	1.1%	0.6%	1.6%	-0.1%	1.0%	NA	0.8%

	Lane		Lincoln		Jefferson		Morrow		
	Average Covered Wage	Per Capita Income	Average Covered Wage	Per Capita Income	Average Covered Wage	Per Capita Income	Average Covered Wage	Per Capita Income	Implicit Price Deflator, GDP
1987					$23,280	$16,429	$23,280	$16,429	1.373
1988	$24,395	$18,992	$20,750	$18,543	$23,167	$16,778	$23,167	$16,778	1.325
1989	$24,021	$19,493	$20,596	$18,667	$23,487	$17,355	$23,487	$17,355	1.271
1990	$23,859	$19,627	$20,419	$18,491	$23,369	$18,696	$23,369	$18,696	1.219
1991	$24,129	$19,257	$20,753	$19,075	$23,602	$15,849	$23,602	$15,849	1.172
1992	$24,598	$19,662	$20,989	$19,165	$25,081	$15,710	$25,081	$15,710	1.141
1993	$24,559	$20,185	$20,767	$18,979	$24,931	$15,904	$24,931	$15,904	1.111
1994	$24,435	$20,805	$20,856	$19,133	$25,985	$15,398	$25,985	$15,398	1.085
1995	$24,581	$21,082	$21,134	$19,426	$27,652	$15,126	$27,652	$15,126	1.059
1996	$25,019	$22,288	$21,286	$20,297	$24,029	$16,027	$24,029	$16,027	1.035
1997	$25,491	$22,562	$21,338	$20,388	$25,531	$15,817	$25,531	$15,817	1.015
1998	$26,135		$21,959		$25,095		$25,095		1.000
% Change	7.1%	18.8%	5.8%	10.0%	7.8%	-3.7%	7.8%	-3.7%	
Ave Ann Rate	0.6%	1.7%	0.5%	1.0%	0.7%	-0.6%	0.7%	-0.3%	

Figure 103
Population, Employment, Income and Wage Data Survyed Counties

Baker County

	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufact-uring	Lumber & Wood Products	Average Covered Wage	Per Capita Income
1987	15,300	5,530	1,790	4,140	630	590	440	NA	$11,209
1988	15,150	6,020	1,720	4,300	570	580	410	NA	$12,021
1989	15,350	6,320	1,720	4,600	560	610	440	NA	$13,105
1990	15,300	6,530	1,790	4,740	520	680	470	NA	$13,699
1991	15,700	6,480	1,800	4,680	530	640	460	NA	$13,931
1992	15,800	6,460	1,690	4,770	690	670	470	NA	$14,171
1993	16,100	6,630	1,740	4,890	710	620	410	NA	$15,029
1994	16,300	6,860	1,860	5,020	600	640	430	NA	$15,486
1995	16,500	6,820	1,700	5,120	600	690	460	NA	$16,191
1996	16,500	6,760	1,710	5,050	670	690	340	NA	$16,746
1997	16,600	6,770	1,580	5,190	760	660	360	NA	$17,847
1998	16,700	6,980	1,630	5,350	660	700	380	$21,978	NA
% Change	9.2%	17.8%	-8.9%	28.3%	3.2%	18.6%	-13.6%	NA	61.7%
Ave Ann Rate	0.7%	1.3%	-0.6%	2.1%	0.3%	1.4%	-1.2%	NA	4.5%
AAG 90-98	1.0%	0.7%	-1.0%	1.3%	2.5%	0.3%	-2.3%	NA	3.4%

Coos County

	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufact-uring	Lumber & Wood Products	Average Covered Wage	Per Capita Income
1987	57,500	25,470	6,070	19,400	2,250	4,600	3,390	$17,734	$13,235
1988	58,000	25,540	5,830	19,710	2,600	4,420	3,090	$18,530	$14,325
1989	60,200	24,720	5,300	19,340	2,700	3,700	2,540	$18,670	$15,308
1990	60,500	24,610	4,960	19,660	2,200	3,660	2,370	$18,766	$16,173
1991	61,200	24,600	5,120	19,380	2,360	3,280	1,880	$20,080	$16,620
1992	62,300	24,170	4,670	19,500	2,960	3,200	1,860	$20,758	$17,342
1993	62,500	25,040	5,090	19,960	3,040	3,210	1,860	$21,149	$18,152
1994	62,600	25,570	5,290	20,280	2,400	3,090	1,620	$21,377	$19,317
1995	62,300	25,500	4,860	20,640	2,030	3,030	1,800	$22,072	$20,108
1996	61,700	25,680	4,500	21,120	2,610	2,900	1,700	$22,420	$21,120
1997	61,400	24,950	3,760	21,190	2,660	2,970	1,900	$23,159	$21,033
1998	61,400	24,730	3,720	21,010	2,770	2,710	1,640	$23,831	NA
% Change	6.8%	-2.9%	-38.7%	8.3%	21.9%	-42.2%	-54.6%	34.4%	68.0%
Ave Ann Rate	0.5%	-0.2%	-4.8%	0.7%	1.8%	-4.5%	-6.4%	2.5%	4.7%
AAG 90-98	0.2%	0.1%	-3.1%	0.8%	2.4%	-3.3%	-4.7%	2.7%	3.8%

Crook County

	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufact-uring	Lumber & Wood Products	Average Covered Wage	Per Capita Income
1987	13,500	6,290	1,790	4,500	550	1,790	1,750	17,987	$11,811
1988	13,300	6,430	1,700	4,730	500	1,840	1,610	19,114	$12,846
1989	13,600	6,730	1,720	5,010	520	2,080	1,940	19,841	$13,580
1990	14,100	6,290	1,150	5,140	470	2,020	1930	20,395	$13,969
1991	14,600	6,370	1,180	5,190	540	1,890	1,910	21,003	$14,423
1992	15,000	6,960	1,460	5,600	620	2,010	1,950	23,030	$15,096
1993	15,300	6,950	1,220	5,730	750	1,970	1,870	22,841	$15,488
1994	15,700	7,430	1,340	6,090	350	2,140	1,990	22,949	$16,479
1995	15,700	7,190	1,280	5,910	640	1,920	1,760	23,030	$16,950
1996	15,800	6,940	1,190	5,750	510	1,650	1,540	24,339	$17,832
1997	16,250	6,900	1,020	5,960	700	1,640	1,490	24,415	$18,274
1998	16,650	6,980	970	6,070	720	1,560	1,290	$26,296	NA
% Change	23.3%	8.7%	-44.9%	29.6%	41.2%	-12.9%	-20.6%	46.6%	57.4%
Ave Ann Rate	1.9%	0.7%	-4.8%	2.2%	2.9%	-1.1%	-1.9%	2.9%	4.2%
AAG 90-98	1.9%	0.9%	-1.9%	1.5%	4.9%	-2.9%	-3.5%	2.4%	3.5%

Curry County

	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufact-uring	Lumber & Wood Products	Average Covered Wage	Per Capita Income
1987	17,200	5,330	3,320	5,010	550	1,210	1,070	$16,353	$13,334
1988	18,400	5,730	3,390	5,340	550	1,270	1,080	$16,580	$13,678
1989	19,200	9,080	3,440	5,650	620	1,200	930	$16,774	$14,608
1990	19,400	7,630	1,940	5,690	520	1,030	730	$16,329	$15,369
1991	20,600	7,670	2,030	5,640	640	970	680	$16,617	$16,189
1992	21,400	7,320	1,830	5,490	730	860	650	$17,025	$16,808
1993	21,300	7,420	1,840	5,580	740	870	640	$17,998	$17,138
1994	22,000	7,790	1,920	5,830	650	860	630	$18,361	$18,055
1995	22,200	7,600	1,580	6,020	620	850	630	$18,504	$18,855
1996	22,000	7,750	1,730	6,020	620	850	630	$19,292	$19,530
1997	22,200	7,590	1,530	6,060	790	890	650	$20,009	$20,318
1998	22,000	7,800	1,700	6,100	740	880	640	$20,669	NA
% Change	27.9%	-6.4%	-48.8%	21.8%	34.5%	-27.3%	-40.2%	36.2%	52.4%
Ave Ann Rate	2.1%	-0.5%	-5.4%	1.7%	2.5%	-2.6%	-4.2%	2.6%	3.9%
AAG 90-98	1.4%	0.2%	-1.5%	0.8%	4.8%	-1.6%	-1.5%	2.8%	3.4%

Deschutes County

	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufact-uring	Lumber & Wood Products	Average Covered Wage	Per Capita Income
1987	65,600	32,650	7,110	25,540	2,700	4,010	3,100	$16,361	$14,211
1988	68,700	34,200	7,840	27,290	2,790	4,000	3,150	$17,040	$15,296
1989	73,600	37,300	7,220	30,080	2,700	6,260	3,420	$17,699	$16,880
1990	75,600	38,800	6,180	32,620	2,240	5,480	3,410	$18,623	$16,175
1991	79,800	40,160	17,710	22,450	2,750	5,220	3,260	$19,454	$16,449
1992	82,600	40,560	6,090	34,470	3,640	5,080	3,050	$20,208	$16,208
1993	86,800	43,150	6,290	36,860	4,120	5,130	2,910	$20,828	$16,977
1994	89,900	45,000	7,170	38,600	3,570	5,100	2,760	$21,350	$20,687
1995	94,100	47,220	6,650	40,670	3,210	5,130	2,600	$21,771	$21,280
1996	98,000	49,030	6,500	42,630	4,680	5,250	2,190	$22,483	$22,279
1997	101,200	49,670	5,160	44,520	4,390	5,330	2,200	$23,096	$22,961
1998	104,500	51,240	5,400	45,640	3,670	5,450	2,130	$24,158	NA
% Change	59.3%	56.9%	-24.1%	78.5%	35.2%	13.3%	-31.4%	47.7%	61.6%
Ave Ann Rate	4.0%	3.8%	-2.3%	5.0%	2.8%	1.0%	-3.1%	3.3%	4.5%
AAG 90-98	3.7%	3.1%	-1.5%	3.9%	6.3%	0.0%	-4.8%	2.9%	3.0%

Douglas County

	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufact-uring	Lumber & Wood Products	Average Covered Wage	Per Capita Income
1987	NA	NA	NA	NA	NA	NA	NA	NA	NA
1988	93,000	41,610	8,750	32,750	3,600	10,400	6,790	19,154	$13,228
1989	99,000	42,160	9,410	32,750	3,660	9,600	7,080	18,997	$13,906
1990	94,700	40,260	6,690	33,580	3,590	9,990	6,230	19,640	$14,577
1991	95,300	39,150	7,020	32,130	4,330	8,870	6,520	20,447	$14,638
1992	96,300	37,200	5,600	31,580	5,050	8,000	6,020	21,573	$15,324
1993	96,400	37,800	5,610	32,080	4,790	7,910	5,970	21,591	$16,002
1994	97,100	39,070	6,210	32,860	3,920	7,900	6,020	22,201	$16,394
1995	97,700	39,880	5,710	34,170	3,800	8,240	6,070	22,900	$17,127
1996	98,600	40,860	5,720	35,140	3,990	8,450	6,110	23,603	$17,608
1997	99,300	40,990	4,440	36,550	3,660	8,860	6,310	24,326	$19,056
1998	100,300	41,460	4,460	36,960	4,250	8,580	6,290	25,054	NA
% Change	7.8%	-0.1%	-48.9%	12.9%	21.4%	-17.5%	-28.8%	30.8%	43.5%
Ave Ann Rate	0.7%	0.0%	-5.9%	1.1%	1.8%	-1.7%	-3.0%	2.5%	3.7%
AAG 90-98	0.6%	0.3%	-4.3%	1.1%	1.9%	-1.7%	-3.0%	2.6%	3.4%

Harney County

	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufact-uring	Lumber & Wood Products	Average Covered Wage	Per Capita Income
1987	7,200	3,930	1,470	2,460	330	630	630	NA	$11,787
1988	7,400	4,090	1,520	2,570	340	720	660	NA	$12,460
1989	7,400	3,730	1,360	2,370	460	570	520	NA	$13,399
1990	7,060	3,370	940	2,430	330	570	540	NA	$13,401
1991	7,100	3,430	990	2,440	290	540	520	NA	$14,331
1992	7,060	3,290	880	2,410	380	480	460	NA	$14,764
1993	6,960	3,340	880	2,460	400	480	460	NA	$15,022
1994	6,900	3,400	960	2,440	390	470	450	NA	$15,667
1995	6,900	3,150	840	2,310	400	310	290	NA	$15,298
1996	7,050	3,270	870	2,400	400	330	240	NA	$16,241
1997	7,500	3,390	820	2,570	370	420	210	NA	$17,479
1998	7,500	3,690	870	3,040	300	550	220	$21,095	NA
% Change	4.2%	-6.1%	-40.8%	18.7%	-9.1%	-12.7%	-62.3%	NA	48.3%
Ave Ann Rate	0.3%	-0.6%	-4.3%	1.1%	-0.8%	-1.1%	-7.8%	NA	3.6%
AAG 90-98	0.7%	1.0%	-0.9%	1.6%	-1.1%	-0.4%	-9.6%	NA	3.3%

Jefferson County

	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufact-uring	Lumber & Wood Products	Average Covered Wages	Per Capita Income
1987	11,800	6,470	2,240	4,230	420	1,220	880	16,674	$11,209
1988	11,900	6,860	2,270	4,590	430	1,320	920	16,651	$12,452
1989	12,500	6,990	2,150	4,800	420	1,460	1,000	17,494	$12,946
1990	13,700	6,550	1,670	4,680	420	1,290	930	18,598	$13,229
1991	14,400	6,500	1,960	4,540	450	1,240	960	18,413	$13,464
1992	14,600	7,280	2,150	5,100	610	1,280	1,030	22,019	$15,077
1993	14,900	7,330	2,160	5,170	660	1,450	1,070	22,618	$15,356
1994	15,400	7,860	2,270	5,590	550	1,700	1,260	21,960	$15,334
1995	16,300	7,960	2,020	5,940	460	1,610	1,350	22,179	$16,012
1996	16,900	8,390	2,470	5,920	650	1,600	1,190	23,003	$17,109
1997	17,100	8,350	2,370	5,980	560	1,570	1,150	23,036	$17,125
1998	17,400	8,370	2,450	5,880	550	1,460	1,070	24,021	NA
% Change	47.5%	29.4%	11.2%	39.0%	31.0%	19.7%	21.6%	44.1%	51.1%
Ave Ann Rate	3.3%	2.2%	0.8%	2.8%	2.3%	1.6%	1.8%	3.1%	3.8%
AAG 90-98	2.7%	3.0%	3.2%	2.6%	3.0%	0.5%	1.8%	2.9%	3.3%

Lane County

	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufact-uring	Lumber & Wood Products	Average Covered Wage	Per Capita Income
1987	NA	NA	NA	NA	NA	NA	NA	NA	NA
1988	273,700	133,900	24,100	109,800	7,500	20,900	11,500	18,411	$14,333
1989	280,800	139,400	24,200	115,200	8,200	21,400	11,400	19,003	$15,332
1990	282,900	138,000	20,100	117,900	9,100	20,700	10,200	19,588	$16,167
1991	290,800	136,300	20,600	115,700	9,600	19,000	8,700	20,687	$16,400
1992	293,700	134,900	17,700	117,200	10,700	19,200	8,300	21,564	$17,207
1993	296,800	139,200	19,000	120,200	11,300	18,500	7,900	22,098	$18,162
1994	300,800	147,400	20,800	126,600	8,500	19,400	8,000	22,511	$19,187
1995	301,900	147,700	18,100	129,600	8,200	19,500	7,600	23,222	$19,917
1996	305,800	149,600	15,700	133,500	8,200	19,900	7,400	24,173	$21,534
1997	309,500	148,500	11,700	136,000	9,000	21,400	7,300	25,117	$22,221
1998	313,000	153,900	13,400	140,500	8,600	22,200	7,100	26,126	NA
% Change	14.4%	14.6%	-44.4%	27.9%	11.4%	6.2%	-38.3%	42.0%	55.1%
Ave Ann Rate	1.2%	1.2%	-5.2%	2.2%	1.0%	0.6%	-4.3%	3.2%	4.5%
AAG 90-98	1.1%	1.2%	-4.4%	1.9%	-0.4%	0.0%	-3.9%	3.3%	4.1%

Lincoln County

	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufactur-ing	Lumber & Wood Products	Average Covered Wage	Per Capita Income
1987	NA	NA	NA	NA	NA	NA	NA	NA	NA
1988	38,600	18,030	5,050	12,980	1,170	1,680	480	$15,660	$13,094
1989	39,500	18,180	4,910	13,270	1,150	1,600	460	$16,109	$14,082
1990	38,900	18,560	4,670	13,890	1,150	1,600	470	$16,757	$15,172
1991	39,200	19,330	4,960	14,370	1,150	1,730	490	$17,707	$16,276
1992	39,600	18,890	3,830	15,060	1,460	1,660	490	$18,400	$16,801
1993	40,000	19,080	3,790	15,290	1,600	1,680	400	$18,686	$17,077
1994	41,000	19,720	3,940	15,780	1,270	1,630	370	$19,214	$17,626
1995	41,600	19,600	3,530	16,070	1,400	1,520	270	$19,966	$18,352
1996	42,200	20,080	3,410	16,670	1,620	1,470	250	$20,566	$19,011
1997	42,500	19,670	2,890	16,780	1,050	1,360	200	$21,025	$20,008
1998	43,200	19,720	2,850	16,870	1,670	1,210	180	$21,969	NA
% Change	11.3%	9.4%	-43.6%	30.0%	42.7%	-22.8%	-62.5%	34.3%	43.6%
Ave Ann Rate	1.0%	0.8%	-5.1%	2.4%	3.3%	-2.3%	-8.5%	3.0%	3.7%
AAG 90-98	1.2%	0.7%	-5.3%	2.2%	3.9%	-2.7%	-10.1%	3.0%	3.6%

Morrow County

	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufact-uring	Lumber & Wood Products	Average Covered Wage	Per Capita Income
1987	8,000	3,450	980	2,470	560	960	220	$16,950	$11,962
1988	7,800	3,180	1,030	2,150	410	820	260	$17,464	$12,682
1989	7,500	3,010	860	2,150	430	790	250	$16,473	$13,859
1990	7,650	3,540	1,170	2,370	310	950	240	$19,178	$15,340
1991	7,800	3,160	1,000	2,160	320	620	220	$20,138	$13,523
1992	8,100	3,280	1,010	2,270	400	900	200	$21,987	$13,772
1993	8,450	3,680	1,180	2,800	420	740	200	$22,433	$14,310
1994	8,600	3,570	1,130	2,440	320	730	170	$23,939	$14,186
1995	8,700	3,560	870	2,690	280	770	150	$26,123	$14,296
1996	9,000	3,720	1,000	2,720	360	840	170	$23,216	$15,485
1997	9,050	4,070	1,140	2,930	360	910	200	$25,157	$15,595
1998	9,400	3,870	810	3,060	390	910	200	$25,095	NA
% Change	17.5%	12.2%	-17.3%	23.9%	-30.4%	-5.2%	-9.1%	48.1%	30.3%
Ave Ann Rate	1.4%	1.0%	-1.6%	1.8%	-3.0%	-0.4%	-0.8%	3.3%	2.4%
AAG 90-98	2.5%	1.0%	-4.0%	2.9%	2.6%	-0.5%	-2.0%	3.0%	0.3%

Oregon Total

	Population	Total Employment	Farm Employment	Non-Farm Employment	Unemploy-ment	Manufact-uring	Lumber & Wood Products	Average Covered Wage	Per Capita Income
1987	2,689,500							$18,895	$14,260
1988	2,741,000							$19,637	$15,313
1989	2,791,000							$20,290	$16,357
1990	2,847,000	1,409,800	161,900	1,247,100	82,000	228,300	64,000	$21,321	$17,420
1991	2,930,000	1,509,800	263,300	1,244,700	90,000	211,700	56,600	$22,353	$17,090
1992	2,979,000	1,642,800	274,200	1,367,800	116,000	209,000	54,700	$23,613	$18,079
1993	3,038,000	1,596,800	287,800	1,308,400	116,000	211,500	53,600	$24,091	$19,518
1994	3,082,000	1,660,800	287,100	1,362,900	90,000	221,300	54,200	$24,799	$20,508
1995	3,132,000	1,652,700	234,300	1,418,400	86,300	228,300	52,400	$25,837	$21,618
1996	3,181,000	1,717,800	243,000	1,474,600	101,500	235,800	51,500	$27,046	$22,094
1997	3,217,000	1,727,800	201,400	1,526,400	100,600	240,600	52,000	$28,407	$23,020
1998	3,267,550	1,782,300	205,600	1,556,400	98,600	244,700	50,300	$29,040	$24,760
% Change	21.5%	26.1%	27.0%	24.8%	20.1%	11.1%	-21.4%	38.6%	73.4%
Ave Ann Rate	1.6%	2.6%	2.7%	2.6%	2.1%	1.2%	-2.6%	3.7%	4.7%
AAG 90-98	1.5%	2.6%	2.7%	2.6%	2.1%	1.2%	-2.6%	3.7%	4.0%