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# Appendix

In April 1994, after the completion of the calibration experiments described in Chapter 2 of this volume, revisions were made to the employment and travel time components of the 100-zone Portland data set. The employment data were revised so that the numbers of employees by county and Standard Industrial Classification (SIC) were equal to Bureau of Economic Assessment (BEA) estimates of employment. The BEA estimates of employment are approximately 18% greater than the levels of employment used in the base year data (1990) for the experiments described in Chapter 2.

Because of the substantial increase in the total numbers of employees, it was necessary to revise the travel time data. A new travel time matrix was estimated by assigning the revised 100-zone base year data to the Portland transportation network. The average value of the revised travel time matrix is 39.6 minutes, for the previous travel time matrix the average value is 35.1 minutes.

This appendix describes DRAM and EMPAL calibration results for the revised 100-zone Portland data set. The linked transportation and land use model sensitivity tests will use the estimated DRAM and EMPAL parameters shown in Tables 37 and 38.

## n Calibration Results for the EMPAL Model

The calibration results for the EMPAL model are shown in Table 37. These results are comparable to the results shown in Table 14 of Chapter 2. For Industrial and Wholesale/Retail employment, the two sets of calibrated parameters are quite similar. The results for Office and Services employment are quite different when compared to the results for the original employment data (Table 14). However, both sets of calibration results indicate that Office and Services employment is concentrated in the most accessible zones within the Portland region.

For the 100-zone Portland data set, larger zones (in terms of land area) tend to be less accessible (i.e., farther from the center of the region) and smaller zones tend to be more accessible. Therefore, employment types that are highly centralized will have large, negative travel time parameters and/or negative land area parameters. For both data sets, the calibrated parameters for Office and Services employment follow this pattern, indicating that both of these employment types tend to cluster near the Portland central business district.

**Table 37. EMPAL Parameters for the Portland Region<sup>1</sup>**  
(100-Zone System)

	<b>Industrial</b>	<b>Whl/Ret</b>	<b>Office</b>	<b>Services</b>
<b>Alpha - <math>\alpha</math></b>	0.5127 (42.9)	0.5359 (42.4)	-0.6654 (45.9)	0.5588 (24.1)
<b>Beta - <math>\beta</math></b>	-0.0520 (119.8)	-0.0399 (87.7)	-0.2364 (207.4)	-0.2191 (128.0)
<b>Employment</b>	0.8248 (430.8)	0.8686 (379.6)	1.0209 (275.7)	0.5629 (170.9)
<b>Total Acres</b>	0.1951 (83.5)	0.1381 (50.4)	-1.3472 (164.7)	-0.2776 (38.4)
<b>Lagged Emp.</b>	0.0000 (114.3)	0.0208 (66.2)	0.7036 (82.3)	0.7743 (45.8)
<b>R<sup>2</sup></b>	0.8531	0.8214	0.9592	0.9525
<b>Likelihood Criterion</b>	0.8628	0.8740	0.8993	0.9164
<b>MAPE</b>	103.95%	123.99%	204.69%	308.03%
<b>MAPE (Smallest)</b>	292.49%	405.67%	678.22%	1406.48%
<b>MAPE (Largest)</b>	27.81%	25.23%	30.82%	22.44%

<sup>1</sup> Asymptotic t-test shown in parentheses.

### Calibration Results for the DRAM Model

The calibration results for the DRAM model are shown in Table 38. These results are for an extended version of the DRAM model that includes a multiplicative lag term, and are not directly comparable to any of the results presented in Chapter 2. Calibration results for a DRAM model with a multiplicative lag term are shown in Table 31, but these results are for the 328-zone Portland data set. The calibrated parameters for the revised 100-zone data set are similar to those shown in Table 31.

None of the calibration experiments for the original 100-zone data set use a multiplicative lag term, but the results shown in Table 35 are for a model which includes lagged total households as an *additive* lag term. Because of this difference in mathematical structure, it is not possible to make a direct comparison of the calibrated parameters in Table 35 and the results for the revised 100-zone data set. However, the goodness-of-fit statistics for both sets of calibrations are similar, since the same set of independent variables are used in both model structures.

**Table 38. DRAM Parameters for the Portland Region<sup>1</sup>**  
 (100-Zone System, Lagged Households Included in Potential Term)

	Low_Income	Lower-Middle Income	Middle Income	Upper-Middle Income	Upper Income
<b>Alpha - <math>\alpha</math></b>	0.6060 (58.3)	0.6065 (52.4)	0.5319 (45.0)	0.6135 (54.9)	0.7276 (68.0)
<b>Beta - <math>\beta</math></b>	-0.1497 (42.0)	-0.1698 (43.7)	-0.1640 (42.8)	-0.1713 (48.3)	-0.2059 (59.4)
<b>Vacant Land</b>	-0.0358 (17.3)	-0.0275 (12.6)	-0.0195 (8.8)	-0.0097 (4.7)	-0.0025 (1.4)
<b>% Developed</b>	-0.0079 (0.5)	0.1192 (7.3)	0.1273 (7.8)	0.2300 (15.5)	0.3608 (27.1)
<b>Residential Land</b>	0.1843 (53.0)	0.2026 (49.7)	0.2173 (53.0)	0.2201 (57.4)	0.1564 (46.2)
<b>Lagged Total Households</b>	0.8018 (207.1)	0.7397 (180.9)	0.7088 (172.0)	0.6992 (180.0)	0.7302 (206.0)
<b>LIHH</b>	3.8639 (101.8)	0.6031 (13.3)	0.3936 (8.1)	-0.2163 (4.7)	-1.0928 (26.3)
<b>LMIHH</b>	0.7885 (8.1)	7.4548 (72.9)	1.3611 (13.1)	1.0161 (10.6)	-0.0268 (0.3)
<b>MIHH</b>	-2.2347 (19.9)	-1.3249 (10.1)	5.3369 (39.9)	-0.9164 (7.5)	-1.1991 (11.8)
<b>UMIHH</b>	-0.9349 (11.2)	0.5336 (5.6)	0.6972 (6.9)	5.5903 (59.1)	-0.3927 (4.5)
<b>UIHH</b>	-1.1559 (29.1)	0.6124 (15.0)	0.5367 (12.9)	0.2254 (5.9)	4.0017 (127.9)
<b>R<sup>2</sup></b>	0.9865	0.9840	0.9724	0.9608	0.9500
<b>Likelihood Criterion</b>	0.9779	0.9769	0.9672	0.9603	0.9538
<b>Avg. Trip Length (minutes)</b>	26.12	26.86	27.68	28.65	28.44
<b>MAPE</b>	15.07%	13.73%	14.54%	14.63%	17.79%
<b>MAPE (Smallest)</b>	17.49%	25.75%	24.04%	23.92%	34.81%
<b>MAPE (Largest)</b>	4.83%	7.05%	7.38%	8.11%	9.11%

<sup>1</sup> Asymptotic t-tests in parentheses.

**Map 1. Portland Metropolitan Region  
Location of Employment 1990**

**Map 2. Portland Metropolitan Region  
Location of Employment 1995  
Baseline Forecast**

**Map 3. Portland Metropolitan Region  
Percentage Change in Employment 1990 to 1995  
Baseline Forecast**

**Map 4. Portland Metropolitan Region  
Location of Employment 1995  
Convex Combinations Algorithm  
100 Load Nodes**

**Map 5. Portland Metropolitan Region  
Location of Employment 1995  
Convex Combinations Algorithm  
1200 Load Nodes**

**Map 6. Portland Metropolitan Region  
Percentage Change in Employment 1990 to 1995  
Convex Combinations Algorithm  
1200 Load Nodes**

**Map 7. Portland Metropolitan Region  
Difference in Employment Location 1995  
Convex Combinations Algorithm 1200 Load Nodes  
minus Baseline Forecast**

**Map 8. Portland Metropolitan Region  
Location of Households 1990**

**Map 9. Portland Metropolitan Region  
Location of Households 1995  
Baseline Forecast**

**Map 10. Portland Metropolitan Region  
Percentage Change in Households 1990 to 1995  
Baseline Forecast**

**Map 11. Portland Metropolitan Region  
Location of Households 1995  
Convex Combinations Algorithm  
100 Load Nodes**

**Map 12. Portland Metropolitan Region  
Location of Households 1995  
Convex Combinations Algorithm  
1200 Load Nodes**

**Map 13. Portland Metropolitan Region  
Percentage Change in Households 1990 to 1995  
Convex Combinations Algorithm  
1200 Load Nodes**

**Map 14. Portland Metropolitan Region  
Difference in Household Location 1995  
Convex Combinations Algorithm 1200 Load Nodes  
minus Baseline Forecast**

