OREGON TRANSPORTATION PLAN UPDATE
Statewide Congestion

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OREGON TRANSPORTATION PLAN
Statewide Congestion Overview

Background

The Statewide Congestion Overview is one of the products of the state congestion management system (CMS). The CMS provides information on transportation system performance related to traffic congestion. This information is intended to help transportation engineers, planners and managers develop plans and projects for managing traffic congestion.

The purpose of this report is to provide background information on statewide congestion trends and the major factors influencing those trends. Information is drawn primarily from published data sources and ODOT databases. Because the information presented is of a general nature, it is most applicable to the development of statewide policy.

This report should not be used for identifying site specific congestion problems or solutions to those problems. Detailed analysis is usually required in such situations. This report condenses a large amount of research. Readers with questions about sources or methods should consult the complete *Statewide Congestion Overview for Oregon* report.

Travel and Congestion Trends

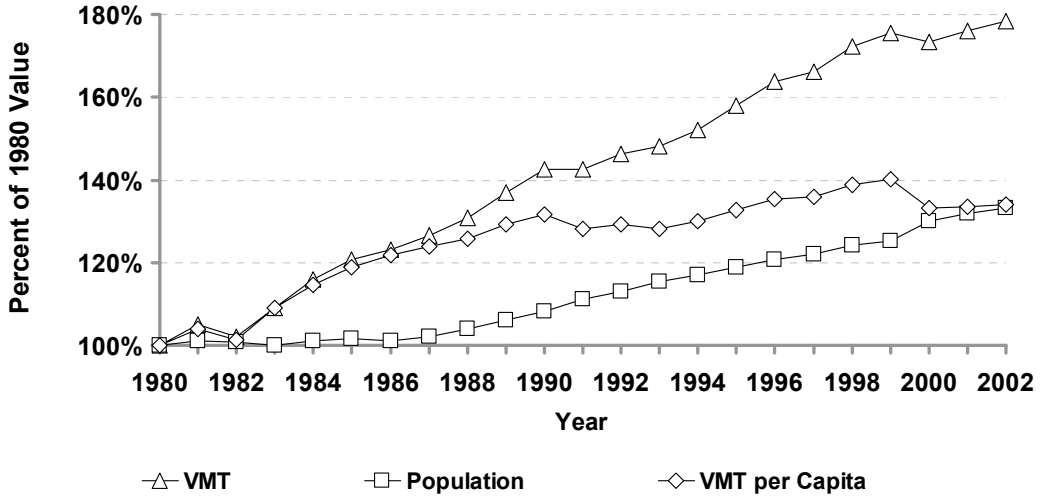
Public Perception

Public concerns about congestion are increasing. In 1990 almost 50 percent of the respondents to the Oregon Population Survey thought that traffic congestion was a small problem and less than 25 percent thought that it was a serious problem. By 2002, a third of the respondents thought that congestion was only a small problem and 29 percent thought it was a serious problem. Public attitudes reflect the growth of traffic and crowding on the road system.

Vehicle Miles Traveled

Vehicle travel in Oregon has grown almost continuously since 1980. Average vehicle miles traveled (VMT) per capita increased by about 35 percent from 1980 to 2002. Rapid growth occurred after 1982 as the state recovered from economic recession. The rate of per capita VMT growth slowed after 1990, but population continued to grow steadily. As a result, total VMT grew almost continuously, increasing almost 80 percent between 1980 and 2002 (Figure 1).

Figure 1. Statewide Vehicle Miles Traveled, Population and Vehicle Miles Traveled per Capita 1980-2002



Note: Indexed to 1980 Values
Sources: VMT - ODOT Finance Section. Population - Portland State University Center of Population Research & Census.

Traffic Growth vs. Lane-Miles

Traffic growth was not matched by growth in lane miles of the major road system (freeways and other principal arterials). From 1982 to 2002, traffic on major roads in urban areas grew about 4 times faster than the number of roadway lane-miles. On urban freeways and expressways alone, traffic grew about 6 times faster than lane-miles. On average, urban freeway lanes in 2002 were carrying almost double the amount of traffic they carried in 1982. The gap between the growth of traffic and expansion of the major road system grew faster in the Portland area than in most other large metropolitan areas in the country (populations of 1 to 3 million).[1] By 2001, peak period traffic on the major road system in the Portland area was almost enough to consume 4 hours of capacity.[2]

Travel Speeds

Peak period travel speeds on major urban roads declined as traffic densities increased. In 2001 for the Portland-Vancouver urban area, it took on average 24 percent more time per mile of travel during the peak period than during the off-peak period. Peak period travel speeds were therefore about 20 percent lower than off-peak speeds. In comparison, in Portland in 1982, it was estimated to take only 3 percent more time per mile of travel

[1] David Schrank and Tim Lomax, *The 2003 Annual Urban Mobility Report,* Texas Transportation Institute, September 2003, Exhibit A-18, p. 80. The Roadway Congestion Index (RCI) compares daily traffic volumes to lane-miles of the major road system.

[2] Brian Gregor, *Statewide Congestion Overview for Oregon*, Oregon Department of Transportation, February 2004, Appendix A, p. A-16.

during the peak period than during the off-peak period. These estimates consider the effects of everyday recurring congestion but do not include the effects of congestion due to incidents.[3]

The increase in demand on major roadways is not limited to the Portland area. Traffic congestion on major roads also increased in the Salem and Eugene-Springfield areas, although by much less than in Portland. It is estimated that it takes about 5 percent more travel time during peak times than during off-peak times, not counting the effects of traffic incidents.[4] Congestion increased in the Medford and other urbanized areas, but congestion trend measures for these areas are not currently estimated.

As congestion increases, the variability of travel speeds increases. When traffic volumes approach the capacity of a roadway, traffic flows become more chaotic and travel speeds decrease and become more variable. The potential for disruptions caused by traffic accidents or other incidents increase and the effects of incidents on delay increases. The effects can be substantial. As congestion becomes more severe, travel time becomes more unreliable and the amount of delay due to unexpected events increases.

Adding the average effects of incident congestion to the effects of recurring congestion, an estimate can be made of the total effects of congestion delay on peak period travel speeds. In the Portland area in 2001, travel during the peak period took about 44 percent more time per mile traveled if all the recurring and incident-caused delays were averaged together. This compares to the 1982 value of 5 percent more time in the peak period than the off-peak period in Portland.[5]

Incident delays are usually unpredictable and that makes peak period travel times unreliable. Travel reliability can be measured by estimating the percentage increase in the average congested travel time required to have a 95 percent confidence of on-time arrival. For Portland area freeways in 2001, this increase was estimated to be about 40 percent.[6]

Travel Time

Although average peak period travel speed in the Portland area was lower than the average for all large urban areas, the average travel time was shorter. The Portland area had among the lowest peak period travel speeds of cities in its size class. In 2001, the

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[3] Texas Transportation Institute, *2003 Urban Mobility Report: Methodology,* pp. 16-18. The Travel Rate Index (TRI) estimates of how much slower travel is on the major road system during peak times versus off-peak times. The TRI for the Portland-Vancouver urban area in 2001 was estimated to be about 1.24. The Portland area TRI in 1982 was estimated as 1.03.

[4] Ibid. The TRI values reported for the Eugene and Salem areas were 1.06 and 1.05 respectively.

[5] The *2003 Annual Urban Mobility Report* (Exhibit A-2, p. 64) includes a measure that adds the average effects of incident congestion to the effects of recurring congestion. The resulting Travel Time Index (TTI) estimates the total effects of congestion delay on peak period travel speeds. The estimated TTI for the Portland area in 2001 was 1.44. In comparison, the TTI for the Portland area in 1982 was estimated to be 1.05.

[6] Texas Transportation Institute, *Monitoring Urban Roadways in 2001: Examining Reliability and Mobility with Archived Data*, June 2003, Appendix PDX, p. PDX-9. Report is available at http://mobility.tamu.edu/mmp/reports/monitoring_urban_roadways/appendices/PDFs/portland.pdf.

estimated average peak period speed in the Portland area was about 70 percent of the off-peak speed, while the estimated average peak period speed for all large urban areas was about 78 percent of the average off-peak speed. Peak period speeds in the Portland area were therefore about 90 percent of the large urban area average.[7] On the other hand, average peak period travel times show that Portland area travelers spend relatively less time traveling. In 2001, the average peak period traveler in the Portland area spent about 148 annual hours traveling on the major road system during peak periods. The large urban area average was about 177 annual hours. Peak period travel times in the Portland area were 83 percent of the large urban area average.[8]

Travel times in the Portland area are shorter than the large area average despite slower than average travel speeds because average travel distances on major roads in the Portland area are shorter. In other words, while the major road system is more congested in Portland, people do not travel on it as far. In 2001, there were 10.8 VMT per peak period traveler in the Portland area. In comparison, the 2001 large urban area average was 12.2 VMT per peak period traveler. The average distance in Portland was therefore 88 percent of the average distance for large urban areas as a whole.

Data from the Census also show the average Portland area commute time to be shorter than the large urban area average. The average journey to work time for Portland area residents in 2000 was 24.4 minutes. This is 96 percent of the overall large urban area average of 25.3 minutes.[9]

Travel Cost

The limited increases in travel time help to limit the impacts of congestion on the Portland area economy. This can be seen by comparing estimated travel costs during peak periods with total personal income for each urban area, adjusting for inflation and cost-of-living differences. This produces a relative cost of travel. While travel time for the Portland area increased by a small amount from 1982 to 2001, relative peak period travel cost declined by a small amount. The large urban area average increased by a small amount during the same time period, but the trends for urban areas in general show that

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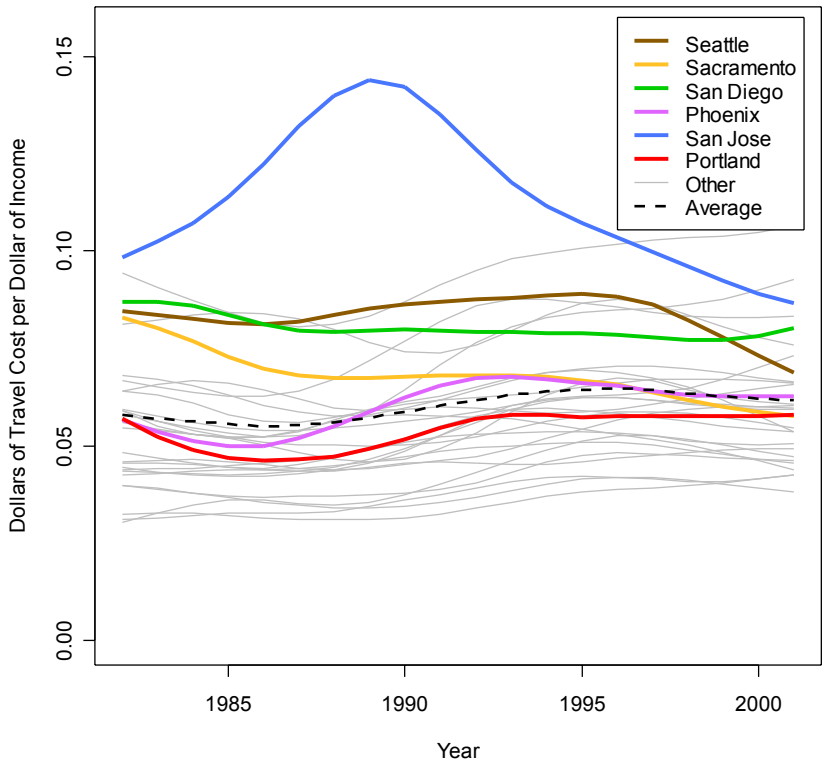
[7] From the *2003 Annual Urban Mobility Report*. The ratio of peak to off-peak speeds is 1/TTI. Since the 2001 TTI for the Portland area was 1.44, the speed ratio was 0.694. Similarly the average TTI and speed ratios for all large urban areas were 1.29 and 0.776, respectively. Since the UMR assumes the same off-peak speeds for all urban areas (60 mph freeway and 35 mph for other major roads), the ratio of average peak period speeds in Portland and all large urban areas is 0.894 (0.694/0.776).

[8] The *2003 Annual Urban Mobility Report* reports delay rather than travel time. The formula for calculating travel time from delay and the TTI is as follows: Since congested travel time-freeflow travel time=delay, and congested travel time= freeflow travel time* travel time index, therefore congested travel time = delay* travel time index/ (travel time index–1).

[9] Brian Gregor, *Statewide Congestion Overview for Oregon*, Oregon Department of Transportation, February 2004, Appendix A, Table A-5, p. A-28. The difference between the Portland and large area commute time averages is not as great as travel time difference computed from the *2003 Annual Urban Mobility Report*, but that may be due to differences in what is measured in each case. The Census journey-to-work data only addresses commutes. Also, the Census includes a larger area and reports all work trips, not just work trips on major roads in the urbanized area.

relative travel costs for most urban areas have changed little over time. This is shown in Figure 2.

Figure 2. Trends in Travel Cost for Large Urbanized Areas



Sources: Delay costs - 2003 Urban Mobility Report. CPI - Bureau of Labor Statistics (Portland area CPI). Cost of Living Index - *Sperling's Best Places*, http://www.bestplaces.net/

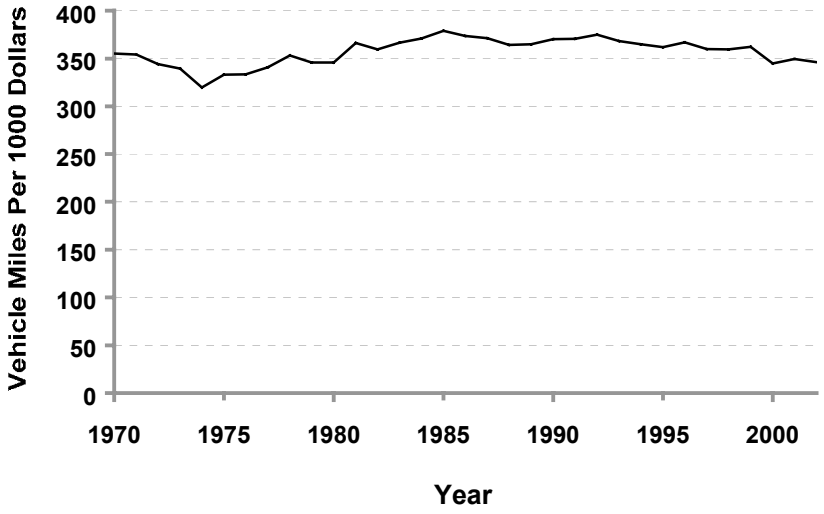
The cost of peak period travel relative to income for large metropolitan areas has not changed much despite large increases in congestion for most areas. This suggests that changes in congestion interact with other urban forces to maintain some equilibrium between the cost of transportation and economic output. This leads to a conclusion that travel and congestion need to be evaluated in an economic context.

Economic Basis of Travel and Congestion

Relationship of VMT and the Economy

Over the long run (30+ years) changes in per capita VMT have closely followed changes in Oregon's economy. Although per capita VMT has grown substantially over the past 3 decades, the average amount of VMT per job in Oregon and the ratio of VMT to total statewide personal income have not. Each job added to Oregon's economy has on average added about 15,500 VMT to Oregon's roads and highways. The ratio of total statewide income to VMT is fairly constant at about 360 miles per $1,000 (year 2000 dollars). This is shown in Figure 3.

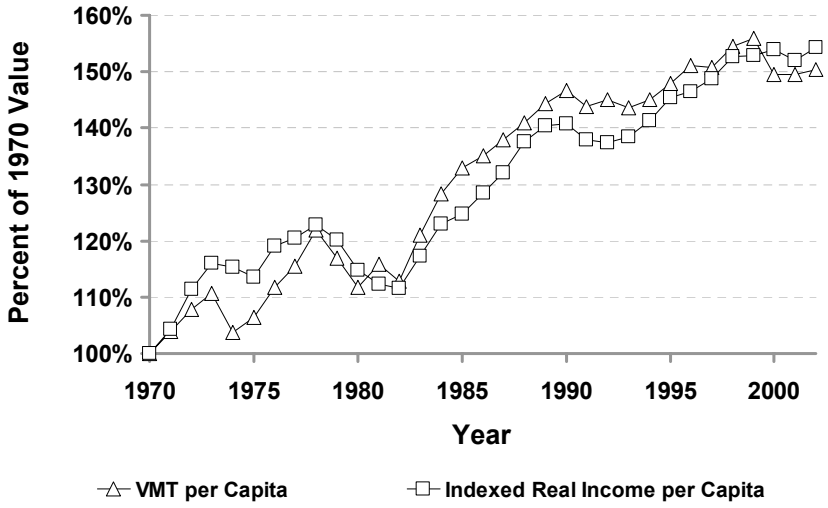
Figure 3. Average Vehicle Miles Traveled per $1,000 of Real Personal Income in Oregon: 1970-2002



Note: Year 2000 dollars.
Source: VMT - ODOT Finance Section. Personal Income - US Bureau of Economic Analysis.

The constancy of the relationship between VMT and the economy seems rather remarkable given the many changes that have occurred in the state. Increases in population account for much of the growth of the economy and travel, but increases in per capita travel also track increases in per capita incomes fairly closely (Figure 4). This relationship is not coincidental. Economic and social changes in the United States have been responsible for the growth of both the economy and travel.

Figure 4. Comparison of Per Capita Vehicle Travel and Real Personal Income in Oregon: 1970-2002



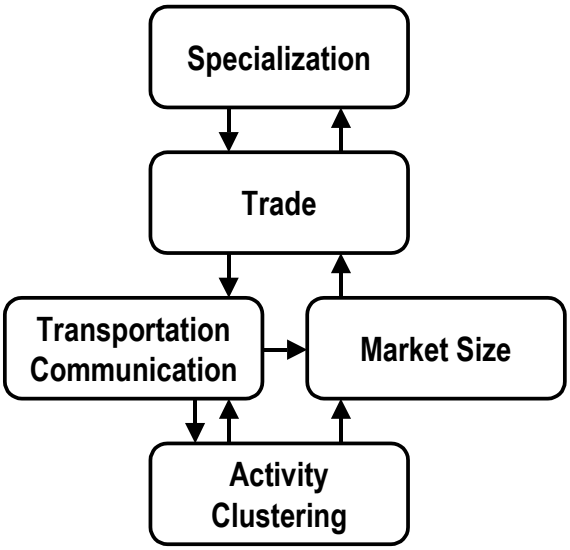
Sources: VMT - ODOT Finance Section; Income - Bureau of Economic Analysis; CPI–Bureau of Labor Statistics (Portland area CPI).

Specialization, Trade and Transportation

The connection between travel and the economy is explained by the fundamental economic principle of comparative advantage. People gain economically when they specialize in producing goods and services they can produce most efficiently and trade with others for the things that they are less efficient at producing. It is the benefits of comparative advantage that encourage people, businesses and regions to specialize. This is also why most travel and goods transport occurs. Travel and communication are necessary for trade to occur, and trade is necessary for specialization to occur.

While trade produces travel, changes to the transportation system may in turn induce trade by lowering travel costs and expanding market areas. Several researchers have estimated that past investments in highways stimulated a substantial amount of economic growth and a sizable return on investment.[10] Figure 5 illustrates the connections between specialization, trade and transportation.

Figure 5. Connection between Specialization, Trade and Transportation



The transportation system also affects the clustering of activities and that in turn affects market areas. Urbanization occurs primarily because people and businesses cluster geographically to reduce their transportation and communication costs. This increases

[10] David Alan Aschauer, *Public Investment and Private Sector Growth: The Economic Benefits of Reducing America's "Third Deficit",* Washington, D.C: Economic Policy Institute, 1990. Kazem Attaran and Philippe Auclair, "Highway Stock and Private-Sector Productivity," *Transportation Research Record 1274*, pp. 119-124. Arthur C. Jacoby, "Recent Advances in Understanding the Effects of Highway Investment on the U.S. Economy," *Transportation Quarterly*, Vol. 53, No. 3 (Summer 1999), pp. 27-34.

the size of the market for a given transportation cost and thereby increases the economic benefits of specialization and trade.

Activity Clustering and Travel

While clustering reduces transportation costs, it also increases the competition for space as space becomes a scarcer commodity. This is true for both the space available for development and the space on transportation facilities available to travelers. Increased demand for space increases the price of space for development and the travel time cost for transportation. These costs act in opposition to the benefits of clustering, so urban densities achieve a balance at the point where the benefits of additional clustering are offset by the additional costs. Changes to the transportation system influence the relative costs and thereby influence the degree of clustering that occurs.

The costs of clustering are also mitigated by a number of ways people have available to minimize the effects of congestion on travel time. These include:

- Use less congested routes.
- Travel during less congested times.
- Chain trips to accomplish more with each trip (e.g. shop on the way home from work).
- Travel to a destination requiring less travel on congested routes.
- Use a transportation mode that is less affected by congestion.
- Substitute communications for travel.
- Move to a location that requires less travel time to accomplish desired activities.

Perhaps it should not be surprising that the ratio of peak period travel costs to income for the Portland area did not change appreciably over time despite rising congestion. Increases in congestion were probably offset by the economic benefits of increased clustering and by the various strategies people used to limit the effects of congestion on travel time.

Effect of the Economy on VMT Growth

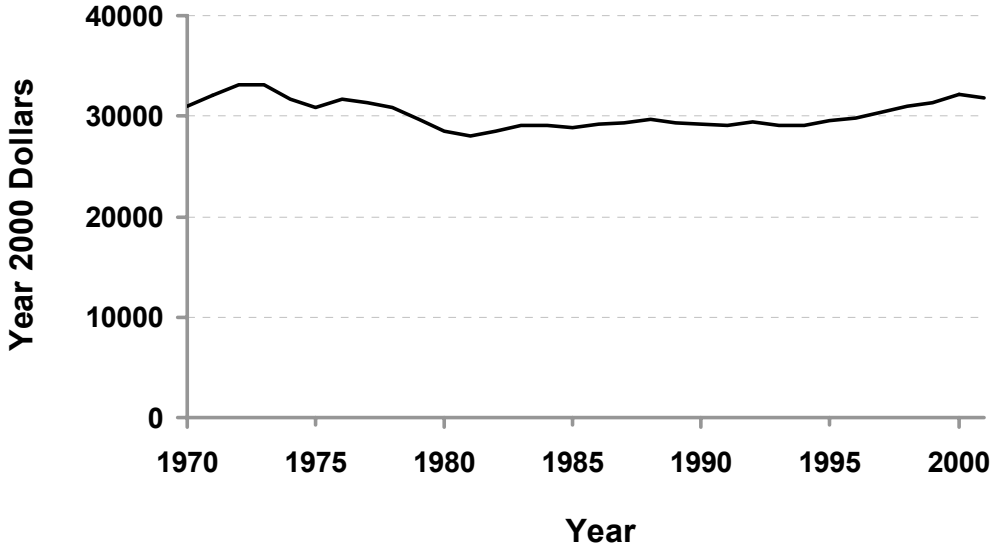
The growth of travel and the economy since 1970 are linked to demographic, social and economic changes that increased the amount of specialization, trade and economic output. The population of the state grew by 63 percent from 1970 to 2002. Job growth was even greater (128 percent) due to the entry of baby boomers and an increased percentage of women into the labor force as well as to economic factors. Households put more time into paid labor to compensate for declining hourly wages as the country lost higher paid manufacturing jobs overseas and other economic and political pressures drove hourly wages down. Households adjusted to these changes by putting a larger share of their time into specialized paid labor and buying more household products and services. This trend was also encouraged by increasing foreign trade which lowered

consumer goods prices and encouraged greater substitution of purchases for household activities.[11]

Not only are more people working today, but many are working more hours, a trend that is contrary to what has occurred in the rest of the industrialized world. According to the Harris Poll, the average number of hours spent working per week in the United States increased from 41 in 1973 to 50 in 1998 where it remained until 2002, when it dropped to 47 hours because of the recession. Workers in the United States worked an average of 171 more hours in 1998 than they worked in 1960, the equivalent of about a month's worth of work. This was accompanied by a relative decline in hourly wages in the United States compared to wages in Europe and Japan.

Households increased their working hours in part because of declining hourly wages. Average wage and salary income in Oregon has remained almost constant despite growth in working hours (see Figure 6). Moreover, the trend for most households is somewhat worse because an increased share of income goes to people in the highest income brackets. Since the 1970s, most households experienced little or no economic gain despite increasing the number of paid workers. Figure 7 shows that the median income for 4-person households in Oregon has seen no improvement over the past 30 years.

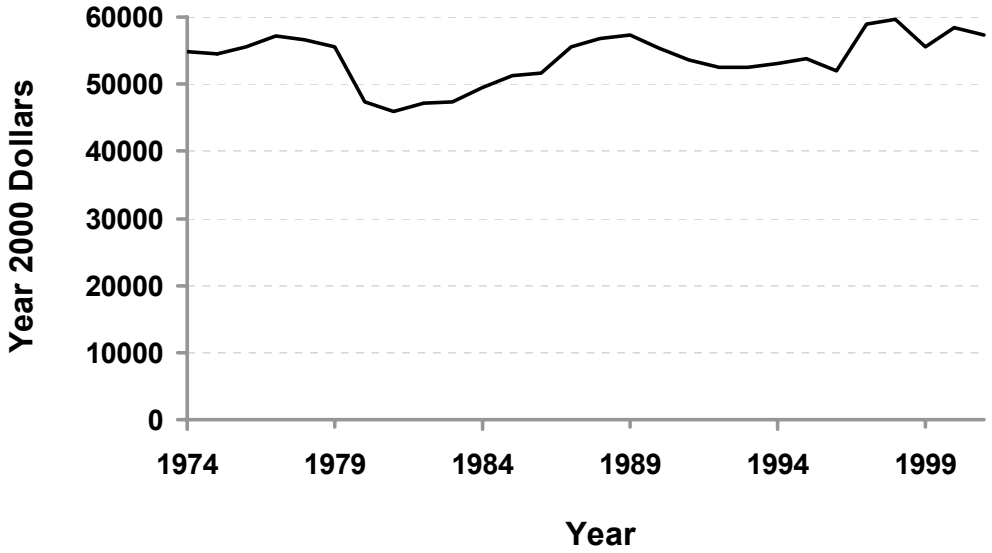
Figure 6. Average Annual Wages in Oregon: 1970-2001



Sources: Income - Bureau of Economic Analysis; CPI - Bureau of Labor Statistics (Portland area CPI).

[11] As an example, consider two different household responses to declining wages. One household decides to make more household goods to substitute for goods they formerly bought. Another household decides to work more hours to maintain household purchasing power. In general, the household that spends more time in paid labor should be better off economically because they can purchase more goods and services with their wages than they could produce themselves, i.e., most people can buy more clothes with a day's worth of wages than they can sew in a day.

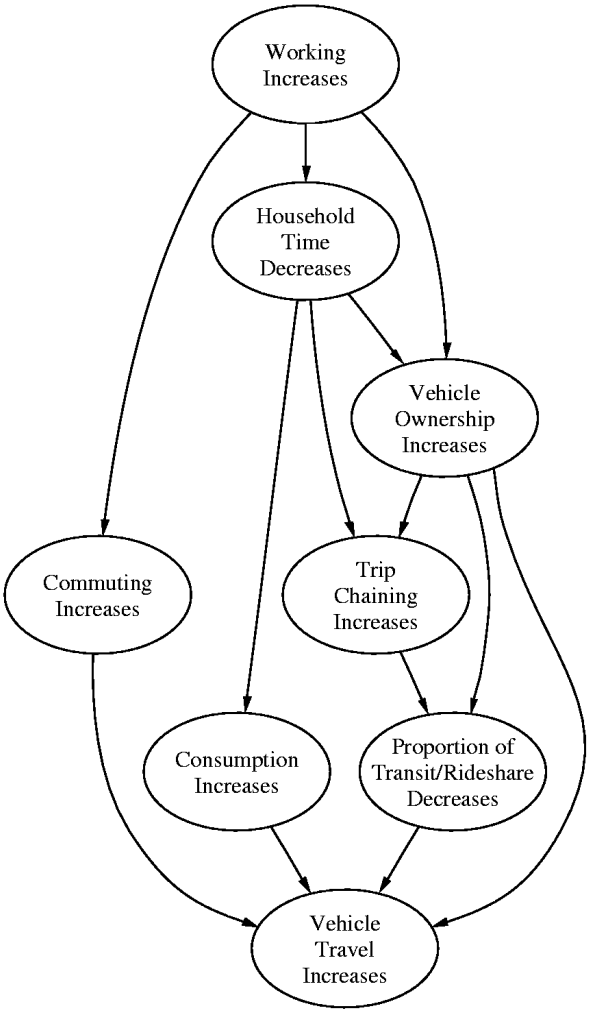
Figure 7. Median Income for 4-Person Families in Oregon: 1974-2001



Sources: Income - U.S. Census Bureau, Median Income for 4-Person Families by State. CPI - Bureau of Labor Statistics (Portland area CPI).

Households in Oregon maintain their standard of living by working more. Of course, more people working more days results in more commuting. But that is only one of the effects of increased work on travel. The larger effects result from increasing specialization and trade as households put more hours into paid labor and fewer into household labor and leisure. This has a chain of effects on travel (Figure 8).

Figure 8. Effects of Changes in Work and Consumption on Travel



Increased work hours result in less time available to do household activities such as caring for children, cooking and cleaning. From 1969 to 1987, the average time that women spent annually on household work declined by 249 hours while men's household work time increased by 151 hours, resulting in an overall decline of about 70 hours per year per adult.[12] As the average time spent on household work declined, purchases towards household services increased. Workers hire others to assume some of the care for their children, purchase more prepared foods, and purchase more cleaning and household maintenance services, among other things. For example, the number of paid childcare employees increased nationally from 190,000 to 468,000 from 1977 to 1992.[13] The proportion of household food expenditures spent on eating out increased from 26

[12] Juliet B. Schor, *The Overworked American: The Unexpected Decline of Leisure*, Basic Books, New York, 1992, p. 36.

[13] Lynne M. Casper and Martin O'Connell, *State Estimates of Organized Child Care Facilities,* Population Division, U.S. Bureau of the Census, Population Division Working Paper No. 21, March 1998, Washington, D.C.

percent in 1970 to 38 percent in 1997.[14] Nationally, per capita personal consumption expenditures doubled between 1970 and 2000.[15] More purchases resulted in more travel by households and the commercial transport sector. Truck VMT in Oregon grew at a faster rate than overall VMT. From 1980 to 2002, truck VMT doubled while overall VMT grew by 78 percent.

The increase in work and decline of household time has also increased the ownership and use of automobiles and other personal vehicles.[16] The increase in travel necessary to maintain households makes it necessary for people to economize on travel time. They do this by increasingly using private vehicles for transportation and by linking other trips with work trips. Using a personal vehicle offers considerable time savings for many people. For example, people who drive or ride in private vehicles spend, on average, half the time on their commutes as people who use public transit.[17] By using private vehicles, they can more easily combine other activities with their trips to and from work. Women workers in particular chain together work and non-work trips.[18] The increase in the number of vehicles and the increase in trip chaining has an adverse effect on the proportion of trips that involve shared rides or public transportation. All of this increases the amount of vehicle travel.

Comparison of Highway Investment and Economic Growth

Since the rates of growth of VMT and the state's economy are nearly identical, one would expect that congestion growth might have been avoided if a constant proportion of the state's economy were invested in highway expansion. This assumes that the relative costs of expansion remained constant and that expansion was done in a way that supported comprehensive plans and avoided induced travel.

The capital investment in highways since the 1960s was a shrinking proportion of the state economy (Figure 9). During the 1960s, an average of 2.5 percent of total state

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[14] Judith Jones Putnam and Jane E. Allshouse, *Food Consumption, Prices, and Expenditures, 1970-1997,* Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture, Statistical Bulletin No. 965, Table 99 – Food expenditures by families and individuals as a share of disposable personal income, 1970-97.

[15] Personal consumption expenditures in 1970 were $2,317.5 billion in 1996 dollars and population was 205,052,000. In 2000, personal consumption expenditures were $6,257.8 billion in 1996 dollars and population was 275,372,000. This equals an increase of 2.01. Source: *Economic Report of the President*, Council of Economic Advisors, February 2002, Tables B-2 and B-34.

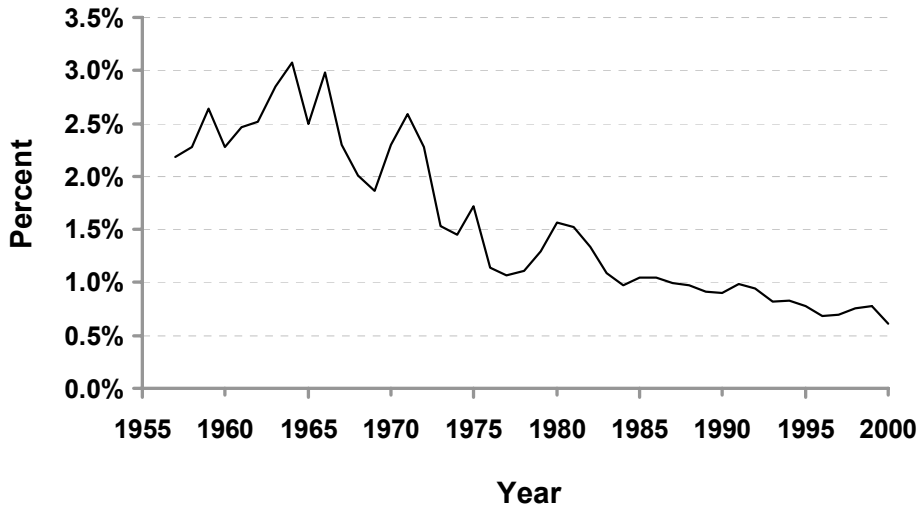
[16] From 1975 to 2001, the number of vehicles per driving-age person in Oregon increased by about 18 percent. In 1975, there were about 1,628,000 motor vehicles registered in Oregon, and in 2001 there were about 3,039,000 registered motor vehicles in Oregon (Source: *Highway Statistics*). The population 16 years and older in Oregon grew from about 1,666,000 in 1975 to about 2,633,000 in 2001 (Source: Oregon Employment Department).

[17] Patricia S. Hu and Jennifer R. Young, "Summary of Travel Trends," *1995 Nationwide Personal Transportation Survey*, U.S. Department of Transportation, Federal Highway Administration, December 1999, Figure 11, p. 43.

[18] Nancy McGuckin and Elaine Murakami, *Examining Trip-Chaining Behavior: A Comparison of Travel by Men and Women,* Federal Highway Administration, one of a series of papers published on the 1995 NPTS, npts.ornl.gov/npts/1995/Doc/Chain2.pdf.

personal income was spent on highway capital outlay. By the 1990s, the average dropped to 0.8 percent.

Figure 9. Percentage of Total State Personal Income Spent on Highway Capital Outlay in Oregon: 1957-2000



Sources: Personal Income–US Bureau of Economic Analysis; Capital Expenditures-*Highway Statistics Summary to 1995*, Table HF-202C, *Highway Statistics* reports for years 1996-1999, Table HF2.

The significance of the declining investment rate is seen in the deficit between the increase in major road system VMT and lane-miles. In general, the greater the deficit, the greater the increase in congestion.[19] Daily VMT on the major road systems of Eugene, Portland and Salem grew by 43 percent from the year 1990 to the year 2000. Over that same time period, lane-miles grew by 20 percent or 37.5 lane-miles per year. If lane-miles had grown at the same rate as VMT, an annual rate of 80.6 lane-miles per year would have been added, just over twice the actual increase. However, the investment rate in the 1990s was a third of the rate during the 1960s. If spending on capacity in the 1990s had equaled the 1960 rates, the lane-mile deficit probably would not have occurred during that time period.

Contribution of Induced Travel to VMT Growth

These findings raise questions about some popular notions regarding the causes of per capita VMT growth. Some assert that highway construction and suburban sprawl are the principal causes of rising vehicle travel. Induced travel arguments suggest that adding capacity is ineffective because it causes sprawl and induces travel growth that negates the benefits of highway expansion. This is important because transportation policies based on

[19] Schrank and Lomax, *2003 Annual Urban Mobility Report*. pp. 31-33.

the assumption that highways and sprawl cause travel growth could be very different than policies based on the belief that economic changes are primarily responsible.

The induced travel theory is that demand for travel behaves like demand for most other goods and services - if the cost goes down, people will travel more and if the cost goes up, people will travel less. Declining travel costs may increase travel by encouraging people to make more vehicle trips, make longer vehicle trips, substitute vehicle travel for riding public transportation or walking, or to spread out (sprawl) where they build their homes or businesses. This is consistent with the model shown in Figure 5.

There is no doubt among most researchers of the subject that the induced travel phenomenon is real, but there is little consensus on the magnitude of the effects of adding road capacity.[20] Research results vary widely because of varying definitions of induced travel, methods of calculating induced travel, assumptions regarding causal relationships, and limitations in the quality of the data used. Consequently, the research results cannot be directly applied to general transportation policy development or to specific transportation projects. Oregon's unique land use planning laws also make it difficult to apply research results from other areas of the country.

No induced travel studies have been done in Oregon. However, related studies and information cast doubt on the notion that induced travel and sprawl are significant causes of the growth of travel in Oregon over the past 30 years. It is expected, for example, that Oregon's strong land use planning laws have had an influence on curbing sprawl and associated increases in travel. This is borne out by an Oregon study of the effects of highway expansion on land use changes.[21]

The study compared urbanization trends in 20 Oregon cities with state highway improvements in those cities. It included in-depth case studies of highway projects and changes in land use patterns in 6 Oregon cities. The case studies examined land use changes using a variety of data and interviews with local focus groups of city and county planning staff, ODOT staff, developers and realtors. The study found that:

- Developments occurring after highway improvements were generally consistent with the comprehensive plans established before the highway improvements were made.
- None of the highway improvements appeared to be associated with annexations or urban growth boundary (UGB) expansions.
- Development of all types occurring after highway construction was dispersed throughout the communities and was not concentrated around the highway projects.
- No cases were found of major new developments occurring outside UGBs along highways that were expanded.

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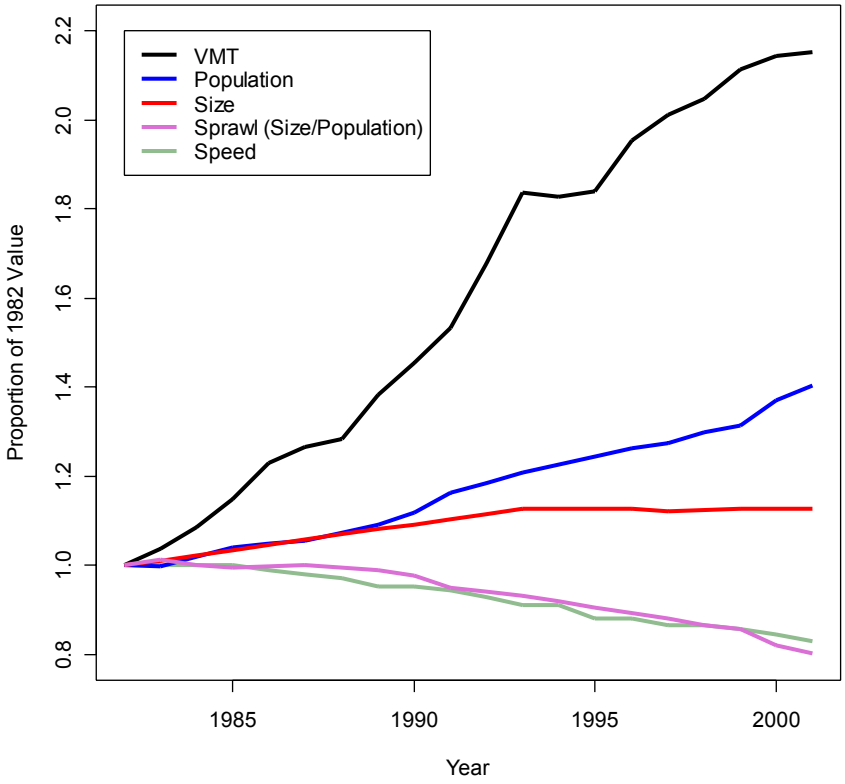
[20] For a good current overview of induced travel research findings see *Working Together to Address Induced Demand*, ENO Transportation Foundation, Washington, D.C., 2002.

[21] ECONorthwest and Portland State University, *A Guidebook for Evaluating the Indirect Land Use and Growth Impacts of Highway Improvements*, Oregon Department of Transportation, SPR Project 327, April 2001.

The sprawl and induced travel explanation of rising VMT in Oregon is also inconsistent with the theory of induced travel. The theory says that induced travel occurs when transportation system improvements reduce the cost of travel. Therefore, if induced travel occurred, evidence of increasing highway speeds would be expected. Although the number of lane-miles of the major road system in the Portland area increased by 58 percent between 1982 and 2001, travel speeds on the major road system decreased continually during that time period. The declining speed trend is shown in Figure 10.

Figure 10. Portland Area Vehicle Miles Traveled, Speed and Sprawl Trends 1982-2002



Sources: VMT & Speed - 2003 Urban Mobility Report; Size - FHWA Highway Performance Monitoring System database; Population - Portland State University Center for Population Research & Census and FHWA Highway Performance Monitoring System database.

If sprawl were a cause of rising VMT, then evidence should show that the population of the Portland area became more dispersed, but instead it became more concentrated. This is also shown in Figure 10. It does not appear likely that sprawl and induced travel due to road widening were responsible for the growth of travel in Oregon. It is more likely that the combination of population growth and increasing amounts of work were responsible.

What to do About Congestion

Highway Capacity Expansion

Increasing investment in highway capacity helps to reduce congestion. Urban areas with smaller lane-mile deficits have experienced less growth in traveler delay.[22] Congestion on major roads in Oregon has grown, in large part, because traffic has grown as the state's economy has grown, but the portion of the economy reinvested in road system expansion has declined substantially. To a large extent, the mobility that Oregonians have enjoyed has been a result of decisions made decades ago to plan for and build roads to serve future needs. Mobility has declined as surplus capacity has been used up.

The future of congestion in Oregon depends on how Oregonians plan and build road systems for tomorrow. This is not just an issue for the Portland area. It is also an issue for the smaller metropolitan areas and other urban areas that are growing rapidly. These areas need to plan for road systems that will serve the needs of future growth or they will experience future undesirable levels of congestion. They may find their economies are not large enough to offer agglomeration benefits to offset rising congestion levels.

Roadway expansion, however, is unlikely to succeed as the only approach to congestion relief. Only 5 of 75 urban areas in the country were able to keep the difference between traffic growth and lane-mile growth to less than 10 percent.[23]

There are several reasons why the lane-mile deficit is likely to continue. It is unlikely that investment levels in roadway modernization will approach past levels. This is because the public is unlikely to approve large tax increases and because a large share of future highway expenditures will go towards replacing existing aging roads and bridges. The public has also chosen to limit road expansions because of the amount of land they consume and their impacts on neighborhoods and the environment. Roads become more costly to build as urban areas grow because property values increase, more buildings must be purchased and torn down, and more expensive construction techniques must be used to reduce neighborhood or environmental impacts. Therefore, successful approaches to alleviating congestion are likely to involve the combination of roadway expansion and other complementary actions.

Operational Treatments

A variety of operational treatments can improve roadway performance and reduce congestion and its effects. The UMR evaluated the effects of 5 of these: ramp metering, traffic signal coordination, incident management programs, high occupancy vehicle (HOV) lanes and public transportation services.[24]

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[22] Schrank and Lomax, *2003 Annual Urban Mobility Report*. pp. 31-33.
[23] Ibid, pp. 31-33.
[24] Ibid, pp. 36-50.

The report found that ramp metering, which helps to maintain freeway speeds under heavy traffic loads, reduced delay by an average of about 4 percent in the 26 urban areas in the country with ramp metering.[25] Traffic signal coordination is estimated to produce an average of about a 1.5 percent reduction in arterial delay in the study areas.[26] Incident management programs are estimated to reduce freeway delay an average of 5 percent in the 56 areas that have incident management programs.[27] HOV lanes are estimated to lower delay by about 1 percent in the 8 areas that have them.[28] Public transportation services in large urban areas reduced delay by over 16 percent.[29] The total annual delay savings for the Portland area was estimated to be over 15,000 hours in 2001. That is about 40 percent of the estimated delay in the area.[30]

The effectiveness of operational treatments in reducing congestion delay depends on the extent of deployment. It is estimated that full deployment of ramp metering could reduce congestion delay by over 11 percent. Full deployment of traffic signal coordination could reduce delay by about 3 percent more. Full deployment of incident management could reduce delay by about 9 percent. The combined potential reduction from these operational strategies is about 23 percent.[31] In comparison, the 2001 level of deployment in the Portland area was estimated to produce about 7 percent reduction in delay.[32]

Rail and bus lines on separate rights-of-way reduce travel demand on highways and permit travelers to avoid congestion delays and travel with greater reliability. The Portland metropolitan area is building light-rail lines to relieve congestion in capacity-constrained highway corridors including the I-84, I-5 and US 26 corridors. Investments in public transportation in Portland appear to be successful in the growth of transit ridership and reduction of congestion delay. The last decade has seen passenger miles of travel on public transportation grow faster than VMT on the major road system (Table 1). It is estimated that public transportation services alone in the Portland area reduced congestion delay by an amount equal to about a third of the area's annual delay.[33]

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[25] David Schrank and Tim Lomax, *The 2003 Annual Urban Mobility Report: Volume 2, Five Congestion Reduction Strategies and Their Effects on Mobility,* Texas Transportation Institute, September 2003. p. 8.
[26] Ibid, p. 11.
[27] Ibid, p. 16.
[28] Ibid, p. 18.
[29] Ibid, p. 22.
[30] *The 2003 Annual Urban Mobility Report.* Exhibit A-5, page 67. Annual hours of delay are estimated to be 37,975. Delay reductions due to public transportation are estimated to be 12,820 hours annually. Delay reductions due to other operations programs are estimated to be 2,935 hours annually.
[31] *The 2003 Annual Urban Mobility Report: Volume 2, Five Congestion Reduction Strategies and Their Effects on Mobility*. pp. 24-25.
[32] See note 30.
[33] See note 30.

Table 1. Daily Portland Area Travel by Private and Public Transportation

Mode	1990 (thousands)	2000 (thousands)	Change (percent)
Public Transport (units are passenger miles traveled)	547	952	74
Bus	437	624	43
Light Rail	110	328	198
Roads (units are vehicle miles traveled)	19,398	26,254	35
Freeway	7,490	9,974	33
Other Principal Arterial	3,177	5,328	67
Other Road	8,197	10,952	34

Source: Daily passenger miles traveled computed from annual data provided by Tri-Met at http://www.trimet.org/inside/ridership.htm. Highway and road VMT from ODOT HPMS databases.

Regulatory and Policy Tools

Land use planning provides other tools for managing the effects of congestion. Zoning and other land use regulations can improve travel speeds by:

- Managing the distribution of development so that development patterns more closely match the capabilities of the transportation system to serve them.
- Facilitating the construction of collector-distributor roads to serve development and facilitate circulation between nearby land uses and reducing traffic on arterials.
- Managing the locations of access points to arterials and interchange areas to reduce the effects of driveway traffic on congestion.
- Encouraging higher density development in areas where high capacity public transportation exists or is planned.
- Planning and preserving corridors for future major road construction to improve the likelihood that roads can be built in the future when they are needed.

Still other land use policies can reduce the impact of congestion on the public by reducing the length of travel in congestion. Compact urban areas and planning that places destinations near each other can reduce trip lengths, and this can help offset the effects of rising congestion on travel time and delay. This appears to be happening in the Portland-Vancouver area. Although roadway congestion in the area has grown much faster than average for an area of its size, congested travel distances have grown more moderately, with the result that traveler delay is about average and travel times are below average.

Value pricing (also known as congestion pricing) offers another approach to managing congestion. With value pricing, special highways or highway lanes are available to road users who pay a toll which varies with the congestion level. When demand is low, the price is low, and when the demand is high, the price is high. By adjusting price in this way, the level of use is managed to keep traffic flowing smoothly. Value pricing offers

people in a hurry the option of spending money to save travel time. For example, a parent who is rushing to the daycare provider to avoid paying a dollar a minute late fee might welcome such an option. The price is set at a level that optimizes road performance. One value pricing approach tries to alleviate fairness concerns by compensating those who travel in the unpriced highway lanes with revenues generated from the priced lanes.

Another pricing approach is to replace some of the fixed costs of driving with costs that vary with the number of miles driven. For example, automobile insurance can be paid on a per mile basis rather than on an annual basis. Unlike value pricing, such programs do not vary the cost with congestion. Instead they reduce congestion by reducing vehicle travel. It is estimated that a national system of mileage-based automobile insurance could reduce driving by about 9 percent.[34] An Oregon law adopted in 2003 encourages insurance companies to offer pay-as-you-drive insurance as an option.

Alternative approaches to congestion relief are to increase highway throughput by changing the characteristics of highways in more fundamental ways. Car-only highways can be built with narrower lanes and lower clearances to increase the number of automobiles and other light vehicles that can occupy the space. This is particularly beneficial in tunnels or on structures to reduce construction costs. For example, the Cofiroute tunnels under construction in Paris double-deck 6 lanes for passenger vehicles with 10-foot wide lanes and 8.5-foot high clearances.[35] Separate truck and passenger vehicle highway lanes can also make automated highways safer and more effective. In the longer run, automated vehicle and highway systems might substantially increase highway capacities. Although the benefits could be substantial, the technical and institutional challenges are substantial as well. This is a growing area of investigation and may yield some surprising results in the next several decades.

Conclusions and Recommendations

The causes of congestion on Oregon roadways are complex. There is no single action that will reduce congestion to acceptable levels. Understanding the effects of the economy on travel and congestion is important to help target policies and limited resources towards actions that do the most good. This is also important to help avoid policies and actions that are counterproductive or that do not act in the best interests of Oregonians.

This study only addresses the economic connections at a general level. However, the following findings provide useful guidance for transportation and land use planners and decision-makers:

- ***Travel in the future is likely to grow as the state's economy grows, but the nature of economic growth may change.*** On average, every new job in Oregon adds about

[34] Aaron S. Edlin, *Per-Mile Premiums for Auto Insurance,* Institute of Business and Economic Research Economics Department Working Papers, University of California, Berkeley, CA, Paper E02'318.
[35] Peter Samuel, *How to 'Build Our Way Out of Congestion': Innovative Approaches to Expanding Urban Highway Capacity*, RPPI Policy Study 20, Reason Foundation, 1999.

15,500 vehicle miles annually. Every $1,000 increase in total state personal income adds about 360 VMT annually. As the economy grows in the future, similar changes can probably be expected. How the economy will grow may be different, however, and the social and economic changes that resulted in the shift of household time into paid labor may not continue to the same degree in the future. For example, there has been very little change in the female labor force participation rate since 1993.

- ***Congestion is expected to get much worse if economic growth continues to greatly exceed capital investment in the road system.*** To a large extent, the levels of mobility and accessibility enjoyed by Oregonians over the past 3 decades is a result of highway investments made at the beginning of that time. Since then, the rate of investment dropped and lagged growth of the economy and VMT significantly. Congestion increased as the capacity of the system was used up and not replaced.

- ***It is possible to increase the capacity of existing road space with traffic operations programs and improvements.*** Evidence is showing that operations programs such as ramp metering, incident management and traffic signal coordination can greatly reduce travel delay due to congestion and can improve travel time reliability. It is estimated that full deployment of operation programs in large urban areas can reduce delay by about 26 percent. These programs are cost effective means of reducing the impacts of congestion.

- ***Public transportation services can significantly reduce the impacts of congestion.*** It is estimated that public transportation services alone reduce delay in the Portland area by an amount equal to about a third of the area's annual delay. Public transportation offers the greatest congestion relief where it is provided on exclusive rights-of- way in congested corridors. The benefits of public transportation are increased when land development is coordinated with public transportation services.

- ***Land use policies can reduce the impacts of congestion.*** Some land use policies can help reduce congestion by making the road system work more efficiently. An example is managing the location of activities so that the distribution and routing of trips more closely matches the availability of transportation services. Other examples include developing collector-distributor roads in conjunction with land developments so that traffic can be directed to enter the arterial system where disruptions of flow will be least impacted, and managing accesses to help reduce disruptions to arterial flow. In addition, maintaining compact urban areas can reduce trip lengths so that shorter distances offset declining travel speeds.

- ***Since congestion is most likely to get worse in the future, it is important to recognize how people cope with congestion and take actions that improve their ability to cope***. Helping people reduce the impacts of congestion on their lives requires knowledge about how people manage the conflicting time demands of their jobs, households and travel. The experience of the past several decades shows that people substantially limit the effects of rising congestion on their travel time budgets through their own actions. The availability of choices allows them to shift routes,

change travel times, chain trips, change how they travel, and change where they live or work. Failure to recognize the significance of these coping strategies could result in policies that are counterproductive. For example, efforts to reduce automobile commuting need to recognize that many people (particularly working women) combine commuting and household trips to help balance the time demands of work, home, children and travel.

- ***Congestion relief should be directed towards activities that provide the most benefits to Oregonians.*** Different activities are affected to varying degrees by congestion. Congestion levels that shoppers and retail storeowners are willing to tolerate may be unacceptable to some manufacturers and other businesses. With limited dollars available to address congestion problems, it is important to do analysis that goes beyond simply estimating how vehicles are affected by a proposed improvement. It is also necessary to estimate how different households and businesses will be affected. The ability to direct congestion relief would also be improved by offering value pricing options in congested freeway corridors.

- ***Directing congestion relief requires the use of integrated transportation, economic and land use analysis tools.*** Targeting congestion relief to get the most benefit requires analysis that identifies who is likely to benefit from potential improvements and how much they will benefit. This is a significant undertaking because of the complex relationships between the economy, transportation and land use. ODOT has worked for several years to develop integrated models to be used for this type of analysis. The first generation statewide integrated model was used to analyze the economic implications of Oregon's cracked bridge problem. A second-generation statewide model permits more detailed analysis and will soon be tested for use. The regional planning agency for the Portland area (Metro) is also using a land use model in conjunction with its economic and transportation models to evaluate the effects of transportation and land use policies for the Portland metro area. It is important to continue to develop and refine better analysis tools.

Although the statistics on the growth of congestion on Oregon’s freeways and other major roads look grim, the ability of the Portland area to avoid increased travel costs relative to income is promising. Oregon cannot avoid large increases in congestion without substantially increasing investment in its major road system. However, congestion is not going to be managed successfully by road building only. Improving efficiency through operations improvements and providing alternative travel options such as public transportation are very important as well. Success will depend on how well the transportation system is planned today and whether land use and transportation systems are planned and managed to reinforce each other. Policy-makers must make careful choices about how and where resources are spent. Making effective choices requires an understanding of how travel affects people's lives and the economy and how people respond to different public policy actions.