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Research Report

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The Oregon Tax Incidence Model (OTIM)

Oregon Legislative Revenue Office and Oregon State University.

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EXECUTIVE SUMMARY

Development of an Oregon tax incidence model was directed by the 1999 Oregon Legislature (SB 5511). The decision to commit resources to creation of an incidence model is the result of policymakers' desire to improve the state's ability to analyze its tax system and proposed changes.

The Oregon tax incidence project has two primary objectives:

Provide taxpayers and policymakers with information on the overall distribution and ultimate burden of Oregon taxes.

Develop capacity to identify and quantify behavioral responses to significant changes in Oregon tax law.

With the approval of the technical advisory work group and the policy oversight committee, the Legislative Revenue Office made the decision to construct a computable general equilibrium (CGE) model jointly with Oregon State University. The outcome of this effort is the Oregon Tax Incidence Model (OTIM).

The foundation for OTIM is a CGE model of the Oregon economy. OTIM contains a description of the relationship among Oregon producers, Oregon households, Oregon government and the rest of the world. For the OTIM model, the Oregon economy has been divided into 101 distinct sectors: 29 industrial sectors, two factor sectors (labor and capital), 8 household sectors, one investment sector, 69 government sectors, and one sector that represents the rest of the world. The government sector is the most detailed in OTIM because of its focus on the impact of state government policy. The California Department of Finance provided valuable input into the construction of OTIM.

Like all economic models, OTIM results are dependent on its assumptions regarding economic behavior. The key behavioral relationships in OTIM are consumer demand, producer behavior, trade with other states and countries, investment, labor supply, migration and public infrastructure investment.

A unique aspect of OTIM is the linking of a CGE model with distribution of the tax burden. This aspect of the project benefited greatly from the work of the Minnesota Department of Revenue. OTIM estimates the total tax burden for households in each of 8 income groups. The lowest group is those below $14,525 while the highest group has income above $126,172.

OTIM shows that Oregon's state and local tax burden is distributed in a roughly proportional manner. However, the tax burden is distributed regressively at the lowest end of the spectrum and progressively at the upper end.

This report also contains simulations of proposed tax changes. These simulations demonstrate OTIM estimates of feedback effects. OTIM indicates that the largest revenue feedback effects result from changes in the corporate income tax. However, changes in personal income taxes have the largest feedback effects on overall employment.

OTIM is based on the best knowledge and data available at the state level. It is intended to provide valuable information on the economic effects of taxes and the distribution of the tax burden. Most importantly, it gives policymakers a powerful analytical tool for addressing the consequences of tax proposals for Oregon.

CHAPTER 1
INTRODUCTION

Policymakers' desire for a more sophisticated tool for analyzing Oregon's revenue system is the driving force behind the development of the Oregon Tax Incidence Model (OTIM). The origins of OTIM can be traced back to the early 1990's. This chapter discusses those origins, the process established to construct OTIM, and the decisions made regarding the approach to the project.

ORIGINS

Oregon's method and tools for analyzing its tax system were under pressure from two forces throughout the 1990's. The first was concern over "static" revenue impact analysis. This is the same criticism that led to intense discussion at the federal level and major model building efforts in Massachusetts and California. The second force was recognition of a significant shift in the legal incidence of overall state-local taxes from business taxpayers to households. (Legislative Revenue Office 1997). Oregon policymakers did not have a tool that could either analyze behavioral responses to tax changes or examine the economic incidence of taxes to determine who bears the ultimate burden. The 1999 Legislature, in agreement with the Governor, set aside funding for a tax incidence model.

In 1995, the Department of Administrative Services (DAS) established a work group in conjunction with the Legislative Revenue Office (LRO). The purpose of the work group was to examine the efficacy of dynamic revenue analysis in Oregon. The report focused on the different methods of incorporating both primary and secondary feedback effects brought about by tax changes. Primary feedback effects are behavioral adjustments made by taxpayers who actually pay the tax. Secondary feedback effects are the impacts of the tax change in all other markets.

The work group report concluded that approaches adopted by states to analyze feedback effects varies from informal *ad hoc* efforts to the construction of computable general equilibrium (CGE) models. At the time the work group report was issued (April 1996), California's CGE, known as DRAM (Dynamic Revenue Analysis Model) was in final review. The work group concluded that the CGE approach was the most theoretically sound, but the most resource intensive. It was recommended that the California experiment be monitored closely. The Interim House Revenue Committee, concerned about costs and an uncertain product, decided to take a wait-and-see approach.

In the fall of 1997, Governor John Kitzhaber, appointed a team of experts to review Oregon's overall tax system and the changes it had undergone over the past twenty years. The tax review process consisted of two groups. The first group was charged with documenting major changes in the tax system and posing the relevant policy questions for policymakers. The second group's task was to make policy recommendations. The first group was called the Technical Advisory Committee (TAC). The second group was referred to as the Policy Advisory Committee (PAC). The TAC's final report was issued in June of 1998. The PAC report came out in January 1999.

The TAC report reviewed Oregon's tax system in terms of stability, equity and overall policy goals. The TAC report addressed tax incidence in the context of changing shares of household and business taxes:

"The shift in the tax burden from business to households reflects only the initial incidence of taxes, not any passing through of taxes from business to individuals. An economic incidence study would more fully address the implications of this shift." (Governor's Tax Review Technical Advisory Committee, p. 33).

The TAC went on to recommend the establishment of a periodic tax incidence report. Such a report would facilitate tax policy development by giving policymakers "a better understanding of equity and business competitiveness issues…". (Governor's Tax Review Technical Advisory Committee, p.2)

The PAC also recommended developing the technical capacity to do a tax incidence report. The PAC was very concerned about the stability implications of Oregon's increasing dependence on the highly elastic personal income tax. It was in the context of examining alternative revenue proposals; particularly those aimed at diversifying Oregon's revenue base, that the PAC recommended a tax incidence model.

"A well-designed objective tax incidence study would be a valuable tool for policymakers. It would be especially helpful in analyzing major tax proposals. An incidence analysis should be used when considering a number of the long-term alternatives discussed in the appendix of this report." (Governor's Tax Review Policy Advisory Committee, p. 13)

In response to the study group recommendations, House Bill 3443 was introduced in the 1999 legislative session. This measure established a task force to oversee the development of a tax incidence model. The bill specified legislative and executive branch membership on the task force. HB 3443 provided for an appropriation of $300,000 for purposes of "acquiring a full tax incidence model." The measure passed the House Revenue Committee with a referral to the Ways and Means Committee due to its budgetary impact.

Pressure to take feedback effects into account when estimating the revenue impact of proposals continued to build throughout the 1999 legislative session. This was most pronounced in the case of Senate Bill 1275. Originally this measure changed Oregon's three-factor apportionment formula for corporate income tax purposes to one based solely on the sales factor. It was modified to maintain the three-factor approach but raise the weight given to sales from 0.5 to 0.8. Proponents argued that this change would encourage capital investment thereby producing significant revenue feedback effects. Although the measure carried a negative revenue impact estimate it passed both houses of the Legislature. However, the Governor vetoed SB 1275.

Although HB 3443 did not become law, the tax incidence project was revived in the final budget negotiation process between legislative leadership and the Governor. A reservation of $300,000 was set aside for the Legislative Revenue Office to acquire a tax incidence model.

APPROACH

The tax incidence project addresses two sets of policy-maker demands. The first is the desire to incorporate feedback effects into revenue impact analysis. The second is to trace the effects of taxation down to its ultimate burden. A comprehensive tax incidence model has the capability of addressing both of these issues.

The Oregon tax incidence project has two objectives:

Provide taxpayers and policymakers with information on the overall distribution and ultimate burden of Oregon taxes.

Develop capacity to identify and quantify behavioral responses to significant changes in Oregon tax law.

Two approaches were identified within the project budget constraint. The first is a micro-simulation approach. The second is a general equilibrium approach. Both approaches could potentially be contracted out or developed in-house.

The micro-simulation approach is based on a sample of taxpayers. A critical element of this approach is the merging of databases to link major taxes. In Oregon's case, this means personal income and property taxes. Oregon currently has a personal income tax micro-simulation model.

The general equilibrium approach requires either the purchase or construction of a model of the Oregon economy. The general equilibrium approach specifies product and resource markets and how they interact.

A survey of other states shows that both approaches are in use. Minnesota, Michigan, Indiana, Nebraska, New York and Texas are all identified as states that make use of micro-simulation models. Following an extensive study in 1996, Michigan decided to invest in micro-simulation models rather than develop a general equilibrium model of the Michigan economy.

Minnesota is the most advanced in using a micro-simulation model to produce tax incidence results. A 1990 state law directed the Minnesota Department of Revenue to publish a tax incidence study every two years. The Minnesota report distributes all state and local taxes by income decile. Tax shifting assumptions are based on the economic literature.

The first state to make a concerted effort to develop a general equilibrium model was Massachusetts in 1992. The project linked micro-simulation models to a general equilibrium model. The general equilibrium model was developed by REMI. The Massachusetts model has received mixed reviews and is only used on an infrequent basis.

California has made the most extensive effort to develop and maintain a general equilibrium model. In 1994 the California Legislature statutorily directed the Department of Finance to acquire the capacity to incorporate dynamic feedback analysis for tax bills. The model is used for all measures that show a static revenue impact of $10 million or more on an annual basis. The California general equilibrium model has become a standard part of revenue impact analysis. The model continues to be refined and updated.

The objectives of the Oregon tax incidence project dictate using a general equilibrium model approach. Micro-simulation models provide valuable information on distributional effects and they have the advantage of being highly intuitive. Legislative Revenue Office currently uses micro-simulation models to estimate static revenue impacts of proposed tax law changes. However, micro-simulation models are not designed to incorporate behavioral responses to tax changes.

OTIM is designed to address both distribution effects and behavioral effects of tax changes.

In this report, the term "dynamic revenue analysis" refers to the use of an equilibrium-based economic model to estimate the revenue impact of a tax change, including the behavioral adjustments made by producers and consumers in response to the change. These behavioral responses generally run counter to the direction of the tax change. So a tax increase will generally net less revenue than a "static" estimate (ignoring behavioral change) would indicate, and vice versa. This type of analysis is not "dynamic" strictly speaking because it doesn't explicitly chart the discrete time path of optimal economic changes. Rather it uses a comparative static-type model to take a "snapshot" of the economy at the baseline equilibrium (supply equals demand in all markets simultaneously) and again after producers and consumers have altered their behavior and the economy has moved to a new equilibrium. Comparing these two snapshots produces an estimate of the change in revenues and other economic variables due to the tax change.

"Distributional impact" refers to the changes in the distribution of income among the eight household income groups due to the tax change and resulting behavioral adjustments. These are a specific subset of the variables produced by the model. Households participate in the economy as owners of capital (shareholders), suppliers of labor (employees), consumers of goods and services, and as recipients of

government transfer payments. Many households participate in all four capacities. The impact of a tax change on a household is the net effect of changes in a combination of disparate economic variables. Comparing the net economic circumstances of the eight household groups before and after the tax change provides the estimate of the change in household income distribution.

PROCESS

Both the Massachusetts and California general equilibrium models were funded in the context of declining regional economies. They were seen as a way of evaluating proposals designed to stimulate state economic growth. The policy context in Oregon is quite different. While the desire to evaluate potentially stimulative tax proposals is clearly present, Oregon's strong economic performance in the 1990's has muted these concerns. The policy pressures driving Oregon to develop a tax incidence model are broader and more eclectic than the forces at work in early 1990's Massachusetts and California.

This broader set of demands suggests that the tax incidence model should be able to produce traditional tax burden distribution results such as those coming from the Minnesota tax incidence report as well as the behavioral feedback effects produced by the California model. It also suggests that the Oregon project would benefit from extensive input from policymakers during the development stage.

A structure was designed to facilitate input from policymakers and advice from technical experts. This structure has three elements. The project structure is shown in Table 1-1.

Table 1-1: Oregon Tax Incidence Project Structure

Tax Incidence Project Oversight Committee

Membership

- Four Legislators (two each from House and Senate)
- Governor's Office
- Department of Revenue
- Umbrella Organizations (Industry, Labor)

Role

- Give overall project direction
- Set project scope
- Review draft report
- Explain incidence tool to policy makers

Model Review Work Group

Membership

- Individuals from academia, public interest groups and state government with expertise in tax theory and economic modeling.

Role

- Review model assumptions and structure
- Suggest alternative approaches, assumptions and data
- Review draft report

Model Building Team

Membership

- Legislative Revenue, Revenue Department, Department of Administrative Services and University faculty, supplemented by outside consultants.

Role

- Construct and test tax incidence model.
- Prepare report
- Explain structure and workings of model.

The first component of the project structure is a project oversight committee. This committee consists of four legislators (two from each chamber and two from each party). It also has a representative from each of the following: the Governor's office, the Department of Revenue, industry and labor. The primary functions of the project oversight committee are to give overall direction, set project scope, establish criteria for using OTIM and review the draft report. Another important role for the committee is to build a knowledge base among policymakers as to what OTIM is and what information it is capable of providing.

The second major element of the project structure is a model review work group. This group consists of individuals from academia, public interest groups and state & local government. Members have expertise in tax theory and economic modeling. The functions of the work group are to review model assumptions and structure, suggest alternative assumptions, approaches and data and finally to review the draft report.

The first major decision of the review groups was project approach. There were two elements to this decision. The first involved approving the decision to use a general equilibrium approach over a micro-simulation model. Both groups had strong interest in modeling behavioral feedbacks. This dictated the choice of a general equilibrium model.

The second major decision involved resource allocation. The general equilibrium model could either be contracted out to a consulting firm such as REMI or a model could be designed using resources within the state. The committees agreed on the latter choice for two primary reasons. The first reason was concern over "black box" solutions. Given the complexity of tax incidence and sensitivity over distribution issues,

the committees emphasized the importance of local understanding of the model and its limitations. Secondly, considerable CGE expertise exists within Oregon, both within the LRO and at Oregon State University (OSU). Based on oversight committee approval, an interagency agreement to build a CGE model was reached between LRO and OSU.

A model building team was formed by OSU and LRO to construct the model and report back to the review committees. The model building team is augmented by additional CGE expertise from Washington State University and Ohio State University. The model building team's major tasks were:

Design and build an Oregon CGE model.

Develop a detailed public finance sector.

Develop a detailed household sector that allows for distribution of the tax burden by income group.

The model building team has the advantage of having the California DRAM model to use as a prototype (Berck, Golan and Smith 1996). While there are significant differences between the Oregon and California economies, the California experience provides a very useful starting point.

This is the first report to the Legislature based on OTIM analysis. It is intended to provide valuable information on the economic effects of taxes and the distribution of the tax burden. Most importantly it gives policymakers a powerful analytical tool for addressing the consequences of tax proposals for Oregon. It will not however, provide the answer to the best tax system for Oregon. That issue will continue to be debated for a long time to come.

CHAPTER 2
MODEL DESCRIPTION

Dynamic analysis of the effects of Oregon taxation requires a comprehensive model of the Oregon economy. The model needs to track income of individuals and firms since this is the basis for income taxation. It needs to track sales of goods and services since this is the basis of the sales, excise and insurance taxes. But, to be dynamic, it needs to do more than that. It must account for the effects of taxation on the economy's use of labor and capital. A computable general equilibrium model (CGE) is a model that does all of these according to the basic economic principle that quantity supplied is equal to quantity demanded at a particular price. It is called "computable" because, rather than calculating algebraic solutions, a computer is used to find specific numeric solutions to questions posed to the model. It is called "general" because all markets and all income flows are included in the model. And it is called an "equilibrium" model because prices in the model adjust to make the demand for and supply of goods, services, and factors of production (labor and capital) equal. The Oregon Dynamic Tax Incidence Model (OTIM) is a CGE model for making dynamic revenue estimates.

A DESCRIPTION OF CGE MODELS

A Oregon CGE model is a description of the relationship among Oregon producers, Oregon households, Oregon government, and the rest of the world. However, before the relationship between the different agents in the economy can be examined, the relevant agents for revenue analysis must be identified. The model cannot include an accounting of every individual producer, household, or government agency in the economy. To provide focus to the model, agents must be aggregated into sectors. This first step of model construction is described in the next section. This discussion is followed by a description of the key agents in the economy: households and producers.

AGGREGATION

The OTIM, like all other empirical economic models, treats aggregates rather than individual agents. This is done both to provide focus for the analysis and contain the number of variables in the model. Aggregation or sectoring is an important element in the development of any intersectoral CGE model because it determines what flows the model will be able to trace explicitly. For OTIM, the Oregon economy has been divided into 118 distinct sectors: 29 industrial sectors, 8 consumption commodity aggregates, 2 factors of production (labor and capital), 8 household groupings, one savings-investment sector, 61 government revenue items, 7 government spending sectors and one sector representing the rest of the world.

For the industrial sectoring, a grouping of firms, all of which make similar, though by no means identical, products is called a sector. Thus, all firms producing agricultural plant products are grouped together. The value of all Oregon "crops" is added together, and this is the value of output for the Crops agricultural sector. The total use of labor by the agricultural sector is added together, and this is the sector's labor usage. There are 28 other such industrial aggregates in the model. These represent the major industrial and commercial sectors of the Oregon economy, though a few are designed to capture special tax situations. The most extreme example is the "Petro" sector. Oregon does not have a petroleum production or refining industry but taxes on gasoline generate considerable revenue for the State and so the model gives special attention to the use of petroleum products in the Oregon economy.

Data for the industrial sectors originated with the Bureau of Economic Analysis (BEA) of the U.S. Department of Commerce, based on the Census of Business — a detailed survey of companies conducted in the United States every five years. In this survey, information is gathered about the purchases of intermediate goods, payments to factors (labor, capital, land and entrepreneurship), and taxes. Although the survey is quite extensive, it yields only enough detail to be able to make inferences about groups of firms at the national level. In addition, the most recent survey available was made in 1992. The conversion of national data to updated Oregon data is accomplished by Impact Analysis for Planning (IMPLAN)[1]. The IMPLAN software package utilizes annual U.S. Bureau of Labor Statistics price deflators and state-level employment data to scale the 1992 national-level industrial data down to the state level for a given year. To check IMPLAN estimates of employment, independent estimates of employment by sector from covered employment[2] (ES-202) data were compared with IMPLAN estimates of employment. In cases where the IMPLAN estimate diverged from the ES-202 estimate, the IMPLAN estimate was adjusted to be consistent with the ES-202 estimate.[3] Output and value added in those sectors were adjusted proportionally. In this way IMPLAN data was used to arrive at a reasonable approximation of 1997 economic conditions.

Like firms, households are also aggregated. Oregon households were divided into categories based upon their income. There are eight such categories in the model, representing the full range of household income in Oregon from the lowest income households to the very highest income households. Thus, the income from all households in the lowest bracket is added together and becomes the income for the lowest household. Similarly, all expenditure on agricultural goods for these households is added and becomes the expenditure of the lowest household on agricultural goods. The total expenditure on agricultural goods is found by adding the expenditures of all households together, and similarly for the remaining goods and services in the model. Data for income come from the Current Population Survey (CPS) for Oregon by the U.S. Bureau of Census, while data on consumption by income come from the national Consumer Expenditure Survey (CES) by the Bureau of Census.

The government sectors in OTIM are organized so that both government revenue flows and expenditure flows can be traced explicitly. The OTIM includes 69 government sectors: eleven federal, 33 state, and 25 local. Data for the government sectors come from published federal, state, and local government reports, especially the State and Local Government Finance Series produced by the U.S. Bureau of the Census, Oregon Personal Income Tax Annual Statistics from the Oregon Department of Revenue, and the Governor's and Legislature's biennial budget documents produced by State of Oregon.

PRODUCERS AND HOUSEHOLDS

The beginning point for the description of the Oregon economy and, hence, the Oregon CGE model is the relationship of the two major types of agents: producers and households.

Producers, also known as firms, are represented in the model as aggregates or sectors, where each sector is treated as a representative firm. For instance, all of Oregon's crop agricultural crop output is treated by the model as if it came from a single entity. Each of these sectors or producers treats the prices that it sells

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[1] IMPLAN is a microcomputer-based system originally developed by the U.S. Forest Service for constructing regional economic accounts and input-output tables. It is currently updated and maintained by Minnesota IMPLAN Group, Inc., 1725 Tower Drive West, Suite 140, Stillwater, MN 55082. www.implan.com

[2] 1997 Oregon Covered Employment and Payrolls, State of Oregon, Employment Department, Research and Analysis, ES-202 Program, 875 Union St., NE, Salem, OR 97311 (503) 947-1248.

[3] Significant adjustment was done in one case, IMPLAN Sector 505: Religious Organizations. IMPLAN estimates of Oregon employment and payroll were more than double ES-202 totals for this sector.

its product (e.g., agricultural products) and the prices that it pays for its inputs (capital and labor, called "factors of production," and goods and services purchased from other firms (called "intermediate goods") as fixed. This is the assumption of perfect competition. The producers do not believe that their decisions have an effect on prices. Each producer is assumed to choose inputs and output levels to maximize profits. Thus the producer's supply of output and demand for inputs are a function of price.

Households make two types of decisions. They decide to buy goods and services. They decide to sell labor and capital services. They are assumed to make these decisions in the way that maximizes their happiness (called "utility" in the economics literature). Like the firms, they take the prices of the goods that they buy and the wage of the labor that they sell as fixed. Their supply of labor, as a function of the wage rate, is called the "labor-supply function." Their demand for goods or services, as a function of prices, is called, simply, the "demand function." In addition to their labor income, households receive dividends and interest from their stocks and bonds and other ownership interests in capital, and transfer payments from government and other households.

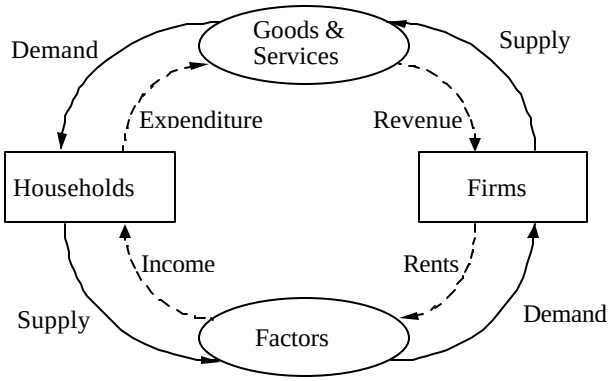
EQUILIBRIUM

So far, two types of agents have been described: firms and households. It remains to be explained how these agents relate. They relate through two types of markets: factor markets and goods-and-services markets. Firms sell goods and services to households on the goods-and-services markets. Households sell labor and capital services to firms on the factor markets. There is a price in each of these markets. There is a price for the output of each of the 29 sectors. There is a price for labor, called the "wage," and a price for capital services, called the "rental rate." Equilibrium in a market means that the quantity supplied (which is a function of price) is equal to the quantity demanded (which is also a function of price) in that market. Equilibrium in the factor markets for labor and capital and in the goods-and-services markets for goods and services defines a simple general equilibrium system. That is, there are 31 prices (the wage, the capital rental rate, and one for each of the 29 goods made by the 29 sectors) and these 31 prices have the property that they equate quantities supplied and demanded in all 31 markets. They are market-clearing prices.

These relationships are shown in more detail in the figure below, called a "circular-flow diagram." The outer set of flows, shown as solid lines, are the flows of "real" items, goods, services, labor, and capital. The inner set of flows, shown as broken lines, are the monetary flows. Thus, firms supply goods and services to the goods-and-services market in return for revenues that they receive from the goods-and-services buyers. Firms demand capital and labor from the factor markets and in return pay wages and rents to the factor owners.

Households, the other type of agent in a simple model, buy, or in economic parlance, demand, goods and services from the goods-and-services markets and give up their expenditure as compensation. They sell capital and labor services on the factor markets and receive income in exchange.

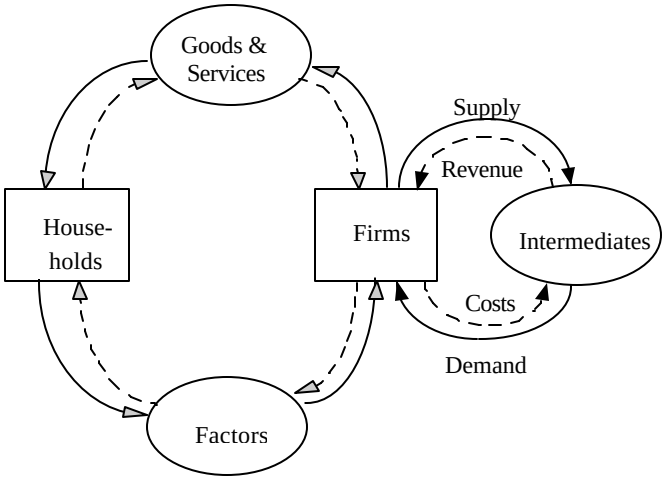
Figure 2-1.The Basic Circular-Flow Diagram



INTERMEDIATE GOODS

The economy of Oregon is far more complex than that shown in the figure above. There are not only final goods-and-services markets but also intermediate goods markets in which firms sell to firms. A typical example of this would be chemicals sold to agricultural firms. The final output of the chemical industry (perhaps fertilizer) is said to be an intermediate good in the agricultural industry. This type of market is demonstrated in the figure below. Here, part of the supply of a firm (chemical industry in the example) is not sold to households but rather to another firm in exchange for revenue. From the other firm's point of view, it buys an input to production from a firm rather than from a household. The expense of buying the input is a cost of production.

Figure 2-2. The Circular-Flow Diagram with Intermediate Goods

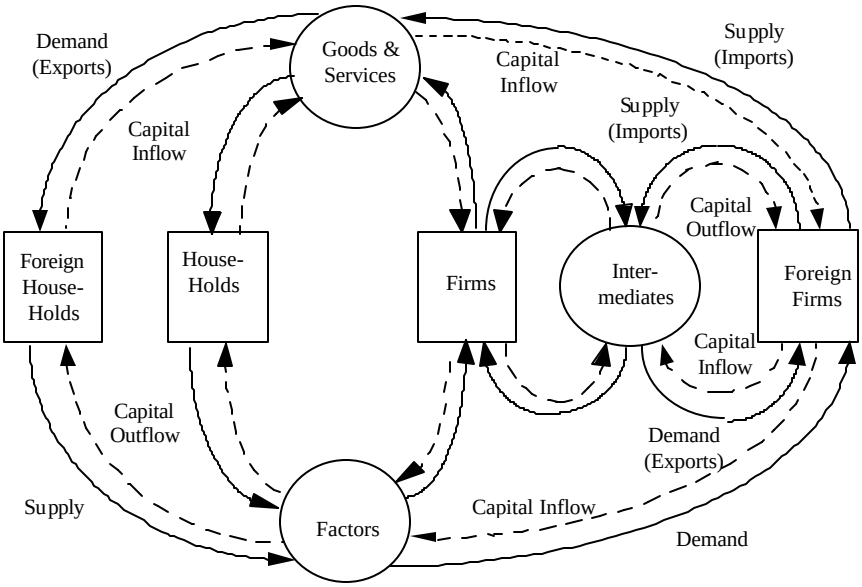


REST OF THE WORLD

Oregon is an open economy, which means that it trades goods, services, labor, and capital readily with neighboring states and countries. In this model, all agents outside Oregon are modeled in one group called "Rest of World." No distinction is made between the rest of the US and foreign countries. Oregon interacts with two types of agents: foreign consumers and foreign producers. Taking the producers first, the figure below shows that the producers sell goods on the (final) goods-and-services markets and on the intermediate markets, i.e., they sell goods to both households and firms. The model assumes these goods are imperfect substitutes for the goods made in Oregon. For example, agricultural products from outside of Oregon (e.g., feed grains, bananas) are taken as being close, but not identical to, Oregon-grown

products (e.g., wheat). Oregon agricultural products can substitute for some but not all of the imported agricultural commodities, and vice versa. The degree to which foreign and domestic goods substitute for each other in the model is determined by trade (price) elasticities and is very important (see Elasticity Experiments section).

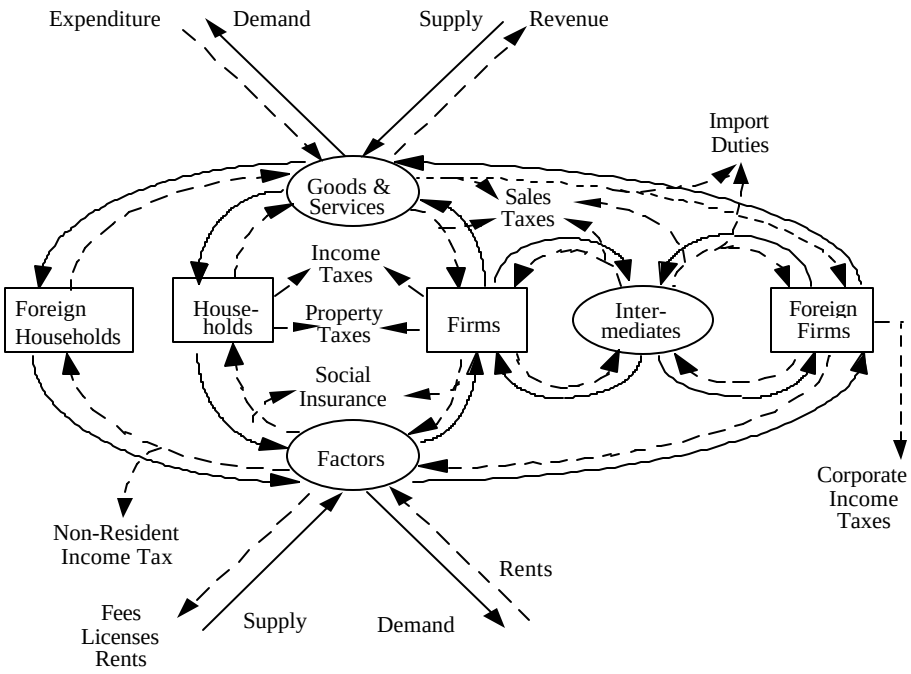
Figure 2-3. The Circular-Flow Diagram with Intermediate Goods and Trade



GOVERNMENT

Finally, government is considered. Combining the taxing and spending effects of the three levels of government (federal, state, and local) gives the additional flows in the figure below. Beginning at the top, the figure shows that government buys goods and services and gives up expenditure. It supplies goods and services for which it may or may not receive revenue. Government also supplies factors of production, such as roads and education. The model does not currently include goods such as K-12 education as such goods are not always traded in organized markets. Government also makes transfers to households, which are not shown in the diagram. The middle section of the diagram shows the myriad of ways in which government raises revenue through taxation.

Figure 2-4. The Complete Circular-Flow Diagram



REGIONAL AND NATIONAL MODELS

There have been hundreds of CGE models built and used for analyzing public policy at the national and international level. Regional, or sub-national, CGE models are very similar in design to national and international models, but exhibit major differences in several key assumptions. The seven most important differences between national and regional CGE models are discussed below.

The first, and maybe most important, difference is that regional CGE models do not require that regional savings equal regional investment. When Oregonians save more than Oregon investors want to use, excess savings flow out of the state. When the reverse is true, savings flow into the state. Rational economic agents would not accept less interest on their savings from Oregon investors if higher interest rates were available in other states or countries. Conversely, rational investors in Oregon would not pay higher interest for the use of Oregonian savings if other states or countries offered lower rates.

The second difference is that regional economies trade a larger share of their output. Therefore, trade is more important in regional models. Note that interstate trade is part of the Rest of World for Oregon but ignored in national considerations of trade.

The third difference is that regional economies face larger and more volatile migration flows than nations. Regional and international migration to Oregon is a major factor in the State's economy.

The fourth difference between national and regional CGE's is that regional economies have no control over monetary policy. The Federal Reserve is responsible for monetary policy and is a national institution.

The fifth difference is that in regional models taxes are interdependent through deductibility. Some local and state taxes are deductible from incomes subject to federal personal income tax and may be eligible for deduction from corporate incomes for federal purposes. In OTIM, the personal tax deductibility is

explicitly modeled. Since corporate deductibility is more uncertain and since the apportionment rules may reduce the connection to federal corporate taxes, corporate deductibility has not been included in OTIM.

Sixth, while good data for a CGE are hard to find at the national level, in many cases they are nonexistent for regional economies. The OTIM uses published economic and statistical literature to simulate much of the data important to our model. In some cases, such as labor supply, a wide variety of results is presented in the literature. This problem is addressed in three ways: (1) values are chosen so as to avoid the extremes, (2) the model is tested to determine the degree to which results are dependent upon our assumptions (this process is called "sensitivity analysis"), and (3) the use of published literature, especially of national results, has been minimized.

Seventh, the Oregon CGE differs from a national CGE in that Oregon faces a balanced-budget requirement. Even if this constraint were ignored in the short run, bond markets would tend to reflect this fact. Ultimately, Oregon would face unreasonable borrowing costs should it decide to maintain borrowing in excess of revenues.

OTHER CONSIDERATIONS

The CGE models are not forecasting models; they are calibrated to reproduce a base year. In the case of OTIM, the model is constructed to exactly reproduce the economic conditions of Fiscal Year 1996/97. Of course, there are forecasting models. However, such models typically do not have the level of detail needed to examine dynamic tax effects. Given the paucity of Oregon-specific data, it seems a better compromise to use a forecasting model, such as the one maintained by Oregon Department of Administrative Services (DAS), to set a base case and then use a policy model, such as OTIM, to find the differences from that case.

The OTIM model incorporates two assumptions that require some comment. It assumes competitive behavior in all private sectors. This is a good first approximation, particularly at an aggregated sectoral level. The alternative, oligopoly behavior, may well be present, but the degree of markup of price over marginal cost is not likely to be significant since the regional industries compete directly against other U.S. and foreign producers. The second assumption is that involuntary unemployment is constant. This is unlikely to be strictly true. The model does include voluntary unemployment, which is agents deciding to work less when the wage is lower.

Once the major agents in the economy and the relationship between these agents have been specified, the model can be built. In OTIM, the algebraic representation of the relationships between the agents in the Oregon economy is achieved using the General Algebraic Modeling System[4] (GAMS). The model currently has over 1,100 equations, not including definitions and code to read in and organize the data.

HOW THE MODEL CAN BE USED

When the final developmental details are complete, three streams of uses of the model appear evident:

1. The immediate goal of LRO fulfilling the requirements of the Legislature will be met. The LRO staff will use the model to trace economic feedbacks and distributional effects of proposed tax changes.

[4] GAMS is a computer program allowing interface between code written in a simple, algebraic format and a choice of powerful solvers. OTIM currently uses the CONOPT solver, developed by ARKI Consulting and Development. See also: Brooke, Kendrick, Meeraus and Raman, 1998. GAMS Development Corporation, Inc.

2. The LRO plans to use OTIM as the basis for further research by Oregon State University team members and other researchers in 2001. CGE models are particularly sensitive to the design of factor markets, and the team was forced to use national data from several years ago in the model. Current research to establish Oregon consumption, labor supply, migration, investment, and production functions would enhance the model considerably.
3. Other state governments are in the midst of developing their own forms of dynamic revenue analyses—whether in response to legislated demands or expectation of the need for these analyses. The LRO will share its research with other states; in fact this process has already begun in Washington and Ohio. The details of the OTIM model are available on request, and the OTIM team hopes to gain from the research of others and the insight of others reviewing their models.

DATA ORGANIZATION: SOCIAL ACCOUNTING MATRIX

The first step in constructing a CGE model is to organize the data. The traditional approach to data organization for a CGE model is to construct a Social Accounting Matrix (SAM). A SAM is a square matrix consisting of a row and column for each sector of the economy. A SAM is like an input-output (IO) model, but with the traditional inter-industry accounts supplemented by a detailed representation of the interactions of households and government with the producer sectors. Each entry in the SAM identifies an exchange of goods and services purchased by one sector from another sector or itself. The entries along a row in the SAM show each payment received by that particular sector. Summing the data across the row gives the total of payments made to that sector. The entries down a column in the SAM show the expenditures made by a particular sector. Summing the data down a column gives the total expenditures by sector.

For OTIM, the Oregon economy has been divided into a SAM composed of 109 distinct sectors: 29 industrial sectors, two factor sectors (labor, capital), 8 household sectors, one investment sector, 69 government sectors, and one sector which represents the rest of the world. The design of the sectoring is an important element in the development of any CGE, Social-Accounting or IO model because it determines the flows that the model will be able to trace explicitly. If the sectoring is done correctly, the major flows in the economy, both positive and negative, will be evident. If the sectoring is done incorrectly, the impact of policy may be blurred, with negative and positive flows occurring within a single sector. Without a correct sectoring, it would be difficult, if not impossible, to differentiate the distributive impact of government spending and taxation.

In the sections that follow, the criteria for the sectoring of the SAM are presented and each sector is described in detail. The data sources for each sector are also discussed. Industrial sectoring is examined in the first section. The two factor sectors in the model are discussed in the second section. The household sectoring is described in the third section. And the government sectoring is described in the fourth section.

CRITERIA FOR INDUSTRIAL SECTORING

Four criteria are considered in establishing the industrial sectoring for use in OTIM. First, the major industries in the economy in terms of employment, value of production, exports, and revenue are differentiated. Second, the major taxpayers in the economy are distinguished. Third, the distributive impact of government taxation and industrial-development policy are considered. Fourth, standard sectoring schemes, such as the Standard Industrial Classification (SIC) system, are followed when possible. Each of these criteria is examined in detail below. This discussion is followed by presentation of the industrial-sectoring scheme adopted for OTIM.

MAJOR OREGON INDUSTRIES

The first criterion considered when establishing the industrial sectoring is the importance of the industry in terms of its employment, value of production, exports, and revenue. Not only do these key industries capture the major flows in the economy but changes in these industries could trigger relatively large changes throughout the economy. The major Oregon industries are outlined in the four tables following. Because the main source of data base used for the generation of the SAM is the 1997 IMPLAN, 1997 data are presented in all tables when possible.

A ranking of major industries according to value of gross output is presented in the table below. This ranking reflects the observation that Oregon has become increasingly a service-oriented economy, but with traditionally strong manufacturing and trade sectors.

Table 2-1. Oregon Industries Ranked According to Value of Gross Output (in millions $)

Industry	Gross Output	Rank
Livestock	1,490.53	24
Crops	1,702.30	22
Greenhouse and nursery products	559.70	27
Other Agriculture and Natural Resources	1,537.31	23
Construction	12,466.36	2
Agricultural processing	5,760.98	12
Tobacco and Alcohol	748.87	26
Apparel	288.68	28
Wood and Construction Products	12,652.84	1
Pulp and Paper Products	4,408.81	15
Chemicals & Related Products	2,405.89	19
Petroleum Refining	0.00	29
High Tech Manufacturing	10,544.01	4
Motor Vehicles	3,702.43	17
Other Manufacturing	9,855.25	5
Transportation Services	7,103.11	10
Communication	2,428.92	18
Utilities	5,243.80	13
Wholesale Trade	9,562.73	6
Retail Trade except restaurants	8,112.14	9
Eating, Drinking & Lodging	4,914.86	14
Banking Services	4,274.54	16
Insurance	2,198.08	20
Real Estate	6,998.90	11
Other financial insurance and real estate	1,249.38	25
Business Services	11,052.32	3
Health Services	9,288.03	8
Entertainment	2,008.80	21
Other Services	9,378.82	7

Source: IMPLAN, 1997 Oregon SAM

Wood and Construction Products is the largest sector in terms of gross output, followed by Construction. The traditional importance of these sectors in Oregon has been magnified in recent years by the boom in business and residential construction, especially in the Portland Metro area. The largest service sector by this measure is Business Services, which was third.

The ranking of major industries according to the number of employees presented in the table below reproduces results similar to those in the previous table; service and trade industries are the dominant employment sectors for the State. However, Manufacturing especially in the form of wood and paper products, food products and electronic products continues to provide an important part of the employment base.

Table 2-2. Wage and Salary Workers by Major Industry, 1997

Industry	Employment	Rank
Livestock	17,640	20
Crops	39,475	14
Greenhouse and nursery products	7,062	26
Other Agriculture and Natural Resources	23,070	18
Construction	117,585	6
Agricultural processing	24,821	17
Tobacco and Alcohol	1,335	28
Apparel	3,558	27
Wood and Construction Products	84,857	8
Pulp and Paper Products	27,785	16
Chemicals & Related Products	11,639	23
Petroleum Refining	0	29
High Tech Manufacturing	39,594	13
Motor Vehicles	10,579	24
Other Manufacturing	58,384	10
Transportation Services	64,013	9
Communication	13,758	22
Utilities	10,341	25
Wholesale Trade	101,076	7
Retail Trade except restaurants	240,646	1
Eating, Drinking & Lodging	137,575	4
Banking Services	45,229	11
Insurance	17,317	21
Real Estate	38,024	15
Other financial insurance and real estate	21,519	19
Business Services	230,453	2
Health Services	127,524	5
Entertainment	41,770	12
Other Services	186,683	3

Source: IMPLAN, 1997 Oregon SAM

The Oregon industries ranked in terms of export sales for 1997 are listed in the table below. The listing was compiled with 1997 IMPLAN data. Here exports include sales to other states as well as foreign shipments. It is important to distinguish the major export industries in the industrial sectoring because

changes in these industries can have particularly large repercussions on the rest of the economy. Changes in export earnings are like exogenous shocks to the Oregon domestic economy, entailing more than a redistribution of expenditure within the economy.

Table 2-3. Oregon's Ranking of Export Industries, 1997 (in millions $)

Industry	Export Earnings	Rank
Livestock	1,025.76	19
Crops	1,234.68	16
Greenhouse and nursery products	359.59	24
Other Agriculture and Natural Resources	1,005.58	20
Construction	3,497.77	5
Agricultural processing	3,784.26	4
Tobacco and Alcohol	360.35	23
Apparel	151.90	28
Wood and Construction Products	8,868.04	1
Pulp and Paper Products	3,211.71	6
Chemicals & Related Products	1,555.76	14
Petroleum Refining	0.00	29
High Tech Manufacturing	6,769.24	3
Motor Vehicles	3,048.33	7
Other Manufacturing	7,209.19	2
Transportation Services	1,623.80	13
Communication	356.70	25
Utilities	1,657.84	12
Wholesale Trade	1,683.04	11
Retail Trade except restaurants	1,507.14	15
Eating, Drinking & Lodging	1,050.48	18
Banking Services	1,229.44	17
Insurance	721.43	21
Real Estate	2,227.12	8
Other financial insurance and real estate	348.80	26
Business Services	1,846.99	10
Health Services	698.68	22
Entertainment	321.34	27
Other Services	2,085.44	9

Source: IMPLAN, 1997 Oregon SAM

A perhaps surprising result is that High Tech Manufacturing is the third largest export industry in the state, behind Wood and Construction Products and Other manufacturing. Wood and Construction products in OTIM is a broad aggregate and includes Lumber and Wood Products, Furniture and Fixtures, Stone, Clay, Glass, & Concrete and Fabricated Metals. These activities combined into broadly defined "Wood and Construction Products" place this sector as the export leader, followed by the even broader "Other Manufacturing." High Tech Manufacturing has recently emerged as a major industry in Oregon. Using more narrow sector definitions would probably accentuate the ranking of this sector in the tables in this section.

MAJOR TAXPAYERS

Another criterion considered when establishing the industrial sectoring is the tax structure. A primary focus of the study is to ensure that the Legislature and the Governor are presented with reliable information as to the probable behavioral responses of taxpayers, businesses and other citizens to changes in state tax laws. In order to model explicitly taxpayer response to changes in state tax laws, OTIM must necessarily identify the major taxpayers in the State. Industry payments of the Oregon corporate tax are listed in the following table. Data are taken from summary reports prepared by Department of Revenue.

Table 2-4. Ranking of Industries Paying Corporate Taxes in 1997 (in millions $)

Industry	Corporate Tax	Rank
Livestock	0.12	27
Crops	0.13	26
Greenhouse and nursery products	0.06	28
Other Agriculture and Natural Resources	0.16	25
Construction	6.42	15
Agricultural processing	7.23	13
Tobacco and Alcohol	0.76	22
Apparel	0.43	24
Wood and Construction Products	27.58	5
Pulp and Paper Products	8.03	10
Chemicals & Related Products	4.26	17
Petroleum Refining	0.00	29
High Tech Manufacturing	43.14	3
Motor Vehicles	3.03	19
Other Manufacturing	8.28	9
Transportation Services	7.98	11
Communication	9.98	8
Utilities	29.08	4
Wholesale Trade	61.76	1
Retail Trade except restaurants	19.86	7
Eating, Drinking & Lodging	7.58	12
Banking Services	22.30	6
Insurance	6.58	14
Real Estate	49.37	2
Other financial insurance and real estate	0.47	23
Business Services	5.01	16
Health Services	2.43	20
Entertainment	1.36	21
Other Services	4.13	18

Source: IMPLAN and Oregon Department of Revenue, 1997 Oregon SAM

This table shows Wholesale Trade, Real Estate and High Tech Manufacturing occupying the top spots in terms of state corporate income taxes paid. Wholesale Trade includes Oregon-based distribution and merchandising firms that may apportion a large share of income to Oregon under current tax law. The data may tend to overstate corporate taxes paid by the Real Estate sector since these include taxes paid by firms identified as property management companies on behalf of firms in other industries.

DISTRIBUTIVE IMPACT

The third criterion considered when establishing the industrial sectoring is the distributive impact of government taxation and spending. In order to trace effectively the impacts of government spending and taxation on the distribution and incidence of production, income, spending and savings in the economy, it is important to establish an industrial sectoring that can be used to map the effects of government policy. The sectoring in OTIM distinguishes industries that clearly stand to benefit from increased government spending (e.g. Construction) from those industries that may incur negative repercussions from revenues raised to finance such spending.

As a first cut at differentiating the impacts of government policy, it is important to distinguish major taxpayers by size and by type of tax as was done in the previous section. Not only do the major taxpayers represent the primary source of funding for government spending but they also represent important variables in any industrial-development strategy. Targeted tax cuts or even general tax cuts are primary tools in industrial-development incentive policy. The industrial sectoring must explicitly include the major taxpayers in order to trace the impact of such policies.

The industrial beneficiaries of government spending on infrastructure or education are difficult to isolate. Both theory and empirical observation suggest that the benefits of infrastructure and education are diffused throughout the economy. The direct beneficiaries of industrial-development spending are likely to be more narrowly delineated. A primary focus of many industrial-development strategies has been creating employment in wage-premium, high-export industries. Wage-premium jobs have a high salary to education ratio, and the earning effects of local employment are greater for new jobs in wage-premium industries. More jobs at higher wages provide the biggest "payoff" for employment-creation projects. Export industries are targeted because out-of-state earnings can have large economy wide impacts.

Oregon's largest wage-premium export industries are Wood and Construction Products, Pulp and Paper, High Technology and Business Services. Even if these industries are not specifically targeted by development incentives, they are important industries to track in the model. The economy-wide impact resulting from changes in these industries should be large because they are large employers with large export earnings paying high salaries.

STANDARD INDUSTRIAL CLASSIFICATION (SIC)

The fourth criterion considered when devising the industrial sectoring is comparability with other industrial classifications. The Standard Industrial Classification scheme (SIC) is the most commonly used system for categorizing industries.[5] IMPLAN's 528 industry sector detail provide considerable flexibility in defining industry aggregates. When possible, the IMPLAN industry classifications used in OTIM are defined to coincide with industry classifications regularly used in the SIC.

THE INDUSTRIAL SECTORS

The 29 non-governmental "industries" or industrial sectors are differentiated for inclusion in OTIM. The industry aggregates included in OTIM, along with their SIC codes and IMPLAN codes are presented in the table below. A description of each industry aggregate follows the table.

[5] The North American Industry Classification System (NAICS) is an example of another scheme. It was recently developed to aid statistical standardization between the U.S., Canada and Mexico. Although more detailed, it is consistent with SIC, especially at higher levels of aggregation.

Table 2-5. Industrial Sectoring and Codes

OTIM Sector	Industries	SICs	Description	IMPLAN Sectors
CROPS	Crops	01	Crops	10-21
LVSTK	Livestock	02	Livestock	1-9, 22
NRSGRH	Greenhouse and nursery products	01	Greenhouse And Nursery Products	23
OANR	Other Agriculture and Natural Resources	08	Forestry	24
		09	Fishing	25
		07	Ag. Services	26
		10	Metal Mining	28-36
		12-13	Energy Mining	37-39
		14	Nonmetallic Non-fuels Mining	40-47
CONST	Construction	15	Building Construction	48-57 (not by SIC)
		16	Heavy Non-building Construction	
		17	Special Trade Contractors	
FOODPRC	Agricultural processing	20	Food and Kindred Products	58-90, 95-103
TOBAC	Tobacco and Alcohol	21	Tobacco and Alcohol	91-94,104-107
APPRL	Apparel	23	Apparel	124-132
WOODCON	Wood and Construction Products	24	Lumber and Wood Products	133-147
		25	Furniture and Fixtures	148-160
		32	Stone, Clay, Glass, & Concrete	230-253
		34	Fabricated Metals	273-306
PLPPAPR	Pulp and Paper Products	26	Paper and Allied Products	161-173
		27	Printing and Publishing	174-185
CHEMS	Chemicals & Related Products	28	Chemicals and Allied Products	186-209
		29	Petroleum Related	211-214
		30	Rubber & Miscellaneous Plastics	215-220
PETRO	Petroleum Refining	291	Petroleum Refining	210
ELECT	High Tech Manufacturing	357	Computers and Office Equipment	339-344
		366	Communications Equipment	372-374
		367	Electronic Components & Accessory	375-378
		382	Laboratory & Measuring Instrument	401-403
MOTOR	Motor Vehicles	371	Motor Vehicles	384-388,395,397
OTHMA	Other Manufacturing	22	Textile Mill Products	108-123
		31	Leather	221-229
		33	Primary Metals	254-272
		35	Machinery & Equipment	307-338,345-354
		36	Electronic Equipment	355-371,379-383
		37	Transportation Equipment	389-394, 396,
		38	Instruments	398,399
		39	Miscellaneous Manufacturing	400, 404-414, 415-432
TRANSP	Transportation	40	Railroads	433

Table 2-5. Industrial Sectoring and Codes

OTIM Sector	Industries	SICs	Description	IMPLAN Sectors
	Services	41	Transit & Interurban Passenger	434
		42	Motor Freight	435
		44	Water Transportation	436
		45	Air Transportation	437
		46	Pipelines, except Natural Gas	438
		47	Transportation Services	439-440,
			Public Passenger Transit	510
COMMUNC	Communication	48	Communications	441-442
UTILIT	Utilities		Electric, Gas, and Sanitary Services	443-446,
		49	Public Electric Utilities	511,514
WHLSTRD	Wholesale Trade	50	Durable Goods	
		51	Non-durable Goods	447 (combined)
RTLTRD	Retail Trade	52	Building Materials	448
	except	53	General Merchandise	449
	restaurants	54	Food	450
		55	Automotive & Gas Stations	451
		56	Apparel	452
		57	Home Furniture	453
		59	Miscellaneous Retail	455
RESTRNT	Eating, Drinking	58	Eating and Drinking Places	454
	& Lodging	72	Lodging	463
BANKS	Banking	60	Depository Institutions	456
	Services	61	Non-depository Credit Institutions	457
INSUR	Insurance	63	Insurance Carriers	459
REALE	Real Estate	65	Real Estate	462
OFIRE	Other financial	62	Security & Commodity Brokers	460
	insurance and	64	Insurance Agents, Brokers, Services	458
	real estate	67	Holding and other Investment	(457)
BSERV	Business	07	Agricultural Services	27
	Services	73	Business Services	469-476
		81	Legal Services	494
		87	Engineering, Accounting, etc.	506-509
HEALTH	Health Services	80	Health Services	490-493
ENTER	Entertainment	78	Motion Pictures	483
		79	Amusement & Recreation	484-486,488-489
OTHSERV	Other Services	70	Personal Services	464-468
		75	Automobile Services	477-479
		76	Miscellaneous Repair Services	480-482
			Racing Tracks	487
		82	Educational Services	495-497
		83	Social Services	498-501
		84	Museums, Galleries, & Zoos	
		86	Membership Organizations	502-505
		88	Private Households*	525
		89	Miscellaneous Services	526, 527, 528

Table 2-5. Industrial Sectoring and Codes

OTIM Sector	Industries	SICs	Description	IMPLAN Sectors
			Non-comparable Imports	516
			Scrap	517
			Used and Secondhand	518
			Inventory Valuation Adjustment	524
FED	Federal	43	U.S. Postal Service	
	Government	91	Executive, Legislative, General	
		92	Justice, Public Order, & Safety	
		93	Public Finance, Taxation, Monetary	
		94	Admin. of Human Resource Policy	
		95	Admin. of Env. Quality & Housing	513
		96	Admin. of Economic Programs	515, 519, 520,
		97	National Security and Internal Affairs	521
State Government			3 Spending Units: Non-education, Education, Public Investment.	522, 523
Local Government			3 Spending Units: Non-education, Education, Public Investment.	522, 523 512 Oth. Local Ent.
* Domestic services produced and traded among private households.				

CROPS

The Crops industry includes all field crops, tree fruits and nuts and vegetables. It does not include agricultural services or nursery and greenhouse production. Oregon is one of the most diverse agricultural states in the nation. Oregon farmers produce crops ranging from small fruits and berries to significant amounts of grass seed, other field crops as well as vegetables. By value of sales, grass seed production ranks in first place with vegetable production and field crops tied for second. Next are tree fruits and nuts and then small fruits and berries. In 1997 Oregon farmers sold an estimated $1.7 billion of farm products. Direct employment in crop production was 17,600 in 1997.

LIVESTOCK

Oregon's livestock industry is led by the production of beef cattle and calves ($342 million). Dairy production is the second largest sector in this industry $218 million. Poultry and eggs ($218 million) and other livestock such as sheep round out the major components of this industry. In 1997 total industrial output for the industry (sales) was valued at $1.49 billion. The IMPLAN category Forest Products (sector 22) is also added here because this commodity sector includes much of the public and private livestock range in the state. Direct employment in livestock production was 39,400 jobs in 1997.

GREENHOUSE AND NURSERY PRODUCTS

The greenhouse and nursery products industry is the most rapidly growing agricultural sector in Oregon and has become a major agricultural industry in the state with sales of $560 million in 1997 (Oregon SAM). Employment in the industry was 7,000 jobs in 1997.

OTHER AGRICULTURAL AND NATURAL RESOURCES

This industry group includes five SIC categories: Agricultural Forestry and Fishery Services, Fishing, Hunting and Trapping, Forestry, and Metal, Nonmetallic and Non-fuels Mining. Together, the 1997 output of these industries was valued at $1.54 billion, employing approximately 23,000 workers (Oregon SAM 1997).

Hunting and Trapping are the smallest of the industries included in the Other Agriculture and Natural Resources grouping. The fishing industry in Oregon is much larger with $272 million in sales and direct employment of 3,900 jobs.

The Forestry Industry classification includes Forestry Products (IMPLAN sector 24), primarily consisting of establishments engaged in the operation of timber tracts, tree farms, and forest nurseries as well as reforestation and the growing of Christmas trees (IMPLAN, 1997).

Harvest levels on both national forests and private lands have been declining and will probably continue to do so as a result of environmental regulations, endangered species acts, and declining number of trees available for harvest. Despite declining harvest levels, Oregon is among the top five lumber producing states in the nation. As an industry, Forestry is assessed a Forest Products Tax, and this tax will be tracked through the Other Agriculture and Natural Resources sector.

The mining sector, except for sand and gravel, is insignificant in Oregon. Oregon contains no known petroleum deposits and is not a major source of precious metals. Dimension stone and sand and gravel operations are the major mining sectors in Oregon with roughly $90 million of sales in 1997 and employment of 800-900 jobs in each sector.

CONSTRUCTION

Construction includes three SIC categories: Building Construction, Heavy Non-building Construction, and Special Trade Contractors. Commercial, industrial, and residential building all serve as indicators of the strength of the economy. Construction, particularly Building Construction, is firmly tied to the rest of the economy; the link between the creation of new jobs and the demand for new housing is well documented as is the link between economic growth and the demand for commercial and industrial space. Heavy construction, primarily public works and utilities, is less sensitive to business cycles but will be one of the first sectors to react to changes in government spending on infrastructure. Construction employment was 118,600 in 1997 making this one of the largest industries in Oregon

AGRICULTURAL PROCESSING

Agricultural Processing includes those industries engaged in the processing of all food and kindred products. Agricultural Processing is the State's largest non-durable goods manufacturing industry. In 1997, Agricultural Processing supplied approximately 24,800 jobs and $5.8 billion output. A large portion of Agricultural Processing involves production for the local market, such as bakeries, dairies, and bottlers. Nevertheless, the 1997 Oregon SAM shows Agricultural Processing as a major export industry for the State with $3.7 billion in exports.

TOBACCO AND ALCOHOL

Though Tobacco and Alcohol production represents minor economic activity in Oregon, they are differentiated as a separate sector because of the special taxes that are applied to these products. The 1997 Oregon SAM estimates the value of these combined sales at $748 Million. Employment is estimated at

roughly 1,300 workers. Taxes and revenues from these industries generated almost 3.1% of Oregon's state revenue, and are accounted for in OTIM through this combined sector.

APPAREL

The Apparel industry in Oregon is not one of the State's largest manufacturing employers. In 1997, the industry supplied 3,600 wage and salary jobs. Employment in the apparel industry has been increasing since 1985. Most of the industry's employment is concentrated in apparel made from purchased material. Although Apparel is not a large sector it has been one in which shifting trade patterns threaten to remove some Oregon jobs. Imported apparel is also a major component of household consumption. Industries that operate "at the margin" in the face of imports are of particular interest when modeling regional tax policy.

WOOD AND CONSTRUCTION PRODUCTS

Wood and Construction Products includes four SIC categories: Lumber and Wood Products; Furniture and Fixtures; Stone, Clay, Glass, and Concrete; and Fabricated Metals. The strength of Wood and Construction Products is directly linked with that of the primary construction sector and in the export market for wood products. Improvements in construction activity signal growth in employment in lumber, stone-clay-glass, furniture, and fabricated metals. Of course Lumber and Wood products have been a mainstay of the Oregon economy for many years. This sector employed 84,000 people in 1997. The 1997 Oregon SAM estimates industry output at $12.65 billion. Wood and Construction Products was also the largest export industry in the State in 1997.

PULP AND PAPER PRODUCTS

In 1997, Paper Products supplied 11,000 jobs while printing and publishing supplied 16,000. Both Paper and Printing are mainly population-serving industries that grow or contract in response to changes in population. Pulp and Paper was also the fifth largest export industry in the State in 1997. The 1997 Oregon SAM estimates industry output at $4.4 billion.

CHEMICALS & RELATED PRODUCTS

Chemicals and Related Products includes Chemicals and Allied Products (such as industrial inorganic chemicals, plastics, drugs, soaps, paints and agricultural chemicals), Petroleum and Coal Products (other than petroleum refining), and Rubber and Miscellaneous Plastics Products (such as tires and footwear). Employment in Chemicals and Related Products was 11,600 in 1997. The 1997 Oregon SAM estimates industry output at $2.40 billion Sales of Chemicals and Related Products were concentrated on the Oregon domestic market with exports constituting about 25% of total sales.

PETROLEUM REFINING

Oregon depends on petroleum for 50% of its energy needs, and all of the petroleum products consumed in Oregon are refined outside of Oregon. Imported petroleum products were estimated to be $2.33 billion in 1997 (1997 Oregon SAM). The reason for including petroleum refining as a commodity in the OTIM model is that fuel taxes are an important source of state and government revenues, and a major policy issue in recent years. In OTIM, Oregon's fuel tax is accounted for through the Petroleum Refining "industry."

HIGH TECH MANUFACTURING

The High Technology Manufacturing classification delineates the primary high-tech electronic industries. These include four SIC categories: Computers and Office Equipment, Communications Equipment, Electronic Components and Accessories, and Laboratory and Measuring Instruments. The last several years have seen strong increases in the demand and production of computer chips and electronic components in Oregon. Increased sales of the past few years have been largely fueled by falling prices and increasing efficiencies within the industry. In 1997, employment in High Technology Manufacturing was 39,600 wage and salary jobs. The 1997 Oregon SAM estimates industry output at $10.5 billion, value added at $4.2 billion, and employee compensation at $2.4 billion. This industry also supplies a large number of wage-premium jobs and approximately 65% of industry production is exported out of Oregon. The 1997 Oregon SAM ranks High Technology Manufacturing as the second largest export industry for 1997.

MOTOR VEHICLES

Motor Vehicles was delineated as a separate industry in the original industrial sectoring in order to treat the increasingly important heavy truck and recreational vehicle manufacturing industries and to account for motor-vehicle fees and registration. In 1997, value added for Motor Vehicles was approximately $3.7 billion and the number of employees was approximately 10,600 jobs.

OTHER MANUFACTURING

The Other Manufacturing industry includes seven SIC categories: Textile Mill Products, Leather, Primary Metals, Machinery and Equipment, Transportation Equipment, Instruments, and Miscellaneous Manufacturing. The 1997 Oregon SAM estimates the value of industry output at $9.85 billion, and employee compensation at $2.59 billion.

TRANSPORTATION

The Transportation industry includes six SIC categories: Railroads, Transit and Interurban Passenger Busses, Motor Freight, Water Transportation, Pipelines (except natural gas), and Transportation Services. Employment in the industry has been declining for the last few years. In 1997, approximately 64,000 people were employed in Transportation. The 1997 Oregon SAM estimates industry output at $7.1 billion.

COMMUNICATIONS

Employment in the Communications industry was approximately 13,700 wage and salary employees in 1997. Growth within the industry has been led by the cellular communication industry. The 1997 Oregon SAM estimates industry output at $2.4 billion. Although the value of gross output for Communications is not as large other industries, it does generate significant receipts of corporate taxes, ranking eighth in the state.

UTILITIES

The Utility industry includes Electric, Gas and Sanitary Services. In 1997, employment in the industry was 10,300 salary and wage employees. From 1992 to date, employment in the Utility industry has been falling—a trend that is expected to continue as large utilities make cuts in their work force. The 1997

Oregon SAM estimates industry output at $5.2 billion Similar to the Communications industries, Utilities generated relatively large corporate taxes, ranking fourth in the state.

WHOLESALE TRADE

In 1997, the number of jobs in Wholesale Trade was 101,000. Wholesale Trade, including distribution and merchandising firms, was the fifth largest major-industry employer in 1997. The Oregon SAM estimates industry output at $9.56 billion. Wholesale Trade ranked first in state corporate tax payments.

RETAIL TRADE EXCEPT RESTAURANTS

The Retail Trade category includes Building Materials, General Merchandise, Food, Automotive and Gas Stations, Apparel, Home Furniture, and Miscellaneous Retail. Retail Trade is the largest employer in Oregon. In 1997, employment for the industry was approximately 240,600. The 1997 Oregon SAM estimates Retail Trade output at $8.1 billion. In terms of the value of gross output, Retail Trade ranked eighth in the State. Since Oregon dose not have a state sales tax, this sector is not as important as a tax source as it is in many other states, but it does serve a significant "export" market of non-resident shoppers.

EATING, DRINKING AND LODGING

The Eating, Drinking and Lodging category includes Eating and Drinking establishments as well as Hotels and Lodging places. Employment in 1997 was 137,600 jobs. Total industrial output was $4.9 billion (1997 Oregon SAM).

BANKING

The Banking industry is composed of depository institutions and non-depository credit institutions. As a whole, Banking has recently experienced some job losses due to mergers, consolidations, automation, and cost-cutting measures. Like manufacturing industries, Banking is subject to corporation taxes, and in 1997 Banking reported the sixth highest corporate income tax. For the same year, the value of gross output in Banking was the tenth largest in the State. The 1997 Oregon SAM estimates industry output at $4.27 billion, value added at $2.8 billion, and employee compensation at $1.4 billion.

INSURANCE CARRIERS

This industrial section includes carriers of insurance of all types, including reinsurance. As specified in the SIC codes, agents and brokers dealing in insurance and organizations rendering services to insurance carriers or to policyholders are not included in the Insurance Carriers category (see Other FIRE, below). Insurance employment was 17,300 wage and salary employees in 1997. The 1997 Oregon SAM estimates industry output at $2.20 billion. Non-Oregon insurers are also taxed separately from other corporations and, in 1997, the insurance tax accounted for $76 million of state revenues.

REAL ESTATE

As specified in the SIC Manual (1989), the Real Estate industry includes real estate operators, owners and lessors of real property, buyers, sellers, developers, agents and brokers. In 1997, employment in Real Estate was 38,000. The Real Estate industry is driven by low interest rates and population growth in Oregon, complemented by increased employment and income. The 1997 Oregon SAM estimates industry

output at $6.99 billion. In terms of corporate income taxes paid as a sector for 1997, Real Estate ranked second.

OTHER FINANCE, INSURANCE, AND REAL ESTAT E

The Other Finance industry includes three major groups: (1) establishments engaged in the underwriting, purchase, sale, or brokerage of securities and other financial contracts on their own account or for the account of others, and exchanges, exchange clearinghouses, and other services allied with the exchange of securities and commodities; (2) establishments, agents, and brokers dealing in insurance and organizations offering services to insurance companies and policyholders; and (3) investment trusts, investment companies, holding companies, and miscellaneous investment offices (classifications according to SIC Manual, 1989). The 1997 Oregon SAM estimates that this sector generated a gross output of $1.25 billion in 1997 and employed approximately 21,500 people.

BUSINESS-RELATED SERVICES

Business-Related Services include four SIC categories: Landscape and Horticultural Services, Business Services, Legal Services, and Engineering and Accounting Services. So defined, Business-Related Services was the largest service employer and the second largest single industry in terms of employment for 1997. The recent growth in Business Services has been slanted toward growth in temporary employment agencies and toward the practice of employee "leasing" through business-service firms. The 1997 Oregon SAM estimates that Business-Related Services supplied approximately 230,400 wage and salary jobs in 1997 and produced an output valued at approximately $11.05 billion.

HEALTH SERVICES

Health Services is the third largest employer of the service industries. In 1997, 127,400 wage and salary workers were employed in Health Services making it the fifth largest employer in the state Recently slow employment growth in the industry is attributed to cost-containment efforts throughout the industry. The 1997 Oregon SAM estimates Health Services output at $9.29 billion.

ENTERTAINMENT SERVICES

Entertainment Services includes two SIC categories: Motion Pictures and Amusement and Recreation. Entertainment Services is a significant employer, employing 41,800 wage and salary workers in Oregon in 1997. The fact that the industry's rate of growth is high in proportion to other industries warrants separating this industry for OTIM. The 1997 Oregon SAM estimates Entertainment Services output at $2.0 billion.

OTHER SERVICES

Other Services include Personal Services, Automobile Services, Miscellaneous Repair Services, Educational Services (non-governmental), Social Services, Museums, Galleries, Zoos, Membership Organizations, Private Households and Miscellaneous Services. The 1997 Oregon SAM estimates Other Services output at $9.38 billion. Employment in 1997 was 186,600 making it the third largest employment sector in the state.

THE FACTOR SECTORS

A factor of production is a stock that generates a flow of services used in the production of goods and services. In a SAM, value added is distributed through the factors of production to households owning the factors. Factor markets define many of the results of a CGE model and its ability to react to policy change. There are two factor of production sectors in OTIM: Labor (including wage and salary workers and proprietors) and all other factors aggregated into "Capital."

The IMPLAN's 1997 SAM formed the starting point for distributing factor payments to households. In OTIM, total value added from to Labor is $56.03 billion and from Capital, $19.04 billion.

THE HOUSEHOLD SECTORS

Households have a number of functions in the economy: they receive income from value added; they consume goods and services and save and invest; and they pay taxes. In the sectoring of households for the SAM, each of these functions must be represented. However, because Senate Bill 5511 specifies that a complete dynamic analysis must examine incidence of household burden to changes in taxes, the primary criterion for household sectoring is an accurate picture of the distribution of household income across income classes in Oregon. For OTIM, eight household sectors are delineated. These sector labels correspond to income brackets from the Current Population Survey (CPS) for Oregon for 1996,1997 and 1998.

This grouping of households allows the modeler to distinguish consumption and income patterns by income levels. The household sectoring scheme was matched to a sample of merged Oregon personal income tax and local residential property tax filers to obtain information on property taxes and income taxes paid by households. This information was used to estimate property tax, Oregon income tax, and Federal income tax payments by each of the eight household groups. IMPLAN uses Consumer Expenditure Survey data to distribute consumption by household income categories. These expenditure patterns were applied to the eight household groups.

THE INVESTMENT SECTOR

In economic models investment means industry demand for capital assets. Goods and services are purchased from other industry sectors and used to augment or replace an industry's capital stock. No data exists on the industry distribution of investment spending or capital stocks at the state level. However national estimates of private industry capital stock are available.[6] The capital stock of each OTIM industry is estimated using the national industry's capital stock multiplied by the ratio of Oregon's industry gross state product to the national gross domestic product in that same industry.

Gross investment by destination for the 29 industrial sectors of OTIM consists of net additions to capital stock resulting from economic expansion (in response to an exogenous stimulus) and purchases to replace and maintain depleted capital, assuming an average real depreciation rate of six percent.

These estimates of industry gross investment are combined with a share matrix adapted from the most current (1992) BEA matrix of capital purchases by source and destination for the United States.[7] This share matrix, which identifies how a dollar of gross investment purchases made by an industry is

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[6] Fixed Reproducible Tangible Wealth of the United States, 1925-97. U.S. Department of Commerce, Economics and Statistics Administration, Bureau of Economic Analysis, CD-ROM #NCN-0229.

[7] Available from U.S. Dept. of Commerce BEA webpage http://www.bea.doc.gov/bea/dn2.htm

distributed across the source industries, is multiplied by estimated industry gross investment to yield a vector of investment demands by source from which the goods and services were purchased.

A series of assumptions underlie the OTIM investment calculations. To the extent that the economy is not in equilibrium in the base year, the levels of investment in the base SAM will be understated. To the extent that the distribution of investment sources has changed since 1992, some error may also be introduced. However, at the fairly gross levels of aggregation used in OTIM, we feel that the gains from being able to trace how an investment decision in one sector results in investment demand for other sector's goods and services outweigh the downside of introducing these potential errors.

THE GOVERNMENT SECTORS

The primary purpose of OTIM is to analyze the dynamics of Oregon state revenue. However, OTIM must account for government expenditures in order to trace any feedback effect to state revenue from changing demand for goods, services, and factors as expenditure changes. Further, some elements of government will change their expenditures as their revenue changes.

As a result of these considerations, government sectors must be organized so that both revenue flows and expenditure flows can be traced explicitly. The major government revenues are taxes, sales of services, and intergovernmental transfers. The major government expenditures are the purchase of goods and services, transfer payments to households, and intergovernmental transfers. Federal, state, and local governments all engage in revenue collection and expenditure, and all three levels of government are represented in OTIM. Oregon state and local government revenue and taxation receive the greatest scrutiny while federal government is held primarily exogenous in the model.

For OTIM 69 government sectors representing federal, state, and local revenues and spending have been created. This sectoring allows the modeler to trace explicitly the major government expenditure and revenue flows. A description of the criteria and sectoring for each level of government follows.

FEDERAL GOVERNMENT SECTORING

In order to model the federal government for the purposes of OTIM, eleven federal government sectors are created: ten to account for federal government revenue flows and one to account for federal government expenditure flows. The primary sources of revenue for the federal government in Oregon are summarized in the following table.

Table 2-6. Federal Government Revenue, 1997 (in million $)

	Total
Fuel Tax	315.2
Tobacco Tax	78.5
Other Excise Taxes	652.5
Import Duty	344.6
Non-tax Revenue	256.7
Social Insurance	8,106.0
Corporate Profits Tax	2,421.8
Personal Income Tax	8,090.3
Estate Tax	179.0
Miscellaneous Tax	32.9
Total	20,477.4

Source: IMPLAN, 1997 Oregon SAM

Federal government expenditure is aggregated into one sector. This includes defense expenditures (goods and service acquisition from particular sectors and rental of labor) and the rest of the federal government's expenditures in Oregon (transfer payments to individuals, intergovernmental transfer payments, purchases of goods and services, and factor rentals).

Note that most elements of the federal government are exogenous to OTIM. Taxation rates, expenditures on goods and services, and rental of factors are fixed in nominal terms, and real quantities are allowed to change in response to prices. Transfer payments to individuals (Social Security benefits and federal pensions) are fixed in per-household nominal terms. The federal government sectors are described in detail below.

SOCIAL SECURITY (FTSOC)

This is the social-security component of federal revenues, consisting of payroll and self-employment taxes for FICA and Medicare.. The primary source of data on payments made by industries, households and governments to FTSOC is IMPLAN estimates.

PERSONAL INCOME TAX (FTPIT)

This is the personal income tax component of federal revenues. Data for federal personal income taxes are from Department of Revenue staff and made available to LRO. These data are allocated according to OTIM's household categories. The model explicitly accounts for the deductibility of state and local taxes from federal incomes subject to taxes. Average rates of itemizing deductions are used for each household category.

CORPORATE PROFITS TAX (FTPRO)

This is the corporation tax component of federal revenues. Federal corporate profit taxes by industry in Oregon were treated as proportional to state corporate profit taxes. Estimates of state corporate profit taxes by industry were provided by the Oregon Department of Revenue.

IMPORT DUTIES (FTID)

This is the import duty component of federal revenues. Import and export data for regional economies are quite poor in detail. One major problem with the data is the lack of ability to distinguish which items are simply passing through the state en route to a final destination. The latest data currently available are from IMPLAN. This data is problematic due to the level of aggregation and requires much refinement. Import duty estimates in total are updated and distributed by category of good or service using IMPLAN-generated estimates of imports.

OTHER FEDERAL TAXES (FTFUEL, FTTOB, FTOEX, FTNT, FTEST, FTMISC)

There are a number of other federal revenues. Excise taxes on tobacco, alcohol and liquid fuels are the major taxes. Excise taxes on liquid fuels are assigned to the industrial sector PETRO, likewise tobacco and alcohol taxes are assigned to the sector TOBAC. The remainder are distributed across the industrial sectors and/or households by their percentage share of domestic demand.

FEDERAL SPENDING (FGSPEND)

This sector accounts for federal spending in Oregon and receives its income from all federal revenue sources. Its expenditures include: purchases of goods and services, rentals of factors (labor), transfers to households and intergovernmental transfers. Patterns of expenditures shown in IMPLAN data are applied to updated expenditure totals to arrive at expenditures on goods and services and factors.

While not fully implemented at the federal level, it is assumed that all intergovernmental transfers from the federal government to Oregon and local governments are "block grants." Given the indirect relationship between liquid fuels taxes and transfers for transportation and the thrust at the federal level to turn all health and human services into block grants, this seems a reasonable assumption. In making this assumption, any connection between economic activity in Oregon and federal grants to Oregon and local governments is ignored.

STATE GOVERNMENT SECTORING

In order to model the Oregon State government, 32 state government sectors are created in OTIM: 29 to account for government revenue flows and three to account for government expenditure flows.

STATE REVENUES

State revenues in Table 2-7 are classified into two main categories: the General Fund, and Other Funds. Taxes and fees that are collected without a specific expenditure allocation are deposited into the General Fund. Revenue collected from special taxes, fees, or revenue designated to a specific expenditure destination are Other Funds. State revenues are also augmented by federal funds, counted as inter-governmental transfers, and by other "exogenous" revenues, such as interest earnings on fund balances and net lottery transfers. All Oregon state government revenue details are extracted from state and local government revenue and expenditure data provided by the U.S. Bureau of the Census, Oregon Department of Revenue and Oregon Department of Administrative Services.

Table 2-7. Oregon State Government Revenue Sectors, 1997 (in million $)

Description	OTIM Sector	General fund	Other funds	Total
Tobacco tax	ORTTOB	222.34	0	222.34
Beer and wine tax	ORTBW	12.02	0	12.02
Alcohol beverage tax	ORTALC	1.82	0	1.82
Fuel tax	ORTFUEL	0	383.16	383.16
Insurance tax	ORTINS	75.94	0	75.94
Amusement device tax	ORTAMUS	2.67	0	2.67
Pari-mutuel tax	ORTPARI	1.14	0	1.14
Utilities tax	ORTUTIL	18.80	0	18.80
Weight-mile tax	ORTWTMI	0	224.00	224.00
Forest products tax	ORTFOR	0	52.90	52.90
Other indirect business taxes	ORTOIBT	0	138.96	138.96
Unemployment compensation assessment	ORTLABU	0	332.81	332.81
Workers compensation assessment	ORTLABW	0	28.02	28.02
Other payroll taxes	ORTLABO	0	168.50	168.50
Corporate income tax	ORTCORP	337.53	0	337.53
Personal income tax	ORTPIT	3,272.59	0	3,272.59
Estate tax	ORTEST	33.86	0	33.86
Fines and fees	OLRFF	56.19	0	56.19
Hunting & fishing licenses	ORLHF	25.90	0	25.90
Motor vehicle licenses	ORLMV	0	101.21	101.21
Motor vehicle operators licenses	ORLMVO	0	17.80	17.80
Liquor apportionment revenue	ORZLIQ	93.34	0	93.34
Public hospitals charges	ORCHOSP	0	340.87	340.87
Natural resources charges	ORCNR	92.80	0	92.80
Parks and recreation charges	ORCPARKS	14.96	0	14.96
Highway charges	ORCHW	12.05	0	12.05
Housing and community development charges	ORCHCD	3.16	0	3.16
Higher education charges	ORCHiED	0	528.29	528.29
All other charges	OLRCAO	0	635.77	635.77
Sub-Total		4,277.10	2,952.30	7,229.40
Transfers from Federal Government		0	3,420.10	3,420.10
TOTAL		4,277.10	6,372.40	10,649.50

Source: 1997 U.S. Census State and Local Government Finance Data adapted to OTIM

In the general funds group the Oregon personal income tax is the major revenue source. Among the major sources of revenue in the other funds category are fuel tax, the weight mile tax, public hospital charges and higher education charges. The total figure for state taxes, revenues, charges and fees for Oregon in 1997 was $7.229 billion. There were also an additional $3.42 billion in intergovernmental transfers from the federal government to Oregon state and local government programs. This total does not include Social Security, federal retirement and most welfare transfers which are treated as direct payments from the federal government to households.

STATE EXPENDITURES

The major governmental spending units in OTIM are identified in Table 2-8 along with their respective levels of expenditure. There are a total of 7 governmental spending accounts in the model. Three expenditure accounts represent state government, three accounts represent local government and an additional account represents federal government expenditures.

Table 2-8. OTIM Government Spending Units

OTIM Name	Description	1997 Expenditures (million $)
State		
ORSNED	OR Spending Non Ed	8,973.30
ORSED	OR Spending Education	1,244.18
ORSINV	OR Spending Public Investment	722.78
Local		
LSNED	Local Spending Non Ed	5,760.84
LSED	Local Spending Education	3,744.11
LSINV	Local Spending Public Investment	2,032.75
Federal		
FGSpend	Federal Govt. Spending	20,477.35

Source: IMPLAN, 1997 Oregon SAM

State government expenditures are of three kinds: purchases of goods and services, rentals of factors (labor) and intergovernmental transfers. IMPLAN expenditure patterns for state and local government education and non-Education sectors are derived from the U.S. Benchmark IO model. These expenditures were applied to updated Oregon expenditure totals to derive expenditure shares for four separate accounts: State Education (ORSED), State Non-education (ORSNED), Local Education (LSED) and Local Non-education (LSNED). IMPLAN also provides estimates of state and local government capital spending ('construction' and 'capital outlay' expenditures and as reported in the Annual Survey of Government Finances). This data is combined by IMPLAN in state and local government investment account. In OTIM this account has been split into a separate state component and a local government component using the Census government finance data.. The accounts are, respectively, State Government Investment (ORSINV) and Local Government Investment (LSINV).

The mapping between Oregon state revenue and expenditure accounts in OTIM is summarized in the next table. The first two columns identify the various sources of revenue and the third column identifies the expenditure account to which the revenue is transferred in OTIM. For example, revenues from the tobacco tax (ORTTOB) are transferred to the Oregon non-educational spending account (ORSNED), etc.

Table 2-9. Mapping Oregon Revenue Units to OTIM Government Spending Units

OTIM Revenue Sector	Name	OTIM Spending Account(s)
ORTTOB	Tobacco tax	ORSNED
ORTBW	Beer and wine tax	ORSNED
		LSNED
ORTALC	Alcohol beverage tax	ORSNED
ORTFUEL	Fuel tax	ORSINV
ORTINS	Insurance tax	ORSNED
ORTAMUS	Amusement device tax	ORSNED
ORTPARI	Pari-mutuel tax	ORSNED
ORTUTIL	Utilities tax	ORSNED
ORTWTMI	Weight-mile tax	ORSINV
ORTFOR	Forest products tax	ORSNED
ORTOIBT	Other indirect business taxes	ORSNED
ORTLABU	Unemployment compensation assessment	ORSNED
ORTLABW	Workers compensation assessment	ORSNED
ORTLABO	Other payroll taxes	ORSNED
ORTCORP	Corporate income tax	ORSNED
ORTPIT	Personal income tax	ORSNED
ORTEST	Estate tax	ORSNED
OLRFF	Fines and fees	ORSNED,
		LSNED
ORLHF	Hunting & fishing licenses	ORSNED
ORLMV	Motor vehicle licenses	ORSINV,
		LSINV
ORLMVO	Motor vehicle operators licenses	ORSINV
ORZLIQ	Liquor apportionment revenue	ORSNED
ORCHOSP	Public hospitals charges	ORSNED
ORCNR	Natural resources charges	ORSNED
ORCPARKS	Parks and recreation charges	ORSNED
ORCHW	Highway charges	ORSNED
ORCHCD	Housing and community development charges	ORSNED
ORCHiED	Higher education charges	ORSED
OLRCAO	All other charges	ORSNED,
		LSNED

Source: OTIM, 1997 Oregon SAM.

LOCAL GOVERNMENT SECTORING

The local revenue sources fall into four main categories: property taxes, fees, miscellaneous revenues, and intergovernmental transfers from the federal government and from Oregon state government. There are twenty two different sources of local taxes and revenues represented in OTIM. Local government spending is split by expenditure category: education, non-education and investment. A summary of each of the local government revenue sector, its spending sector destination and the amount of revenue collected is given in the table below.

Table 2-10. Mapping Local Government Revenue to OTIM Government Spending Units

OTIM Revenue Sector	Name	OTIM Spending Account(s)	Total (million $)
LRTFUEL	Fuel tax	LSINV	14.08
LRTUTIL	Utilities taxes	LSNED	93.13
LRTHOT	Hotel-motel tax	LSNED	54.18
LRTMBIT	Multnomah County business income tax	LSNED	83.10
LRTOIBT	Other local indirect business tax	LSNED	189.57
LRTLAB	Payroll Transit tax	LSNED	146.72
LRTPROP	Property tax	LSNED, LSED	2,533.09
LRZWAT	Other water revenue	LSNED	297.89
LRZELEC	Other electricity revenue	LSNED	462.74
LRZTRAN	Other transportation revenue	LSNED	53.37
LRCAIR	Air transport charges	LSNED	80.95
LRCHOSP	Public hospitals charges	LSNED	265.79
LRCNR	Natural resources charges	LSNED	26.68
LRCPORT	Port facilities charges	LSNED	92.97
LRCPARKI	Parking fees	LSNED	23.12
LRCPARKS	Parks and recreation charges	LSNED	60.02
LRCSEWER	Sewerage charges	LSNED	357.80
LRCSOLWA	Solid waste disposal charges	LSNED	46.12
LRCHW	Highways charges	LSNED	21.47
LRCHCD	Housing and community development charges	LSNED	26.57
LRCK12	K-12 education charges	LSED	142.90
LRCCC	Community colleges charges	LSED	144.52
Sub-Total			5,216.78
	Transfers from Federal Government		745.10
TOTAL			5,961.88

Source: 1997 U.S. Census State and Local Government Finance Data adapted to OTIM

LOCAL PROPERTY TAX (LRTPROP)

Many local entities, such as counties, cities, and special districts, have the legal authority to levy taxes on real and certain personal property. With the advent of tax reform in the 1990s (such as Measure 5), these revenues have fallen as a proportion of total local government revenues, but property taxes remain the dominate source of local revenues in Oregon. For Fiscal Year 1997, these revenues were estimated at approximately $2.5 billion.

Given more developmental time for OTIM, the value of property stock by industry and household would have been included in the model. Thus, the relationship between economic activity and local government revenues could have been reflected more closely. However, since the taxed value of property has a limited relationship to market prices and since no data appear to exist to properly identify the value of real estate by industry or household type, property tax revenues collected by local governments is identified and treated in two ways: (1) residential property taxes are treated as a per-household tax, and (2) business property taxes are treated as an excise tax on business. The average per-household rate is determined from the base data. Although not allowed to vary from these levels, different household categories pay different average property taxes. Business property/excise rates vary by industry and are distributed by domestic demand in the model.. This design merits further work in future enhancements of OTIM.

LOCAL CHARGES

Local governments operate some utilities especially electrical, water and sewer on a large scale, and generate fairly significant revenue from these activities in Oregon. Other major charges are Community College tuition and charges (school lunches) associated with the K-12 educational system.

THE REST OF THE WORLD SECTOR

Oregon has a complex economy that maintains trading relationships with other regional economies in the United States and other countries. In OTIM economic activity outside of Oregon is modeled as a single economic unit. Thus, a household in Ohio buying Oregon's potatoes is as foreign as a firm in Osaka buying computer chips built in Hillsboro. It is assumed that, like in Oregon, households and firms outside Oregon maximize utility and profits. Oregon exports to Ohio or Osaka compete with local production in those economies and with goods and services produced elsewhere in the world.

Finding reliable data for these exports and for imports from the rest of the United States or the rest of the world is not possible. Foreign trade statistics are notoriously weak. Exports from Portland and other ports in Oregon are only partially documented as to their original sources, and transshipments through Oregon for export are frequently identified as exports from Oregon. Imports arriving in Oregon's ports are documented even more poorly as to their final destination. Trade between Oregon and the rest of the United States attracts no usable documentation for trade analysis purposes. With the advent of the North American Free Trade Agreement (NAFTA), the already limited documentation of trade between Oregon and two of its three largest bilateral trade partners (Mexico and Canada) is deteriorating.

OTIM relies on IMPLAN as the primary source for trade estimates. The IMPLAN produces estimates of interstate and international trade for 528 industry sectors. Imports and exports are derived by estimating regional supply and demand for each commodity and then applying regional purchase coefficients (RPCs) that determine the share of total demand supplied from local sources.[8] Excess supply is assumed to be exported. Residual demand is satisfied by imports. The international component of total trade is determined using national import and export ratios (assuming national trade patterns apply to Oregon). The 528 sectors are then aggregated into OTIM's 29 industry sectors. Completion of OTIM's SAM involved using adjustment of import and export values to balance payments to and from the 29 industry sectors. While the levels of imports and exports are probably some of the weakest data, trade in OTIM responds to changes in the relative price of Oregon-produced commodities vs. those produced outside, thus capturing the direction of the trade effects of a given change on the Oregon economy.

KEY MODEL ASSUMPTIONS

OTIM is a regional Computable General Equilibrium Model patterned after California Department of Finance's DRAM model. The choice of functional forms and baseline parameters in OTIM was led by examples in DRAM. Some of the key underlying assumptions are described below.

CONSUMER DEMAND

The consumer expenditure model employed in OTIM is the Almost Ideal Demand System (AIDS). This system is both flexible and easy to estimate. The properties of the AIDS model are described by Deaton

[8] RPCs are estimated by IMPLAN for each commodity in each region using a methodology pioneered in the 1977 U.S. Multi Region Input Output Accounts. Explanatory variables include employment share in each sector and land area share compared with the U.S. total.

and Muellbauer (1980). They show that it satisfies the theory of economic demand, is simple to estimate and is consistent with known household budget data. Review of the theoretical literature on household consumption reveals AIDS consumption functions as a preferred theoretical choice if good estimates of the numerous 'cross-price' elasticity parameters[9] can be obtained. In this respect the Oregon model OTIM was able to build on the experience of California. DRAM uses AIDS-based consumption functions. In OTIM AIDS consumption functions were implemented by borrowing the household income elasticities and price elasticities from DRAM.

PRODUCER BEHAVIOR

The functional form chosen for OTIM production functions was Constant Elasticity of Substitution (CES) for factors and fixed-shares for intermediates. CES functions accommodate a range of assumptions about the substitutability of production inputs. In the empirical literature, estimates of the elasticity of substitution between labor and capital are usually found to be less than one (equally substitutable) but greater than zero (no substitution allowed). In OTIM, elasticities of substitution between labor and capital were chosen as in DRAM: factor elasticities just below 1.0 were chosen for all industries. The elasticity of substitution between non-factor (intermediate commodity) inputs was set at zero.

TRADE

To evaluate the impact of trade on the Oregon economy, the share equation form of Armington's CES function is used in OTIM. The Armington model shares some elements of both neoclassical and new trade models. The main assertion is that the products imported from the rest of the world are considered to be imperfect substitutes for products made locally. Two commodities are imperfect substitutes if a change in their price ratio results in a less than proportionate change in demand. Applying this to traded commodities, if the price of imports relative to the price of similar goods in the domestic economy goes up, Oregon consumers will adjust by demanding more domestic products. However due to the partly heterogeneous nature of the imported and domestic goods, consumers will not switch completely to one source of supply over the other. For example, a relative increase in the price of bananas will induce some consumers to switch to locally grown melons, but some consumers will still purchase bananas.

On one hand, the Armington model resembles the new trade models in postulating that consumers get utility from consuming a variety of products. On the other hand, it is in the neoclassical tradition in that goods are produced by firms enjoying constant returns to scale who face perfect competition in trade.

Reliable trade data at the state level are not available nor are trade elasticities for states. The elasticities used for Oregon import demand and export supply in OTIM were chosen to represent the middle ground of published estimates obtained from the literature. All of these studies use U.S. data. The assumption is that Oregon's trade patterns mimic U.S. trade and that true parameters for Oregon resemble those of U.S. At worst, the U.S. estimates are lower bounds for Oregon because there is good reason to believe that a region's goods are more price sensitive than those of a nation. For OTIM, import and export elasticities are set at the DRAM values of 1.5 and 1.65, respectively, except for less traded goods such as most services, which have import and export elasticities set at 0.5 and 0.65, respectively.

INVESTMENT

Investment behavior in OTIM is a variant of the cost-of-capital model. This model has solid theoretical grounding and is simple to implement. Net investment (change in the capital stock) in Oregon is assumed

[9] Measures of price-driven factors affecting consumer's choice between different consumption goods.

to respond to change in the rate of return to capital in Oregon relative to the rest of the world. A change in the Oregon corporate income tax is an example of a policy that would result in a change in the relative rate of return to capital.

Reliable estimates of the elasticity of investment with respect to rates of return are scarce because good data on regional investment are difficult to find. For OTIM, elasticity of investment with respect to the rate of return is set at 20, implying that investment response to differential capital return in Oregon is quite complete during the model's 5 year adjustment period.

LABOR SUPPLY

The primary consensus in the literature on labor supply is that the working hours and participation rates of men are relatively insensitive to net wages and exogenous income while the working hours and participation rates of women are more sensitive to both. There is also evidence of a differential labor supply responsiveness among income groups.

In OTIM household labor supply is modeled as a function of the change in statewide wage rates, the change in income taxes and the change in transfer payments.

In order to weight the labor supply elasticities of men and women reviewed in the text for the aggregated elasticity estimates that will be used in OTIM, information on labor-force participation rates for men and women was used. According to the U.S. Bureau of Labor Statistics, in 1988, men were 55% of the labor force and women were 45%. Applying these weights to the average of the wage elasticities reported in the literature results in a general labor supply elasticity with respect to wage of approximately 0.4. As in DRAM, this elasticity is applied to income groups in OTIM on a sliding scale, from zero for the lowest income group to 0.8 for the highest income group. Likewise, OTIM elasticities of labor supply with respect to personal income taxes range from 0 for the low-income group to –0.5 for the highest income group.

As in DRAM, the elasticity of labor supply with respect to transfer payments has been set at 0.05 for the lowest income group and zero for the other income groups. These numbers reflect the observation that labor supply decisions by upper-income groups are relatively unaffected by transfer payments.

POPULATION

The population equations in OTIM express number of households as a function of the natural rate of population growth, inmigration and outmigration for each household type. Migration responds to economic factors and government education spending. Future versions of the model will attempt to separate the responses of different age cohorts and add additional variables, including housing prices and amenity values.

OTIM currently uses a simple adjustment function for the number of households in each of the eight household groups. In-migration is added to the baseline number of households and adjusts upward as per-household after-tax wages and government education spending rise, and downward as unemployment rates rise. Out-migration is subtracted and adjusts in the opposite direction in response to the same variables. The migration responsiveness elasticities for upper-income households are relatively high with respect to after-tax incomes (2.5), low with respect to unemployment (0.2) rates and not responsive to government education spending (0). Responsiveness of low-income households is lower with respect to after-tax incomes (1.3) and higher with respect to unemployment rates (0.8) and education spending (0.02). The six household groups in between were assigned intermediate values of these elasticities.

PUBLIC INFRASTRUCTURE

OTIM includes a variable that directly transmits the effect of changes in public spending back to the private industry supply functions. This variable accounts for the fact that changes in public infrastructure spending have direct effects on private producer costs, and thus acts as a partial counterweight to the otherwise negative effect increased taxes have on supply-side behavior, and vice versa.

Unfortunately there is little guidance in the literature as to the magnitude or components of this response. Studies report a wide variation in the magnitude and even direction of the response, depending on the geographical area, time frame and what revenues and spending items are included. For this first version of OTIM, change in public infrastructure is measured as the change in real, total state and local government expenditures (compared against the baseline level), and the elasticity of the effect on private industry was set at a relatively modest 0.01, implying that a 10% increase in total state and local government spending will reduce average private production costs by 0.1%.

CHAPTER 3

THE DISTRIBUTION OF OREGON'S STATE AND LOCAL TAX BURDEN: ANALYTIC FRAMEWORK AND DATABASE

This chapter outlines the framework for distributional analysis in the Oregon Tax Incidence Model, the databases used in constructing the baseline distribution table, and some characteristics of the Oregon households in different income classes.

CRITICAL DECISIONS IN A DISTRIBUTIONAL ANALYSIS

The first section of the chapter identifies the major decisions underlying any distributional analysis, and the alternatives considered and decisions made in the Oregon model. Four critical decisions in a tax incidence study relate to:

- Demographic unit
- Income measure
- Taxes included
- Income distribution framework

The Oregon Tax Incidence Model was constrained to some degree in these basic structural decisions by the need to make the tax burden distribution analysis consistent with the IMPLAN Social Accounting Matrix that provides the analytical underpinning for the dynamic tax analysis. For the Oregon Tax Incidence Model, the following decisions were made:

- Households (as defined by the Census) are the basic demographic unit.
- A broad definition of income (Current Population Survey money income plus realized capital gains) is used in the distributional analysis.
- Although a distribution of federal, state, and local taxes is presented, the baseline distribution and analysis of changes in the tax burden focus on Oregon state and local taxes.
- The eight income groups defined in the Social Accounting Matrix provide the income distribution framework.

CHOICE OF DEMOGRAPHIC UNIT OF ANALYSIS: TAX-FILERS, FAMILIES, HOUSEHOLDS

An important initial decision for a tax incidence study is the choice of an economic unit across which to analyze the distribution of income and taxes. As Graetz notes, "In principle, since a family or household's aggregate income is typically shared for living expenses, the family or household is the appropriate unit for use in distributional tables" (Graetz, 1995, p. 43). Analyses based on microsimulation models using tax record data often must tradeoff between a conceptually preferred "family" and the "tax filer" unit on which the analyst has good data. The Joint Committee on Taxation of the U.S. Congress analyzes units that hew closely to "tax filers," ignoring dependents who file separate returns.

Distribution analysis more typically uses the "family" as the unit of analysis. The Office of Tax Analysis of the U.S. Treasury and the Congressional Budget Office (CBO) use families as their unit of analysis, statistically estimating family income. It is common in distribution tables that present incidence results by household decile to include all families in each decile, regardless of family size. This kind of analysis has most single people in the lower deciles and finds two-earner married couples disproportionately represented in the upper deciles. The CBO produces distribution tables in which families are ranked by an income-equivalent scale that standardize families by adjusting for family size. Sometimes, as in the Institute of Taxation and Economic Policy studies, the unit is a "typical family of four" or some other standard prototype family unit to adjust for the size of the family.

The Minnesota Tax Incidence Study is based on "households," defined as "an actual or potential income tax filer and all dependents, even if not living under the same roof" (p. 19). The Minnesota study argues that "The definition of a household should be consistent with the average citizen's use of the term" (p. 18), and thus ends up with a definition that is like the "family" unit used in other analyses.

The Minnesota study compared the number of households in its incidence analysis with the Census estimate of household numbers and found that their "incidence household" count (2,193,971 in 1996) was 24 percent higher than the U.S. Census estimate of 1,763,000 for the same year. (Median income for the "incidence households" was $27,866, 80 percent of the Census median income of over $35,000. The lower median income is primarily due to spreading the same amount of total income over a larger number of households.) The estimates are argued to be consistent due to different definitions of households. Since the Oregon study uses a Census definition of households, it is worth spending some effort to explore this difference.

The Census defines a household as follows:

> A household includes all the persons who occupy a housing unit… in which the occupants live and eat separately from any other persons in the building and which has direct access from the outside of the building or through a common hall. The occupants may be a single family, one person living alone, two or more families living together, or any other group of related or unrelated persons who share living arrangements. [quoted in Minnesota, p.19]

There are three basic ways in which Census households and Minnesota "incidence households" differ, the last two of which account for most of the 24 percent difference in household numbers:

- Some Census households (college students living in an apartment claimed as a dependent on the parents' return) are not counted as "incidence households."
- Census households (three self-supporting single people sharing an apartment) often count as more than one incidence household.
- Census households do not include people living in "group quarters" (college dormitories, nursing facilities), but some of these people may be "incidence households.

The conceptual issue in the definition of an analytical unit revolves around what is an appropriate economic unit. A group of people who share income and expenses and tax liabilities broadly satisfies the idea of an economic unit. The Minnesota "incidence household" matches the average citizen's concept of a "family" in that the unit shares some income, certain expenses and certain taxes. The members of a Census household, as defined above, share housing but may or may not share income, food expenses, or property taxes.

The Oregon Tax Incidence Model uses the Census definition of households as the demographic unit of analysis, the people living in a housing unit. The Census definition of a household used in this study includes single person households, multiple person households, single family households, and multiple family households.

CHOICE OF INCOME MEASURE

Economists generally prefer a comprehensive measure of income in tax incidence studies. The Haig-Simons definition is the broadest definition of income. Under this definition income is "the amount that a family consumes in a year plus the net increase or decrease in the inflation-adjusted (real) value of their assets" (Minnesota Department of Revenue, 1999, p. 14). This measure includes cash and selected noncash sources of income, such as food stamps and accrued capital gains. One advantage of this income measure is that it is more consistent with national income accounts and the social accounts based on this system of accounting. The Haig-Simson definition has certain drawbacks, however. One drawback is that it does not conform to common perceptions about income and therefore, is difficult to explain to nontechnical audiences. Another concern is that survey data is insufficient to estimate some elements of Haig-Simson income.

Incidence studies generally define income in a way that excludes certain features of the Haig-Simons definition but that is a broader definition than the "adjusted gross income" used in filing income taxes. The Joint Committee on Taxation (JCT) of the U.S. Congress describes its income concept as "a considered compromise between theory, ease of implementation and understandability" (Graetz, 1995, p. 41). JCT employs a concept of "expanded income" which adds to "adjusted gross income" certain cash receipts, such as tax exempt interest and workers' compensation payments, Social Security, and excluded employer paid health and life insurance. Expanded income also includes realized capital gains and retirement income when received not when accrued.

The Minnesota study uses a "comprehensive income" that is similar to the JCT concept, in that it includes only monetary sources of income. The Minnesota study begins with federal adjusted gross income and adds "public assistance payments, the wage replacement portion of workers' compensation, tax exempt interest, nontaxable social security and nontaxable pensions, annuities and IRA distributions" (Minnesota Department of Revenue, 1999, p. 15). This total does not include income earned by persons who did not file an income tax return but filed for a property tax refund. Also, it does not include income earned by persons who did not file either type of return. An estimated 16 percent of the households and 4 percent of the income falls into these types of categories.

The distributional analysis in the Oregon Tax Incidence Model uses a comprehensive definition of money income that starts with the Current Population Survey (CPS) concept of income. The eleven income categories in the CPS are money wages and salaries, net income from nonfarm self-employment, net income from farm self-employment, Social Security and/or railroad retirement, Supplemental Security income, public assistance or Welfare payments, interest on savings and bonds, income from dividends, estates or trusts and net rental income, veterans' payments or unemployment and workmen's compensation, private pensions or government employee's pensions, and alimony or child support and other periodic income. Since the primary database for income is the CPS and not the Department of Revenue tax files, the income base includes income from households that do not file income tax returns or pay property taxes.

CPS money income does not include realized capital gains, and the Social Accounting Matrix underlying the dynamic analysis in OTIM does not model capital gains income. The income groups in OTIM are therefore defined on the basis of CPS income. However, the income base used in the computation of

effective tax rates in the distributional analysis includes realized capital gains income, as described in below.

CHOICE OF TAXES TO INCLUDE

The classic studies of tax incidence at the national level examine the distribution of federal, state and local taxes (Pechman, Peckman and Ockner, Browning and Johnson). Studies that look at the incidence in different states have tended to analyze the distribution of only state-local taxes (Phares, Ettlinger et. al., and McIntyre et. al.). The Minnesota Tax Incidence Study examined only the distribution of Minnesota state and local taxes. The Minnesota study analyzed all the major taxes on businesses and individuals (income and sales taxes for the state and property taxes for local governments) and included taxes that accounted for 98 percent of tax collections.

The Oregon Tax Incidence model provides baseline information about the distribution of all federal and Oregon state and local taxes. In the analysis of alternative tax proposals, however, the model estimates the impact only on the distribution of Oregon state and local taxes. The model takes into account the deductibility of federal taxes against the state personal income tax and the deductibility of state personal income and local property taxes against the federal personal income tax.

The distribution of tax payments among sectors, households, enterprises, and factors is described in the IMPLAN Social Accounting Matrix (SAM). The amounts of taxes in the original IMPLAN SAM are adjusted with two databases. First, the Department of Revenue merged Personal Income Tax/Property Tax file for 1997 Oregon Households is used to allocate personal income and household property taxes to each income class. The control total here is the Department of Revenue data on personal income taxes and property taxes. Second, all other taxes and nontax charges are benchmarked against the US Bureau of the Census *State and Local Government Finances 1996-97* for state and local government expenditures and revenues.

CHOICE OF INCOME DISTRIBUTION FRAMEWORK

The most common framework for displaying the distribution of incomes and tax burdens is the population decile: ten groups of taxpayers or households ranked by income, each group representing 10 percent of the population. The Minnesota Tax Incidence Study uses this classification. A common variant is to group taxpayers or households by population quintile (fifths of the population ranked on income), often with special attention to the upper income groups (upper 5 percent, upper 1 percent). Ettlinger et. al. and McIntyre et. al. use this classification system. Another alternate approach, found in the Minnesota study, is to use income deciles, in which households are ranked by income (as in the population deciles) and divided into 10 groups; households in each of the groups, however, have ten percent of *income* rather than of the population.

Other studies define groups by income ranges (e.g., less than $5,000, $5,000-$9,999, etc.) and analyze the distribution of income and tax burden among these income groups. Phares, and Weber and Moore define income groups this way. Some works use a summary measure of inequality to characterize the distribution of the tax burden. The Minnesota study uses a Suits index: a measure with a value of –1 (indicating a very regressive tax structure) to +1 (indicating a very progressive structure). A Suits index of 0 indicates a proportional system.

The Federal Congressional Budget Office uses “adjusted family income” to rank families and to group them into quintiles. This measure adjusts household income by an index of well being to account for different family sizes. Family income is divided by the poverty index for the given size of family to create

an index of well being. We are not aware of any studies at the state-local level that have used "adjusted family income quintiles" to analyze distribution of incomes or tax burdens.

Many studies offer several different perspectives on the distribution of incomes and tax burden. Pechman, for example, shows tax incidence by population decile and income range. Different combinations of reporting provide a wider range of information. Phares shows the distribution by income range and Suits index. Minnesota presents an analysis by income decile, population decile, and Suits index.

The Oregon Tax Incidence Model reports the distribution of income and taxes for eight income groups defined by income ranges. The eight income groups are defined to be consistent with the income groups in the 1997 Consumer Expenditure Survey, which are the basis of expenditure estimates for the IMPLAN household income groups. This choice was required by the need to link the distributional analysis to the dynamic revenue analysis using the CGE model built on the IMPLAN SAM.

THE DATABASE FOR THE DISTRIBUTIONAL ANALYSIS

Creation of a database for distributional analysis of tax burdens requires the selection of a distributional framework and then a distribution of households, income, and taxes among the relevant income groups. The OTIM distributional analysis is based on eight income groups. Federal, state and local taxes and money income are distributed among households in these eight groups.

Three primary data sources are used in the construction of the distributional database for the Tax Incidence Model. A fourth database, the 1998 Oregon Population Survey [OPS], is used to discuss the characteristics of Oregon households by income group. The three data sources for the distribution of 1997 households, income, and taxes in Oregon are IMPLAN SAM, the Oregon sub-sample of the March Current Population Survey for 1997-99 [CPS97-99], and the Oregon Department of Revenue Merged Household Tax file [MERGE97]. The MERGE97 data source is a sample of 1997 Oregon personal income tax filers grouped into households by address and merged with property tax records. Adjusted gross income reported in these records has been modified to approximate "money income," by including some non-taxable income and excluding taxable capital gains, in order to allocates taxes into the eight income groups defined by money income. Realized capital gains in the MERGE97 file are then added to money income in each group to get the comprehensive income measure used in the distributional analysis. Because the Current Population Survey (CPS) sample size for any given year is only about 700 households in Oregon, it is necessary to pool the Oregon data from the three years 1996-98 to get reliable estimates of 1997 variables. Since the CPS asks about money income in the previous year, the 1997-1999 CPSs report 1996-1998 income data. IMPLAN, MERGE97 and the 1998 OPS present 1997 income data, as well.

Each of the three databases has part of the information needed to construct a distributional table. The IMPLAN SAM, as the underlying structure for the CGE model, provides the "eight-income-group" structure for describing the income distribution and information about the shares of income in each of eight income groups, and some information about the distribution of taxes among income groups. The CPS provides information about the amount of money income in 1997 and about the income ranges and number of households in each income group. And the MERGE97 file provides information about the amount and distribution of realized capital gains, and about how property taxes and income taxes are distributed among each of the income groups.

The process of constructing the IMPLAN SAM household income distributional matrix involved four steps:

- Using the IMPLAN SAM 1997 Consumer Expenditure Survey-based income groups as the distributional framework and the IMPLAN SAM income shares from the 1990 Census to distribute income among the income groups.
- Using the CPS to determine the amount of money income and number of households, and to establish the income ranges for each income group and allocate households among income groups.
- Adding taxable realized capital gains income from the MERGE97 database to the CPS money income estimates to establish the distribution of OTIM comprehensive money income.
- Allocating taxes paid directly by households among the income groups: the federal income tax and the two major Oregon taxes (property and personal income) using the MERGE97 file, and other household taxes using information from the IMPLAN SAM.

A challenge associated with the creation of this database is that income definitions and categories vary quite a bit among different data sources. Table 3-1 illustrates the differences in income and income definitions between data sources. There are important differences difference between CPS97-99 (a survey) and MERGE97 (administrative income tax data), for example, in definition of income and in the incentives to report accurately information about income. Tax records contain data on taxable income, and in filing taxes people have no incentive to over-report income but face possible penalties for underreporting. The CPS is based on a survey in which people are asked to recall information on a variety of taxable and nontaxable income sources from the previous year. There are also significant differences between the IMPLAN "personal income" and the other CPS and MERGE97 "money income" estimates. Most important among these is that "personal income" includes estimates of private pension accruals and imputed rental income on owner-occupied homes, which make IMPLAN personal income estimates much higher than the "money income" estimates of the other two sources that do not include these sources.

Table 3-1. Income Categories across Data Sources (thousands of dollars)

Definition of Category	IMPLAN Personal Income	CPS97-99 Money Income	MERGE 97 "Money Income"
1. Money wages or salaries	$43,660,337	$45,754,512	$35,819,024
2. Net income from non-farm self-employment	$6,735,651	$4,498,813	$2,709,647
3. Net income from farm self employment	$114,773	$198,809	$125,745
4. Social Security or Railroad Retirement	$11,609,636	$3,761,151	$1,625,148
5. Private pensions or government employee pensions		$2,759,908	$3,165,300
6. Interest (on savings or bonds)	$14,257,275	$2,429,599	$2,037,501
7. Dividends, income from estates or trusts, or net rental income		$2,296,674	$4,699,306
8. Supplemental Security income	$801,081	$198,841	
9. Public assistance or welfare payments		$525,088	
10. Alimony or child support, regular contributions from persons not living in the household, and other periodic income		$918,806	$1,030,688
11. Veterans' payment or unemployment, and workmen's compensation	$400,290	$660,792	$258,563
TOTAL	$77,579,043	$64,002,993	$51,470,922

The IMPLAN SAM is a database that draws on a number of federal and state data sources and organizes them into a unique array for economic and distributional analysis at a sub-national level. The three federal databases that are most relevant for the SAM distributional analysis are the US Bureau of Economic Analysis (BEA) Personal Income estimates for 1997, the 1990 Census of Population and the 1997 Consumer Expenditure Survey. The Consumer Expenditure Survey reports expenditures on various goods and services by nine income groups. IMPLAN uses this information to produce estimates of expenditures on nine consumption categories by each of the nine income groups. The 1990 census provides information about distribution of income across the nine CES Income groups. Households in lowest CES income group, for example, received 0.49 percent of income. This set of households reports negative income from business losses and it is believed that many of the households under-report a significant share of their income, and so their reported income does not truly represent their ability to pay. While underreporting is believed to occur in all income groups, this problem has more impact on the lowest income group because the total income base is so small. The lowest two income groups from IMPLAN SAM are therefore collapsed into a single category so that the Oregon Tax Incidence Model has eight income groups.

The CPS97-99 provides the most reliable and current information about 1997 money income and the household distribution among income groups for Oregon. The Oregon CPS sample households were ranked by household money income and divided into the eight income groups based on the percentage shares of income reported for each group in the IMPLAN SAM (which was in turn based on the 1990 Census distribution). For example, the lowest income group in the IMPLAN SAM (actually, the lowest

two CES groups combined into a single group as discussed above) received 2.96 percent of the total income. To establish the income range for this lowest income group the CPS sample of households was ranked on income and a cumulative share of total income from lowest to highest was reported for each household. The household whose income produced a cumulative total of 2.96 percent of had an income of $14,525. This figure is used as the upper limit for the lowest group. Table 3-2 shows the income ranges, number of households and CPS money income distribution for the eight income groups.

Table 3-2. CPS97-99 Distribution of Households and Money Income

Income Range	No. of HHs	% of Households	Mean Income	Total Income	% of Total Income
< $14,526	213,130	16.6%	$8,872	$1,890,889,360	3.0%
$14,526 - $21,225	152,876	11.9%	$17,832	$2,726,056,459	4.3%
$21,226 - $28,739	152,642	11.9%	$25,176	$3,842,902,377	6.0%
$28,740 - $45,024	250,955	19.5%	$37,120	$9,315,561,002	14.6%
$45,025 - $62,026	189,249	14.7%	$53,205	$10,069,021,808	15.8%
$62,027 - $80,000	125,167	9.7%	$70,486	$8,822,490,263	13.8%
$80,001 - $126,172	132,913	10.3%	$99,002	$13,158,622,449	20.6%
> $126,172	67,777	5.3%	$209,182	$14,177,618,675	22.1%
Total	1,284,709	100.0%	$49,820	$64,003,162,393	100.0%

Source: 1997-1999 Current Population Survey

The income groups are defined in OTIM based on CPS money income of the households, which does not include capital gains income. However, realized capital gains income represents a substantial percentage of household income for some households, and should be included in the database for the distributional analysis. The 1997-99 CPS reports that about 15 percent of all households report capital gains, and 45 percent of the households in the highest income group reports such income. (Although the CPS money income definition does not include capital gains, the CPS does collect information about the capital gains.)

In order to better represent the income of Oregon households in the distributional analysis, an estimate of taxable realized capital gains for 1997 was added to CPS money income for the calculation of effective tax rates reported in the distributional analysis. Oregon Department of Revenue data in the MERGE97 file on the taxable realized capital gains suggest that such income totaled $4,127 million in 1997. This amount was added to CPS money income estimate of $64,003 million for the distributional analysis, and distributed among income groups based on data in the MERGE 97 database. Table 3-3 shows the distribution of CPS money income plus realized capital gains used as the baseline income distribution in the OTIM distributional analysis.

Table 3-3. OTIM Distribution of Households and Comprehensive Money Income

Income Range	No. of HHs	% of Households	Mean Income (w/ capital gains)	Mean Realized Capital Gains	Total Income (w/ capital gains)	% of Total Income
< $14,525	213,130	16.6%	$9,439	$567	$2,011,823,232	3.0%
$14,526 -	152,876	11.9%	$18,527	$695	$2,832,352,951	4.2%
$21,226 -	152,642	11.9%	$25,797	$621	$3,937,649,591	5.8%
$28,740 -	250,955	19.5%	$38,649	$1,529	$9,699,263,080	14.2%
$45,025 -	189,249	14.7%	$54,785	$1,580	$10,367,947,562	15.2%
$62,027 -	125,167	9.7%	$72,678	$2,192	$9,096,882,702	13.4%
$80,001 -	132,913	10.3%	$102,973	$3,971	$13,686,400,028	20.1%
> $126,172	67,777	5.3%	$243,417	$34,235	$16,498,099,084	24.2%
Total	1,284,709	100.0%	$53,033	$3,213	$68,131,386,380	100%

Source: 1997-1999 Current Population Survey, realized capital gains from MERGE97

The final step in creating the distributional database is to distribute direct household taxes to these households. The direct tax payments by households in each income group are estimated in the IMPLAN SAM for all taxes except the federal and state income taxes and the local property tax. The IMPLAN SAM estimates are used for federal estate, Social Security, miscellaneous taxes, the Oregon estate tax, and other taxes and nontax charges. The MERGE97 file is used to estimate the distribution of the federal personal income tax and Oregon property and personal income taxes (Oregon's two major taxes) among income groups. The 35,000 income tax filer households in the MERGE97 file were matched with property-tax-paying households based on names and addresses on property tax records. The resultant MERGE97 file has reported personal income taxes and reported property taxes for a random sample of Oregon tax filers. About 90 percent of homeowner property taxes were able to be matched to income tax filer records. The homeowner property taxes that were not able to be matched were allocated among income classes in proportion to the allocation in the matched records. The MERGE 97 households are sorted into income groups so that the shares of "expanded money income" in the MERGE97 income groups matched the income distribution in the CPS and IMPLAN data. The total property and income taxes paid by each group are assigned to the appropriate household income group in the IMPLAN SAM.

This process produces a distributional database for the Oregon Tax Incidence Model, which contains information about the distribution of households, income and taxes for the State of Oregon. This database is the foundation of the analysis of the baseline incidence in Chapter 4 and the analysis of tax changes such as those reported in Chapter 5.

CHARACTERISTICS OF THE OREGON HOUSEHOLDS: 1997

In assessing the impact of changes in the distribution of the tax burden among the various income classes, it is important to understand who is in each of these income classes. This section of the chapter examines the characteristics and sources of income for the Oregon households in the eight income groups in 1997. The description of the distribution by income by source comes from the CPS97-99 and the characteristics of Oregon's households come from the 1998 Oregon Population Survey (OPS), which reports 1997 income data. Both the OPS and the CPS use the Census definition of households.

A major hurdle regarding income had to be overcome in order to place households in the OPS into the CPS-defined income groups. The CPS and OPS share a common definition of income but report income in different ways. The CPS reports exact measures of household income while the OPS reports income in

categorical form. That is, the survey respondents indicate which of 17 categories (e.g. less than $5,000, $5,000 - $7,500, etc.) best represents their household income.

In order to sort households from the 1998 OPS into the income ranges determined by the 1997-1999 CPS, point estimates of income are needed for the 1998 OPS. The existing OPS data is used to econometrically impute a useful, continuous measure of income. This is accomplished through Maximum Likelihood Estimation of an econometric model containing demographic and economic explanatory variables. A unique likelihood function is used that restricts estimates so that they fall within the original, observed category of income. Therefore, the estimated values of income remain consistent with the original data. A technical description of this technique and its application to the 1998 CPS is available on request.

HOUSEHOLD TYPES AND DEMOGRAPHIC CHARACTERISTICS

Households, as defined by the Census and as used in this distributional analysis, include many different arrangements of family, friends and strangers. Table 3-4 lists the nine household types used in this analysis and their percentage share of total households in Oregon and in each of the income groups. Table 3-4 also shows percentage shares for groups based on *Age , Disability Status, Education Level, Housing Status, Rural-Urban residence, Race/Ethnicity* and *Occupation*. The first six household types are similar to those in the Minnesota study and the last three represent the households that do not easily fit into the previous household categories. These later categories include "roommate only" households where there is no relation among any of the inhabitants, "multi-generation" households in which at least one relative besides a spouse or child resides, and "other" households with both relatives and non-relatives. The last category includes, for example, households of families living with boarders. Couple households include legally married couples, cohabiting couples and same sex, cohabiting couples.

Figure 3-1 shows that couple households with children under 24 years old account for the largest share of Oregon households. Single households, both elderly and not elderly, dominate the lowest three income groups. The percentage of single, non-elderly households begins to taper off after the third income group while the single, elderly households fall off quickly after the second income group. The single parent households account for a higher percentage in the lower income groups. Couple households, both with and without children, increase in percentage share as income increases.

Figure 3-1. Household Type of Income Group

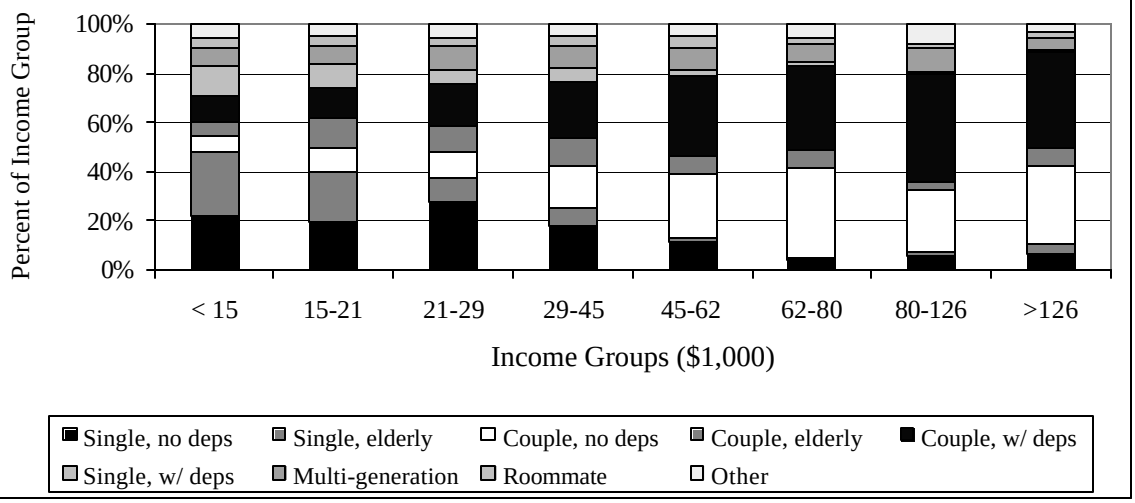


Table 3-4. Demographic Characteristics by Income Group

Sub-group of Population	Categories	< 15K	15-21K	21-29K	29-45K	45-62K	62-80K	80-126K	>126K	Total
Household Type	Single, no deps	22.4%	19.7%	27.2%	18.0%	11.4%	4.3%	5.9%	6.7%	16.6%
	Single, elderly	25.6%	20.1%	10.2%	7.4%	1.3%	0.8%	1.8%	4.4%	9.3%
	Couple, no deps	6.4%	9.8%	10.6%	16.5%	26.6%	36.5%	24.7%	31.5%	18.5%
	Couple, elderly	6.2%	12.1%	10.8%	11.6%	7.0%	7.0%	3.4%	7.0%	8.7%
	Couple, w/ deps	9.9%	12.5%	16.4%	22.9%	33.0%	34.8%	43.9%	39.5%	24.1%
	Single, w/ deps	12.2%	9.9%	6.1%	5.6%	2.3%	1.1%	0.8%	0.7%	5.4%
	Multi-Generation	7.7%	7.0%	9.3%	9.0%	9.2%	7.3%	10.2%	4.4%	8.5%
	Roommate Only	4.2%	4.0%	3.8%	3.8%	4.3%	2.7%	1.4%	2.3%	3.7%
	Other	5.5%	5.0%	5.2%	5.1%	4.9%	5.6%	7.9%	3.6%	5.3%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%
Age Group	18-25	14.8%	11.0%	12.2%	7.8%	5.9%	1.9%	2.2%	2.0%	8.3%
	26-44	26.6%	29.8%	35.7%	38.0%	43.1%	45.6%	48.7%	30.7%	37.4%
	45-65	26.4%	27.3%	30.4%	36.5%	43.2%	44.4%	45.5%	55.0%	36.6%
	65+	32.2%	31.9%	21.7%	17.7%	7.9%	8.0%	3.6%	12.4%	17.6%
	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Disability Status	With Disability	29.1%	20.1%	14.3%	12.5%	8.9%	11.6%	5.7%	4.0%	14.3%
	No Disability	70.9%	79.9%	85.7%	87.5%	91.1%	88.4%	94.3%	96.0%	85.7%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%
Education Level	Post Grad	2.1%	3.4%	3.9%	7.5%	11.0%	23.2%	23.3%	17.7%	9.3%
	College Degree	8.4%	8.2%	17.6%	17.3%	24.0%	28.6%	30.4%	37.5%	19.3%
	Some College	31.1%	34.6%	36.3%	38.7%	40.1%	29.9%	32.2%	32.4%	35.7%
	HS	34.9%	36.9%	32.0%	29.9%	21.3%	16.6%	12.0%	10.3%	26.8%
	No HS	23.5%	16.9%	10.2%	6.6%	3.5%	1.7%	2.1%	2.0%	8.9%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%
Housing Status	Free and clear	30.8%	35.7%	25.4%	24.1%	14.8%	12.7%	13.5%	25.9%	22.7%
	Mortgage	18.8%	18.6%	28.1%	44.2%	64.2%	73.1%	77.9%	67.0%	45.4%
	Renter	43.8%	43.2%	43.6%	28.8%	18.9%	13.1%	8.7%	5.2%	29.0%
	Other	6.5%	2.5%	3.0%	2.9%	2.1%	1.1%	0.0%	1.9%	2.9%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%
Rural-Urban	Rural	35.8%	35.2%	33.9%	32.2%	27.8%	21.8%	22.6%	23.5%	30.5%
	Urban	64.2%	64.8%	66.1%	67.8%	72.2%	78.2%	77.4%	76.5%	69.5%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%
Race/ Ethnicity	Non-Hispanic White	81.2%	75.6%	85.1%	86.3%	87.7%	89.2%	89.8%	90.1%	85.5%
	Non-Hispanic African American	3.7%	2.1%	2.0%	2.2%	1.6%	0.6%	0.5%	2.5%	2.1%
	Hispanic	7.3%	10.5%	6.8%	4.9%	3.5%	2.8%	3.6%	1.5%	5.3%
	Other	7.7%	11.8%	6.0%	6.6%	7.3%	7.3%	6.1%	5.9%	7.2%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%
Occupation	High-Wage	15.8%	27.4%	36.4%	49.9%	61.2%	71.2%	69.0%	65.9%	46.8%
	Low-Wage	15.4%	19.7%	24.6%	18.1%	18.2%	13.7%	17.8%	10.3%	18.2%
	Not Working <65	33.1%	18.5%	17.3%	12.0%	12.2%	9.1%	9.2%	16.1%	16.3%
	Not Working >65	35.7%	34.4%	21.7%	19.9%	8.4%	6.0%	4.1%	7.6%	18.7%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%
Household Size	Average Household Size	2.1	2.2	2.3	2.5	2.9	3.0	3.3	2.8	2.5

Source: 1998 Oregon Population Survey

Table 3-4 presents additional detail about selected characteristics of Oregon's households. Figure 3-2 and Table 3-4 report age by income group. The age of the primary respondent is divided into 4 categories: 18 to 25, 26 to 44, 45 to 64 and 65 and older. The numbers reported are the percentages of the income group in a particular age category. The young and the elderly are over represented in the lowest three income groups. Those entering the labor force and those out of the labor force have lower incomes than others.

The shares of the two middle age categories increase as income increases. The wealthiest income group is dominated by the 45-65 age category.

Figure 3-2. Age by Income Groups

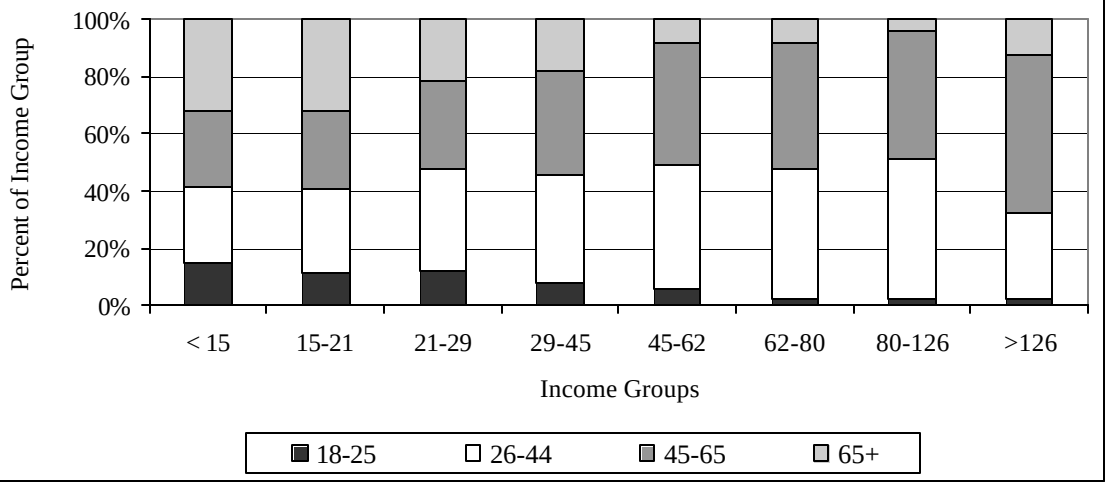
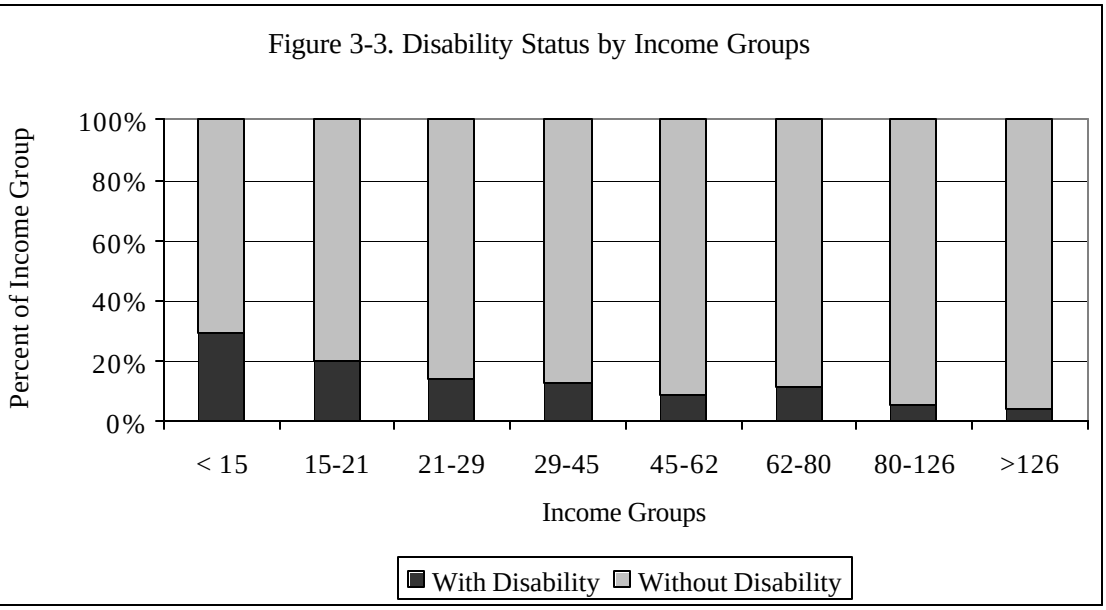


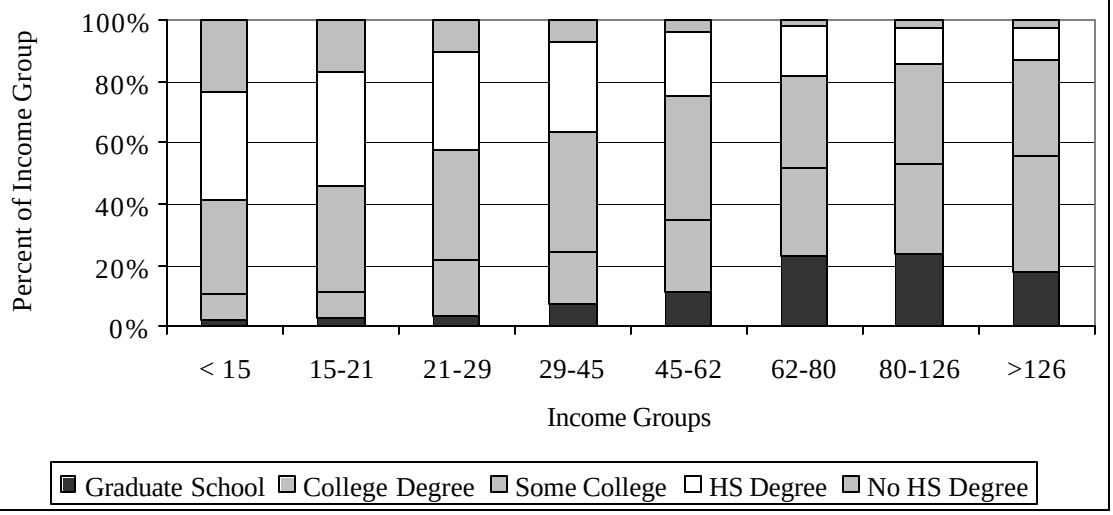
Figure 3-3 and Table 3-4 show disability status across income groups for the primary respondent. The OPS asks whether the respondent has a disability. The 1998 OPS defines a disability as a *lasting mental, developmental or physical disability*. As income increases the percentage share of those with a disability decreases. The lowest income group has the highest share of respondents with a disability.

Figure 3-3. Disability Status by Income Groups

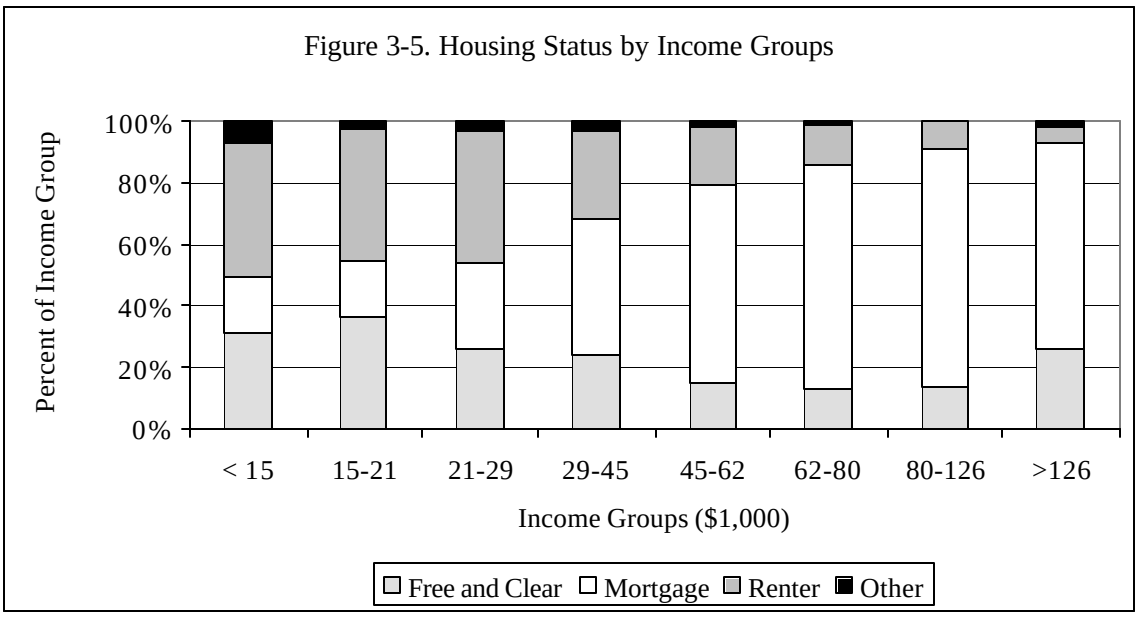


The education levels in Table 3-4 and Figure 3-4 are the highest level of education achieved by the respondent. *HS Degree* indicates completion of a high school degree, including GEDs. *Some College* includes post high school study at four-year colleges, community colleges, technical schools and trade schools. *College Degree* indicates graduation from a four-year college. Finally, *Graduate School* indicates completion of a professional, master's or doctorate degree. Those with less formal education are disproportionately represented in the lowest income groups. Nearly 60 percent of the lowest income group has a high school education or less while less than 13 percent of the highest income group has this level of education. While those with college or graduate degrees comprise just over a quarter of the respondents, they account for over half of the households in the upper three income groups.

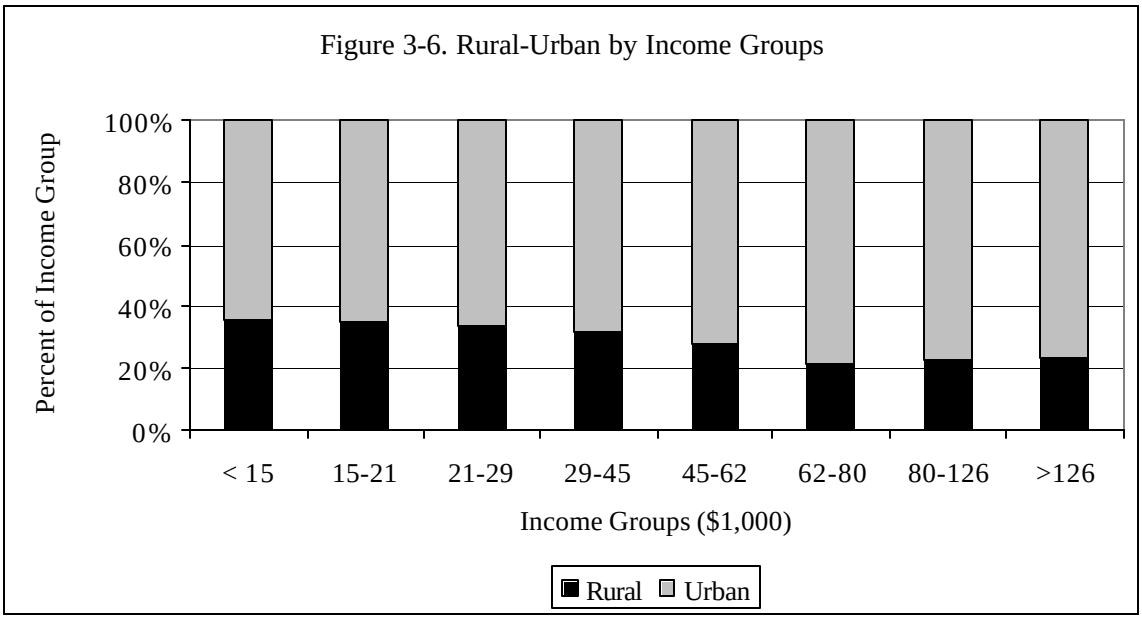
Figure 3-4. Education by Income Groups



Housing status also varies by income group. Those who own their houses without debt are classified as *Free and Clear*. Those who are buying their house are in the *Mortgage* category. *Renters* are those who rent, and *Other* are those who have some other type of arrangement. Examples of *Other* are boarders and other people living rent-free. Figure 3-5 and Table 3-4 depict housing status by income group. The share of households with mortgages increases as income increases. The share of renters decreases as income increases. The *Free and Clear* group maintains a larger presence in the lower income groups, which can perhaps be explained by the predominance of the elderly in these income groups.



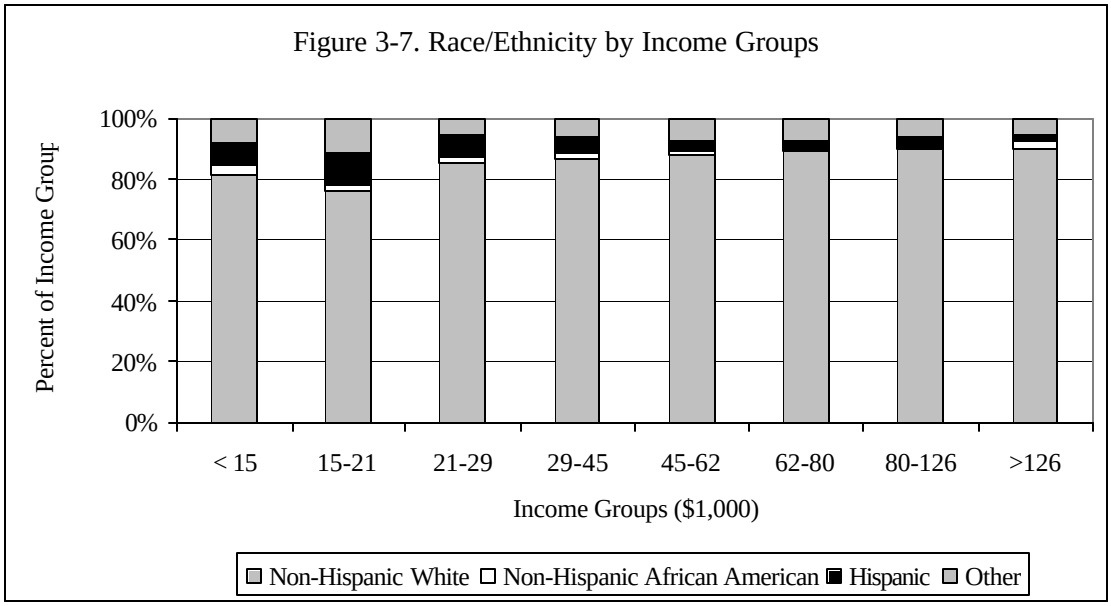
Where one lives affects one's income in Oregon: rural households are disproportionately in the lower income classes. Rural counties are those defined by the Office of Management and Budget as "non-metropolitan" in 1997: Baker, Benton, Clatsop, Coos, Crook, Curry, Deschutes, Douglas, Gilliam, Grant, Harney, Hood River, Jefferson, Josephine, Klamath, Lake, Lincoln, Linn, Malheur, Morrow, Sherman, Tillamook, Umatilla, Wallowa, Wasco and Wheeler. Urban counties are those defined as "metropolitan": Clackamas, Columbia, Jackson, Lane, Marion, Multnomah, Polk, Washington and Yamhill. Figure 3-6 and Table 3-3 shows the shares of each income group in rural and urban areas. Rural areas typically have lower average incomes than urban areas due to lower wages and higher unemployment rates.



Race and ethnicity also affect income. Using the race/ethnicity of primary respondent as the indicator, the Oregon population was 85.5 percent Non-Hispanic White, 2.1 percent Non-Hispanic African-American, 5.3 percent Hispanic and 7.2 percent other in 1997. Hispanics can be of any race. Figure 3-7 and Table 3-

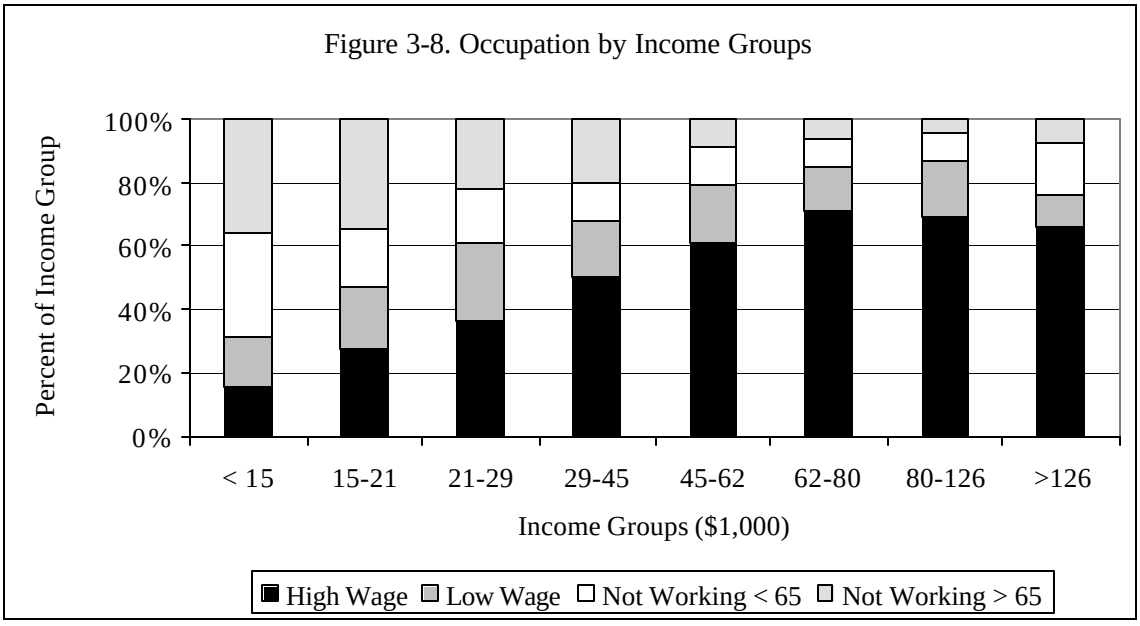
4 present race/ethnicity by income groups. African-Americans and Hispanics and other are disproportionately represented in the lower two income groups.

Figure 3-7. Race/Ethnicity by Income Groups



Occupation of the respondent also affects household income. Figure 3-8 and Table 3-4 show occupation by income group. Occupations are classified as high wage or low wage depending on whether average earnings for an occupation are higher or lower than the statewide average. (See Kraybill and Weber for more information on the classification procedure.) High wage occupations include managerial, owner, professional, craftsmen, machine operator, fishing, forestry and protective service. Low wage occupations include sales, clerical, laborer, agriculture, other service and "other." High wage workers dominate the upper half of the income groups. The data show that those who are not working and are 65 years old and older are concentrated in the lower half of the income groups.

Figure 3-8. Occupation by Income Groups



CPS MONEY INCOME SOURCES BY INCOME GROUP

Eleven components of income are used in the measure of CPS household money income. Table 3-5 shows these components as a share of total income for each of the income groups. The lowest income group receives the lowest percentage of income from salaries and earnings while it receives the highest percentage of income from public assistance, supplemental security, veterans' payments and social security. The percentage of income from nonfarm self-employment is highest in the eighth income group but the percentage of income from wages and salaries peaks in the fifth income group. Dividends, self-employment and interest reach their peaks in the later income groups. Social Security, as a percentage of income, falls off quickly after the third income group and private and government pensions peak in the fourth income group.

Table 3-5. CPS Money Income Sources for Income Groups

Income Component	**Income Groups** < 15K	15-21K	21-29K	29-45K	45-62K	62-80K	80-126K	> 126K	Oregon
1. Wages	42.8%	45.5%	67.1%	68.9%	83.0%	77.8%	74.9%	67.9%	71.5%
2. Self-employment	1.2%	6.0%	3.7%	4.3%	4.0%	4.9%	6.7%	14.5%	7.0%
3. Farm self-employment	-0.2%	0.0%	0.0%	0.5%	0.4%	0.0%	0.7%	0.2%	0.3%
4. Social Security	33.5%	30.8%	14.3%	8.8%	2.7%	2.6%	2.3%	0.8%	5.9%
5. Pensions	2.2%	5.6%	4.7%	6.8%	2.4%	4.7%	4.2%	3.8%	4.3%
6. Interest	2.4%	3.8%	2.3%	2.7%	2.3%	3.0%	4.6%	6.0%	3.8%
7. Dividends, etc.	1.1%	0.8%	1.4%	2.2%	1.9%	4.8%	4.1%	6.0%	3.6%
8. Supplemental Security	3.2%	0.8%	1.0%	0.4%	0.1%	0.2%	0.1%	0.0%	0.3%
9. Public assistance	7.1%	2.2%	1.4%	1.0%	0.6%	0.2%	0.8%	0.1%	0.8%
10. Alimony, etc.	3.1%	3.1%	1.9%	3.1%	1.3%	1.0%	0.7%	0.8%	1.4%
11. Veterans' payments	3.6%	1.5%	2.3%	1.6%	1.3%	0.7%	0.9%	0.1%	1.0%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: 1997-1999 Current Population Survey

Understanding how household types and income sources are distributed among income groups enriches the understanding of the impacts of tax changes. High-income groups have different demographic characteristics than low-income groups. By knowing who is in each income group, one can better understand who is helped or hurt by changes in the tax system that affect the distribution of taxes among income groups.

CHAPTER 4

CURRENT DISTRIBUTION OF OREGON'S STATE AND LOCAL TAX BURDEN: THE OREGON TAX INCIDENCE MODEL BASELINE

The burden of a tax does not necessarily fall on the one who writes the tax payment check. One of the fundamental distinctions in the economic literature on taxation is between the "impact" of a tax (which falls on the person who is legally liable for the tax payment) and the "incidence" of a tax (the final resting place of the tax burden after the "shifting" has occurred).

The *impact* of a corporate income tax, for example, is on the corporation earning the income. The corporation, however, does not bear the final burden of the tax, as it will shift the taxes to one or more groups of people. The *incidence* of the tax will be on the consumer (in the form of the higher prices the company may charge to cover the cost of the tax) and/or the corporate shareholder (in the form of lower returns to corporate ownership) and/or the employee of the company (in the form of lower wages). Tax incidence analysis uses economic theory to determine the final incidence of the tax after all the shifting has occurred, the distribution of the tax burden among various groups of persons or households.

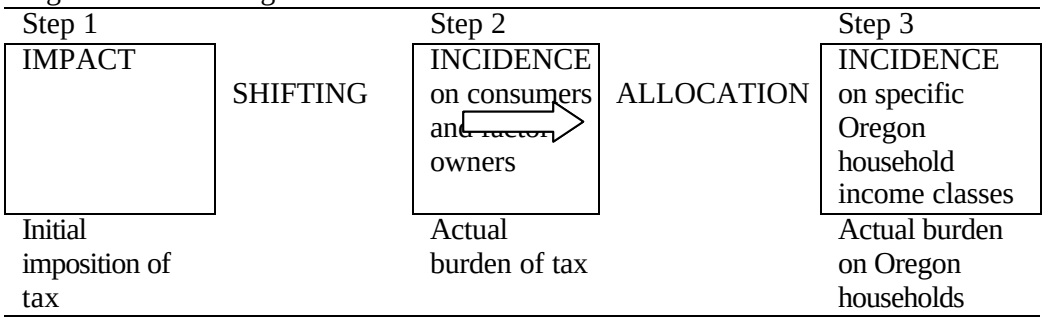
The Oregon Tax Incidence Model, unlike the Minnesota Tax Incidence Study, is linked to a dynamic computable general equilibrium (CGE) model that will determine the shifting of the tax resulting from a *change* in the tax codes. However, the CGE model itself does not have a baseline distribution of the tax burden among income classes. The Social Accounting Matrix (SAM) does identify the *impact* of each tax by industry, factor, enterprise account and household income class. But it does not have an accounting system that displays the baseline *incidence* of the tax system, the distribution of Oregon state and local taxes among income classes.

This chapter explains how the baseline distribution of tax burdens was constructed. It first reviews the process of estimating the distribution of tax burdens in previous studies, focusing on the central role that assumptions play in the outcome and reviewing the assumptions that have been used in previous studies. It then outlines the estimation procedure used in this study and the resulting baseline distribution of taxes among income classes.

ESTIMATING TAX INCIDENCE: A REVIEW OF PREVIOUS STUDIES

The process of estimating the distribution of the final burden or incidence of state-local taxes has been viewed as a three-step process in most previous studies. This conceptualization of estimating tax incidence as a three step process goes back at least a half century, and was the basis for the pioneering 1951 *National Tax Journal* article "Distribution of Tax Payments by Income Group: A Case Study of 1948" by Richard Musgrave et. al.. Figure 4-1, adapted from the Minnesota Department of Revenue *1999 Minnesota Tax Incidence Study*, outlines the process.

Figure 4-1 Estimating Tax Incidence[10]



Step 1 involves obtaining data on the initial impact of taxes, on how much different household income classes and other economic entities (factors, enterprises, industries) pay in taxes. In the Oregon model, this information is built into the IMPLAN SAM. Step 2 involves estimating how much of each tax is shifted to consumers, owners and workers, basing the decision on economic theory and the public finance literature to the extent possible. In the Minnesota study, this step also involved identifying how much of the taxes get shifted to workers, owners and consumers in other states, that is, how much of the tax burden is exported. In the Oregon analysis, information on tax exporting is built into the SAM. Step 3 takes the burden of taxes assigned or shifted to in-state consumers, owners, and workers and to out-of-staters from Step 2 and distributes this burden to the various income classes of in-state households. This distribution is based on the distribution of certain economic indicators among income classes (each class' share of total consumption, or capital income or wages, for example). For example, if half of the tax is determined to be shifted to consumers, the tax is distributed among income classes in proportion to the distribution of consumer expenditures among the classes.

The incidence of taxes paid *by households* is assumed to be on the households themselves. The personal income tax is assumed to be borne by the taxpayer. The homeowner property tax is assumed to be borne by the homeowner. Taxes on consumer purchases (cigarettes, liquor, etc.) are borne by the consumer. Vehicle registration and gasoline taxes are borne by the vehicle owner.

The incidence of taxes paid *by businesses* is assumed to be shifted to consumers, workers and/or owners of capital. The proper shifting assumptions for various taxes and various industries are a matter of some disagreement among economists. Whether the burden of a business tax is shifted to consumers, workers or owners of capital depends of a number of factors, including the characteristics of the market for the good or service being taxed (geographic scope, elasticities of supply and demand), of the industry (degree of competition), and the level of particular state and local business taxes relative to the nation.

Previous studies have used two basic approaches to the shifting of business taxes. The first approach, used in most previous studies of the incidence of state-local taxes, shifts a fixed proportion of each type of tax to either consumers or to owners of capital. See Table 4-1. Phares, for example, in his benchmark case, shifts half of the corporate income tax and residential rental property tax to consumers and half to owners of capital; shifts two-thirds of the nonresidential property tax to consumers and one-third to capital owners; and shifts all of any excise tax to consumers. Weber and Moore split all business taxes the same way, half to consumers and half to owners of capital. Citizens for Tax Justice (McIntyre et. al., 1991) shifts all of the corporate income tax to capital owners, and splits the property tax between consumers and capital owners.

[10] This figure is adapted from the Minnesota Department of Revenue *1999 Minnesota Tax Incidence Study*

Table 4-1 Shifting Assumptions in Tax Incidence Studies							
Study	**Corporate Income Tax**	**Property Tax: Rental Residential**	**Property Tax: Non-rental**	**Excises (Gasoline)**	**Licenses (Motor Vehicle, Corp, Public Utilities)**	**Payroll and Social Security taxes**	**Estate Taxes**
Musgrave et. al. 1951	.542 Profits .125 Wages .333 Consumers	1.0 Renter	(13 classes) usu. 1.0 Owner	1.0 Consumer		Employer Contribution .33 Wages, .66 Consumer; Employee Contribution 1.0 Wages	All by households in highest income class
Phares 1980	5. Capital .5 Consumer	.5 Capital .5 Consumer	.33 Capital .66 Consumer	1.0 Consumer	.5 Capital .5 Consumer		
Weber and Moore 1985[11]	5. Capital .5 Consumer	5. Capital .5 Consumer	5. Capital .5 Consumer				
Citizens for Tax Justice[12] 1991	1.0 Capital	5. Capital based on Rental income .5 Consumer based on rent paid	5. Capital .5 Consumer				
Citizens for Tax Justice[13] 1996	1.0 Capital[14]	5. Capital[4] .5 Consumer based on rent paid	Capital[4]	1.0 Consumer[15]			
Minnesota Department of Revenue [16] 1999	.03 Capital .08 Wages .39 Consumer .50 Export	.30 Capital .55 Consumer .15 Export	.25 Capital .02 Wages .33 Consumer .40 Export	.63 Consumers .37 Exports	.14 Capital .09 Wages .31 Consumer .46 Exports		

[11] Forty (40) percent of business taxes shifted to consumers was exported; 25 percent of taxes on capital was exported

[12] "Much" of business non-residential property taxes gets exported; "close to three quarters" of corporate income tax is exported.

[13] Complex exporting rule yields how much of business taxes is paid by *instate* companies: national share of capital income + average of .5 of remaining tax for rental property + average of .2 of remaining tax for other property.

[14] For industries where taxes were higher than the median national share of output for the industry, the "excess" of capital taxes is shifted back to instate wages or to in- and out-of-state consumers depending on type of activity.

[15] For businesses selling principally to a national market, where sales and excise taxes were "excessive"—above the median for that industry—half of the excess is shifted to in-state wages and half to in-state capital.

[7] The study assumed that nonresidents own 90 percent of the stock of corporations subject to Minnesota taxes, 5 percent of nonhomestead residential property and 20 percent of other noncorporate businesses. Thus it assumed that similar proportions of business taxes were exported to out of state capital owners.

The second approach, used by the Minnesota Department of Revenue is more complex. For each type of tax and each economic sector, the shifting of taxes is different. Each tax has three components:

- a portion that represents a national average tax rate on capital; it is assumed that this portion is borne by owners of capital.
- a portion that represents a differential for that industry; this portion is assumed to be borne by consumers.
- a portion that depends on whether the industry serves primarily local or national markets; consumers bear this portion of the tax if the industry serves local markets, and owners of land used for business bear this portion of the tax if the industry serves national markets.

For taxes and sectors where the Minnesota tax rate is equal to the national average tax rate on all capital, the burden of the tax is shifted entirely to capital. For taxes and sectors where the Minnesota tax rate is above the national average, the burden is shifted to consumers or business landowners depending on how much the national tax rate for that industry differs from the national average rate for all industries. If the entire differential between the actual Minnesota tax rate for that industry and the national average tax rate on capital is due to a national industry differential tax rate, then the remaining burden is shifted entirely to consumers. Otherwise it is shared between consumers and business landowners.

Almost all of the studies, recognizing that the different assumptions about shifting will produce quite different distributions of the burden of taxes among income classes, explore the sensitivity of the tax distribution results to alternative shifting assumptions. See Weber and Moore for an example of the sensitivity of results to alternative assumptions.

ESTIMATING BASELINE TAX INCIDENCE USING A CGE MODEL

The Social Accounting Matrix underlying the CGE model specifies the impact of each tax in step 1. The CGE model combines the last two steps of the three-step process used in previous incidence studies, *shifting* the tax burden to factor incomes and consumer expenditures and then using the information in the SAM to *allocate* the tax burden associated with changes in factor incomes and consumer expenditures to out-of-state taxpayers and to the eight income classes of Oregon taxpayers. The shifting of the tax and allocation among income classes are based on assumptions built into the CGE model about the responsiveness of consumers and firms to changes in factor and product prices induced by a change in taxes and on the distributions of factor incomes and expenditures in the SAM.

The baseline incidence estimates in OTIM take advantage of the shift and allocation information built into the model. In order to appreciate how OTIM incorporates this information, it is important to understand how a baseline analysis (as reported in this Chapter) differs from an analysis of a tax change (reported in Chapter 5), and how the concept of a tax burden differs between the static analyses reviewed above and the dynamic analysis of OTIM. A *baseline incidence* analysis takes taxes in a base year and distributes the burden of these taxes among income groups. The burden of the tax is equal to the tax revenues raised. In an analysis of the *incidence of a tax change* (in which the change in burden is distributed among income groups), however, the static and dynamic analyses produce different estimates of revenue and have different conceptions of tax burden. In a static analysis of a tax increase, for example, the increase in revenue is the change in tax rate multiplied by the tax base in the base year; the change in tax burden is ordinarily treated as equal to the change in revenue. In a dynamic analysis based on a CGE model, however, the change in revenue will generally be smaller than that suggested by the static analysis, and the change in burden is measured by the change in after-tax household income, which can be either larger or smaller than the amount of revenue raised.

To appreciate how this works, consider how tax revenues and after-tax household incomes respond to a tax increase in a CGE model. As consumers face higher prices for goods and services, and producers face higher prices for factors of production, both make decisions that are different than they would if taxes were lower. Workers may work less or move out of state, owners of capital may invest less in the state. This reduces the size of the economy and the income earned by factor owners. Consumers change their consumption bundle and producers alter production. This has two implications. First, because of tax-induced changes in economic behavior, the change in revenue yield would be less than that estimated by a static analysis (by multiplying the increase in tax rate by the current tax base). Furthermore, because of these tax-induced responses, household after-tax income would be reduced more than the amount of tax payments. Suppose, for example, that the imposition of a new tax on corporate income would raise $55 million in a static analysis. In a simple CGE model with two income classes, business owners would respond by investing less and producing less and net income would decline. The actual yield would be, say, only $50 million in new tax revenue. Suppose further that the CGE model yields an outcome for income classes showing real after-tax income to decrease by $40 million for rich Oregonians and by $20 million for poor Oregonians. In this example, imposition of a corporate income tax change estimated to raise $55 million in a static analysis would impose a burden on Oregon taxpayers of $60 million, while raising only $50illion in new revenue.

In this chapter, a baseline incidence analysis is presented that distributes 1997 Oregon state and local taxes among income groups using the shifting and allocation results from a dynamic CGE analysis. (The distribution of Federal taxes is also presented to place the Oregon tax system in its context, but the focus is on the state and local tax system.) The estimated baseline incidence in this study was derived in two steps. First, estimates of the taxes exported to out of state workers, capital owners and purchasers were subtracted from the total Oregon state and local taxes. Second, the remaining taxes were distributed to the eight Oregon income groups in proportion to the shares of changes in after-tax income derived from a series of simulations using the Oregon computable general equilibrium model.

EXPORT OF TAXES

In the baseline analysis, a share of the taxes on factors is exported to out of state owners of factors. Oregon had $52 billion in labor income and $19 billion in property income in 1997. $1 billion of labor income and $6.3 billion of property income was paid to nonresidents. In the baseline distribution, therefore, 1.9 percent ($1billion/$52 billion) of any state and local payroll tax paid by businesses is exported to out of state workers. The state and local payroll taxes on labor in the model are the Oregon unemployment compensation and workers compensation taxes and other state payroll taxes and two local payroll taxes. In the baseline, about one-third ($6.3 billion/$19 billion or 33.2 percent) of any state and local business tax on capital is exported to out of state owners of capital. This export share is applied to the Oregon corporate income tax.

It is less clear how to handle excise taxes on Oregon goods and services purchased as intermediate inputs in the production of Oregon products. The ability of producers to pass on the tax to out of state purchasers through higher product prices will differ by industrial sector, depending among other things on the extent to which the product is traded in a national market, the elasticity of demand for the product, the state's share of the market, and transportation costs. A cautious approach would not allow any shifting of taxes to out-of-state consumers. On the other hand, if we can assume that the baseline economy is in equilibrium, and that the prices of Oregon goods and services include some part of the taxes imposed on firms, then it is appropriate to allocate some share of the tax assumed to be shifted to consumers to out-of-state purchasers. Using information in the IMPLAN SAM about the percent of regional supply exported by each sector along with information about excise taxes paid by each sector on inputs purchased

regionally, the model can be used to estimate the percent of each Oregon excise tax that was exported to out of state purchasers of Oregon goods.

Table 4-2 reports the estimates of exported taxes reflected in the baseline analysis. Over one-sixth (17.8 percent) of Oregon's business taxes are exported to out-of-state taxpayers.

Oregon consumers and owners of factors employed in other states also pay taxes to other states. OTIM does not estimate these "imported" taxes, since changes in Oregon tax policy do not affect imported taxes.

Table 4-2. Oregon Business Taxes exported to taxpayers outside of Oregon: Baseline Analysis

Type of tax	Tax	Amount	Amount exported	Retained Amount	Percent Exported
Excise	OR revenue tax tobacco	222.3	13.3	209.0	6.0
Excise	OR revenue tax beer and wine	12.0	0.7	11.3	6.0
Excise	OR revenue tax alcohol	1.8	0.2	1.6	9.9
Excise	OR revenue tax fuel	383.2	78.7	304.5	20.5
Excise	OR revenue tax insurance	75.9	5.4	70.5	7.2
Excise	OR revenue tax amusement	2.7	0.2	2.4	8.5
Excise	OR revenue tax parimutuel	1.1	0.1	1.0	12.5
Excise	OR revenue tax utilities	18.8	2.9	15.9	15.4
Excise	OR revenue tax wt.-mile	224.0	53.3	170.7	23.8
Excise	OR revenue tax forest products	52.9	32.7	20.2	61.9
Excise	OR revenue tax other indirect business tax	139.0	32.3	106.6	23.3
Labor	OR revenue tax unemployment comp.	332.8	6.7	326.1	2.0
Labor	OR revenue tax workers comp.	28.0	0.6	27.5	2.0
Labor	OR revenue tax other payroll tax	168.5	3.4	165.1	2.0
Capital	OR revenue tax corp income	337.5	112.5	225.0	33.3
Excise	Local revenue tax fuel	14.1	2.9	11.2	20.5
Excise	Local revenue tax utilities	93.1	14.3	78.8	15.4
Excise	Local revenue tax hotel-motel	54.2	5.4	48.8	9.9
Labor	Local revenue tax Mult. Co. business income	83.1	1.7	81.4	2.0
Excise	Local revenue tax other indirect business tax	189.6	44.1	145.5	23.3
Labor	Local revenue tax payroll (Transit)	146.7	2.9	143.8	2.0
Property	Local revenue tax property	1013.2	224.9	788.3	22.2
Total		3594.6	639.3	2955.2	17.8

SHARING OUT THE REMAINING SHIFTED BUSINESS TAX BURDEN

The CGE model, as noted above, distributes changes in tax burdens among income classes. The OTIM baseline distributes the business taxes that are not exported based on the results of simulations in which the major taxes are changed by $100 million. In these simulations, each of four taxes was increased, holding everything else constant, and the distribution of changes in real income to each of the 8 income classes was observed. The percent distribution among income classes of the change in real income observed for a given tax in this simulation is used to distribute the baseline shares of the revenue from this tax among income classes.[17] In the example above, where the tax change raising $50 million in revenue resulted in a change in after-tax household income of $ 60 million, , our baseline procedure would

[17] The four taxes were a corporate income tax, a business property tax, an excise tax and a payroll tax. Each of the 28 federal, state and local taxes was distributed according to the distributions from these four simulations. The average burden of a tax is assumed to be distributed the same way as the marginal burden from these simulations.

allocate two-thirds ($40 million/$60 million)of the baseline year taxes on capital to the rich and one-third ($20 million/$60 million) to the poor.

Consider the result of the simulation of the corporate income tax rate increase. The total revenue that would be raised by this increase in a static model is $100 million. Because producers, factor owners and consumers respond to the resulting price changes, however, only $83 million in total net state and local tax revenue is raised. The $83 million tax burden is distributed among the eight Oregon income classes in proportion to the shares of income change from the CGE simulation, as shown in Table 4-3.

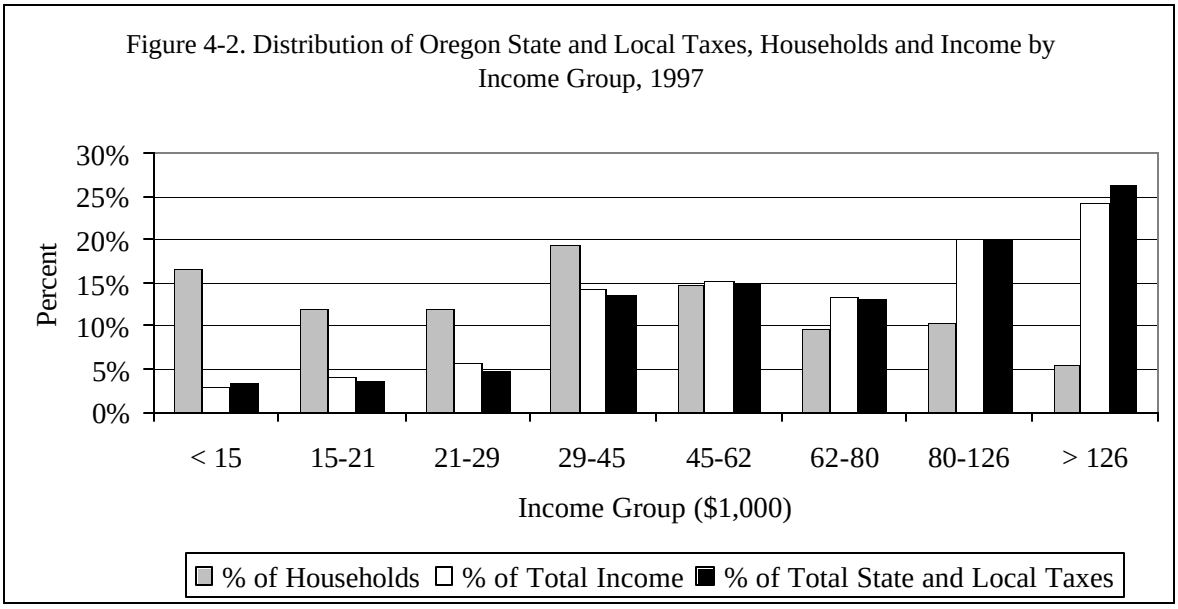
THE BASELINE DISTRIBUTION OF OREGON STATE AND LOCAL TAXES

Table 4-3. Distribution of Net Corporate Tax Increase Among Oregon Households

Income group	Net tax revenue ($ million)	Change in real after-tax income from CGE analysis ($million)	Share of real after-tax income change from CGE analysis (%)	Distribution of tax burden ($ million)
< $14,525		-1.11	1.13	0.94
$14,525 - $21,225		-2.78	2.84	2.36
$21,225 - $28,739		-5.03	5.14	4.26
$28,739 - $45,024		-14.38	14.7	12.19
$45,024 - $62,026		-17.15	17.53	14.53
$62,026 - $80,000		-15.35	15.69	13.01
$80,000 - $126,173		-20.23	20.68	17.14
> $126,173		-21.82	22.29	18.48
Total	82.91	-97.86	100%	82.91

Figure 4-2 shows the distribution of households, income and total Oregon state and local taxes among the eight income classes.

Figure 4-2. Distribution of Oregon State and Local Taxes, Households and Income by Income Group, 1997



The lowest income group contains about one sixth (16.6%) of the households, receives 3.0 percent of the income and pays 3.4 percent of the taxes. The highest income group contains 5.3 percent of the households, who receive 24.2 percent of the income and pay 26.3 percent of total taxes.

The distribution of taxes among households is most commonly portrayed by calculating "Effective tax rates"(ETR) for each income class. The effective tax rate for any given income group is the sum of taxes directly paid by households and the business taxes shifted to households divided by the total income of the households in that class. The last column of Table 4-3 displays the effective tax rates estimated by OTIM for the current tax system. These effective tax rates are used as the baseline rates in the analysis of the impacts of tax changes on the distribution of the tax burden.

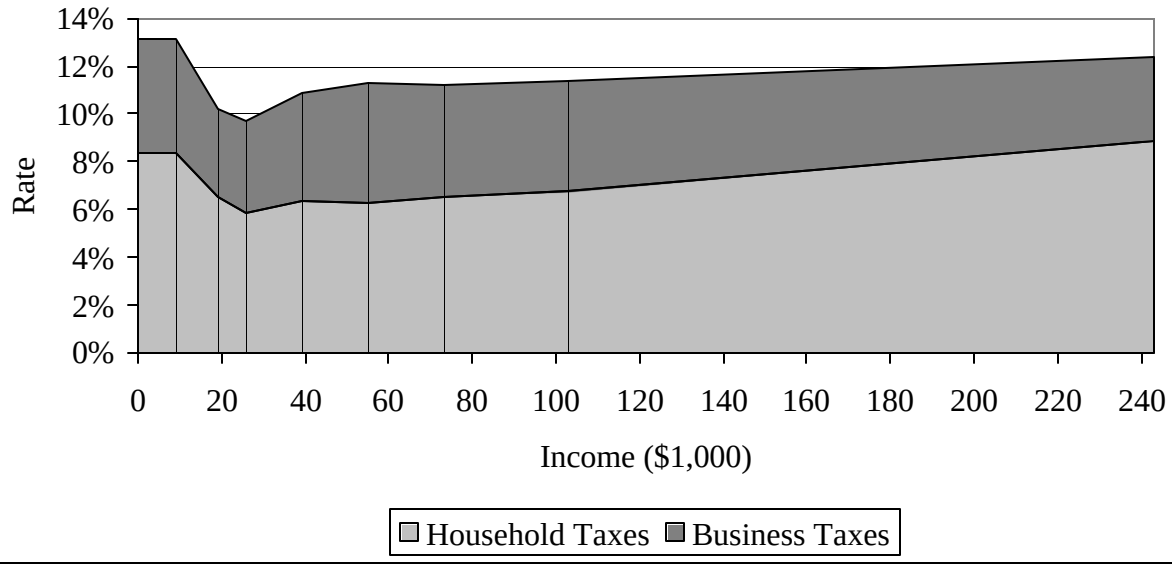
Table 4-4. Distribution of Oregon Tax Burden Among Income Classes

Income Group	Households	Total comprehensive income (w/ capital gains) ($ million)	Household taxes ($ million)	Business taxes (OTIM) ($million)	Effective tax rate (OTIM)
< $14,525	213,130	2,012	169	96	13.1%
$14,525 - $21,225	152,876	2,832	184	105	10.2%
$21,225 - $28,739	152,642	3,938	231	152	9.7%
$28,739 - $45,024	250,955	9,699	616	437	10.9%
$45,024 - $62,026	189,249	10,368	651	518	11.3%
$62,026 - $80,000	125,167	9,097	590	434	11.3%
$80,000 - $126,173	132,913	13,686	921	634	11.4%
> $126,173	67,777	16,498	1,464	580	12.4%
TOTAL	1,284,709	68,130	4,826	2,955	11.4%

Figure 4-3 shows the baseline OTIM effective tax rates for 1997. Oregon's state and local tax system, under the baseline assumptions in our model, places the highest percent tax burden (as measured by effective tax rates) on the lowest and highest income classes.

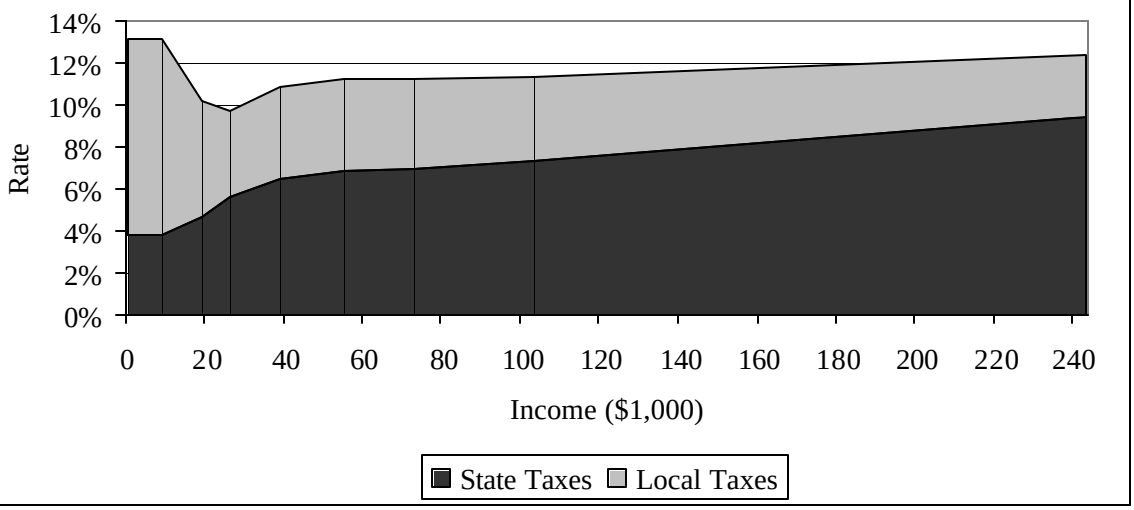
Under the baseline assumptions, effective tax rates for the business taxes shifted to households (shown in the dark gray shading of Figure 4-3) are about the same for all income classes. It is the direct taxes paid by households that are the major source of variation across income classes. The highest effective tax rates for direct household taxes, represented by the light gray shaded area, are for the lowest and highest income classes.

Figure 4-3. Effective State and Local Tax Rates for Direct Household Taxes and Shifted Business Taxes in Oregon, 1997



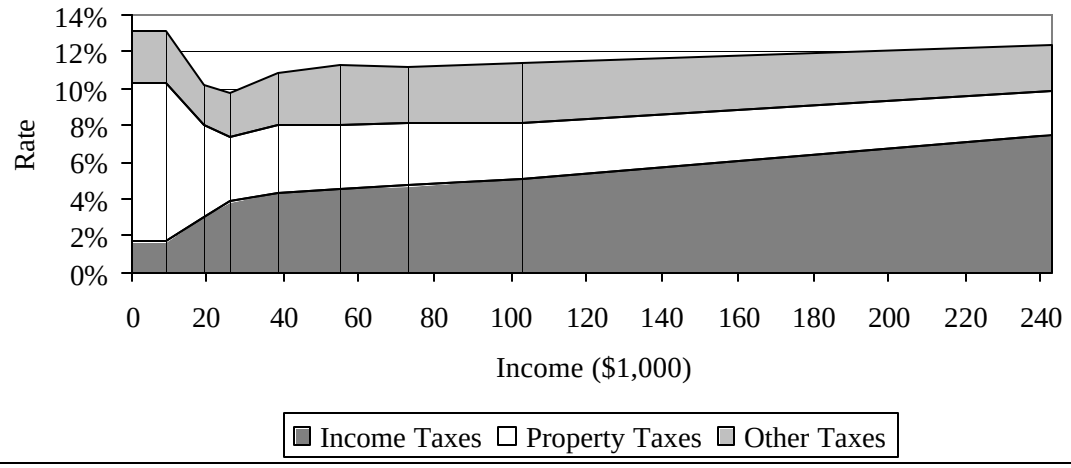
Another way of looking at the distribution of state and local taxes is to disaggregate taxes into state and local taxes. This is done in Figure 4-4. A regressive local taxes structure (light grey shading) is partially offset by a quite progressive state tax structure.

Figure 4-4. Effective Tax Rates for Oregon State and Local Taxes



Looking at the types of taxes that make the system more or less progressive provides more insight into the sources of progressivity. Figure 4-5 disaggregates taxes into the state income tax, the local property tax and other state and local taxes. The state income tax is obviously the major source of progressivity in the Oregon state-local tax system. The local property tax is highly regressive. Other state and local taxes appear to be distributed roughly proportionally among income classes.

Figure 4-5. Effective Tax Rates for State Income Tax, Local Property Tax and Other State and Local Taxes



THE DISTRIBUTION OF FEDERAL, STATE AND LOCAL TAX BURDEN

Table 4-4 shows the distribution among income classes of taxes directly paid by households and of all taxes (including those paid by businesses that are shifted to households as described above). The effective tax rates of each income class for household taxes paid by Oregon households is shown in the top rows of each section of Table 4-4. Household direct taxes include personal income taxes (federal and state), estate and gift taxes (federal and state), and the homeowner property tax. The top section shows effective tax rates for federal, state and local taxes and the bottom section shows the effective tax rates for Oregon state and local taxes by income class.

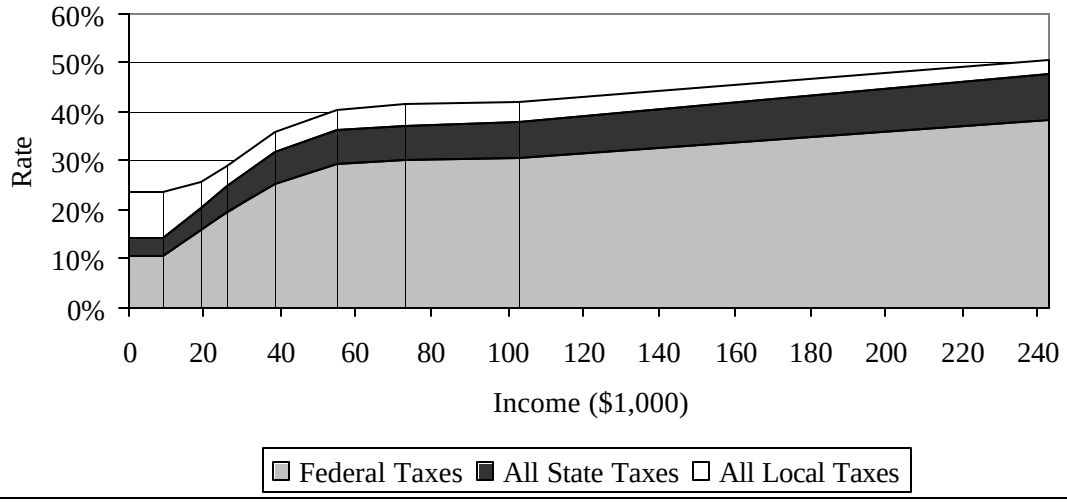
Table 4-5. Effective Tax Rates for Federal State and Local Taxes in Oregon (Including Capital Gains)

	Household Income Groups								
	<$14,525	$14,525-$21,225	$21,225-$28,739	$28,739-$45,024	$45,024-$62,026	$62,026-$80,000	$80,000-$126,172	>$126,172	TOTAL
Federal, State, and Local Taxes	Effective Tax Rates (ETR)								
Household Taxes	12.50%	14.90%	16.20%	19.80%	21.80%	23.20%	24.20%	36.40%	24.80%
All Taxes	23.50%	25.90%	28.90%	36.00%	40.70%	41.60%	42.20%	50.80%	41.10%
State and Local Taxes Only									
Household Taxes	8.40%	6.50%	5.90%	6.40%	6.30%	6.50%	6.70%	8.90%	7.10%
All Taxes	13.10%	10.20%	9.70%	10.90%	11.30%	11.30%	11.40%	12.40%	11.40%

It is clear from this table that the overall tax structure for Oregon taxpayers is dominated by the Federal tax system. The federal tax system is both larger and much more progressive than the state local system. Figure 4-6 shows the incidence of federal, state and local taxes by income class. For the highest income

class, federal state and local taxes, both direct and the taxes shifted from businesses to households, under our distributional baseline are about 51 percent of income.

Figure 4-6. Effective Tax Rates for Federal, State and Local Taxes



CHAPTER 5
MODEL USES
INTRODUCTION

OTIM is designed for analysis of the current revenue system and major proposals that affect a broad array of taxpayers in the state. It is not reliable for narrowly based proposals aimed at specific industries or regions within the state.

The Tax Incidence Oversight Committee recommends the following guidelines for using OTIM to analyze legislative proposals:

- Static revenue impact estimate of at least $10 million for the upcoming biennium.
- Report feedback effect and distribution effects for measures in which OTIM is used.
- Report results over the next three biennia.
- Revenue committee chairs have final discretion on appropriate use of OTIM during Legislative session.

Major changes in Oregon's broad-based taxes—personal and corporate income taxes and the property tax, are obvious candidates for OTIM analysis. OTIM can also provide useful insights into the impact of introducing a broad-based consumption tax.

The results of model simulations are shown in the next three tables. Four simulations were run to show how OTIM responds to different types of tax changes: Personal Income Tax, Corporate Income Tax, Business Excise Tax and Business Property Tax.

Tables 5-1a and 5-1b show estimates of the economic and revenue effects for representative tax increases and tax decreases, respectively. Table 5-2 shows how the representative tax increases affect different household income groups (Note: The impacts on households were nearly symmetrical for the $100 million tax increases and reductions examined).

Table 5-1a. Simulation Results:
Revenue & Economic Effects for Representative $100 million Tax Increases

Revenue Impact	Personal Income Tax	Corporate Income Tax	Business Excise Tax	Business Property Tax
Static impact (mil.)	$100	$100	$100	$100
Impact after feedbacks * (mil.)	$90.36	$82.91	$89.56	$88.69
% Feedback effect	9.64%	17.09%	10.44%	11.31%
Economic Effects				
Personal income (% ch)	-0.12%	-0.2%	-0.17%	-0.17%
Wages (%ch)	0.14%	-0.07%	-0.03%	-0.03%
Return to capital (% ch)	-0.007%	-0.03%	-0.008%	-0.0095%
Employment (%ch)	-0.22%	-0.06%	-0.08%	-0.08%
Investment (%ch)	-0.14%	-0.52%	-0.14%	-0.20%
Consumer prices (%ch)	0.04%	0.03%	0.07%	0.08%

* State and local government revenue, excludes federal revenue.

Table 5-1b. Simulation Results:
Revenue & Economic Effects for Representative $100 million Tax Reductions

Revenue Impact	Personal Income Tax	Corporate Income Tax	Business Excise Tax	Business Property Tax
Static impact (mil.)	-$100	-$100	[t]	-$100
Impact after feedbacks * (mil.)	-$90.35	-$84.16		$89.02
% Feedback effect	9.65%	15.84%		10.98%
Economic Effects				
Personal income (% ch)	0.12%	0.2%		0.17%
Wages (%ch)	-0.14%	0.07%		0.03%
Return to capital (% ch)	0.0075%	0.03%		0.0095%
Employment (%ch)	0.22%	0.06%		0.08%
Investment (%ch)	0.14%	0.53%		0.20%
Consumer prices (%ch)	-0.045%	-0.03%		-0.08%

* State and local government revenue, excludes federal revenue.
[t] There is currently no general state or local government business excise tax in Oregon.

Table5-2 Simulation Results: Effects on Household Income Distribution for Representative Tax Increases *

		Personal Income Tax Change		Corporate Income Tax Change		Business Excise Tax Change		Business Property Tax Change	
Household Income Group	Share of Total Household Income (%)	Share of Total Tax Change (%)	Change as % of Income	Share of Total Tax Change (%)	Change as % of Income	Share of Total Tax Change (%)	Change as % of Income	Share of Total Tax Change (%)	Change as % of Income
< 14,525	2.96	1.63	-0.11	1.13	-0.06	4.30	-0.24	4.65	-0.26
14,525 – 21,225	4.27	3.69	-0.12	2.84	-0.08	4.09	-0.13	4.58	-0.14
21,225 - 28,739	6.01	6.21	-0.13	5.14	-0.10	5.75	-0.12	6.15	-0.13
28,739 - 45,024	14.58	16.42	-0.12	14.70	-0.11	15.20	-0.12	15.80	-0.12
45,024 - 62,026	15.76	16.67	-0.11	17.53	-0.12	17.39	-0.12	17.44	-0.12
62,026 - 80,000	13.8	12.99	-0.10	15.69	-0.12	14.27	-0.11	14.28	-0.11
80,000 - 126,173	20.58	17.04	-0.09	20.68	-0.10	20.82	-0.11	19.71	-0.10
> 126,173	22.05	25.34	-0.17	22.29	-0.13	18.18	-0.10	17.38	-0.09
TOTAL	100%	100%	-0.13	100%	-0.12	100%	-0.13	100%	-0.12

* Note: For tax decreases, the magnitudes are comparable but the sign of 'Change as % of Income' is + in all cases.

INTERPRETATION OF THE RESULTS

OTIM produces results for a new equilibrium after all adjustments have taken place. Similar to California's DRAM, we assume these adjustments take 5 years to work though the economic system. This means that the results contained in Tables 5-1a, 5-1b and 5-2 show conditions after this 5-year adjustment period has run its course.

Tables 5-1a and 5-1b show three revenue measures and six economic variables. The first revenue measure is a "static" revenue impact. It is the impact in the absence of feedback effects. The second revenue measure is the impact after the model has solved for a new equilibrium incorporating the feedback effects on all state and local government revenues. Feedback effects are positive for tax decreases and negative for tax increases. However the magnitude of the feedback effects varies considerably with the type of tax change. Finally, the feedback effect is shown as a percentage of the static revenue impact estimate.

Tables 5-1a and 5-1b also show economic effects resulting from the tax change. It is these economic changes that cause the revenue feedback effects. A tax change will cause a change in the actions of workers, consumers and owners of capital and natural resources (businesses). This in turn will affect overall income, jobs and relative prices in the economy. The changes in the tables are in relation to a baseline. For use in estimating the effects of tax proposals the baseline comparison will be the latest quarterly economic and revenue forecast.

The effect of the tax change across different income groups is shown in Table 5-2. The table apportions a $100 million static revenue impact among the eight household income groups in OTIM. Table 5-2 also shows the percentage change in after-tax income resulting from the tax change for each group.

SIMULATIONS

Broad-based general tax increases and reductions of $100 million are used to simulate the model results. The four representative tax simulations are:

Personal income tax rate change: a proportional increase (reduction) in personal income taxes paid by each household.

Corporate income tax rate change: a proportional increase (reduction) in corporate-level income taxes paid by each industry.

A general excise tax change: a proportional increase (only) in the total selective sales taxes paid by businesses, consumers and government on their purchases of goods and services (Note: In OTIM, excise taxes include all types of taxes paid by business except those that are measured by net income, payroll or employment).

A change in the business portion of the property tax: a proportional increase (reduction) in the property taxes paid by businesses (Note: In OTIM, business property taxes are treated like business excise taxes, and become part of the gross price paid by purchasers).

PERSONAL INCOME TAX CHANGE

OTIM was used to simulate a proportional change in income tax liability for all taxpayers. This change would work like Oregon's 2% surplus kicker refund in the case of a tax decrease or like a surcharge in the case of a tax increase. The changes are assumed to be permanent with a static revenue impact of $100 million per year.

Table 5-1a shows a $100 million static increase in personal income taxes results in a total annual state and local revenue increase of $90.36 million after 5 years. After the feedback effects have worked through the system, General Fund revenues increase by $96.7 million rather than $100 million, other fund revenues fall $3.5 million and local revenues fall $2.8 million. The total revenue feedback effect in the fifth year is thus -$9.6 million.

Table 5-1b shows a $100 million static reduction in personal income taxes results in a total annual state and local revenue reduction of $90.35 million after 5 years. After the feedback effects have worked through the system, General Fund revenues fall by $96.8 million rather than $100 million, other fund revenues rise $3.5 million and local revenues rise $2.8 million. The total revenue feedback effect in the fifth year is thus +$9.6 million.

As economic agents (consumers, workers and businesses) react to the tax change, income and employment are also effected. The impact of a $100 million tax change is relatively small in a $100

billion state economy. But OTIM clearly shows a measurable impact from such a change. Table 5-1a and 5-1b show that a $100 million static change in personal income taxes leads to a 0.12% change in personal income and a 0.22% change in total employment, both variables moving in the opposite direction to the tax change. Return to capital changes marginally in the opposite direction of the tax change while the wage index moves in the same direction as the tax change, indicating that a personal income tax increase pushes up average wages in the state. The reason for this result is that an income tax increase reduces employment more than investment. This results in a higher capital labor ratio and therefore more capital and wages per worker. This leads to the unusual conclusion that a change in personal income taxes has the largest employment impact yet the smallest revenue feedback effect of the four simulations presented.

The only variable in Tables 5-1a and 5-1b that consistently moves in the same direction as tax changes is consumer prices. The consumer price measure in OTIM is similar to the consumption price deflator in the national income accounts. In the case of a $100 million personal income tax increase, consumer prices rise 0.04% (and vice versa). Changes in revenue and economic variables are fairly symmetrical given an increase or decrease in personal income taxes.

Changes in the personal income tax cause very little tax shifting. This means that the distribution effects are very similar to those of a static revenue estimator such as the Tax Calculator developed by the Legislative Revenue Office in the 1980's. The distribution effects of Oregon's personal income tax shown in Table 5-2 are mildly progressive overall, with higher income taxpayers slightly more affected by changes in the tax than lower income households. The highest income group (households above $126,173) experiences the largest percentage income change in response to broad-based personal income tax change.

CORPORATE INCOME TAX

A similar $100 million proportional change in the corporate income tax generates larger feedback effects than a change in the personal income tax. This is because corporate investment behavior is more sensitive to changes in the after tax rate of return. This result is consistent with California's DRAM findings.

Table 5-1a shows a $100 million static increase in corporate income taxes results in a total annual state and local revenue increase of $82.91 million after 5 years. After the feedback effects have worked through the system, General Fund revenues increase by $88.8 million rather than $100 million, other fund revenues fall $3.7 million and local revenues fall $2.2 million. The total revenue feedback effect in the fifth year is thus -$17.09 million.

Table 5-1b shows a $100 million static reduction in corporate income taxes results in a total annual state and local revenue reduction of $84.16 million after 5 years. After the feedback effects have worked through the system, General Fund revenues fall by $90.1 million rather than $100 million, other fund revenues rise $3.7 million and local revenues rise $2.2 million. The total revenue feedback effect in the fifth year is thus +$15.84 million.

A change in corporate income taxes affects business investment in Oregon. This in turn changes the amount of physical capital in the state. A different level of capital will impact business hiring decisions and therefore employment and income in the state. OTIM estimates that business investment will respond 0.5% in the opposite direction to the tax change. This triggers a 0.2% change in personal income and a 0.06% employment change both also in the opposite direction to the tax change.

Changes in the corporate income tax produce the largest revenue feedback effects among the four simulations. However, corporate income tax changes have the smallest employment feedback effects. Revenue feedback effects are also relatively greater for a tax increase than for a tax decrease.

Distribution of the change in the corporate income tax burden is fairly similar to changes in the personal income tax. A change in the corporate income tax has the smallest proportional effect on low-income households and the largest effect on the highest income group. It is important to keep in mind that these income changes are for Oregon households only. They do not include that portion of the corporate income tax (33%) that is absorbed by non-resident capital owners.

EXCISE TAX

Oregon currently has excise taxes on a number of commodities such as gasoline, tobacco and hotel-motel (local governments). However it does not have a general consumption tax. OTIM can simulate the affects of a general tax on business gross receipts. This is broad base and therefore would require a small rate change to generate the $100 million static revenue impacts shown in table 5-1a.

Table 5-1a shows a $100 million static increase in business excise taxes results in a total annual state and local revenue increase of $89.56 million after 5 years. After the feedback effects have worked through the system, General Fund revenues increase by $94.64 million rather than $100 million, other fund revenues fall $3.1 million and local revenues fall $2.0 million. The total revenue feedback effect in the fifth year is thus -$10.44 million.

The impact business excise taxes is closest to the business portion of the property tax, shown below. Overall revenue feedback effects are about 10%.

Consumer prices increase an estimated 0.07% in response to a general excise tax increase. This leads to a 0.17% reduction in personal income and 0.08% reduction in employment.

Table 5-2 shows the business excise tax is distributed disproportionately toward low-income households. This is because consumer prices are changing in response to the tax. Lower income households consume a higher percentage of their income. This means they are disproportionately affected by taxes that have a significant impact on consumer prices.

Note that these simulations are based on uniform, broad-based changes in sales and excise taxes. A major consumption tax proposal would require would require much more detailed work within the model structure to account for specific features of the proposal and exemptions.

PROPERTY TAX—BUSINESS PORTION

OTIM can also be used to simulate the effect of changing the nonresidential portion of the property tax. This is treated as a business excise tax in OTIM, although the proceeds go directly to local government rather than to the state general fund.

Table 5-1a shows a $100 million static increase in business property taxes results in a total annual state and local revenue increase of $88.69 million after 5 years. After the feedback effects have worked through the system, local revenues increase by $96.76 million rather than $100 million, state General Fund revenues fall by $5.7 million, and other fund revenues fall $2.4 million. The total revenue feedback effect in the fifth year is thus -$11.3 million.

Table 5-1b shows a $100 million static reduction in business property taxes results in a total annual state and local revenue reduction $89 million after 5 years. After the feedback effects have worked through the system, local revenues fall by $96.76 million rather than $100 million, state General Fund revenues increase by $5.7 million, and other fund revenues rise $2.4 million. The total revenue feedback effect in the fifth year is thus +$11.0 million.

A large portion of the impact shows up as a change in consumer prices. The consumption deflator changes 0.08% in response to the $100 million change in the business property tax. Unlike the other variables in Tables 5-1a and 5-1b, changes in consumer prices are in the same direction as the tax change. This is the largest general price change of the simulations considered. Overall revenue feedback effects are about 11%, although slightly larger for a tax increase than for a tax decrease.

The business property tax change also causes a 0.17% change in personal income, a 0.08% change in employment, a 0.2% change in investment and 0.03% change in wages, all in the opposite direction to the tax change.

Table 5-2 shows that like the excise tax, the business property tax is distributed disproportionately toward low-income households. This is because consumer prices are changing in response to the tax. Lower income households consume a higher percentage of their income. Thus they are disproportionately affected by taxes that significantly impact consumer prices.

CHANGING OTIM ASSUMPTIONS

Like all general equilibrium models, OTIM is dependent on key assumptions. The basis for values for key parameters generally comes from the economic literature. The California DRAM serves as a starting point for most model parameter values.

Five sets of experiments were conducted for changes in corporate income taxes, personal income taxes and a consumption tax. These involved choosing combinations of key parameters and solving the model for three levels of these parameters:

1. ½ of their current levels;
2. their current levels; and
3. 1½ times their current levels.

By solving the model at these three levels for combinations of key parameters, the properties of OTIM tend to be revealed, while the importance of the key parameters is explored. Each of these experiments is described below.

ELASTICITY EXPERIMENTS: TRADE

The responsiveness of exports and domestic share to relative prices is at the core of many of the economic effects explained in the base results. Trade represents a very large share of a regional economy and small changes in relative prices can have large changes in the economy. Further, trade data (as stated elsewhere in this report) are those upon which the least confidence should be placed by those analyzing the results from OTIM. Thus, if the model's results are particularly sensitive to the trade elasticities imposed, the recipients of such analyses should be made aware of these implications. Baseline trade assumptions are shown in the table below. In the baseline, import elasticities are set at 1.5 for traded goods and 0.5 for less traded goods (e.g. services). Export elasticities are 1.65 for traded goods and 0.65 for less traded goods. These values follow from the notion that markets for traded goods are more competitive and thus relatively more price-responsive than are markets for locally-supplied, less-traded services.

Table 5-3. Trade Elasticities used in OTIM

Industry	Import Elasticities	Export Elasticities
Livestock	1.5	-1.65
Crops	1.5	-1.65
Greenhouse and nursery products	1.5	-1.65
Other Ag. and Natural Resources	1.5	-1.65
Construction	1.5	-1.65
Agricultural processing	1.5	-1.65
Tobacco and Alcohol	1.5	-1.65
Apparel	1.5	-1.65
Wood and Construction Products	1.5	-1.65
Pulp and Paper Products	1.5	-1.65
Chemicals & Related Products	1.5	-1.65
Petroleum Refining	1.5	-1.65
High Tech Manufacturing	1.5	-1.65
Motor Vehicles	1.5	-1.65
Other Manufacturing	1.5	-1.65
Transportation Services	1.5	-1.65
Communication	1.5	-1.65
Utilities	1.5	-1.65
Wholesale Trade	0.5	-0.65
Retail Trade except restaurants	0.5	-0.65
Eating, Drinking & Lodging	1.5	-1.65
Banking Services	1.5	-1.65
Insurance	1.5	-1.65
Real Estate	1.5	-1.65
Other financial insurance and real estate	1.5	-1.65
Business Services	0.5	-0.65
Health Services	0.5	-0.65
Entertainment	0.5	-0.65
Other Services	0.5	-0.65

Table 5-4 Trade Elasticity Experiments

		CORP			PIT			SAU		
	BASE	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
CORP	337.53	435.22	434.61	434.29	337.38	337.06	336.94	337.21	337.01	336.93
PIT	3,272.59	3,270.64	3,265.43	3,263.30	3,375.59	3,370.86	3,369.07	3,271.26	3,268.58	3,267.56
SAU	0	0	0	0	0	0		99.93	99.88	99.86
GFREV	4,277.08	4,372.14	4,365.90	4,363.26	4,379.22	4,373.79	4,371.75	4,374.89	4,371.73	4,370.51
OFREV	6,372.40	6,371.26	6,368.70	6,367.66	6,371.14	6,368.86	6,368.00	6,370.75	6,369.34	6,368.76
LFREV	5,961.88	5,962.54	5,959.68	5,958.46	5,961.51	5,959.07	5,958.14	5,961.37	5,959.85	5,959.22
STATIC	0	100	100	100	100	100	100	100	100	100
DGF	0	95.05	88.81	86.17	102.13	96.70	94.66	97.80	94.64	93.42
DOF	0	-1.13	-3.70	-4.74	-1.26	-3.53	-4.39	-1.65	-3.05	-3.64
DLF	0	0.66	-2.19	-3.41	-0.37	-2.81	-3.73	-0.51	-2.03	-2.66
DDRE	0	-5.42	-17.09	-21.98	0.50	-9.64	-13.47	-4.37	-10.44	-12.87
PDRE	0	5.42%	17.09%	21.98%	-0.50%	9.64%	13.47%	4.37%	10.44%	12.87%
SPI	77,704.5	77,704.4	77,552.5	77,530.5	77,653.4	77,611.0	77,595.0	77,599.3	77,574.4	77,564.8
GN	7,409.14	7,409.13	7,370.39	7,364.92	7,405.17	7,398.85	7,396.53	7,402.47	7,398.61	7,397.06
POP	1.284709	1.284709	1.284185	1.284136	1.283844	1.283755	1.283721	1.284241	1.284188	1.284167
W	100.00	100.00	99.93	99.89	100.24	100.14	100.10	100.03	99.97	99.94
R	100.00	100.00	99.97	99.97	100.00	99.99	99.99	100.00	99.99	99.99
LD	1.994850	1.994848	1.993701	1.993619	1.990713	1.990495	1.990413	1.993419	1.993292	1.993244
KD	1,234.86	1,234.86	1,228.40	1,227.49	1,234.20	1,233.14	1,232.75	1,233.75	1,233.10	1,232.84

Heading	Description
CORP	millions of dollars of Corporate Income Tax revenue at solution.
PIT	millions of dollars of Personal Income Tax revenue at solution.
SAU	millions of dollars of Sales and Use Tax revenue at solution.
GFREV	millions of dollars of State Government General Fund Revenue at solution.
OFREV	millions of dollars of State Government Other Funds Revenue at solution.
LFREV	millions of dollars of Local Government Funds Revenue at solution.
STATIC	The static estimate of the tax change.
DGF	millions of dollars of change in General Fund Revenue from initial conditions.
DOF	millions of dollars of change in Other Funds Revenue from initial conditions.
DLF	millions of dollars of change in Local Funds Revenue from initial conditions.
DDRE	millions of dollars of dynamic revenue effects.
PDRE	percent of dynamic revenue effects expressed in terms of the static cost.
SPI	millions of dollars of Personal Income statewide.
GN	Millions of dollars of Gross Investment.
POP	The population of households in the state in millions.
W	The change in the wage rate (base = 100)
R	The change in the return to capital (base =100)
LD	Labor demand (jobs) in millions.
KD	Capital demand in hundreds of million dollars.
BASE	The initial data supplied to OTIM
CORP	The experiment changing Corporate taxes by a static estimate of $100 million.
PIT	The experiment changing Personal Income taxes by a static estimate of $100 million.
SAU	The experiment changing Sales (Excise) taxes by a static estimate of $100 million.

The table above demonstrates how the base solutions change when trade elasticities are set at fifty percent below their current levels (LOW), at their current levels (MEDIUM) and at one hundred and fifty percent of their current levels (HIGH). The results in the MEDIUM column in this table and in the four elasticity experiments reported below repeat the base case experiment results from the previous section.

The first observation is that trade elasticities matter. The dynamic feedback effects vary significantly with trade elasticities for corporate income taxes (CORP) tax reductions. When trade elasticities are halved, the feedback percentage is reduced by 2/3. When trade elasticities are increased by 50%, feedback percentage increases less than proportionately. Results for consumption taxes (SAU) are roughly similar to the CORP pattern. The relatively smaller dynamic feedback effects found for the personal income tax (PIT) respond in similar ways, but note that PIT feedbacks under the low elasticity scenario actually reverse: the $100 million static increase actually raises more than $100 million in personal income taxes and total state and local revenues. These type of results are expected in CGE models when the parameters governing trade response are changed from relatively elastic (greater than 1.0) into the inelastic range (less than 1.0).

The cautions implied by these results are not only that these elasticities are important, but also that they are applied to the weakest data in the model. Regional economic data are much more sparse than national data (being non-existent in many cases) and are updated much less regularly. Trade data do not exist for inter-state trade and international trade data are declining in quality. Further research into trade data and the elasticity parameters appears critical to improving the reliability of the model.

ELASTICITY EXPERIMENTS: LABOR SUPPLY

The responsiveness of the existing population (the workforce participation rate) to changes in economic variables is important in generating the dynamic feedback results reported in the base cases above. While the literature indicates that labor supply responses from the existing population can be expected to be low, small changes in the participation rate compounded with migration effects can be significant. The labor data in OTIM deserve more confidence than do those for trade. However, their elasticities were adopted from DRAM which used published national data. Tests of these rates of response are critical to evaluating the results of OTIM. The general labor supply elasticity with respect to wage is a sliding scale from zero for the lowest income group, 0.4 for the middle groups and 0.8 for the highest income group. The elasticities of labor supply with respect to taxes range from 0 for the low-income group, –0.25 for the mid-income groups, and –0.5 for the high-income group. The elasticity of labor supply with respect to transfer payments has been set at 0.05 for the lowest income group and zero for other income groups. Table 5-5 shows the household labor supply assumptions underlying OTIM.

Table 5-5 Labor Supply and Migration Elasticities in OTIM

	Labor Supply Elasticities			Migration Elasticities		
Household Income Group	Real Wage	Personal Income Tax	Transfer Payments	After Tax Income	Unemploy -ment	Education Spending
< 14,525	0.0	-0.0	-0.05	1.3	-0.8	0.02
14,525 – 21,225	0.2	-0.1	0	1.5	-0.7	0.02
21,225 - 28,739	0.3	-0.15	0	1.6	-0.6	0.02
28,739 - 45,024	0.4	-0.2	0	1.8	-0.5	0.01
45,024 - 62,026	0.5	-0.25	0	2.0	-0.4	0.01
62,026 - 80,000	0.7	-0.35	0	2.1	-0.3	0.005
80,000 - 126,173	0.8	-0.4	0	2.3	-0.2	0.0025
> 126,173	0.8	-0.5	0	2.5	-0.2	0.0

Table 5-6 Labor Supply Elasticity Experiments

		CORP			PIT			SAU		
	BASE	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
CORP	337.53	434.64	434.61	434.60	337.24	337.06	336.91	337.05	337.01	336.97
PIT	3,272.59	3,265.60	3,265.43	3,265.30	3,372.74	3,370.86	3,369.35	3,269.03	3,268.58	3,268.22
SAU	0	0	0	0	0	0	0	99.90	99.88	99.87
GFREV	4,277.08	4,366.12	4,365.90	4,365.72	4,376.15	4,373.79	4,371.92	4,372.30	4,371.73	4,371.27
OFREV	6,372.40	6,368.84	6,368.70	6,368.59	6,370.31	6,368.86	6,367.71	6,369.70	6,369.34	6,369.06
LFREV	5,961.88	5,959.84	5,959.68	5,959.56	5,960.69	5,959.07	5,957.77	5,960.25	5,959.85	5,959.53
STATIC	0	100	100	100	100	100	100	100	100	100
DGF	0	89.03	88.81	88.63	99.06	96.70	94.83	95.21	94.64	94.18
DOF	0	-3.56	-3.70	-3.81	-2.08	-3.53	-4.69	-2.70	-3.05	-3.34
DLF	0	-2.04	-2.19	-2.31	-1.19	-2.81	-4.10	-1.63	-2.03	-2.35
DDRE	0	-16.57	-17.09	-17.49	-4.22	-9.64	-13.97	-9.11	-10.44	-11.50
PDRE	0	16.57%	17.09%	17.49%	4.22%	9.64%	13.97%	9.11%	10.44%	11.50%
SPI	77,704.5	77,556.6	77,552.5	77,549.2	77,654.1	77,611.0	77,576.6	77,584.9	77,574.4	77,565.9
GN	7,409.14	7,370.76	7,370.39	7,370.09	7,402.76	7,398.85	7,395.74	7,399.57	7,398.61	7,397.84
POP	1.284709	1.284214	1.284185	1.284161	1.284029	1.283755	1.283533	1.284253	1.284188	1.284136
W	100.00	99.93	99.93	99.94	100.11	100.14	100.17	99.96	99.97	99.97
R	100.00	99.97	99.97	99.97	100.00	99.99	99.99	99.99	99.99	99.99
LD	1.994850	1.993856	1.993701	1.993580	1.992154	1.990495	1.989176	1.993702	1.993292	1.992965
KD	1,234.86	1,228.46	1,228.40	1,228.35	1,233.79	1,233.14	1,232.62	1,233.26	1,233.10	1,232.97

Heading	Description
CORP	millions of dollars of Corporate Income Tax revenue at solution.
PIT	millions of dollars of Personal Income Tax revenue at solution.
SAU	millions of dollars of Sales and Use Tax revenue at solution.
GFREV	millions of dollars of State Government General Fund Revenue at solution.
OFREV	millions of dollars of State Government Other Funds Revenue at solution.
LFREV	millions of dollars of Local Government Funds Revenue at solution.
STATIC	The static estimate of the tax change.
DGF	millions of dollars of change in General Fund Revenue from initial conditions.
DOF	millions of dollars of change in Other Funds Revenue from initial conditions.
DLF	millions of dollars of change in Local Funds Revenue from initial conditions.
DDRE	millions of dollars of dynamic revenue effects.
PDRE	percent of dynamic revenue effects expressed in terms of the static cost.
SPI	millions of dollars of Personal Income statewide.
GN	Millions of dollars of Gross Investment.
POP	The population of households in the state in millions.
W	The change in the wage rate (base = 100)
R	The change in the return to capital (base =100)
LD	Labor demand (jobs) in millions.
KD	Capital demand in hundreds of million dollars.
BASE	The initial data supplied to OTIM
CORP	The experiment changing Corporate taxes by a static estimate of $100 million.
PIT	The experiment changing Personal Income taxes by a static estimate of $100 million.
SAU	The experiment changing Sales (Excise) taxes by a static estimate of $100 million.

The results imply that labor supply elasticities have relatively smaller effects on the dynamic response of tax revenues than trade elasticities. This is in agreement with the literature on the labor supply effects of a tax change. Relatively more dynamic response is generated by the effects of migration than by changes in

the current population's willingness to work. As expected, the greatest effects of changing assumptions about labor supply responsiveness are associated with the personal income tax simulation (PIT), since changes in personal income taxes directly affect households' labor supply functions.

ELASTICITY EXPERIMENTS: MIGRATION

The responsiveness of in- and out-migration to changes economic variables is also central to CGE analyses of regional economies. There is strong empirical evidence that migration tends to equalize after-tax incomes over the long run. Migration elasticities were tested to see how the results change with different assumptions. The baseline migration responsiveness to after-tax incomes parameters range from 2.5 for upper-income households to 1.3 for the lowest income group. Responsiveness of migration to unemployment rates ranges from 0.8 for low-income households to 0.2 for high income households. Proportionate intermediate values for these parameters were assigned to the six household groups in between. Table 5-5 shows the household migration assumptions underlying OTIM.

As with labor supply, different migration elasticities affect dynamic response much less than do different trade assumptions. Also as with labor supply, the greatest effects of changing assumptions about migration responsiveness are associated with the personal income tax simulation (PIT), since changes in personal income taxes directly affect variables in households' migration functions in OTIM. For the PIT simulation, migration response assumptions have less impact on dynamic feedbacks than do labor supply assumptions. For the CORP and SAU simulations, however, the reverse is true: migration response assumptions have relatively more effect than labor supply assumptions.

Table 5-7 Migration Elasticity Experiments

		CORP			PIT			SAU		
	BASE	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
CORP	337.53	434.68	434.61	434.55	337.15	337.06	336.97	337.06	337.01	336.96
PIT	3,272.59	3,265.80	3,265.43	3,265.08	3,371.60	3,370.86	3,370.16	3,268.94	3,268.58	3,268.24
SAU	0	0	0	0	0	0	0	99.90	99.88	99.87
GFREV	4,277.08	4,366.45	4,365.90	4,365.38	4,374.84	4,373.79	4,372.81	4,372.27	4,371.73	4,371.22
OFREV	6,372.40	6,369.17	6,368.70	6,368.26	6,369.72	6,368.86	6,368.06	6,369.80	6,369.34	6,368.91
LFREV	5,961.88	5,960.42	5,959.68	5,959.00	5,960.37	5,959.07	5,957.84	5,960.57	5,959.85	5,959.18
STATIC	0	100	100	100	100	100	100	100	100	100
DGF	0	89.36	88.81	88.29	97.75	96.70	95.72	95.18	94.64	94.13
DOF	0	-3.23	-3.70	-4.14	-2.68	-3.53	-4.34	-2.60	-3.05	-3.49
DLF	0	-1.46	-2.19	-2.88	-1.51	-2.81	-4.03	-1.31	-2.03	-2.69
DDRE	0	-15.33	-17.09	-18.73	-6.44	-9.64	-12.66	-8.72	-10.44	-12.04
PDRE	0	15.33%	17.09%	18.73%	6.44%	9.64%	12.66%	8.72%	10.44%	12.04%
SPI	77,704.5	77,566.7	77,552.5	77,539.2	77,636.7	77,611.0	77,586.7	77,588.2	77,574.4	77,561.4
GN	7,409.14	7,371.54	7,370.39	7,369.31	7,400.94	7,398.85	7,396.89	7,399.74	7,398.61	7,397.56
POP	1.284709	1.284438	1.284185	1.283948	1.284217	1.283755	1.283318	1.284439	1.284188	1.283953
W	100.00	99.93	99.93	99.94	100.13	100.14	100.15	99.96	99.97	99.97
R	100.00	99.97	99.97	99.97	99.99	99.99	99.99	99.99	99.99	99.99
LD	1.994850	1.994163	1.993701	1.993269	1.991321	1.990495	1.989719	1.993743	1.993292	1.992873
KD	1,234.86	1,228.59	1,228.40	1,228.22	1,233.49	1,233.14	1,232.81	1,233.29	1,233.10	1,232.93

Heading	Description
CORP	millions of dollars of Corporate Income Tax revenue at solution.
PIT	millions of dollars of Personal Income Tax revenue at solution.
SAU	millions of dollars of Sales and Use Tax revenue at solution.
GFREV	millions of dollars of State Government General Fund Revenue at solution.
OFREV	millions of dollars of State Government Other Funds Revenue at solution.
LFREV	millions of dollars of Local Government Funds Revenue at solution.
STATIC	The static estimate of the tax change.
DGF	millions of dollars of change in General Fund Revenue from initial conditions.
DOF	millions of dollars of change in Other Funds Revenue from initial conditions.
DLF	millions of dollars of change in Local Funds Revenue from initial conditions.
DDRE	millions of dollars of dynamic revenue effects.
PDRE	percent of dynamic revenue effects expressed in terms of the static cost.
SPI	millions of dollars of Personal Income statewide.
GN	millions of dollars of Gross Investment.
POP	The population of households in the state in millions.
W	The change in the wage rate (base = 100)
R	The change in the return to capital (base =100)
LD	Labor demand (jobs) in millions.
KD	Capital demand in hundreds of million dollars.
BASE	The initial data supplied to OTIM
CORP	The experiment changing Corporate taxes by a static estimate of $100 million.
PIT	The experiment changing Personal Income taxes by a static estimate of $100 million.
SAU	The experiment changing Sales (Excise) taxes by a static estimate of $100 million.

ELASTICITY EXPERIMENTS: INVESTMENT

There are two types of factors in OTIM: labor and capital. The responsiveness of investment to changes in the after-tax return to capital should attract as much attention as labor elasticities. Factor markets are the key to understanding many of the properties of CGE models. In the development of OTIM, considerable efforts were made to focus on the investment supply decision. However, given the lack of reliable

estimates, OTIM relies on the elasticity assumption used in DRAM. The relatively high estimate used for each industry sector (20.0) was tested to identify sensitivity to investment responsiveness in OTIM. The results of these experiments are shown in the following table.

Table 5-8 Investment Elasticity Experiments

		CORP			PIT			SAU		
	BASE	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
CORP	337.53	434.64	434.61	434.61	337.06	337.06	337.05	337.02	337.01	337.01
PIT	3,272.59	3,265.89	3,265.43	3,265.26	3,371.01	3,370.86	3,370.80	3,268.73	3,268.58	3,268.53
SAU	0	0	0	0	0	0	0	99.89	99.88	99.88
GFREV	4,277.08	4,366.44	4,365.90	4,365.70	4,373.97	4,373.79	4,373.73	4,371.90	4,371.73	4,371.67
OFREV	6,372.40	6,368.99	6,368.70	6,368.59	6,368.96	6,368.86	6,368.83	6,369.44	6,369.34	6,369.31
LFREV	5,961.88	5,959.96	5,959.68	5,959.58	5,959.16	5,959.07	5,959.03	5,959.95	5,959.85	5,959.82
STATIC	0	100	100	100	100	100	100	100	100	100
DGF	0	89.35	88.81	88.61	96.88	96.70	96.64	94.81	94.64	94.58
DOF	0	-3.40	-3.70	-3.81	-3.44	-3.53	-3.57	-2.96	-3.05	-3.09
DLF	0	-1.92	-2.19	-2.29	-2.72	-2.81	-2.84	-1.93	-2.03	-2.06
DDRE	0	-15.97	-17.09	-17.49	-9.28	-9.64	-9.77	-10.08	-10.44	-10.57
PDRE	0	15.97%	17.09%	17.49%	9.28%	9.64%	9.77%	10.08%	10.44%	10.57%
SPI	77,704.5	77,559.8	77,552.5	77,549.9	77,613.2	77,611.0	77,610.2	77,576.5	77,574.4	77,573.6
GN	7,409.14	7,372.65	7,370.39	7,369.57	7,399.48	7,398.85	7,398.63	7,399.25	7,398.61	7,398.38
POP	1.284709	1.284209	1.284185	1.284176	1.283762	1.283755	1.283752	1.284195	1.284188	1.284186
W	100.00	99.94	99.93	99.93	100.14	100.14	100.14	99.97	99.97	99.96
R	100.00	99.95	99.97	99.98	99.99	99.99	99.99	99.99	99.99	99.99
LD	1.994850	1.993772	1.993701	1.993675	1.990516	1.990495	1.990487	1.993313	1.993292	1.993285
KD	1,234.86	1,228.77	1,228.40	1,228.26	1,233.25	1,233.14	1,233.10	1,233.21	1,233.10	1,233.06

Heading	Description
CORP	millions of dollars of Corporate Income Tax revenue at solution.
PIT	millions of dollars of Personal Income Tax revenue at solution.
SAU	millions of dollars of Sales and Use Tax revenue at solution.
GFREV	millions of dollars of State Government General Fund Revenue at solution.
OFREV	millions of dollars of State Government Other Funds Revenue at solution.
LFREV	millions of dollars of Local Government Funds Revenue at solution.
STATIC	The static estimate of the tax change.
DGF	millions of dollars of change in General Fund Revenue from initial conditions.
DOF	millions of dollars of change in Other Funds Revenue from initial conditions.
DLF	millions of dollars of change in Local Funds Revenue from initial conditions.
DDRE	millions of dollars of dynamic revenue effects.
PDRE	percent of dynamic revenue effects expressed in terms of the static cost.
SPI	millions of dollars of Personal Income statewide.
GN	millions of dollars of Gross Investment.
POP	The population of households in the state in millions.
W	The change in the wage rate (base = 100)
R	The change in the return to capital (base =100)
LD	Labor demand (jobs) in millions.
KD	Capital demand in hundreds of million dollars.
BASE	The initial data supplied to OTIM
CORP	The experiment changing Corporate taxes by a static estimate of $100 million.
PIT	The experiment changing Personal Income taxes by a static estimate of $100 million.
SAU	The experiment changing Sales (Excise) taxes by a static estimate of $100 million.

Investment elasticities matter relatively less than labor, migration and trade elasticities in all cases except one (the change in CORP response is a bit less under the LOW labor supply elasticity set). If investment response is less elastic with respect to after tax return to capital, dynamic response to the CORP tax reduction is lower than if the relationship is highly elastic – but the differences are not large over the range of elasticities examined. As the PIT and SAU tax changes depend less on investment than on the responses of households and producers to higher cost goods, the effect of changing the investment elasticity is smaller for these scenarios.

ELASTICITY EXPERIMENTS: PUBLIC INFRASTRUCTURE

These results below show responsiveness to different assumed values for the elasticity of private production with respect to public spending. A value of 0.01 was assumed for the base case. A low value of 0.005 was compared with a high value of 0.015.

The results show slight variation in the dynamic effect of different assumptions for this parameter over the range examined. Note that in contrast to the other parameters examined in this section, the revenue feedback increases with decreasing value of this elasticity. The interpretation is that a higher elasticity transmits relatively more benefit to producers from the increased government spending associated with a tax increase, thereby reducing producers' negative response to the tax increase.

Table 5-9 Public Infrastructure Elasticity Experiments

		CORP			PIT			SAU		
	BASE	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH	LOW	MEDIUM	HIGH
CORP	337.53	434.60	434.61	434.63	337.05	337.06	337.07	337.00	337.01	337.02
PIT	3,272.59	3,265.24	3,265.43	3,265.62	3,370.72	3,370.86	3,370.99	3,268.40	3,268.58	3,268.76
SAU	0	0	0	0	0	0	0	99.88	99.88	99.89
GFREV	4,277.08	4,365.67	4,365.90	4,366.12	4,373.64	4,373.79	4,373.95	4,371.52	4,371.73	4,371.94
OFREV	6,372.40	6,368.61	6,368.70	6,368.79	6,368.80	6,368.86	6,368.92	6,369.26	6,369.34	6,369.43
LFREV	5,961.88	5,959.61	5,959.68	5,959.76	5,959.01	5,959.07	5,959.12	5,959.78	5,959.85	5,959.92
STATIC	0	100	100	100	100	100	100	100	100	100
DGF	0	88.58	88.81	89.03	96.55	96.70	96.86	94.43	94.64	94.85
DOF	0	-3.79	-3.70	-3.61	-3.59	-3.53	-3.48	-3.14	-3.05	-2.97
DLF	0	-2.27	-2.19	-2.12	-2.86	-2.81	-2.76	-2.10	-2.03	-1.95
DDRE	0	-17.47	-17.09	-16.70	-9.91	-9.64	-9.37	-10.81	-10.44	-10.07
PDRE	0	17.47%	17.09%	16.70%	9.91%	9.64%	9.37%	10.81%	10.44%	10.07%
SPI	77,704.5	77,549.7	77,552.5	77,555.2	77,609.1	77,611.0	77,612.9	77,571.7	77,574.4	77,577.0
GN	7,409.14	7,370.09	7,370.39	7,370.68	7,398.65	7,398.85	7,399.05	7,398.33	7,398.61	7,398.89
POP	1.284709	1.284176	1.284185	1.284193	1.283749	1.283755	1.283761	1.284180	1.284188	1.284196
W	100.00	99.93	99.93	99.94	100.14	100.14	100.14	99.96	99.97	99.97
R	100.00	99.97	99.97	99.97	99.99	99.99	99.99	99.99	99.99	99.99
LD	1.994850	1.993676	1.993701	1.993726	1.990478	1.990495	1.990512	1.993269	1.993292	1.993316
KD	1,234.86	1,228.35	1,228.40	1,228.45	1,233.11	1,233.14	1,233.18	1,233.06	1,233.10	1,233.15

Heading	Description
CORP	millions of dollars of Corporate Income Tax revenue at solution.
PIT	millions of dollars of Personal Income Tax revenue at solution.
SAU	millions of dollars of Sales and Use Tax revenue at solution.
GFREV	millions of dollars of State Government General Fund Revenue at solution.
OFREV	millions of dollars of State Government Other Funds Revenue at solution.
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STATIC	The static estimate of the tax change.
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CONCLUSIONS

The results from the base simulations and sensitivity experiments are encouraging. When capital taxes are increased, firms appear to switch from capital to labor, increasing prices and the share of imported goods and services in the economy. When capital taxes are reduced, the reverse is true: firms switch from labor to capital, reducing prices and the share of imported goods and services in the economy. Effects of changes in excise taxes, including business property taxes, are transmitted via changes in goods and services prices and the opposite effect this has on demand: increased excise taxes increase prices thereby reducing demand, and vice versa. When income taxes are changed, labor supply and migration act to counter some of the static impact: higher income taxes are associated with lower migration and labor supply response. Significant alternative assumptions are relatively easy to accommodate in OTIM's structure. Results are as expected from a CGE model embodying perfect competition assumptions.

The experiments show that the model is most sensitive to the trade elasticities. Trade represents a very large share of a regional economy and small changes in the relative prices of imported and domestic goods and services can cause large changes in the economy.

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