DYNAMIC TAX ANALYSIS FOR OKLAHOMA:
A COMPUTABLE GENERAL
EQUILIBRIUM APPROACH

By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The political environment of the 90's is one that favors tax and spending reform at all levels of government. Any tax reform, however, has implications for economic variables such as output, employment, population, income, investment, and government tax revenue and expenditures. It is important to be able to estimate the economic effects of policy reform so that policy-makers can make better informed judgments about policy proposals. There are two ways to estimate the economic effects of policies: partial equilibrium and general equilibrium analysis. Partial equilibrium analysis examines the effects on agents in the market or markets directly affected by the proposed policy, assuming all else remains constant. Partial equilibrium analysis is generally accomplished with econometric models. General equilibrium analysis is concerned with the direct effects as well as any ripple effects through the economy as a result of the direct effects, i.e., not holding all else constant. While giving a good indication of the preliminary effects of proposed policy and being easy and relatively low cost to use, partial equilibrium analysis, by itself, is incomplete. There are many interrelated variables in an economy that must be considered when examining the effects of proposed policy. Therefore, for a better overall analysis, general equilibrium procedures should be used. This is the reason for the development of computable general equilibrium (CGE) models for policy analysis.

The first CGE models were "static" in nature, meaning there were no long-run considerations of investment changes from the proposed policy. The analysis was limited to a single period estimation of the model showing the effects on output, employment, and income as well as incidence and efficiency cost measures. For "dynamic" estimation, a theory of investment is required and the model needs to be estimated for as many periods as it takes for the model economy to reach a balanced growth path.

Dynamic estimation is popular due to its consideration of the ripple or "feedback" effects, including the effects on capital accumulation. These effects include behavioral changes, or the direct effects, predicted by economic theory concerning individuals' and businesses' reactions to changes in incomes, revenues and costs and also the indirect effects on other agents in the economy from these behavioral changes. These changes occur as agents reallocate their resources and adjust their optimal choices as a result of the policy change. The direct effects would be consumers buying less of a good because the tax on that good increased its price. An indirect effect would be the effect of that higher price on the use of any input for the good as well as the effects on any substitute goods or complementary goods.

Even though dynamic models are very popular, they are impractical at the state level. The reason it can be done at the national level but not at the state level has to do with the assumption at the national level that investment equals savings. At the national level, this assumption can be made with only the smallest of qualifications. However, at the state level, the economy is so open, especially to interstate commerce, that there is no way that savings will equal investment. In fact, because of this openness, it is impossible to determine the exact or even an approximate relationship between savings and investment. With all of the leakages involved, determining a dynamic model is very difficult. The solution is to do a model that represents a comparative static of the economy. This model will estimate the total effects of a change in the economy, independent of time. This is similar to saying that the economy is at equilibrium given the current tax policies, and that instituting a new set of policies would have led the economy to a different equilibrium, represented by the numbers generated during the simulation. Tax revenue changes will be dynamic in the sense that the whole economy will be modelled and there will be changes on most variables in the economy due to a tax change.

Previous Work

The earliest work with CGE models for tax analysis is contributed to Arnold Harberger. He set up a static Neoclassical general equilibrium model to analyze the incidence and efficiency effects of distortionary taxes on capital. This model was very simple. Harberger developed an economy with only two sectors, corporate and noncorporate. The model also had only two factors, labor and capital. Harberger was interested in the effects of capital taxes on the distribution of capital, labor and output between the two sectors and also on the distribution of income between labor owners and capital owners. The model was strictly analitical, different from the more recent models which use search algorithems and more detail. The problem with this type of analitical model is computational difficulty of increasing model detail.

Harberger found that the equilibrium effects of a tax on capital depend on many things including: labor to capital ratio in each industry, relative elasticities in each industry and for each input, and relative elasticity of substitutions for both industries and both inputs.

From the work of Harberger, other models were developed. The most well known model is by Ballard, et al. (1985), which developed a national, multi-sector static CGE model and then extended it to include dynamics. Their model is, as are most current models, based on nested constant elasticity of substitution (CES) consumption and production functions with the government sector being modeled as a consumer. The dynamics are included in the model by calculating a sequence of equilibria. This sequence is calculated until the model reaches a new, policy change induced, steady-state growth path. This type of dynamic estimation is simple and easy to use, but there is much criticism because there is no economic theory of investment in the model.

Most CGE models at the national level pertaining to taxes are concerned with efficiency and tax burden. Some studies simulate tax integration, especially between corporate income and personal income. Keller (1980) found that by changing marginal tax rates, in both consumption and production, there were small efficiency effects in the Netherlands. Ballentine and Thirsk (1979) found the Canadian personal income tax progressive while the corporate income and property tax incidences are mixed.

The first attempt at a state CGE model is the dynamic revenue analysis model (DRAM) for California, by the California Department of Finance. Their model is similar to the Ballard, et al. model in many ways. They use nested CES consumption and production functions to estimate multiple sectors of the California economy and model government as a consumer. The dynamics are different from Ballard, et al., however; the DRAM for California uses Engle's relative rates of return approach to calculating investment that was originally developed for Massachusetts. This investment theory is based on the cost of capital theory developed by Jorgenson and was developed for analysis at the regional level. However, in the DRAM model when a simulation is run the effects measured are the total effects. There is no consideration of time. This means that a simulation result could happen in one month, one year, or even 10 years.

The DRAM model was used to run several simulations. The ones relevant to this study were reducing the bank and corporation tax and reducing the personal income tax. When the bank and corporation tax simulation was run, they found the rental rate of capital falling by 0.4% and the wage rate increasing, marginally. Also, employment increased soley due to migration. There were two effects on tax revenue, fist they cut the revenue by $1 billion, then because of feedback effects there was on off setting increase in tax revenue of $184 million, thus leading to an estimated 18% dynamic feedback effect.

The personal income simulation was eliminating personal income tax revenues by $1 billion. Total tax revenue fell $990 million, leading to an estimate 1% dynamic feedback effect. The rental rate of capital rose marginally and the pre-tax wage fell by 0.2%. Again there was migration, but the migration only accounted for about 1/3 of the increase in labor.

There have been several non tax CGE models for the state of Oklahoma. Koh (1991) created a CGE model to analyze the effects of Oklahoma's boom and bust on factor markets. This model only had 9 economic sectors, and assumed a fixed supply of resources. Households were divided into income groups of low ($10,000 and below), medium ($10,000 - $29,999), and high ($30,000 and above). Koh found that for evaluating short-term impacts (2-5 years) on regions from economic shocks, CGE models seemed more appropriate than a fixed price multiplier approach, picking up both price and quantity effects.

Lee (1993) was concerned with developing a model to help measure welfare changes of rural development policies on households, both for the state and at the county level. Production was aggregated into agriculture, mining, manufacturing, and services. Consumers were aggregated into three income groups, below $20,000, $20,000-$40,000, and $40,000 and above. While finding little welfare effects of two different simulations, Lee did find that there were differences based on income level.

Budiyanti (1996) was concerned with the welfare effects of sport fishing in Oklahoma. Budiyanti's model had more sectoral detail than the previous model, with 14 production sectors, but not to the extent of the current model. Budiyanti also had consumers divided into 3 income classes, following Lee. Budiyanti found significant welfare effects of imposing a quality tax and/or assessing a pollution tax.

There are several differences between these earlier models and the current model. These models were not concerned with tax changes on factors, so the government section of these models were very simple and largely secondary. Also, to fully capture any effects of tax changes, the wages that producers pay should be a function of the income tax rate. Since the above models weren't concerned with changes in income tax rates, they didn't need to impose this on their structure. The model here has the wages that employers pay being a function of the income tax. Specificallly, employers pay a before tax wage equal to the after tax wage divided by one minus the income tax rate. Workers receive the after tax wage. Whenever there is a change in the income tax rate, the wages that producers pay and the wages that consumers receive both change.

Current Study

The purpose of this study is to develop a CGE model for the state of Oklahoma for estimating the effects of government policy on the economy. The model will be a comparative static model, all effects will be measured outside of time. There will be two simulations calculated: the effects of cutting the personal income tax by 10% and the effects of eliminating the corporate profits tax.

The first step in developing a CGE model is to try and understand the economic flows in the economy that need to be modeled. In figure 1-1, the flow of goods and services are shown in a representative economy. The agents involved are households, firms, the government, and the rest of the world. Whenever there is a flow of goods and services from a source in the economy, there is a corresponding flow of money for payment for the use of the goods and services. This flow of payment represents income to firms. Goods and services and money flow among all four agents and must be explicitly modeled that way in a CGE model.

In figure 1-2, the flow of resources among the four agents is shown. For simplification, the only resources to be considered in the CGE for Oklahoma will be labor and capital. For any flow of a resource from a source, there will be a reciprocal flow of money as payment for use of that resource. This flow of money represents income to resource owners. All of these flows need to be considered when creating a CGE model.

Figure 1-3 shows the explicit flows of goods and services, resources, and money through the government sector. The Government sector represents all levels of government. The expenditures represent government spending on roads and infrastructure, education, employee compensation, and so on. The money flowing into the government represents tax revenue. Within the Oklahoma tax CGE the federal and local governments will be exogenous, as will be state expenditures, only the state government revenues will be explicitly modeled.

The following chapter will develop the basic CGE model. Chapter 3 will explain the data and calibration procedures. Chapter 4 will explain the simulation and give results of the simulation, and chapter 5 will be a conclusion and possible extension to the work.

Figure 1-1
Flow of Goods and Services in Oklahoma

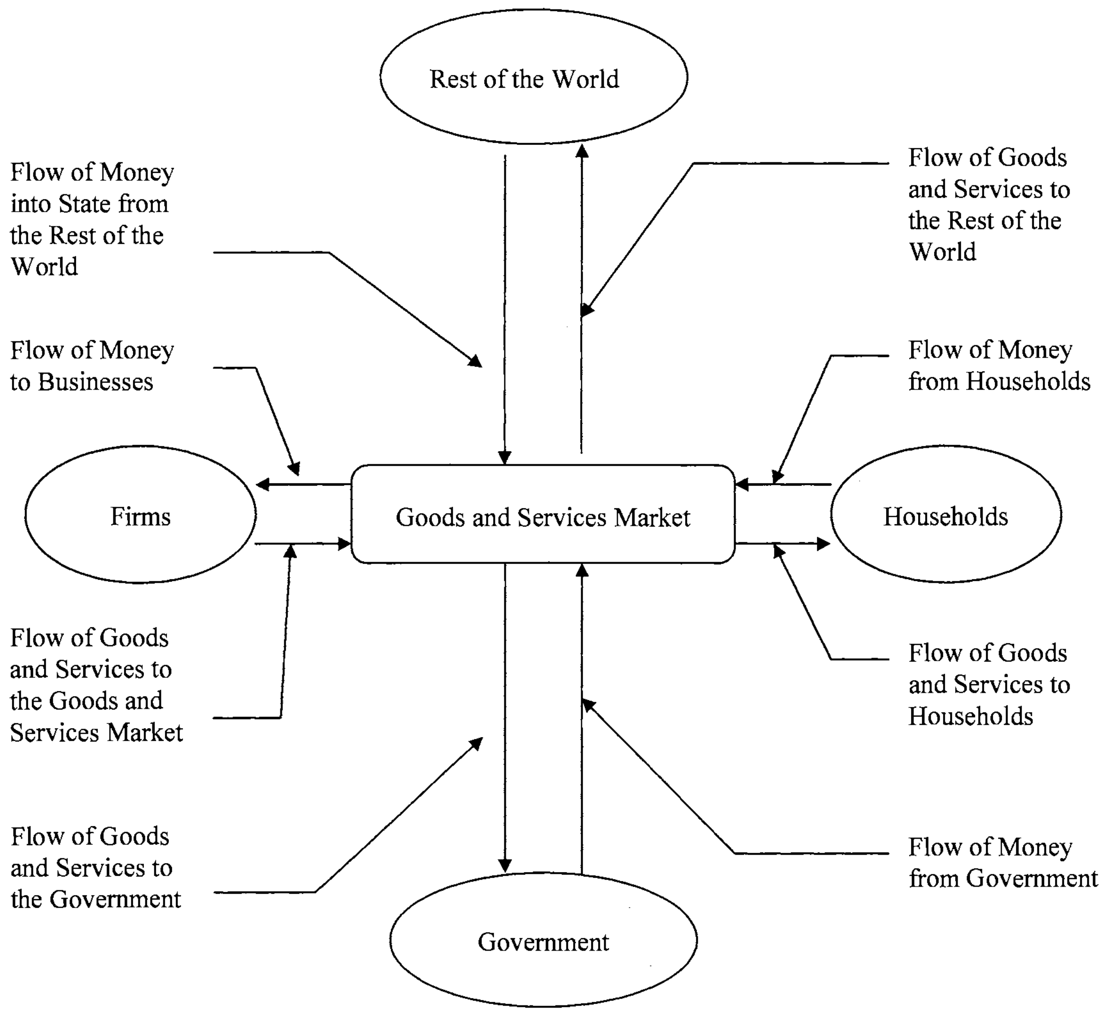


Figure 1-2
Flow of Factors of Production in Oklahoma

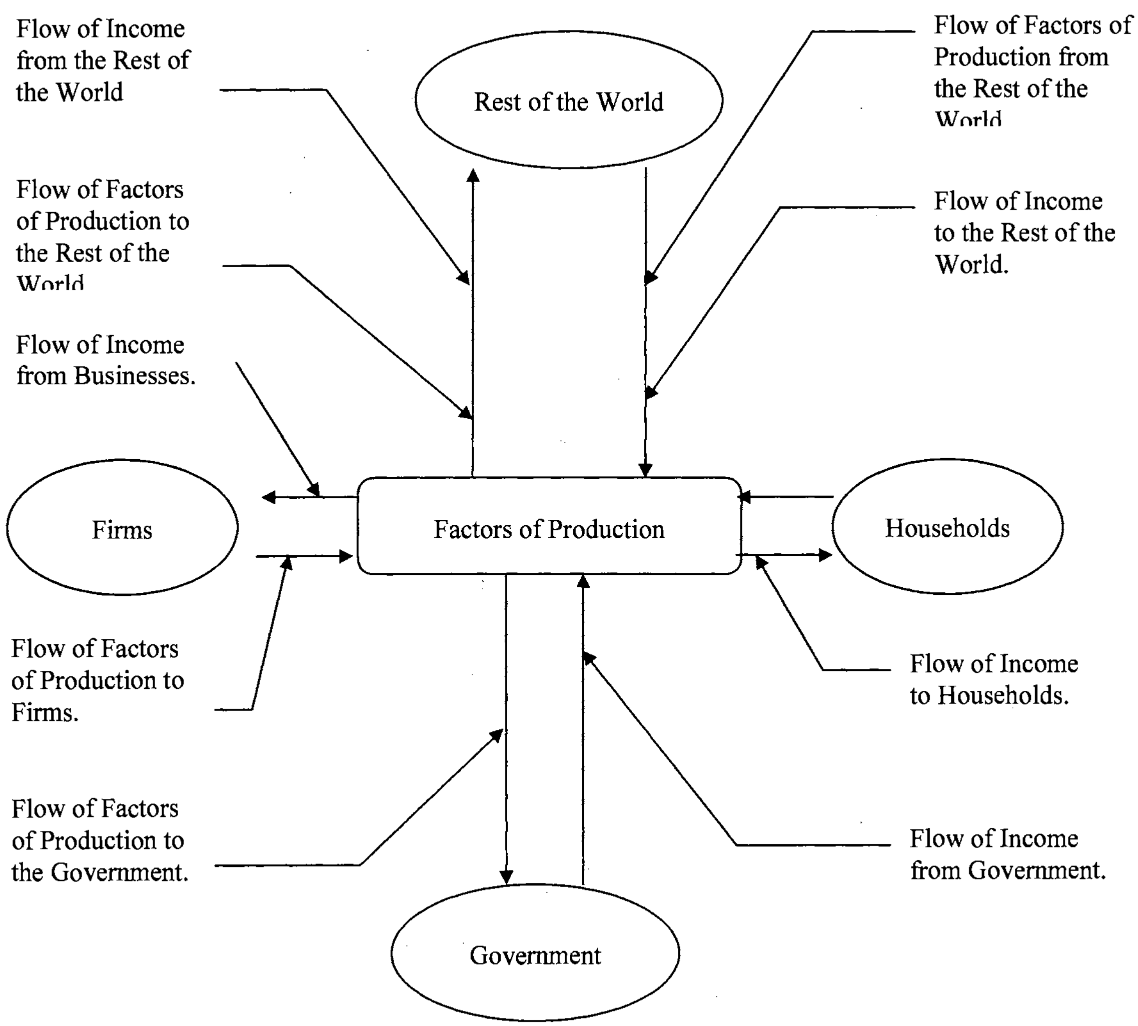
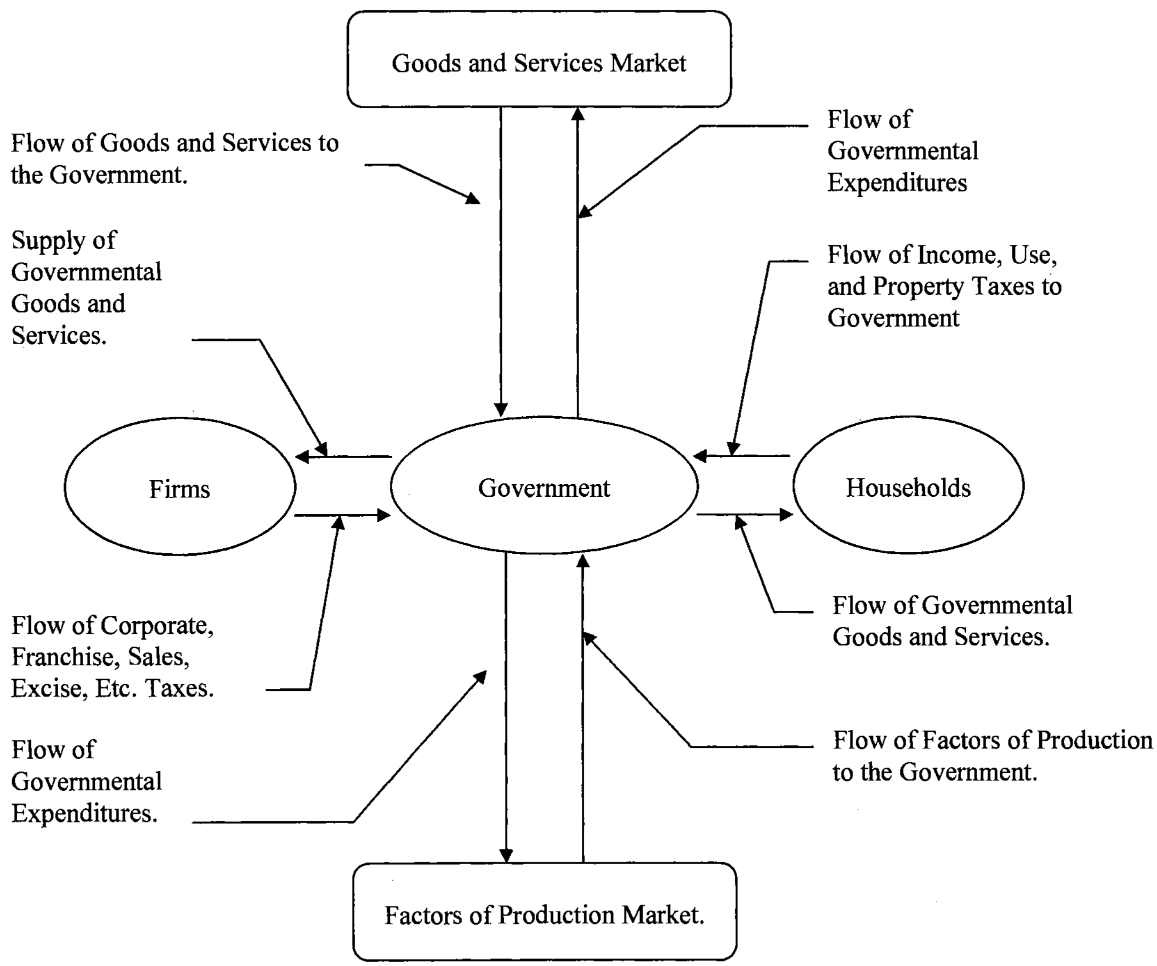


Figure 1-3
Expenditure and Revenue Flow for the State of Oklahoma



Chapter 2

Model Structure

The first step in developing a CGE model for dynamic tax analysis is to develop the basic CGE model for the state of Oklahoma. There will be two sectors in this model: the private sector, which includes domestic production and consumption, and the trade sector representing imports and exports for Oklahoma. Both consumption and production will be modeled using nested functions. The standard Neoclassical model assumptions are used. The output of the Oklahoma economy will be disaggregated by sector similarly to the disaggregation used by the Oklahoma State Econometric Model. The sectors, along with their SIC and IMPLAN (Impact Analysis for Planing) codes, are presented in chapter three, Table 3-1.

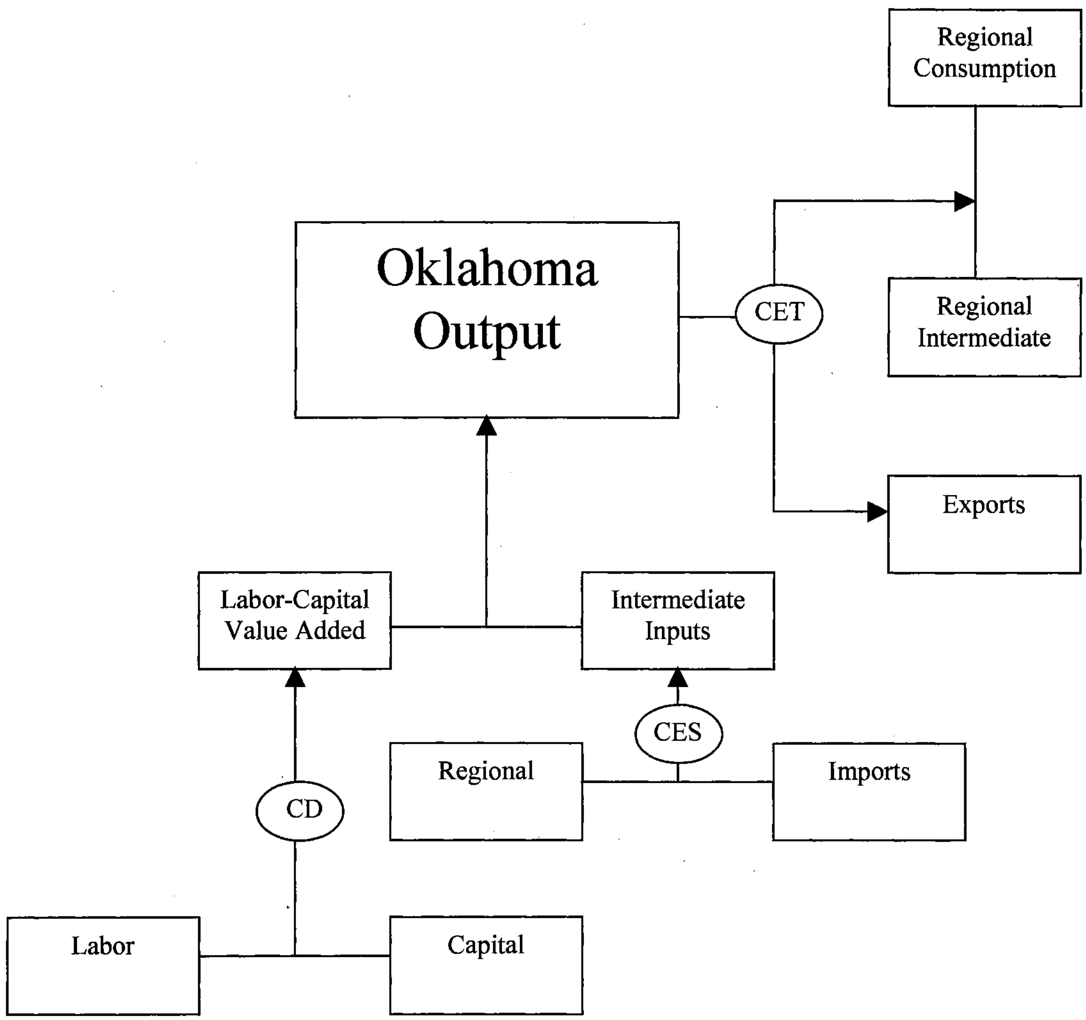
Production

Output for the state will be modeled using nested production and value added functions (see figure 2-1). Total state output will be modeled using Leontief technology. Under Leontief production technology, it is assumed that intermediate goods are used in fixed proportion to output in the production process and that labor and capital are combined into something called value added and this valued added is also used in fixed proportion to output. Also, producers are assumed to maximize profits. The following functional form will be used:

$$(1)\quad Y_i = \min\left(\frac{VA_i}{\alpha_{i0}}, \frac{X_{i1}}{\alpha_{i1}}, \frac{X_{i2}}{\alpha_{i2}}, \ldots, \frac{X_{im}}{\alpha_{im)}}\right),$$

where:

Figure 2-1
Oklahoma Output



Y_i = output for sector i

VA_i = composite value-added of labor and capital used in producing Y_i

X_{ij} = intermediate good X_j used in the production process in sector i, and

α_{ij} = share parameter for X_j used in the production process in sector i.

Factor Demand

A simplified CES function will be used to calculate the composite value-added of labor and capital. In the composite value added calculation, constant returns to scale is assumed and the elasticity of substitution between capital and labor is assumed to be 1. These assumptions lead to the use of the following Cobb-Douglas (CD) production function in calculating the composite value-added of labor and capital:

(2) $VA_i = vaa_i * LD_i^{\beta_i} * KD_i^{(1-\beta_i)}$,

where:

VA_i = composite value-added from labor and capital for sector i

vaa_i = efficiency parameter for sector i

LD_i = labor in sector i

KD_i = capital in sector i, and

β_i = share parameter for sector i.

Using this production function, the following profit function can be written:

(3) $\Pi_i = PN_i * \left(vaa_i * LD_i^{\beta_i} * KD_i^{(1-\beta_i)} \right) - PL * LD_i - PK_i * KD_i$,

where:

Π_i = profit

PN_i = after tax price received by producers for good i, net of all other costs

PL_i = price of labor, and

PK_i = sectoral price of capital.

The demand for labor and capital are found from the first order conditions of maximizing profits with respect to labor and capital:

(4) $LD_i = \frac{(\beta_i) * PN_i * Y_i}{PL}$, and

(5) $KD_i = \frac{(1-\beta_i) * PN_i * Y_i}{PK_i}$,

where all variables and parameters are as defined above.

Factor Supply

Changes in supply of each of the resources will be explicitly modeled. Changes in labor supply will be determined through utility maximization between consumption of goods and consumption of leisure. The Linear Expenditure System (LES) developed by Stone (1954) will be implemented into this model to determine the consumers choice between consuming goods and consuming leisure. The LES is derived from maximizing a Stone-Geary utility function subject to income. Incorporating the good leisure entails redefining income to include a time concept, therefore income will be any nonlabor income plus the wage rate times the total time available to the consumers. Consumers in Oklahoma are assumed to maximize utility, represented by the following,

(6) $U = \sum_{j=0}^{m} \phi_j \ln(C_j - g_j)$,

where:

U = utility for consuming good j, including leisure,

C_j = consumption of good j, including leisure,

ϕ_j = share parameter, sums up to one over j,

g_j = the minimum subsistence level of consumption for good i,

and j=0 is the good leisure. Each household faces the following income constraint:

$$(7)\quad \sum_{j=1}^{m} CPDC_j * C_j + PL * l = FM \ ,$$

where:

$CPDC_j$ = after tax composite price for consumer good j,

PL = the price of leisure, or the wage,

FM = full income,

and all other variables are as previously defined.

Assuming the individual household maximizes utility subject to its budget constraint, the following demand function for leisure is found from the first order conditions:

$$(8)\quad l = g_0 + \left(\frac{(1-\phi_0)}{PL}\right) * \left(FM - \sum_{j=1}^{m} CPDC_j g_j\right).$$

Equation (8) will not be used directly in the model, but will be used to determine labor supply. However, FM is not something that is measurable and needs to be eliminated from equation (8). Assuming that T represents the total time available to consumers, less some minimum necessary time for sleep and other life sustaining activities, then:

$$(9)\quad FM = NONLAB + PL * T\,,$$

where NONLAB represents nonlabor income. What equation (9) represents is that household full income is any nonlabor income plus what the household would earn if there was zero consumption of leisure, i.e. the household worked all available hours of the day. Another way of thinking of the budget constaint is to realize that leisure demand plus labor supply represents T. Therefore, equation (9) becomes:

(10) $FM = NONLAB + PL * (LSH + l)$,

where LSH is household labor supply and all other variables are as defined above. Equation (10) simplifies down to:

(11) $FM = MH + PL * l$,

where MH is household income. Substituting (11) into (8) and solving for leisure demand minus the minimum subsistence level of leisure yields:

$$(12)\quad l - g_0 = \left[\frac{\phi_0}{PL}\right] * \left[MH - \sum_{j=1}^{m} CPDC_j g_j\right].$$

Subtracting $\sum_{j=0}^{m} CPDC_j g_j$ from both sides of (11) and substituting (12) in for $l - g_0$ yields:

$$(13)\quad FM - \sum_{j=0}^{m} CPDC_j g_j = \frac{MH - \sum_{j=1}^{m} CPDC_j g_j}{1 - \phi_0}.$$

Substituting the above into (8) will give leisure demand. Subtracting leisure demand from the total time available to households yields labor supply:

$$(14)\quad LS = \psi - \left[\frac{\phi_0}{PL}\right] * \left[\frac{HHE - \sum_{j=1}^{m} CPDC_j g_j}{(1 - \phi_0)}\right],$$

where ψ is the total time available to households less the minimum subsistence consumption level of leisure.

Changes in labor supply are determined by regional labor force participation rate changes and migration of labor into and out of the state. Migration can depend on many factors: relative wage rates, relative price differences, relative differences in employment conditions, etc. For simplification, migration in the Oklahoma tax CGE will be determined by relative wage rates:

$$(15)\quad LMH = LSHO * \left[\frac{PL}{PLUS}\right]^{\eta},$$

where:

LMH = labor migration,

LSHO = initial labor supply,

PL = price of labor, Oklahoma,

PLUS = price of labor, United States,

η = labor migration elasticity with respect to the price of labor.

However, given equal wage rates between the region and the United States, labor migration would equal initial labor supply. Therefore, equation (15) needs to be modified so that there is no migration when the wage rates are equal. Following Lee (1993), a log transformation of (15) was implemented in the model:

$$(16)\quad LMH = \eta * LSHO * \ln\left[\frac{PL}{PLUS}\right].$$

Total labor supply in the new equilibrium will be labor supply plus any migration that occurs during the simulation. The migration can be either positive or negative.

Capital supply changes will be caused by changes in the demand for capital. Given that Oklahoma is an open economy, capital is assumed perfectly mobile and capital supply will adjust to meet capital demand. Because capital is perfectly mobile, the after tax price of capital will equal the after tax world price of capital, and the only difference between the domestic price of capital and the world price of capital will be the corporate profits tax.

Intermediate Good Demand

Intermediate goods will be used in a fixed proportion to regional output. From equation (1):

(17) $X_i = \alpha_{ij} * Y_{ij}$ where,

X_{ij} = sector i's demand for intermediate good j,

α_{ij} = share parameter,

Y_i = output, sector i.

Intermediate goods will be produced both locally and imported from abroad. The following CES function will be used to determine the share of intermediate goods that will be produced locally:

$$(18)\quad X_{ij} = vda_{ij} * \left(\mu_{ij} * V_{ij}^{\left(\frac{\sigma_j^{vd}-1}{\sigma_j^{vd}}\right)} + (1-\mu_{ij}) * D_{ij}^{\left(\frac{\sigma_j^{vd}-1}{\sigma_j^{vd}}\right)} \right)^{\left(\frac{\sigma_j^{vd}}{\sigma_j^{vd}-1}\right)},$$

where:

vda_{ij} = technology parameter,

μ_{ij} = share parameter,

V_{ij} = imported intermediate good j purchased by sector i,

D_{ij} = domestic intermediate good j purchased by sector i,

σ_j^{vd} = elasticity of substitution between imported and domestically produced intermediate good j.

Demand for imported and domestic intermediate goods is determined from minimizing costs subject to constant output and assuming constant returns to scale, or:

$$\min\ C_{ij} = PW_j V_j + PD_j D_j \text{ s.t. } X_{ij} = vda_{ij} * \left(\mu_{ij} * V_{ij}^{\left(\frac{\sigma_j^{vd}-1}{\sigma_j^{vd}}\right)} + (1-\mu_{ij}) * D_{ij}^{\left(\frac{\sigma_j^{vd}-1}{\sigma_j^{vd}}\right)} \right)^{\left(\frac{\sigma_j^{vd}}{\sigma_j^{vd}-1}\right)}.$$

Industry i's domestic and import demand for intermediate good j is, respectively :

$$(19)\quad D_{ij} = \frac{X_{ij} * (1-\mu_{ij})^{\sigma_j^{vd}}}{vda_{ij} * PD_j^{\sigma_j^{vd}} * \left[\mu_{ij}^{\sigma_j^{vd}} * PW_j^{(1-\sigma_j^{vd})} + (1-\mu_{ij})^{\sigma_j^{vd}} * PD_j^{(1-\sigma_j^{vd})}\right]^{\left(\frac{\sigma_j^{vd}}{\sigma_j^{vd}-1}\right)}}, \text{ and}$$

$$(20)\quad V_{ij} = \frac{X_{ij} * \mu_{ij}^{\sigma_j^{vd}}}{vda_{ij} * PW_j^{\sigma_j^{vd}} * \left[\mu_{ij}^{\sigma_j^{vd}} * PW_j^{(1-\sigma_j^{vd})} + (1-\mu_{ij})^{\sigma_j^{vd}} * PD_j^{(1-\sigma_j^{vd})}\right]^{\left(\frac{\sigma_j^{vd}}{\sigma_j^{vd}-1}\right)}}$$

where all variables and parameters are defined above. However, for computational reasons, the following, from the first order conditions, will be used in the CGE model:

$$(21)\quad D_{ij} = V_{ij} * \left[\left(\frac{(1-\mu_{ij})}{\mu_{ij}}\right) * \left(\frac{PW_j}{PD_j}\right)\right]^{\sigma_j^{vd}}.$$

<u>Exports</u>

Regional output will be used for either regional consumption or out-of-state consumption. The constant elasticity of transformation (CET) function developed by Powell and Gruen (1968) is used in CGE models to incorporate regional product differentiation. The following CET function is used to derive the export share of Oklahoma production:

$$(22)\quad Y_i = era_i * [\gamma_i * E_i^{\left(\frac{\sigma_i^{er}+1}{\sigma_i^{er}}\right)} + (1-\gamma_i) * R_i^{\left(\frac{\sigma_i^{er}+1}{\sigma_i^{er}}\right)}]^{\left(\frac{\sigma_i^{er}}{\sigma_i^{er}+1}\right)},$$

where

Y_i = regional output, sector i,

E_i = regional output that is exported, sector i,

R_i = regional output that is consumed domestically, sector i,

era_i = technology parameter,

γ_i = share parameter,

σ_i^{er} = elasticity of substitution between exported regional output and domestically consumed regional output for sector i.

The demand for exports is found from assuming that for the firm to maximize profits, it must maximize revenues between world and regional sales:

$\max PW_i E_i + PD_i R_i$ s.t.

$$Y_i = era_i * [\gamma_i * E_i^{\left(\frac{\sigma_i^{er}+1}{\sigma_i^{er}}\right)} + (1-\gamma_i) * R_i^{\left(\frac{\sigma_i^{er}+1}{\sigma_i^{er}}\right)}]^{\left(\frac{\sigma_i^{er}}{\sigma_i^{er}+1}\right)}.$$

From the first order conditions, export and region demand can be calculated:

$$(23)\quad E_i = \frac{\gamma_i^{-\sigma_i^{er}} * Y_i}{era_i * PW_i^{-\sigma_i^{er}} * \left(\gamma_i^{-\sigma_i^{er}} * PW_i^{(1+\sigma_i^{er})} + (1-\gamma_i)^{-\sigma_i^{er}} * PD_i^{(1+\sigma_i^{er})}\right)^{\left(\frac{\sigma_i^{er}}{\sigma_i^{er}+1}\right)}}, \text{ and}$$

$$(24)\quad R_i = \frac{(1-\gamma_i)^{-\sigma_i^{er}} * Y_i}{era_i * PD_i^{-\sigma_i^{er}} * \left(\gamma_i^{-\sigma_i^{er}} * PW_i^{(1+\sigma_i^{er})} + (1-\gamma_i)^{-\sigma_i^{er}} * PD_i^{(1+\sigma_i^{er})}\right)^{\left(\frac{\sigma_i^{er}}{\sigma_i^{er}+1}\right)}}$$

where all variables and parameters are defined above. Again, for computational reasons, the following, from the first order conditions, will be used in the CGE model:

$$(25)\quad R_i = E_i * \left[\left(\frac{(1-\gamma_i)}{\gamma_i} \right) * \left(\frac{PW_i}{PD_i} \right) \right]^{-\sigma_i^{er}} .$$

Consumption

Preferences will be modeled using nested utility functions. Consumers in Oklahoma will decide what goods to purchase based on utility maximization of the Stone-Geary utility function discussed previously. Once consumers decide what to consume, they then decide from where to purchase the goods. Consumers' choice of imported or domestic consumption goods will be modeled using CES utility functions.

Household Demand

From the derivation of labor supply, consumption demand for good j:

$$(26)\quad C_j = g_j + \left(\frac{\phi_j}{CPDC_j} \right) * \left(FM - \sum_{i \neq j} CPDC_i g_i \right).$$

By substituting (14) into the above and solving for C_{hj} yields good j's consumption demand in terms of household monetary income:

$$(27)\quad C_j = g_j + \left[\frac{\phi_j}{(1-\phi_0)CPDC_j} \right] * \left[MH - \sum_{i=1}^{m} CPDC_i g_i \right].$$

Once consumers have chosen what goods to consume, they then face the choice of either purchasing the goods from domestic producers or from producers outside the state. For the consumer's choice between domestic and imported consumption goods, preferences are represented by the following CES utility function[1]:

[1] The following is known as the Armington specification.

$$(28)\quad C_j = vra_j * \left[\lambda_j * CI_j^{\left(\frac{\sigma_j^{VR}-1}{\sigma_j^{VR}}\right)} + (1-\lambda_j) * CR_j^{\left(\frac{\sigma_j^{VR}-1}{\sigma_j^{VR}}\right)} \right]^{\left(\frac{\sigma_j^{VR}}{\sigma_j^{VR}-1}\right)},$$

where:

vra_j = technology parameter,

λ_j = share parameter for good j,

CI_j = import demand for good j,

CR_j = demand for domestically produced good j,

σ_j^{VR} = elasticity of substitution between consuming domestically produced good j and imported good j.

The budget constraint that each consumer faces is:

$$(29)\quad PW_j * CI_j + PD_j * CR_j = DMH.$$

Assuming that consumers maximize utility given the above income constraint, or that the consumer minimizes cost subject to utility, the demand for imports and regionally produced goods is, respectively:

$$(30)\quad CI_j = \frac{\lambda_j^{\sigma_j^{VR}} * C_j}{vra_j * PW_j^{\sigma_j^{VR}} * \left(\lambda_j^{\sigma_j^{VR}} * PW_j^{(1-\sigma_j^{VR})} + (1-\lambda_j)^{\sigma_j^{VR}} * PD_j^{(1-\sigma_j^{VR})}\right)^{\left(\frac{\sigma_j^{VR}}{\sigma_j^{VR}-1}\right)}}, \text{ and}$$

$$(31)\quad CR_j = \frac{(1-\lambda_j)^{\sigma_j^{VR}} * C_j}{vra_j * PD_j^{\sigma_j^{VR}} * \left(\lambda_j^{\sigma_j^{VR}} * PW_j^{(1-\sigma_j^{VR})} + (1-\lambda_j)^{\sigma_j^{VR}} * PD_j^{(1-\sigma_j^{VR})}\right)^{\left(\frac{\sigma_j^{VR}}{\sigma_j^{VR}-1}\right)}}$$

where all variables and parameters are defined above. Once again, it is computationally easier to use the following from the first order conditions:

$$(32)\quad CR_j = CI_j * \left[\left(\frac{(1-\lambda_j)}{\lambda_j} \right) * \left(\frac{PW_j}{PD_j} \right) \right]^{\sigma_j^{YR}} .$$

<u>Income</u>

Income for each individual arises from the following sources: labor income, capital income, transfer payments, and other. Labor income is just the price of labor times the amount of labor supplied, and is the largest source of household income:

$$(33)\quad YLAB = PL * (1 - ftss) * \sum_{i=1}^{n} LD_i ,$$

where:

YLAB = labor income,

PL = price of labor,

LD_i = the labor demand, sector i, and

ftss = social security tax rate.

Because of migration, changes in labor income could be generated by individuals leaving or entering the state. To separate out the changes in income caused by migration from the changes in income to current residents from the policy change, the total number of households needs to be corrected for migration. To account for migration, income needs to be adjusted so that the new level of income is for the same number of households as the base year level of income. Following Lee(1993), the adjustment factor is simply the initial household labor supply plus any migration divided by the initial household labor supply, or:

$$(34)\quad LADJ = \frac{LSHO + LMH}{LSHO} .$$

Household expenditures and consumption demand will also be adjusted for labor migration.

Capital income by household is the return that the owners receive from providing capital services. Capital value added is not only distributed among households, but also to the government in the form of taxes, and some is kept in the form of retained earnings. Households only receive a share of the capital value added. It is assumed that the household share of capital valued added is constant during the simulation, therefore, the capital income households receive is:

(35) $YCAP = svak * \sum_{i=1}^{n} PK_i * (1 - stca_i) * KD_i$,

where,

YCAP = capital income,

svak = share capital value added accrued to households,

PK = price of capital,

KD_i = capital demand, sector i, and

$stca_i$ = corporate profits tax sector i.

Transfer payments are just lump sum payments from the federal and state local governments Transfer payments and other income will be exogenous to the model and will be represented as TPFEDO, TPSLO, and OTHERO. Total household income will be:

(36) $MH = YLAB + YCAP + TPFEDO + TPSLO + OTHERO$.

Household savings is determined by assuming the rate of savings, or the marginal propensity to save, for each household remains constant during the simulation. The marginal propensity to save is calculated by dividing the base year's savings by the base year's income. Then using income and savings, household expenditures can be calculated and used to determine labor supply and good j household demand.

Other Demand

There are two other sources of demand within the state. There is demand for good j from governments and demand from firms purchasing good j for investment. These two demands are exogenous within the Oklahoma tax CGE, but need to be included to help determine total, domestic, and import demand for good j.

Both the federal and state and local governments demand goods. The demand from these governments is exogenous, but the source is not. Governments can demand goods from within the state or from imports. This choice is modeled similarly to the household choice between domestic and imported goods. A CES function will be used and the governments attempt to minimize costs subject to the expenditures the incur. For state and local governments, the following CES function is assumed:

$$(37)\quad SGEO_j = sgea_j * \left(\pi_j * SGI_j^{\left(\frac{\sigma_j^{sge}-1}{\sigma_j^{sge}}\right)} + (1-\pi_j) * SGD_j^{\left(\frac{\sigma_j^{sge}-1}{\sigma_j^{sge}}\right)} \right)^{\left(\frac{\sigma_j^{sge}}{\sigma_j^{sge}-1}\right)}$$

where

$SGEO_j$ = exogenous state and local government expenditures, good j

$sgea_j$ = technology parameter

π_j = share parameter

SGI_j = state and local government imports, good j

SGD_j = state and local government domestic consumption, good j, and

σ_j = elasticity of substitution between imports and domestic goods.

Assuming state and local governments minimize costs subject to the above consumption, the demands for domestic and import goods by the state and local government, respectively, are:

$$(38)\quad SGD_j = \frac{(1-\pi_j)^{\sigma_j^{sge}} * SGEO_j}{sgea_j * PD_j^{\sigma_j^{sge}} * \left(\pi_j^{\sigma_j^{sge}} * PW_j^{(1-\sigma_j^{sge})} + (1-\pi_j)^{\sigma_j^{sge}} * PD_j^{(1-\sigma_j^{sge})}\right)^{\left(\frac{\sigma_j^{sge}}{\sigma_j^{sge}-1}\right)}}$$

$$(39)\quad SGI_j = \frac{\pi_j^{\sigma_j^{sge}} * SGEO_j}{sgea_j * PW_j^{\sigma_j^{sge}} * \left(\pi_j^{\sigma_j^{sge}} * PW_j^{(1-\sigma_j^{sge})} + (1-\pi_j)^{\sigma_j^{sge}} * PD_j^{(1-\sigma_j^{sge})}\right)^{\left(\frac{\sigma_j^{sge}}{\sigma_j^{sge}-1}\right)}},$$

where all variables are as previously defined. For computation ease, the equation used in the Oklahoma tax CGE, from the first order conditions, is:

$$(40)\quad SGD_j = SGI_j * \left[\left(\frac{(1-\pi_j)}{\pi_j}\right) * \left(\frac{PW_j}{PD_j}\right)\right]^{\sigma_j^{sge}}.$$

The federal government acts the same as the state and local government, minimizing costs subject to:

$$(41)\quad FGEO_j = fgea_j * \left(\varepsilon_j * FGI_j^{\left(\frac{\sigma_j^{fge}-1}{\sigma_j^{fge}}\right)} + (1-\varepsilon_j) * FGD_j^{\left(\frac{\sigma_j^{fge}-1}{\sigma_j^{fge}}\right)}\right)^{\left(\frac{\sigma_j^{fge}}{\sigma_j^{fge}-1}\right)},$$

and with demands for domestic and import good j, respectively:

$$(42)\quad FGD_j = \frac{(1-\varepsilon_j)^{\sigma_j^{fge}} * FGEO_j}{fgea_j * PD_j^{\sigma_j^{fge}} * \left(\varepsilon_j^{\sigma_j^{fge}} * PW_j^{(1-\sigma_j^{fge})} + (1-\varepsilon_j)^{\sigma_j^{fge}} * PD_j^{(1-\sigma_j^{fge})}\right)^{\left(\frac{\sigma_j^{fge}}{\sigma_j^{fge}-1}\right)}}$$

$$(43)\quad FGI_j = \frac{\varepsilon_j^{\sigma_j^{fge}} * FGEO_j}{fgea_j * PW_j^{\sigma_j^{fge}} * \left(\varepsilon_j^{\sigma_j^{fge}} * PW_j^{(1-\sigma_j^{fge})} + (1-\varepsilon_j)^{\sigma_j^{fge}} * PD_j^{(1-\sigma_j^{fge})}\right)^{\left(\frac{\sigma_j^{fge}}{\sigma_j^{fge}-1}\right)}}.$$

For computational ease, the following is implemented in the Oklahoma tax CGE:

$$(44)\quad FGD_j = FGI_j * \left[\left(\frac{(1-\varepsilon_j)}{\varepsilon_j} \right) * \left(\frac{PW_j}{PD_j} \right) \right]^{\sigma_j^{fge}}.$$

Goods and services are also demanded for use as capital. The 1995 IMPLAN generated data set contains sectoral investment demand by source, but not by destination. Therefore, total demand for goods and services to be used as capital will be held constant in the Oklahoma tax CGE. A CES function will be used to determine the share of demand that is satisfied from imports. The process is similar to the above government demand derivation, minimize costs subject to:

$$(45)\quad CAPO_j = capa_j * \left(\rho_j * CAPI_j^{\left(\frac{\sigma_j^{ca}-1}{\sigma_j^{ca}}\right)} + (1-\rho_j) * CAPD_j^{\left(\frac{\sigma_j^{ca}-1}{\sigma_j^{ca}}\right)} \right)^{\left(\frac{\sigma_j^{ca}}{\sigma_j^{ca}-1}\right)},$$

to get the following demand functions:

$$(46)\quad CAPD_j = \frac{(1-\rho_j)^{\sigma_j^{ca}} * CAPO_j}{capa_j * PD_j^{\sigma_j^{ca}} * \left(\rho_j^{\sigma_j^{ca}} * PW_j^{(1-\sigma_j^{ca})} + (1-\rho_j)^{\sigma_j^{ca}} * PD_j^{(1-\sigma_j^{ca})} \right)^{\left(\frac{\sigma_j^{ca}}{\sigma_j^{ca}-1}\right)}}$$

$$(47)\quad CAPI_j = \frac{\rho_j^{\sigma_j^{ca}} * CAPO_j}{capa_j * PW_j^{\sigma_j^{ca}} * \left(\rho_j^{\sigma_j^{ca}} * PW_j^{(1-\sigma_j^{ca})} + (1-\rho_j)^{\sigma_j^{ca}} * PD_j^{(1-\sigma_j^{ca})} \right)^{\left(\frac{\sigma_j^{ca}}{\sigma_j^{ca}-1}\right)}}.$$

Again, as previously, the following will be used for computational ease:

$$(48)\quad CAPD_j = CAPI_j * \left[\left(\frac{(1-\rho_j)}{\rho_j} \right) * \left(\frac{PW_j}{PD_j} \right) \right]^{\sigma_j^{ca}}.$$

Model Closure

For the model to be complete, supply must equal demand for each sector and for both factors of production. For each each sector, regional supply must equal domestic consumption of regional production plus exports:

(49) $Y_j = TD_j + CR_j + SGD_j + FGD_j + CAPD_j + E_j$,

where j represents the sector, Y is total output for the state, TD, CR, SGD, FGD, and CAPD are domestic consumption of domestic production for intermediate goods, consumption goods, state and local government goods, federal goods, anc capital goods, respectively, and E is exports.

For the labor market, total labor demand for the state must equal total labor supplied by residents plus any migration, which could either be postitive or negative. Labor market equilibrium is represented by:

(50) $\sum_j LD_j = LSH + LMH$,

where LD is the sectoral labor demand, LSH is resident household labor supply, and LMH is household migration.

Capital is assumed perfectly mobile, so there is no equilibrium condition for the capital market.

The next section will incorporate taxes into the model. Appendix D has a list of all the equations, in GAMS (General Algebraic Modeling System) format, that will be used in the model.

Government

After the initial model has been set up, the next step is to incorporate the government sector into the model. Governments perform several functions, including collecting taxes and purchasing goods and services. The primary focus of this study is the impacts of changing the state government's tax policies. Therefore, it is necessary to model the state government as an agent in the Oklahoma economy who collects revenue and spends its revenue on goods and services. However, the analysis is very specific in nature, therefore, the state government part of the model will be tightly focused. Any part of the government not specifically affected by the simulation will be assumed exogenous and constant. Also, both the federal and local governments will be exogenous.

Personal income tax is the largest source of revenue to the state. Each household in Oklahoma pays income taxes based on marginal tax rates, deductions, and their level of income. At this time, it would be very difficult to model each marginal tax rate in the state and include deductions. Therefore, an alternative needs to be considered. A computationally tractable alternative is to take the total income tax collections and divide that by total taxable income to derive an average tax rate for the state. Then, personal income tax will be modeled as a linear function of income. This average tax rate, called stin, will be used to calculate total personal income tax during the simulation period using the following equation:

(51) $STRIN = stin * MH$.

Households also pay taxes on any income earned from capital. In the 1995 IMPLAN generated data set, there is capital income from two sources, noncorporate (valued added capital) and corporate. Noncorporate capital returns are distributed to the households via value added payments. Corporate returns are either kept by the firms in the form of retained earnings, or distributed to the households in the form of dividend payments. Capital income is taxed at a different rate than labor income and is usually an important factor in a firm's decision on location. One of the simulations to be performed is a cut in the corporate profit tax to zero for the state. Therefore, this is part of the state government that needs to be explicitly included in the model. In the Oklahoma tax CGE, businesses pay capital owners for the use of capital. These payments are called value added capital. Households receive this value added capital payment less any capital tax, and use it to purchase goods and services. Since the simulation is only concerned with corporate profits tax, the rest of the capital taxes will be left exogenous.

The 1995 IMPLAN generated data set used for this model only has total corporate profits, there is no sectoral detail on corporate profits. Using national numbers for total capital value added and corporate profits by sector, a national share of coporate returns to total returns was found and used to approximate the state's share. Using the state's share, an average corporate income tax rate was calculated on total value added capital. Since this process is an approximation, the total corporate income using these share figures did not equal the total for the state. The shares had to be adjusted so that corporate income for the state was equal to $272.006 million. The data used in this corporate income tax determination are listed in Table 2-2.

All other taxes are exogenous. Indirect business taxes are treated as ad valorem taxes on production. Social security taxes are taken out of employee compensation prior to distribution to households. There are also other taxes that households pay. These other taxes are grouped together into a category called "other" and are assumed constant during the simulations.

Adding the tax parts to the model is not difficult. There will be a domestic price for capital that firms pay, and a domestic price for capital, less the capital tax, that households

Table 2-1
Oklahoma
Sectoral Corporate Returns
1995

SECTOR	CORPORATE RETURNS TO CAPITAL, U.S., BILLIONS*	TOTAL RETURNS TO CAPITAL, U.S., BILLIONS*	U.S. CORPORATE SHARE OF TOTAL CAPITAL RETURNS	OKLAHOMA TOTAL RETURNS TO CAPITAL, MILLIONS**	OKLAHOMA SECTORAL CORPORATE PROFIT, BASED ON SHARES, MILLIONS	ADJUSTMENT FACTOR
AGRI	1.3840	77.9000	0.0178	371.1936	6.5948	1.8896
MINE	3.4160	51.8000	0.0659	3802.5342	250.7617	1.8896
CONS	13.7560	81.0000	0.1698	232.5480	39.4930	1.8896
FOOD	20.3530	48.2843	0.4215	268.1636	113.0373	1.8896
APPA	3.1480	7.4681	0.4215	34.6220	14.5940	1.8896
CRGS	10.8220	25.6735	0.4215	143.3922	60.4432	1.8896
OMAN	56.0880	133.0601	0.4215	517.5895	218.1763	1.8896
PRIN	13.2690	31.4787	0.4215	78.4397	33.0642	1.8896
PETR	4.5870	10.8819	0.4215	590.0287	248.7111	1.8896
METL	15.2240	36.1166	0.4215	388.6097	163.8082	1.8896
MACH	35.2970	83.7367	0.4215	711.8442	300.0592	1.8896
TCPU	83.1380	272.6000	0.3050	2863.6311	873.3550	1.8896
WHOL	33.3110	96.8000	0.3441	647.1166	222.6870	1.8896
RETL	48.8030	135.7000	0.3596	971.7034	349.4624	1.8896
FIRE	72.3410	779.8000	0.0928	7063.2700	655.2501	1.8896
OSER	16.7510	123.2254	0.1359	595.7052	80.9789	1.8896
BSER	14.4310	106.1588	0.1359	249.4567	33.9106	1.8896
HEAL	14.9480	109.9620	0.1359	229.8460	31.2448	1.8896
EDUC	0.6870	5.0538	0.1359	11.2147	1.5245	1.8896
Total	**461.7540**	**2216.7000**	**0.1359**	**19770.9092**	**3697.1562**	

*Source: U.S. Department of Commerce, Bureau of Economic Analysis.
**Source: 1995 IMPLAN generated data set.

Table 2-1 (Continued)
Oklahoma
Sectoral Corporate Returns
1995

SECTOR	OKLAHOMA ADJUSTED CORPORATE PROFIT, MILLIONS	OKLAHOMA SECTOR SHARE CORPORATE TAX	OKLAHOMA TOTAL CORPORATE PROFITS, MILLIONS**	OKLAHOMA CORPORATE PROFITS PER SECTOR, MILLIONS	OKLAHOMA CORPORATE PROFITS TAX RATE PER SECTOR	PERCENT SHARE OF TOTAL CAPITAL RETURNS DUE TO CORPORATE
AGRI	12.4618	0.0018	272.0060	0.4852	0.0013	3.3572
MINE	473.8507	0.0678	272.0060	18.4490	0.0049	12.4614
CONS	74.6277	0.0107	272.0060	2.9056	0.0125	32.0913
FOOD	213.6005	0.0306	272.0060	8.3163	0.0310	79.6530
APPA	27.5775	0.0039	272.0060	1.0737	0.0310	79.6530
CRGS	114.2162	0.0163	272.0060	4.4469	0.0310	79.6530
OMAN	412.2758	0.0590	272.0060	16.0516	0.0310	79.6530
PRIN	62.4796	0.0089	272.0060	2.4326	0.0310	79.6530
PETR	469.9758	0.0673	272.0060	18.2981	0.0310	79.6530
METL	309.5394	0.0443	272.0060	12.0516	0.0310	79.6530
MACH	567.0055	0.0812	272.0060	22.0759	0.0310	79.6530
TCPU	1650.3311	0.2362	272.0060	64.2542	0.0224	57.6307
WHOL	420.7994	0.0602	272.0060	16.3835	0.0253	65.0268
RETL	660.3599	0.0945	272.0060	25.7105	0.0265	67.9590
FIRE	1238.1903	0.1772	272.0060	48.2079	0.0068	17.5300
OSER	153.0214	0.0219	272.0060	5.9578	0.0100	25.6874
BSER	64.0790	0.0092	272.0060	2.4949	0.0100	25.6874
HEAL	59.0415	0.0085	272.0060	2.2987	0.0100	25.6874
EDUC	2.8808	0.0004	272.0060	0.1122	0.0100	25.6874
Total	**6986.3140**	**1.0000**		**272.0060**		

*Source: U.S. Department of Commerce, Bureau of Economic Analysis.
**Source: 1995 IMPLAN generated data set.

receive. Firms will pay out employee compensation to households. Households will receive this compensation, less social security taxes as labor income. Disposable income will be determined using average personal income tax rates and total household income:

$$(52)\quad DMH = (1 - stin - ftin - ohht) * \begin{pmatrix} YLAB + YCAP + TPFEDO \\ + TPSLO + OTHERO \end{pmatrix},$$

where stin and ftin are state and federal income tax rate, respectively, and ohht is other household tax rate. The two simulations under consideration, elimination of the corporate profits tax and cutting personal income tax rates by 10%, will both affect consumers directly, and the rest of the economy indirectly.

Chapter 3

Data and Calibration

For a CGE model the data must come in the form of a social accounting matrix (SAM). A SAM of Oklahoma represents the flow of expenditures and incomes within the state economy. The columns of a SAM represent expenditures (demands) from a sector and the rows represent incomes. For the SAM to work, each column sum must equal the corresponding row sum, meaning that incomes must equal expenditures for each sector. The data for the Oklahoma SAM used in this study is from the 1995 Impact Analysis for Planing (IMPLAN) model for Oklahoma. The IMPLAN input/output model is based on state shares of national income and regional purchase coefficients (RPCs). An RPC is an estimate of the amount of domestic production that is used to meet domestic demand. An RPC of .6 means that 60% of the domestic demand for a good is met by domestic production, while the rest of the demand is met by imports. Using RPCs, trade flows can be calculated and traced through the Oklahoma economy.

The Oklahoma economy has many different individual economic sectors, in fact there are so many that it would be too costly to try and model them all. One way of simplifying the model is to combine or aggregate economic sectors that are similar. The IMPLAN model generates 528 sectors for the state of Oklahoma. For this model, the number of sectors is aggregated down to 21 production sectors, one trade sector, one household sector, one investment demand sector, and two government sectors. Each production sector generates output that is either purchased regionally or exported. Each production sector also purchases intermediate goods, both from within the region and imports from the rest of the world, and purchases factors of production, i.e. labor and capital, to use in the production process. Households and governments each receive income, households in the form of factor returns, and governments in the form of taxes, which is then used to purchase goods, both regionally and from outside the region. The household sector is divided into three income groups, low, medium and high while the government sector is divided into two parts, the federal government and state and local government.

The aggregation of the production sector in the model is by one and two digit SIC code. The aggregation is similar to the aggregation used by the Oklahoma State Econometric Model, and is represented in Table 3-1.

Factors of Production

For the Oklahoma Tax CGE, there will be two factors of production, labor and capital. Households supply the factors to firms, who use the factors to help produce output. In exchange for the factors, households receive income. Factor income is based on the value added by the factors during the production process and any governmental taxes placed on factor use. The households then use the income, net of any taxes, from the factors to purchase goods and services.

IMPLAN, however, separates value added into four categories: employee compensation, proprietary income, other property income, and indirect business taxes. For the Oklahoma tax CGE, the data need to be aggregated into labor and capital. Employee

Table 3-1
Oklahoma SAM Aggregation

SECTOR	IMPLAN SECTOR	SIC CODE
Agriculture	1-27	01-09
Mining	28-47, 57	10-14
Construction	48-56	15-17
Food and Kindred Products	58-107	20
Apparel and Related	108-132	23
Printing and Publishing	174-185	27
Oil Related Products	210-220	29-30
Construction Related	133-160, 230-253	24-25, 32
Metal Goods	254-306	33-34
Machinery and Equipment	307-399	35
Other Manufacturing	161-173, 186-209, 221-229, 400-432	21-22, 26, 28, 31, 36-39
Transportation, Comm., and P.U.	433-446,510-511, 514	40-49
Wholesale Trade	447	50-51
Retail Trade	448-455	52-59
Finance, Insurance and Real Estate	456-462	60-67
Business Services	469-476	73
Health Services	490-493	80
Educational Services	495-497	82
Other Services	463-468, 477-489, 494, 498-509, 525-527	70-72, 75-79, 81, 83-89
State and Local Government	512, 522-523	91-97
Fed Government	513, 515, 519-521	91-97
Not in Aggregation		
Noncomparable imports	516	
Scrap	517	
Used and Secondhand goods	518	
Rest of the world industry	524	
Inventory valuation	528	

compensation and proprietary income[2] are combined into labor, while other property income is capital.

Indirect business taxes are taxes imposed on firms during the production and distribution process. State and local indirect business taxes included in the 1995 IMPLAN generated SAM are sales taxes, property taxes, motor vehicle license taxes, severance taxes, other taxes, and state and local nontaxes (fees, etc.). Federal indirect business taxes included are excise taxes, custom duties, and federal nontaxes (fees, etc.). For simplification, indirect business taxes will be exogenous to the model since none of them are considered during the simulation. Indirect business taxes are modeled as a tax on the sale of the good by the firm. An overall indirect business tax rate will be calculated and imposed on firms in the region. IMPLAN generated value added income is represented in Table 3-2, while the combined categories of labor and capital value added are in Table 3-3.

There is also a category called enterprises. This category represents corporate profits, retained earnings, corporate profit tax, and dividend income (not by sector). Corporate profits represent capital returns for corporations and is part of the capital value added distributed to households. These data were used to determine the capital tax rate by industry.

[2] Usually, proprietary income is composed of both labor and capital income. However, after contacting IMPLAN it was confirmed that their proprietary income is composed soley of labor income.

Table 3-2
IMPLAN Oklahoma
Factor Income
1995
(Millions of Dollars)

Sector	Employee Comp.	Proprietor Income	Other Property income	Indirect Business Taxes
Agriculture	261.7789	285.6521	371.1936	61.94696
Mining	1646.889	528.2943	3802.534	667.3356
Construction	1846.283	714.5263	232.548	22.02077
Food and Kindred Products	470.9213	8.843541	268.1636	10.8936
Apparel and Related Products	155.8837	6.903046	34.62203	1.807096
Construction Related Goods	516.275	36.496	143.3922	9.695257
Other Manufacturing	625.7907	201.6039	517.5895	46.22022
Printing and Publishing	320.0099	27.35538	78.43973	3.579619
Oil Related Products	869.0044	22.91923	590.0287	162.8249
Metal Goods	936.9593	56.87996	388.6097	16.55978
Machinery and Equipment Goods	2469.206	332.8373	711.8442	56.53101
Trans., Comm., and Public Utilities	2894.705	516.3906	2863.631	681.4026
Wholesale Trade	2185.808	221.3266	647.1166	1314.469
Retail Trade	3848.541	545.2475	971.7034	1527.566
Finance, Insurance and Real Estate	1994.566	193.486	7063.27	1317.447
Other Services	3368.995	914.5552	595.7052	203.71
Business Services	1261.769	417.0732	249.4567	67.85571
Health Services	3466.773	592.4083	229.846	34.95586
Educational Services	284.9451	12.02332	11.21467	10.73653
State and Local Government	6008.281	0	724.6583	0
Federal Government	4072.482	0	1027.873	0

Source: 1995 IMPLAN model.

Table 3-3
OklahomaValue Added
Labor and Capital
1995
(Millions of Dollars)

Sector	Labor Value Added	Capital Value Added
Agriculture	547.431	371.1936
Mining	2175.1833	3802.534
Construction	2560.8093	232.548
Food and Kindred Products	479.764841	268.1636
Apparel and Related Products	162.786746	34.62203
Construction Related Goods	552.771	143.3922
Other Manufacturing	827.3946	517.5895
Printing and Publishing	347.36528	78.43973
Oil Related Products	891.92363	590.0287
Metal Goods	993.83926	388.6097
Machinery and Equipment Goods	2802.0433	711.8442
Trans., Comm., and Public Utilities	3411.0956	2863.631
Wholesale Trade	2407.1346	647.1166
Retail Trade	4393.7885	971.7034
Finance, Insurance and Real Estate	2188.052	7063.27
Other Services	4283.5502	595.7052
Business Services	1678.8422	249.4567
Health Services	4059.1813	229.846
Educational Services	296.96842	11.21467
State and Local Government	6008.281	724.6583
Federal Government	4072.482	1027.873

Table 3-4
Oklahoma Intermediate Demand
1995
(Millions of Dollars)

Sector	Domestic	Imports
Agriculture	1946.44	1100.56
Mining	3004.18	0.00
Construction	2074.64	0.00
Food and Kindred Products	1814.50	889.63
Apparel and Related Products	227.41	363.84
Construction Related Goods	523.38	1721.78
Other Manufacturing	1114.34	3818.96
Printing and Publishing	298.94	454.00
Oil Related Products	4078.63	1681.64
Metal Goods	918.02	3952.76
Machinery and Equipment Goods	3837.40	2716.76
Transportation, Comm., and P.U.	4901.14	1565.68
Wholesale Trade	1521.02	600.33
Retail Trade	1948.76	51.04
Finance, Insurance and Real Estate	2938.75	2497.59
Other Services	3172.52	1022.03
Business Services	924.87	1869.45
Health Services	1663.21	13.48
Educational Services	238.93	84.94
State and Local Government	384.90	0.00
Federal Government	139.68	58.66

Source: 1995 IMPLAN model.

Demands

Business Demand

Businesses, households and governments all demand final goods and services in any economy. Goods demanded by businesses and used in the production of other goods are called intermediate goods. Businesses demand intermediate goods from both domestic producers and producers in the rest of the world. RPCs are used to calculate the share of domestic production demanded by domestic businesses in the form of intermediate goods. The 1995 IMPLAN generated domestic and import intermediate demands, by sector, are in Table 3-4.

Businesses also demand goods and services for investment. Investment is when a firm buys goods and services now to add to the productive process sometime in the future. Investment goods can also be domestic or imported. This category is set up like another consumer in Oklahoma. There is no indication where the goods go, expect that they go for investment. Table 3-5 has the investment demand; both domestic and foreign, for Oklahoma according to the 1995 IMPLAN generated SAM.

Household Demand

Households demand goods and services for consumption. Regional RPCs are used to calculate the share of domestic production used to fill domestic demand. The amount of regional goods consumed by households within the state depends on preferences, income levels, and the relative price of goods. Domestic and import household consumption is presented in Table 3-6. For computational reasons in determining the before and after tax wage rate, the three household groups will be aggregated into one group.

Government Demand

Governments are the final regional component of demand. All levels of government demand goods for use in the government provision of services. Governments demand goods from both within the region and from the rest of the world. Again, RPCs were used to calculate the share of domestic output versus imports demanded by the government. Government demand is presented in Table 3-7.

Output

Oklahoma firms combine intermediate goods and factors of production to generate output. Output in each sector will either be used domestically, in the form of intermediate goods or final demands, or exported to the rest of the world. The Oklahoma economy does have some sectors that generate substantial exports. For example, agriculture exports 61% of the state production, mining exports 51%, construction related goods 92%, other manufacturing exports 69%, printing and publishing 76%, oil related products 81%, and metal goods 97%. Table 3-8 presents exports for the state based on the 1995 IMPLAN generated SAM.

Calibration

While data are available for all of the agents in the Oklahoma Tax CGE, not all of the parameters are available. Fortunately, there are estimates for the elasticities and Frisch parameter[3]. While these estimates are for national numbers, they are commonly accepted as

[3] All of the elasticity estimates and the Frisch Parameter are from "Application of General Equilibrium Modeling For Measuring Regional Economic And Welfare Impacts of Quality Changes in Sport Fishing in Oklahoma."

Table 3-5
Oklahoma Investment Demand
1995
(Millions of Dollars)

	Domestic		Import	
Sector	Capital Accumulation	Inventory Additions	Capital Accumulation	Inventory Additions
Agriculture	0.00	2.010408	0.00	1.52
Mining	24.93192	0.451409	0.00	0.00
Construction	3587.409	0.00	0.00	0.00
Food and Kindred Products	0.00	15.99713	0.00	15.36
Apparel and Related	5.587702	1.377381	10.69	2.64
Construction Related	12.60503	1.87598	189.27	28.17
Other Manufacturing	66.41624	11.4468	347.13	59.83
Printing and Publishing		2.482798	0.00	7.28
Oil Related Products	0.724985	14.99287	1.25	25.88
Metal Goods	8.60879	0.943883	316.80	34.74
Machinery and Equipment Goods	2554.687	73.13562	2055.73	58.85
Trans., Comm., and Public Utilities	153.2408	46.47637	43.80	13.28
Wholesale Trade	506.481	183.4348	88.74	32.14
Retail Trade	195.7979	0.00	12.27	0.00
Finance, Insurance and Real Estate	155.367	0.00	90.95	0.00
Other Services	2.474759	0.175649	0.55	0.04
Business Services	11.88559	0.00	7.31	0.00
Health Services	0.00	0.00	0.00	0.00
Educational Services	0.00	0.00	0.00	0.00
State and Local Government	0.00	0.00	0.00	0.00
Federal Government	0.00	0.00	0.00	0.00

Source: 1995 IMPLAN model.

Table 3-6
Oklahoma Household Consumption
1995
(Millions of Dollars)

	Domestic			Imports		
	HHL	**HHM**	**HHH**	**HHL**	**HHM**	**HHH**
Agriculture	53.38	96.19	64.20	40.29	72.60	48.46
Mining	0.37	0.65	0.41	0.00	0.00	0.00
Construction	0.00	0.00	0.00	0.00	0.00	0.00
Food and Kindred Products	475.05	818.68	520.74	456.07	785.97	499.94
Apparel and Related Products	70.90	189.22	167.11	135.68	362.10	319.77
Construction Related Goods	3.71	8.99	8.67	55.78	134.98	130.13
Other Manufacturing	76.86	147.00	105.32	401.72	768.32	550.47
Printing and Publishing	17.14	42.65	33.76	50.23	124.98	98.91
Oil Related Products	69.18	155.67	109.79	119.42	268.72	189.51
Metal Goods	0.42	1.10	0.98	15.39	40.50	36.05
Machinery and Equipment Goods	216.59	547.90	508.27	174.28	440.88	409.00
Trans., Comm., and Public Utilities	753.22	1337.78	1003.38	215.27	382.33	286.76
Wholesale Trade	414.33	865.51	656.97	72.60	151.65	115.11
Retail Trade	1570.37	3767.78	2966.84	98.39	236.08	185.89
Finance, Insurance and Real Estate	1554.09	3416.28	2811.69	909.76	1999.88	1645.95
Other Services	828.41	1935.52	1790.20	183.02	427.61	395.50
Business Services	30.26	69.65	63.44	18.60	42.81	38.99
Health Services	1988.33	3597.17	2273.88	190.54	344.72	217.91
Educational Services	165.01	249.06	404.88	61.31	92.54	150.43
State and Local Government	60.48	133.05	98.21	0.00	0.00	0.00
Federal Government	15.41	27.98	31.67	2.20	4.00	4.53

Source: 1995 IMPLAN model.

Table 3-7
Oklahoma Government Demand
1995
(Millions of Dollars)

	Domestic		Imports	
	State and Local Government	Federal Government	State and Local Government	Federal Government
Agriculture	0.402056	0.077872	0.30	0.06
Mining	0.855983	0.137244	0.00	0.00
Construction	34.22654	63.42499	0.00	0.00
Food and Kindred Products	0.278555	1.365849	0.27	1.31
Apparel and Related Products	0.038682	0.103383	0.07	0.20
Construction Related Goods	0.003509	0.091013	0.05	1.37
Other Manufacturing	0.310522	0.393506	1.62	2.06
Printing and Publishing		0.031574	0.00	0.09
Oil Related Products	0.169985	52.80959	0.29	91.16
Metal Goods	0.005295	0.08816	0.19	3.24
Machinery and Equipment Goods	3.760706	142.8521	3.03	114.95
Trans., Comm., and Public Utilities	3.532713	95.92184	1.01	27.41
Wholesale Trade	0.844548	32.91782	0.15	5.77
Retail Trade	0.316802	14.35428	0.02	0.90
Finance, Insurance and Real Estate	4.518325	0.185436	2.65	0.11
Other Services	57.64267	356.1889	12.73	78.69
Business Services	10.62293	95.93983	6.53	58.97
Health Services	20.97946	7.304831	2.01	0.70
Educational Services	5.277211	2.76379	1.96	1.03
State and Local Government			0.00	0.00
Federal Government	1944.898	2332.606	277.97	96.50

Source: 1995 IMPLAN model.

Table 3-8
Oklahoma Exports
1995

Industry	Exports (Millions)	Share
Agriculture (1)	2703.22	0.61
Mining (28)	5402.14	0.51
Construction (48)	114.71	0.02
Food and Kindred Products (58)	1204.63	0.30
Apparel and Related Products (108)	69.09	0.10
Construction Related Goods (133)	1808.70	0.92
Other Manufacturing (161)	2596.10	0.69
Printing and Publishing (174)	837.11	0.76
Oil Related Products (210)	6203.00	0.81
Metal Goods (254)	3739.26	0.97
Machinery and Equipment Goods (307)	4012.94	0.35
Trans., Comm., and P. U. (433)	4232.89	0.31
Wholesale Trade (447)	512.30	0.08
Retail Trade (448)	647.78	0.06
Fin., Ins., and R. E. (456)	2345.29	0.16
Other Services (463)	100.14	0.01
Business Services (469)	29.00	0.01
Health Services (490)	74.43	0.01
Educational Services (495)	49.95	0.04
State & Local Gov (512-522)	334.23	0.05
Fed Gov (513-519)	522.84	0.10

Source: 1999 IMPLAN model.

good estimate for states. And given the data limitations, these estimates are the best that are available. Table 3-9 presents the exogenous parameter estimates and their respective sources.

The rest of the parameters in the model need to be estimated. The accepted process is called calibration. Assuming that the initial base year data represents an equilibrium for the economy, the base year data is used to estimate the unknown parameters. The parameters that need to be calibrated are technology and share parameters for the CES and CD functional forms, the minimum subsistence levels of all goods, including leisure for the LES function, and the total time available for households to work minus the minimum subsistence level of leisure for the labor supply function.

CES Functions

Starting with the CES functions, the share parameters need to be calculated first, as they are used in the calibration of the technology parameter. Given

$$(1)\quad C_j = vra_j * \left[\lambda_j * CI_j^{\left(\frac{\sigma_j^{VR}-1}{\sigma_j^{VR}}\right)} + (1-\lambda_j) * CR_j^{\left(\frac{\sigma_j^{VR}-1}{\sigma_j^{VR}}\right)} \right]^{\left(\frac{\sigma_j^{VR}}{\sigma_j^{VR}-1}\right)}$$

as a representative CES function and (2) $PW_j * CI_j + PD_j * CR_j = DMH$

as a representative cost function, the following is found from the first order conditions of minimizing costs subject to output:

$$(3)\quad CR_j = CI_j * \left[\left(\frac{(1-\lambda_j)}{\lambda_j} \right) * \left(\frac{PW_j}{PD_j} \right) \right]^{\frac{1}{\sigma_j^{VR}}}.$$

Table 3-9
Exogenous Estimates

Parameter	Value	Source
Elasticity of Substitution		de Melo and Tarr (1992)
Agriculture	1.42	
Mining	0.5	
Manufacturing	3.55	
Services	2	
Elasticity of Transformation		de Melo and Tarr (1992)
Agriculture	3.9	
Mining	2.9	
Manufacturing	2.9	
Services	0.7	
Income Elasticity of Household Consumption		de Melo and Tarr (1992)
Agriculture	0.3	
Mining	0.89	
Manufacturing	1.06	
Services	1.05	
Income Elasticity of Labor Supply		Abbot and Ashenfelter (1979)
HHL	-0.12	
HHM	-0.18	
HHH	-0.24	
Frisch Parameter		Lluch, Powell, and Williams (1977)
HHL	-1.8	
HHM	-1.6	
HHH	-1.4	
Labor Migration Elasticity	0.92	Rickman (1992)

Source: Lee 1993.

Knowing the initial values for CR, CI, PW, PD, and the elasticity of substitution allows the above equation to be solved for lambda. The easiest way computationally is to solve the above for $\left(\frac{(1-\lambda_j)}{\lambda_j}\right)$ and then add one to the result and divide into 1 to get lambda:

(4) $\frac{(1-\lambda_j)}{\lambda_j}=\left(\frac{PD_j}{PW_j}\right)*\left(\frac{CR_j}{CI_j}\right)^{\sigma_j^{VR}}$, and

(5) $\frac{1}{1+\frac{(1-\lambda_j)}{\lambda_j}}=\lambda_j$.

The technology parameter is now solved for using the new estimate of lambda and equation (1):

(6) $vra_j=\frac{C_j}{\left[\lambda_j*CI_j^{\left(\frac{\sigma_j^{VR}-1}{\sigma_j^{VR}}\right)}+(1-\lambda_j)*CR_j^{\left(\frac{\sigma_j^{VR}-1}{\sigma_j^{VR}}\right)}\right]^{\left(\frac{\sigma_j^{VR}}{\sigma_j^{VR}-1}\right)}}$.

This process was implemented on all of the CES functions and also on the CET function[4].

Cobb-Douglas Functions

The CD function for labor and capital value added also has share and technology parameters that need to be calibrated. For the share parameter the following equation is used:

(7) $\beta_i=\frac{PL*LD_i}{VA_i}$.

Using the estimate of beta, the technology parameter is found from:

[4] The CET function was different by negative sigma.

(8) $VA_i = vaa_i * LD_i^{\beta_i} * KD_i^{(1-\beta_i)}$.

Rearranging and solving for vaa yields:

(9) $$vaa_i = \frac{VA_i}{LD_i^{\beta_i} * KD_i^{(1-\beta_i)}}.$$

Leontief Production Function

The Leontief production function only has share parameters that need to be calibrated. From equation (1) in chapter 2, the shares are calculated as:

(10) $$\alpha_{i0} = \frac{VA_i}{Y_i}$$

for share value added in the production of good i, and

(11) $$\alpha_{ij} = \frac{X_{ij}}{Y_i}$$

for the share of intermediate good j in the production of good i.

Linear Expenditure Function

For the LES function the calibration is more complicated. The parameters to be calibrated include the phi's, or marginal budget shares, the g's, or the minimum subsistence levels of each good, and psi, or the total time available to consumers less the minimum subsistence level of leisure. To start, the phi's are calculated from the equations for income elasticity of labor supply and income elasticity of consumption demand. The relative elasticities, respectively, are:

(12) $$\varepsilon_{LS}^{m} = \frac{\phi_o * HHE}{(1-\phi_o) * PL * LSH},$$ and

$$(13)\quad \varepsilon_j^m = \frac{\phi_j * HHE}{(1-\phi_o) * CPDC_j * C_j}.$$

Using exogenous elasticity estimates and initial values for prices, consumption, labor supply, and household expenditures, equations (12) and (13) can be solved for the phi's:

$$(14)\quad \phi_o = \frac{PL * LSH * \varepsilon_{LS}^m}{PL * LSH * \varepsilon_{LS}^m - HHE}, \text{ and}$$

$$(15)\quad \phi_j = \frac{\varepsilon_j^m * (1-\phi_o) * CPDC_j * C_j}{HHE}.$$

Next, the phi's need to be constrained to sum to one, since they represent the marginal budget shares. The phi's are adjusted by decreasing each of the j (exluding leisure) phi's, proportionally so that the constraint holds.

Once the phi's are found, they are used to calculate the g_j's from the demand functions for each j good:

$$(16)\quad C_i = g_i + \left[\frac{\phi_i}{(1-\phi_0)CPDC_i}\right] * \left[HHE - \sum_{j=1}^{m} CPDC_j g_j\right],$$

rearranging and solving for g yields:

$$(17)\quad g_i = C_i - \left[\frac{\phi_i}{(1-\phi_0)CPDC_i}\right] * \left[HHE - \sum_{j=1}^{m} CPDC_j g_j\right].$$

To be able to solve for an individual g, an exogenously determined Frisch parameter needs to be used. The Frisch parameter measures the income elasticity of marginal utility of income, or the elasticity of the lagrangian multiplier with respect to household expenditures. The Lagrangian for maximizing utility subject to income is:

$$(18)\quad L = \sum_{j=0}^{m} \phi_j \ln(C_j - g_j) + \lambda * \left(HHE - \sum_{j=1}^{m} CPDC_j * C_j\right).$$

From the first order conditions for utility maximization, the Lagrangian multiplier is found to be:

$$(19)\quad \lambda = \frac{\sum_{j=0}^{m} \phi_j}{HHE - \sum_{j=1}^{m} CPDC_j * g_j}.$$

Since the phi's sum to one, (20) becomes:

$$(20)\quad \lambda = \frac{1}{HHE - \sum_{j=1}^{m} CPDC_j * g_j}.$$

The elasticity of lambda with respect to HHE, or the Frisch parameter (fr), is equal to:

$$(21)\quad fr = \frac{HHE}{HHE - \sum_{j=1}^{m} CPDC_j * g_j}.$$

Simple rearranging yields:

$$(22)\quad HHE - \sum_{j=1}^{m} CPDC_j * g_j = \frac{HHE}{fr},$$

which when substituted into (17) yields:

$$(23)\quad g_j = C_j - \left[\frac{\phi_j}{(1-\phi_0)CPDC_j}\right] * \left[\frac{HHE}{fr}\right].$$

Finally, using the phi's and g's, psi can be calibrated using the equation for labor supply:

$$(24)\quad \psi = LS + \left[\frac{\phi_0}{PL}\right] * \left[\frac{HHE - \sum_{j=1}^{m} CPDC_j g_j}{(1-\phi_0)}\right].$$

Now the model is calibrated and ready to run the simulations. Table 3-10 lists the initial values of key variables for the base year and the model generated values for the

Table 3-10
Comparison Between Model and Base Year

	Output (Millions)				Labor Demand (Millions)				Capital Demand (Millions)		
	Model	Base Year	Diff.		Model	Base Year	Diff.		Model	Base Year	Diff.
AGRI	4399.66	4399.67	0.00		533.56	533.56	0.00		370.71	370.71	0.00
MINE	10535.99	10536.00	0.00		2120.06	2120.05	0.00		3784.08	3784.09	0.00
CONS	7393.97	7393.97	0.00		2495.91	2495.91	0.00		229.64	229.64	0.00
FOOD	4012.02	4012.01	0.01		467.61	467.61	0.00		259.85	259.85	0.00
APPA	701.25	701.25	0.00		158.66	158.66	0.00		33.55	33.55	0.00
CRGS	1961.55	1961.54	0.01		538.76	538.76	0.00		138.95	138.95	0.00
OMAN	3777.73	3777.74	-0.01		806.42	806.42	0.00		501.54	501.54	0.00
PRIN	1106.22	1106.22	0.00		338.56	338.56	0.00		76.01	76.01	0.00
PETR	7637.23	7637.23	0.00		869.32	869.32	0.00		571.73	571.73	0.00
METL	3859.39	3859.41	-0.02		968.65	968.65	0.00		376.56	376.56	0.00
MACH	11560.71	11560.74	-0.03		2731.02	2731.03	-0.01		689.77	689.77	0.00
TCPU	13448.35	13448.35	0.00		3324.64	3324.64	0.00		2799.38	2799.38	0.00
WHOL	6708.23	6708.23	0.00		2346.13	2346.13	0.00		630.73	630.73	0.00
RETL	10021.47	10021.47	0.00		4282.43	4282.43	0.00		945.99	945.99	0.00
FIRE	14723.33	14723.32	0.01		2132.60	2132.60	0.00		7015.06	7015.06	0.00
OSER	9970.79	9970.79	0.00		4174.99	4174.99	0.00		589.75	589.75	0.00
BSER	3482.27	3482.27	0.00		1636.29	1636.29	0.00		246.96	246.96	0.00
HEAL	8108.18	8108.18	0.00		3956.30	3956.30	0.00		227.55	227.55	0.00
EDUC	1115.97	1115.97	0.00		289.44	289.44	0.00		11.10	11.10	0.00
SLGV	7202.93	7202.94	0.00		5856.00	5856.00	0.00		724.66	724.66	0.00
FGOV	5309.61	5309.61	0.00		3969.27	3969.27	0.00		1027.87	1027.87	0.00

	Total Intermediate Good Demand (Millions)				Domestic Intermediate Good Demand (Millions)				Import Intermediate Good Demand (Millions)		
	Model	Base Year	Diff.		Model	Base Year	Diff.		Model	Base Year	Diff.
AGRI	2558.67	2558.67	0.00		1458.12	1458.12	0.00		1100.56	1100.56	0.00
MINE	5103.31	5103.31	0.00		5103.31	5103.31	0.00		0.00	0.00	0.00
CONS	2022.90	2022.90	0.00		2022.90	2022.90	0.00		0.00	0.00	0.00
FOOD	1816.30	1816.29	0.00		926.66	926.66	0.00		889.63	889.63	0.00
APPA	553.97	553.97	0.00		190.13	190.13	0.00		363.84	363.84	0.00
CRGS	1836.45	1836.44	0.00		114.67	114.67	0.00		1721.78	1721.78	0.00
OMAN	4549.64	4549.65	0.00		730.68	730.68	0.00		3818.96	3818.96	0.00
PRIN	608.94	608.94	0.00		154.94	154.94	0.00		454.00	454.00	0.00
PETR	2655.83	2655.83	0.00		974.20	974.20	0.00		1681.64	1681.64	0.00
METL	4060.16	4060.17	-0.01		107.41	107.41	0.00		3952.75	3952.76	-0.01
MACH	6092.92	6092.92	-0.01		3376.16	3376.17	-0.01		2716.76	2716.76	0.00
TCPU	7044.01	7044.01	0.00		5478.33	5478.33	0.00		1565.68	1565.68	0.00
WHOL	4026.62	4026.62	0.00		3426.29	3426.29	0.00		600.33	600.33	0.00
RETL	865.57	865.57	0.00		814.53	814.53	0.00		51.04	51.04	0.00
FIRE	6764.09	6764.09	0.00		4266.50	4266.50	0.00		2497.59	2497.59	0.00
OSER	5648.18	5648.18	0.00		4626.15	4626.15	0.00		1022.03	1022.03	0.00
BSER	4911.01	4911.01	0.00		3041.56	3041.56	0.00		1869.45	1869.45	0.00
HEAL	154.13	154.13	0.00		140.66	140.66	0.00		13.48	13.48	0.00
EDUC	313.56	313.56	0.00		228.61	228.61	0.00		84.94	84.94	0.00
SLGV	79.44	79.44	0.00		79.44	79.44	0.00		0.00	0.00	0.00
FGOV	469.06	469.06	0.00		410.41	410.41	0.00		58.66	58.66	0.00

Table 3-10
Comparison Between Model and Base Year
Continued

	Total Consumption Demand (Millions)			Domestic Consumption Demand (Millions)			Import Consumption Demand (Millions)		
	Model	Base Year	Diff.	Model	Base Year	Diff.	Model	Base Year	Diff.
AGRI	375.11	375.11	0.00	213.77	213.77	0.00	161.35	161.35	0.00
MINE	1.43	1.43	0.00	1.43	1.43	0.00	0.00	0.00	0.00
CONS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FOOD	3556.44	3556.44	0.00	1814.47	1814.47	0.00	1741.97	1741.97	0.00
APPA	1244.79	1244.79	0.00	427.23	427.23	0.00	817.56	817.56	0.00
CRGS	342.26	342.26	0.00	21.37	21.37	0.00	320.89	320.89	0.00
OMAN	2049.69	2049.70	0.00	329.19	329.19	0.00	1720.51	1720.51	0.00
PRIN	367.68	367.68	0.00	93.55	93.55	0.00	274.12	274.12	0.00
PETR	912.30	912.30	0.00	334.64	334.64	0.00	577.65	577.65	0.00
METL	94.44	94.44	0.00	2.50	2.50	0.00	91.94	91.94	0.00
MACH	2296.91	2296.91	0.00	1272.75	1272.75	0.00	1024.17	1024.16	0.00
TCPU	3978.73	3978.73	0.00	3094.38	3094.37	0.00	884.35	884.35	0.00
WHOL	2276.17	2276.17	0.00	1936.81	1936.81	0.00	339.36	339.36	0.00
RETL	8825.35	8825.36	-0.01	8304.99	8304.99	0.00	520.37	520.37	0.00
FIRE	12337.65	12337.65	0.00	7782.06	7782.06	0.00	4555.58	4555.59	0.00
OSER	5560.25	5560.26	0.00	4554.13	4554.14	0.00	1006.12	1006.12	0.00
BSER	263.75	263.75	0.00	163.35	163.35	0.00	100.40	100.40	0.00
HEAL	8612.54	8612.55	0.00	7859.38	7859.38	0.00	753.17	753.17	0.00
EDUC	1123.23	1123.23	0.00	818.95	818.95	0.00	304.28	304.28	0.00
SLGV	291.74	291.74	0.00	291.74	291.74	0.00	0.00	0.00	0.00
FGOV	85.79	85.79	0.00	75.07	75.07	0.00	10.73	10.73	0.00

	Domestic Price			Household Composite Price			Domestic Price of Capital		
	Model	Base Year	Diff.	Model	Base Year	Diff.	Model	Base Year	Diff.
AGRI	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
MINE	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
CONS	1.00	1.00	0.00	1.00	1.00	0.00	1.01	1.01	0.00
FOOD	1.00	1.00	0.00	1.00	1.00	0.00	1.03	1.03	0.00
APPA	1.00	1.00	0.00	1.00	1.00	0.00	1.03	1.03	0.00
CRGS	1.00	1.00	0.00	1.00	1.00	0.00	1.03	1.03	0.00
OMAN	1.00	1.00	0.00	1.00	1.00	0.00	1.03	1.03	0.00
PRIN	1.00	1.00	0.00	1.00	1.00	0.00	1.03	1.03	0.00
PETR	1.00	1.00	0.00	1.00	1.00	0.00	1.03	1.03	0.00
METL	1.00	1.00	0.00	1.00	1.00	0.00	1.03	1.03	0.00
MACH	1.00	1.00	0.00	1.00	1.00	0.00	1.03	1.03	0.00
TCPU	1.00	1.00	0.00	1.00	1.00	0.00	1.02	1.02	0.00
WHOL	1.00	1.00	0.00	1.00	1.00	0.00	1.03	1.03	0.00
RETL	1.00	1.00	0.00	1.00	1.00	0.00	1.03	1.03	0.00
FIRE	1.00	1.00	0.00	1.00	1.00	0.00	1.01	1.01	0.00
OSER	1.00	1.00	0.00	1.00	1.00	0.00	1.01	1.01	0.00
BSER	1.00	1.00	0.00	1.00	1.00	0.00	1.01	1.01	0.00
HEAL	1.00	1.00	0.00	1.00	1.00	0.00	1.01	1.01	0.00
EDUC	1.00	1.00	0.00	1.00	1.00	0.00	1.01	1.01	0.00
SLGV	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
FGOV	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00

Table 3-10
Continued

	Regional Output				Exports		
	Model	Base Year	Diff.		Model	Base Year	Diff.
AGRI	1696.45	1696.45	0.00		2703.22	2703.22	0.00
MINE	5133.85	5133.85	0.00		5402.14	5402.14	0.00
CONS	7279.27	7279.27	0.00		114.71	114.71	0.00
FOOD	2807.39	2807.38	0.00		1204.64	1204.63	0.00
APPA	632.16	632.16	0.00		69.09	69.09	0.00
CRGS	152.84	152.84	0.00		1808.71	1808.70	0.01
OMAN	1181.64	1181.64	0.00		2596.09	2596.10	0.00
PRIN	269.11	269.11	0.00		837.11	837.11	0.00
PETR	1434.23	1434.23	0.00		6203.00	6203.00	0.00
METL	120.15	120.15	0.00		3739.24	3739.26	-0.02
MACH	7547.79	7547.80	-0.01		4012.92	4012.94	-0.01
TCPU	9215.46	9215.46	0.00		4232.89	4232.89	0.00
WHOL	6195.93	6195.93	0.00		512.30	512.30	0.00
RETL	9373.69	9373.69	0.00		647.78	647.78	0.00
FIRE	12378.04	12378.04	0.00		2345.29	2345.29	0.00
OSER	9870.65	9870.65	0.00		100.14	100.14	0.00
BSER	3453.26	3453.27	0.00		29.00	29.00	0.00
HEAL	8033.75	8033.75	0.00		74.43	74.43	0.00
EDUC	1066.01	1066.01	0.00		49.95	49.95	0.00
SLGV	6868.71	6868.71	0.00		334.23	334.23	0.00
FGOV	4786.77	4786.77	0.00		522.84	522.84	0.00

same variables along with the difference. The next chapter will focus on the simulations and simulation results.

Chapter 4

Simulation and Results

Once the Oklahoma Tax CGE is calibrated, it is ready for simulations. There are two simulations to be run, eliminating the corporate income tax and cutting the personal income tax rate by 10%.

Simulation 1: Eliminate Corporate Income Tax

The first simulation was eliminating the corporate income tax (see Table 4-1). This tax is not very large in Oklahoma, only about $272 million and represents only about 3 percent of total tax revenue for the state. The corporate income tax per sector was estimated in chapter 2. Now, the tax is eliminated and the model is solved for a new equilibrium. The results indicate that there will not be much of an impact, in absolute terms, from eliminating this tax. Of course, different sectors will be affected according to their amount of incorporation, capital intensity, and labor intensity. Manufacturing has the highest sectoral corporate income tax rate and experiences the largest changes from the simulation.

<u>Output</u>

Overall output increased by 1.75 percent. The five sectors experiencing the largest increase in output were other manufacturing, increasing 6.29 percent, petroleum related goods manufacturing, increasing 6.00 percent, mining, increasing 4.88 percent, metal goods manufacturing, increasing 4.69 percent, and food and kindred products, increasing 2.72 percent. The four manufacturing sectors all had high rates of incorporation, 79.65 percent of total capital returns were corporate. However, capital

Table 4-1
Simulation 1 Results
Key Variables

	Output (Millions)				Labor Demand (Millions)				Capital Demand (Millions)			
	Simulation	Base	Diff	%	Simulation	Base	Diff	%	New Run	Base	Diff	%
AGRI	4406.42	4399.67	6.75	**0.15**	532.63	533.56	-0.93	**-0.17**	373.08	370.71	2.37	**0.64**
MINE	11050.22	10536.00	514.23	**4.88**	2207.07	2120.05	87.02	**4.10**	3985.67	3784.09	201.59	**5.33**
CONS	7423.16	7393.97	29.19	**0.39**	2501.72	2495.91	5.81	**0.23**	234.68	229.64	5.04	**2.19**
FOOD	4121.29	4012.01	109.27	**2.72**	473.79	467.61	6.18	**1.32**	273.57	259.85	13.72	**5.28**
APPA	706.89	701.25	5.64	**0.80**	158.87	158.66	0.21	**0.13**	34.90	33.55	1.36	**4.04**
CRGS	1995.18	1961.54	33.64	**1.72**	543.69	538.76	4.93	**0.92**	145.69	138.95	6.75	**4.86**
OMAN	4015.22	3777.74	237.48	**6.29**	844.57	806.42	38.15	**4.73**	545.78	501.54	44.24	**8.82**
PRIN	1115.73	1106.22	9.50	**0.86**	339.07	338.56	0.51	**0.15**	79.09	76.01	3.09	**4.06**
PETR	8095.51	7637.23	458.28	**6.00**	907.53	869.32	38.21	**4.40**	620.18	571.73	48.45	**8.47**
METL	4040.41	3859.41	181.00	**4.69**	1003.22	968.65	34.57	**3.57**	405.23	376.56	28.67	**7.61**
MACH	11677.01	11560.74	116.27	**1.01**	2737.17	2731.03	6.14	**0.22**	718.32	689.77	28.55	**4.14**
TCPU	13738.52	13448.35	290.18	**2.16**	3350.95	3324.64	26.31	**0.79**	2906.02	2799.38	106.65	**3.81**
WHOL	6798.94	6708.23	90.71	**1.35**	2361.55	2346.13	15.43	**0.66**	655.83	630.73	25.09	**3.98**
RETL	10068.28	10021.47	46.81	**0.47**	4276.31	4282.43	-6.12	**-0.14**	976.95	945.99	30.96	**3.27**
FIRE	14899.61	14723.32	176.29	**1.20**	2135.74	2132.60	3.14	**0.15**	7122.03	7015.06	106.97	**1.52**
OSER	10029.35	9970.79	58.56	**0.59**	4190.87	4174.99	15.88	**0.38**	602.06	589.75	12.31	**2.09**
BSER	3513.11	3482.27	30.84	**0.89**	1647.19	1636.29	10.89	**0.67**	252.83	246.96	5.87	**2.38**
HEAL	8109.80	8108.18	1.62	**0.02**	3953.52	3956.30	-2.78	**-0.07**	231.25	227.55	3.71	**1.63**
EDUC	1118.61	1115.97	2.64	**0.24**	289.95	289.44	0.51	**0.18**	11.31	11.10	0.21	**1.88**
SLGV	7203.23	7202.94	0.29	**0.00**	5851.95	5856.00	-4.05	**-0.07**	729.11	724.66	4.45	**0.61**
FGOV	5307.01	5309.61	-2.60	**-0.05**	3961.88	3969.27	-7.39	**-0.19**	1032.97	1027.87	5.10	**0.50**
Total	**139433.50**	**137036.89**	**2396.61**	**1.75**	**44269.23**	**43996.63**	**272.60**	**0.62**	**21936.57**	**21251.43**	**685.14**	**3.22**

Table 4-1 (Continued)
Simulation 1 Results
Key Variables

	Regional Supply (Millions)				Exports (Millions)				Domestic Price			
	Simulation	Base	Diff	%	Simulation	Base	Diff	%	Simulation	Base	Diff	%
AGRI	1713.44	1696.45	17.00	**1.00**	2692.95	2703.22	-10.27	**-0.38**	1.0035	1.00	0.0035	**0.35**
MINE	5379.50	5133.85	245.65	**4.78**	5670.72	5402.14	268.58	**4.97**	0.9994	1.00	-0.0006	**-0.06**
CONS	7309.69	7279.27	30.43	**0.42**	113.46	114.71	-1.24	**-1.08**	1.0052	1.00	0.0052	**0.52**
FOOD	2866.35	2807.38	58.96	**2.10**	1254.88	1204.63	50.25	**4.17**	0.9931	1.00	-0.0069	**-0.69**
APPA	637.26	632.16	5.10	**0.81**	69.63	69.09	0.54	**0.78**	1.0001	1.00	0.0001	**0.01**
CRGS	155.01	152.84	2.17	**1.42**	1840.17	1808.70	31.47	**1.74**	0.9989	1.00	-0.0011	**-0.11**
OMAN	1236.13	1181.64	54.49	**4.61**	2779.01	2596.10	182.91	**7.05**	0.9921	1.00	-0.0079	**-0.79**
PRIN	271.28	269.11	2.17	**0.80**	844.45	837.11	7.34	**0.88**	0.9998	1.00	-0.0002	**-0.02**
PETR	1490.27	1434.23	56.04	**3.91**	6605.12	6203.00	402.11	**6.48**	0.9916	1.00	-0.0084	**-0.84**
METL	124.40	120.15	4.24	**3.53**	3916.01	3739.26	176.76	**4.73**	0.9961	1.00	-0.0040	**-0.40**
MACH	7616.43	7547.80	68.63	**0.91**	4060.58	4012.94	47.64	**1.19**	0.9991	1.00	-0.0009	**-0.09**
TCPU	9400.46	9215.46	185.00	**2.01**	4338.02	4232.89	105.13	**2.48**	0.9934	1.00	-0.0066	**-0.66**
WHOL	6279.69	6195.93	83.76	**1.35**	519.25	512.30	6.95	**1.36**	0.9999	1.00	-0.0001	**-0.01**
RETL	9417.78	9373.69	44.09	**0.47**	650.50	647.78	2.72	**0.42**	1.0007	1.00	0.0007	**0.07**
FIRE	12521.18	12378.04	143.14	**1.16**	2378.42	2345.29	33.14	**1.41**	0.9964	1.00	-0.0036	**-0.36**
OSER	9928.95	9870.65	58.30	**0.59**	100.40	100.14	0.26	**0.26**	1.0048	1.00	0.0048	**0.48**
BSER	3483.94	3453.27	30.68	**0.89**	29.16	29.00	0.16	**0.56**	1.0046	1.00	0.0046	**0.46**
HEAL	8035.66	8033.75	1.91	**0.02**	74.14	74.43	-0.29	**-0.39**	1.0059	1.00	0.0059	**0.59**
EDUC	1068.75	1066.01	2.73	**0.26**	49.86	49.95	-0.09	**-0.18**	1.0062	1.00	0.0062	**0.62**
SLGV	6870.34	6868.71	1.63	**0.02**	332.89	334.23	-1.34	**-0.40**	1.0061	1.00	0.0061	**0.61**
FGOV	4786.21	4786.77	-0.56	**-0.01**	520.79	522.84	-2.05	**-0.39**	1.0055	1.00	0.0055	**0.55**
Total	**100592.72**	**99497.15**	**1095.57**	**1.10**	**38840.41**	**37539.73**	**1300.67**	**3.46**				

Table 4-1 (Continued)
Simulation 1 Results
Key Variables

	Total Intermediate Good Demand (Millions)				Domestic Intermediate Good Demand (Millions)				Import Intermediate Good Demand (Millions)			
	Simulation	Base	Diff	%	Simulation	Base	Diff	%	Simulation	Base	Diff	%
AGRI	2594.68	2558.67	36.01	**1.41**	1475.45	1458.12	17.33	**1.19**	1119.24	1100.56	18.68	**1.70**
MINE	5348.95	5103.31	245.64	**4.81**	5348.95	5103.31	245.64	**4.81**	0.00	0.00	0.00	**NA**
CONS	2053.33	2022.90	30.43	**1.50**	2053.33	2022.90	30.43	**1.50**	0.00	0.00	0.00	**NA**
FOOD	1840.32	1816.29	24.02	**1.32**	950.24	926.66	23.58	**2.54**	890.12	889.63	0.48	**0.05**
APPA	563.37	553.97	9.40	**1.70**	193.32	190.13	3.18	**1.67**	370.05	363.84	6.22	**1.71**
CRGS	1860.73	1836.44	24.28	**1.32**	116.60	114.67	1.93	**1.69**	1744.13	1721.78	22.35	**1.30**
OMAN	4699.20	4549.65	149.55	**3.29**	772.72	730.68	42.04	**5.75**	3926.55	3818.96	107.59	**2.82**
PRIN	615.01	608.94	6.07	**1.00**	156.58	154.94	1.64	**1.06**	458.43	454.00	4.42	**0.97**
PETR	2727.03	2655.83	71.20	**2.68**	1019.40	974.20	45.20	**4.64**	1707.71	1681.64	26.08	**1.55**
METL	4156.50	4060.17	96.33	**2.37**	111.47	107.41	4.06	**3.78**	4045.03	3952.76	92.27	**2.33**
MACH	6184.53	6092.92	91.61	**1.50**	3432.07	3376.17	55.91	**1.66**	2752.46	2716.76	35.70	**1.31**
TCPU	7214.72	7044.01	170.71	**2.42**	5627.67	5478.33	149.34	**2.73**	1587.10	1565.68	21.42	**1.37**
WHOL	4114.16	4026.62	87.54	**2.17**	3500.84	3426.29	74.55	**2.18**	613.32	600.33	12.98	**2.16**
RETL	875.66	865.57	10.09	**1.17**	823.96	814.53	9.42	**1.16**	51.70	51.04	0.67	**1.30**
FIRE	6862.50	6764.09	98.42	**1.45**	4340.14	4266.50	73.64	**1.73**	2522.39	2497.59	24.80	**0.99**
OSER	5727.87	5648.18	79.69	**1.41**	4683.34	4626.15	57.19	**1.24**	1044.55	1022.03	22.52	**2.20**
BSER	4979.73	4911.01	68.72	**1.40**	3073.25	3041.56	31.69	**1.04**	1906.51	1869.45	37.06	**1.98**
HEAL	154.21	154.13	0.08	**0.05**	140.58	140.66	-0.08	**-0.05**	13.63	13.48	0.15	**1.13**
EDUC	320.18	313.56	6.63	**2.11**	232.66	228.61	4.05	**1.77**	87.52	84.94	2.58	**3.04**
SLGV	80.83	79.44	1.38	**1.74**	80.83	79.44	1.38	**1.74**	0.00	0.00	0.00	**NA**
FGOV	473.41	469.06	4.35	**0.93**	413.65	410.41	3.24	**0.79**	59.77	58.66	1.11	**1.89**
Total	**63446.92**	**62134.78**	**1312.14**	**2.11**	**38547.05**	**37671.65**	**875.40**	**2.32**	**24900.20**	**24463.12**	**437.08**	**1.79**

Table 4-1 (Continued)
Simulation 1 Results
Key Variables

	Adjusted Total Consumption Demand (Millions)				Adjusted Domestic Consumption Demand (Millions)				Adjusted Import Consumption Demand (Millions)			
	Simulation	Base	Diff	%	Simulation	Base	Diff	%	Simulation	Base	Diff	%
AGRI	375.48	375.11	0.37	**0.10**	213.51	213.77	-0.25	**-0.12**	161.97	161.35	0.62	**0.38**
MINE	1.44	1.43	0.01	**0.43**	1.44	1.43	0.01	**0.43**	0.00	0.00	0.00	**NA**
CONS	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**
FOOD	3581.40	3556.44	24.95	**0.70**	1849.23	1814.47	34.77	**1.92**	1732.24	1741.97	-9.73	**-0.56**
APPA	1250.66	1244.79	5.87	**0.47**	429.15	427.23	1.92	**0.45**	821.51	817.56	3.95	**0.48**
CRGS	343.90	342.26	1.64	**0.48**	21.55	21.37	0.18	**0.84**	322.35	320.89	1.46	**0.45**
OMAN	2061.10	2049.70	11.41	**0.56**	338.92	329.19	9.74	**2.96**	1722.21	1720.51	1.70	**0.10**
PRIN	369.43	367.68	1.76	**0.48**	94.06	93.55	0.51	**0.54**	275.37	274.12	1.25	**0.46**
PETR	918.45	912.30	6.15	**0.67**	343.33	334.64	8.69	**2.60**	575.15	577.65	-2.50	**-0.43**
METL	94.89	94.44	0.45	**0.48**	2.54	2.50	0.05	**1.86**	92.35	91.94	0.41	**0.44**
MACH	2308.56	2296.91	11.65	**0.51**	1281.13	1272.75	8.38	**0.66**	1027.44	1024.16	3.27	**0.32**
TCPU	4010.47	3978.73	31.73	**0.80**	3128.27	3094.37	33.90	**1.10**	882.22	884.35	-2.13	**-0.24**
WHOL	2286.93	2276.17	10.76	**0.47**	1946.00	1936.81	9.19	**0.47**	340.92	339.36	1.57	**0.46**
RETL	8862.98	8825.36	37.62	**0.43**	8339.68	8304.99	34.69	**0.42**	523.29	520.37	2.93	**0.56**
FIRE	12413.38	12337.65	75.72	**0.61**	7850.75	7782.06	68.69	**0.88**	4562.67	4555.59	7.08	**0.16**
OSER	5572.72	5560.26	12.46	**0.22**	4556.48	4554.14	2.34	**0.05**	1016.26	1006.12	10.14	**1.01**
BSER	264.51	263.75	0.76	**0.29**	163.24	163.35	-0.11	**-0.06**	101.27	100.40	0.87	**0.87**
HEAL	8623.72	8612.55	11.18	**0.13**	7861.43	7859.38	2.05	**0.03**	762.32	753.17	9.15	**1.22**
EDUC	1125.31	1123.23	2.08	**0.19**	817.71	818.95	-1.24	**-0.15**	307.61	304.28	3.33	**1.09**
SLGV	291.99	291.74	0.25	**0.09**	291.99	291.74	0.25	**0.09**	0.00	0.00	0.00	**NA**
FGOV	85.93	85.79	0.13	**0.16**	75.08	75.07	0.01	**0.02**	10.85	10.73	0.12	**1.11**
Total	**54843.24**	**54596.29**	**246.95**	**0.45**	**39605.51**	**39391.75**	**213.75**	**0.54**	**15238.00**	**15204.52**	**33.47**	**0.22**

Table 4-1 (Continued)
Simulation 1 Results
Key Variables

	Adjusted Real Total Consumption Demand (Millions)				Adjusted Real Domestic Consumption Demand (Millions)				Adjusted Real Import Consumption Demand (Millions)			
	Simulation	**Base**	**Diff**	**%**	**Simulation**	**Base**	**Diff**	**%**	**Simulation**	**Base**	**Diff**	**%**
AGRI	375.29	375.11	0.18	**0.05**	213.41	213.77	-0.36	**-0.17**	161.89	161.35	0.54	**0.33**
MINE	1.44	1.43	0.01	**0.38**	1.44	1.43	0.01	**0.38**	0.00	0.00	0.00	**NA**
CONS	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**
FOOD	3579.61	3556.44	23.16	**0.65**	1848.31	1814.47	33.84	**1.87**	1731.37	1741.97	-10.60	**-0.61**
APPA	1250.04	1244.79	5.25	**0.42**	428.94	427.23	1.71	**0.40**	821.09	817.56	3.54	**0.43**
CRGS	343.73	342.26	1.46	**0.43**	21.54	21.37	0.17	**0.79**	322.19	320.89	1.30	**0.40**
OMAN	2060.07	2049.70	10.38	**0.51**	338.75	329.19	9.57	**2.91**	1721.35	1720.51	0.84	**0.05**
PRIN	369.25	367.68	1.57	**0.43**	94.01	93.55	0.46	**0.49**	275.24	274.12	1.11	**0.41**
PETR	917.99	912.30	5.70	**0.62**	343.16	334.64	8.51	**2.54**	574.86	577.65	-2.79	**-0.48**
METL	94.84	94.44	0.41	**0.43**	2.54	2.50	0.05	**1.81**	92.30	91.94	0.36	**0.39**
MACH	2307.41	2296.91	10.50	**0.46**	1280.48	1272.75	7.74	**0.61**	1026.93	1024.16	2.76	**0.27**
TCPU	4008.46	3978.73	29.73	**0.75**	3126.71	3094.37	32.34	**1.05**	881.78	884.35	-2.57	**-0.29**
WHOL	2285.78	2276.17	9.61	**0.42**	1945.03	1936.81	8.22	**0.42**	340.75	339.36	1.40	**0.41**
RETL	8858.55	8825.36	33.19	**0.38**	8335.51	8304.99	30.53	**0.37**	523.03	520.37	2.67	**0.51**
FIRE	12407.17	12337.65	69.52	**0.56**	7846.82	7782.06	64.76	**0.83**	4560.39	4555.59	4.80	**0.11**
OSER	5569.93	5560.26	9.67	**0.17**	4554.20	4554.14	0.06	**0.00**	1015.75	1006.12	9.63	**0.96**
BSER	264.38	263.75	0.63	**0.24**	163.16	163.35	-0.19	**-0.11**	101.22	100.40	0.82	**0.81**
HEAL	8619.41	8612.55	6.87	**0.08**	7857.50	7859.38	-1.88	**-0.02**	761.94	753.17	8.77	**1.16**
EDUC	1124.75	1123.23	1.52	**0.14**	817.30	818.95	-1.65	**-0.20**	307.46	304.28	3.18	**1.04**
SLGV	291.85	291.74	0.11	**0.04**	291.85	291.74	0.11	**0.04**	0.00	0.00	0.00	**NA**
FGOV	85.89	85.79	0.09	**0.11**	75.04	75.07	-0.02	**-0.03**	10.84	10.73	0.11	**1.06**
Total	**54815.84**	**54596.29**	**219.55**	**0.40**	**39585.71**	**39391.75**	**193.96**	**0.49**	**15230.38**	**15204.52**	**25.86**	**0.17**

Table 4-1 (Continued)
Simulation 1 Results
Key Variables

Labor Supply		Labor Migration		Before Tax Wage	
Simulation	43993.44	Simulation	275.79	Simulation	1.0330
Base	43996.63	Base	0.00	Base	1.0260
Diff	-3.19	Diff	275.79	Diff	0.0070
%	-0.01	%	NA	%	0.68

Disposable Income (Millions)		Household Expenditures (Millions)		After Tax Wage	
Simulation	54430.51	Simulation	55201.50	Simulation	1.0068
Base	53846.08	Base	54596.28	Base	1.0000
Diff	584.43	Diff	605.23	Diff	0.0068
%	1.09	%	1.11	%	0.68

Real Disposable Income (Millions)		Real Household Expenditures (Millions)		Household Savings (Millions)	
Simulation	54403.31	Simulation	55173.92	Simulation	-1937.19
Base	53846.08	Base	54596.28	Base	-1916.39
Diff	557.23	Diff	577.64	Diff	-20.80
%	1.03	%	1.06	%	1.09

Adjusted Disposable Income (Millions)		Adjusted Household Expenditures (Millions)			
Simulation	54091.44	Simulation	54857.63		
Base	53846.08	Base	54596.28		
Diff	245.36	Diff	261.35		
%	0.46	%	0.48		

Adjusted Real Disposable Income (Millions)		Adjusted Real Household Expenditures (Millions)			
Simulation	54064.41	Simulation	54830.21		
Base	53846.08	Base	54596.28		
Diff	218.32	Diff	233.94		
%	0.41	%	0.43		

State Tax Revenue Personal Income Tax (Millions)		State Tax Revenue Corporate Income Tax (Millions)		Tax Revenue Indirect Business Tax (Millions)	
Simulation	1587.59	Simulation	0.00	Simulation	8193.07
Base	1570.54	Base	272.01	Base	8084.25
Diff	17.05	Diff	-272.01	Diff	108.82
%	1.09	%	-100.00	%	1.35

intensities for these same sectors were below the average for the state. In this case, the large share of corporate returns led to cost decreases that allowed the sectors to increase their output. Mining had a lower level of incorporation, only 12.46 percent but experienced relatively large output gains because of its capital intensity. The mining industry has a capital intensity of 36 percent. In other words, 36 percent of the total value of output in the mining industry is derived from capital. This level of capital intensity is over twice the average for the state.

When the price of capital fell, producers in the state could increase their output. This led to an increase in the demand for labor. Since labor supply is imperfectly mobile, the wage paid to workers in Oklahoma increased. All five sectors had labor intensities that were less than the average for Oklahoma, which translated into relative cost advantages due to the increase in the wage. All five sectors experienced a decrease in both the domestic price and the composite price for their good, caused by the decrease in the price for capital. This led to an increase in domestic demand by agents, as well as an increase in demand through increased exports, all of which magnified the impacts on output. All five sectors have an above average share of their output in the form of exports, along with fairly responsive export elasticities, each equal to 2.9.

The least affected sectors are federal government services, decreasing by 0.05 percent, state and local government services, remaining unchanged, health services, increasing by 0.02 percent, agriculture, increasing by 0.15 percent, and educational services, increasing by 0.24 percent. Governmental services has no corporate part, therefore they received little of the benefits from the tax cut. Also, governmental services depend on other things unrelated to market prices.

Health and educational services both had high levels of labor intensity and low levels of capital intensity. Their levels of incorporation were both 25.69 percent. The overall effect was that they received small cost advantages from the decrease in the price of capital and relatively large cost increase from the increase in the wage. The increase in costs for these sectors actually drove up the domestic and composite price. This led to some offsetting decreases in demand by domestic agents and a decrease in exports which further retarded the output growth in these sectors.

The agriculture sector is unique in that it had a low level of capital intensity (0.08 percent) and a low level of incorporation (3.36 percent). These two things led to very little cost savings from the tax cut. The labor intensity in the agriculture sector is also not very high (21 percent), but there was still an increase in cost that led to an increase in the domestic and composite price. This price increase also led to a decrease in exports, which is important to the agriculture sector because it exports 61 percent of its output.

Demand

Consumption demand increased by .45 percent for Oklahoma residents. The five sectors experiencing the largest increase are transportation, communication and public utilities, increasing by 0.80 percent, food and kindred products, increasing by 0.70 percent, petroleum related goods manufacturing, increasing by 0.67 percent, finance, insurance, and real estate, increasing by 0.61 percent, and other manufacturing, increasing by 0.56 percent.

Since the capital tax is modeled as being paid by households, eliminating the tax will increase their disposable income and consumption demand will increase. However, only about 25 percent of capital returns are paid to individuals within the state, the rest leaves the state. Also, the numbers should be adjusted by an aggregate price index to account for changes in prices. Using the composite price that households pay for consumption goods, an aggregate composite price was found to be 1.0005. After adjusting the consumption numbers for the aggregate composite price level, real adjusted consumption was found to increase for the state by 0.40 percent.

The effects on the domestic price were varied. Agriculture, construction, apparel and related goods manufacturing, retail trade, other services, business services, health services, educational services, and government services all experienced increases in costs which led to slight increases in their domestic price. These sectors experienced increasing costs because they each had relatively large labor intensities and relatively low capital intensities. The increase in the wage rate, caused by the increase in labor demand and imperfectly mobile labor supply, offset any cost savings to these sectors and drove up their costs.

The rest of the sectors in the economy experienced slight decreases in domestic price. In these sectors, the labor intensity, the capital intensity, and/or the rate of incorporation was such that the increase in the wage did not completely offset the lower costs caused by the decrease in the price of capital.

This lead to varied effects on import demand. For the industries with increasing domestic price, the consumption demand for imports tended to increase larger relative to the industries experiencing a decrease in domestic price, except construction, which has no imports.

Overall intermediate good demand increased by 2.11 percent, a larger percentage than the increase in consumption demand, and the increase in output. In absolute value terms, the increase in intermediate goods was close to 4.5 times as large as the increase in consumption demand. This is due to the inflexibility of firms when deciding what intermediate goods they need during the production process, i.e. fixed proportions and also to the fact that the tax cut was on production. It has implications for tax analysis, since the purchase of intermediate goods is tax deductible.

The sectors experiencing the largest gain include mining, increasing by 4.81 percent, other manufacturing, increasing by 3.29 percent, and petroleum related goods, increasing by 2.68 percent, transportation, communication and public utilities, increasing by 2.42 percent, and metal goods manufacturing, increasing by 2.37 percent. These five sectors represent 37.68 percent of all intermediate good demand in the state and are all sectors that are usually strongly demanded by firms during production. All five sectors experienced a decrease in the domestic price, which magnified the demand effects. Since all five sectors experienced lower prices, the demand for these goods by domestic producers rose larger than the demand for imports by the domestic producers.

Exports behaved like expected, with industries experiencing a decrease in domestic price increasing relatively larger than those industries experiencing an increase in domestic price. In the extreme case agriculture, construction, educational services, and government services all experienced decreases in exports due to their increased domestic price.

Factor Demand

There are two effects in the factor markets. First, there is the decrease in the cost of capital due to the tax cut. This will lower the cost to the firm, who in turn will demand more capital. However, because costs are lower, the firm now increases output, which leads directly to an increase in the demand for labor. Since labor supply is imperfectly mobile, the increase in labor demand drives up the wage, which drives up costs to the firm and partially offsets the cost gains from the tax cut. By cutting the corporate income tax, owners of capital will experience an increase in disposable income. Also, since the wage is increasing, there will be a secondary increase in income to suppliers of labor.

Capital demand is directly affected because cutting the corporate income tax lowers the price of capital to firms. Capital demand increased for all sectors in the model with the strongest increases in other manufacturing, increasing by 8.82 percent, petroleum goods manufacturing, increasing by 8.47 percent, metal goods manufacturing, increasing by 7.61 percent, mining, increasing by 5.33 percent, and food and kindred products, increasing by 5.28 percent. The four manufacturing sectors have high rates of incorporation (79.65 percent) and mining, as mentioned earlier, has a relatively large level of capital intensity.

Not surprisingly, the five sectors experiencing the largest gain in labor demand were the same five that experienced the largest gains in output and capital demand; other manufacturing, increasing by 4.73 percent, petroleum related goods, increasing 4.40 percent, mining, increasing by 4.10 percent, metal goods manufacturing, increasing by 3.57 percent, and food and kindred products, increasing 1.32 percent. The increase in capital demand, the increase in output, and the increase in overall demand for goods and services generated the increase in labor demand. However, since labor supply is imperfectly mobile, there is an increase in the wage that partially offsets some of the increase in output, capital demand, labor demand, and overall demand.

<u>Tax Revenue</u>

Eliminating the corporate income tax eliminates $272 million in tax revenue. However, because there is an increase in economic activity, both income and indirect business tax revenues increase. The increase in state income tax revenue is $17.05 million while indirect business tax revenue increases by $108.82 million. This last number is misleading because indirect business tax is composed of state, local and federal taxes. Only 85% of indirect business tax revenue is accrued to state and local government, of which only some part, unknown due to the data source, accrues to the state. Assuming that local revenue is constant, and that 85 percent of indirect business tax revenues accrues to state and local governments, than an estimate of total state revenues would be $8551.69 million during the simulation year, and $8714.16 million during the base year. This simulation generated a deficit of $162.46 million that the state government is going to have to deal with, either by increasing some other tax or decreasing expenditures.

Welfare

Disposable income increased for the state by 1.09 percent. Adjusting for migration and changes in the price level faced by Oklahoma residents, this increase falls to 0.41 percent. Therefore, Oklahoma residents now have 0.41 percent more disposable income to spend on goods and services or to save. Also, for every dollar of deficit generated by the tax cut, disposable income to residents increased by $1.34.

Simulation 2: Cut Personal Income Tax By 10%

The second simulation cut average personal income tax in Oklahoma by 10 percent, or $155.39 million. The average tax rate calculated using the 1995 IMPLAN generated SAM was 2.5 percent. Therefore, the tax rate was cut by 0.25 percentage points. For results, see Table 4-2. Cutting the personal income tax leads to an increase in disposable income, which stimulates demand by consumers in Oklahoma. Also, the wage that producers pay is cut, lowering costs to producers and stimulating output.

<u>Output</u>

Output increased by 0.23 percent overall, with the largest gains from metal goods manufacturing, increasing by 0.38 percent, printing and publishing, increasing by 0.36 percent, other manufacturing, increasing by 0.34 percent, construction related goods, increasing by 0.33 percent, and agriculture, increasing by 0.33 percent. Cutting the personal income tax rate lowered costs to all firms, through the reduction of the wage. All of the above five sectors, except for agriculture, have labor intensities above 20 percent, which led to some relative cost gains. However, almost all of the five sectors experiencing the smallest gains in output have larger labor intensities. Therefore, there are capital market and demand side effects that are also important.

The lower cost also led to a decrease in the domestic price for all goods in the state economy, with these five sectors experiencing some of the largest decreases in domestic price. However, for these sectors the composite price only fell for printing and publishing and agriculture, both by 0.01 percent. This led to very little of the output gains for these sectors originating from increased consumption by households.

The lower domestic price did stimulate demand by foreign agents. One of the stronger effects for these five sectors came from exports. All five of these sectors have relatively large export shares, with agriculture exporting 61 percent of its output in the base year, other manufacturing exporting 69 percent, printing and publishing exporting 76 percent, construction related goods manufacturing exporting 92 percent, and metal goods manufacturing exporting 97 percent. Agriculture exported 67 percent of its tax cut generated additional output, other manufacturing 73 percent, printing and publishing 80 percent, construction related goods 94 percent, and metal goods manufacturing 97 percent. The four manufacturing industries each had an export elasticity of 2.9 and agriculture had an export elasticity of 3.9. These elasticities led to an increase in the export share for each of these sectors except for metal goods manufacturing, which remained constant.

The sectors experiencing the least gains in output were state and local government services, increasing by 0.01 percent, federal government services, increasing by 0.03 percent, construction, increasing by 0.06 percent, machinery goods production, increasing by 0.21 percent, and wholesale trade, increasing by 0.22 percent. These sectors had relatively high labor intensities, as mentioned earlier. However, there was not much demand stimulus associated with these sectors which led to the low output growth. Since these sectors are regionally intensive, i.e. they do not have very large export shares, there was not as much stimulus from outside the region as for the largest output gainers. Governmental services is usually determined by factors outside of the market. The other three sectors all have a relatively large share of their output being demanded as intermediate goods and a relatively smaller share being demanded by consumers. Since output gains are not very large, in absolute value, these sectors did not experience very much demand side stimulus on their production.

Interestingly, the five sectors with the largest labor intensities were among the sectors experiencing the smallest gains in output. These five sectors, state and local government, federal government, health services, business services, and retail trade all

Table 4-2
Simulation 2 Results
Key Variables

	Output (Millions)				Labor Demand (Millions)				Capital Demand (Millions)			
	Simulation	Base	Diff	%	Simulation	Base	Diff	%	Simulation	Base	Diff	%
AGRI	4414.15	4399.67	14.48	0.33	535.39	533.56	1.83	0.34	371.85	370.71	1.14	0.31
MINE	10569.79	10536.00	33.80	0.32	2127.33	2120.05	7.28	0.34	3795.74	3784.09	11.66	0.31
CONS	7398.58	7393.97	4.61	0.06	2497.54	2495.91	1.63	0.07	229.71	229.64	0.07	0.03
FOOD	4023.58	4012.01	11.56	0.29	469.01	467.61	1.41	0.30	260.54	259.85	0.69	0.27
APPA	703.39	701.25	2.14	0.31	159.16	158.66	0.49	0.31	33.64	33.55	0.09	0.28
CRGS	1968.02	1961.54	6.49	0.33	540.58	538.76	1.82	0.34	139.37	138.95	0.42	0.30
OMAN	3790.72	3777.74	12.98	0.34	809.31	806.42	2.88	0.36	503.15	501.54	1.62	0.32
PRIN	1110.24	1106.22	4.01	0.36	339.81	338.56	1.25	0.37	76.26	76.01	0.25	0.33
PETR	7661.59	7637.23	24.36	0.32	872.21	869.32	2.89	0.33	573.43	571.73	1.70	0.30
METL	3874.22	3859.41	14.81	0.38	972.46	968.65	3.81	0.39	377.91	376.56	1.35	0.36
MACH	11584.52	11560.74	23.78	0.21	2736.84	2731.03	5.81	0.21	690.99	689.77	1.23	0.18
TCPU	13480.19	13448.35	31.84	0.24	3333.05	3324.64	8.41	0.25	2805.47	2799.38	6.09	0.22
WHOL	6723.04	6708.23	14.81	0.22	2351.48	2346.13	5.35	0.23	631.95	630.73	1.22	0.19
RETL	10043.38	10021.47	21.91	0.22	4292.07	4282.43	9.64	0.23	947.79	945.99	1.80	0.19
FIRE	14756.19	14723.32	32.87	0.22	2137.93	2132.60	5.33	0.25	7030.14	7015.06	15.08	0.21
OSER	9992.66	9970.79	21.87	0.22	4184.32	4174.99	9.34	0.22	590.86	589.75	1.11	0.19
BSER	3490.66	3482.27	8.40	0.24	1640.31	1636.29	4.02	0.25	247.48	246.96	0.52	0.21
HEAL	8127.04	8108.18	18.86	0.23	3965.58	3956.30	9.28	0.23	228.00	227.55	0.45	0.20
EDUC	1118.71	1115.97	2.74	0.25	290.16	289.44	0.71	0.25	11.13	11.10	0.02	0.21
SLGV	7203.89	7202.94	0.96	0.01	5857.00	5856.00	1.00	0.02	724.53	724.66	-0.13	-0.02
FGOV	5311.18	5309.61	1.58	0.03	3970.73	3969.27	1.46	0.04	1027.89	1027.87	0.02	0.00
Total	137345.76	137036.89	308.87	0.23	44082.27	43996.63	85.64	0.19	21297.84	21251.43	46.40	0.22

Table 4-2 (Continued)
Simulation 2 Results
Key Variables

	Regional Supply (Millions)				Exports (Millions)				Domestic Price (Millions)			
	Simulation	**Base**	**Diff**	**%**	**Simulation**	**Base**	**Diff**	**%**	**Simulation**	**Base**	**Diff**	**%**
AGRI	1701.18	1696.45	4.73	**0.28**	2712.97	2703.22	9.75	**0.36**	0.9998	1.00	0.000	**-0.02**
MINE	5149.35	5133.85	15.49	**0.30**	5420.45	5402.14	18.31	**0.34**	0.9999	1.00	0.000	**-0.01**
CONS	7283.70	7279.27	4.43	**0.06**	114.88	114.71	0.18	**0.15**	0.9997	1.00	0.000	**-0.03**
FOOD	2814.92	2807.38	7.54	**0.27**	1208.65	1204.63	4.02	**0.33**	0.9998	1.00	0.000	**-0.02**
APPA	634.04	632.16	1.88	**0.30**	69.36	69.09	0.26	**0.38**	0.9997	1.00	0.000	**-0.03**
CRGS	153.23	152.84	0.39	**0.26**	1814.79	1808.70	6.09	**0.34**	0.9997	1.00	0.000	**-0.03**
OMAN	1185.19	1181.64	3.55	**0.30**	2605.53	2596.10	9.43	**0.36**	0.9998	1.00	0.000	**-0.02**
PRIN	269.92	269.11	0.81	**0.30**	840.31	837.11	3.21	**0.38**	0.9997	1.00	0.000	**-0.03**
PETR	1438.09	1434.23	3.86	**0.27**	6223.50	6203.00	20.50	**0.33**	0.9998	1.00	0.000	**-0.02**
METL	120.53	120.15	0.38	**0.31**	3753.69	3739.26	14.44	**0.39**	0.9997	1.00	0.000	**-0.03**
MACH	7561.20	7547.80	13.40	**0.18**	4023.32	4012.94	10.38	**0.26**	0.9997	1.00	0.000	**-0.03**
TCPU	9236.90	9215.46	21.43	**0.23**	4243.30	4232.89	10.41	**0.25**	0.9998	1.00	0.000	**-0.02**
WHOL	6209.52	6195.93	13.59	**0.22**	513.52	512.30	1.22	**0.24**	0.9997	1.00	0.000	**-0.03**
RETL	9394.06	9373.69	20.38	**0.22**	649.32	647.78	1.54	**0.24**	0.9997	1.00	0.000	**-0.03**
FIRE	12405.56	12378.04	27.52	**0.22**	2350.64	2345.29	5.35	**0.23**	0.9999	1.00	0.000	**-0.01**
OSER	9892.28	9870.65	21.63	**0.22**	100.38	100.14	0.24	**0.24**	0.9997	1.00	0.000	**-0.03**
BSER	3461.59	3453.27	8.32	**0.24**	29.08	29.00	0.08	**0.26**	0.9997	1.00	0.000	**-0.03**
HEAL	8052.42	8033.75	18.67	**0.23**	74.62	74.43	0.19	**0.26**	0.9997	1.00	0.000	**-0.03**
EDUC	1068.62	1066.01	2.61	**0.24**	50.09	49.95	0.13	**0.27**	0.9997	1.00	0.000	**-0.03**
SLGV	6869.55	6868.71	0.84	**0.01**	334.34	334.23	0.11	**0.03**	0.9997	1.00	0.000	**-0.03**
FGOV	4788.10	4786.77	1.33	**0.03**	523.09	522.84	0.25	**0.05**	0.9997	1.00	0.000	**-0.03**
Total	**99689.93**	**99497.15**	**192.78**	**0.19**	**37655.83**	**37539.73**	**116.10**	**0.31**				

Table 4-2 (Continued)
Simulation 2 Results
Key Variables

	Total Intermediate Good Demand (Millions)				Domestic Intermediate Good Demand (Millions)				Import Intermediate Good Demand (Millions)			
	Simulation	**Base**	**Diff**	**%**	**Simulation**	**Base**	**Diff**	**%**	**Simulation**	**Base**	**Diff**	**%**
AGRI	2566.37	2558.67	7.70	**0.30**	1462.69	1458.12	4.57	**0.31**	1103.68	1100.56	3.12	**0.28**
MINE	5118.80	5103.31	15.49	**0.30**	5118.80	5103.31	15.49	**0.30**	0.00	0.00	0.00	**NA**
CONS	2027.33	2022.90	4.43	**0.22**	2027.33	2022.90	4.43	**0.22**	0.00	0.00	0.00	**NA**
FOOD	1821.19	1816.29	4.89	**0.27**	929.52	926.66	2.86	**0.31**	891.67	889.63	2.03	**0.23**
APPA	555.50	553.97	1.54	**0.28**	190.79	190.13	0.66	**0.34**	364.72	363.84	0.88	**0.24**
CRGS	1839.72	1836.44	3.27	**0.18**	114.98	114.67	0.31	**0.27**	1724.74	1721.78	2.96	**0.17**
OMAN	4562.67	4549.65	13.03	**0.29**	733.25	730.68	2.56	**0.35**	3829.42	3818.96	10.46	**0.27**
PRIN	610.52	608.94	1.58	**0.26**	155.46	154.94	0.52	**0.34**	455.07	454.00	1.06	**0.23**
PETR	2662.54	2655.83	6.70	**0.25**	977.12	974.20	2.92	**0.30**	1685.42	1681.64	3.78	**0.22**
METL	4070.22	4060.17	10.05	**0.25**	107.77	107.41	0.36	**0.33**	3962.44	3952.76	9.69	**0.25**
MACH	6106.03	6092.92	13.11	**0.22**	3384.92	3376.17	8.76	**0.26**	2721.11	2716.76	4.35	**0.16**
TCPU	7061.90	7044.01	17.89	**0.25**	5492.71	5478.33	14.38	**0.26**	1569.19	1565.68	3.51	**0.22**
WHOL	4036.91	4026.62	10.29	**0.26**	3435.33	3426.29	9.04	**0.26**	601.58	600.33	1.25	**0.21**
RETL	867.01	865.57	1.44	**0.17**	815.91	814.53	1.38	**0.17**	51.09	51.04	0.06	**0.11**
FIRE	6780.42	6764.09	16.33	**0.24**	4277.06	4266.50	10.56	**0.25**	2503.36	2497.59	5.77	**0.23**
OSER	5660.79	5648.18	12.61	**0.22**	4636.99	4626.15	10.84	**0.23**	1023.80	1022.03	1.76	**0.17**
BSER	4922.57	4911.01	11.56	**0.24**	3049.42	3041.56	7.87	**0.26**	1873.14	1869.45	3.69	**0.20**
HEAL	154.51	154.13	0.38	**0.25**	141.01	140.66	0.35	**0.25**	13.50	13.48	0.02	**0.18**
EDUC	314.35	313.56	0.80	**0.25**	229.24	228.61	0.62	**0.27**	85.12	84.94	0.17	**0.20**
SLGV	79.62	79.44	0.18	**0.23**	79.62	79.44	0.18	**0.23**	0.00	0.00	0.00	**NA**
FGOV	470.13	469.06	1.06	**0.23**	411.37	410.41	0.96	**0.23**	58.76	58.66	0.10	**0.18**
Total	**62289.09**	**62134.78**	**154.32**	**0.25**	**37771.29**	**37671.65**	**99.63**	**0.26**	**24517.81**	**24463.12**	**54.68**	**0.22**

Table 4-2 (Continued)
Simulation 2 Results
Key Variables

	Adjusted Total Consumption Demand (Millions)				Adjusted Domestic Consumption Demand (Millions)				Adjusted Import Consumption Demand (Millions)			
	Simulation	**Base**	**Diff**	**%**	**Simulation**	**Base**	**Diff**	**%**	**Simulation**	**Base**	**Diff**	**%**
AGRI	375.34	375.11	0.23	**0.06**	213.93	213.77	0.16	**0.07**	161.42	161.35	0.07	**0.04**
MINE	1.43	1.43	0.00	**0.18**	1.43	1.43	0.00	**0.18**	0.00	0.00	0.00	**NA**
CONS	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**
FOOD	3564.17	3556.44	7.73	**0.22**	1819.12	1814.47	4.66	**0.26**	1745.05	1741.97	3.08	**0.18**
APPA	1247.48	1244.79	2.69	**0.22**	428.45	427.23	1.21	**0.28**	819.04	817.56	1.48	**0.18**
CRGS	342.98	342.26	0.72	**0.21**	21.44	21.37	0.06	**0.30**	321.55	320.89	0.66	**0.21**
OMAN	2054.05	2049.70	4.35	**0.21**	330.10	329.19	0.91	**0.28**	1723.95	1720.51	3.44	**0.20**
PRIN	368.47	367.68	0.79	**0.21**	93.82	93.55	0.27	**0.29**	274.64	274.12	0.52	**0.19**
PETR	914.26	912.30	1.96	**0.22**	335.52	334.64	0.88	**0.26**	578.74	577.65	1.08	**0.19**
METL	94.64	94.44	0.20	**0.21**	2.51	2.50	0.01	**0.30**	92.13	91.94	0.19	**0.21**
MACH	2301.97	2296.91	5.05	**0.22**	1276.11	1272.75	3.36	**0.26**	1025.85	1024.16	1.69	**0.16**
TCPU	3987.39	3978.73	8.65	**0.22**	3101.37	3094.37	7.00	**0.23**	886.02	884.35	1.66	**0.19**
WHOL	2281.24	2276.17	5.07	**0.22**	1941.29	1936.81	4.48	**0.23**	339.95	339.36	0.60	**0.18**
RETL	8845.23	8825.36	19.87	**0.23**	8323.97	8304.99	18.99	**0.23**	521.26	520.37	0.89	**0.17**
FIRE	12363.74	12337.65	26.09	**0.21**	7799.00	7782.06	16.94	**0.22**	4564.74	4555.59	9.16	**0.20**
OSER	5572.71	5560.26	12.46	**0.22**	4564.85	4554.14	10.71	**0.24**	1007.87	1006.12	1.75	**0.17**
BSER	264.33	263.75	0.58	**0.22**	163.75	163.35	0.40	**0.24**	100.58	100.40	0.18	**0.18**
HEAL	8632.11	8612.55	19.57	**0.23**	7877.69	7859.38	18.31	**0.23**	754.42	753.17	1.25	**0.17**
EDUC	1125.74	1123.23	2.51	**0.22**	820.93	818.95	1.98	**0.24**	304.81	304.28	0.53	**0.17**
SLGV	292.41	291.74	0.66	**0.23**	292.41	291.74	0.66	**0.23**	0.00	0.00	0.00	**NA**
FGOV	85.99	85.79	0.19	**0.22**	75.24	75.07	0.17	**0.23**	10.75	10.73	0.02	**0.18**
Total	**54715.69**	**54596.29**	**119.40**	**0.22**	**39482.92**	**39391.75**	**91.17**	**0.23**	**15232.77**	**15204.52**	**28.25**	**0.19**

Table 4-2 (Continued)
Simulation 2 Results
Key Variables

	Adjusted Real Total Consumption Demand (Millions)				Adjusted Real Domestic Consumption Demand (Millions)				Adjusted Real Import Consumption Demand (Millions)			
	Simulation	Base	Diff	%	Simulation	Base	Diff	%	Simulation	Base	Diff	%
AGRI	375.42	375.11	0.31	**0.08**	213.97	213.77	0.20	**0.09**	161.45	161.35	0.10	**0.06**
MINE	1.44	1.43	0.00	**0.20**	1.44	1.43	0.00	**0.20**	0.00	0.00	0.00	**NA**
CONS	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**
FOOD	3564.89	3556.44	8.45	**0.24**	1819.49	1814.47	5.02	**0.28**	1745.40	1741.97	3.43	**0.20**
APPA	1247.73	1244.79	2.94	**0.24**	428.53	427.23	1.30	**0.30**	819.20	817.56	1.65	**0.20**
CRGS	343.05	342.26	0.79	**0.23**	21.44	21.37	0.07	**0.32**	321.61	320.89	0.72	**0.23**
OMAN	2054.46	2049.70	4.76	**0.23**	330.16	329.19	0.98	**0.30**	1724.30	1720.51	3.79	**0.22**
PRIN	368.54	367.68	0.86	**0.23**	93.84	93.55	0.29	**0.31**	274.70	274.12	0.57	**0.21**
PETR	914.44	912.30	2.14	**0.24**	335.59	334.64	0.95	**0.28**	578.85	577.65	1.20	**0.21**
METL	94.66	94.44	0.22	**0.23**	2.51	2.50	0.01	**0.32**	92.15	91.94	0.21	**0.23**
MACH	2302.43	2296.91	5.51	**0.24**	1276.37	1272.75	3.62	**0.28**	1026.06	1024.16	1.89	**0.18**
TCPU	3988.19	3978.73	9.45	**0.24**	3101.99	3094.37	7.62	**0.25**	886.19	884.35	1.84	**0.21**
WHOL	2281.70	2276.17	5.53	**0.24**	1941.68	1936.81	4.87	**0.25**	340.02	339.36	0.66	**0.20**
RETL	8847.00	8825.36	21.64	**0.25**	8325.64	8304.99	20.65	**0.25**	521.36	520.37	0.99	**0.19**
FIRE	12366.21	12337.65	28.56	**0.23**	7800.56	7782.06	18.50	**0.24**	4565.66	4555.59	10.07	**0.22**
OSER	5573.83	5560.26	13.57	**0.24**	4565.76	4554.14	11.62	**0.26**	1008.07	1006.12	1.95	**0.19**
BSER	264.38	263.75	0.63	**0.24**	163.78	163.35	0.43	**0.26**	100.60	100.40	0.20	**0.20**
HEAL	8633.84	8612.55	21.29	**0.25**	7879.27	7859.38	19.89	**0.25**	754.57	753.17	1.41	**0.19**
EDUC	1125.97	1123.23	2.74	**0.24**	821.09	818.95	2.15	**0.26**	304.87	304.28	0.59	**0.19**
SLGV	292.46	291.74	0.72	**0.25**	292.46	291.74	0.72	**0.25**	0.00	0.00	0.00	**NA**
FGOV	86.00	85.79	0.21	**0.24**	75.25	75.07	0.19	**0.25**	10.75	10.73	0.02	**0.20**
Total	**54726.64**	**54596.29**	**130.35**	**0.24**	**39490.82**	**39391.75**	**99.07**	**0.25**	**15235.82**	**15204.52**	**31.30**	**0.21**

Table 4-2 (Continued)
Simulation 2 Results
Key Variables

Labor Supply Residents		**Labor Migration**		**Before Tax Wage**	
Simulation	43991.33	**Simulation**	90.94	**Simulation**	1.0256
Base	43996.63	**Base**	0.00	**Base**	1.0260
Diff	-5.29	**Diff**	90.94	**Diff**	-0.0004
%	-0.01	**%**	NA	**%**	-0.03
Household Disposable Income (Millions)		**Household Expenditures (Millions)**		**After Tax Wage**	
Simulation	54066.59	**Simulation**	54819.04	**Simulation**	1.0022
Base	53846.08	**Base**	54596.28	**Base**	1.0000
Diff	220.51	**Diff**	222.76	**Diff**	0.0022
%	0.41	**%**	0.41	**%**	0.22
Real Household Disposable Income (Millions)		**Real Household Expenditures (Millions)**		**Household Savings (Millions)**	
Simulation	54077.41	**Simulation**	54830.00	**Simulation**	-1918.64
Base	53846.08	**Base**	54596.28	**Base**	-1916.39
Diff	231.33	**Diff**	233.73	**Diff**	-2.25
%	0.43	**%**	0.43	**%**	0.12
Adjusted Household Disposable Income (Millions)		**Adjusted Household Expenditures (Millions)**			
Simulation	53955.07	**Simulation**	54705.97		
Base	53846.08	**Base**	54596.28		
Diff	108.99	**Diff**	109.69		
%	0.20	**%**	0.20		
Real Adjusted Household Disposable Income (Millions)		**Real Adjusted Household Expenditures (Millions)**			
Simulation	53965.86	**Simulation**	54716.91		
Base	53846.08	**Base**	54596.28		
Diff	119.78	**Diff**	120.63		
%	0.22	**%**	0.22		
State Tax Revenue Personal Income Tax (Millions)		**State Tax Revenue Corporate Income Tax (Millions)**		**Tax Revenue Indirect Business Tax (Millions)**	
Simulation	1415.15	**Simulation**	272.65	**Simulation**	8103.46
Base	1570.54	**Base**	272.01	**Base**	8084.25
Diff	-155.39	**Diff**	0.64	**Diff**	19.21
%	-9.89	**%**	0.24	**%**	0.24

have high labor intensities, ranging from 81 percent to 43 percent. However, all of these sectors are service sectors, which have relatively low export elasticities, all equal to 0.7. This led to little demand side effects from the decrease in the wage.

Demand

Consumption demand rose a total of 0.22 percent for Oklahoma residents, with all sectors increasing at a rate close to 0.22 percent, except for agriculture, which only increased by 0.06 percent. Because the domestic price fell in all sectors, consumption demand for regionally produced goods increased by a larger percentage than the increase in import demand. The aggregate composite price faced by consumers was calculated to be 0.9998. Adjusting consumption for price level changes, adjusted real total consumption for the state increased by 0.24 percent. Adjusted real disposable income rose by 0.22 percent, leading to the increase in consumption. The household response to the increase in adjusted real disposable income was larger than in simulation one, due primarily to the distribution of the tax cut to Oklahoma residents, not individuals outside of the state.

The demand for intermediate goods increased by 0.25 percent, with the largest gains in agriculture, increasing by 0.30 percent, mining, increasing by 0.30 percent, other manufacturing, increasing by 0.29 percent, apparel and textile goods, increasing by 0.28 percent, and food and kindred products, increasing by 0.27 percent. Intermediate good demand is a derived demand, depending on output changes and technology.

Factor Demand

The affects on factor demand were also positive, with labor demand increasing 0.19 percent overall and capital demand increasing 0.22 percent overall. This is a strange result considering that in each sector labor demand increased by a larger percentage than did capital demand. However, the sectors experiencing the smallest gains for each factor demand represented some of the larger labor intensities and some of the smaller capital intensities. This led to the result that even though each sector experienced a larger percent increase in labor demand, at the aggregate capital demand increased by a larger percentage.

The price of labor faced by firms in Oklahoma fell from 1.026 to 1.0256 because of the decrease in the tax rate. This lowered costs to firms and stimulated output. Increasing output also increased the demand for capital. However, since the price of capital remained unchanged, there was also an offsetting substitution effect of labor for capital. For the state, the first affect dominated, with state and local governmental services being the only sector to experience a slight decrease in capital demand (-0.02). Cutting the personal income tax also increased the after tax wage paid to households. This stimulated consumption demand which also fed back into output, labor, and capital demand.

For labor demand, the sectors experiencing the strongest growth were metal goods manufacturing, increasing by 0.39 percent, printing and publishing goods manufacturing, increasing by 0.37 percent, other manufacturing, increasing by 0.36 percent, construction related goods manufacturing, increasing by 0.34 percent, and agriculture, increasing by 0.34 percent. Not surprisingly, these are the same sectors that experienced the largest gains in output. Again, the demand side, export demand specifically, drove these sectors to have the largest gains in labor demand.

The degree of factor mobility also affected the results of the simulation. Capital is perfectly mobile, labor is not. The fact that labor is not perfectly mobile retards some of the impact from the tax cut. If labor was assumed perfectly mobile, the after tax wage rate would adjust back to 1. As the wage adjusts downward, the firms would experience lower costs and would continue to increase labor demand. This would lead to higher output and a lower domestic price, which would stimulate demand and output.

Capital demand experienced similar impacts, with metal goods manufacturing increasing by 0.36 percent, printing and publishing goods manufacturing increasing by 0.33, other manufacturing increasing by 0.32 percent, agriculture and mining both increasing by 0.31 percent. All of these sectors have relatively low labor to capital ratios, therefore, with these sectors experiencing relatively larger gains in labor demand, capital demand will be pulled upward. Again, factor mobility affects the result. If labor was perfectly mobile, the adjustment would continue until the after tax wage was equal to 1. Capital would be demanded to work with the labor, but there would also be an offsetting substitution effect of labor for capital.

Tax Revenue

Tax rates were cut by 10 percent, leading to a direct decrease of personal income taxes of $155.39 million. Again, due to the increase in disposable income, economic activity in the state was stimulated and created an offsetting affect on total tax revenue. Corporate income tax revenue increased by $.64 million and indirect business tax revenue increased by $19.21 million. Again, the simulation demonstrates the need for the state government to either cut expenditures or increase some other tax in the state to offset the budget deficit that a tax cut will generate (at least $138.42 million).

Welfare

Disposable income increased for the state by 0.41 percent. Adjusting for migration and changes in the price level faced by Oklahoma residents, this increase falls to 0.22 percent. Therefore, Oklahoma residents now have 0.22 percent more disposable income to spend on goods and services or to save. Also, for every dollar of deficit generated by the tax cut, disposable income to residents increased by $0.87.

It would appear that the corporate income tax cut generated larger welfare gains than did the personal income tax cut. However, the amount of the corporate tax cut was larger than the amount of the personal income tax cut. The corporate tax cut was approximately $272 million while the personal income tax was approximately $155 million. A simulation was run with the personal income tax cut equal to $272 million. The real disposable income increased by 0.38 percent, which is very comparable to the corporate income tax simulation.

This is very interesting, since so much of the corporate income tax break accrues to individual outside the state. The reason for this result is from the dynamic output response of each simulation. The corporate income tax cut generated relatively more of an output response. Capital supply is assumed perfectly mobile, which means that under simulation 1, capital supply will adjust until the domestic price of capital is equal to the rest of the world price of capital. Under simulation 2, labor is assumed imperfectly mobile so that the domestic price of labor will increase as labor adjusts. This will partially offset output gains from the personal income tax cut.

Also, the sectoral breakdown was different between the two simulations. For the corporate income tax cut simulation the manufacturing sectors experienced the largest cost decreases and also the largest domestic price decreases. This led to relatively large increases in export demand which helped stimulate more output growth. This output growth led to more increases in real disposable income for Oklahoma residents.

For the personal income tax simulation, the sectors experiencing the largest decrease in costs should have been the labor intensive sectors. Looking at labor intensities, the average for the state is 32 percent. The sectors with the largest intensities are state and local government, federal government, health services, business services, retail trade, and other services, all with intensities of over 40 percent. However, these sectors are mostly regional, with very low exports. There was no stimulus from export demand for these sectors which would have helped to drive up output.

Sensitivity Analysis

Since some of the parameters of the model are taken from national estimates, sensitivity analysis is usually done to judge the effects of these estimates on the performance of the model. For sensitivity analysis, the elasticity of substitution, the elasticity of transformation, and the labor migration elasticity were each doubled and a new equilibrium was calculated. The results of the sensitivity analysis on key variables for simulation 1 is listed in Appendix D and for simulation 2, Appendix E. As can be seen from the Tables, the model is not very sensitive to the parameter estimates. Also, there is greater sensitivity for simulation 1 than simulation 2.

Elasticity of Substitution

The elasticity of substitution determines the import demand for consumption and intermediate goods in Oklahoma. By doubling the elasticity, agents in Oklahoma become more responsive to price changes. For any sector experiencing an increase in the price level, doubling this elasticity will magnify the effect on price. As the domestic price increases, agents in Oklahoma demand more imports relative to domestic production. The size of this change is determined by the elasticity of substitution. If the agents in Oklahoma become more responsive to price changes, then when a domestic price increases, relatively more imports will be demanded and relatively less domestic production will be demanded. This is like experiencing a decrease in domestic demand between the to simulations, which will magnify the effect on domestic price, i.e. the domestic price will increase by a larger percent. The reverse also holds true. Doubling the elasticity of substitution will dampen the effect on the domestic price level for those sectors experiencing a decrease in the domestic price level. As the domestic price level falls, agents in Oklahoma now demand more domestic production relative to import goods. This increase in domestic demand will be larger when the elasticity of substitution is doubled, which will lead to a larger offsetting effect on domestic price. The decrease in price will be less with the elasticity of substitution doubled.

For output, labor demand, and capital demand the effects of doubling the elasticity of substitution are very similar due to the functional form that was assumed (Cobb-Douglas). These changes are primarily demand driven. For simulation 1, the largest changes in output, labor demand, and capital demand from doubling the elasticity of substitution were in mining, other manufacturing, and petroleum goods manufacturing, each changing by more than one percent (larger). The later two were two of the sectors experiencing the largest decrease in domestic price for the base simulation, and manufacturing has the largest elasticity of substitution, equal to 3.55. The mining sector started out the lowest elasticity, 0.5. By doubling the elasticity of substitution, the mining sector went from being inelastic to unitary elastic. This is a big step, and caused the mining sector to be sensitive to doubling the elasticity of substitution.

For exports, the largest differences were in mining, food and kindred products, other manufacturing, and petroleum goods manufacturing, each changing by more than one percent. These sectors were the most affected due to the same reasons as above, with food and kindred products experiencing the third largest decrease in domestic price. Also, exports from these sectors are already responsive to price changes, each sector with an elasticity of transformation of 2.9. For simulation 2, the changes in output, labor demand, capital demand, and exports were very close to zero for all sectors.

For consumption demand the effects were even smaller. For simulation 1, the largest differences occurred in the regional consumption of other manufacturing and petroleum goods manufacturing and for import consumption of other services, health services, educational services, and federal government services. As before, other manufacturing and petroleum goods manufacturing were the top two sectors experiencing a decrease in domestic price. Also, manufacturing has the largest elasticity of substitution, equal to 3.55. For import consumption, these sectors experienced some of the largest gains in domestic price, which is magnified by doubling the elasticity of substitution. These sectors also started out with a elasticity of substitution of 2, which is elastic. Again, for simulation 2 the differences were all very close to zero.

For simulation 1, intermediate good demand for mining, other manufacturing, petroleum goods manufacturing, metal goods manufacturing, transportation, communications, and public utilities, wholesale trade, and educational services were all larger by more than 1 percent after doubling the elasticity of substitution. All of these sectors, except for educational services, were also larger for domestic intermediate good demand, along with food and kindred products. All of these sectors experiencing an increase in domestic intermediate good demand experienced decreases in the price level, which was dampened by doubling the elasticity of substitution, which would seem contrary to what should have happened. However, intermediate good demand is determined by prices and output. Therefore, the relationship between prices and intermediate good demand is not as clear cut as in other areas of analysis. Import demand for intermediate goods had even larger differences. Agriculture, other manufacturing, metal goods manufacturing, wholesale trade, retail trade, other services, business services, health services, educational services, and federal government services were all larger by more than 1 percent and food and kindred products was smaller by 1.29 percent. For simulation 2, the difference was very close to zero.

Labor migration was very sensitive to the elasticity of substitution, being 19.32 percent larger for simulation 1 and 3.85 percent larger for simulation 2. Labor migration was the most sensitive variable in all of the sensitivity analysis, and is primarily determined by output changes and changes in the relative wage rate. The after tax wage ended up larger after doubling the elasticity of substitution. Since the wage rate is a price, it is affected similarly to other prices in the economy. In the original simulation, the after tax wage increased. By doubling the elasticity of substitution, this effect was magnified.

For the corporate income tax cut simulation, the deficit was smaller after doubling the elasticity of substitution, down by almost $20 million to $142.6 million. For simulation 2, the deficit fell from $138.42 million to $137.57 million. Just as was the case for all of the other variables, the deficit is more sensitive under simulation 1.

Elasticity of Transformation

The elasticity of transformation determines the demand for goods produced in Oklahoma by foreign agents. Since Oklahoma is a relatively small regional economy, the export demand for goods produced in Oklahoma is very responsive to changes in the domestic price. Agriculture is the most responsive, with an elasticity of transformation equal to 3.9. Mining and manufacturing are also responsive with elasticities of 2.9. The service sectors are not responsive, with elasticity of transformation equal to 0.7. This is due to most services being region specific. By doubling the elasticity of transformation, each sector will become more responsive to changes in the domestic price level. This will lead to larger increases in export demand for sectors experiencing a decrease in domestic price and smaller increases in export demand for sectors experiencing an increase in domestic price. This greater responsiveness will also effect the change in domestic price. With a decrease in the domestic price, a relatively larger amount of exports will lead to an offsetting positive effect on price. With an increase in price, this larger responsiveness will lead to relatively less export demand, magnifying the effect on domestic price. The effects will be similar to changing the elasticity of substitution.

Output, labor demand, and capital demand reacted similarly to doubling the elasticity of transformation, again due to the functional form assumed. The changes are driven by demand side differences in exports, and also by demand changes caused by the effects on the domestic price. For simulation 1 output, labor demand, and capital demand experienced increases in mining, other manufacturing, and petroleum goods manufacturing by more than 1 percent. Agriculture was the only sector to experience a decrease, (over 1 percent). This was due to an increase in the domestic price of agriculture compounded by the fact that the agriculture sector was the most responsive to price changes with an elasticity of transformation of 3.9.

For exports, mining, food and kindred products, other manufacturing, and petroleum goods manufacturing were all larger by more than 1 percent. Agriculture and construction were smaller by more than 2 percent. For simulation 2, there was no significant changes in any of the sectors.

For both simulations, consumption demand was very unresponsive to changing the elasticity of transformation. All of the differences were close to zero, with domestic consumption generally larger than the base run and import consumption smaller.

Intermediate good demand was the most responsive, with mining, other manufacturing, petroleum goods manufacturing, metal manufacturing, and transportation, communications, and public utilities experiencing the largest differences for simulation 1, each increasing over the base run by more than 1 percent. For domestic intermediate demand, the same sectors had the largest differences, while for import intermediate good demand other manufacturing, metal goods manufacturing, transportation, communications, and public utilities, and educational services were all larger than the base run. Intermediate good demand under simulation 2 had little response.

Again, the most responsive variable was labor migration. Under simulation 1, labor migration was larger by 16.73 percent, and under simulation 2, labor migration was larger by 3.19 percent. The after tax wage rate increased by a larger percentage after doubling the elasticity of transformation, which lead to an increase in labor migration.

The deficit under each simulation was smaller after doubling the elasticity of transformation. For simulation 1, the deficit fell to $145.6 million, which is a little larger than the deficit generated when the elasticity of substitution was doubled. For simulation 2, the deficit fell to $137.64 million, which is a little larger than the deficit generated when the elasticity of substitution was doubled.

Labor Migration Elasticity

The labor migration elasticity determines how workers enter and leave the state due to relative differences between Oklahoma and the rest of the world's after tax wage rate. By doubling this elasticity, workers are more responsive to changes in the relative wage rate. As more workers enter the state, the increase in the after tax wage rate will be dampened. Also, the before tax cost of labor to employers in Oklahoma will fall, leading to some output affects. However, the change between the base simulation and doubling the labor migration elasticity did not lead to a very large relative change in the wage rate, only about 0.18 percent less in the sensitivity analysis than in the base simulation. Therefore, the effects on all other variables in the economy is relatively small.

Doubling the labor migration elasticity had little effect on output, labor demand, capital demand, and exports. Under simulation 1, only two sectors experienced a change from the base year that was larger than 1 percent, construction related goods and metal goods manufacturing. Under simulation 2, the effects were still small, although they were relatively larger than the other two parameter changes.

Consumption demand is relatively unresponsive to changes in the labor migration elasticity, with small decreases under simulation 1 and simulation 2. Almost half of the sectors experienced decrease in domestic consumption demand and all sectors experienced a decrease in import consumption demand.

Intermediate good demand was very responsive under simulation 1. Mining and other manufacturing each experienced an increase of over 2 percent from the base run. Petroleum goods manufacturing, metal goods manufacturing, transportation, communications, and public utilities, wholesale trade, and educational services all experienced increases over the base run of 1 percent or larger. Domestic intermediate good demand reacted similarly with more sectors experiencing a greater than 1 percent change over the base run. Import intermediate good demand also reacted similarly. Under simulation 2, the changes were not very large.

Under simulation 1, labor migration increase over the base run by 47.63 percent and under simulation 2, by 46.87 percent. This shouldn't be surprising considering that labor migration is a function of the labor migration elasticity.

The deficit generated under simulation 1 after the labor migration elasticity was doubled fell to $145.8 million, smaller than the base run but larger than the other two sensitivity analyses. Similarly, for simulation 2 the deficit fell to $132.9 million, however this was quit a bit lower than the base run and other two sensitivity analyses.

Chapter 5

Conclusion

The purpose of this study was to develop a CGE model for tax policy analysis for the state of Oklahoma. Two different simulations were run and the results analyzed and compared. The following sections explain the conclusions found.

Corporate Income Tax Cut

Eliminating the corporate income tax did stimulate the Oklahoma economy. Oklahoma capital demand, exports, intermediate good demand and output experienced the largest gains. However, consumption demand and disposable income experienced relatively smaller gains. While cutting the tax did increase income in the state, only about 25 percent of capital returns stay in the state. Therefore, 75 percent of the increase in capital income leaks out of the state and has no effect on residents.

During the sensitivity analysis, the deficit was lower than the base simulation. Doubling the elasticity of substitution led to a deficit of $142.6 million, doubling the elasticity of transformation led to a deficit of $145.6 million, and doubling the labor migration elasticity led to a deficit of $145.8 million. Two more sensitivity analyses were run, doubling all three parameters simultaneously and assuming perfectly mobile labor. The first one represents a best case scenario, while the other lets the after tax wage adjust back to one. Interestingly, both of these analyses generated the smallest deficits, $95.4 million and $97.6 million, respectively. However, none of the sensitivity analyses generated enough additional economic activity to have the tax "pay for itself."

Personal Income Tax Cut

While the cut in the personal income tax generated less economic activity than the corporate income tax cut, that is not the entire story. The benefits from cutting the personal income tax accrue to Oklahoma residents, while cutting the corporate income tax generated substantial benefits to nonresidents. Also, most capital owned by Oklahomans is owned by the medium and high income groups.

When cutting the personal income tax, for every dollar of tax cut, the deficit increased by $0.88. This is larger than with the corporate income tax cut. There was not as much of a dynamic response, i.e. increases in output, as there was with the corporate income tax cut. This is due to the corporate income tax cut generating a relatively larger drop in the price for capital. This is especially true for the capital intensive industries like manufacturing. The lower capital price led to a relatively larger decrease in costs, which generated larger increases in output.

When doing the sensitivity analysis it was found that the deficit was smaller. When doubling the elasticity of substitution, the deficit fell to $137.57 million, when doubling the elasticity of transformation, the deficit fell to $137.64 million, and when doubling the labor migration elasticity, the deficit fell to $132.9 million. Again, two additional sensitivity analyses were run and similar results were obtained, with a deficit of $128.3 million generated when doubling all three parameters simultaneously, and the smallest deficit being generated when labor is assumed to be perfectly mobile ($117.46 million).

Which is Best?

Given that the purpose of a CGE model is to help policy makers, what conclusions can be drawn about which policy is better? Clearly, the corporate income tax cut generates larger changes in all economic variables. While the welfare effects are about the same between the two simulations, a lot of the direct effects from the corporate income tax cut leaves the state (75%). Also, since most of the in-state capital returns go to the high and medium level income groups, the tax cut is also regressive. The individuals being helped out by the tax cut may not be the ones in most need.

The cut in personal income tax was evenly spread out among household income groups. It did not generate the economic activity that the corporate income tax cut did. The direct benefits accrue to individuals within the state, there is no leakage like there is with the corporate income tax cut. The welfare effects, however, were approximately the same. The problem with the personal income tax cut is the deficit that is created. It is clear that if the goal of policy makers is to help current residents, then this tax cut is the preferred one. However, a rather large deficit will be created and the policy makers will have to determine what will be done to offset the deficit, either cutting spending or raising other taxes. There are all kinds of possibilities, but it is doubtful that any of the possibilities will be met with universal support. Basically, someone will have to pay!

CGE Versus Partial Equilibrium

The next question to be asked is what are the benefits of CGE models over partial equilibrium models. Of course, one of the biggest advantages is the sectoral detail. The Oklahoma Tax CGE had 21 output sectors, 1 consumption sector, 1 trade sector, and 2 resource sectors. So, the modeler not only gets total results of different policies, but also can see what is happening to different sectors, to labor demand and supply, to capital flows and to households in the state. This is very important if the policy makers are concerned with unintended negative effects of their policies. As was shown by simulation one, cutting the corporate income tax had varying degrees of impacts on the different sectors, with some negative effects on labor demand. Also, while output and domestic demand increased because of relative cost decreases, there were some sectors that experienced higher costs due to their high labor intensities and increase wage rates, and these sectors experienced some offsetting demand effects through a reduction in exports.

Interestingly, the CGE model also showed that a lot of the output gains from cutting the personal income tax were driven by export demand. If costs are cut relative to the rest of the world, firms in Oklahoma are better able to compete globally and Oklahoma residents receive additional benefits from a given tax policy.

CGE models show that there are many factors that can be affected when changing a tax, like labor intensity, capital intensity, import and export shares, sectoral price, and labor migration. A tax policy may look good in a partial equilibrium analysis, like cutting corporate income taxes, but until a general equilibrium analysis is done, it is difficult, maybe even impossible, to see that most of the benefits of the tax cut leaves the state or does not help the individuals it was intended to help.

Extensions and Weaknesses

There are many areas for improvement with the Oklahoma tax CGE. First, and maybe most obvious has to do with the households. Dividing households into income groups according to their marginal tax rate would make it so that some of the distributional effects could be better analyzed. Also, each income group responds differently to price changes, allowing one to see who responds most and who responds least. And finally, it would allow the modeler to analyze the effects of supposedly progressive policy alternatives, like eliminating the sales tax of food.

Disaggregating the data more would provide little in terms of analysis. Of course, if there is some special industry under study, the model could be rearranged so that the focus is upon that one industry. But this model is disaggregated to the point that any better sectoral detail could increase costs more than any benefits that might come from disaggregating.

Capital was assumed perfectly mobile for this study. Of course, in reality this may not be the case. An alternative would be to model either investment by sector or capital mobility by sector. This would also increase the price effects of policy analysis, because the after tax price of capital would no longer necessarily be equal to the world price of capital. Also, the extent of mobility could alter the results. If capital is less mobile than assumed, than the price affects will be altered. If capital doesn't adjust to meet demand, than there will be upward pressure on the price of capital.

Also, labor was not assumed perfectly mobile. Since this model is a comparative static model, meaning it is outside of time, it might be more realistic to allow labor to fully adjust to wage changes.

Of course the data is also a limitation. It seems that the IMPLAN data is a little weak and it might be better if future researchers generated their own data. At least this way, tax rates could be assumed prior to the data set being created and the model might end up with tax rates that look a little more realistic.

Different functional forms could be instituted. For production functions, a constant elasticity of substitution function or a TRANSLOG function could be implemented for the value added of labor and capital. Also, a constant elasticity of substitution function could be used for deriving the demand functions.

Finally, a time element could be instituted to make the model dynamic. This would allow the modeler to estimate both short-run and long-run effects of different tax policies. Also, labor and capital elasticities could be assumed different between the short-run and the long-run.

Concluding Remarks

The purpose of this study was to develop a CGE tax model for the state of Oklahoma, in an attempt to determine if there are enough advantages to CGE models to justify using them to analyze policy at the state level. Comparing the results of two different simulations, it was found that a CGE model does give a more complete view of the effects of a proposed policy. CGE models not only generate more complete results than do their partial equilibrium counterparts, that also generate results than cause one to think and analyze what is really going on in an economy.

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Appendixes

Appendix A
Model Variables

VARIABLE		DESCRIPTION
MATH	GAMS	
Y	Y	Regional Output
VA	VA	Value Added
LD	LD	Labor Demand
KD	KD	Capital Demand
LSH	LSH	Labor Supply
ALSH	ALSH	Labor Supply, Adjusted For Labor Migration
LMH	LMH	Labor Migration
CAPD	CAPD	Sectoral Investment Demand, Domestic
CAPI	CAPI	Sectoral Investment Demand, Imports
X	X	Intermediate Good Demand
VD	VD	Equation to Determine Intermediate Import Demand
D	D	Intermediate Good Demand, Domestic
V	V	Intermediate Good Demand, Imports
R	R	Regional Production Consumed Domestically
E	E	Regional Production Exported
L	L	Leisure Demand
C	C	Consumption Demand
CI	CI	Household Demand, Import Goods
CR	CR	Household Demand, Domestic Goods
AC	AC	Consumption Demand, Adjusted For Labor Migration
ACI	ACI	Household Demand, Import Goods, Adjusted For Labor Migration
ACR	ACR	Household Demand, Domestic Goods, Adjusted For Labor Migration
YLAB	YLAB	Labor Income
YCAP	YCAP	Capital Income
MH	MH	Household Income
DMH	DMH	Household Disposable Income
AMH	AMH	Household Income, Adjusted For Labor Migration
ADMH	ADMH	Household Disposable Income, Adjusted For Labor Migration
TX	TX	Total Demand, Intermediate Good
TD	TD	Total Domestic Demand, Intermediate Good
TV	TV	Total Import Demand, Intermediate Good
HHE	HHE	Total Household Expenditures
AHHE	AHHE	Total Household Expenditures, Adjusted For Labor Migration
HHS	HHS	Total Domestic Household Savings
PD	PD	Domestic Price, All Goods
PL	PL	Domestic Price, Labor
PLT	PLT	After Tax Domestic Price, Labor
PK	PK	Domestic Price, Capital
CPDC	CPDC	After Tax Composite Price, Consumption Goods in Oklahoma

Appendix A (Continued)
Model Variables

VARIABLE		DESCRIPTION
MATH	GAMS	
PN	PN	Net Price, Oklahoma Producers
STRIN	STRIN	State Tax, Income
STRCA	STRCA	State Tax, Capital
SGI	SGI	State and Local Government Expenditures, Import Goods
SGD	SGD	State and Local Government Expenditures, Domestic Goods
FGI	FGI	Federal Government Expenditures, Import Goods
FGD	FGD	Federal Government Expenditures, Domestic Goods
i	(i)	Sector
j	(j)	Good
n	(n)	Total number of sectors
k	(k)	Total number of goods

Appendix B
Model Parameters

PARAMETER		DESCRIPTION
Math	**GAMS**	
α	alpha	Share Parameter, Leontieff Production
β	beta	Share Parameter, Value Added
ψ	psi	Minimum Time Necessary For Sleep And Other Minimum Requirements
ϕ	phi	Share Parameter, Labor Supply
μ	mu	Share Parameter, CES Trade, Intermediate Good
γ	gamma	Share Parameter, CET Trade, Exports
ρ	rho	Share Parameter, CES Trade, Capital Demand
vva	vva	Technology Parameter, Value Added
capa	capa	Technology Parameter, CES Trade, Capital Demand
vda	vda	Technology Parameter, CES Trade, Intermediate Good
era	era	Technology Parameter, CET Trade, Exports
σ^{cl}	sigcl	Elasticity of Substitution, Leisure-Consumption
σ^{ca}	sigca	Elasticity of Substitution, Capital Demand, Imports-Domestic
σ^{vd}	sigvd	Elasticity of Substitution, Intermediate Goods, Imports-Domestic
σ^{er}	siger	Elasticity of Transformation, Exports-Domestic
η	nu	Labor Migration Elasticity
svak	svak	Household Share Value Added, Capital
YO	YO	Regional Output, Base Year
VAO	VAO	Value Added, Base Year
LDO	LDO	Labor Demand, Base Year
KDO	KDO	Capital Demand, Base Year
LSHO	LSHO	Household Labor Supply, Base Year
INVO	INVO	Investment, Base Year
XO	XO	Intermediate Good Demand, Base Year
DO	DO	Intermediate Good Demand, Domestic, Base Year
VO	VO	Intermediate Good Demand, Imports, Base Year
RO	RO	Regional Production Consumed Domestically, Base Year
EO	EO	Regional Production Exported, Base Year
λ	lam	Share Parameter, CES Trade, Consumption Demand
σ^{vr}	sigvr	Elasticity of Substitution, Consumption Demand, Imports-Domestic
vra	vra	Technology Parameter, CES Trade, Consumption Demand
CO	CO	Consumption Demand, Base Year
CIO	CIO	Consumption Demand, Import Goods, Base Year
CRO	CRO	Consumption Demand, Domestic Goods, Base Year
TPSLO	TPSLO	Transfer Payments, State and Local Government
TPFEDO	TPFEDO	Transfer Payments, Federal Government

Appendix B (Continued)
Model Parameters

PARAMETER		DESCRIPTION
Math	**GAMS**	
OTHERO	OTHERO	Income, Other
π	pi	Share Parameter, CES Trade, State And Local Government Demand
sgea	sgea	Technology Paramter, CES Trade, State And Local Government Demand
ε	epsi	Share Parameter, CES Trade, Federal Government Demand
fgea	fgea	Technology Parameter, CES Trade, Federal Government Demand
σ^{sg}	sigsg	Elasticity of Substitution, State And Local Demand, Imports-Domestic
σ^{fg}	sigfg	Elasticity of Substitution, Federal Government, Imports-Domestic
stin	stin	State Tax Rate, Income
stca	stca	State Tax Rate, Corporate Income
ftss	ftss	Federal Tax Rate, Social Security
ftin	ftin	Federal Tax Rate, Income
SGEO	SGEO	State and Local Government Expenditures, Base Year
SGIO	SGIO	State and Local Government Expenditures, Import Goods, Base Year
SGDO	SGDO	State and Local Government Expenditures, Domestic Goods, Base Year
FGEO	FGEO	Federal Government Expenditures, Base Year
FGIO	FGIO	Federal Government Expenditures, Import Goods, Base Year
FGDO	FGDO	Federal Government Expenditures, Domestic Goods, Base Year
YLABO	YLABO	Labor Income, Base Year
YCAPO	YCAPO	Capital Income, Base Year
MHO	MHO	Household Income, Base Year
DMHO	DMHO	Household Disposable Income, Base Year
TXO	TXO	Total Intermediate Demand, Base Year
TDO	TDO	Total Domestic Intermediate Demand, Domestic Goods, Base Year
TVO	TVO	Total Domestic Intermediate Demand, Import Goods, Base Year
HHEO	HHEO	Total Domestic Household Expenditures, Base Year
HHSO	HHSO	Total Domestic Household Savings, Base Year

Appendix B (Continued)
Model Parameters

PARAMETER		DESCRIPTION
Math	**GAMS**	
PDO	PDO	Domestic Price, Consumption Goods, Base Year
PWO	PWO	World Price, Consumption and Intermediate Goods, Base Year
PLO	PLO	Domestic Price, Labor, Base Year
PLUSO	PLUSO	United States Price, Labor, Base Year
PKO	PKO	Domestic Price, Capital, Base Year
PKWO	PKWO	World Price, Capital, Base Year
CPDO	CPDO	After Tax Composite Price, Goods in Oklahoma, Base Year

Appendix C
Model Equations

EQUATION NAME	EQUATION
Production	
EQZ..	Z=e=sum(i,SLACK1(i)+SLACK2(i))
POUTVA(i)..	VA(i)+SLACK1(i)-SLACK2(i)=e=alphao(i)*Y(i)
PVALUE(i)..	VA(i)=e=vaa(i)*LD(i)**beta(i)* KD(i)**(1-beta(i))
PLABRD(i)..	LD(i)=e=(beta(i)*PN(i)*Y(i))/PL
PCAPLD(i)..	KD(i)=e=((1-beta(i))*PN(i)*Y(i))/PK(i)
PCAPT(j)$(NZCAP(j))..	CAPO(j)=e=capa(j)*(rho(j)*CAPI(j)** ((sigca(j)-1)/sigca(j))+ (1-rho(j))*CAPD(j)**((sigca(j)-1)/ sigca(j)))**(sigca(j)/(sigca(j)-1))
PCAPD(j)$(NZCAP(j))..	CAPD(j)=e=(((1-rho(j))/rho(j))**sigca(j))* ((PWO(j)/PD(j))**sigca(j))*CAPI(j)
PCAPD1(j)$(ZCAPI(j))..	CAPD(j)=e=CAPO(j)
PIGOOD(i,j)..	X(i,j)=e=alpha(i,j)*Y(i)
PITRAD(i,j)$(NZVD(i,j)) ..	X(i,j)=e=vda(i,j)*(mu(i,j)*V(i,j)** ((sigvd(j)-1)/sigvd(j))+ (1-mu(i,j))*D(i,j)**((sigvd(j)-1)/ sigvd(j)))**(sigvd(j)/(sigvd(j)-1))
PIDOMP(i,j)$(NZVD(i,j)) ..	D(i,j)=e=V(i,j)*(((1-mu(i,j))/mu(i,j))* (PWO(j)/PD(j)))**sigvd(j)
PIDOMP1(i,j)$(ZV(i,j)). .	D(i,j)=e=X(i,j)
PYTRAD(i)..	Y(i)=e=era(i)*(gamma(i)*E(i)**((1+siger(i))/ siger(i))+(1-gamma(i))*R(i)** ((1+siger(i))/siger(i)))** (siger(i)/(1+siger(i)))
PYDOMS(i)..	R(i)=e=E(i)*(((1-gamma(i))/gamma(i))* (PWO(i)/PD(i)))**(-siger(i))

Appendix C (Continued)
Model Equations

EQUATION NAME	EQUATION
Consumption	
CLABRM..	LMH=e=nu*LSHO*log(PLT/PLUSO)
CLABRS..	LSH=e=psi-(phio/((1-phio)*PLT))* (AHHE-sum(j,CPDC(j)*gam(j)))
CLADJ..	LADJ=e= (LSHO+LMH)/LSHO
CALABRS..	ALSH=e= LSH/LADJ
CCONSD(j)..	C(j)=e=gam(j)+(phi(j)/(CPDC(j)*(1-phio)))* (HHE-sum(i,CPDC(i)*gam(i)))
CACONSD(j)..	AC(j)=e=C(j)/LADJ
CDTRAD(j)$(NZVR(j))..	C(j)=e=vra(j)*(lam(j)*CI(j)**((sigvr(j)-1)/ sigvr(j))+(1-lam(j))*CR(j)** ((sigvr(j)-1)/sigvr(j)))** (sigvr(j)/(sigvr(j)-1))
CDDOMP(j)$(NZVR(j))..	CR(j)=e=CI(j)*(((1-lam(j))/lam(j))* (PWO(j)/PD(j)))**sigvr(j)
CDDOMP1(j)$(ZCI(j))..	CR(j)=e=C(j)
CADDOMP(j)..	ACR(j)=e=CR(j)/LADJ
CADIMP(j)..	ACI(j)=e=CI(j)/LADJ
Government	
GSLSE(j)$(NZSGE(j))..	SGEO(j)=e=sgea(j)*(pi(j)*(SGI(j)** ((sigsg(j)-1)/sigsg(j)))+(1-pi(j))* (SGD(j)**((sigsg(j)-1)/sigsg(j))))** (sigsg(j)/(sigsg(j)-1))
GSLSD(j)$(NZSGE(j))..	SGD(j)=e=(((1-pi(j))/pi(j))**sigsg(j))* ((PWO(j)/PD(j))**sigsg(j))*SGI(j)
GSLSD1(j)$(ZSGI(j))..	SGD(j)=e=SGEO(j)
GFEDSE(j)$(NZFGE(j))..	FGEO(j)=e=fgea(j)*(epsi(j)*(FGI(j)** ((sigfg(j)-1)/sigfg(j)))+(1-epsi(j)) *(FGD(j)**((sigfg(j)-1)/sigfg(j)))) **(sigfg(j)/(sigfg(j)-1))

Appendix C (Continued)
Model Equations

EQUATION NAME	EQUATION
GFEDSD(j)$(NZFGE(j))..	FGD(j)=e=(((1-epsi(j))/epsi(j))**sigfg(j))* ((PWO(j)/PD(j))**sigfg(j))*FGI(j)
GFEDSD1(j)$(ZFGI(j))..	FGD(j)=e=FGEO(j)
Income	
INCLAB..	YLAB=e=PL*sum(i,LD(i))*(1-ftss)
INCCAP..	YCAP=e=svak*sum(i,PKTO*KD(i))
INCTOT..	MH=e=YLAB+YCAP+TPSLO+TPFEDO+OTHERO
AINCTOT..	AMH=e=MH/LADJ
INCDIS..	DMH=e=(1-stin-ftin-ohht)*MH
AINCDIS..	ADMH=e=DMH/LADJ
Prices	
ICPDC(j)..	CPDC(j)=e=(PD(j)*(TD(j)+CR(j)+CAPD(j)+SGD(j)+ FGD(j))+PWO(j)*(TV(j)+CI(j)+SGI(j)+ FGI(j)+CAPI(j)))/(TD(j)+CR(j)+ CAPD(j)+SGD(j)+FGD(j)+TV(j)+ CI(j)+SGI(j)+FGI(j)+CAPI(j))
IPN(i)..	PN(i)=e=PD(i)-sum(j,alpha(i,j))*CPDC(i)- ibt(i)*PD(i)-(PKTO*INVO(i))/(PD(i) *Y(i))
IPK(i)..	PK(i)=e=PKTO/(1-stca(i))
IPLD..	PL=e=PLT/(1-stin)
Identities	
IIGDT(j)..	TX(j)=e=sum(i,X(i,j))
IIGDD(j)..	TD(j)=e=sum(i,D(i,j))
IIGDI(j)..	TV(j)=e=sum(i,V(i,j))
IHHSAV..	HHS=e=mps*MH

Appendix C (Continued)
Model Equations

EQUATION NAME	EQUATION
IHHEXP..	HHE=e=DMH-HHS-OTHEXO
IAHHEXP..	AHHE=e=HHE/LADJ
Equilibrium	
ELABOR..	sum(i,LD(i))=e=LSH+LMH
EOUTPT(j)..	Y(j)=e=TX(j)+C(j)+SGEO(j)+FGEO(j)+CAPO(j)+ E(j)-TV(j)-CI(j)-SGI(j)-FGI(j)-CAPI(j)

Appendix D
Sensitivity Analsysis
Simulation 1

DOUBLE THE ELASTICITY OF SUBSTITUTION Output, Labor Demand and Capital Demand												
	Output New Run	Output Base Run	Diff	%	Labor Demand New Run	Labor Demand Base Run	Diff	%	Capital Demand New Run	Capital Demand Base Run	Diff	%
AGRI	4396.71	4406.42	-9.71	**-0.22**	531.17	532.63	-1.46	**-0.27**	372.55	373.08	-0.53	**-0.14**
MINE	11191.63	11050.22	141.41	**1.28**	2233.45	2207.07	26.37	**1.19**	4038.61	3985.67	52.94	**1.33**
CONS	7429.62	7423.16	6.46	**0.09**	2503.62	2501.72	1.90	**0.08**	235.17	234.68	0.49	**0.21**
FOOD	4161.07	4121.29	39.79	**0.97**	478.14	473.79	4.35	**0.92**	276.44	273.57	2.87	**1.05**
APPA	703.21	706.89	-3.68	**-0.52**	158.00	158.87	-0.86	**-0.54**	34.76	34.90	-0.14	**-0.41**
CRGS	1984.45	1995.18	-10.73	**-0.54**	540.62	543.69	-3.07	**-0.56**	145.06	145.69	-0.63	**-0.43**
OMAN	4107.71	4015.22	92.49	**2.30**	863.59	844.57	19.02	**2.25**	558.81	545.78	13.02	**2.39**
PRIN	1106.78	1115.73	-8.94	**-0.80**	336.27	339.07	-2.80	**-0.83**	78.54	79.09	-0.55	**-0.70**
PETR	8241.65	8095.51	146.14	**1.81**	923.43	907.53	15.90	**1.75**	631.87	620.18	11.70	**1.89**
METL	4069.01	4040.41	28.59	**0.71**	1009.94	1003.22	6.73	**0.67**	408.48	405.23	3.25	**0.80**
MACH	11648.21	11677.01	-28.80	**-0.25**	2729.69	2737.17	-7.48	**-0.27**	717.30	718.32	-1.02	**-0.14**
TCPU	13815.95	13738.52	77.43	**0.56**	3367.81	3350.95	16.86	**0.50**	2924.49	2906.02	18.47	**0.64**
WHOL	6810.17	6798.94	11.23	**0.17**	2364.80	2361.55	3.24	**0.14**	657.59	655.83	1.77	**0.27**
RETL	10066.77	10068.28	-1.51	**-0.01**	4274.65	4276.31	-1.66	**-0.04**	977.86	976.95	0.91	**0.09**
FIRE	14951.28	14899.61	51.67	**0.35**	2140.99	2135.74	5.25	**0.25**	7148.95	7122.03	26.92	**0.38**
OSER	10014.04	10029.35	-15.31	**-0.15**	4183.80	4190.87	-7.07	**-0.17**	601.84	602.06	-0.22	**-0.04**
BSER	3500.64	3513.11	-12.47	**-0.35**	1641.06	1647.19	-6.13	**-0.37**	252.23	252.83	-0.61	**-0.24**
HEAL	8097.23	8109.80	-12.57	**-0.16**	3947.11	3953.52	-6.41	**-0.16**	231.18	231.25	-0.07	**-0.03**
EDUC	1114.18	1118.61	-4.43	**-0.40**	288.79	289.95	-1.16	**-0.40**	11.28	11.31	-0.03	**-0.27**
SLGV	7203.20	7203.23	-0.03	**0.00**	5851.09	5851.95	-0.86	**-0.01**	729.96	729.11	0.85	**0.12**
FGOV	5299.97	5307.01	-7.04	**-0.13**	3955.58	3961.88	-6.30	**-0.16**	1032.69	1032.97	-0.28	**-0.03**
Total	**139913.49**	**139433.50**	**479.99**	**0.34**	**44323.60**	**44269.23**	**54.37**	**0.12**	**22065.67**	**21936.57**	**129.10**	**0.59**

DOUBLE THE ELASTICITY OF SUBSTITUTION Regional Supply, Exports, and Domestic Price												
	Regional New Run	Regional Base Run	Diff	%	Exports New Run	Exports Base Run	Diff	%	Domestic Price New Run	Domestic Price Base Run	Diff	%
AGRI	1712.86	1713.44	-0.58	**-0.03**	2683.81	2692.95	-9.14	**-0.34**	1.0043	1.0035	0.0008	**0.08**
MINE	5452.23	5379.50	72.72	**1.35**	5739.40	5670.72	68.68	**1.21**	0.9999	0.9994	0.0005	**0.05**
CONS	7316.44	7309.69	6.75	**0.09**	113.17	113.46	-0.29	**-0.26**	1.0064	1.0052	0.0012	**0.12**
FOOD	2896.18	2866.35	29.84	**1.04**	1264.84	1254.88	9.96	**0.79**	0.9939	0.9931	0.0008	**0.08**
APPA	634.14	637.26	-3.12	**-0.49**	69.07	69.63	-0.56	**-0.80**	1.0012	1.0001	0.0011	**0.11**
CRGS	154.61	155.01	-0.40	**-0.26**	1829.84	1840.17	-10.33	**-0.56**	1.0000	0.9989	0.0011	**0.11**
OMAN	1266.67	1236.13	30.54	**2.47**	2840.98	2779.01	61.97	**2.23**	0.9929	0.9921	0.0008	**0.08**
PRIN	269.74	271.28	-1.54	**-0.57**	837.04	844.45	-7.40	**-0.88**	1.0008	0.9998	0.0010	**0.10**
PETR	1520.02	1490.27	29.75	**2.00**	6721.53	6605.12	116.41	**1.76**	0.9924	0.9916	0.0008	**0.08**
METL	125.61	124.40	1.21	**0.98**	3943.40	3916.01	27.38	**0.70**	0.9970	0.9961	0.0010	**0.10**
MACH	7605.68	7616.43	-10.75	**-0.14**	4042.52	4060.58	-18.05	**-0.44**	1.0001	0.9991	0.0010	**0.10**
TCPU	9454.94	9400.46	54.48	**0.58**	4360.97	4338.02	22.96	**0.53**	0.9941	0.9934	0.0007	**0.07**
WHOL	6290.41	6279.69	10.72	**0.17**	519.76	519.25	0.51	**0.10**	1.0010	0.9999	0.0011	**0.11**

Appendix D (Continued)
Sensitivity Analsysis
Simulation 1

DOUBLE THE ELASTICITY OF SUBSTITUTION												
Regional Supply, Exports, and Domestic Price												
	Regional New Run	Regional Base Run	Diff	%	Exports New Run	Exports Base Run	Diff	%	Domestic Price New Run	Domestic Price Base Run	Diff	%
RETL	9416.83	9417.78	-0.95	**-0.01**	649.94	650.50	-0.56	**-0.09**	1.0018	1.0007	0.0011	**0.11**
FIRE	12565.04	12521.18	43.86	**0.35**	2386.23	2378.42	7.81	**0.33**	0.9967	0.9964	0.0003	**0.03**
OSER	9913.87	9928.95	-15.07	**-0.15**	100.17	100.40	-0.23	**-0.23**	1.0059	1.0048	0.0011	**0.11**
BSER	3471.60	3483.94	-12.34	**-0.35**	29.04	29.16	-0.13	**-0.43**	1.0058	1.0046	0.0012	**0.12**
HEAL	8023.26	8035.66	-12.39	**-0.15**	73.96	74.14	-0.18	**-0.24**	1.0072	1.0059	0.0013	**0.13**
EDUC	1064.55	1068.75	-4.19	**-0.39**	49.62	49.86	-0.24	**-0.48**	1.0075	1.0062	0.0013	**0.13**
SLGV	6870.56	6870.34	0.23	**0.00**	332.63	332.89	-0.26	**-0.08**	1.0073	1.0061	0.0012	**0.12**
FGOV	4780.21	4786.21	-6.00	**-0.13**	519.75	520.79	-1.04	**-0.20**	1.0065	1.0055	0.0010	**0.10**
Total	**100805.48**	**100592.72**	**212.76**	**0.21**	**39107.68**	**38840.41**	**267.27**	**0.69**				

DOUBLE THE ELASTICITY OF SUBSTITUTION												
Consumption Demand												
	Total New Run	Total Base Run	Diff	%	Domestic New Run	Domestic Base Run	Diff	%	Import New Run	Import Base Run	Diff	%
AGRI	375.53	375.48	0.04	**0.01**	212.87	213.51	-0.64	**-0.30**	162.65	161.97	0.69	**0.42**
MINE	1.44	1.44	0.00	**0.03**	1.44	1.44	0.00	**0.03**	0.00	0.00	0.00	**NA**
CONS	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**
FOOD	3582.97	3581.40	1.57	**0.04**	1866.69	1849.23	17.46	**0.94**	1716.39	1732.24	-15.85	**-0.91**
APPA	1251.24	1250.66	0.58	**0.05**	427.09	429.15	-2.07	**-0.48**	824.15	821.51	2.64	**0.32**
CRGS	344.12	343.90	0.23	**0.07**	21.49	21.55	-0.06	**-0.27**	322.63	322.35	0.28	**0.09**
OMAN	2062.40	2061.10	1.29	**0.06**	345.54	338.92	6.61	**1.95**	1716.91	1722.21	-5.30	**-0.31**
PRIN	369.63	369.43	0.19	**0.05**	93.63	94.06	-0.42	**-0.45**	275.99	275.37	0.62	**0.22**
PETR	918.95	918.45	0.49	**0.05**	348.77	343.33	5.44	**1.59**	570.22	575.15	-4.93	**-0.86**
METL	94.96	94.89	0.06	**0.07**	2.56	2.54	0.02	**0.79**	92.39	92.35	0.04	**0.05**
MACH	2309.32	2308.56	0.75	**0.03**	1279.21	1281.13	-1.91	**-0.15**	1030.11	1027.44	2.67	**0.26**
TCPU	4011.86	4010.47	1.39	**0.03**	3136.54	3128.27	8.27	**0.26**	875.37	882.22	-6.86	**-0.78**
WHOL	2287.24	2286.93	0.31	**0.01**	1945.10	1946.00	-0.91	**-0.05**	342.14	340.92	1.22	**0.36**
RETL	8863.44	8862.98	0.46	**0.01**	8337.28	8339.68	-2.40	**-0.03**	526.17	523.29	2.87	**0.55**
FIRE	12420.45	12413.38	7.07	**0.06**	7872.52	7850.75	21.77	**0.28**	4548.00	4562.67	-14.67	**-0.32**
OSER	5573.29	5572.72	0.57	**0.01**	4545.18	4556.48	-11.30	**-0.25**	1028.16	1016.26	11.91	**1.17**
BSER	264.58	264.51	0.07	**0.03**	162.42	163.24	-0.82	**-0.50**	102.16	101.27	0.89	**0.88**
HEAL	8623.56	8623.72	-0.16	**0.00**	7849.57	7861.43	-11.86	**-0.15**	774.07	762.32	11.75	**1.54**
EDUC	1125.45	1125.31	0.14	**0.01**	813.90	817.71	-3.81	**-0.47**	311.58	307.61	3.96	**1.29**
SLGV	291.98	291.99	-0.01	**0.00**	291.98	291.99	-0.01	**0.00**	0.00	0.00	0.00	**NA**
FGOV	85.94	85.93	0.01	**0.01**	74.94	75.08	-0.14	**-0.18**	10.99	10.85	0.14	**1.34**
Total	**54858.31**	**54843.24**	**15.07**	**0.03**	**39628.73**	**39605.51**	**23.22**	**0.06**	**15230.08**	**15238.00**	**-7.92**	**-0.05**

Appendix D (Continued)
Sensitivity Analsysis
Simulation 1

DOUBLE THE ELASTICITY OF SUBSTITUTION												
Intermediate Good Demand												
	Total New Run	Total Base Run	Diff	%	Domestic New Run	Domestic Base Run	Diff	%	Imports New Run	Imports Base Run	Diff	%
AGRI	2603.09	2591.22	11.88	0.46	1475.61	1476.03	-0.41	-0.03	1127.50	1115.19	12.31	1.10
MINE	5421.67	5225.55	196.12	3.75	5421.67	5225.55	196.12	3.75	0.00	0.00	0.00	NA
CONS	2060.08	2048.76	11.32	0.55	2060.08	2048.76	11.32	0.55	0.00	0.00	0.00	NA
FOOD	1846.60	1838.19	8.42	0.46	962.06	942.03	20.03	2.13	884.60	896.16	-11.56	-1.29
APPA	563.50	561.19	2.31	0.41	192.34	192.84	-0.49	-0.26	371.16	368.35	2.81	0.76
CRGS	1862.40	1853.54	8.87	0.48	116.31	116.09	0.23	0.19	1746.09	1737.45	8.64	0.50
OMAN	4741.25	4633.38	107.86	2.33	794.35	752.19	42.17	5.61	3947.01	3881.21	65.80	1.70
PRIN	614.12	615.49	-1.37	-0.22	155.57	156.92	-1.35	-0.86	458.55	458.57	-0.02	-0.01
PETR	2744.96	2698.56	46.40	1.72	1041.81	995.80	46.01	4.62	1703.28	1702.76	0.52	0.03
METL	4168.39	4121.04	47.35	1.15	112.59	109.74	2.85	2.60	4055.80	4011.30	44.50	1.11
MACH	6189.38	6164.58	24.80	0.40	3428.51	3422.45	6.06	0.18	2760.86	2742.13	18.73	0.68
TCPU	7255.47	7157.46	98.01	1.37	5672.45	5581.86	90.59	1.62	1583.11	1575.65	7.46	0.47
WHOL	4130.90	4084.95	45.95	1.12	3512.97	3477.25	35.72	1.03	617.92	607.70	10.23	1.68
RETL	877.60	873.39	4.21	0.48	825.50	821.96	3.54	0.43	52.10	51.43	0.67	1.29
FIRE	6881.20	6850.23	30.97	0.45	4361.54	4331.86	29.68	0.69	2519.69	2518.38	1.31	0.05
OSER	5740.35	5713.79	26.56	0.46	4681.43	4675.24	6.19	0.13	1058.98	1038.56	20.43	1.97
BSER	4989.73	4969.35	20.38	0.41	3063.10	3072.02	-8.91	-0.29	1926.71	1897.34	29.37	1.55
HEAL	153.96	155.05	-1.08	-0.70	140.15	141.39	-1.24	-0.88	13.82	13.66	0.16	1.18
EDUC	321.34	318.17	3.17	1.00	232.38	231.54	0.85	0.37	88.96	86.63	2.33	2.69
SLGV	81.07	80.45	0.63	0.78	81.07	80.45	0.63	0.78	0.00	0.00	0.00	NA
FGOV	473.71	473.79	-0.07	-0.02	413.12	414.12	-1.00	-0.24	60.60	59.67	0.93	1.56
Total	63720.78	63028.10	692.68	1.10	38744.64	38266.06	478.57	1.25	24976.75	24762.15	214.60	0.87

DOUBLE THE ELASTICITY OF SUBSTITUTION				
Other Household Data				
Labor Supply			Labor Migration	
New Run	43994.53		New Run	329.08
Base Run	43993.44		Base Run	275.79
Diff	1.09		Diff	53.28
%	0.00		%	19.32
Before Tax Wage			After Tax Wage	
New Run	1.0344		New Run	1.0082
Base Run	1.0330		Base Run	1.0068
Diff	0.0014		Diff	0.0014
%	0.13		%	0.14

Appendix D (Continued)
Sensitivity Analsysis
Simulation 1

DOUBLE THE ELASTICITY OF SUBSTITUTION				
Other Household Data				
Dispoable Income			**Household**	
			Expenditures	
New Run	54544.52		**New Run**	55319.58
Base Run	54430.51		**Base Run**	55201.50
Diff	114.02		**Diff**	118.07
%	**0.21**		**%**	**0.21**
Household Savings				
New Run	-1941.25			
Base Run	-1937.19			
Diff	-4.06			
%	**0.21**			
Disposable Income			**Household Expenditures**	
Adjusted for Migration			**Adjusted for Migration**	
New Run	54139.58		**New Run**	54908.88
Base Run	54091.44		**Base Run**	54857.63
Diff	48.14		**Diff**	51.25
%	**0.09**		**%**	**0.09**
State Personal Income			**Indirect Business**	
Tax Collections			**Tax Collections**	
New Run	1590.91		**New Run**	8212.52
Base Run	1587.59		**Base Run**	8193.07
Diff	3.33		**Diff**	19.45
%	**0.21**		**%**	**0.24**

Appendix D (Continued)
Sensitivity Analsysis
Simulation 1

DOUBLE THE ELASTICITY OF TRANSFORMATION												
Output, Labor Demand and Capital Demand												
					Labor	Labor			Capital	Capital		
	Output	Output			Demand	Demand			Demand	Demand		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
AGRI	4312.85	4406.42	-93.57	**-2.12**	520.89	532.63	-11.74	**-2.20**	365.60	373.08	-7.48	**-2.01**
MINE	11319.64	11050.22	269.42	**2.44**	2257.99	2207.07	50.91	**2.31**	4085.84	3985.67	100.17	**2.51**
CONS	7429.01	7423.16	5.85	**0.08**	2503.27	2501.72	1.55	**0.06**	235.30	234.68	0.62	**0.26**
FOOD	4170.60	4121.29	49.31	**1.20**	479.11	473.79	5.32	**1.12**	277.20	273.57	3.63	**1.33**
APPA	700.93	706.89	-5.96	**-0.84**	157.47	158.87	-1.40	**-0.88**	34.67	34.90	-0.24	**-0.68**
CRGS	1970.43	1995.18	-24.75	**-1.24**	536.73	543.69	-6.97	**-1.28**	144.12	145.69	-1.58	**-1.08**
OMAN	4163.81	4015.22	148.60	**3.70**	875.15	844.57	30.58	**3.62**	566.68	545.78	20.90	**3.83**
PRIN	1097.81	1115.73	-17.91	**-1.61**	333.50	339.07	-5.57	**-1.64**	77.95	79.09	-1.14	**-1.44**
PETR	8383.80	8095.51	288.30	**3.56**	939.10	907.53	31.56	**3.48**	643.04	620.18	22.87	**3.69**
METL	4080.00	4040.41	39.58	**0.98**	1012.47	1003.22	9.25	**0.92**	409.79	405.23	4.56	**1.13**
MACH	11612.16	11677.01	-64.85	**-0.56**	2720.85	2737.17	-16.31	**-0.60**	715.48	718.32	-2.84	**-0.40**
TCPU	13855.21	13738.52	116.69	**0.85**	3376.30	3350.95	25.35	**0.76**	2933.92	2906.02	27.89	**0.96**
WHOL	6810.70	6798.94	11.76	**0.17**	2364.63	2361.55	3.08	**0.13**	658.00	655.83	2.18	**0.33**
RETL	10065.44	10068.28	-2.84	**-0.03**	4273.54	4276.31	-2.77	**-0.06**	978.29	976.95	1.34	**0.14**
FIRE	14959.07	14899.61	59.46	**0.40**	2140.96	2135.74	5.23	**0.24**	7153.86	7122.03	31.83	**0.45**
OSER	10014.99	10029.35	-14.36	**-0.14**	4183.84	4190.87	-7.03	**-0.17**	602.26	602.06	0.20	**0.03**
BSER	3500.39	3513.11	-12.72	**-0.36**	1640.80	1647.19	-6.39	**-0.39**	252.36	252.83	-0.47	**-0.19**
HEAL	8094.53	8109.80	-15.27	**-0.19**	3945.65	3953.52	-7.87	**-0.20**	231.26	231.25	0.01	**0.00**
EDUC	1113.73	1118.61	-4.88	**-0.44**	288.66	289.95	-1.29	**-0.44**	11.28	11.31	-0.03	**-0.24**
SLGV	7201.30	7203.23	-1.93	**-0.03**	5849.12	5851.95	-2.83	**-0.05**	730.22	729.11	1.12	**0.15**
FGOV	5296.31	5307.01	-10.70	**-0.20**	3952.29	3961.88	-9.59	**-0.24**	1032.55	1032.97	-0.42	**-0.04**
Total	**140152.71**	**139433.50**	**719.22**	**0.52**	**44352.32**	**44269.23**	**83.09**	**0.19**	**22139.69**	**21936.57**	**203.11**	**0.93**

DOUBLE THE ELASTICITY OF TRANSFORMATION												
Regional Supply, Exports, and Domestic Price												
									Domestic	Domestic		
	Regional	Regional			Exports	Exports			Price	Price		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
AGRI	1700.81	1713.44	-12.63	**-0.74**	2611.95	2692.95	-81.00	**-3.01**	1.0047	1.0035	0.0012	**0.12**
MINE	5517.65	5379.50	138.15	**2.57**	5801.99	5670.72	131.27	**2.31**	1.0001	0.9994	0.0007	**0.07**
CONS	7318.29	7309.69	8.60	**0.12**	110.70	113.46	-2.76	**-2.43**	1.0071	1.0052	0.0019	**0.19**
FOOD	2889.49	2866.35	23.14	**0.81**	1281.03	1254.88	26.15	**2.08**	0.9944	0.9931	0.0013	**0.13**
APPA	632.50	637.26	-4.76	**-0.75**	68.43	69.63	-1.20	**-1.73**	1.0018	1.0001	0.0017	**0.17**
CRGS	153.96	155.01	-1.05	**-0.68**	1816.47	1840.17	-23.70	**-1.29**	1.0005	0.9989	0.0016	**0.16**
OMAN	1267.88	1236.13	31.75	**2.57**	2895.82	2779.01	116.81	**4.20**	0.9933	0.9921	0.0012	**0.12**
PRIN	268.71	271.28	-2.57	**-0.95**	829.10	844.45	-15.34	**-1.82**	1.0014	0.9998	0.0016	**0.16**
PETR	1521.48	1490.27	31.21	**2.09**	6862.14	6605.12	257.02	**3.89**	0.9928	0.9916	0.0012	**0.12**
METL	125.24	124.40	0.85	**0.68**	3954.75	3916.01	38.74	**0.99**	0.9975	0.9961	0.0015	**0.15**
MACH	7591.41	7616.43	-25.01	**-0.33**	4020.74	4060.58	-39.84	**-0.98**	1.0007	0.9991	0.0016	**0.16**

Appendix D (Continued)
Sensitivity Analsysis
Simulation 1

DOUBLE THE ELASTICITY OF TRANSFORMATION												
Regional Supply, Exports, and Domestic Price												
									Domestic	Domestic		
	Regional	Regional			Exports	Exports			Price	Price		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
TCPU	9470.94	9400.46	70.47	**0.75**	4384.21	4338.02	46.19	**1.06**	0.9945	0.9934	0.0011	**0.11**
WHOL	6291.60	6279.69	11.91	**0.19**	519.10	519.25	-0.15	**-0.03**	1.0015	0.9999	0.0016	**0.16**
RETL	9416.83	9417.78	-0.95	**-0.01**	648.60	650.50	-1.90	**-0.29**	1.0024	1.0007	0.0017	**0.17**
FIRE	12567.40	12521.18	46.22	**0.37**	2391.66	2378.42	13.24	**0.56**	0.9969	0.9964	0.0005	**0.05**
OSER	9915.31	9928.95	-13.64	**-0.14**	99.68	100.40	-0.72	**-0.72**	1.0065	1.0048	0.0017	**0.17**
BSER	3471.50	3483.94	-12.45	**-0.36**	28.89	29.16	-0.27	**-0.92**	1.0064	1.0046	0.0018	**0.17**
HEAL	8021.02	8035.66	-14.64	**-0.18**	73.51	74.14	-0.64	**-0.86**	1.0078	1.0059	0.0019	**0.19**
EDUC	1064.42	1068.75	-4.33	**-0.41**	49.31	49.86	-0.55	**-1.11**	1.0082	1.0062	0.0020	**0.20**
SLGV	6870.64	6870.34	0.30	**0.00**	330.66	332.89	-2.23	**-0.67**	1.0079	1.0061	0.0018	**0.18**
FGOV	4779.38	4786.21	-6.83	**-0.14**	516.90	520.79	-3.89	**-0.75**	1.0071	1.0055	0.0016	**0.16**
Total	**100856.45**	**100592.72**	**263.73**	**0.26**	**39295.64**	**38840.41**	**455.23**	**1.17**				

DOUBLE THE ELASTICITY OF TRANSFORMATION												
Consumption Demand												
	Total	Total			Domestic	Domestic			Import	Import		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
AGRI	375.55	375.48	0.07	**0.02**	212.78	213.51	-0.74	**-0.34**	162.77	161.97	0.81	**0.50**
MINE	1.44	1.44	0.00	**0.06**	1.44	1.44	0.00	**0.06**	0.00	0.00	0.00	**NA**
CONS	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**
FOOD	3583.82	3581.40	2.43	**0.07**	1864.28	1849.23	15.05	**0.81**	1719.64	1732.24	-12.60	**-0.73**
APPA	1251.57	1250.66	0.91	**0.07**	426.05	429.15	-3.10	**-0.72**	825.52	821.51	4.01	**0.49**
CRGS	344.25	343.90	0.35	**0.10**	21.42	21.55	-0.13	**-0.60**	322.83	322.35	0.48	**0.15**
OMAN	2063.10	2061.10	2.00	**0.10**	344.78	338.92	5.85	**1.73**	1718.37	1722.21	-3.84	**-0.22**
PRIN	369.73	369.43	0.30	**0.08**	93.38	94.06	-0.68	**-0.72**	276.36	275.37	0.98	**0.36**
PETR	919.21	918.45	0.76	**0.08**	348.22	343.33	4.89	**1.43**	571.02	575.15	-4.13	**-0.72**
METL	94.99	94.89	0.10	**0.11**	2.56	2.54	0.01	**0.47**	92.44	92.35	0.09	**0.10**
MACH	2309.76	2308.56	1.20	**0.05**	1277.20	1281.13	-3.92	**-0.31**	1032.56	1027.44	5.12	**0.50**
TCPU	4012.65	4010.47	2.18	**0.05**	3136.11	3128.27	7.84	**0.25**	876.58	882.22	-5.65	**-0.64**
WHOL	2287.44	2286.93	0.52	**0.02**	1944.63	1946.00	-1.37	**-0.07**	342.81	340.92	1.89	**0.55**
RETL	8863.85	8862.98	0.87	**0.01**	8336.53	8339.68	-3.15	**-0.04**	527.32	523.29	4.03	**0.77**
FIRE	12424.41	12413.38	11.03	**0.09**	7873.12	7850.75	22.37	**0.28**	4551.35	4562.67	-11.31	**-0.25**
OSER	5573.68	5572.72	0.97	**0.02**	4543.46	4556.48	-13.02	**-0.29**	1030.30	1016.26	14.04	**1.38**
BSER	264.62	264.51	0.11	**0.04**	162.29	163.24	-0.95	**-0.58**	102.33	101.27	1.06	**1.05**
HEAL	8623.62	8623.72	-0.10	**0.00**	7847.77	7861.43	-13.66	**-0.17**	775.94	762.32	13.62	**1.79**
EDUC	1125.54	1125.31	0.23	**0.02**	813.36	817.71	-4.35	**-0.53**	312.21	307.61	4.60	**1.49**
SLGV	291.98	291.99	-0.02	**-0.01**	291.98	291.99	-0.02	**-0.01**	0.00	0.00	0.00	**NA**
FGOV	85.94	85.93	0.01	**0.02**	74.93	75.08	-0.15	**-0.20**	11.02	10.85	0.17	**1.54**
Total	**54867.17**	**54843.24**	**23.92**	**0.04**	**39616.28**	**39605.51**	**10.78**	**0.03**	**15251.38**	**15238.00**	**13.38**	**0.09**

Appendix D (Continued)
Sensitivity Analsysis
Simulation 1

DOUBLE THE ELASTICITY OF TRANSFORMATION												
Intermediate Good Demand												
	Total	Total			Domestic	Domestic			Imports	Imports		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
AGRI	2583.44	2591.22	-7.78	**-0.30**	1463.72	1476.03	-12.30	**-0.83**	1119.74	1115.19	4.55	**0.41**
MINE	5487.10	5225.55	261.55	**5.01**	5487.10	5225.55	261.55	**5.01**	0.00	0.00	0.00	**NA**
CONS	2061.94	2048.76	13.18	**0.64**	2061.94	2048.76	13.18	**0.64**	0.00	0.00	0.00	**NA**
FOOD	1841.41	1838.19	3.22	**0.18**	957.89	942.03	15.86	**1.68**	883.57	896.16	-12.59	**-1.41**
APPA	563.38	561.19	2.19	**0.39**	191.78	192.84	-1.06	**-0.55**	371.60	368.35	3.25	**0.88**
CRGS	1861.00	1853.54	7.46	**0.40**	115.80	116.09	-0.29	**-0.25**	1745.20	1737.45	7.75	**0.45**
OMAN	4767.25	4633.38	133.86	**2.89**	796.68	752.19	44.49	**5.92**	3970.67	3881.21	89.46	**2.30**
PRIN	613.17	615.49	-2.32	**-0.38**	154.86	156.92	-2.06	**-1.31**	458.31	458.57	-0.26	**-0.06**
PETR	2756.17	2698.56	57.62	**2.14**	1044.12	995.80	48.32	**4.85**	1712.17	1702.76	9.41	**0.55**
METL	4170.80	4121.04	49.75	**1.21**	112.27	109.74	2.53	**2.30**	4058.53	4011.30	47.23	**1.18**
MACH	6187.42	6164.58	22.84	**0.37**	3421.38	3422.45	-1.07	**-0.03**	2766.04	2742.13	23.91	**0.87**
TCPU	7279.19	7157.46	121.73	**1.70**	5689.10	5581.86	107.24	**1.92**	1590.17	1575.65	14.52	**0.92**
WHOL	4134.53	4084.95	49.58	**1.21**	3514.90	3477.25	37.65	**1.08**	619.63	607.70	11.93	**1.96**
RETL	878.55	873.39	5.16	**0.59**	826.29	821.96	4.33	**0.53**	52.27	51.43	0.83	**1.62**
FIRE	6885.77	6850.23	35.54	**0.52**	4363.38	4331.86	31.52	**0.73**	2522.42	2518.38	4.03	**0.16**
OSER	5747.23	5713.79	33.44	**0.59**	4684.93	4675.24	9.69	**0.21**	1062.38	1038.56	23.82	**2.29**
BSER	4994.86	4969.35	25.50	**0.51**	3063.37	3072.02	-8.64	**-0.28**	1931.58	1897.34	34.24	**1.80**
HEAL	153.54	155.05	-1.51	**-0.97**	139.72	141.39	-1.66	**-1.18**	13.81	13.66	0.16	**1.14**
EDUC	322.16	318.17	4.00	**1.26**	232.81	231.54	1.27	**0.55**	89.36	86.63	2.73	**3.16**
SLGV	81.15	80.45	0.71	**0.88**	81.15	80.45	0.71	**0.88**	0.00	0.00	0.00	**NA**
FGOV	473.84	473.79	0.06	**0.01**	413.11	414.12	-1.01	**-0.24**	60.73	59.67	1.06	**1.78**
Total	**63843.88**	**63028.10**	**815.78**	**1.29**	**38816.30**	**38266.06**	**550.23**	**1.44**	**25028.18**	**24762.15**	**266.03**	**1.07**

DOUBLE THE ELASTICITY OF TRANSFORMATION				
Other Household Data				
Labor Supply			**Labor Migration**	
New Run	43994.96		**New Run**	357.37
Base Run	43993.44		**Base Run**	275.79
Diff	1.52		**Diff**	81.57
%	**0.00**		%	**29.58**
Before Tax Wage			**After Tax Wage**	
New Run	1.0351		**New Run**	1.0089
Base Run	1.0330		**Base Run**	1.0068
Diff	0.0021		**Diff**	0.0021
%	**0.20**		%	**0.20**

Appendix D (Continued)
Sensitivity Analsysis
Simulation 1

DOUBLE THE ELASTICITY OF TRANSFORMATION				
Other Household Data				
Dispoable Income			**Household Expenditures**	
New Run	54606.19		**New Run**	55383.44
Base Run	54430.51		**Base Run**	55201.50
Diff	175.69		**Diff**	181.94
%	**0.32**		%	**0.33**
Household Savings				
New Run	-1943.44			
Base Run	-1937.19			
Diff	-6.25			
%	**0.32**			
Disposable Income Adjusted for Migration			**Household Expenditures Adjusted for Migration**	
New Run	54166.23		**New Run**	54937.21
Base Run	54091.44		**Base Run**	54857.63
Diff	74.79		**Diff**	79.58
%	**0.14**		%	**0.15**
State Personal Income Tax Collections			**Indirect Business Tax Collections**	
New Run	1592.71		**New Run**	8225.11
Base Run	1587.59		**Base Run**	8193.07
Diff	5.12		**Diff**	32.04
%	**0.32**		%	**0.39**

Appendix D (Continued)
Sensitivity Analsysis
Simulation 1

DOUBLE THE LABOR MIGRATION ELASTICITY												
Output, Labor Demand and Capital Demand												
	Output New Run	Output Base Run	Diff	%	Labor Demand New Run	Labor Demand Base Run	Diff	%	Capital Demand New Run	Capital Demand Base Run	Diff	%
AGRI	4441.99	4406.42	35.57	**0.81**	537.01	532.63	4.38	**0.82**	376.00	373.08	2.93	**0.78**
MINE	11323.31	11050.22	273.09	**2.47**	2262.17	2207.07	55.10	**2.50**	4083.60	3985.67	97.93	**2.46**
CONS	7438.89	7423.16	15.73	**0.21**	2507.10	2501.72	5.38	**0.22**	235.10	234.68	0.41	**0.18**
FOOD	4182.34	4121.29	61.05	**1.48**	480.87	473.79	7.08	**1.50**	277.55	273.57	3.98	**1.46**
APPA	709.32	706.89	2.43	**0.34**	159.42	158.87	0.56	**0.35**	35.01	34.90	0.11	**0.31**
CRGS	2020.12	1995.18	24.94	**1.25**	550.53	543.69	6.84	**1.26**	147.47	145.69	1.78	**1.22**
OMAN	4164.44	4015.22	149.23	**3.72**	876.09	844.57	31.52	**3.73**	565.93	545.78	20.15	**3.69**
PRIN	1121.59	1115.73	5.86	**0.53**	340.87	339.07	1.81	**0.53**	79.48	79.09	0.39	**0.49**
PETR	8341.03	8095.51	245.52	**3.03**	935.20	907.53	27.67	**3.05**	638.84	620.18	18.66	**3.01**
METL	4161.41	4040.41	121.00	**2.99**	1033.37	1003.22	30.15	**3.01**	417.25	405.23	12.02	**2.97**
MACH	11753.00	11677.01	75.99	**0.65**	2755.19	2737.17	18.03	**0.66**	722.77	718.32	4.45	**0.62**
TCPU	13883.14	13738.52	144.61	**1.05**	3386.82	3350.95	35.87	**1.07**	2936.00	2906.02	29.97	**1.03**
WHOL	6846.72	6798.94	47.78	**0.70**	2378.35	2361.55	16.79	**0.71**	660.23	655.83	4.41	**0.67**
RETL	10064.81	10068.28	-3.48	**-0.03**	4275.13	4276.31	-1.18	**-0.03**	976.30	976.95	-0.65	**-0.07**
FIRE	14966.92	14899.61	67.31	**0.45**	2146.02	2135.74	10.28	**0.48**	7153.55	7122.03	31.52	**0.44**
OSER	10042.25	10029.35	12.90	**0.13**	4196.46	4190.87	5.59	**0.13**	602.63	602.06	0.57	**0.09**
BSER	3522.75	3513.11	9.64	**0.27**	1651.79	1647.19	4.60	**0.28**	253.44	252.83	0.61	**0.24**
HEAL	8094.79	8109.80	-15.01	**-0.19**	3946.28	3953.52	-7.24	**-0.18**	230.74	231.25	-0.51	**-0.22**
EDUC	1117.14	1118.61	-1.47	**-0.13**	289.57	289.95	-0.38	**-0.13**	11.29	11.31	-0.02	**-0.17**
SLGV	7203.84	7203.23	0.61	**0.01**	5852.69	5851.95	0.74	**0.01**	728.92	729.11	-0.19	**-0.03**
FGOV	5304.24	5307.01	-2.77	**-0.05**	3960.12	3961.88	-1.76	**-0.04**	1032.12	1032.97	-0.86	**-0.08**
Total	**140704.03**	**139433.50**	**1270.53**	**0.91**	**44521.07**	**44269.23**	**251.84**	**0.57**	**22164.24**	**21936.57**	**227.67**	**1.04**

DOUBLE THE LABOR MIGRATION ELASTICITY												
Regional Supply, Exports, and Domestic Price												
	Regional New Run	Regional Base Run	Diff	%	Exports New Run	Exports Base Run	Diff	%	Domestic Price New Run	Domestic Price Base Run	Diff	%
AGRI	1726.33	1713.44	12.89	**0.75**	2715.64	2692.95	22.69	**0.84**	1.0033	1.0035	-0.0002	**-0.02**
MINE	5511.30	5379.50	131.79	**2.45**	5812.01	5670.72	141.29	**2.49**	0.9992	0.9994	-0.0002	**-0.02**
CONS	7325.07	7309.69	15.38	**0.21**	113.82	113.46	0.36	**0.31**	1.0049	1.0052	-0.0003	**-0.03**
FOOD	2908.17	2866.35	41.82	**1.46**	1274.10	1254.88	19.22	**1.53**	0.9929	0.9931	-0.0002	**-0.02**
APPA	639.39	637.26	2.13	**0.33**	69.93	69.63	0.30	**0.43**	0.9998	1.0001	-0.0003	**-0.03**
CRGS	156.82	155.01	1.81	**1.17**	1863.30	1840.17	23.13	**1.26**	0.9986	0.9989	-0.0003	**-0.03**
OMAN	1281.46	1236.13	45.33	**3.67**	2882.90	2779.01	103.89	**3.74**	0.9919	0.9921	-0.0002	**-0.02**
PRIN	272.52	271.28	1.24	**0.46**	849.07	844.45	4.62	**0.55**	0.9994	0.9998	-0.0004	**-0.04**
PETR	1534.62	1490.27	44.35	**2.98**	6806.27	6605.12	201.16	**3.05**	0.9914	0.9916	-0.0002	**-0.02**
METL	128.02	124.40	3.63	**2.91**	4033.39	3916.01	117.37	**3.00**	0.9958	0.9961	-0.0002	**-0.03**
MACH	7663.62	7616.43	47.19	**0.62**	4089.38	4060.58	28.80	**0.71**	0.9987	0.9991	-0.0004	**-0.04**

Appendix D (Continued)
Sensitivity Analsysis
Simulation 1

DOUBLE THE LABOR MIGRATION ELASTICITY

Regional Supply, Exports, and Domestic Price

	Regional New Run	Regional Base Run	Diff	%	Exports New Run	Exports Base Run	Diff	%	Domestic Price New Run	Domestic Price Base Run	Diff	%
TCPU	9498.97	9400.46	98.51	1.05	4384.12	4338.02	46.10	1.06	0.9932	0.9934	-0.0002	-0.02
WHOL	6323.72	6279.69	44.03	0.70	523.00	519.25	3.75	0.72	0.9996	0.9999	-0.0003	-0.03
RETL	9414.40	9417.78	-3.39	-0.04	650.41	650.50	-0.09	-0.01	1.0004	1.0007	-0.0003	-0.03
FIRE	12577.61	12521.18	56.43	0.45	2389.29	2378.42	10.87	0.46	0.9963	0.9964	-0.0001	-0.01
OSER	9941.69	9928.95	12.75	0.13	100.55	100.40	0.15	0.15	1.0044	1.0048	-0.0004	-0.04
BSER	3493.50	3483.94	9.55	0.27	29.25	29.16	0.09	0.30	1.0043	1.0046	-0.0003	-0.03
HEAL	8020.77	8035.66	-14.89	-0.19	74.02	74.14	-0.12	-0.16	1.0056	1.0059	-0.0003	-0.03
EDUC	1067.33	1068.75	-1.42	-0.13	49.81	49.86	-0.05	-0.11	1.0058	1.0062	-0.0004	-0.04
SLGV	6870.85	6870.34	0.51	0.01	332.99	332.89	0.10	0.03	1.0058	1.0061	-0.0003	-0.03
FGOV	4783.62	4786.21	-2.60	-0.05	520.62	520.79	-0.17	-0.03	1.0051	1.0055	-0.0004	-0.04
Total	101139.76	100592.72	547.04	0.54	39563.87	38840.41	723.46	1.86				

DOUBLE THE LABOR MIGRATION ELASTICITY

Consumption Demand

	Total New Run	Total Base Run	Diff	%	Domestic New Run	Domestic Base Run	Diff	%	Import New Run	Import Base Run	Diff	%
AGRI	375.37	375.48	-0.12	-0.03	213.05	213.51	-0.47	-0.22	162.32	161.97	0.35	0.22
MINE	1.44	1.44	0.00	-0.09	1.44	1.44	0.00	-0.09	0.00	0.00	0.00	NA
CONS	0.00	0.00	0.00	NA	0.00	0.00	0.00	NA	0.00	0.00	0.00	NA
FOOD	3577.59	3581.40	-3.80	-0.11	1870.84	1849.23	21.60	1.17	1706.92	1732.24	-25.32	-1.46
APPA	1249.28	1250.66	-1.38	-0.11	429.22	429.15	0.07	0.02	820.06	821.51	-1.45	-0.18
CRGS	343.50	343.90	-0.40	-0.12	21.65	21.55	0.10	0.45	321.85	322.35	-0.49	-0.15
OMAN	2058.78	2061.10	-2.32	-0.11	347.07	338.92	8.15	2.40	1711.78	1722.21	-10.43	-0.61
PRIN	369.02	369.43	-0.41	-0.11	94.17	94.06	0.11	0.12	274.85	275.37	-0.53	-0.19
PETR	917.46	918.45	-0.99	-0.11	349.79	343.33	6.46	1.88	567.73	575.15	-7.42	-1.29
METL	94.78	94.89	-0.11	-0.12	2.58	2.54	0.04	1.45	92.20	92.35	-0.15	-0.16
MACH	2306.11	2308.56	-2.45	-0.11	1282.93	1281.13	1.80	0.14	1023.19	1027.44	-4.25	-0.41
TCPU	4006.26	4010.47	-4.21	-0.10	3134.70	3128.27	6.43	0.21	871.62	882.22	-10.60	-1.20
WHOL	2284.65	2286.93	-2.28	-0.10	1944.45	1946.00	-1.55	-0.08	340.19	340.92	-0.73	-0.21
RETL	8854.35	8862.98	-8.63	-0.10	8331.47	8339.68	-8.21	-0.10	522.88	523.29	-0.42	-0.08
FIRE	12399.47	12413.38	-13.91	-0.11	7863.86	7850.75	13.11	0.17	4535.69	4562.67	-26.98	-0.59
OSER	5567.25	5572.72	-5.47	-0.10	4545.23	4556.48	-11.25	-0.25	1022.05	1016.26	5.79	0.57
BSER	264.24	264.51	-0.27	-0.10	162.58	163.24	-0.66	-0.41	101.66	101.27	0.39	0.39
HEAL	8615.56	8623.72	-8.16	-0.09	7846.78	7861.43	-14.65	-0.19	768.83	762.32	6.50	0.85
EDUC	1124.21	1125.31	-1.10	-0.10	814.47	817.71	-3.24	-0.40	309.76	307.61	2.14	0.70
SLGV	291.72	291.99	-0.28	-0.09	291.72	291.99	-0.28	-0.09	0.00	0.00	0.00	NA
FGOV	85.84	85.93	-0.08	-0.10	74.92	75.08	-0.17	-0.22	10.93	10.85	0.08	0.75
Total	54786.88	54843.24	-56.37	-0.10	39622.90	39605.51	17.40	0.04	15164.50	15238.00	-73.49	-0.48

Appendix D (Continued)
Sensitivity Analsysis
Simulation 1

DOUBLE THE LABOR MIGRATION ELASTICITY												
Intermediate Good Demand												
	Total	Total			Domestic	Domestic			Imports	Imports		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
AGRI	2623.19	2591.22	31.97	**1.23**	1488.85	1476.03	12.83	**0.87**	1134.35	1115.19	19.15	**1.72**
MINE	5480.75	5225.55	255.20	**4.88**	5480.75	5225.55	255.20	**4.88**	0.00	0.00	0.00	**NA**
CONS	2068.71	2048.76	19.95	**0.97**	2068.71	2048.76	19.95	**0.97**	0.00	0.00	0.00	**NA**
FOOD	1854.44	1838.19	16.25	**0.88**	969.74	942.03	27.71	**2.94**	884.78	896.16	-11.38	**-1.27**
APPA	568.60	561.19	7.41	**1.32**	195.36	192.84	2.52	**1.31**	373.25	368.35	4.89	**1.33**
CRGS	1875.98	1853.54	22.44	**1.21**	118.22	116.09	2.13	**1.84**	1757.76	1737.45	20.31	**1.17**
OMAN	4786.43	4633.38	153.04	**3.30**	806.90	752.19	54.72	**7.27**	3979.68	3881.21	98.47	**2.54**
PRIN	617.81	615.49	2.32	**0.38**	157.66	156.92	0.74	**0.47**	460.15	458.57	1.58	**0.34**
PETR	2766.91	2698.56	68.35	**2.53**	1054.90	995.80	59.09	**5.93**	1712.18	1702.76	9.42	**0.55**
METL	4218.16	4121.04	97.12	**2.36**	114.90	109.74	5.16	**4.70**	4103.26	4011.30	91.96	**2.29**
MACH	6238.02	6164.58	73.44	**1.19**	3470.31	3422.45	47.86	**1.40**	2767.72	2742.13	25.59	**0.93**
TCPU	7307.62	7157.46	150.17	**2.10**	5717.86	5581.86	136.00	**2.44**	1589.88	1575.65	14.24	**0.90**
WHOL	4166.70	4084.95	81.75	**2.00**	3546.26	3477.25	69.00	**1.98**	620.44	607.70	12.75	**2.10**
RETL	880.80	873.39	7.41	**0.85**	828.78	821.96	6.83	**0.83**	52.01	51.43	0.58	**1.13**
FIRE	6910.35	6850.23	60.12	**0.88**	4382.61	4331.86	50.74	**1.17**	2527.78	2518.38	9.40	**0.37**
OSER	5767.10	5713.79	53.31	**0.93**	4708.39	4675.24	33.15	**0.71**	1058.74	1038.56	20.18	**1.94**
BSER	5012.73	4969.35	43.38	**0.87**	3084.23	3072.02	12.22	**0.40**	1928.54	1897.34	31.20	**1.64**
HEAL	154.14	155.05	-0.91	**-0.59**	140.38	141.39	-1.00	**-0.71**	13.75	13.66	0.10	**0.70**
EDUC	323.75	318.17	5.58	**1.75**	234.55	231.54	3.01	**1.30**	89.20	86.63	2.57	**2.97**
SLGV	81.61	80.45	1.16	**1.45**	81.61	80.45	1.16	**1.45**	0.00	0.00	0.00	**NA**
FGOV	475.10	473.79	1.32	**0.28**	414.62	414.12	0.50	**0.12**	60.49	59.67	0.82	**1.38**
Total	**64178.88**	**63028.10**	**1150.78**	**1.83**	**39065.59**	**38266.06**	**799.52**	**2.09**	**25113.98**	**24762.15**	**351.83**	**1.42**

DOUBLE THE LABOR MIGRATION ELASTICITY				
Other Household Data				
Labor Supply			**Labor Migration**	
New Run	44000.67		**New Run**	520.40
Base Run	43993.44		**Base Run**	275.79
Diff	7.23		**Diff**	244.60
%	**0.02**		**%**	**88.69**
Before Tax Wage			**After Tax Wage**	
New Run	1.0326		**New Run**	1.0064
Base Run	1.0330		**Base Run**	1.0068
Diff	-0.0004		**Diff**	-0.0004
%	**-0.04**		**%**	**-0.04**

Appendix D (Continued)
Sensitivity Analsysis
Simulation 1

DOUBLE THE LABOR MIGRATION ELASTICITY				
Other Household Data				
Dispoable Income			**Household**	
			Expenditures	
New Run	54658.93		**New Run**	55438.06
Base Run	54430.51		**Base Run**	55201.50
Diff	228.43		**Diff**	236.56
%	**0.42**		%	**0.43**
Household Savings				
New Run	-1945.32			
Base Run	-1937.19			
Diff	-8.13			
%	**0.42**			
Disposable Income			**Household Expenditures**	
Adjusted for Migration			**Adjusted for Migration**	
New Run	54019.98		**New Run**	54790.00
Base Run	54091.44		**Base Run**	54857.63
Diff	-71.46		**Diff**	-67.63
%	**-0.13**		%	**-0.12**
State Personal Income			**Indirect Business**	
Tax Collections			**Tax Collections**	
New Run	1594.25		**New Run**	8240.17
Base Run	1587.59		**Base Run**	8193.07
Diff	6.66		**Diff**	47.11
%	**0.42**		%	**0.57**

Appendix E
Sensitivity Analsysis
Simulation 2

DOUBLE THE ELASTICITY OF SUBSTITUTION												
Output, Labor Demand and Capital Demand												
					Labor	Labor			Capital	Capital		
	Output	Output			Demand	Demand			Demand	Demand		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
AGRI	4414.35	4414.15	0.20	**0.00**	535.39	535.39	0.01	**0.00**	371.89	371.85	0.04	**0.01**
MINE	10571.40	10569.79	1.61	**0.02**	2127.54	2127.33	0.21	**0.01**	3796.44	3795.74	0.70	**0.02**
CONS	7398.79	7398.58	0.21	**0.00**	2497.59	2497.54	0.05	**0.00**	229.74	229.71	0.02	**0.01**
FOOD	4024.32	4023.58	0.75	**0.02**	469.08	469.01	0.07	**0.02**	260.60	260.54	0.06	**0.02**
APPA	703.69	703.39	0.29	**0.04**	159.22	159.16	0.06	**0.04**	33.66	33.64	0.02	**0.05**
CRGS	1968.85	1968.02	0.82	**0.04**	540.80	540.58	0.22	**0.04**	139.43	139.37	0.07	**0.05**
OMAN	3792.09	3790.72	1.37	**0.04**	809.57	809.31	0.26	**0.03**	503.36	503.15	0.21	**0.04**
PRIN	1110.61	1110.24	0.37	**0.03**	339.92	339.81	0.11	**0.03**	76.29	76.26	0.03	**0.04**
PETR	7663.45	7661.59	1.86	**0.02**	872.39	872.21	0.18	**0.02**	573.60	573.43	0.17	**0.03**
METL	3876.24	3874.22	2.02	**0.05**	972.95	972.46	0.48	**0.05**	378.13	377.91	0.22	**0.06**
MACH	11587.36	11584.52	2.84	**0.02**	2737.46	2736.84	0.62	**0.02**	691.21	690.99	0.22	**0.03**
TCPU	13482.00	13480.19	1.80	**0.01**	3333.36	3333.05	0.31	**0.01**	2805.98	2805.47	0.51	**0.02**
WHOL	6724.02	6723.04	0.98	**0.01**	2351.78	2351.48	0.30	**0.01**	632.09	631.95	0.14	**0.02**
RETL	10043.47	10043.38	0.09	**0.00**	4292.04	4292.07	-0.03	**0.00**	947.87	947.79	0.08	**0.01**
FIRE	14757.32	14756.19	1.13	**0.01**	2137.95	2137.93	0.02	**0.00**	7030.82	7030.14	0.68	**0.01**
OSER	9993.77	9992.66	1.11	**0.01**	4184.74	4184.32	0.42	**0.01**	590.97	590.86	0.11	**0.02**
BSER	3491.50	3490.66	0.83	**0.02**	1640.69	1640.31	0.37	**0.02**	247.56	247.48	0.08	**0.03**
HEAL	8127.12	8127.04	0.08	**0.00**	3965.60	3965.58	0.02	**0.00**	228.02	228.00	0.02	**0.01**
EDUC	1118.85	1118.71	0.14	**0.01**	290.19	290.16	0.03	**0.01**	11.13	11.13	0.00	**0.02**
SLGV	7203.88	7203.89	-0.01	**0.00**	5856.94	5857.00	-0.06	**0.00**	724.58	724.53	0.05	**0.01**
FGOV	5311.33	5311.18	0.15	**0.00**	3970.77	3970.73	0.04	**0.00**	1027.99	1027.89	0.10	**0.01**
Total	**137364.39**	**137345.76**	**18.63**	**0.01**	**44085.98**	**44082.27**	**3.71**	**0.01**	**21301.35**	**21297.84**	**3.52**	**0.02**

DOUBLE THE ELASTICITY OF SUBSTITUTION												
Regional Supply, Exports, and Domestic Price												
									Domestic	Domestic		
	Regional	Regional			Exports	Exports			Price	Price		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
AGRI	1701.47	1701.18	0.29	**0.02**	2712.88	2712.97	-0.09	**0.00**	0.9998	0.9998	0.0000	**0.00**
MINE	5150.37	5149.35	1.02	**0.02**	5421.03	5420.45	0.58	**0.01**	0.9999	0.9999	0.0000	**0.00**
CONS	7283.93	7283.70	0.23	**0.00**	114.86	114.88	-0.02	**-0.02**	0.9998	0.9997	0.0001	**0.01**
FOOD	2815.58	2814.92	0.66	**0.02**	1208.74	1208.65	0.09	**0.01**	0.9998	0.9998	0.0000	**0.00**
APPA	634.31	634.04	0.28	**0.04**	69.37	69.36	0.02	**0.02**	0.9998	0.9997	0.0001	**0.01**
CRGS	153.32	153.23	0.09	**0.06**	1815.52	1814.79	0.73	**0.04**	0.9998	0.9997	0.0001	**0.01**
OMAN	1185.75	1185.19	0.55	**0.05**	2606.34	2605.53	0.81	**0.03**	0.9998	0.9998	0.0000	**0.00**
PRIN	270.05	269.92	0.13	**0.05**	840.55	840.31	0.24	**0.03**	0.9998	0.9997	0.0001	**0.01**
PETR	1438.61	1438.09	0.53	**0.04**	6224.84	6223.50	1.34	**0.02**	0.9998	0.9998	0.0000	**0.00**
METL	120.61	120.53	0.08	**0.07**	3755.63	3753.69	1.94	**0.05**	0.9998	0.9997	0.0001	**0.01**
MACH	7563.58	7561.20	2.38	**0.03**	4023.78	4023.32	0.46	**0.01**	0.9998	0.9997	0.0001	**0.01**
TCPU	9238.23	9236.90	1.33	**0.01**	4243.77	4243.30	0.47	**0.01**	0.9999	0.9998	0.0001	**0.01**
WHOL	6210.45	6209.52	0.93	**0.01**	513.57	513.52	0.05	**0.01**	0.9998	0.9997	0.0001	**0.01**

Appendix E (Continued)
Sensitivity Analsysis
Simulation 2

DOUBLE THE ELASTICITY OF SUBSTITUTION												
Regional Supply, Exports, and Domestic Price												
	Regional New Run	Regional Base Run	Diff	%	Exports New Run	Exports Base Run	Diff	%	Domestic Price New Run	Domestic Price Base Run	Diff	%
RETL	9394.18	9394.06	0.11	**0.00**	649.30	649.32	-0.02	**0.00**	0.9998	0.9997	0.0001	**0.01**
FIRE	12406.54	12405.56	0.98	**0.01**	2350.79	2350.64	0.15	**0.01**	0.9999	0.9999	0.0000	**0.00**
OSER	9893.38	9892.28	1.10	**0.01**	100.39	100.38	0.01	**0.01**	0.9998	0.9997	0.0001	**0.01**
BSER	3462.41	3461.59	0.83	**0.02**	29.08	29.08	0.01	**0.02**	0.9998	0.9997	0.0001	**0.01**
HEAL	8052.50	8052.42	0.08	**0.00**	74.62	74.62	0.00	**0.00**	0.9998	0.9997	0.0001	**0.01**
EDUC	1068.76	1068.62	0.13	**0.01**	50.09	50.09	0.00	**0.01**	0.9997	0.9997	0.0000	**0.00**
SLGV	6869.56	6869.55	0.01	**0.00**	334.33	334.34	-0.02	**-0.01**	0.9998	0.9997	0.0001	**0.01**
FGOV	4788.25	4788.10	0.16	**0.00**	523.08	523.09	-0.01	**0.00**	0.9998	0.9997	0.0001	**0.01**
Total	**99701.83**	**99689.93**	**11.90**	**0.01**	**37662.56**	**37655.83**	**6.73**	**0.02**				

DOUBLE THE ELASTICITY OF SUBSTITUTION												
Consumption Demand												
	Total New Run	Total Base Run	Diff	%	Domestic New Run	Domestic Base Run	Diff	%	Import New Run	Import Base Run	Diff	%
AGRI	375.35	375.34	0.00	**0.00**	213.94	213.93	0.01	**0.01**	161.41	161.42	-0.01	**-0.01**
MINE	1.43	1.43	0.00	**0.00**	1.43	1.43	0.00	**0.00**	0.00	0.00	0.00	**NA**
CONS	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**
FOOD	3564.21	3564.17	0.03	**0.00**	1819.50	1819.12	0.38	**0.02**	1744.70	1745.05	-0.34	**-0.02**
APPA	1247.50	1247.48	0.01	**0.00**	428.60	428.45	0.15	**0.04**	818.90	819.04	-0.14	**-0.02**
CRGS	342.99	342.98	0.01	**0.00**	21.45	21.44	0.01	**0.05**	321.55	321.55	0.00	**0.00**
OMAN	2054.09	2054.05	0.04	**0.00**	330.21	330.10	0.11	**0.03**	1723.88	1723.95	-0.07	**0.00**
PRIN	368.47	368.47	0.01	**0.00**	93.86	93.82	0.04	**0.04**	274.61	274.64	-0.03	**-0.01**
PETR	914.27	914.26	0.01	**0.00**	335.61	335.52	0.09	**0.03**	578.67	578.74	-0.07	**-0.01**
METL	94.64	94.64	0.00	**0.00**	2.51	2.51	0.00	**0.05**	92.13	92.13	0.00	**0.00**
MACH	2301.97	2301.97	0.01	**0.00**	1276.40	1276.11	0.29	**0.02**	1025.57	1025.85	-0.28	**-0.03**
TCPU	3987.40	3987.39	0.02	**0.00**	3101.52	3101.37	0.15	**0.00**	885.89	886.02	-0.13	**-0.01**
WHOL	2281.22	2281.24	-0.02	**0.00**	1941.35	1941.29	0.06	**0.00**	339.87	339.95	-0.08	**-0.02**
RETL	8845.10	8845.23	-0.13	**0.00**	8323.99	8323.97	0.02	**0.00**	521.10	521.26	-0.15	**-0.03**
FIRE	12363.97	12363.74	0.23	**0.00**	7799.38	7799.00	0.39	**0.00**	4564.59	4564.74	-0.16	**0.00**
OSER	5572.65	5572.71	-0.07	**0.00**	4565.05	4564.85	0.20	**0.00**	1007.60	1007.87	-0.27	**-0.03**
BSER	264.33	264.33	0.00	**0.00**	163.77	163.75	0.02	**0.01**	100.56	100.58	-0.02	**-0.02**
HEAL	8631.94	8632.11	-0.17	**0.00**	7877.77	7877.69	0.07	**0.00**	754.18	754.42	-0.25	**-0.03**
EDUC	1125.73	1125.74	-0.01	**0.00**	821.00	820.93	0.07	**0.01**	304.73	304.81	-0.08	**-0.03**
SLGV	292.40	292.41	-0.01	**0.00**	292.40	292.41	-0.01	**0.00**	0.00	0.00	0.00	**NA**
FGOV	85.99	85.99	0.00	**0.00**	75.24	75.24	0.00	**0.00**	10.74	10.75	0.00	**-0.03**
Total	**54715.65**	**54715.69**	**-0.04**	**0.00**	**39484.97**	**39482.92**	**2.05**	**0.01**	**15230.68**	**15232.77**	**-2.09**	**-0.01**

Appendix E (Continued)
Sensitivity Analsysis
Simulation 2

DOUBLE THE ELASTICITY OF SUBSTITUTION												
Intermediate Good Demand												
	Total New Run	Total Base Run	Diff	%	Domestic New Run	Domestic Base Run	Diff	%	Imports New Run	Imports Base Run	Diff	%
AGRI	2566.68	2566.37	0.31	**0.01**	1462.96	1462.69	0.27	**0.02**	1103.72	1103.68	0.04	**0.00**
MINE	5119.82	5118.80	1.02	**0.02**	5119.82	5118.80	1.02	**0.02**	0.00	0.00	0.00	**NA**
CONS	2027.56	2027.33	0.23	**0.01**	2027.56	2027.33	0.23	**0.01**	0.00	0.00	0.00	**NA**
FOOD	1821.35	1821.19	0.16	**0.01**	929.79	929.52	0.27	**0.03**	891.56	891.67	-0.10	**-0.01**
APPA	555.67	555.50	0.17	**0.03**	190.91	190.79	0.12	**0.06**	364.76	364.72	0.04	**0.01**
CRGS	1840.03	1839.72	0.31	**0.02**	115.05	114.98	0.07	**0.06**	1724.98	1724.74	0.24	**0.01**
OMAN	4563.67	4562.67	1.00	**0.02**	733.64	733.25	0.40	**0.05**	3830.02	3829.42	0.60	**0.02**
PRIN	610.63	610.52	0.11	**0.02**	155.54	155.46	0.09	**0.06**	455.09	455.07	0.02	**0.00**
PETR	2663.01	2662.54	0.48	**0.02**	977.53	977.12	0.41	**0.04**	1685.49	1685.42	0.07	**0.00**
METL	4071.37	4070.22	1.16	**0.03**	107.85	107.77	0.08	**0.07**	3963.52	3962.44	1.08	**0.03**
MACH	6107.26	6106.03	1.23	**0.02**	3386.36	3384.92	1.44	**0.04**	2720.90	2721.11	-0.21	**-0.01**
TCPU	7063.09	7061.90	1.19	**0.02**	5493.87	5492.71	1.16	**0.02**	1569.22	1569.19	0.03	**0.00**
WHOL	4037.72	4036.91	0.81	**0.02**	3436.16	3435.33	0.83	**0.02**	601.56	601.58	-0.02	**0.00**
RETL	867.09	867.01	0.08	**0.01**	816.01	815.91	0.09	**0.01**	51.08	51.09	-0.01	**-0.02**
FIRE	6781.13	6780.42	0.71	**0.01**	4277.64	4277.06	0.58	**0.01**	2503.49	2503.36	0.13	**0.01**
OSER	5661.52	5660.79	0.73	**0.01**	4637.86	4636.99	0.86	**0.02**	1023.67	1023.80	-0.13	**-0.01**
BSER	4923.25	4922.57	0.68	**0.01**	3050.20	3049.42	0.78	**0.03**	1873.04	1873.14	-0.10	**-0.01**
HEAL	154.52	154.51	0.00	**0.00**	141.02	141.01	0.01	**0.00**	13.50	13.50	0.00	**-0.03**
EDUC	314.41	314.35	0.06	**0.02**	229.30	229.24	0.06	**0.03**	85.11	85.12	-0.01	**-0.01**
SLGV	79.64	79.62	0.01	**0.02**	79.64	79.62	0.01	**0.02**	0.00	0.00	0.00	**NA**
FGOV	470.18	470.13	0.05	**0.01**	411.42	411.37	0.06	**0.01**	58.75	58.76	-0.01	**-0.01**
Total	**62299.59**	**62289.09**	**10.50**	**0.02**	**37780.13**	**37771.29**	**8.85**	**0.02**	**24519.46**	**24517.81**	**1.65**	**0.01**

DOUBLE THE ELASTICITY OF SUBSTITUTION				
Other Household Data				
Labor Supply			Labor Migration	
New Run	43991.55		New Run	94.43
Base Run	43991.33		Base Run	90.94
Diff	0.22		Diff	3.50
%	**0.00**		%	**3.85**
Before Tax Wage			After Tax Wage	
New Run	1.0257		New Run	1.0023
Base Run	1.0256		Base Run	1.0022
Diff	0.0001		Diff	0.0001
%	**0.01**		%	**0.01**

Appendix E (Continued)
Sensitivity Analsysis
Simulation 2

DOUBLE THE ELASTICITY OF SUBSTITUTION				
Other Household Data				
Dispoable Income			Household	
			Expenditures	
New Run	54073.07		New Run	54825.75
Base Run	54066.59		Base Run	54819.04
Diff	6.48		Diff	6.71
%	**0.01**		%	**0.01**
Household Savings				
New Run	-1918.87			
Base Run	-1918.64			
Diff	-0.23			
%	**0.01**			
Disposable Income			Household Expenditures	
Adjusted for Migration			Adjusted for Migration	
New Run	53957.26		New Run	54708.32
Base Run	53955.07		Base Run	54705.97
Diff	2.19		Diff	2.36
%	**0.00**		%	**0.00**
State Personal Income			Corporate Income	
Tax Collections			Tax Collections	
New Run	1415.32		New Run	272.71
Base Run	1415.15		Base Run	272.65
Diff	0.17		Diff	0.06
%	**0.01**		%	**0.02**
Indirect Business				
Tax Collection				
New Run	8104.19			
Base Run	8103.46			
Diff	0.73			
%	**0.01**			

Appendix E (Continued)
Sensitivity Analsysis
Simulation 2

DOUBLE THE ELASTICITY OF TRANSFORMATION

Output, Labor Demand and Capital Demand

	Output New Run	Output Base Run	Diff	%	Labor Demand New Run	Labor Demand Base Run	Diff	%	Capital Demand New Run	Capital Demand Base Run	Diff	%
AGRI	4416.48	4414.15	2.33	0.05	535.66	535.39	0.27	0.05	372.06	371.85	0.21	0.06
MINE	10574.42	10569.79	4.62	0.04	2128.16	2127.33	0.83	0.04	3797.50	3795.74	1.76	0.05
CONS	7398.87	7398.58	0.29	0.00	2497.62	2497.54	0.08	0.00	229.74	229.71	0.02	0.01
FOOD	4023.95	4023.58	0.37	0.01	469.04	469.01	0.03	0.01	260.57	260.54	0.04	0.01
APPA	703.36	703.39	-0.03	0.00	159.15	159.16	-0.01	-0.01	33.64	33.64	0.00	0.00
CRGS	1968.76	1968.02	0.73	0.04	540.78	540.58	0.19	0.04	139.43	139.37	0.06	0.04
OMAN	3791.74	3790.72	1.02	0.03	809.50	809.31	0.19	0.02	503.31	503.15	0.16	0.03
PRIN	1110.55	1110.24	0.31	0.03	339.90	339.81	0.09	0.03	76.29	76.26	0.03	0.03
PETR	7664.15	7661.59	2.56	0.03	872.48	872.21	0.27	0.03	573.65	573.43	0.22	0.04
METL	3875.95	3874.22	1.73	0.04	972.88	972.46	0.41	0.04	378.10	377.91	0.19	0.05
MACH	11586.19	11584.52	1.67	0.01	2737.20	2736.84	0.35	0.01	691.13	690.99	0.14	0.02
TCPU	13481.73	13480.19	1.53	0.01	3333.32	3333.05	0.27	0.01	2805.90	2805.47	0.43	0.02
WHOL	6723.72	6723.04	0.68	0.01	2351.68	2351.48	0.20	0.01	632.05	631.95	0.10	0.02
RETL	10043.39	10043.38	0.00	0.00	4292.01	4292.07	-0.05	0.00	947.85	947.79	0.06	0.01
FIRE	14756.89	14756.19	0.70	0.00	2137.91	2137.93	-0.02	0.00	7030.59	7030.14	0.45	0.01
OSER	9992.86	9992.66	0.19	0.00	4184.37	4184.32	0.04	0.00	590.91	590.86	0.05	0.01
BSER	3490.75	3490.66	0.09	0.00	1640.34	1640.31	0.03	0.00	247.50	247.48	0.02	0.01
HEAL	8126.86	8127.04	-0.18	0.00	3965.48	3965.58	-0.10	0.00	228.01	228.00	0.01	0.00
EDUC	1118.71	1118.71	0.00	0.00	290.16	290.16	0.00	0.00	11.13	11.13	0.00	0.01
SLGV	7203.94	7203.89	0.05	0.00	5857.00	5857.00	0.00	0.00	724.58	724.53	0.05	0.01
FGOV	5311.21	5311.18	0.03	0.00	3970.69	3970.73	-0.03	0.00	1027.95	1027.89	0.06	0.01
Total	137364.46	137345.76	18.70	0.01	44085.32	44082.27	3.05	0.01	21301.89	21297.84	4.05	0.02

DOUBLE THE ELASTICITY OF TRANSFORMATION

Regional Supply, Exports, and Domestic Price

	Regional New Run	Regional Base Run	Diff	%	Exports New Run	Exports Base Run	Diff	%	Domestic Price New Run	Domestic Price Base Run	Diff	%
AGRI	1701.58	1701.18	0.40	0.02	2714.91	2712.97	1.94	0.07	0.9998	0.9998	0.0000	0.00
MINE	5151.02	5149.35	1.68	0.03	5423.39	5420.45	2.95	0.05	0.9999	0.9999	0.0000	0.00
CONS	7283.92	7283.70	0.22	0.00	114.95	114.88	0.07	0.06	0.9997	0.9997	0.0000	0.00
FOOD	2814.86	2814.92	-0.07	0.00	1209.09	1208.65	0.44	0.04	0.9998	0.9998	0.0000	0.00
APPA	633.98	634.04	-0.06	-0.01	69.38	69.36	0.03	0.04	0.9998	0.9997	0.0001	0.01
CRGS	153.22	153.23	-0.01	-0.01	1815.54	1814.79	0.74	0.04	0.9998	0.9997	0.0001	0.01
OMAN	1185.21	1185.19	0.02	0.00	2606.53	2605.53	1.00	0.04	0.9998	0.9998	0.0000	0.00
PRIN	269.90	269.92	-0.02	-0.01	840.65	840.31	0.34	0.04	0.9998	0.9997	0.0001	0.01
PETR	1438.15	1438.09	0.06	0.00	6226.00	6223.50	2.50	0.04	0.9998	0.9998	0.0000	0.00
METL	120.53	120.53	0.00	0.00	3755.42	3753.69	1.73	0.05	0.9998	0.9997	0.0001	0.01
MACH	7561.03	7561.20	-0.17	0.00	4025.15	4023.32	1.84	0.05	0.9998	0.9997	0.0001	0.01

Appendix E (Continued)
Sensitivity Analsysis
Simulation 2

DOUBLE THE ELASTICITY OF TRANSFORMATION												
Regional Supply, Exports, and Domestic Price												
	Regional New Run	Regional Base Run	Diff	%	Exports New Run	Exports Base Run	Diff	%	Domestic Price New Run	Domestic Price Base Run	Diff	%
TCPU	9237.72	9236.90	0.82	**0.01**	4244.01	4243.30	0.71	**0.02**	0.9998	0.9998	0.0000	**0.00**
WHOL	6210.09	6209.52	0.58	**0.01**	513.63	513.52	0.11	**0.02**	0.9998	0.9997	0.0001	**0.01**
RETL	9394.00	9394.06	-0.07	**0.00**	649.39	649.32	0.07	**0.01**	0.9998	0.9997	0.0001	**0.01**
FIRE	12406.08	12405.56	0.52	**0.00**	2350.82	2350.64	0.18	**0.01**	0.9999	0.9999	0.0000	**0.00**
OSER	9892.46	9892.28	0.18	**0.00**	100.40	100.38	0.01	**0.01**	0.9998	0.9997	0.0001	**0.01**
BSER	3461.67	3461.59	0.09	**0.00**	29.08	29.08	0.00	**0.02**	0.9998	0.9997	0.0001	**0.01**
HEAL	8052.23	8052.42	-0.19	**0.00**	74.63	74.62	0.01	**0.01**	0.9997	0.9997	0.0000	**0.00**
EDUC	1068.61	1068.62	-0.01	**0.00**	50.09	50.09	0.01	**0.01**	0.9997	0.9997	0.0000	**0.00**
SLGV	6869.56	6869.55	0.01	**0.00**	334.39	334.34	0.04	**0.01**	0.9998	0.9997	0.0001	**0.01**
FGOV	4788.07	4788.10	-0.03	**0.00**	523.14	523.09	0.06	**0.01**	0.9998	0.9997	0.0001	**0.01**
Total	**99693.87**	**99689.93**	**3.94**	**0.00**	**37670.59**	**37655.83**	**14.76**	**0.04**				

DOUBLE THE ELASTICITY OF TRANSFORMATION												
Consumption Demand												
	Total New Run	Total Base Run	Diff	%	Domestic New Run	Domestic Base Run	Diff	%	Import New Run	Import Base Run	Diff	%
AGRI	375.35	375.34	0.00	**0.00**	213.92	213.93	0.00	**0.00**	161.43	161.42	0.01	**0.00**
MINE	1.43	1.43	0.00	**0.00**	1.43	1.43	0.00	**0.00**	0.00	0.00	0.00	**NA**
CONS	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**	0.00	0.00	0.00	**NA**
FOOD	3564.22	3564.17	0.04	**0.00**	1819.00	1819.12	-0.12	**-0.01**	1745.21	1745.05	0.17	**0.01**
APPA	1247.50	1247.48	0.02	**0.00**	428.39	428.45	-0.05	**-0.01**	819.11	819.04	0.07	**0.01**
CRGS	342.99	342.98	0.01	**0.00**	21.43	21.44	0.00	**-0.02**	321.56	321.55	0.01	**0.00**
OMAN	2054.09	2054.05	0.05	**0.00**	330.06	330.10	-0.04	**-0.01**	1724.03	1723.95	0.08	**0.00**
PRIN	368.47	368.47	0.01	**0.00**	93.81	93.82	-0.01	**-0.01**	274.66	274.64	0.02	**0.01**
PETR	914.27	914.26	0.02	**0.00**	335.49	335.52	-0.03	**-0.01**	578.78	578.74	0.04	**0.01**
METL	94.64	94.64	0.00	**0.00**	2.51	2.51	0.00	**-0.02**	92.13	92.13	0.00	**0.00**
MACH	2301.98	2301.97	0.02	**0.00**	1276.00	1276.11	-0.11	**-0.01**	1025.98	1025.85	0.12	**0.01**
TCPU	3987.42	3987.39	0.03	**0.00**	3101.34	3101.37	-0.03	**0.00**	886.08	886.02	0.06	**0.01**
WHOL	2281.24	2281.24	-0.01	**0.00**	1941.25	1941.29	-0.04	**0.00**	339.98	339.95	0.03	**0.01**
RETL	8845.16	8845.23	-0.07	**0.00**	8323.85	8323.97	-0.13	**0.00**	521.31	521.26	0.05	**0.01**
FIRE	12363.98	12363.74	0.24	**0.00**	7799.05	7799.00	0.06	**0.00**	4564.93	4564.74	0.19	**0.00**
OSER	5572.68	5572.71	-0.03	**0.00**	4564.71	4564.85	-0.13	**0.00**	1007.97	1007.87	0.10	**0.01**
BSER	264.33	264.33	0.00	**0.00**	163.74	163.75	-0.01	**0.00**	100.59	100.58	0.01	**0.01**
HEAL	8632.01	8632.11	-0.11	**0.00**	7877.50	7877.69	-0.19	**0.00**	754.51	754.42	0.08	**0.01**
EDUC	1125.74	1125.74	-0.01	**0.00**	820.90	820.93	-0.04	**0.00**	304.84	304.81	0.03	**0.01**
SLGV	292.40	292.41	0.00	**0.00**	292.40	292.41	0.00	**0.00**	0.00	0.00	0.00	**NA**
FGOV	85.99	85.99	0.00	**0.00**	75.24	75.24	0.00	**0.00**	10.75	10.75	0.00	**0.01**
Total	**54715.89**	**54715.69**	**0.20**	**0.00**	**39482.04**	**39482.92**	**-0.88**	**0.00**	**15233.85**	**15232.77**	**1.08**	**0.01**

Appendix E (Continued)
Sensitivity Analsysis
Simulation 2

DOUBLE THE ELASTICITY OF TRANSFORMATION												
Intermediate Good Demand												
	Total	Total			Domestic	Domestic			Imports	Imports		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
AGRI	2567.14	2566.37	0.77	**0.03**	1463.09	1462.69	0.40	**0.03**	1104.05	1103.68	0.37	**0.03**
MINE	5120.47	5118.80	1.68	**0.03**	5120.47	5118.80	1.68	**0.03**	0.00	0.00	0.00	**NA**
CONS	2027.55	2027.33	0.22	**0.01**	2027.55	2027.33	0.22	**0.01**	0.00	0.00	0.00	**NA**
FOOD	1821.45	1821.19	0.27	**0.01**	929.58	929.52	0.06	**0.01**	891.87	891.67	0.21	**0.02**
APPA	555.56	555.50	0.06	**0.01**	190.78	190.79	-0.01	**0.00**	364.78	364.72	0.06	**0.02**
CRGS	1840.01	1839.72	0.29	**0.02**	114.97	114.98	0.00	**0.00**	1725.04	1724.74	0.29	**0.02**
OMAN	4563.70	4562.67	1.03	**0.02**	733.32	733.25	0.07	**0.01**	3830.39	3829.42	0.96	**0.03**
PRIN	610.59	610.52	0.07	**0.01**	155.45	155.46	-0.01	**0.00**	455.14	455.07	0.07	**0.02**
PETR	2663.06	2662.54	0.53	**0.02**	977.22	977.12	0.10	**0.01**	1685.85	1685.42	0.43	**0.03**
METL	4071.15	4070.22	0.94	**0.02**	107.78	107.77	0.01	**0.01**	3963.38	3962.44	0.93	**0.02**
MACH	6106.95	6106.03	0.92	**0.01**	3385.13	3384.92	0.20	**0.01**	2721.82	2721.11	0.71	**0.03**
TCPU	7063.13	7061.90	1.23	**0.02**	5493.58	5492.71	0.86	**0.02**	1569.56	1569.19	0.37	**0.02**
WHOL	4037.72	4036.91	0.81	**0.02**	3435.96	3435.33	0.63	**0.02**	601.76	601.58	0.18	**0.03**
RETL	867.08	867.01	0.07	**0.01**	815.97	815.91	0.06	**0.01**	51.10	51.09	0.01	**0.02**
FIRE	6781.25	6780.42	0.83	**0.01**	4277.53	4277.06	0.47	**0.01**	2503.72	2503.36	0.36	**0.01**
OSER	5661.32	5660.79	0.53	**0.01**	4637.32	4636.99	0.33	**0.01**	1024.00	1023.80	0.20	**0.02**
BSER	4922.97	4922.57	0.40	**0.01**	3049.53	3049.42	0.11	**0.00**	1873.44	1873.14	0.30	**0.02**
HEAL	154.52	154.51	0.01	**0.01**	141.01	141.01	0.01	**0.00**	13.51	13.50	0.00	**0.02**
EDUC	314.40	314.35	0.05	**0.02**	229.26	229.24	0.03	**0.01**	85.14	85.12	0.02	**0.03**
SLGV	79.63	79.62	0.01	**0.01**	79.63	79.62	0.01	**0.01**	0.00	0.00	0.00	**NA**
FGOV	470.15	470.13	0.02	**0.00**	411.38	411.37	0.01	**0.00**	58.77	58.76	0.01	**0.01**
Total	**62299.81**	**62289.09**	**10.72**	**0.02**	**37776.51**	**37771.29**	**5.23**	**0.01**	**24523.30**	**24517.81**	**5.49**	**0.02**

DOUBLE THE ELASTICITY OF TRANSFORMATION				
Other Household Data				
Labor Supply			Labor Migration	
New Run	43991.48		New Run	93.84
Base Run	43991.33		Base Run	90.94
Diff	0.15		Diff	2.90
%	**0.00**		%	**3.19**
Before Tax Wage			After Tax Wage	
New Run	1.0257		New Run	1.0023
Base Run	1.0256		Base Run	1.0022
Diff	0.0001		Diff	0.0001
%	**0.01**		%	**0.01**

Appendix E (Continued)
Sensitivity Analsysis
Simulation 2

DOUBLE THE ELASTICITY OF TRANSFORMATION				
Other Household Data				
Dispoable Income			**Household**	
			Expenditures	
New Run	54072.19		**New Run**	54824.84
Base Run	54066.59		**Base Run**	54819.04
Diff	5.60		**Diff**	5.80
%	**0.01**		%	**0.01**
Household Savings				
New Run	-1918.84			
Base Run	-1918.64			
Diff	-0.20			
%	**0.01**			
Disposable Income			**Household Expenditures**	
Adjusted for Migration			**Adjusted for Migration**	
New Run	53957.11		**New Run**	54708.15
Base Run	53955.07		**Base Run**	54705.97
Diff	2.04		**Diff**	2.19
%	**0.00**		%	**0.00**
State Personal Income			**Corporate Income**	
Tax Collections			**Tax Collections**	
New Run	1415.29		**New Run**	272.70
Base Run	1415.15		**Base Run**	272.65
Diff	0.15		**Diff**	0.05
%	**0.01**		%	**0.02**
Indirect Business				
Tax Collection				
New Run	8104.15			
Base Run	8103.46			
Diff	0.69			
%	**0.01**			

Appendix E (Continued)
Sensitivity Analsysis
Simulation 2

DOUBLE THE LABOR MIGRATION ELASTICITY												
Output, Labor Demand and Capital Demand												
					Labor	Labor			Capital	Capital		
	Output	Output			Demand	Demand			Demand	Demand		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
AGRI	4425.83	4414.15	11.68	**0.26**	536.94	535.39	1.55	**0.29**	372.70	371.85	0.85	**0.23**
MINE	10599.30	10569.79	29.51	**0.28**	2134.08	2127.33	6.75	**0.32**	3805.51	3795.74	9.77	**0.26**
CONS	7400.57	7398.58	1.99	**0.03**	2498.33	2497.54	0.79	**0.03**	229.65	229.71	-0.06	**-0.03**
FOOD	4027.82	4023.58	4.24	**0.11**	469.61	469.01	0.59	**0.13**	260.71	260.54	0.17	**0.07**
APPA	704.48	703.39	1.09	**0.16**	159.42	159.16	0.26	**0.17**	33.68	33.64	0.04	**0.11**
CRGS	1975.84	1968.02	7.82	**0.40**	542.80	540.58	2.21	**0.41**	139.85	139.37	0.49	**0.35**
OMAN	3802.02	3790.72	11.30	**0.30**	811.90	809.31	2.60	**0.32**	504.47	503.15	1.31	**0.26**
PRIN	1113.49	1110.24	3.25	**0.29**	340.84	339.81	1.03	**0.30**	76.45	76.26	0.19	**0.24**
PETR	7682.59	7661.59	21.00	**0.27**	874.81	872.21	2.60	**0.30**	574.80	573.43	1.37	**0.24**
METL	3893.55	3874.22	19.33	**0.50**	977.48	972.46	5.02	**0.52**	379.63	377.91	1.72	**0.46**
MACH	11606.85	11584.52	22.33	**0.19**	2742.45	2736.84	5.61	**0.20**	692.00	690.99	1.00	**0.15**
TCPU	13493.89	13480.19	13.70	**0.10**	3337.35	3333.05	4.30	**0.13**	2807.41	2805.47	1.94	**0.07**
WHOL	6730.61	6723.04	7.57	**0.11**	2354.43	2351.48	2.95	**0.13**	632.37	631.95	0.41	**0.07**
RETL	10042.71	10043.38	-0.68	**-0.01**	4292.24	4292.07	0.17	**0.00**	947.26	947.79	-0.53	**-0.06**
FIRE	14758.16	14756.19	1.97	**0.01**	2139.19	2137.93	1.26	**0.06**	7030.09	7030.14	-0.05	**0.00**
OSER	9997.92	9992.66	5.26	**0.05**	4186.83	4184.32	2.51	**0.06**	590.86	590.86	0.00	**0.00**
BSER	3494.90	3490.66	4.23	**0.12**	1642.43	1640.31	2.12	**0.13**	247.65	247.48	0.17	**0.07**
HEAL	8126.27	8127.04	-0.77	**-0.01**	3965.33	3965.58	-0.25	**-0.01**	227.85	228.00	-0.15	**-0.07**
EDUC	1119.23	1118.71	0.52	**0.05**	290.30	290.16	0.14	**0.05**	11.12	11.13	0.00	**-0.01**
SLGV	7204.08	7203.89	0.18	**0.00**	5857.53	5857.00	0.52	**0.01**	724.16	724.53	-0.37	**-0.05**
FGOV	5312.03	5311.18	0.85	**0.02**	3971.84	3970.73	1.11	**0.03**	1027.56	1027.89	-0.33	**-0.03**
Total	**137512.14**	**137345.76**	**166.38**	**0.12**	**44126.11**	**44082.27**	**43.84**	**0.10**	**21315.79**	**21297.84**	**17.95**	**0.08**

DOUBLE THE LABOR MIGRATION ELASTICITY												
Regional Supply, Exports, and Domestic Price												
									Domestic	Domestic		
	Regional	Regional			Exports	Exports			Price	Price		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
AGRI	1704.23	1701.18	3.05	**0.18**	2721.60	2712.97	8.63	**0.32**	0.9994	0.9998	-0.0004	**-0.04**
MINE	5162.06	5149.35	12.71	**0.25**	5437.25	5420.45	16.80	**0.31**	0.9997	0.9999	-0.0002	**-0.02**
CONS	7285.47	7283.70	1.78	**0.02**	115.09	114.88	0.21	**0.18**	0.9991	0.9997	-0.0006	**-0.06**
FOOD	2816.95	2814.92	2.03	**0.07**	1210.87	1208.65	2.21	**0.18**	0.9994	0.9998	-0.0004	**-0.04**
APPA	634.93	634.04	0.90	**0.14**	69.55	69.36	0.20	**0.28**	0.9992	0.9997	-0.0005	**-0.05**
CRGS	153.64	153.23	0.41	**0.27**	1822.20	1814.79	7.40	**0.41**	0.9992	0.9997	-0.0005	**-0.05**
OMAN	1187.86	1185.19	2.66	**0.22**	2614.16	2605.53	8.63	**0.33**	0.9994	0.9998	-0.0004	**-0.04**
PRIN	270.42	269.92	0.50	**0.19**	843.06	840.31	2.75	**0.33**	0.9992	0.9997	-0.0005	**-0.05**
PETR	1440.81	1438.09	2.72	**0.19**	6241.78	6223.50	18.28	**0.29**	0.9994	0.9998	-0.0004	**-0.04**
METL	120.98	120.53	0.46	**0.38**	3772.57	3753.69	18.88	**0.50**	0.9993	0.9997	-0.0004	**-0.04**
MACH	7572.14	7561.20	10.94	**0.14**	4034.71	4023.32	11.39	**0.28**	0.9992	0.9997	-0.0005	**-0.05**

Appendix E (Continued)
Sensitivity Analsysis
Simulation 2

DOUBLE THE LABOR MIGRATION ELASTICITY												
Regional Supply, Exports, and Domestic Price												
									Domestic	Domestic		
	Regional	Regional			Exports	Exports			Price	Price		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
TCPU	9245.62	9236.90	8.73	0.09	4248.27	4243.30	4.97	0.12	0.9995	0.9998	-0.0003	-0.03
WHOL	6216.36	6209.52	6.84	0.11	514.26	513.52	0.73	0.14	0.9993	0.9997	-0.0004	-0.04
RETL	9393.22	9394.06	-0.84	-0.01	649.48	649.32	0.16	0.03	0.9992	0.9997	-0.0005	-0.05
FIRE	12407.02	12405.56	1.46	0.01	2351.15	2350.64	0.51	0.02	0.9998	0.9999	-0.0001	-0.01
OSER	9897.44	9892.28	5.17	0.05	100.47	100.38	0.09	0.09	0.9992	0.9997	-0.0005	-0.05
BSER	3465.77	3461.59	4.19	0.12	29.12	29.08	0.05	0.16	0.9992	0.9997	-0.0005	-0.05
HEAL	8051.63	8052.42	-0.79	-0.01	74.64	74.62	0.02	0.03	0.9991	0.9997	-0.0006	-0.06
EDUC	1069.10	1068.62	0.48	0.04	50.13	50.09	0.04	0.09	0.9991	0.9997	-0.0006	-0.06
SLGV	6869.60	6869.55	0.06	0.00	334.47	334.34	0.13	0.04	0.9992	0.9997	-0.0005	-0.05
FGOV	4788.70	4788.10	0.61	0.01	523.33	523.09	0.24	0.05	0.9992	0.9997	-0.0005	-0.05
Total	**99753.97**	**99689.93**	**64.04**	**0.06**	**37758.16**	**37655.83**	**102.33**	**0.27**				

DOUBLE THE LABOR MIGRATION ELASTICITY												
Consumption Demand												
	Total	Total			Domestic	Domestic			Import	Import		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
AGRI	375.30	375.34	-0.04	-0.01	213.95	213.93	0.02	0.01	161.35	161.42	-0.07	-0.04
MINE	1.43	1.43	0.00	-0.03	1.43	1.43	0.00	-0.03	0.00	0.00	0.00	NA
CONS	0.00	0.00	0.00	NA	0.00	0.00	0.00	NA	0.00	0.00	0.00	NA
FOOD	3562.71	3564.17	-1.46	-0.04	1819.59	1819.12	0.46	0.03	1743.12	1745.05	-1.93	-0.11
APPA	1246.95	1247.48	-0.53	-0.04	428.76	428.45	0.31	0.07	818.20	819.04	-0.84	-0.10
CRGS	342.81	342.98	-0.18	-0.05	21.46	21.44	0.02	0.11	321.35	321.55	-0.20	-0.06
OMAN	2053.03	2054.05	-1.02	-0.05	330.29	330.10	0.20	0.06	1722.73	1723.95	-1.22	-0.07
PRIN	368.30	368.47	-0.17	-0.05	93.90	93.82	0.08	0.08	274.40	274.64	-0.25	-0.09
PETR	913.85	914.26	-0.41	-0.05	335.64	335.52	0.12	0.04	578.21	578.74	-0.53	-0.09
METL	94.59	94.64	-0.05	-0.05	2.51	2.51	0.00	0.10	92.08	92.13	-0.05	-0.06
MACH	2301.12	2301.97	-0.85	-0.04	1276.60	1276.11	0.49	0.04	1024.52	1025.85	-1.34	-0.13
TCPU	3985.91	3987.39	-1.48	-0.04	3100.67	3101.37	-0.70	-0.02	885.24	886.02	-0.78	-0.09
WHOL	2280.61	2281.24	-0.63	-0.03	1941.02	1941.29	-0.27	-0.01	339.59	339.95	-0.37	-0.11
RETL	8843.10	8845.23	-2.13	-0.02	8322.45	8323.97	-1.53	-0.02	520.65	521.26	-0.60	-0.12
FIRE	12357.89	12363.74	-5.86	-0.05	7796.12	7799.00	-2.88	-0.04	4561.77	4564.74	-2.97	-0.07
OSER	5571.26	5572.71	-1.45	-0.03	4564.52	4564.85	-0.32	-0.01	1006.74	1007.87	-1.13	-0.11
BSER	264.24	264.33	-0.09	-0.03	163.76	163.75	0.01	0.01	100.49	100.58	-0.10	-0.10
HEAL	8630.33	8632.11	-1.78	-0.02	7876.85	7877.69	-0.85	-0.01	753.49	754.42	-0.93	-0.12
EDUC	1125.44	1125.74	-0.30	-0.03	820.97	820.93	0.04	0.00	304.48	304.81	-0.34	-0.11
SLGV	292.35	292.41	-0.06	-0.02	292.35	292.41	-0.06	-0.02	0.00	0.00	0.00	NA
FGOV	85.96	85.99	-0.02	-0.03	75.23	75.24	-0.01	-0.01	10.74	10.75	-0.01	-0.11
Total	**54697.18**	**54715.69**	**-18.51**	**-0.03**	**39478.06**	**39482.92**	**-4.86**	**-0.01**	**15219.13**	**15232.77**	**-13.64**	**-0.09**

Appendix E (Continued)
Sensitivity Analsysis
Simulation 2

DOUBLE THE LABOR MIGRATION ELASTICITY												
Intermediate Good Demand												
	Total	Total			Domestic	Domestic			Imports	Imports		
	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%	New Run	Base Run	Diff	%
AGRI	2571.11	2566.37	4.74	**0.18**	1465.71	1462.69	3.02	**0.21**	1105.40	1103.68	1.72	**0.16**
MINE	5131.51	5118.80	12.71	**0.25**	5131.51	5118.80	12.71	**0.25**	0.00	0.00	0.00	**NA**
CONS	2029.11	2027.33	1.78	**0.09**	2029.11	2027.33	1.78	**0.09**	0.00	0.00	0.00	**NA**
FOOD	1822.95	1821.19	1.77	**0.10**	931.04	929.52	1.52	**0.16**	891.91	891.67	0.25	**0.03**
APPA	556.52	555.50	1.02	**0.18**	191.36	190.79	0.57	**0.30**	365.17	364.72	0.45	**0.12**
CRGS	1842.64	1839.72	2.92	**0.16**	115.34	114.98	0.36	**0.32**	1727.30	1724.74	2.56	**0.15**
OMAN	4572.18	4562.67	9.51	**0.21**	735.58	733.25	2.33	**0.32**	3836.60	3829.42	7.18	**0.19**
PRIN	611.29	610.52	0.77	**0.13**	155.85	155.46	0.40	**0.25**	455.44	455.07	0.37	**0.08**
PETR	2667.20	2662.54	4.66	**0.18**	979.62	977.12	2.50	**0.26**	1687.58	1685.42	2.16	**0.13**
METL	4080.70	4070.22	10.49	**0.26**	108.21	107.77	0.44	**0.41**	3972.49	3962.44	10.05	**0.25**
MACH	6116.34	6106.03	10.31	**0.17**	3393.19	3384.92	8.27	**0.24**	2723.15	2721.11	2.04	**0.08**
TCPU	7072.89	7061.90	10.99	**0.16**	5502.05	5492.71	9.34	**0.17**	1570.84	1569.19	1.65	**0.11**
WHOL	4044.56	4036.91	7.65	**0.19**	3442.32	3435.33	6.99	**0.20**	602.24	601.58	0.66	**0.11**
RETL	867.67	867.01	0.66	**0.08**	816.59	815.91	0.67	**0.08**	51.09	51.09	-0.01	**-0.02**
FIRE	6786.54	6780.42	6.12	**0.09**	4281.37	4277.06	4.31	**0.10**	2505.17	2503.36	1.81	**0.07**
OSER	5666.26	5660.79	5.47	**0.10**	4642.35	4636.99	5.36	**0.12**	1023.91	1023.80	0.11	**0.01**
BSER	4927.20	4922.57	4.64	**0.09**	3053.50	3049.42	4.08	**0.13**	1873.70	1873.14	0.56	**0.03**
HEAL	154.56	154.51	0.04	**0.03**	141.06	141.01	0.05	**0.04**	13.49	13.50	-0.01	**-0.08**
EDUC	314.85	314.35	0.50	**0.16**	229.67	229.24	0.44	**0.19**	85.18	85.12	0.06	**0.08**
SLGV	79.74	79.62	0.11	**0.14**	79.74	79.62	0.11	**0.14**	0.00	0.00	0.00	**NA**
FGOV	470.40	470.13	0.27	**0.06**	411.65	411.37	0.29	**0.07**	58.75	58.76	-0.02	**-0.03**
Total	**62386.23**	**62289.09**	**97.14**	**0.16**	**37836.82**	**37771.29**	**65.54**	**0.17**	**24549.41**	**24517.81**	**31.60**	**0.13**

DOUBLE THE LABOR MIGRATION ELASTICITY				
Other Household Data				
Labor Supply			Labor Migration	
New Run	43992.56		New Run	133.56
Base Run	43991.33		Base Run	90.94
Diff	1.22		Diff	42.62
%	**0.00**		%	**46.87**
Before Tax Wage			After Tax Wage	
New Run	1.0250		New Run	1.0017
Base Run	1.0256		Base Run	1.0022
Diff	-0.0006		Diff	-0.0005
%	**-0.06**		%	**-0.05**

Appendix E (Continued)
Sensitivity Analsysis
Simulation 2

DOUBLE THE LABOR MIGRATION ELASTICITY				
Other Household Data				
Dispoable Income			**Household**	
			Expenditures	
New Run	54083.80		**New Run**	54836.86
Base Run	54066.59		**Base Run**	54819.04
Diff	17.21		**Diff**	17.82
%	**0.03**		%	**0.03**
Household Savings				
New Run	-1919.25			
Base Run	-1918.64			
Diff	-0.61			
%	**0.03**			
Disposable Income			**Household Expenditures**	
Adjusted for Migration			**Adjusted for Migration**	
New Run	53920.12		**New Run**	54670.90
Base Run	53955.07		**Base Run**	54705.97
Diff	-34.95		**Diff**	-35.07
%	**-0.06**		%	**-0.06**
State Personal Income			**Corporate Income**	
Tax Collections			**Tax Collections**	
New Run	1415.60		**New Run**	272.94
Base Run	1415.15		**Base Run**	272.65
Diff	0.45		**Diff**	0.29
%	**0.03**		%	**0.11**
Indirect Business				
Tax Collection				
New Run	8109.11			
Base Run	8103.46			
Diff	5.65			
%	**0.07**			

Appendix F

Gams Program For Oklahoma Tax CGE

Base Year Replication And Simulations

```
$TITLE OKLAHOMA CGE MODEL

*=================================================================
*Step 1:  Model Declarations
*=================================================================

*-----------------------------------------------------------------
*I.  Set Declarations
*-----------------------------------------------------------------

SETS

     i         Sectors
     f         Factors
     h         Households
     g         Governments
;

*-----------------------------------------------------------------
*II.  Alias:  Renaming key sets for later use.
*-----------------------------------------------------------------

ALIAS(i,j);
ALIAS(h,hp);

*-----------------------------------------------------------------
*III.  Variable Declarations
*-----------------------------------------------------------------

POSITIVE VARIABLES

*Endogenous

*   Industry

     Y(i)     Sectoral regional output
     VA(i)    Sectoral composite value added labor and capital
     LD(i)    Sectoral labor demand
     KD(i)    Sectoral capital demand
     X(i,j)   Sectoral composite intermediate good demand
     D(i,j)   Sectoral intermediate good demand domestic
     V(i,j)   Sectoral intermediate good demand imports
     TX(j)    Total intermediate demand good j
     TD(j)    Total domestic intermediate demand good j
     TV(j)    Total import intermediate demand good j
     R(i)     Sectoral output domestic
     E(i)     Sectoral output exports

*   Household

     CI(j)    Household consumption demand imports
     ACI(j)   Adjust household consumption demand imports
     CR(j)    Household consumption demand regional goods
     ACR(j)   Adjusted household consumption demand regional goods
     MH       Household income before taxes
     AMH      Adjusted household income before taxes
     DMH      Household disposable income
     ADMH     Adjusted household disposable income
     YLAB     Total labor income Oklahoma
     YCAP     Total capital income Oklahoma
```

```
*   Prices

      PD(j)     After tax domestic price goods
      PL        Domestic price of labor
      PLT       After tax domestic price labor
      PK(i)     Domestic price capital
      CPDC(j)   Composite price Oklahoma consumers
      PN(i)     Net price producers

*   Other

      SLACK1(i)
      SLACK2(i)
      CAPD(j)   Sectoral investment demand domestic
      CAPI(j)   Sectoral investment demand imports

*   Government

      SGI(j)   State and local expenditures imports
      SGD(j)   State and local expenditures domestic goods
      FGI(j)   Federal expenditures imports
      FGD(j)   Federal expenditures domestic goods
;

VARIABLE

      Z        Objective function
      LSH      Household labor supply
      ALSH     Adjusted household labor supply
      C(j)     Household consumption demand
      AC(j)    Adjusted household consumption demand
      LMH      Household labor migration
      HHE      Household expenditures
      AHHE     Adjusted household expenditures
      HHS      Household savings
      LADJ     Adjustment for labor migration
;

*---------------------------------------------------------------------
*IV.  Parameter Declarations
*---------------------------------------------------------------------

PARAMETERS

*Calculated Parameters

  alphao(i)    Share parameter Leontief production function
  alpha(i,j)   Share parameter Leontief production function
  beta(i)      Share parameter CD value added
  gamma1(i)    Used to calculate gamma
  gamma(i)     Share parameter CES export demand
  mu1(i,j)     Used to calculate mu
  mu(i,j)      Share parameter CES import intermediate good demand
  phio         Share parameter LES function
  phi(j)       Share parameter LES function
  phi1         Used to calculate phi
  phi2(j)      Used to calculate phi
  phi3         Used to calculate phi
  lam1(j)      Used to calculate lam
```

```
lam(j)       Share parameter CES import consumption demand
pi1(j)       Used to calculate pi
pi(j)        Share parameter CES state and local government trade
epsi1(i)     Used to calculate epsi
epsi(j)      Share parameter CES federal government trade
rho1(j)      Used to calculate rho
rho(j)       Share parameter CES investment demand trade
psi          Total time available minu minimum subsistence leisure
gam(j)       Minimum subsistence household consumption good j
svak         Household share value added capital
mps          Marginal porpensity to save
vaa(i)       Technology parameter CD value added
capa(j)      Technology parameter CES investment demand
vda(i,j)     Technology parameter CES import intermediate good demand
era(i)       Technology parameter CES export demand
vra(j)       Technology parameter CES import consumption demand
sgea(j)      Technology parameter CES state and local government trade
fgea(j)      Technology parameter CES federal government trade

*Elasticities

    sigvd(j)   Import intermediate good
    sigvds(j)  Import intermediate good sensitivity analysis
    siger(i)   Elasticity of transformation
    sigerb(i)  Elasticity of transformation base year
    sigers(i)  Elasticity of transformation sensitivity analysis
    sigers(i)  Export sensitivity analysis
    sigvr(j)   Import consumption good
    sigvrs(j)  Import consumption good sensitivity analysis
    sigsg(j)   Import state and local government
    sigsgs(j)  Import state and local government sensitivity analysis
    sigfg(j)   Import federal government
    sigfgs(j)  Import federal government sensitivity analysis
    sigca(j)   Import investment demand
    sigcas(j)  Import investment demand sensitivity analysis
    nu         Labor migration
    nub        Labor migration
    nus        Labor migration sensitivity analysis
    fr         Frisch parameter
    frb        Frisch parameter base year
    frs1       Frisch parameter sensitivity analysis
    frs2       Frisch parameter sensitivity analysis
    incel(j)   Income elasticy of household consumption
    incels(j)  Income elasticity sensitivity analysis
    incls      Income elasticity of labor supply
    inclsb     Income elasticity of labor supply
    inclss     Income elasticity of labor supply sensitivity analysis

*Tax

    stin      State tax rate income
    stinb     State tax rate income base year
    stins     State tax rate income simulation
    stca(i)   State tax rate capital
    stcab(i)  State tax rate capital base year
    stcas(i)  State tax rate capital simulation
    ftss      Federal share social security
    ftin      Federal tax rate income
    ohht      Other household tax
    ibt(i)    Indirect business tax rate
    STRIN     State tax revenue total income
```

```
     STRCA     State tax revenue capital
     TRIBT     Tax revenue indirect business tax

*Base Year Values

*Endogenous

*   Industry

     YO(i)    Sectoral regional output
     VAO(i)   Sectoral composite value added labor and capital
     LDO(i)   Sectoral labor demand
     KDO(i)   Sectoral capital demand
     KSO(i)   Sectoral capital supply
     XO(i,j)  Sectoral intermediate good demand
     DO(i,j)  Sectoral intermediate good demand domestic
     VO(i,j)  Sectoral intermediate good demand imports
     RO(i)    Sectoral output domestic
     EO(i)    Sectoral output exports
     INVO(i)  Initial investment sector i

*   Household

     LMHO      Household labor migration
     LSHO      Household labor supply
     CO(j)     Household consumption demand
     CIO(j)    Household consumption demand imports
     CRO(j)    Household consumption demand regional goods
     MHO       Household income before taxes
     DMHO      Household disposable income
     YLABO     Total labor income Oklahoma
     YCAPO     Total capital income Oklahoma
     HHEO      Household expenditures
     HHSO      Household savings
     TXO(j)    Total intermediate demand good j
     TDO(j)    Total domestic intermediate demand good j
     TVO(j)    Total import intermediate demand good j

*   Prices

     PDO(j)    After tax domestic price goods
     PLO       Domestic price of labor
     PLTO      After tax domestic price labor
     PKO(i)    Domestic price capital
     PKTO      After tax domestic price capital
     CPDCO(j)  Composite price Oklahoma consumers
     PNO(i)    Net price producers

*Exogenous

*   Industry

     CAPDO(j)  Sectoral investment demand domestic
     CAPIO(j)  Sectoral investment demand imports
     CAPO(j)   Sectoral investment demand total

*   Household

     TPSLO   Household income transfers from state local govt
     TPFEDO  Household income transfers from federal govt
     OTHERO  Household income other
```

```
     OTHEXO  Household expenditures other

*  Prices

     PWO(j)   World price exports
     PKWO     After tax world price capital sector i
     PLUSO    After tax price labor United States

*  Government

     SGEO(j)  State and local expenditures trade
     SGIO(j)  State and local expenditures imports
     SGDO(j)  State and local expenditures domestic goods
     FGEO(j)  Federal expenditures trade
     FGIO(j)  Federal expenditures imports
     FGDO(j)  Federal expenditures domestic goods
     IBTO(i)  Total indirect business taxes

*Trade

     NZVD(i,j)  Non zero intermediate good j demand
     ZV(i,j)    Zero intermediate good j imports
     NZVR(j)    Non zero consumption demand good j
     ZCI(j)     Zero import consumption demand
     NZCAP(j)   Non zero capital demand good j
     ZCAPI(j)   Zero import capital demand
     NZSGE(j)   Non zero state and local govt demand good j
     ZSGI(j)    Zero import state and local govt good demand
     NZFGE(j)   Non zero federal govt demand good j
     ZFGI(j)    Zero import federal govt good demand
;

*------------------------------------------------------------------
*V.  Equation Declarations
*------------------------------------------------------------------

EQUATIONS

*Production

EQZ            Objective function
POUTVA(i)      Sectoral output
PVALUE(i)      Sectoral composite value added
PLABRD(i)      Sectoral labor demand
PCAPLD(i)      Sectoral capital demand
PIGOOD(i,j)    Sectoral intermediate good j demand total
PITRAD(i,j)    Sectoral intermediate good j demand total trade
PIDOMP(i,j)    Sectoral intermediate good j demand domestic with imports
PIDOMP1(i,j)   Zero import intermediate good j demand
PYTRAD(i)      Sectoral supply total trade
PYDOMS(i)      Sectoral supply region
PCAPT(j)       Sectoral investment demand trade
PCAPD(j)       Sectoral investment demand domestic with imports
PCAPD1(j)      Zero import capital good j demand

*Consumption

CLABRM        Household labor migration
CLABRS        Household labor supply
CLADJ         Adjustment factor household h
CCONSD(j)     Household good j consumption total
```

```
CDTRAD(j)    Household good j consumption total trade
CDDOMP(j)    Household good j consumption domestic with imports
CDDOMP1(j)   Zero household good j import consumption demand
CACONSD(j)   Adjusted household good j consumption total
CADDOMP(j)   Adjusted household good j consumption domestic
CADIMP(j)    Adjusted household good j consumption imports

*Government

GSLSE(j)    Sectoral expenditures state and local total
GSLSD(j)    Sectoral expenditures state and local domestic with imports
GSLSD1(j)   Zero import demand federal govt
GFEDSE(j)   Sectoral expenditures federal total
GFEDSD(j)   Sectoral expenditures federal domestic with imports
GFEDSD1(j)  Zero import demand state and local govt

*Income

INCLAB      Total labor income Oklahoma
INCCAP      Total capital income Oklahoma
INCTOT      Household total income
AINCTOT     Adjusted household total income
INCDIS      Household disposable income
AINCDIS     Adjusted household disposable income

*Prices

ICPDC(j)    Composite price Oklahoma consumers
IPLD         Domestic price of labor
IPK         Domestic price of capital

*Identities

IIGDT(j)    Total demand intermediate good j
IIGDD(j)    Total domestic demand intermediate good j
IIGDI(j)    Total import demand intermediate good j
IHHEXP      Household expenditures
IAHHEXP     Adjusted household expenditures
IHHSAV      Household savings

*Equilibrium

ELABOR      Labor market
EOUTPT(j)   Sectoral output market
;

*==========================================================
*STEP 2:  Model Definitions
*==========================================================

*-----------------------------------------------------------------------
--------
*I.  Set Definitions
*-----------------------------------------------------------------------
--------

SET i           /AGRI   Agriculture
                 MINE   Mining
                 CONS   Consturction
                 FOOD   Food and kindred products
                 APPA   Apparel and related products
```

```
                    CRGS   Construction related goods
                    OMAN   Other manufacturing
                    PRIN   Printing and publishing
                    PETR   Oil related products
                    METL   Metal goods
                    MACH   Machinery and equipment
                    TCPU   Transportation comm. and public utilities
                    WHOL   Wholesale trade
                    RETL   Retail trade
                    FIRE   Finance insurance and real estate
                    OSER   Other services
                    BSER   Business services
                    HEAL   Health services
                    EDUC   Educational services
                    SLGV   State and local government
                    FGOV   Federal government/
;
DISPLAY i;

SET f        /LABR   Labor value added
              CAPL   Capital value added/
;
DISPLAY f;

SET h        /HHL   Household low income
              HHM   Household medium income
              HHH   Household high income/
;
DISPLAY h;

SET g       /SLG   State and local government
             FDG   Federal government/
;
DISPLAY g;

*-----------------------------------------------------------------------
*II.  Variables and Parameters
*-----------------------------------------------------------------------

TABLE IGDDT(i,j)  Intermediate good demand domestic trade

          AGRI            MINE            CONS            FOOD
AGRI    672.301         7.98799         86.811         189.403
MINE    0.84686         1674.46        41.3573               0
CONS    27.5619         64.2305        7.86103               0
FOOD     583.97         4.13795        26.9307         348.747
APPA    10.1496         0.54235        5.39433         0.03294
CRGS    42.6178         41.4151        12.6829         0.29002
OMAN    6.39669          72.173        40.6444         9.41872
PRIN    0.23081               0        9.57277               0
PETR    24.3536         2233.75         64.599         2.00001
METL    0.64977         105.989        30.4541               0
MACH    2.02348         7.53086        89.3988         0.05055
TCPU    0.41146         889.571        454.623         2.33947
WHOL    2.48715         0.43149        37.4368         4.42844
RETL    28.8245         0.15482        78.1558         322.926
FIRE    39.4744          0.0774        566.249               0
OSER    7.92374         0.23421         109.13         21.2781
BSER    0.70609         0.02357        12.5958         0.00251
HEAL    5.13425         0.12011        45.3543         25.0906
EDUC    0.60077         0.01896        77.9665               0
```

SLGV	1.39405	0.45717	219.627	0
FGOV	0.05768	0	6.0559	0.65243

+	APPA	CRGS	OMAN	PRIN
AGRI	8.49034	1.15233	49.8119	0.36574
MINE	1.36623	1.2987	13.1667	0.28383
CONS	7.05597	57.5794	30.4569	0.81071
FOOD	0.46935	2.13231	35.4058	5.1241
APPA	82.0938	0.12027	12.4243	0.07387
CRGS	11.1957	26.1476	11.816	0.14004
OMAN	5.64032	4.07993	137.595	1.62116
PRIN	0.30968	0.01244	34.1042	37.6526
PETR	24.1632	3.55271	182.233	0.5697
METL	0.04388	2.09313	13.4476	0.52114
MACH	28.1081	9.08794	61.8601	0.6219
TCPU	2.2875	0.52355	8.22001	7.58046
WHOL	4.08539	1.81171	16.3374	20.7356
RETL	1.0101	0.66344	13.1156	3.39774
FIRE	0.35789	0.40561	6.096	10.2301
OSER	7.61244	1.9375	24.4139	29.0164
BSER	0.34537	0.14868	10.0952	14.3488
HEAL	4.3732	1.19213	64.6383	13.2742
EDUC	0.04587	0.17005	1.73859	5.15766
SLGV	0.10113	0.42257	2.7265	0.17381
FGOV	0.97537	0.13313	0.9803	3.23832

+	PETR	METL	MACH	TCPU
AGRI	49.8806	0.44193	46.3246	195.56
MINE	42.3717	2.79584	199.865	330.637
CONS	90.7809	19.3525	306.625	180.32
FOOD	42.8978	2.891	7.02423	172.26
APPA	3.40046	0.00124	2.1013	26.8832
CRGS	19.8093	2.27079	12.4346	130.31
OMAN	49.6943	2.52139	99.9372	204.845
PRIN	5.72329	0.03027	5.30964	42.162
PETR	204.403	2.11363	44.2995	625.502
METL	19.3609	31.9068	64.6776	219.648
MACH	131.16	38.919	1819.65	282.793
TCPU	162.652	0.98053	237.584	1607.91
WHOL	28.4531	0.54751	78.9612	221.45
RETL	25.2497	0.21635	23.5171	258.015
FIRE	5.8658	0.2235	9.3748	232.425
OSER	37.2363	1.70758	251.344	322.861
BSER	11.4805	0.14477	122.278	106.523
HEAL	36.0834	0.30954	19.1596	173.989
EDUC	1.43063	0.02012	3.30561	12.9978
SLGV	5.20275	0.00267	10.6679	59.8677
FGOV	1.05988	0.01458	11.726	71.3778

+	WHOL	RETL	FIRE	OSER
AGRI	278.366	2.31805	255.409	64.778
MINE	111.131	22.6974	395.859	115.841
CONS	302.435	359.509	86.378	439.931
FOOD	267.603	23.9176	43.4491	82.0737
APPA	35.6108	2.48247	8.86523	14.4753
CRGS	107.472	8.21006	22.0106	39.637
OMAN	202.808	14.0686	42.3893	114.186
PRIN	44.8988	4.26872	32.6561	31.0022
PETR	300.983	22.9844	89.8043	151.617
METL	241.37	11.611	37.1822	75.7992
MACH	682.166	33.5451	119.295	292.012

TCPU	182.898	61.0171	248.947	664.392
WHOL	172.767	38.1451	190.131	299.208
RETL	144.378	61.3597	363.522	247.861
FIRE	22.3881	28.0282	1274.81	359.22
OSER	153.795	57.5061	522.555	1028.28
BSER	54.3338	18.6784	107.646	191.976
HEAL	103.325	40.0975	334.237	344.056
EDUC	7.44156	1.91395	53.4408	27.9261
SLGV	4.06208	0.92622	22.5556	31.0056
FGOV	6.05797	1.24812	15.3544	10.8771

+	BSER	HEAL	EDUC	SLGV	FGOV
AGRI	12.6087	18.4879	3.48024	1.57882	0.88599
MINE	31.7949	0	17.1744	0.369	0.86453
CONS	84.1877	0	0	0.27228	9.28714
FOOD	156.617	0	1.19562	4.37138	3.27776
APPA	20.0267	0	0.40612	1.51069	0.81743
CRGS	25.1765	0	4.52969	3.4506	1.76547
OMAN	84.8473	0	13.6789	4.47984	3.31231
PRIN	40.4914	0	2.06549	2.0001	6.44645
PETR	77.5892	0	16.3114	3.982	3.81764
METL	53.4902	0	3.21576	3.99957	2.55754
MACH	175.433	0	44.3387	9.88322	9.52591
TCPU	293.07	0.68612	46.0586	7.3702	22.0253
WHOL	355.998	0	0	4.08875	43.5197
RETL	338.783	0	0	5.04568	32.5668
FIRE	295.445	0	1.59137	5.452	81.0371
OSER	494.346	0.25388	21.317	6.28499	73.4839
BSER	213.389	0.01414	31.3967	0.71473	28.0285
HEAL	228.476	121.214	19.5616	2.52734	81.0022
EDUC	40.2968	0	1.14112	0.15935	3.15393
SLGV	10.2721	0	1.15064	11.3858	2.89444
FGOV	9.2197	0	0	0.51786	0.13753

;

TABLE IGDIT(i,j) Intermediate good demand import trade

	AGRI	MINE	CONS	FOOD
AGRI	507.4395	0	0	181.83548
MINE	6391951	0	0	0
CONS	20.803131	0	0	0
FOOD	440.7689	0	0	334.81232
APPA	7.660676	0	0	0.03158435
CRGS	32.167045	0	0	0.2784224
OMAN	4.828095	0	0	9.04239
PRIN	0.1742328	0	0	0
PETR	18.381632	0	0	1.9200991
METL	0.4904297	0	0	0
MACH	1.5272802	0	0	0.04843006
TCPU	0.3105305	0	0	2.2459908
WHOL	1.8772518	0	0	4.2514971
RETL	21.756144	0	0	310.0234
FIRE	29.794494	0	0	0
OSER	5.98068	0	0	20.427928
BSER	0.53294	0	0	0.002409836
HEAL	3.875225	0	0	24.088111
EDUC	0.453448	0	0	0
SLGV	1.0521996	0	0	0
FGOV	0.04351687	0	0	0.6263277

+	APPA	CRGS	OMAN	PRIN

AGRI	16.247153	17.303086	260.34498	1.071718
MINE	2.6144272	19.500945	68.81638	0.831705
CONS	13.502343	864.5959	159.18486	2.3755636
FOOD	0.8981551	32.01818	185.05055	15.0148184
APPA	157.0951	1.8059175	64.93613	0.21648141
CRGS	21.424197	392.6249	61.75693	0.4103476
OMAN	10.793334	61.26313	719.1485	4.7503688
PRIN	0.5925744	0.18674884	178.24773	110.3309
PETR	46.238851	53.34644	952.4539	1.669366
METL	0.08401639	31.42977	70.28462	1.5270702
MACH	53.787728	136.46188	323.31537	1.822302
TCPU	4.3773779	7.86141	42.96237	22.2125045
WHOL	7.817826	27.20415	85.38844	60.760263
RETL	1.9329406	9.962031	68.54947	9.956181
FIRE	0.6848684	6.090567	31.861131	29.9765485
OSER	14.567212	29.09296	127.60085	85.024947
BSER	0.6609436	2.232548	52.76298	42.0453159
HEAL	8.368584	17.900703	337.8358	38.8965716
EDUC	0.08783231	2.553417	9.086838	15.1131549
SLGV	0.1935395	6.345265	14.250217	0.5092799
FGOV	1.8664656	1.9990557	5.123578	9.4890365

+	PETR	METL	MACH	TCPU
AGRI	86.10299	16.263131	37.27683	55.8898851
MINE	73.14119	102.88729	160.8288	94.4941806
CONS	156.7043	712.1723	246.73744	51.5344217
FOOD	74.04932	106.38905	5.652311	49.2308782
APPA	5.869809	0.045794888	1.6908923	7.683101
CRGS	34.19451	83.56528	10.005977	37.2419783
OMAN	85.78129	92.78728	80.41826	58.5434938
PRIN	9.879434	1.11414451	4.272603	12.04969
PETR	352.8357	77.78163	35.64727	178.764894
METL	33.42039	1174.1755	52.04527	62.7741871
MACH	226.4053	1432.2255	1464.2494	80.8206969
TCPU	280.767	36.083774	191.18055	459.529957
WHOL	49.11523	20.148516	63.53915	63.28919
RETL	43.58548	7.961545	18.923906	73.7392607
FIRE	10.125425	8.224678	7.543786	66.4257762
OSER	64.27665	62.83924	202.25339	92.2719083
BSER	19.817432	5.3276429	98.39571	30.4436478
HEAL	62.28652	11.390924	15.417471	49.7251783
EDUC	2.469523	0.74038264	2.6599871	3.71466
SLGV	8.980885	0.098201117	8.584347	17.1098325
FGOV	1.8295485	0.53673596	9.435756	20.3993596

+	WHOL	RETL	FIRE	OSER
AGRI	48.77353	0.145242	149.5153036	14.31109
MINE	19.47171	1.422147	231.7340661	25.5921
CONS	52.99078	22.52576	50.56533	97.191579
FOOD	46.88776	1.498602	25.4349426	18.13213
APPA	6.239501	0.1555441	5.189677	3.19794
CRGS	18.83064	0.5144171	12.88487	8.756821
OMAN	35.53469	0.8814924	24.81449	25.22641
PRIN	7.866879	0.2674647	19.1167717	6.849145
PETR	52.73637	1.440133	52.57106	33.4959
METL	42.29132	0.7275068	21.76628	16.74594
MACH	119.5248	2.101835	69.8349	64.51268
TCPU	32.04626	3.823145	145.7325971	146.7806317
WHOL	30.27113	2.390053	111.3018599	66.10247
RETL	25.29702	3.844609	212.8042176	54.75849

```
FIRE      3.9227           1.756162           746.2695372   79.36056
OSER     26.94691          3.603157           305.9016398   227.1722554
BSER      9.520018         1.17033             63.01571     42.41222
HEAL     18.10396          2.512385           195.6609196   76.0104
EDUC      1.303863        0.1199222            31.28409     6.169572
SLGV     0.7117312          0.058              13.20394     6.849903
FGOV      1.061439         0.0782               8.988419    2.403014

+          BSER            HEAL        EDUC         SLGV    FGOV
AGRI      7.749739      1.7717037   1.2930951       0     1266278
MINE     19.5422966         0       6.381224        0     1235613
CONS     51.7448474         0          0            0     1.327341
FOOD     96.2625069         0       0.4442334       0     0.468466
APPA     12.3091143         0       0.1508962       0     0.1168295
CRGS      15.47438          0       1.682998        0     0.2523256
OMAN     52.1502071         0       5.082477        0     0.4734028
PRIN      24.88743          0       0.7674442       0     0.9213421
PETR     47.6891459         0       6.06055         0     0.5456271
METL      32.87697          0       1.194832        0     0.3655303
MACH    107.8273307         0       16.474229       0     1.361466
TCPU    180.1315878    0.065700916  17.1132343      0     3.147912
WHOL    218.8092075         0          0            0     6.219949
RETL    208.2283975         0          0            0     4.654531
FIRE    181.5914801         0       0.5912837       0     11.58202
OSER    303.8427138    0.024300339  7.920422        0     10.50251
BSER    131.1568367    0.001317549  11.66554        0     4.005906
HEAL    140.4293172     11.615942   7.268217        0     11.57704
EDUC      24.76781          0       0.4239838       0     0.4507675
SLGV      6.313618          0       0.427521        0     0.4136807
FGOV     5.6667593          0          0            0     0.0197
;

TABLE VALK(f,i)   Value added of labor and capital

           AGRI           MINE          CONS          FOOD
LABR    547.431000    2175.183533   2560.809021    479.764836
CAPL    371.193634    3802.534180    232.548050    268.163635

+          APPA           CRGS          OMAN          PRIN
LABR    162.786758     552.771023    827.394608    347.365328
CAPL     34.622028     143.392166    517.589478     78.439728

+          PETR           METL          MACH          TCPU
LABR    891.923620     993.839249   2802.043640   3411.095703
CAPL    590.028748     388.609711    711.844177   2863.631104

+          WHOL           RETL          FIRE          OSER
LABR   2407.134735    4393.788513   2188.051758   4283.550293
CAPL    647.116577     971.703430   7063.270020    595.705200

+          BSER           HEAL         EDUC          SLGV          FGOV
LABR   1678.841797    4059.180969  296.968393   6008.280273   4072.481689
CAPL   249.456696     229.846024   11.214665     724.658325   1027.872803
;

TABLE DD(*,j)   demand domestic

        AGRI          MINE          CONS         FOOD
HHL   53.38166      0.365864         0         475.0499
HHM   96.18522      0.652214         0         818.6753
HHH   64.19989      0.414063         0         520.7438
```

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FDG   0.479928          0.993227          97.65153          1.644404
SLG   22.07429          2.73825           1571.305          48.61308
CAP   2.010408          25.38333          3587.409          15.99713

+       APPA              CRGS              OMAN              PRIN
HHL   70.90457          3.714441          76.86145          17.14313
HHM   189.2236          8.989432          147.0035          42.65215
HHH   167.1053          8.666501          105.3208          33.75521
FDG   0.142065          0.094522          0.704028          0.031574
SLG   7.686258          2.228749          43.20489          18.11134
CAP   6.965083          14.48101          77.86304          2.482798

+       PETR              METL              MACH              TCPU
HHL    69.182           0.41818           216.586            753.22
HHM   155.675           1.10063           547.895           1337.78
HHH   109.786           0.97954           508.267           1003.38
FDG   52.9796           0.09346           146.613           99.4546
SLG   56.6903           0.59658           124.451           343.582
CAP   15.7179           9.55267           2627.82           199.717

+       WHOL              RETL              FIRE              OSER
HHL   414.327           1570.37           1554.09           828.408
HHM   865.5116          3767.784          3416.281          1935.524
HHH   656.9749          2966.839          2811.693          1790.204
FDG   33.76237          14.67108          4.703761          413.8316
SLG   109.1506          43.69762          169.4097          273.879
CAP   689.9158          195.7979          155.367           2.650408

+       BSER              HEAL              EDUC         SLGV          FGOV
HHL   30.26132          1988.326          165.0119     60.48029     15.41436
HHM   69.64528          3597.171          249.0607     133.0469     27.97678
HHH   63.44284          2273.881          404.8757     98.21432     31.67458
FDG   106.5628          28.28429          8.041001        0         4272.972302
SLG   129.9102          5.429126          10.41234     6497.52      28.32184
CAP   11.88559             0                 0            0             0
;

TABLE DI(*,j)   demand imports

        AGRI          MINE          CONS          FOOD
HHL     40.2914       0             0             456.0693
HHM     72.59866      0             0             785.965
HHH     48.45678      0             0             499.9374
FDG     0.362141      0             0             1.578731
SLG     16.66122      0             0             46.67074
CAP     1.517416      0             0             15.35797

+       APPA          CRGS          OMAN          PRIN
HHL     135.6833      55.775        401.7211      50.23338
HHM     362.0993      134.9828      768.3228      124.9808
HHH     319.7735      130.1337      550.4655      98.91068
FDG     0.271951      1.419319      3.679646      0.092526
SLG     14.70846      33.46627      225.813       53.07047
CAP     13.32842      217.4427      406.9559      7.27518

+       PETR          METL          MACH          TCPU
HHL     119.4206      15.38907      174.284       215.2659
HHM     268.7227      40.50335      440.8845      382.3284
HHH     189.5105      36.04736      408.9963      286.76
FDG     91.45235      3.43918       117.9776      28.42355
SLG     97.85767      21.95438      100.1446      98.19382
```

```
CAP      27.13186     351.5395     2114.577     57.07805

+        WHOL         RETL         FIRE         OSER
HHL      72.59579     98.39426     909.7564     183.0158
HHM      151.6495     236.0778     1999.878     427.605
HHH      115.111      185.8931     1645.954     395.5004
FDG      5.91563      0.919195     2.753561     91.42569
SLG      19.12468     2.737959     99.1717      60.50664
CAP      120.8827     12.2681      90.95126     0.58558

+        BSER         HEAL         EDUC         SLGV         FGOV
HHL      18.59971     190.5421     61.31085     0            2.203059
HHM      42.80652     344.7183     92.53951     0            3.99851
HHH      38.9943      217.9069     150.4331     0            4.527009
FDG      65.49733     2.710495     2.987669     0            374.466
SLG      79.84749     0.520275     3.868706     0            4.047828
CAP      7.305339     0            0            0            0
;

PARAMETER SINV(i)  Sector investment

/AGRI     60.497800,
MINE     39.803770,
CONS      0.000000,
FOOD      0.465616,
APPA      0.226428,
CRGS      0.230843,
OMAN      0.574953,
PRIN      0.006176,
PETR      0.243637,
METL      0.170679,
MACH     50.616850,
TCPU      0.000000,
WHOL      0.000000,
RETL      0.000000,
FIRE      0.000000,
OSER      0.000000,
BSER      0.899917,
HEAL      0.000000,
EDUC      0.000000,
SLGV      0.000000,
FGOV      0.000000/
;

Parameter SIBT(i)

/AGRI    70.64003
MINE     686.2712
CONS     22.02077
FOOD     16.11104
APPA     1.807096
CRGS     9.695257
OMAN     46.32234
PRIN     3.949916
PETR     162.8249
METL     16.57482
MACH     56.53101
TCPU     696.1074
WHOL     1314.469
RETL     1631.239
FIRE     1317.447
```

```
OSER     328.7702
BSER     113.0303
HEAL     1122.973
EDUC     467.4596
SLGV            0
FGOV            0/
;

TABLE HHY(h,f)    Household factor income

            LABR            CAPL
HHL    2679.891174      667.869995
HHM    17328.364380    2198.635010
HHH    18385.133301    2424.485840
;

TABLE HHT(*,h)    Household values

               HHL             HHM             HHH
SINCO     100.4660034     667.8289795     802.2459717
FINCO     228.2380066     2411.787109     2982.330078
TINCO     633.3540133     3398.466086     4090.26205
;

PARAMETER stcab(i)   Sectoral capital tax

    /AGRI      0.001307101
     MINE      0.004851754
     CONS      0.01249447
     FOOD      0.031012212
     APPA      0.031012212
     CRGS      0.031012212
     OMAN      0.031012212
     PRIN      0.031012212
     PETR      0.031012212
     METL      0.031012212
     MACH      0.031012212
     TCPU      0.022438013
     WHOL      0.025317627
     RETL      0.026459239
     FIRE      0.006825146
     OSER      0.010001177
     BSER      0.010001177
     HEAL      0.010001177
     EDUC      0.010001177
     SLGV      0
     FGOV      0/;

PARAMETER stcas(i)   Sectoral capital tax

    /AGRI      0
     MINE      0
     CONS      0
     FOOD      0
     APPA      0
     CRGS      0
     OMAN      0
     PRIN      0
     PETR      0
     METL      0
     MACH      0
```

```
     TCPU       0
     WHOL       0
     RETL       0
     FIRE       0
     OSER       0
     BSER       0
     HEAL       0
     EDUC       0
     SLGV       0
     FGOV       0/;

*Elasticities

SCALAR nub          /.92/;
SCALAR frb          /-1.60/;
SCALAR frs1         /-1.80/;
SCALAR frs2         /-1.40/;
SCALAR inclsb       /-.18/;

TABLE ELASS(*,j)  Elasticities

          AGRI      MINE      CONS      FOOD      APPA     CRGS   OMAN      PRIN
sigvd     1.42      0.5       3.55      3.55      3.55     3.55   3.55      3.55
sigvr     1.42      0.5       3.55      3.55      3.55     3.55   3.55      3.55
sigsg     1.42      0.5       3.55      3.55      3.55     3.55   3.55      3.55
sigfg     1.42      0.5       3.55      3.55      3.55     3.55   3.55      3.55
sigca     1.42      0.5       3.55      3.55      3.55     3.55   3.55      3.55
incel     0.30      0.89      1.06      1.06      1.06     1.06   1.06      1.06

+         PETR      METL     MACH      TCPU      WHOL     RETL    FIRE      OSER
sigvd     3.55      3.55     3.55      2         2         2       2         2
sigvr     3.55      3.55     3.55      2         2         2       2         2
sigsg     3.55      3.55     3.55      2         2         2       2         2
sigfg     3.55      3.55     3.55      2         2         2       2         2
sigca     3.55      3.55     3.55      2         2         2       2         2
incel     1.06      1.06     1.06      1.05      1.05    1.05     1.05      1.05

+         BSER      HEAL     EDUC      SLGV      FGOV
sigvd     2         2        2         2         2
sigvr     2         2        2         2         2
sigsg     2         2        2         2         2
sigfg     2         2        2         2         2
sigca     2         2        2         2         2
incel     1.05      1.05     1.05      1.05      1.05
;

PARAMETER sigerb(i)  Trade Elasticity

    /AGRI = 3.9
     MINE = 2.9
     CONS = 2.9
     FOOD = 2.9
     APPA = 2.9
     CRGS = 2.9
     OMAN = 2.9
     PRIN = 2.9
     PETR = 2.9
     METL = 2.9
     MACH = 2.9
     TCPU = 0.7
     WHOL = 0.7
```

```
     RETL = 0.7
     FIRE = 0.7
     OSER = 0.7
     BSER = 0.7
     HEAL = 0.7
     EDUC = 0.7
     SLGV = 0.7
     FGOV = 0.7/;

*-----------------------------------------------------------------
*III.  Base Year Values
*-----------------------------------------------------------------

TABLE PBASEI(*,i)   Base year values industries

            AGRI           MINE          CONS          FOOD
PDO            1              1             1             1
CPDCO          1              1             1             1
PWO            1              1             1             1
YO   4399.66590753  10535.99287190  7393.97154340  4012.01377805
EO   2703.21830000  5402.13923000   114.70618640   1204.63070000
RO   1696.44760753  5133.85364190   7279.26535700  2807.38307805

+           APPA           CRGS          OMAN          PRIN
PDO            1              1             1             1
CPDCO          1              1             1             1
PWO            1              1             1             1
YO   701.24979343   1961.53837335   3777.73719960  1106.22233176
EO   69.09201000    1808.69860000   2596.09600000  837.10820000
RO   632.15778343   152.83977335    1181.64119960  269.11413176

+           PETR           METL          MACH          TCPU
PDO            1              1             1             1
CPDCO          1              1             1             1
PWO            1              1             1             1
YO   7637.22804260  3859.40963705   11560.73492600  13448.3483830
EO   6203.00210000  3739.25700000   4012.93500000   4232.88730000
RO   1434.22594260  120.15263705    7547.79992600   9215.46108300

+           WHOL           RETL          FIRE          OSER
PDO            1              1             1             1
CPDCO          1              1             1             1
PWO            1              1             1             1
YO   6708.23192360  10021.46853600  14723.32471160  9970.79230840
EO   512.29970000   647.78095900    2345.28690000   100.14380000
RO   6195.93222360  9373.68757700   12378.03781160  9870.64850840

+           BSER           HEAL          EDUC          SLGV
PDO            1              1             1             1
CPDCO          1              1             1             1
PWO            1              1             1             1
YO   3482.26659500  8108.17898647   1115.96799420  7202.93526850
EO   29.00091000     74.43192060     49.95321100   334.22860000
RO   3453.26568500  8033.74706587   1066.01478320  6868.70666850

+           FGOV
PDO            1
CPDCO          1
PWO            1
YO   5309.60538840
EO   522.83778900
```

```
RO  4786.76759940
;

TABLE PBASEHH(*,h)    Base year values households

              HHL              HHM              HHH
HHSO    -2089.512695    -1709.214844    1882.335938
TPSLO     1038.09          2137.141         776.104
TPFEDO    5608.458         3575.295         1696.391
OTHERO    269.087000       1013.146000      2170.072000
OTHEXO    155.496000       474.839000       535.862000
;

*Base Year Values Calculations

*Prices

PDO(j)          = PBASEI("PDO",j);
PWO(j)          = PBASEI("PWO",j);
CPDCO(j)        = PBASEI("CPDCO",j);
PLUSO           = 1;
PKTO            = 1;
PKWO            = 1;

*Industry

CAPDO(j)        = DD("CAP",j);
CAPIO(j)        = DI("CAP",j);
CAPO(j)         = CAPDO(j)+CAPIO(j);
DO(i,j)         = IGDDT(i,j);
VO(i,j)         = IGDIT(i,j);
XO(i,j)         = DO(i,j)+VO(i,j);
EO(i)           = PBASEI("EO",i);
RO(i)           = PBASEI("RO",i);
YO(i)           = EO(i)+RO(i);
INVO(i)         = SINV(i);

*Household

CIO(j)      = DI("HHL",j)+DI("HHM",j)+DI("HHH",j);
CRO(j)      = DD("HHL",j)+DD("HHM",j)+DD("HHH",j);
CO(j)       = CIO(j)+CRO(j);
TPSLO       = sum(h,PBASEHH("TPSLO",h));
TPFEDO      = sum(h,PBASEHH("TPFEDO",h));
OTHERO      = sum(h,PBASEHH("OTHERO",h));
OTHEXO      = sum(h,PBASEHH("OTHEXO",h));

*Government

FGDO(j)         = DD("FDG",j);
FGIO(j)         = DI("FDG",j);
FGEO(j)         = FGDO(j)+FGIO(j);
SGIO(j)         = DI("SLG",j);
SGDO(j)         = DD("SLG",j);
SGEO(j)         = SGIO(j)+SGDO(j);
IBTO(i)         = SIBT(i);
ibt(i)          = IBTO(i)/YO(i);

*Identities

stca(i)         = stcab(i);
```

```
PKO(i)         = PKTO/(1-stca(i));
HHSO           = sum(h,PBASEHH("HHSO",h));
MHO            =
sum(h,HHY(h,"LABR"))+sum(h,HHY(h,"CAPL"))+TPSLO+TPFEDO+OTHERO;
ftin           = sum(h,HHT("FINCO",h))/MHO;
stinb          = sum(h,HHT("SINCO",h))/MHO;
stins          = .9*stinb;
stin           = stinb;
ohht           = sum(h,(HHT("TINCO",h)-HHT("FINCO",h)-
HHT("SINCO",h)))/MHO;
DMHO           = (1-stin-ftin-ohht)*MHO;
mps            = HHSO/MHO;
HHEO           = DMHO-HHSO-OTHEXO;
TXO(j)         = sum(i,XO(i,j));
TDO(j)         = sum(i,DO(i,j));
TVO(j)         = sum(i,VO(i,j));

PLTO           = 1;
PLO            = PLTO/(1-stin);
LDO(i)         = VALK("LABR",i)/PLO;
KDO(i)         = VALK("CAPL",i)/PKO(i);
VAO(i)         = PLO*LDO(i)+PKO(i)*KDO(i);
LMHO           = 0;
svak           = sum(h,HHY(h,"CAPL"))/sum(i,PKTO*KDO(i));
ftss           = 1-(sum(h,HHY(h,"LABR"))/SUM(i,PLO*LDO(i)));
LSHO           = sum(h,HHY(h,"LABR"))/(PLO*(1-ftss));
YLABO          = (1-ftss)*sum(i,PLO*LDO(i));
YCAPO          = svak*sum(i,PKTO*KDO(i));

*Elasticities

sigvd(j)       = ELASS("sigvd",j);
sigvds(j)      = 2*sigvd(j);
sigvr(j)       = ELASS("sigvr",j);
sigvrs(j)      = 2*sigvr(j);
sigsg(j)       = ELASS("sigsg",j);
sigsgs(j)      = 2*sigsg(j);
sigfg(j)       = ELASS("sigfg",j);
sigfgs(j)      = 2*sigfg(j);
sigca(j)       = ELASS("sigca",j);
sigcas(j)      = 2*sigca(j);
siger(i)       = sigerb(i);
sigers(i)      = 2*sigerb(i);
nus            = 2*nub;
incel(j)       = ELASS("incel",j);
incels(j)      = 2*incel(j);
inclss         = 2*inclsb;
fr             = frb;

*Trade

NZVD(i,j)      = (VO(i,j) <> 0) and (DO(i,j) <> 0);
ZV(i,j)        = VO(i,j) = 0;
NZVR(j)        = (CIO(j) <> 0) and (CRO(j) <> 0);
ZCI(j)         = CIO(j) = 0;
NZCAP(j)       = (CAPIO(j) <> 0) and (CAPDO(j) <> 0);
ZCAPI(j)       = CAPIO(j) = 0;
NZSGE(j)       = (SGIO(j) <> 0) and (SGDO(j) <> 0);
ZSGI(j)        = SGIO(j) = 0;
NZFGE(j)       = (FGIO(j) <> 0) and (FGDO(j) <> 0);
ZFGI(j)        = FGIO(j) = 0;
```

```
*-------------------
*IV.  Calibration
*-------------------

*Production

alphao(i)                  = VAO(i)/YO(i);
rho1(j)$(CAPIO(j) > 0)     =
(PDO(j)/PWO(j))*(CAPDO(j)/CAPIO(j))**(1/sigca(j));
rho(j)                     = 1/(1+rho1(j));
capa(j)$(CAPIO(j) > 0)     = CAPO(j)/(rho(j)*CAPIO(j)**((sigca(j)-
1)/sigca(j))+
                             (1-rho(j))*CAPDO(j)**((sigca(j)-
1)/sigca(j)))**
                             (sigca(j)/(sigca(j)-1));
alpha(i,j)                 = XO(i,j)/YO(i);
beta(i)                    = (PLO*LDO(i))/VAO(i);
vaa(i)                     = VAO(i)/((LDO(i)**beta(i))*(KDO(i)**(1-
beta(i))));
PNO(i)                     = PDO(i)-sum(j,alpha(i,j))*CPDCO(i)-ibt(i)*
                             PDO(i)-(PKTO*INVO(i))/(PDO(i)*YO(i));
mu1(i,j)$(NZVD(i,j))       =
(PDO(j)/PWO(j))*(DO(i,j)/VO(i,j))**(1/(sigvd(j)));
mu(i,j)                    = 1/(1+mu1(i,j));
vda(i,j)$(NZVD(i,j))       = XO(i,j)/((mu(i,j)*VO(i,j)**((sigvd(j)-
1)/sigvd(j)))
                             +((1-mu(i,j))*DO(i,j)**((sigvd(j)-
1)/sigvd(j))))
                             **(sigvd(j)/(sigvd(j)-1));
gamma1(i)                  = (PDO(i)/PWO(i))*(RO(i)/EO(i))**(-1/siger(i));
gamma(i)                   = 1/(1+gamma1(i));
era(i)                     =
YO(i)/(gamma(i)*EO(i)**((1+siger(i))/siger(i))
                             +(1-gamma(i))*RO(i)**((1+siger(i))/siger(i)))
                             **(siger(i)/(1+siger(i)));

*Consumption

phio                     = (PLTO*LSHO*inclsb)/(PLTO*LSHO*inclsb-HHEO);
phi2(j)                  = (CPDCO(j)*CO(j)*incel(j)*(1-phio))/HHEO;
phi1                     = 1-sum(j,phi2(j))-phio;
phi(j)                   = (1+phi1/sum(i,phi2(i)))*phi2(j);
phi3                     = sum(j,phi(j))+phio;
gam(j)                   = CO(j)+(phi(j)/((1-phio)*CPDCO(j)))*(HHEO/fr);
psi                      = LSHO+(phio/((1-phio)*PLTO))
                           *(HHEO-sum(j,CPDCO(j)*gam(j)));
lam1(j)$(CIO(j) > 0)     = (PDO(j)/PWO(j))*(CRO(j)/CIO(j))**(1/sigvr(j));
lam(j)                   = 1/(1+lam1(j));
vra(j)$(CIO(j) > 0)      = CO(j)/(lam(j)*CIO(j)**((sigvr(j)-1)/sigvr(j))
                           +(1-lam(j))*CRO(j)**((sigvr(j)-1)/sigvr(j)))
                           **(sigvr(j)/(sigvr(j)-1));

*Government

pi1(j)$(SGIO(j) > 0)       =
(PDO(j)/PWO(j))*(SGDO(j)/SGIO(j))**(1/sigsg(j));
pi(j)                      = 1/(1+pi1(j));
sgea(j)$(SGIO(j) > 0)      = SGEO(j)/(pi(j)*SGIO(j)**((sigsg(j)-
1)/sigsg(j))
                             +(1-pi(j))*SGDO(j)**((sigsg(j)-1)/sigsg(j)))
```

```
                           **(sigsg(j)/(sigsg(j)-1));
epsi1(j)$(FGIO(j) > 0)    =
(PDO(j)/PWO(j))*(FGDO(j)/FGIO(j))**(1/sigfg(j));
epsi(j)                   = 1/(1+epsi1(j));
fgea(j)$(FGIO(j) > 0)     = FGEO(j)/(epsi(j)*FGIO(j)**((sigfg(j)-
1)/sigfg(j))
                           +(1-epsi(j))*FGDO(j)**((sigfg(j)-
1)/sigfg(j)))
                           **(sigfg(j)/(sigfg(j)-1));

*-------------------------------------------------------------------
*V.  Equations
*-------------------------------------------------------------------

*Production

EQZ..
Z=e=sum(i,SLACK1(i)+SLACK2(i));

POUTVA(i)..
VA(i)+SLACK1(i)-SLACK2(i)=e=alphao(i)*Y(i);

PVALUE(i)..
VA(i)=e=vaa(i)*LD(i)**beta(i)*KD(i)**(1-beta(i));

PLABRD(i)..
LD(i)=e=(beta(i)*alphao(i)*PD(i)*Y(i))/PL;

PCAPLD(i)..
KD(i)=e=((1-beta(i))*alphao(i)*PD(i)*Y(i))/PK(i);

PCAPT(j)$(NZCAP(j))..
CAPO(j)=e=capa(j)*(rho(j)*CAPI(j)**((sigca(j)-1)/sigca(j))+(1-rho(j))
          *CAPD(j)**((sigca(j)-1)/sigca(j)))**(sigca(j)/(sigca(j)-1));

PCAPD(j)$(NZCAP(j))..
CAPD(j)=e=(((1-rho(j))/rho(j))**sigca(j))*((PWO(j)/PD(j))
          **sigca(j))*CAPI(j);

PCAPD1(j)$(ZCAPI(j))..
CAPD(j)=e=CAPO(j);

PIGOOD(i,j)..
X(i,j)=e=alpha(i,j)*Y(i);

PITRAD(i,j)$(NZVD(i,j))..
X(i,j)=e=vda(i,j)*(mu(i,j)*V(i,j)**((sigvd(j)-1)/sigvd(j))
         +(1-mu(i,j))*D(i,j)**((sigvd(j)-1)/sigvd(j)))
         **(sigvd(j)/(sigvd(j)-1));

PIDOMP(i,j)$(NZVD(i,j))..
D(i,j)=e=V(i,j)*(((1-mu(i,j))/mu(i,j))*(PWO(j)/PD(j)))**sigvd(j);

PIDOMP1(i,j)$(ZV(i,j))..
D(i,j)=e=X(i,j);

PYTRAD(i)..
Y(i)=e=era(i)*(gamma(i)*E(i)**((1+siger(i))/siger(i))
       +(1-gamma(i))*R(i)**((1+siger(i))/siger(i)))
       **(siger(i)/(1+siger(i)));
```

```
PYDOMS(i)..
R(i)=e=E(i)*(((1-gamma(i))/gamma(i))*(PWO(i)/PD(i)))**(-siger(i));

*Consumption

CLABRM..
LMH=e=nu*LSHO*log(PLT/PLUSO);

CLABRS..
LSH=e=psi-(phio/((1-phio)*PLT))*(AHHE-sum(j,CPDC(j)*gam(j)));

CLADJ..
LADJ=e= (LSHO+LMH)/LSHO;

*CALABRS..
*ALSH=e= LSH/LADJ;

CCONSD(j)..
C(j)=e=gam(j)+(phi(j)/(CPDC(j)*(1-phio)))
         *(AHHE-sum(i,CPDC(i)*gam(i)));

CACONSD(j)..
AC(j)=e=C(j)/LADJ;

CDTRAD(j)$(NZVR(j))..
C(j)=e=vra(j)*(lam(j)*CI(j)**((sigvr(j)-1)/sigvr(j))
         +(1-lam(j))*CR(j)**((sigvr(j)-1)/sigvr(j)))
         **(sigvr(j)/(sigvr(j)-1));

CDDOMP(j)$(NZVR(j))..
CR(j)=e=CI(j)*(((1-lam(j))/lam(j))*(PWO(j)/PD(j)))**sigvr(j);

CDDOMP1(j)$(ZCI(j))..
CR(j)=e=C(j);

CADDOMP(j)..
ACR(j)=e=CR(j)/LADJ;

CADIMP(j)..
ACI(j)=e=CI(j)/LADJ;

*Government

GSLSE(j)$(NZSGE(j))..
SGEO(j)=e=sgea(j)*(pi(j)*(SGI(j)**((sigsg(j)-1)/sigsg(j)))
          +(1-pi(j))*(SGD(j)**((sigsg(j)-1)/sigsg(j))))
          **(sigsg(j)/(sigsg(j)-1));

GSLSD(j)$(NZSGE(j))..
SGD(j)=e=(((1-
pi(j))/pi(j))**sigsg(j))*((PWO(j)/PD(j))**sigsg(j))*SGI(j);

GSLSD1(j)$(ZSGI(j))..
SGD(j)=e=SGEO(j);

GFEDSE(j)$(NZFGE(j))..
FGEO(j)=e=fgea(j)*(epsi(j)*(FGI(j)**((sigfg(j)-1)/sigfg(j)))
          +(1-epsi(j))*(FGD(j)**((sigfg(j)-1)/sigfg(j))))
          **(sigfg(j)/(sigfg(j)-1));

GFEDSD(j)$(NZFGE(j))..
```

```
FGD(j)=e=(((1-
epsi(j))/epsi(j))**sigfg(j))*((PWO(j)/PD(j))**sigfg(j))*FGI(j);

GFEDSD1(j)$(ZFGI(j))..
FGD(j)=e=FGEO(j);

*Income

INCLAB..
YLAB=e=PLT*sum(i,LD(i))*(1-ftss);

INCCAP..
YCAP=e=svak*sum(i,PKTO*KD(i));

INCTOT..
MH=e=YLAB/(1-STIN)+YCAP+TPSLO+TPFEDO+OTHERO;

AINCTOT..
AMH=e=MH/LADJ;

INCDIS..
DMH=e=(1-stin-ftin-ohht)*MH;

AINCDIS..
ADMH=e=DMH/LADJ;

*Prices

ICPDC(j)..
CPDC(j)=e=(PD(j)*(TD(j)+CR(j)+CAPD(j)+SGD(j)+FGD(j))
          +PWO(j)*(TV(j)+CI(j)+SGI(j)+FGI(j)+CAPI(j)))/
          (TD(j)+CR(j)+CAPD(j)+SGD(j)+FGD(j)+TV(j)
          +CI(j)+SGI(j)+FGI(j)+CAPI(j));

*IPN(i)..
*alphao(i)*PD(i)*Y(i)=e=PL*LD(i)+PK(i)*KD(i);

*PN(i)=e=PD(i)-sum(j,alpha(i,j))*CPDC(i)-ibt(i)*PD(i)-
*(PKTO*INVO(i))/(PD(i)*Y(i));

IPK(i)..
PK(i)=e=PKTO/(1-stca(i));

IPLD..
PL=e=PLT/(1-stin);

*Identities

IIGDT(j)..
TX(j)=e=sum(i,X(i,j));

IIGDD(j)..
TD(j)=e=sum(i,D(i,j));

IIGDI(j)..
TV(j)=e=sum(i,V(i,j));

IHHSAV..
HHS=e=mps*MH;

IHHEXP..
```

```
HHE=e=DMH-HHS-OTHEXO;

IAHHEXP..
AHHE=e=HHE/LADJ;

*Equilibrium

ELABOR..
sum(i,LD(i))=e=LSH+LMH;

EOUTPT(j)..
Y(j)=e=TX(j)+C(j)+SGEO(j)+FGEO(j)+CAPO(j)+E(j)-TV(j)-CI(j)-SGI(j)-
FGI(j)-CAPI(j);

DISPLAY BETA, PNO, GAMMA, SIGER;

*=================================================================
*V.  Variable Initialization
*=================================================================

*Industry

Y.L(i)    = YO(i);
VA.L(i)   = VAO(i);
LD.L(i)   = LDO(i);
KD.L(i)   = KDO(i);
X.L(i,j)  = XO(i,j);
D.L(i,j)  = DO(i,j);
V.L(i,j)  = VO(i,j);
R.L(i)    = RO(i);
E.L(i)    = EO(i);

*Household

LSH.L  = LSHO;
LMH.L  = LMHO;
LADJ.L = 1;
C.L(j)   = CO(j);
CI.L(j)  = CIO(j);
CR.L(j)  = CRO(j);
MH.L   = MHO;
DMH.L  = DMHO;
HHE.L  = HHEO;
HHS.L  = HHSO;
YLAB.L    = YLABO;
YCAP.L    = YCAPO;

*Identities

TX.L(j)   = sum(i,XO(i,j));
TD.L(j)   = sum(i,DO(i,j));
TV.L(j)   = sum(i,VO(i,j));

*Prices

PD.L(j)    = PDO(j);
PN.L(j)    = PNO(j);
PL.L       = PLO;
PLT.L      = PLTO;
PK.L(i)    = PKO(i);
CPDC.L(j)  = CPDCO(j);
```

```
*Capital Demand

CAPD.L(j) = CAPDO(j);
CAPI.L(j) = CAPIO(j);

*Government

SGI.L(j) = SGIO(j);
SGD.L(j) = SGDO(j);
FGI.L(j) = FGIO(j);
FGD.L(j) = FGDO(j);

*-------------------------------------------------------------------
*VI.  Variable Bounds
*-------------------------------------------------------------------

Y.LO(i) = .00001;
X.LO(i,j)$(XO(i,j) <> 0) = .00001;
X.LO(i,j)$(XO(i,j) = 0)  = 0;
X.UP(i,j)$(XO(i,j) = 0)  = 0;

VA.LO(i) = .00001;
LD.LO(i) = .0001;
KD.LO(i) = .0001;

R.LO(i)$(RO(i) <> 0) = .00001;   E.LO(i)$(EO(i) <> 0) = .00001;
R.LO(i)$(RO(i) = 0)  = 0;        E.LO(i)$(EO(i) = 0) = 0;
R.UP(i)$(RO(i) = 0)  = 0;        E.UP(i)$(EO(i) = 0) = 0;

D.LO(i,j)$(DO(i,j) <>0) = .00001;
D.LO(i,j)$(DO(i,j) = 0) = 0;
D.UP(i,j)$(DO(i,j) = 0) = 0;

V.LO(i,j)$(VO(i,j) <> 0) = .00001;
V.LO(i,j)$(VO(i,j) = 0)  = 0;
V.UP(i,j)$(VO(i,j) = 0)  = 0;

C.LO(j)$(CO(j) <> 0) = 0;
C.LO(j)$(CO(j) = 0)  = 0;
C.UP(j)$(CO(j) = 0)  = 0;

CI.LO(j)$(CIO(j) <> 0) = .00001;  CR.LO(j)$(CRO(j) <> 0) = .00001;
CI.LO(j)$(CIO(j) = 0)  = 0;       CR.LO(j)$(CRO(j) = 0)  = 0;
CI.UP(j)$(CIO(j) = 0)  = 0;       CR.UP(j)$(CRO(j) = 0)  = 0;

PD.LO(j)    = .00001;
PN.LO(j)       = .00001;
PK.LO(i)    = .0001;
CPDC.LO(j) = .00001;
PL.LO      = .00001;
PLT.LO  = .00001;

CAPD.LO(j)$(CAPDO(j) <> 0) = .00001;
CAPD.LO(j)$(CAPDO(j) = 0)  = 0;
CAPD.UP(j)$(CAPDO(j) = 0)  = 0;

CAPI.LO(j)$(CAPIO(j) <> 0) = .00001;   SGD.LO(j)$(SGDO(j) <> 0) =
.00001;
CAPI.LO(j)$(CAPIO(j) = 0) = 0;         SGD.LO(j)$(SGDO(j) = 0)  = 0;
CAPI.UP(j)$(CAPIO(j) = 0) = 0;         SGD.UP(j)$(SGDO(j) = 0)  = 0;
```

```
SGI.LO(j)$(SGIO(j) <> 0) = .00001;
SGI.LO(j)$(SGIO(j) = 0)  = 0;
SGI.UP(j)$(SGIO(j) = 0)  = 0;

FGD.LO(j)$(FGDO(j) <> 0) = .00001;
FGD.LO(j)$(FGDO(j) = 0)  = 0;
FGD.UP(j)$(FGDO(j) = 0)  = 0;

FGI.LO(j)$(FGIO(j) <> 0) = .00001;
FGI.LO(j)$(FGIO(j) = 0)  = 0;
FGI.UP(j)$(FGIO(j) = 0)  = 0;

*===================================================================
*STEP 3:  Solve and Results
*===================================================================

MODEL cge  "Oklahoma Tax CGE Model"   /all/;

*CGE.OPTFILE = 1;

*-------------------------------------------------------------------
*Replicating the base year.
*-------------------------------------------------------------------

*-------------------
*List Key Parameters
*-------------------

stin          = stinb;
stca(i)       = stcab(i);

sigvd(j)      = ELASS("sigvd",j);
sigvr(j)      = ELASS("sigvr",j);
sigsg(j)      = ELASS("sigsg",j);
sigfg(j)      = ELASS("sigfg",j);
sigca(j)      = ELASS("sigca",j);
siger(i)      = sigerb(i);
incel(j)      = ELASS("incel",j);
nu            = nub;
incls         = inclsb;
fr            = frb

*-----
*Solve
*-----

OPTION DECIMALS=6;

SOLVE cge using NLP minimizing Z;

STRIN    = stin*MH.L;
STRCA    = sum(i,stca(i)*PK.L(i)*KD.L(i));
TRIBT    = sum(i,ibt(i)*Y.L(i));

*-------------------------------
*Sending Results to Output File
*-------------------------------

FILE BASE;
PUT BASE;
```

```
SGI.LO(j)$(SGIO(j) <> 0) = .00001;
SGI.LO(j)$(SGIO(j) = 0)  = 0;
SGI.UP(j)$(SGIO(j) = 0)  = 0;

FGD.LO(j)$(FGDO(j) <> 0) = .00001;
FGD.LO(j)$(FGDO(j) = 0)  = 0;
FGD.UP(j)$(FGDO(j) = 0)  = 0;

FGI.LO(j)$(FGIO(j) <> 0) = .00001;
FGI.LO(j)$(FGIO(j) = 0)  = 0;
FGI.UP(j)$(FGIO(j) = 0)  = 0;

*===================================================================
*STEP 3:  Solve and Results
*===================================================================

MODEL cge  "Oklahoma Tax CGE Model"   /all/;

*CGE.OPTFILE = 1;

*-------------------------------------------------------------------
*Replicating the base year.
*-------------------------------------------------------------------

*-------------------
*List Key Parameters
*-------------------

stin          = stinb;
stca(i)       = stcab(i);

sigvd(j)      = ELASS("sigvd",j);
sigvr(j)      = ELASS("sigvr",j);
sigsg(j)      = ELASS("sigsg",j);
sigfg(j)      = ELASS("sigfg",j);
sigca(j)      = ELASS("sigca",j);
siger(i)      = sigerb(i);
incel(j)      = ELASS("incel",j);
nu            = nub;
incls         = inclsb;
fr            = frb

*-----
*Solve
*-----

OPTION DECIMALS=6;

SOLVE cge using NLP minimizing Z;

STRIN    = stin*MH.L;
STRCA    = sum(i,stca(i)*PK.L(i)*KD.L(i));
TRIBT    = sum(i,ibt(i)*Y.L(i));

*------------------------------
*Sending Results to Output File
*------------------------------

FILE BASE;
PUT BASE;
```

```
sigsg(j)       = ELASS("sigsg",j);
sigfg(j)       = ELASS("sigfg",j);
sigca(j)       = ELASS("sigca",j);
siger(i)       = sigerb(i);
incel(j)       = ELASS("incel",j);
nu             = nub;
incls          = inclsb;
fr             = frb;

*-----
*Solve
*-----

OPTION DECIMALS=6;

stca(i)=stcas(i);

SOLVE cge using NLP minimizing Z;

STRIN     = stin*MH.L;
STRCA     = sum(i,stca(i)*PK.L(i)*KD.L(i));
TRIBT     = sum(i,ibt(i)*Y.L(i));

*------------------------------
*Sending Results to Output File
*------------------------------

FILE SIM1;
PUT SIM1;
SIM1.ND = 4;
PUT 'SIM1'//;

PUT @13 'YO', @28 'Y', @43 'CO', @58 'C'//;
LOOP(j, put j.tl, @5 YO(j), @20 Y.L(j), @35 CO(j), @50 C.L(j)/);
PUT // @13 'TXO', @28 'TX', @43 'TDO', @58 'TD'//;
LOOP(j, put j.tl, @5 TXO(j), @20 TX.L(j), @35 TDO(j), @50 TD.L(j)/);
PUT // @13 'TVO', @28 'TV', @43 'CRO', @58 'CR'//;
LOOP(j, put j.tl, @5 TVO(j), @20 TV.L(j), @35 CRO(j), @50 CR.L(j)/);
PUT // @13 'CIO', @28 'CI', @43 'LDO', @58 'LD'//;
LOOP(j, put j.tl, @5 CIO(j), @20 CI.L(j), @35 LDO(j), @50 LD.L(j)/);
PUT // @13 'KDO', @28 'KD'//;
LOOP(j, put j.tl, @5 KDO(j), @20 KD.L(j)/);
PUT // @13 'RO', @28 'R', @43 'EO', @58 'E'//;
LOOP(j, put j.tl, @5 RO(j), @20 R.L(j), @35 EO(j), @50 E.L(j)/);

PUT // @13 'PDO', @28 'PD', @43 'PNO', @58 'PN'//;
LOOP(j, put j.tl, @5 PDO(j), @20 PD.L(j), @35 PNO(j), @50 PN.L(j)/);
PUT // @13 'CPDCO', @28 'CPDC', @43 'PKO', @58 'PK'//;
LOOP(j, put j.tl, @5 CPDCO(j), @20 CPDC.L(j), @35 PKO(j), @50 PK.L(j)/);

PUT // @13 'PLO', @28 'PL', @42 'PLTO', @58 'PLT'//;
PUT @5 PLO, @20 PL.L, @35 PLTO, @50 PLT.L;
PUT // @13 'stin'//;
put @5 stin;

PUT // @13 'LSO', @28 'LS', @43 'LMO', @58 'LM'//;
put @5 LSHO, @20 LSH.L, @35 LMHO, @50 LMH.L;
PUT // @13 'DMHO', @28 'DMH', @43 'HHEO', @58 'HHE'//;
put @5 DMHO, @20 DMH.L, @35 HHEO, @50 HHE.L;
PUT // @13 'HHSO', @28 'HHS'//;
put @5 HHSO, @20 HHS.L;
```

```
PUT // @13 'DMHO', @28 'ADMH', @43 'HHEO', @58 'AHHE'//;
PUT @5 DMHO, @20 ADMH.L, @35 HHEO, @50 AHHE.L;
PUT // @13 'CO', @28 'AC', @43 'CRO', @58 'ACR'//;
LOOP(j, put j.tl, @5 CO(j), @20 AC.L(j), @35 CRO(j), @50 ACR.L(j)/);
PUT // @13 'CIO', @28 'ACI'//;
LOOP(j, put j.tl, @5 CIO(j), @20 ACI.L(j)/);

PUT // @13 'YLABO', @28 'YLAB', @43 'YCAPO', @58 'YCAP'/;
PUT @5 YLABO, @20 YLAB.L, @35 YCAPO, @50 YCAP.L;

PUT // @13 'STRIN', @28 'stin', @43 'STRCA', @58 'IBT';
PUT / @5 STRIN, @20 stin, @ 35 STRCA, @50 TRIBT/;

PUTCLOSE SIM1;

*-------------------------------------------------------------------
*II.  Cut Personal Income Tax
*-------------------------------------------------------------------

stin          = stinb;
stca(i)       = stcab(i);

sigvd(j)      = ELASS("sigvd",j);
sigvr(j)      = ELASS("sigvr",j);
sigsg(j)      = ELASS("sigsg",j);
sigfg(j)      = ELASS("sigfg",j);
sigca(j)      = ELASS("sigca",j);
siger(i)      = sigerb(i);
incel(j)      = ELASS("incel",j);
nu            = nub;
incls         = inclsb;
fr            = frb;

*-----------
*Calibration
*-----------

*Production

alphao(i)                 = VAO(i)/YO(i);
rho1(j)$(CAPIO(j) > 0)    =
(PDO(j)/PWO(j))*(CAPDO(j)/CAPIO(j))**(1/sigca(j));
rho(j)                    = 1/(1+rho1(j));
capa(j)$(CAPIO(j) > 0)    = CAPO(j)/(rho(j)*CAPIO(j)**((sigca(j)-
1)/sigca(j))+
                            (1-rho(j))*CAPDO(j)**((sigca(j)-
1)/sigca(j)))**
                            (sigca(j)/(sigca(j)-1));
alpha(i,j)                = XO(i,j)/YO(i);
beta(i)                   = (PLO*LDO(i))/VAO(i);
vaa(i)                    = VAO(i)/((LDO(i)**beta(i))*(KDO(i)**(1-
beta(i))));
PNO(i)                    = PDO(i)-sum(j,alpha(i,j))*CPDCO(i)-ibt(i)*
                            PDO(i)-(PKTO*INVO(i))/(PDO(i)*YO(i));
mu1(i,j)$(NZVD(i,j))      =
(PDO(j)/PWO(j))*(DO(i,j)/VO(i,j))**(1/(sigvd(j)));
mu(i,j)                   = 1/(1+mu1(i,j));
vda(i,j)$(NZVD(i,j))      = XO(i,j)/((mu(i,j)*VO(i,j)**((sigvd(j)-
1)/sigvd(j)))
```

```
                              +((1-mu(i,j))*DO(i,j)**((sigvd(j)-
1)/sigvd(j))))
                              **(sigvd(j)/(sigvd(j)-1));
gamma1(i)                  = (PDO(i)/PWO(i))*(RO(i)/EO(i))**(-1/siger(i));
gamma(i)                   = 1/(1+gamma1(i));
era(i)                     =
YO(i)/(gamma(i)*EO(i)**((1+siger(i))/siger(i))
                              +(1-gamma(i))*RO(i)**((1+siger(i))/siger(i)))
                              **(siger(i)/(1+siger(i)));

*Consumption

phio                     = (PLTO*LSHO*incls)/(PLTO*LSHO*incls-HHEO);
phi2(j)                  = (CPDCO(j)*CO(j)*incel(j)*(1-phio))/HHEO;
phi1                     = 1-sum(j,phi2(j))-phio;
phi(j)                   = (1+phi1/sum(i,phi2(i)))*phi2(j);
phi3                     = sum(j,phi(j))+phio;
gam(j)                   = CO(j)+(phi(j)/((1-phio)*CPDCO(j)))*(HHEO/fr);
psi                      = LSHO+(phio/((1-phio)*PLTO))
                           *(HHEO-sum(j,CPDCO(j)*gam(j)));
lam1(j)$(CIO(j) > 0)     = (PDO(j)/PWO(j))*(CRO(j)/CIO(j))**(1/sigvr(j));
lam(j)                   = 1/(1+lam1(j));
vra(j)$(CIO(j) > 0)      = CO(j)/(lam(j)*CIO(j)**((sigvr(j)-1)/sigvr(j))
                           +(1-lam(j))*CRO(j)**((sigvr(j)-1)/sigvr(j)))
                           **(sigvr(j)/(sigvr(j)-1));

*Government

pi1(j)$(SGIO(j) > 0)       =
(PDO(j)/PWO(j))*(SGDO(j)/SGIO(j))**(1/sigsg(j));
pi(j)                      = 1/(1+pi1(j));
sgea(j)$(SGIO(j) > 0)      = SGEO(j)/(pi(j)*SGIO(j)**((sigsg(j)-
1)/sigsg(j))
                              +(1-pi(j))*SGDO(j)**((sigsg(j)-1)/sigsg(j)))
                              **(sigsg(j)/(sigsg(j)-1));
epsi1(j)$(FGIO(j) > 0)     =
(PDO(j)/PWO(j))*(FGDO(j)/FGIO(j))**(1/sigfg(j));
epsi(j)                    = 1/(1+epsi1(j));
fgea(j)$(FGIO(j) > 0)      = FGEO(j)/(epsi(j)*FGIO(j)**((sigfg(j)-
1)/sigfg(j))
                              +(1-epsi(j))*FGDO(j)**((sigfg(j)-
1)/sigfg(j)))
                              **(sigfg(j)/(sigfg(j)-1));

*-----
*Solve
*-----

OPTION DECIMALS=6;

stin=stins;

SOLVE cge using NLP minimizing Z;

STRIN     = stin*MH.L;
STRCA     = sum(i,stca(i)*PK.L(i)*KD.L(i));
TRIBT     = sum(i,ibt(i)*Y.L(i));

*-------------------------------
*Sending Results to Output File
*-------------------------------
```

```
FILE SIM2;
PUT SIM2;
SIM2.ND = 4;
PUT 'SIM2'//;

PUT @13 'YO', @28 'Y', @43 'CO', @58 'C'//;
LOOP(j, put j.tl, @5 YO(j), @20 Y.L(j), @35 CO(j), @50 C.L(j)/);
PUT // @13 'TXO', @28 'TX', @43 'TDO', @58 'TD'//;
LOOP(j, put j.tl, @5 TXO(j), @20 TX.L(j), @35 TDO(j), @50 TD.L(j)/);
PUT // @13 'TVO', @28 'TV', @43 'CRO', @58 'CR'//;
LOOP(j, put j.tl, @5 TVO(j), @20 TV.L(j), @35 CRO(j), @50 CR.L(j)/);
PUT // @13 'CIO', @28 'CI', @43 'LDO', @58 'LD'//;
LOOP(j, put j.tl, @5 CIO(j), @20 CI.L(j), @35 LDO(j), @50 LD.L(j)/);
PUT // @13 'KDO', @28 'KD'//;
LOOP(j, put j.tl, @5 KDO(j), @20 KD.L(j)/);
PUT // @13 'RO', @28 'R', @43 'EO', @58 'E'//;
LOOP(j, put j.tl, @5 RO(j), @20 R.L(j), @35 EO(j), @50 E.L(j)/);

PUT // @13 'PDO', @28 'PD', @43 'PNO', @58 'PN'//;
LOOP(j, put j.tl, @5 PDO(j), @20 PD.L(j), @35 PNO(j), @50 PN.L(j)/);
PUT // @13 'CPDCO', @28 'CPDC', @43 'PKO', @58 'PK'//;
LOOP(j, put j.tl, @5 CPDCO(j), @20 CPDC.L(j), @35 PKO(j), @50 PK.L(j)/);

PUT // @13 'PLO', @28 'PL', @42 'PLTO', @58 'PLT'//;
PUT @5 PLO, @20 PL.L, @35 PLTO, @50 PLT.L;
PUT // @13 'stin'//;
put @5 stin;

PUT // @13 'LSO', @28 'LS', @43 'LMO', @58 'LM'//;
put @5 LSHO, @20 LSH.L, @35 LMHO, @50 LMH.L;
PUT // @13 'DMHO', @28 'DMH', @43 'HHEO', @58 'HHE'//;
put @5 DMHO, @20 DMH.L, @35 HHEO, @50 HHE.L;
PUT // @13 'HHSO', @28 'HHS'//;
put @5 HHSO, @20 HHS.L;

PUT // @13 'DMHO', @28 'ADMH', @43 'HHEO', @58 'AHHE'//;
PUT @5 DMHO, @20 ADMH.L, @35 HHEO, @50 AHHE.L;
PUT // @13 'CO', @28 'AC', @43 'CRO', @58 'ACR'//;
LOOP(j, put j.tl, @5 CO(j), @20 AC.L(j), @35 CRO(j), @50 ACR.L(j)/);
PUT // @13 'CIO', @28 'ACI'//;
LOOP(j, put j.tl, @5 CIO(j), @20 ACI.L(j)/);

PUT // @13 'YLABO', @28 'YLAB', @43 'YCAPO', @58 'YCAP'/;
PUT @5 YLABO, @20 YLAB.L, @35 YCAPO, @50 YCAP.L;

PUT // @13 'STRIN', @28 'stin', @43 'STRCA', @58 'IBT';
PUT / @5 STRIN, @20 stin, @ 35 STRCA, @50 TRIBT/;

PUTCLOSE SIM2;
```

VITA

Ronald Allan Endsley

Candidate for the Degree of

Doctor of Philosophy

Thesis: DYNAMIC TAX ANALYSIS FOR OKLAHOMA: A COMPUTABLE GENERAL EQUILIBRIUM APPROACH

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Biographical:

Personal Data: Born in Excelsior Springs, Missouri, On February 25, 1967, the son of Jim and Glynda Endsley

Education: Graduated from Excelsior Springs High School, Excelsior Springs, Missouri in May 1985; received Bachelor of Science degree in Business Administration and a Master of Art degree in Economics from Central Missouri State University, May 1990 and May 1992, respectively. Completed the requirements for the Doctor of Philosophy degree at Oklahoma State University in December 1999.

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