A GENERAL EQUILIBRIUM ANALYSIS OF PROPERTY TAX IN FLORIDA

By

MIKE O'CONNELL

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

2007

To Roberta Hammond with love and gratitude

ACKNOWLEDGMENTS

I thank my dissertation committee, Robert Emerson, Burl Long, David Mulkey and David Denslow for their forbearance, patience, help and advice.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

A GENERAL EQUILIBRIUM ANALYSIS OF PROPERTY TAX IN FLORIDA

By

Mike O'Connell

December 2007

Chair: Robert Emerson
Major: Food and Resource Economics

This dissertation uses a general equilibrium model to analyze the effects of property tax policy on various industrial sectors of the economy and on the distribution of income. A general equilibrium model is an established methodology used to evaluate the impact of tax policy. The empirical basis for the model is a social accounting matrix that includes a production section transforming intermediate inputs, labor and capital factors into commodity output for the domestic and export market. The domestic commodities are allocated to intermediate inputs and final consumption by household groups, government and the investment sector.

The behavior of producers and consumers is described by the optimization of profit and utility functions subject to technological and income constraints. There are nine household groups distinguished by income and twelve industry sectors which include owner-occupied housing. The dissertation research consists of running counterfactual scenarios with the model. Each scenario represents an alternative treatment of the ad valorem property tax.

The general equilibrium model formulation with multiple economic agents and institutions permits the estimation of the detailed and systematic impacts of public policy. As with any positive economic approach, the evaluation of policy presents an objective assessment that gives support to decision making. An important conclusion of the research is that the total

consumption by household groups as a welfare measure of the change in public policy indicates a clearly neutral impact. There are differences across income groups as to their consumption of owner-occupied housing. Another conclusion of the research is that there are significant differences in the productive output and use of factor inputs of the various industrial sectors. The change in tax policy also has a positive effect on the housing sector which is composed of owner-occupied housing and real estate which includes rentals.

CHAPTER 1
INTRODUCTION

Taxes are certain and controversial with none more controversial than local government property taxes. Over the last several decades there has been what could be characterized a citizen's revolt against property taxes with a number of legislative actions such as circuit breakers and tax limitation programs. In 1995, the State of Florida introduced a property tax initiative called Save Our Homes. Under Save Our Homes, the increase in taxable value of a residence is limited to three percent a year or less.

As a source for state and local government spending, ad valorem taxes and sales taxes are by far the largest revenue base (Table 1-1). In Florida, an advantage of the sales tax is that a share is paid by nonresidents due to the tourism industry; a disadvantage is that sales tax collections follow the cyclicality of the national economy due to the cyclicality of tourism. At a local level there is a recurring conflict between the requirements for education expenditure at the local level which is primarily funded with ad valorem taxes and property tax relief. The state must evaluate the benefits and costs of one tax source over another. This estimation procedure and resulting decisions with regard to tax collection and spending is a basic application in the field of public economics which deals with the efficiency and equity of government policy.

The research or economic problem addressed in this dissertation is that of establishing a method or tool to assist in choosing the optimal policy in terms of efficiency and fairness. In making the policy analysis and decision, the state evaluates the impact that alternative policies will have on the specific industry sectors, consumers and the overall economy. Government expenditures and revenue collection decisions have an impact on industrial sectors and household groups which in turn have a reciprocal effect on state and local governments. These

shared interactions are described in a model representation where the economic outcome of all agents and institutions is endogenously determined.

A reliable and comprehensive method for conducting the tax policy analysis is not only necessary but fundamental to the types of factors contributing to the outcome of the policy choice. The economic model utilized in this dissertation is a computable general equilibrium (CGE) model. Besides providing detailed information on the individual business sectors and households in the economy, it provides a complete representation of the overall state or regional economy.

The research objective is to determine equilibrium solutions resulting from alternative tax policies through a CGE model as a complete implementation of public policy analysis. Different choices of tax policies are evaluated by examining the alternative equilibria of the economic model that are brought about from changing policy parameters. The CGE model has nine household groups and twelve industry sectors. The model incorporates the state's tax structure.

Three scenarios will be developed with the model to simulate the outcome of alternative tax policy decisions. The analysis will be conducted using the Harberger equal revenue yield procedure where all scenarios maintain the same level of government services. This procedure allows for the separation of the effects of changes in tax policy from changes in the provision of public goods. An examination of the compound effects of a change in revenue and consequent change in public expenditures is relevant but as an initial approach to evaluating tax policy the Harberger procedure is fundamentally important. The approach used in this dissertation can be seen as the first stage in a full analysis. The next stage would be the balanced budget approach.

This topic is an interesting and important one since the 2007 Florida legislature is currently considering changes in the property tax system. Existing tax policy analysis typically concerns

itself with the direct estimation of changes to general revenue funds with strong ceteris paribus assumptions regarding the behavior of economic agents. It is rare for actual tax policy analysis to consider the impact on income distribution of households.

It has been observed that, over time, the distribution of income, both nationally and regionally, has become more unequal. A recent study of the changing pattern of the distribution of income in the United States has been conducted by Dew-Becker and Gordon (2005). The increasing inequalities of income at the top end of the distribution and recent demographic trends have increased the demand for real property in Florida especially in the coastal areas. Upper pressure on real estate prices has prompted the current legislative activity with regards to property tax policy.

The CGE model developed in this dissertation analyzes the effects of changes in property tax policy on various sectors of the economy in the State of Florida and on the distribution of income. By using a CGE model and equal-yield differential tax analysis to study tax policy, this document attempts to makes an original contribution to the field of public economics. A CGE model can incorporate multiple household agents classified according to income. This formulation allows for an assessment of the distributional impact of a change in property taxes.

A general equilibrium model is an established methodology used to evaluate the efficiency and equity of tax policy. The model describes the interactions between multiple markets, sectors and economic agents with the weakest level of ceteris paribus assumptions. Estimation of the feedback effects between interrelated markets and sectors of the economy is essential for determining the final incidence of tax policy and evaluating its distributional and equity impacts. The distributional impact of these programs in terms of their progressivity or regressivity

depends on the incidence of the property tax. The CGE model is used to evaluate the real property tax system within the capital theory of tax incidence

The research was conducted by utilizing the IMPLAN[1] regional database in the construction of a Florida Social Accounting Matrix (SAM). The GAMS (General Algebraic Modeling System) MPSGE (Mathematical Programming System for General Equilibrium) software program was used. This software was originally developed in 1987 by the World Bank.

The State of Florida's tax system is composed of several different tax categories. Table 1-1 presents information on tax sources for general revenue funds as reported by the Florida Department of Revenue and state legislature. Direct taxes are levied on individuals or corporations. Indirect taxes such as sales taxes are imposed on a selection of commodities. Florida has been eliminating the direct revenue source of intangible tax over several years (2002-2005).

Table 1-1: Source of taxes in Florida

2003-04	$ 1,000,000
Sales and use tax	17,814.1
Motor & special fuel taxes	2,017.7
Corporation income tax	1,344.7
Documentary stamp tax	2,632.1
Intangibles tax	857.1
Beverage licenses and tax	624.3
Cigarette and tobacco products tax	446.4
Motor vehicle. & mobile home annual reg.	608.3
Ad valorem taxes	22,405.2
All others	11,091.4

2005 Florida Tax Handbook

An important fact about the relative size of taxes and public spending in Florida is that it ranks near the bottom when compared to levels of other states. It is 48th out of 50 in terms of per capita revenue production. The amount of revenue relative to the state's overall economic

[1] IMPLAN is an economic impact modeling system produced by the Minnesota IMPLAN Group since 1993.

activity has a telling influence on the magnitude of changes in tax policy and the conclusions of this dissertation.

There are three important conclusions that have policy implications. First, the size of the impact of the simulated tax policy is small in terms of final consumption of households as a measure of welfare. Second, the housing services sector which is composed of owner-occupied housing and real estate is positively impacted by the change in property tax policy. Third, the lower income household groups are impacted to a greater degree from the reduction in property taxes in terms of their consumption of owner-occupied housing.

These aspects of the model conclusions are noteworthy. If the welfare of households is the primary valuation of the benefits of public policy, then the insignificant resulting impacts on the distribution of income from the elimination of the property tax represent a neutral appraisal. The positive impacts on specific industries are significant. The individual outcomes of the model's industrial sectors are linked to their relative share of taxes paid and their factor intensity.

An interesting outcome of the counterfactual simulations is the transfer of capital between industries. Of those sectors that are positively affected by the change in tax policy, there is a movement of capital to certain industries. There is an increase in labor in those industries losing capital so that their output remains positive. At the institutional scale level, there is a substitution of investment for household consumption. Once again the magnitude of the substitution is slight but it does show the consequences of a change in a capital tax.

The results of the general equilibrium analysis can be used to present a comprehensive and informative perspective. As with any positive economic approach, the evaluation of public policy functions is an objective assessment that gives support to decision making. The model result of consumption being replaced by investment indicates a need for further research utilizing

a dynamic CGE model where the flow of capital services is related to the capital stock and additional investment could lead to an expansion of consumption in the future due to increased capacity.

The next section will consist of a literature review on general equilibrium modeling and tax policy evaluation. A methodology section will follow with a description of the equations that constitute the CGE model. The methodology section will also explain the social accounting data matrix and equal yield differential tax analysis. The next section, on data analysis, will describe the economy using the summary data from the social accounting matrix (SAM). The IMPLAN SAM will form the source data for the empirical model. The dissertation will conclude with the results of the model simulation and discussion.

CHAPTER 2
LITERATURE REVIEW

Theoretical Literature

General equilibrium modeling is based on microeconomic theory which describes the behavior of firms as maximizing profit subject to a technology constraint and households as maximizing utility subject to a budget constraint. The theory results in the derivations of demand and supply functions which serve as central equations in the model. Prices are determined by the equality of supply and demand within factor and commodity markets. The microeconomic foundations of general equilibrium modeling have been thoroughly explained by Ginsburgh and Keyzer (1997), Starr (1997), and Katzner (1989).

General equilibrium modeling roots extend back to the neoclassical economists of the nineteenth century, especially Walras (1834-1910). His contribution to and continuing influence on general equilibrium theory is evident from the role that "Walras' law" plays in the modern treatment of the theory. Walras created a mathematical model of the economy consisting of an interdependent system of supply and demand equations. Any single market equation was redundant in that if the rest of the system was in equilibrium, then by definition the sole remaining equation would also balance.

The Edgeworth-Bowley box (Edgeworth (1845-1926) and Bowley (1869-1957)) is a standard method for examining the multi-market clearing function of prices by graphing a two-industry or two-household economy. The interdependent markets adjust simultaneously. This simple framework allows for the representation of the efficiency of a multi-market or multi-agent equilibrium allocation. The efficiency of equilibrium is represented by the condition that the rate at which the individual agent is willing to exchange goods must be equal to the rate at which they

are required to trade. These rates are the consumer's marginal rate of substitution, the producer's rate of product transformation and the price ratio.

This basic Edgeworth-Bowley model demonstrates the possibilities that open up when dealing with a multi-market and multi-agent setting. The equilibrium allocation takes on additional significance in terms of its efficiency. A market outcome is Pareto efficient if no agent can improve his situation with further trades without making some other agent worse off. The First Welfare Theorem demonstrates that the competitive market price equilibrium is a Pareto efficient allocation. .

The multi-market and multi-agent framework also allows for the possibilities of introducing the concepts of social welfare and the equity or distributional property of the equilibrium allocation. This critical attribute of the equilibrium solution will play an essential role in this dissertation. Another significant property of a general equilibrium solution is its existence.

The theoretical basis for the existence of a general equilibrium model solution was established forty years ago by Arrow (1971, 1974), Debreu (1959) and Scarf (1967, 1973). Along with postulating the critical assumptions necessary for a solution, the Arrow-Debreu general equilibrium model uses a fixed-point theorem to prove the existence of an equilibrium solution.

General equilibrium models are mainly built to analyze the effects of real world policy on the economy. At this point they are called applied or computable general equilibrium models. Thus, the ability to actually establish an equilibrium given empirical data is essential. The fixed point mapping can be developed into a numerical algorithm that converges to a solution of the model as established by Scarf (1967, 1973). The numerical recalculation of an equilibrium

solution comes into play when a policy variable is changed in order to determine its effect on the model's solution

Empirical Literature

A computable or applied general equilibrium model (CGE) is the empirical application of general equilibrium theory using real world data and practical solution algorithms. This research effort makes it possible to estimate the economic response to policy changes. Shoven and Whalley (1984 and 1992) laid the groundwork for much of this activity. They used their applied models to analyze trade and tax policy. Other general introductions are those by Gunning and Keyzer (1995), and by Kehoe and Kehoe (1994).

A CGE model is made up of a system of demand and supply equations, income identities and other functions. The general equilibrium model can be represented as a system of nonlinear equations and solved as such. The model's parameters or coefficients are calibrated rather than estimated. The model is calibrated when its initial solution reproduces or replicates the benchmark data. The primary or benchmark database used in the calibration process to derive the model equation's parameter values takes the form of a social accounting matrix (SAM).

A social accounting matrix is a comprehensive mapping of the structure of the economy. It describes by the means of accounts represented by rows and columns of a table the production process of industries, the returns to factor markets, final demand for commodities, the external balance and the distribution of income among institutional agents. It is the inclusion of the income accounts of households that makes general equilibrium analysis wholly suited for assessing the equity outcomes and redistribution effects of policies.

The system's parameterized equations produce the equilibrium prices and quantities for all the endogenous variables as observed in the SAM database. By changing a parameter or exogenous variable, a counterfactual equilibrium of the general equilibrium model can be

simulated and compared to the benchmark solution. Conclusions about the impact of policy can be drawn from the change in the model's equilibrium variables, especially the welfare change in the level and distribution of income.

The early CGE models in the 1970s and 1980s were national in scale. National CGE models benefit from the prevalence of data, such as the National Product and Income Accounts and the Input-Output Accounts compiled by the Bureau of Economic Analysis (BEA). Later, in the 1990s, regional CGE models were built. A major review of regional general equilibrium models was done by Partridge and Rickman (1998). The amount and detail of data needed for a CGE model is acutely limiting on the regional level as compared to the national and international levels.

IMPLAN Based Regional CGE Models

One existing source of data that can form the basis for constructing a regional CGE model is the commercial IMPLAN software product and related database. IMPLAN is primarily used for economic impact analysis by means of an extended input-output methodology which generates employment, income and output multipliers. It was initially developed by the USDA Forest Service. IMPLAN develops a regional SAM as part of its analysis procedures. The SAM is then available as a stand-alone structure.

There have been a number of regional CGE models built using the IMPLAN SAM. Some models represent prototypes that serve as standard examples for a cluster of individual research efforts. These prototypes can be characterized by the particular specification of the IMPLAN SAM. The problem being addressed determines the way in which a SAM is specified.

In order to understand the prototype variations, it is necessary to present the structure of the standard IMPLAN SAM. The columns and rows of the SAM are indexed by the following ordered list: industrial sectors, commodities, factors of production, institutions and foreign trade.

IMPLAN has 509 different industries and commodities which can be aggregated according to the characteristics of the subject matter being investigated.

Proceeding down the first column of Appendices A and B, collection of industries, there is a use matrix that corresponds to an input-output table. Next there are the factors of production and indirect business taxes. The labor and capital factor inputs follow the BEA classifications where employment compensation and proprietor income are assigned to labor returns and other property income is assigned to the return to capital. The final element is the use of imports in the production process.

The next column corresponds to a set of commodities which is composed of a make matrix that represents the output of industries and an institutional make matrix that represents the output of institutions. The latter matrix is unique to the IMPLAN SAM and is derived from the negative entries in the BEA accounts. Institutions consist of households distinguished by income levels, government (federal, state and local), enterprise and capital (investment and inventory change).

The factor column is the distribution of factor returns to institutions and the imports of factors. Factor imports are unique to the IMPLAN SAM and are derived as residuals. The institutional column consists of final demand of commodity, inter-institutional transfers and commodity imports. The final column represents exports of commodities by industries and institutions. Institutional exports are also unique to the IMPLAN SAM.

The State of Oklahoma IMPLAN CGE is documented in the web book by Vargas and Schreiner (1996). This Oklahoma CGE model has served as the basis for numerous dissertations and research articles such as Budiyanti (1990) and Koh (1991). A frequent re-specification of the IMPLAN SAM is to move indirect business tax from factor returns to the government row of

the institution sector. An individual feature of each prototype is how it translates the BEA income categories into the factors of production, land, labor and capital. As with all regional IMPLAN CGE models, employment compensation is readily consigned to labor. The Budiyanti (1990) Oklahoma IMPLAN CGE model translates proprietor income as capital and other property income as returns to land.

The Koh (1991) Oklahoma IMPLAN CGE model translates other property income as capital which seems to be the general practice in these types of models. Koh allocates proprietor income between capital and labor. Land is derived from an external calculation and both models assign land only to the agricultural sector. Both SAMs lack an institutional make matrix but both have labor inputs into the household and government institutions.

Another early example of a regional CGE model is the Ohio model by Kraybill and Pai (1995). This Ohio CGE model has formed the basis of a number of dissertations and research articles such as Seung (1996) and Seung and Kraybill (1999, 2001). The model has two factors of production, labor and capital. This is true for most of the CGE models covered in this section. The Ohio model considers federal government expenditures as an exogenous part of the external trade or rest of world sector.

One current version of the IMPLAN model is the Washington-Idaho regional CGE model developed by Stodick, Holland and Devadoss (2004). This model is based on the International Food Policy Research Institute (IFPRI) Standard CGE model (Lofgren, Harris, et al. 2001). The interindustry use matrix is import-laden which means that imported commodities that are used in production are combined with domestic inputs in the SAM. Institutional imports are totaled and relocated to the commodity make column. Industrial and institutional exports are combined and relocated to the final demand commodity row.

The United States Department of Agriculture (USDA) CGE model was developed by Hanson and Vogel (1998, 2000). It is based on the USDA/ERS CGE model by Robinson, Kilkenny, et al. (1990). Hanson and Vogel's adjustments to the basic IMPLAN SAM are used in this dissertation. They perform major revisions to the structure of the IMPLAN SAM. Domestic and imported commodities are combined for intermediate and final demand. The difference between the investment institution column and its row represents net savings which is typically negative for low income households. Net savings replaces the investment institution row in the inter-institutional transfer matrix and its corresponding column is zeroed out.

The institutional make and export matrix which represent negative final demands are recombined with the final demand matrix. Indirect business taxes are moved from factor returns to the government institution account. This particular re-specification was encountered in the first two SAM prototypes. In the standard IMPLAN SAM other property income is mapped to the enterprise institution and then from the enterprise account to other institutions. In the USDA SAM, other property income is mapped directly to the appropriate corresponding institutional account. The enterprise account becomes a balancing account for adjustment made to other SAM components.

Another recent version of the IMPLAN based model is the Rutherford regional CGE model (2004). In the Rutherford SAM the intermediate and final demand sectors are import-laden. Industry and institution exports are combined to form total exports. The institutional make and exports are assigned to proprietor income and factor imports are assigned to factor endowment. The base data are adjusted and standardized to guarantee that they balance.

There are a number of individual regional CGE models that use the IMPLAN SAM (Berck, Goland, et al. (1996); Hoffmann, Robinson, et al., (1996)). The former CGE model was

designed to examine the fiscal policy of the California state tax system. Two other relevant instances of IMPLAN regional general equilibrium models that were used to evaluate state property tax program initiatives are those created by Julia-Wise, et al. (2002) and Waters, et al. (1997). Because the programs that they analyzed were linked to public education expenditures, their models used a balanced budget incidence approach whereby a change in revenue is accompanied by a corresponding change in expenditure so as to maintain a balanced budget. Equal-yield differential tax analysis is in contrast to the Julia-Wise et al. and Waters et al. method with a revenue-neutral approach "where government activity is held fixed in real terms, and the direct incidence of taxes is shifted from one set of economic factors to another (Waters et al. (1997), p. 75)."

However, the balanced budget type of analysis method "precludes comprehensive welfare comparisons (Waters et al. (1997), p. 75)." Both papers use the same methodology and result in the income distributional impacts of property tax policy. These articles are thus exemplars for this dissertation and serve as the basis for a crucial extension. Knowledge of the change in income distribution given a change in the consumption of public goods does not permit a judgment as to who is better or worse off due to the change in tax policy. Given a similar tax policy situation and method this dissertation conducts a revenue-neutral or equal-yield tax policy analysis and examines the distributional effects.

Tax Policy Analysis

There are a number of taxes that the government may employ to collect revenue. Tax policy in general analyzes the different taxes as to their efficiency and equity. The latter concept is related to the incidence of a tax or who actually pays it. Equity consists of how that burden is distributed across those individuals paying the tax.

The inequity of the income distribution of households and whether it is increasing over time has been the subject of numerous articles, studies and editorials (Berliner 2007; Wheelan 2007; and Levy 2002). A few have looked specifically at the State of Florida (Kim 2004; Lynch 2003 and the Economic Policy Institute 2002). A complete set of papers on the topic of tax policy and income inequality can be found in the edited books by Bradford (1995) and Hassett and Hubbard (2001).

The hypothesis of who pays the property tax has been explained from at least two different theoretical perspectives. The different arguments are covered in an extensive collection of sources such as Aaron (1975), Blake (1979 and 1981), Fisher (1996), Raimondo (1992), Hamilton (1976), Mieszkowski (1972), and Zodrow (1986, 2001). The new or capital view represents the property tax as a tax on capital and the owners of capital. The tax cost is capitalized into the value of the land and improvements.

The old or traditional view is that the tax burden falls upon consumers and producers who own real property. Business firms depending on the elasticity of demand for their product are able to shift the tax onto the purchasers of their goods and services as an increase in costs. Households are unable to shift the tax. However, households are seen as receiving a corresponding benefit from their contribution towards the provision of public services. Thus property tax is viewed as a benefit payment or user charge.

Mieszkowski (1972) attempted to reconcile the two viewpoints making a distinction between the national and local effects of property taxes. Local differences from a global average property tax rate would create an excise-like tax that affects prices and land use allocation between low and high tax areas. The reduction or elimination of the state's property tax results in a regional difference from the national average. The transfer of real property ownership title

to out-of-state residents is crucially important to the Florida real estate market. There is a contrast between the exchange of productive factors and the exchange of the commodities made up of those factors.

The application of a quasi national model with fixed factors of production and an open exchange of goods seems appropriate to the study of the local components of tax policy where land is immobile but its ownership is highly mobile. The CGE model solution represents the equilibrated rate of return on capital. Investment in the model is endogenous and responds to the price of capital.

Property tax is definitely seen as a tax on capital assets which includes land and improvements to the land. Two types of property are modeled: residential and non-residential. Residential property is categorized as owner-occupied and rental housing. Non-residential includes industrial and commercial property.

Harberger is a forerunner of empirical tax policy analysis (1959, 1962 and 1966). His major focus was corporate income tax but the methodology that he created has been used to analyze other taxes. His approach to tax policy analysis is called equal-yield equilibrium where the yield refers to the amount of revenue collected. Harberger's rudimentary general equilibrium model was composed of two goods and two consumers. The problem with examining the impact of changing, introducing or eliminating a tax is that the resulting change in public expenditures would confound the welfare effects and prevent the separate measurement of the impact of the tax as opposed to the altered consumption bundle demanded by households. If there could be an offsetting change in another revenue source so as to maintain a constant level of government, then the unique effect of the subject tax could be estimated. This approach to examining the

welfare consequences of the tax policy analysis is also referred to as revenue-neutral or differential tax analysis (Musgrave, 1959).

The technique of equal-yield differential tax policy analysis holds the real value of government expenditures constant by adjusting an alternative tax instrument while the impact of the existing tax is estimated. The level of the former tax rate becomes an endogenous variable that adjusts so as to maintain the value of public spending constant.

CHAPTER 3
METHODOLOGY

The General Equilibrium Model

The general equilibrium model is composed of market exchanges and transactions between economic agents such as households, firms, government, capital, and the foreign sectors. It describes the interdependent behavior of economic agents. Each product and factor market is characterized by a demand equation, a supply equation and a market clearing condition. The behavior of firms is characterized by the purchase of factors of production from households and intermediate goods from other firms in order to produce commodities so as to maximize its profits.

Commodity sector supply is built up from the individual producers within that sector. Each sector, Y, produces a domestic commodity, D, and an export commodity, E, according to a constant elasticity of transformation (CET) function

$$Y_i = \left[\theta_i D_i^{1+\eta} + (1-\theta_i) E_i^{1+\eta}\right]^{1/(1+\eta)} \qquad 3\text{-}1$$

The production process is represented by a nested function of intermediate goods, labor and capital. At the lowest level the composite intermediate inputs are made up of domestic and imported commodities. These inputs are a constant elasticity of substitution (CES) Armington function of domestic and imported commodities.

$$X_i = \left[\beta_i XD_i^{\rho} + (1-\beta_i) XM_i^{\rho}\right]^{1/\rho} \qquad 3\text{-}2$$

The composite intermediate goods enter the production process via a Leontief function where a_i is a share parameter greater than zero and summing to one.

$$Y = \min_i \left[x_i / a_i\right] \qquad 3\text{-}3$$

Capital and labor factors enter as a Cobb-Douglas value added function. Capital is an inclusive term which contains the flow of services from all productive assets whether they are physical equipment or improved land and real property. Finally, the value added and the composite intermediate goods are incorporated into a Leontief function at the highest level of nesting. These technological equations enter into a cost minimizing optimization process to derive cost and demand functions that are components of the CGE model.

Taxes are introduced into the CGE model either as a tax on output or as a tax on the inputs to production. The sales tax which is a tax on output is paid for on a gross basis (1 + tax rate) and the capital tax which is a tax on inputs is paid for on a net basis (1 – tax rate). Given the tax system in Florida the majority of taxes will enter as indirect business taxes on output. Property taxes are introduced as a tax on the capital input.

Final demands by households, government and investment are modeled by a Cobb-Douglas (CD) Armington function of domestic and imported goods.

$$A_i = D_j^{\alpha D_i} M_j^{\alpha M_i} \qquad 3\text{-}4$$

The structure of the CGE model is illustrated by Figure 3-1 which was used by Rutherford and Paltsev (1999) and Rutherford and Light (2001). Output (Y) is produced by means of labor (L) and capital (K) which are supplied by households. Intermediate goods (A) which are an Armington aggregate of domestic (D) and imported goods (M) are also an input to the production of output. Output is distributed between the export sector (E) and domestic market via a constant elasticity of transformation function. The Armington composite good is purchased by final consumption (C), government (G) and investment (I). Households consume final goods (C), public services (G) and save or borrow funds (I).

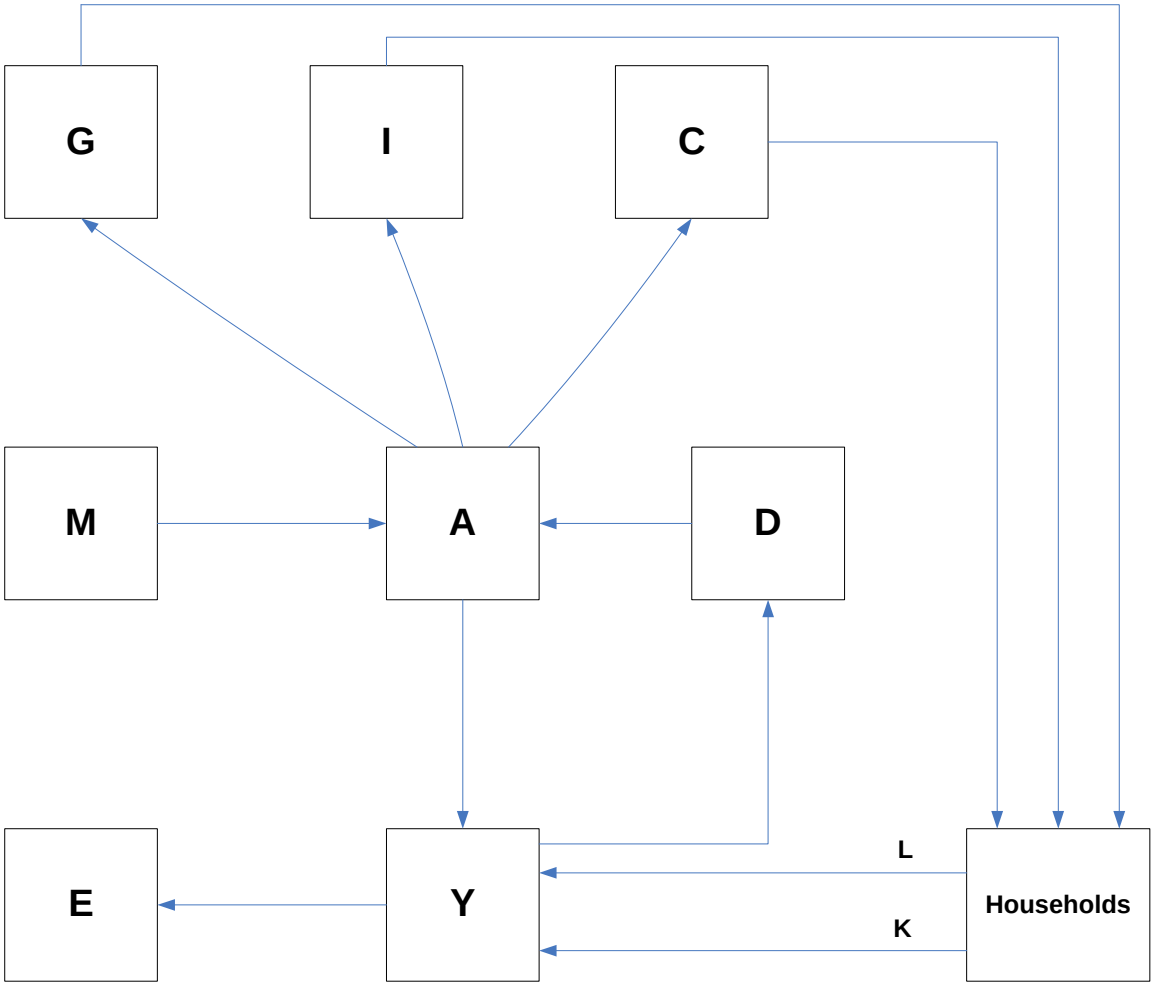

Figure 3-1: CGE framework

In addition to the household block with its endowment of labor and capital, there is a government block with analogous endowments of labor and capital tax revenue. Capital tax revenue contains the corporate income tax as well as property tax. Besides consuming final goods and borrowing funds the government makes transfers to other institutions. The investment block's capital endowment represents accrued depreciation.

One special characteristic of general equilibrium models is that they are solved only in terms of relative prices. This result was established in the first equation system of Walras. A modeling convention is to choose a numéraire such that prices are equal to one in the benchmark model. Thus, the variables are expressed in quantity terms.

The final demand commodity structure contains a composite good called housing service and eleven other goods and services. The composite good housing service is composed of owner occupied dwelling units as defined by the Bureau of Economic Analysis (BEA) and real estate which includes rental units. There is a nested demand structure for consumption goods in the CGE model whereby households decide between their housing expenditures and all other goods and then they decide between a home purchase and renting. Other commodities included in the model are the standard major aggregated NAICS categories (Appendix D). The NAICS codes are the North American industry coding system for the classification of industrial sectors.

Each economic agent or institution is defined by an income and expenditure equation condition. Households earn income from the sale of their endowment of capital and labor plus inter-institutional transfers. They also receive dividends, transfer payments and borrow from the investment agent. They use this income to buy private consumption goods, save and pay taxes so as to maximize utility.

$$U(y) = \left(\sum_i \delta {y_i}^{\rho} \right)^{1/\rho} \qquad 3\text{-}5$$

Public goods enter the utility function as a commodity aggregate. The benefit of this approach is that it allows for the focus to be applied to the revenue side of the analysis which is the purpose of this dissertation. An obvious extension of the analysis would be to break out public services as a separate commodity.

The behavioral equation and budget constraint enter into a utility maximizing or expenditure minimizing optimization process to derive expenditure and demand functions that are components of the CGE model. The income equation for the firms in a constant returns to scale production technology takes the form of a zero profit condition where the value of output is exhausted by the cost of production.

Households and firms display constrained optimizing behavior from which the product and factor market supply and demand equations are derived. The simultaneous solution of the model's equations is specified by the equilibrium price and quantity values to which the agents respond. These prices and quantities in turn determine the income of the economic agents.

Government collects tax revenue in order to finance public expenditures. It supplies and receives transfers from other institutions. The income definition of government states that revenue is equal to expenditures plus transfers. These relationships, one for each level of government, are represented in a social accounting matrix (SAM). Revenue corresponds to row entries and expenditures and transfers are represented by column entries. Row totals equal column totals as the income definition requires. The SAM is populated with data from the IMPLAN modeling system.

The IMPLAN definition of investment is the purchase of commodity by industry for capital formation. Investment expenditures are represented by the SAM column which contains domestic and imported commodities, investment accounts for households and government, the withdrawal from which can be interpreted as loans. The source of investment spending is denoted by the row entries which consist of depreciation, savings and direct foreign investment. The income definition for the investment sector states that row items are equal to column expenditures. For the Florida economy, the equation is nonbinding since there is generally a surplus of foreign savings. The income definition for the foreign sector states that imports are equal to exports plus foreign savings (balance of payments). In a static model the supply of foreign savings is fixed.

The Social Accounting Matrix

A CGE model is built from a SAM which is a consistent dataset representing the full range of transactions within the economy. Initially the parameters of the model need to be calibrated.

The calibration process moves backward from the SAM to construct the model given the functional forms of its equations. The behavior of the agents in the model should replicate the observed data.

An essential part of a SAM is the use table which describes the interindustry flow of goods and services. It is equivalent to the transaction matrix of an input-output model. The use matrix along with the factors of production and indirect taxes determines domestic output. This production is either consumed domestically or exported. The final demand and import matrix shows the consumption of institutions. The SAM includes the distribution of factor income to institutions.

There are certain transactions that do not involve the exchange of goods and services for money such as interinstitutional transfers between household and government agents. Household information displayed by income class allows for the analysis of the distributional impact of public policy. A SAM is balanced in the sense that institutional income equals expenditures. The SAM used in the construction of the CGE model in this dissertation is supplied by the IMPLAN software program. The Florida SAM is displayed in Appendices A and B.

The detailed IMPLAN industrial codes which correspond to the four digit US Census Bureau NAICS codes have been aggregated up to twelve major sectors including owner occupied housing. The following section from the IMPLAN manual describes the owner occupied housing sector:

> Owner occupied dwellings' is a special sector developed by BEA (Bureau of Economic Analysis). It estimates what owner/occupants would pay in rent if they rented rather than owned their homes. This sector creates an industry out of owning a home. Its sole product (or output) is ownership, purchased entirely by personal consumption expenditures
>
> A household owning a house pays property taxes and other related permits and taxes but not directly to the government. A household makes these payments to the owner-occupied dwelling sector that then passes it on to the government as indirect business taxes (IMPLAN Pro User's Guide, p. 229).

Homeownership is a unique durable consumption good for households. It is a long-term investment for which they receive a flow of continuous housing services. Recognizing this fact, BEA distinguishes between the two measures and calculates the short-term costs in maintaining a home such as upkeep, insurance and real estate taxes. The impact of tax cuts which are targeted towards the housing services sector can be modeled. When property taxes are eliminated or reduced, the owner-occupied housing industry in relation to other industrial sectors experiences a decline in their cost of production. This results in an increase in the production of owner-occupied housing and the use of intermediate inputs from the construction industry. Households reallocate their consumption between housing services and all other goods in response to a change in price.

Tax Policy Analysis and Simulation

A change in tax policy has an effect on the behavior of households and firms. The CGE model presents an explanation for the responses that these agents have to alternative policies. It also can account for any consequent reallocation of resources across economic sectors and institutions. The impacts of policies on the welfare of households and the distribution of income among them can be estimated as a result of this analysis.

The CGE can be used for a comparative static simulation of a policy change by altering policy variables or introducing exogenous shocks. A new counterfactual equilibrium solution is calculated with an alternative set of prices, factor demands, production levels and income values which can be compared to the benchmark equilibrium values.

The benefit of the policy decision in terms of consumer welfare can be determined using an income based measure. Because a CGE is based on the household maximization of utility, the welfare index can be calculated as the amount of income the consumer would need to achieve a

specific level of utility or welfare. The indirect utility function formulations in MPSGE code permit a straightforward reporting of this measure.

The CGE model simulation consists of decreasing taxes on real tangible property which, in the model, takes the form of eliminating the capital tax on owner-occupied housing (Simulation I) or on the composite good housing services (Simulation II). Finally, property tax will be eliminated on residential and non-residential property (Simulation III). For each model simulation there will be a corresponding increase to a replacement tax revenue source such as sales taxes so as to keep the real value of public expenditures constant. It is important to hold the provision of public goods fixed since a comparison of welfare changes across households would be problematic in that the public consumption patterns would differ among income classes. The outcome of the property tax simulation will vary depending on the alternative chosen.

The standard short-term static model restricts the level of investments to a fixed exogenous amount. Alternative tax policies have no effect on a fixed capital stock and investment in such a model. The model used in this dissertation depicts capital investment as a final demand sector which is endogenous and adjusts instantaneously to changes in tax policy. The steady-state capital closure of the CGE model was proposed by Rutherford and Light (2001). The formulation is consistent with a long-run equilibrium solution.

CGE Model Code Implementation

In essence, a CGE model is composed of a system of equations such as excess demand functions, a reference dataset based on empirical information and parameter values calibrated by means of the solution process. This system and process can be assembled and executed with a traditional programming language. The solution algorithm may also be coded or the system may be linked to an appropriate numerical routine. The CGE system of equations may be represented in spreadsheet software and its internal solution routine used to solve for the equilibrium values.

Higher level modeling systems, such as Matlab and General Algebraic Modeling System (GAMS) combine a matrix-based programming language with numerical solvers. These products facilitate model representation and execution. GAMS was initially developed for economic modeling by the World Bank and has been available since 1987. It has been used for a wide variety of model building projects and research activities.

The mathematical programming system for general equilibrium (MPSGE) extension to GAMS was developed to formulate and solve CGE models. CGE models are based on a sophisticated set of equations which can be difficult to set out in a detailed structured system that incorporates actual economic data. MPSGE offers a condensed and efficient operational representation for a system of nonlinear equations thus reducing the initial setup time and effort. Users can devote more of their time to the conclusions of the model and less time in programming.

Most programmed CGE models are set up as quasi-optimization problems with their equations corresponding to equilibrium conditions. Developing the underlying production and utility equations into supply and demand functions can be somewhat involved. MPSGE is based on nested CES utility and production functions. Its framework provides for the direct incorporation of data into model statements.

The importance of the numerical algorithm that establishes a model's equilibrium has been mentioned previously. MPSGE is set up as a mixed complementary problem as suggested by Mathiesen (1985). This formulation offers an insight into the unique role that prices and quantities or activity levels play within the model system. There are three MPSGE classes of equations that are analogous to mathematical programming statements. The complementary

problem refers to the dual mathematical programming problem corresponding to the primal specification.

First, there is a market clearance inequality that takes the form of an excess demand inequality with supply minus demand times a price variable that acts like a Lagrange multiplier. If supply is greater than demand then the price variable is zero so that the overall complementary condition is satisfied. If supply is equal to demand then there is a positive price variable. Next there is a zero excess profit inequality with the firm's activity level acting as the Lagrangian multiplier. It states that if the value of production is less than the cost of inputs then the activity level is zero. If they are equal, then the firm produces a positive quantity. Finally, there is an income balance for the institutions or agents such as households or government which specifies the relationship between endowments and expenditures.

The Florida CGE presented in this dissertation is written in and solved with MPSGE. The model code is located in Appendix G. As the code illustrates there are four major elements to the model: sectors, commodities, consumers and auxiliary constraints. The sectors are associated with the production blocks which represent a cost equation based on a nested CES production function. As a corollary to the market clearance equation, commodities enter as prices in the production blocks. Exogenous and endogenous taxes also enter the production block. The demand block represents consumer endowments and preferences. It corresponds to an expenditure equation which is based on a nested CES utility function. The auxiliary variable represents an external constraint and is used to represent endogenous taxes.

CHAPTER 4
DATA ANALYSIS

The share tables (Tables 4-1 – 4-4) display calculated ratios which provide information on the major industry sectors (NAICS) in the State of Florida. The value added share Table 4-1 presents the proportion of labor and capital factor inputs that are used in the production process. It indicates value added over and above raw materials. A corollary of the table would be the relative amount of intermediate inputs used in production. Manufacturing and construction use the greatest amount of intermediate goods and other services uses the least. Other services and owner occupied housing have the largest percentage value added components. Owner-occupied housing is exclusively produced by means of capital and intermediate inputs which according to the input-output table (Appendix B) are predominantly composed of financial activities and professional services.

Table 4-1: Florida industry value added shares, 2003

(Capital + Labor) / Production	Percent
Other services	73.50
Owner occupied housing	66.10
Education and health services	61.10
Trade	60.09
Financial activities	59.69
Real estate	56.35
Natural resources and mining	56.09
Professional and business services	56.05
Transportation and utilities	53.41
Leisure and hospitality services	50.51
Construction	42.51
Manufacturing	31.36
Industry average	55.47

In Table 4-2, Florida industry import shares, the proportion of imports in production also indicates that manufacturing and construction have the greatest relative quantity of imported inputs in the production process whereas owner-occupied housing has the least.

Table 4-2: Florida industry import shares, 2003

Imports / Production	Percent
Manufacturing	34.52
Construction	28.04
Natural resources and mining	21.60
Transportation and utilities	18.14
Leisure and hospitality services	18.09
Professional and business services	13.92
Education and health services	13.56
Financial activities	11.61
Other services	10.53
Real estate	8.55
Trade	7.25
Owner occupied housing	6.64
Industry average	15.98

Table 4-3, Florida industry labor intensity shares displays a measure of labor intensity in production. The most labor intensive sectors are education and health services, other services, construction and professional and business services. Real estate is seen as the most capital intensive. Table 4-4 displays sector labor as a percentage of total labor supply. The table indicates that over half of the labor resource is employed in other services, professional and business services, trade and education and health services.

Table 4-3: Florida industry labor intensity shares, 2003

Labor / (Capital + Labor)	Percent
Education and health services	89.06
Other services	84.82
Construction	83.45
Professional and business services	79.14
Leisure and hospitality services	74.94
Trade	74.74
Manufacturing	68.08
Transportation and utilities	64.55
Financial activities	57.31
Natural resources and mining	55.50
Real estate	27.90
Owner occupied housing	0.00
Industry average	69.38

Table 4-4: Distribution of labor across Florida industries, 2003

Sector labor / Total labor	Percent
Other services	20.43
Professional and business services	20.26
Trade	13.35
Education and health services	11.29
Construction	7.93
Financial activities	6.61
Manufacturing	6.29
Leisure and hospitality services	5.67
Transportation and utilities	4.77
Real estate	2.34
Natural resources and mining	1.05
Owner occupied housing	0.00
Total	100.00

The share of indirect business taxes in output is shown in Table 4-5. The highest share of taxes is collected from the trade, leisure and hospitality services and real estate sectors. Table 4-6 displays the ratios of ad valorem taxes to the capital factor input. It is evident that the owner-occupied housing and real estate industry pay the greatest share of the tax. Housing can be construed as a physical stock or as the flow of services provided by that stock. The value of housing stock is different from the use value of housing services. The value of owner-occupied housing and real estate represents the latter amount.

The ad valorem tax was distributed across industries according to the just and taxable value by usecode table (Appendix E) supplied by the Economic and Demographic Research Office of the Florida State Legislature. Appendix F contains the crosswalk between the Department of Revenue codes and the aggregated NAICS industry sectors.

Table 4-5: Indirect business tax as percent of production

Indirect business taxes / Production	State & local
Trade	12.52
Leisure and hospitality services	4.74
Real estate	4.64
Transportation and utilities	3.49
Financial activities	2.10
Professional and business services	1.36
Other services	1.31
Natural resources and mining	0.65
Manufacturing	0.58
Education and health services	0.54
Construction	0.43
Owner occupied housing	0.03

Table 4-6: Ad valorem tax as percent of capital

Ad valorem tax / Capital	State & local
Owner occupied housing	18.71
Real estate	15.96
Leisure and hospitality services	7.49
Trade	6.74
Natural resources and mining	5.05
Transportation and utilities	4.64
Professional and business services	3.05
Education and health services	1.76
Manufacturing	1.55
Construction	0.37
Financial activities	0.37
Other services	0.33

CHAPTER 5
RESULTS

This dissertation consists of three scenarios ranging from removing property taxes on owner-occupied housing to eliminating property taxes on all real property. There is a set of tables for each simulation. All result tables show the percentage change between the benchmark and counterfactual solutions. For these simulations it is assumed that the term indirect business taxes is an aggregation of several individual taxes and is synonymous with sales tax (Appendix C). Property tax is broken out and treated separately for the purpose of this analysis. The output results tables display the change in total production (some industry output may decline and some may increase). The domestic inputs results tables contain changes in the input-output table due to the elimination of real property taxes. The imported inputs results tables are a foreign (other U.S. states or other countries) analog to the input-output table in that they represent the changes in imported intermediate goods used in the production process. The factor inputs results tables show the amount of change in the use of labor and capital.

The CET (constant elasticity of transformation) result tables represent the process whereby output is produced for domestic use or for the export market (other U.S. states or other countries). There are corresponding domestic and export CET tables showing changes in their respective outputs. Another name for the CET domestic results table is the make matrix. An explanation of the structure of these tables is necessary for those who are unfamiliar with input-output matrices. If an industrial sector only produced a single type of commodity, then only the diagonal cells would be populated. However, some industries produce multiple types of goods called by-products. Thus, an industry in a row may have more than one commodity activity as indicated by the columns.

The total export and import results tables report the changed levels in industrial and institutional external trade. An explanation of the difference between the CET export results table and the total export results table is that the former is the export component of total industrial production, the other component being domestic sales. The latter table shows aggregate exports which include industrial as well as institutional exports.

A construct of the MPSGE model is that exports are transformed into a commodity that functions as foreign exchange. In MPSGE a commodity is represented by its price. The price of foreign exchange is in turn transformed into imports. This complementary variable contributes to the balancing of exports and imports. The interinstitutional transfers are represented in the income blocks by this balancing variable. Thus, domestic and foreign savings enter into the equilibrating equation. Savings is fixed in the model while exports and imports are endogenous.

The household consumption results tables contain the change in final consumption by households. It can be interpreted as the change in total welfare from the change in tax policy. The equivalent variation measure as implemented in MPSGE represents a Hicksian money-metric welfare index which compares the initial reference welfare level with the post simulation level. The following equivalent variation formula is from Rutherford and Paltsev (1999).

$$EV = 100*(W_1 - W_0)/W_0 \qquad 5\text{-}1$$

It is used to evaluate the impact of tax policy in terms of an economic welfare measure. The Armington Household Results Tables show the change in the components of total consumption by household group.

Scenario I: Owner Occupied Housing Tax Results

In the first simulation only the property tax on owner-occupied housing is eliminated. Practically, this may be interpreted as increasing the homestead exemption to the local resident homeowners. Output of trade, transportation and utilities, financial activities, real estate,

education and health services and leisure and hospitality services decline from the initial shock to the model. Owner-occupied housing has the largest increase in output. There is a substitution away from real estate in favor of owner-occupied housing which accounts for its significant decline.

The output results (Table 5-1) seen here occur because in differential tax analysis a cut in real property taxes on owner-occupied housing must be compensated for by an increase in indirect business taxes so as to keep the real value of government output constant in the resulting final consumption allocation. Thus, the costs to industries have increased and they are passed along to the purchasers who reallocate their consumption spending. Output declines due to increased prices. The industries most affected are those that have the highest ranking in terms of indirect business taxes paid as indicated in Table 4-5. The relatively extensive change in the real estate sector is due to a substitution in favor of owner-occupied housing in the nested demand function.

The domestic and imported input results (Tables 5-2 and 5-3) reveal the assorted increases and decreases in the various intermediate commodities levels. Generally the sectors with declining output have falling demand for inputs and in turn their level as an intermediate input into the production of other goods declines. However, this is not a universal outcome with some individual instances of increases in their input amounts.

Labor and capital utilization decreased in the trade, transportation and utilities, real estate and leisure and hospitality service industries (Table 5-4). The factor input effects to these industries correspond to the overall decline in their production resulting from the fiscal shock to the model. Capital inputs decline in the construction, manufacturing, financial activities, professional and business services, education and health services and other service industries.

The largest increase in capital use is in the owner occupied housing sector. There is the apparent substitution from rental to owner-occupied housing in the household's nested consumption allocation and in addition there is a reallocation of capital from the other industries due to the implied subsidy to the owner-occupied housing sector.

Table 5-1 denotes the change in total output. Output is produced for either the domestic market or for foreign trade. Table 5-5, CET domestic results owner occupied housing simulation shows the detailed changes in output supplied to the domestic markets and Table 5-6 CET export results owner occupied housing simulation records the amount of output supplied to the external sector.

Table 5-5 focuses the information in Table 5-1 in terms of the change in industry production. The relationship between the initial change in property taxes and the subsequent economic output is also reflected in Table 5-6. Owner-occupied housing increases in both dimensions with exports showing a large rise.

Table 5-7 indicates that exports of the trade, transportation and utilities, financial activities, real estate and leisure and health services industries decline. Once again, owner-occupied housing shows the highest increase. In Florida, a large number of homes are owned by nonresidents and by residents who live for the most part outside of the state but who may be attracted to the state's favorable tax system and ideal climate. This phenomenon can be construed as the export of owner-occupied housing. Imports decline for all industries except for trade and owner-occupied housing (Table 5-8).

The consumption levels of the bottom two income classes of households have increased slightly according to Table 5-9. The welfare levels for the other seven household income classes decline. These amounts can be considered as the equivalent variation measures of the costs or

benefit of the property tax reduction by income class. The elimination of property tax on owner-occupied housing can be seen as a subsidy for that industry. The average impact by household group is about a tenth of a percent, somewhat insignificant.

The largest percentage changes in the consumption of various goods are for higher income levels (Table 5-10). Of some interest is the change in commodities consumed by household group. There is a decline in manufacturing, trade, transportation and utilities, financial activities, real estate, professional and business services, leisure and hospitality services. Consumption of the owner-occupied housing sector increases and real estate decreases across all the income levels. This occurs due to the substitution effect within the nested housing services composite. Owner-occupied housing expenditures increase for the lower income classes to a greater degree than they do for the upper income classes. Real estate expenditures decrease for the higher income classes to a greater degree than they do for the lower income classes. The consumption of natural resources and mining, professional and business services, education and health services and other services also increases for the lower income classes.

Investment as a final demand sector increases by 0.05 percent. This is not shown in a table since there is only one common investment good or capital stock, and it is not mapped to individual sectors or commodities. Indirect business taxes increase by 23.89 percent to make up for the reduction in property tax revenue so as to keep the level of real state government output constant. This amounts to an increase of the existing six percent sales tax (.06) to seven point four percent (.074).

Scenario II: Housing Services Tax Results

In the second simulation, the property tax on all housing services which includes both real estate (rental) and owner-occupied housing is eliminated. The impacts on the economy are greater than the previous simulation since the indirect business taxes now increase by 34.7

percent to make up for the reduction in property tax revenue. This amounts to an increase of a six percent (.06) sales tax to eight point one percent (.081). Table 5-11 shows that production of natural resources and mining, manufacturing, trade, transportation and utilities, financial activities and leisure and hospitality services declines. Real estate and owner-occupied housing increases along with construction, professional and business services, education and health services and other services. The relative increase in expenditures indicates an exchange in favor of real estate or rental housing from owner-occupied housing. Real estate can take advantage of a lower cost of production as it substitutes the use of capital for labor. Owner-occupied housing can not act accordingly.

The large increase in real estate can be accounted for by the fact that it is a major input to the owner-occupied housing sector as indicated by Table 5-12. Real estate is also a prime input to other sectors mostly in the form of office rental. Imports of real estate decline sharply with a substitution towards domestic production under the housing services simulation (Table 5-13). This can be interpreted as Florida businesses renting space outside of the state. Compared to the previous simulation, more returns to factors have fallen in value due to the transfer of resources toward housing services (Table 5-14). Factor inputs decrease for those industries whose levels of production have fallen.

There is a larger response in exports than domestic output as indicated by the CET domestic results and export housing services simulations (Tables 5-15 and 5-16). The by-products of real estate increase in export trade but decline domestically. Leisure and hospitality services commodity output by the real estate sector declines as the overall production of leisure and hospitality services decreases. Other services commodity output by the real estate sector declines but for a different reason than the previous fall off. The major by-products of the other

services sector are transportation and utilities and financial activities. Total output of these sectors has declined, thus lowering the demand for the by-product output of real estate. The overall pattern of exports reflects those of total production as evidenced by Tables 5-17 5-11 with the housing services simulation. Imports of real estate decline due to the fact that a lower cost of production from the reduced capital tax favors domestic output over imports (Table 5-18).

The consumption levels of all but the bottom income class of households have declined (Table 5-19). Whereas, the purchase of real estate increases for the lower and middle income classes, it decreases for the upper income classes. Owner-occupied housing expenditures have a greater increase for the lower income classes than the other income groups (Table 5-20). There is an increase in capital investment expenditures of 1.6 percent. As stated previously the final demand investment sector purchases commodities for capital formation.

Scenario III: Capital Tax Results

In the last simulation, the property tax on every sector is eliminated. The production of manufacturing, trade, transportation and utilities, financial activities, leisure and hospitality services declines with the capital tax simulation (Table 5-21). The combination of the elimination of property taxes and a corresponding increase in indirect business taxes so as to maintain constant real government output is spread out over all of the industrial sectors. Trade, transportation and utilities, financial activity and leisure and hospitality services pay a substantial amount of the indirect business taxes which can account for those sectors' resulting decline in production. Once again there are declines in the levels of intermediate input usage by the declining industries and a corollary decrease of those industry goods as intermediate inputs to other sectors as evidenced by Tables 5-22 and 5-23.

The previous patterns exist for the current simulation in that there is a decrease in both factors for those industries experiencing a decline in production and a substitution in favor of labor for the other sectors except for real estate (Table 5-24). The latter sector has a relatively higher level of property tax than indirect business tax and has a high level of capital intensity so that it benefits from the capital tax scenario's design. The industry sectors with increases in factor inputs are real estate, owner-occupied housing and natural resources and mining. The output and factor usage in the housing services sector are up. The real estate industry has the greatest increase in capital. This could be due to the fact that in a capital intensive industry decreasing the relative price of the intensive factor of production increases the output of that good and the use of the factor in that industry.

Table 5-25 indicates that natural resources and mining, construction, real estate, owner-occupied housing, professional and business services and education and health services increase across all commodities. Manufacturing, trade, transportation and utilities, financial activities and leisure and hospitality services decline across all commodities. Other services show mixed results. There seems to be a larger response in exports than domestic output as in the other simulations. Exports (Table 5-26) mirror the effects observed in Table 5-25 except for leisure and hospitality services and other services. Owner-occupied housing displays the largest increase. The by-products of real estate increase in export trade but decline domestically as they did in the second scenario. The explanation is analogous to that given for the second scenario.

As with the previous simulation, the pattern of commodity exports follows those of overall output (Table 5-27). The large increase in exports of owner-occupied housing is due to the very small initial value. A small increase will register as a significant percentage change. The

quantity of total imports shows almost no decline (Table 5-28). There is a substitution in favor of domestic production of real estate.

The consumption levels of each income class of households have declined (Table 5-29). However, there is a large increase in owner-occupied housing expenditures with the lower income groups experiencing the greatest increase (Table 5-30). The consumption of real estate increases for the two lower income classes and it decreases for the upper income classes.

The nested demand structure for the housing services composite good represents the trade-off in consumption between a home purchase and rental units. Its parameters are calibrated using the benchmark data. The final consumption block of the detailed IMPLAN SAM in Appendix B indicates that higher income groups consume more owner-occupied housing and less real estate including rentals. The opposite situation is indicated for lower income groups. Thus there should be a bias towards rental units for the lower income classes and towards owner-occupied housing for the higher income groups. Now that the tax incidence is spread over all industry groups one would expect the shifts among income groups found for owner-occupied housing and real estate under the capital tax simulation.

There is an increase of 2.0 percent in the investment sector's expenditures on commodities for the purpose of capital formation which is the largest of all the simulations. Thus, there is a reallocation of final demand goods and services to the capital investment sector. Indirect business taxes now must increase by 46.5 percent to make up for the reduction in property tax on all sectors and still maintain a constant level of real government output. This amounts to an increase of a six percent sales tax (.06) to eight point eight percent (.088).

Summary

The final seven tables (Tables 5-31 through 5-37) summarize the results in dollar values rather than percentage terms for the three simulations and the benchmark amounts for

investments, output, labor and capital inputs, exports and imports and household consumption. The same three simulations are presented for the output and factor use situations. First, owner occupied housing and real estate experience an increase in output, labor and capital except for simulation one where owner-occupied housing is substituted for real estate in the nested demand function (Tables 5-32 – 5-34). Next, manufacturing, financial activities, trade, transportation and utilities, and leisure and hospitality services undergo a decrease in output, labor and capital. There are a two exceptions again for simulation one. Finally, construction, professional and business services, education and health services and other services display an increase in output and labor but a decrease in capital. The first situation can be accounted for by the fact that the capital tax directly impacts the capital intensive industry sectors of owner occupied housing and real estate. The next group of industries is not capital intensive and its members are particularly affected by the compensating increase in indirect business taxes.

The final collection of industries are all labor intensive and are as a whole not as impacted by indirect business taxes as the second group. The labor intensive production process can account for the substitution of labor for capital as output increases. Considering the adjustment under a partial equilibrium framework first, the market equilibrium condition for a tax on an input is characterized as the price times (1 + tax rate) equal to the marginal factor cost. The marginal cost of supplying an additional input up to the fixed factor supply level is zero. The marginal cost of producing an amount in excess of the fixed input supply level is essentially infinite. A tax on an inelastic supplied good is paid by entirely by the provider. A decrease in the tax will solely benefit the supplier. Demand and output will be unchanged. By contrast, in the general equilibrium setting, output and factor use are altered in each scenario as inputs are reallocated among markets.

Total output declines between the benchmark and each consecutive scenario. Owner-occupied housing increases from the benchmark across all the simulations and real estate increases from the benchmark in Scenarios II and III. Household consumption decreases between the benchmark and each consecutive scenario (Table 5-37). Owner-occupied housing consumption increases from the benchmark in each simulation. Exports and imports decline from the benchmark in each of the simulations (Tables 5-35 and 5-36). Whereas real estate consumption in Scenario III is slightly below its benchmark, real estate exports in Scenario III are above its benchmark. Investment is the only aggregate final demand variable that increases consistently from the benchmark (Table 5-31).

Table 5-1: Output results owner occupied housing simulation[2]

Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner Occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
3.46	0.03	1.12	-5.42	-2.71	-0.38	-8.50	15.59	1.57	-0.11	-3.16	1.11

[2] All result tables show the percentage change between the benchmark and counterfactual solutions

Table 5-2: Domestic inputs results owner occupied housing simulation

	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Natural resources & mining	4.98	2.81	2.77	-4.07	-0.76	2.09	-7.46	18.73	2.94	1.48	-1.12	3.03
Construction	4.20	0.75	1.85	-4.74	-2.03	0.34	-7.87	16.08	2.30	0.61	-2.46	1.78
Manufacturing	4.67	1.08	2.11	-4.51	-1.58	0.75	-7.56	16.74	2.57	0.81	-2.20	2.15
Trade	2.16	-1.03	-0.34	-6.88	-6.45	-6.54	-9.49	14.42	-0.87	-1.28	-4.31	-1.41
Transportation& utilities	3.09	-0.36	0.67	-5.83	-3.25	-0.91	-8.79	15.19	1.06	-0.59	-3.53	0.64
Financial activities	3.45	0.03	1.12	-5.42	-2.71	-0.38	-8.50	15.59	1.57	-0.11	-3.16	1.11
Real estate	1.10	-2.25	-1.19	-7.57	-4.93	-2.65	-10.58	12.96	-0.74	-2.39	-5.37	-1.20
Owner occupied housing												
Professional& business services	4.18	0.61	1.98	-4.66	-1.88	0.37	-7.85	16.20	2.59	0.72	-2.32	1.98
Education & health services	4.56	1.10	2.23	-4.41	-1.69	0.62	-7.53		2.60	0.36	-2.39	1.96
Leisure & hospitality services	2.51	-0.57	0.54	-5.94	-3.09	-0.95	-9.06		0.79	-0.56	-4.12	0.34
Other services	4.31	0.71	1.75	-4.85	-2.20	0.36	-7.97	17.18	2.20	0.51	-2.58	1.64

Table 5-3: Imported inputs results owner occupied housing simulation

	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Natural resources & mining	1.95	-0.16	-0.20	-6.84	-3.63	-0.86	-10.13	15.30	-0.04	-1.45	-3.97	0.05
Construction	2.67	-0.73	0.35	-6.14	-3.47	-1.14	-9.23	14.37	0.79	-0.87	-3.90	0.28
Manufacturing	3.27	-0.26	0.75	-5.78	-2.89	-0.60	-8.79	15.18	1.20	-0.54	-3.51	0.78
Trade	15.70	12.09	12.88	5.47	5.95	5.85	2.50	29.59	12.27	11.81	8.38	11.66
Transportation & utilities	4.87	1.36	2.41	-4.20	-1.57	0.81	-7.22	17.18	2.80	1.13	-1.86	2.38
Financial activities	3.46	0.03	1.12	-5.41	-2.71	-0.37	-8.49	15.60	1.57	-0.11	-3.16	1.11
Real estate	9.01	5.40	6.54	-0.34	2.51	4.97	-3.59	21.80	7.02	5.25	2.03	6.53
Owner occupied housing												
Professional & business Services	0.64	-2.81	-1.49	-7.91	-5.22	-3.05	-10.98	12.25	-0.90	-2.71	-5.65	-1.49
Education & health services	0.70	-2.63	-1.54	-7.94	-5.31	-3.09	-10.94		-1.19	-3.34	-5.99	-1.80
Leisure & hospitality services	6.14	2.96	4.11	-2.61	0.35	2.57	-5.83		4.36	2.97	-0.72	3.90
Other services	-0.11	-3.55	-2.56	-8.88	-6.34	-3.89	-11.87	12.22	-2.13	-3.75	-6.71	-2.66

Table 5-4: Factor inputs results owner occupied housing simulation

	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Labor	4.69	0.46	1.97	-4.76	-1.78	0.74	-6.70		2.14	0.18	-2.50	1.51
Capital	2.01	-2.11	-0.65	-7.20	-4.30	-1.85	-9.09	15.59	-0.48	-2.39	-5.00	-1.09

Table 5-5: CET domestic results owner occupied housing simulation

CET domestic table	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Natural resources & mining	1.77		-1.50		-3.74				1.36			
Construction		0.02										
Manufacturing	3.36		0.42						1.23			
Trade				-3.59								5.88
Transportation & utilities					-2.21							2.55
Financial activities						-0.34						1.97
Real estate							-6.05				0.06	5.98
Owner occupied housing								15.59				
Professional & business services			-0.04						0.33		-4.99	0.67
Education & health services									0.60	-0.38		
Leisure & hospitality services	6.52										-2.08	3.26
Other services					-4.63	-2.41						0.42

Table 5-6: CET export results owner occupied housing simulation

	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Natural resources & mining	4.80		1.44		-0.88				4.37			
Construction		1.51										
Manufacturing	4.76		1.77						2.60			
Trade				-14.87								-6.51
Transportation & utilities					-3.87							0.81
Financial activities						-0.34						1.96
Real estate							-12.86				-7.20	-1.71
Owner occupied housing								93.59				
Professional & business services			3.48						3.86		-1.64	4.21
Education & health services									4.46	3.43		
Leisure & hospitality services	2.87										-5.44	-0.28
Other services					-0.41	1.90						4.86

Table 5-7: Export results owner occupied housing simulation

Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
3.36	0.15	0.59	-11.16	-2.69	-0.25	-9.39	73.58	2.87	1.73	-4.14	3.49

Table 5-8: Import results owner occupied housing simulation

Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
-0.72	-1.05	-0.63	1.09	-0.22	-0.28	-0.14	0.05	-1.16	-1.33	-0.09	-0.52

Table 5-9: Final household consumption results owner occupied housing simulation

Households	LT10k	10-15k	15-25k	25-35k	35-50k	50-75k	75-100k	100-150k	150k+
Armington	0.34	0.08	-0.24	-0.49	-0.27	-0.51	-0.06	-0.27	-0.52

Table 5-10: Armington household results owner occupied housing simulation

	LT10k	10-15k	15-25k	25-35k	35-50k	50-75k	75-100k	100-150k	150k+
Natural resources & mining	0.12	-0.18	-0.50	-0.71	-0.75	-1.24	-1.04	-1.25	-1.49
Construction									
Manufacturing	-0.18	-0.48	-0.80	-1.01	-1.05	-1.55	-1.36	-1.57	-1.81
Trade	-3.02	-3.28	-3.58	-3.79	-3.82	-4.33	-4.14	-4.35	-4.57
Transportation & utilities	-0.57	-0.86	-1.18	-1.38	-1.42	-1.92	-1.71	-1.93	-2.16
Financial activities	-0.24	-0.54	-0.85	-1.06	-1.10	-1.61	-1.41	-1.62	-1.86
Real estate	-8.70	-9.43	-9.71	-10.02	-11.67	-13.65	-14.51	-14.70	-14.90
Owner occupied housing	21.31	20.34	19.96	19.55	17.36	14.73	13.58	13.34	13.07
Professional & business services	0.29	0.00	-0.32	-0.54	-0.59	-1.09	-0.90	-1.11	-1.35
Education & health services	0.61	0.30	-0.02	-0.23	-0.27	-0.78	-0.59	-0.81	-1.04
Leisure & hospitality services	-0.99	-1.28	-1.59	-1.80	-1.85	-2.35	-2.14	-2.36	-2.59
Other services	0.70	0.37	0.06	-0.16	-0.18	-0.69	-0.50	-0.72	-0.95

Table 5-11: Output results housing services simulation

Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
-9.53	1.27	-4.97	-8.61	-6.39	-4.77	22.69	10.49	1.12	0.55	-5.33	1.10

Table 5-12: Domestic inputs results housing services simulation

	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Natural resources & mining	-11.94	-3.67	-7.77	-10.97	-9.74	-8.93	20.15	5.22	-1.35	-2.33	-8.90	-2.33
Construction	-9.52	1.28	-4.96	-8.60	-6.38	-4.76	22.70	10.50	1.13	0.56	-5.33	1.11
Manufacturing	-12.52	-1.76	-7.63	-11.10	-9.48	-7.81	19.12	7.37	-1.71	-2.09	-8.01	-1.85
Trade	-11.49	-0.59	-7.33	-11.04	-12.52	-14.65	20.37	8.55	-3.05	-1.48	-7.27	-3.22
Transportation & utilities	-10.96	-0.53	-6.86	-10.40	-8.71	-7.04	20.91	8.75	-1.17	-1.61	-6.93	-0.98
Financial activities	-11.36	-0.79	-6.87	-10.43	-8.34	-6.75	20.17	8.18	-0.91	-1.47	-7.23	-0.92
Real estate	-1.84	9.87	3.10	-0.84	1.56	3.32	33.12	19.88	9.71	9.10	2.71	9.70
Owner occupied housing												
Professional & business services	-9.12	1.65	-4.45	-8.14	-5.88	-4.31	23.26	10.87	1.78	1.09	-4.80	1.67
Education & health services	-8.17	2.79	-3.50	-7.24	-5.01	-3.43	24.53		2.56	1.22	-4.27	2.30
Leisure & hospitality services	-11.33	-0.05	-6.15	-9.72	-7.19	-5.97	21.04		-0.58	-0.44	-7.37	-0.57
Other services	-8.80	1.94	-4.39	-8.08	-5.91	-4.09	23.37	11.96	1.73	1.16	-4.79	1.62

Table 5-13: Imported inputs results housing services simulation

	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Natural resources & mining	-7.11	1.61	-2.71	-6.08	-4.79	-3.94	26.74	10.99	4.06	3.02	-3.91	3.02
Construction	-9.53	1.26	-4.98	-8.61	-6.40	-4.78	22.68	10.48	1.11	0.55	-5.34	1.10
Manufacturing	-9.06	2.12	-3.98	-7.59	-5.90	-4.16	23.83	11.62	2.18	1.79	-4.37	2.03
Trade	9.22	22.67	14.36	9.77	7.95	5.32	48.54	33.95	19.64	21.57	14.42	19.43
Transportation & utilities	-3.90	7.36	0.53	-3.29	-1.47	0.34	30.50	17.38	6.67	6.20	0.46	6.88
Financial activities	-5.60	5.66	-0.82	-4.60	-2.38	-0.68	27.99	15.22	5.54	4.94	-1.19	5.53
Real estate	-26.83	-18.10	-23.14	-26.08	-24.29	-22.98	-0.77	-10.64	-18.22	-18.68	-23.44	-18.23
Owner occupied housing												
Professional & business services	-11.13	-0.60	-6.56	-10.17	-7.96	-6.43	20.53	8.42	-0.47	-1.14	-6.91	-0.58
Education & health services	-12.92	-2.52	-8.48	-12.03	-9.92	-8.42	18.09		-2.74	-4.01	-9.22	-2.98
Leisure & hospitality services	-4.38	7.78	1.21	-2.64	0.08	1.41	30.53		7.22	7.36	-0.11	7.23
Other services	-12.55	-2.25	-8.32	-11.85	-9.78	-8.03	18.31	7.36	-2.45	-3.00	-8.70	-2.55

Table 5-14: Factor inputs results housing services simulation

	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Labor	-6.61	2.44	-2.82	-6.91	-3.99	-1.90	15.66		2.63	1.33	-3.58	2.18
Capital	-12.87	-4.42	-9.33	-13.15	-10.43	-8.48	25.13	10.49	-4.25	-5.46	-10.04	-4.67

Table 5-15: CET domestic results housing services simulation

Resources & CET domestic table	Natural mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Natural resources & mining	-6.85		-0.52		-6.35				2.91			
Construction		1.27										
Manufacturing	-9.01		-3.06						4.11			
Trade				-5.73								8.56
Transportation & utilities					-4.28							4.52
Financial activities						-3.05						4.98
Real estate							8.92				-20.57	-13.39
Owner occupied housing								10.49				
Professional & business services			-6.21						0.33		-7.32	1.08
Education & health services									-0.66	0.16		
Leisure & hospitality services	-4.91										-3.06	4.73
Other services					-9.15	-7.67						0.43

Table 5-16: CET export results housing services simulation

	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Natural Resources & Mining	-11.69		-5.69		-11.22				-2.44			
Construction		1.29										
Manufacturing	-12.47		-6.75						0.15			
Trade				-23.61								-12.02
Transportation & Utilities					-11.32							-3.16
Financial Activities						-8.97						-1.43
Real Estate							46.11				6.55	16.19
Owner Occupied Housing								65.97				
Professional & Business Services			-4.09						2.60		-5.22	3.37
Education & Health Services									4.75	5.62		
Leisure & Hospitality Services	-11.82										-10.10	-2.88
Other Services					-5.26	-3.72						4.73

Table 5-17: Export results housing services simulation

Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
-8.20	0.13	-2.22	-17.71	-8.04	-6.51	33.78	51.88	1.92	2.84	-7.70	3.09

Table 5-18: Import results housing services simulation

Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
-1.62	1.13	-1.11	2.75	1.60	1.01	-6.36	1.62	-0.10	-1.28	1.25	0.36

Table 5-19: Final household consumption results housing services simulation

Households	LT10k	10-15k	15-25k	25-35k	35-50k	50-75k	75-100k	100-150k	150k+
Armington	0.07	-0.28	-0.57	-0.85	-0.75	-1.25	-0.44	-0.76	-1.10

Table 5-20: Armington household results housing services simulation

	LT10k	10-15k	15-25k	25-35k	35-50k	50-75k	75-100k	100-150k	150k+
Natural resources & mining	-0.89	-1.22	-1.50	-1.70	-1.69	-2.32	-1.75	-2.07	-2.38
Construction									
Manufacturing	-0.41	-0.74	-1.03	-1.22	-1.20	-1.82	-1.22	-1.54	-1.86
Trade	-4.89	-5.16	-5.43	-5.62	-5.60	-6.22	-5.66	-5.96	-6.28
Transportation & utilities	-1.68	-2.02	-2.30	-2.48	-2.46	-3.06	-2.43	-2.74	-3.06
Financial activities	-1.30	-1.63	-1.92	-2.11	-2.10	-2.71	-2.12	-2.44	-2.76
Real estate	2.31	1.79	1.49	1.24	0.61	-0.66	-0.50	-0.82	-1.16
Owner occupied housing	13.14	12.56	12.23	11.96	11.25	9.85	10.03	9.68	9.31
Professional & business services	0.10	-0.23	-0.52	-0.72	-0.71	-1.34	-0.74	-1.06	-1.39
Education & health services	0.96	0.60	0.31	0.12	0.14	-0.50	0.08	-0.24	-0.57
Leisure & hospitality services	-1.86	-2.18	-2.46	-2.66	-2.66	-3.27	-2.66	-2.97	-3.30
Other services	0.67	0.30	0.01	-0.19	-0.15	-0.78	-0.19	-0.51	-0.85

Table 5-21: Output results capital tax simulation

Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
6.82	1.52	-3.49	-9.39	-4.40	-6.29	15.60	9.68	2.25	0.67	-4.09	1.10

Table 5-22: Domestic inputs results capital tax simulation

	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Natural resources & mining	10.43	8.09	0.12	-6.43	0.00	-0.92	18.59	16.60	5.40	4.35	0.59	5.52
Construction	6.84	1.54	-3.48	-9.38	-4.39	-6.28	15.61	9.69	2.26	0.69	-4.08	1.12
Manufacturing	4.34	-0.61	-5.39	-11.12	-6.61	-8.39	13.24	7.51	0.24	-1.18	-5.99	-0.97
Trade	4.17	-0.61	-6.23	-12.15	-11.52	-17.29	13.10	7.48	-2.56	-1.66	-6.34	-3.83
Transportation & utilities	5.77	0.40	-4.68	-10.49	-5.87	-7.68	14.56	8.61	0.81	-0.67	-5.09	-0.19
Financial activities	3.91	-1.24	-6.09	-11.81	-7.07	-8.90	12.41	6.61	-0.50	-2.05	-6.66	-1.61
Real estate	13.62	7.98	2.64	-3.63	1.68	-0.33	22.95	16.66	8.75	7.07	2.01	7.53
Owner occupied housing												
Professional & business Services	7.65	2.18	-2.58	-8.59	-3.50	-5.51	16.51	10.32	3.39	1.60	-3.17	2.07
Education & health services	8.58	3.19	-1.85	-7.91	-2.85	-4.85	17.49		3.84	1.41	-2.91	2.42
Leisure & hospitality services	5.35	0.61	-4.32	-10.15	-4.96	-7.10	14.52		1.06	-0.01	-5.52	-0.05
Other services	7.62	2.15	-2.95	-8.90	-3.95	-5.67	16.19	11.04	2.82	1.24	-3.57	1.58

Table 5-23: Imported inputs results capital tax simulation

	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Natural resources & mining	3.27	1.08	-6.37	-12.50	-6.48	-7.35	10.90	9.04	-1.44	-2.42	-5.94	-1.32
Construction	6.81	1.51	-3.51	-9.40	-4.42	-6.31	15.58	9.66	2.23	0.66	-4.11	1.08
Manufacturing	7.21	2.12	-2.79	-8.68	-4.05	-5.87	16.35	10.47	2.99	1.54	-3.41	1.75
Trade	32.22	26.15	19.02	11.51	12.31	4.98	43.55	36.42	23.68	24.83	18.88	22.07
Transportation & utilities	10.92	5.29	-0.05	-6.14	-1.29	-3.19	20.13	13.89	5.71	4.16	-0.48	4.66
Financial activities	13.06	7.45	2.18	-4.05	1.11	-0.89	22.30	15.99	8.25	6.57	1.55	7.05
Real estate	-8.61	-13.14	-17.43	-22.48	-18.21	-19.83	-1.10	-6.16	-12.52	-13.87	-17.95	-13.50
Owner occupied housing												
Professional & Business Services	3.58	-1.68	-6.26	-12.04	-7.15	-9.09	12.11	6.15	-0.52	-2.24	-6.83	-1.79
Education & health services	2.44	-2.64	-7.40	-13.11	-8.34	-10.22	10.85		-2.03	-4.33	-8.40	-3.37
Leisure & hospitality services	11.00	6.01	0.82	-5.33	0.13	-2.12	20.67		6.48	5.35	-0.45	5.31
Other services	3.50	-1.76	-6.66	-12.39	-7.62	-9.28	11.75	6.79	-1.12	-2.64	-7.27	-2.31

Table 5-24: Factor inputs results capital tax simulation

	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Labor	8.42	2.84	-1.41	-8.99	-3.12	-3.11	9.98		3.38	1.39	-3.85	2.32
Capital	4.96	-4.87	-7.73	-10.48	-6.58	-10.38	17.53	9.68	-1.82	-4.92	-4.75	-5.40

Table 5-25: CET domestic results capital tax simulation

CET domestic table	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Natural resources & mining	2.80		-9.74		-6.85				1.09			
Construction		1.52										
Manufacturing	8.45		-2.13						4.74			
Trade				-6.20								9.42
Transportation & utilities					-3.05							3.50
Financial activities						-4.06						5.97
Real estate							6.10				-15.57	-9.52
Owner occupied housing								9.68				
Professional & business services			-5.21						0.86		-6.31	0.44
Education & health services									0.49	0.24		
Leisure & hospitality services	11.82										-2.48	3.83
Other services					-6.63	-9.36						0.49

Table 5-26: CET export results capital tax simulation

	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
Natural resources & mining	9.93		-3.48		-0.39				8.10			
Construction		1.55										
Manufacturing	5.55		-4.75						1.94			
Trade				-26.10								-13.79
Transportation & utilities					-7.54							-1.30
Financial activities						-11.82						-2.60
Real estate							31.90				4.96	12.48
Owner occupied housing								59.66				
Professional & business services			-1.48						4.82		-2.63	4.38
Education & health services									6.51	6.25		
Leisure & hospitality services	6.13										-7.45	-1.46
Other services					-2.91	-5.75						4.49

Table 5-27: Export results capital tax simulation

Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
6.92	0.16	-1.56	-19.58	-5.34	-8.57	23.39	46.92	3.57	3.15	-5.67	2.82

Table 5-28: Import results capital tax simulation

Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services
-2.08	0.74	-0.77	3.43	1.15	1.34	-4.70	2.00	-0.24	-1.35	1.41	0.71

Table 5-29: Final household consumption results capital tax simulation

Households	LT10k	10-15k	15-25k	25-35k	35-50k	50-75k	75-100k	100-150k	150k+
Armington	-0.10	-0.46	-0.77	-1.06	-0.97	-1.52	-0.58	-0.93	-1.31

Table 5-30: Armington household results capital tax simulation

	LT10k	10-15k	15-25k	25-35k	35-50k	50-75k	75-100k	100-150k	150k+
Natural resources & mining	0.56	0.19	-0.12	-0.32	-0.29	-0.97	-0.23	-0.59	-0.98
Construction									
Manufacturing	-0.38	-0.74	-1.04	-1.24	-1.21	-1.89	-1.18	-1.54	-1.91
Trade	-5.51	-5.80	-6.09	-6.28	-6.25	-6.93	-6.26	-6.60	-6.95
Transportation & utilities	-1.16	-1.52	-1.82	-2.01	-1.99	-2.65	-1.92	-2.28	-2.65
Financial activities	-1.68	-2.03	-2.33	-2.54	-2.51	-3.18	-2.48	-2.83	-3.20
Real estate	0.65	0.09	-0.22	-0.48	-1.16	-2.54	-2.31	-2.67	-3.03
Owner occupied housing	12.53	11.90	11.56	11.27	10.50	8.96	9.21	8.82	8.41
Professional & business services	0.33	-0.03	-0.33	-0.55	-0.53	-1.22	-0.51	-0.87	-1.24
Education & health services	1.05	0.67	0.36	0.16	0.19	-0.51	0.19	-0.17	-0.55
Leisure & hospitality services	-1.38	-1.73	-2.03	-2.24	-2.22	-2.90	-2.18	-2.54	-2.91
Other services	0.59	0.20	-0.11	-0.32	-0.27	-0.96	-0.26	-0.62	-1.00

Table 5-31: Investments results table

Investment	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services	Total
Benchmark	1,848	58,596	5,383	12,092	7,619	2,018	14,959	0	41,135	0	15,680	13,778	173,107
Scenario I	1,849	58,626	5,385	12,098	7,623	2,019	14,967	0	41,157	0	15,688	13,785	173,197
Scenario II	1,878	59,547	5,470	12,288	7,742	2,050	15,202	0	41,803	0	15,935	14,001	175,916
Scenario III	1,885	59,768	5,490	12,333	7,771	2,058	15,258	0	41,958	0	15,994	14,054	176,570

All values in millions of dollars.

Table 5-32: Output results table

Output	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services	Total
Benchmark	11,809	78,326	103,366	104,253	48,453	67,786	52,224	44,482	160,149	72,713	52,536	114,888	910,984
Scenario I	12,217	78,349	104,520	98,606	47,140	67,531	47,787	51,419	162,664	72,633	50,874	116,160	909,901
Scenario II	10,684	79,319	98,228	95,281	45,356	64,552	64,074	49,149	161,946	73,115	49,734	116,157	907,596
Scenario III	12,615	79,517	99,755	94,463	46,321	63,521	60,369	48,789	163,747	73,202	50,386	116,153	908,839

All values in millions of dollars.

Table 5-33: Labor results table

Labor	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services	Total
Benchmark	3,676	27,789	22,066	46,820	16,705	23,191	8,210	0	71,042	39,566	19,886	71,627	350,578
Scenario I	3,849	27,917	22,501	44,590	16,408	23,362	7,660	0	72,559	39,636	19,390	72,707	350,578
Scenario II	3,433	28,467	21,444	43,585	16,038	22,749	9,496	0	72,912	40,093	19,174	73,187	350,578
Scenario III	3,985	28,579	21,756	42,609	16,183	22,469	9,030	0	73,444	40,117	19,120	73,285	350,578

All values in millions of dollars.

Table 5-34: Capital results table

Capital	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services	Total
Benchmark	2,948	5,510	10,348	15,828	9,173	17,274	21,217	29,402	18,728	4,863	6,651	12,820	154,759
Scenario I	3,007	5,393	10,281	14,687	8,779	16,956	19,289	33,987	18,637	4,746	6,318	12,679	154,759
Scenario II	2,568	5,266	9,382	13,747	8,217	15,810	26,550	32,487	17,932	4,597	5,983	12,221	154,759
Scenario III	3,094	5,241	9,548	14,169	8,569	15,481	24,937	32,249	18,386	4,623	6,334	12,127	154,759

All values in millions of dollars.

Table 5-35: Exports results table

Exports	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services	Total
Benchmark	9,137	5,668	161,664	22,842	20,786	24,451	25,999	0	75,463	10,325	22,056	20,849	399,239
Scenario I	9,444	5,677	162,612	20,294	20,226	24,391	23,558	0	77,627	10,504	21,143	21,575	397,049
Scenario II	8,388	5,675	158,069	18,797	19,115	22,860	34,781	0	76,908	10,618	20,357	21,493	397,061
Scenario III	9,770	5,677	159,138	18,370	19,677	22,356	32,080	0	78,155	10,650	20,806	21,436	398,114

All values in millions of dollars.

Table 5-36: Imports results table

Imports	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services	Total
Benchmark	9,137	5,668	161,664	22,842	20,786	24,451	25,999	0	75,463	10,325	22,056	20,849	399,239
Scenario I	9,071	5,608	160,648	23,091	20,740	24,382	25,961	0	74,585	10,187	22,036	20,740	397,049
Scenario II	8,989	5,732	159,877	23,471	21,118	24,698	24,344	0	75,384	10,192	22,332	20,924	397,061
Scenario III	8,947	5,710	160,419	23,626	21,024	24,777	24,778	0	75,283	10,186	22,367	20,996	398,114

All values in millions of dollars.

Table 5-37: Household results table

Households	Natural resources & mining	Construction	Manufacturing	Trade	Transportation & utilities	Financial activities	Real estate	Owner occupied housing	Professional & business services	Education & health services	Leisure & hospitality services	Other services	Total
Benchmark	2,457	0	84,332	72,336	18,824	32,115	14,567	44,482	26,163	87,322	34,024	28,900	445,523
Scenario I	2,435	0	83,303	69,441	18,530	31,690	12,914	51,419	25,963	86,928	33,320	28,782	444,725
Scenario II	2,412	0	83,193	68,164	18,339	31,379	14,672	49,149	25,935	87,299	33,058	28,801	442,401
Scenario III	2,447	0	83,177	67,688	18,426	31,245	14,415	48,789	25,981	87,343	33,202	28,765	441,479

All values in millions of dollars.

CHAPTER 6
CONCLUSIONS

The central issue of this dissertation is how changes in property taxes affect the state's economy and the distribution of household consumption. This topic is a timely one since the Florida legislature is currently considering changes in the property tax system. The tax policy analysis in this dissertation has gone beyond the usual estimation of changes to the general revenue funds. It employs a CGE model to estimate the property tax impact on production, consumption and income in the economy. The CGE model provides a comprehensive outline of the results of a change in tax policy which informs and supports any decision making. The dissertation attempts to accomplish two objectives. First, it is an application of CGE modeling at a regional level. Second, it is a property tax study that analyzes the economic and equity implications of public policy.

The impact of a change in the tax system can be estimated and evaluated by means of the equivalent variation measure of the property tax elimination within the context of constant government revenue. Public policy impact was found to be of little consequence in terms of the total consumption of households. There are significant differences across income groups as to their consumption of owner-occupied housing. There certainly have been winners and losers in terms of the industrial sectors. The winners appear to be the housing sectors and those industries associated with them. The reduction in the property tax can be seen as having a beneficial effect on the housing sector.

A summary of the policy implications includes two major conclusions. First, the level of the overall impact of the simulated changes in tax policy is relatively insignificant in the context of the overall economy. Conceivably a different policy parameter amount or combination could have a larger effect. Second, on an individual sector or household level there are some relatively

significant results. The policy instrument is targeted at the housing services sector. Corespondingly, the production and consumption of owner-occupied housing is dramatically larger under all three alternative scenarios. Household groups are impacted according to the varying proportion of housing services in their commodity consumption bundle. Low income groups benefit to a greater degree from the reduction in property taxes in terms of their consumption of owner-occupied housing.

In all three scenarios, about half of the industrial sectors show an increase in output with the other half of the sectors declining. Owner-occupied housing, construction, business and professional services and other services increase in each simulation. The property tax on owner-occupied housing is lowered in each of the counterfactual situations. The property tax reduction along with the fact that owner-occupied housing has the largest share of property taxes as a percentage of capital input (Table 4-6) and the lowest share of indirect business taxes as a percentage of output (Table 4-5) account for the sector's increase across all scenarios.

The method of equal-yield differential tax analysis necessitates a rise in the level of indirect business taxes. An industry with a low level of indirect business taxes will escape the increase. Construction has the next lowest share of indirect business taxes but it also has a low share of property taxes. Even though it is somewhat unaffected directly by the property tax shock, construction is a necessary input to those industries that are affected, and is therefore indirectly affected.

Business and professional services have a moderate share of indirect business taxes and a slightly higher level of property taxes. It is a significant input to those sectors that are positively affected by the change in tax policy. Other services have a small share of indirect business taxes and the lowest share of property taxes. The average increase in construction and other services is

around one percent (1%) and the average increase in professional and business services is around a percent and a half (1.5%). These minor changes are relatively insignificant.

Clearly, the real estate sector output increases in simulations II and III since its property taxes are lowered. The increase (22.7% and 15.6%) can be attributed to the fact that the industry is highly capital intensive (Table 4-3). Trade, transportation and utilities, financial activity and leisure and hospitality services output decrease in each simulation. These industries pay the highest share of indirect business taxes and thus their increase has a large effect on their economic activity. Lower capital tax would have an effect on the financial sector which is a capital intensive industry but for the fact that the sector pays a small share of property tax and thus is somewhat unaffected by the lower capital tax. Transportation and utilities and leisure and hospitality services do pay a relatively significant share of property taxes but they are labor intensive industries and thus are not greatly affected by a lower capital tax.

The productive factors, labor and capital, follow primarily a general pattern noted earlier. Both capital and labor inputs decrease in those industries with declining levels of production. For those industries with an increasing output, there are two outcomes. First, there are a few industries that experience an increase in both labor and capital. These sectors (real estate and owner-occupied housing) are predominantly those immediately impacted by the change in tax policy. Second, some sectors substitute labor for capital in their production process.

The factor market closer of the CGE model used in this dissertation can be characterized as short-term and static. The total supply of labor and capital as productive factors is fixed in the model simulations, so for the use of capital in some industries to increase, there must be a reallocation away from it in other industries. This accounts for the behavior of those industries with increasing output in the second outcome. The substitution of labor for capital is in fact the

movement of capital to those sectors that are described in the first outcome with increases in both labor and capital.

In each simulation, the level of expenditures by the investment final demand sector increases in order to create capital. In the first scenario it increases by a half of a percent (0.5%), in the second one point six percent (1.6%) and in the third two percent (2%). A dynamic model could explore the long-term implications of the change in capital formation.

The changes in exports mirror the particular changes in industrial sector production. The individual variations in sector quantities are due to large CET commodity substitutions. Of particular interest is the trade-off between the direct and by-product amounts produced domestically and for external trade. The increase in real estate production due to a change in tax policy identified in simulations two and three is accompanied by a decrease in its domestic by-product output and by an increase in exports. Imports have increased for many of the commodities produced domestically by those industries whose production has fallen off.

The smallest change in aggregated household consumption levels, an $800 million reduction, is associated with the first counterfactual scenario. The next largest change corresponds to the second simulation (-$3.1 billion) and the largest with the third (-$4 billion). Consumption levels for the two lowest household income classes increase in the first scenario, but only for the lowest income group in the second scenario. There are no consumption increases for any of the household income groups in the third scenario.

Even though the overall level of consumption of household income classes has changed by a relatively insignificant amount, the reallocation of commodities by households exhibits important changes. The changes in the consumption of owner-occupied housing are sizable and they are greater for lower income classes. In the baseline model, the lower income groups

purchase more real estate (rental housing) and less owner-occupied housing than upper and middle income groups. As a result, in the counterfactual simulations, the lower income groups demonstrate the largest increase in the consumption of owner-occupied housing.

In general, the size of the resulting changes is quite small relative to total consumption and output. There are two explanations for this. First, the numeric conclusions of the analysis are affected by the scale of revenue relative to the state's overall economy. The size of revenues in Florida relative to the overall level of economic activity is small, thus changes in the level of taxes will have a minimum impact. Second, as indicated by Table 4-3 for the most part industries in Florida are labor intensive so a change in a tax on capital will also have a small impact on output.

Even though the impact of the change in tax policy is slight in terms of household consumption, there is an order of magnitude difference between the impact on lower and upper income groups. This outcome is consistent across scenarios and lends credence to the hypothesis that tax policy affects income groups differently. One implication of this research is that a complete evaluation of any policy change should take into consideration the impact on different income groups.

There is a proportionately greater increase in the consumption of owner-occupied housing for lower income groups across the scenarios. These groups consume less of this good in the benchmark data set. If the encouragement of home ownership is a pubic goal, then the model results imply that there is an additional benefit from the proposed tax policy.

There is a difference in the outcome for the real estate industry sector between the capital tax and housing services simulations and the owner occupied housing simulation. The reduction in property taxes is applied in the capital tax and housing services simulations. In the owner

occupied housing simulation, however, the tax reduction does not target the real estate industry sector. In keeping with the interpretation of real estate exports as Florida seasonal property rentals by non-residents, in the capital tax and housing services simulations the increase in the sectors' by-product export of leisure and hospitality services commodity and the associated reduction in its domestic by-products commodity output implies a trade-off in favor of transient compared to permanent residents in contrast to the owner-occupied housing scenario which primarily affects permanent residents.

There are essentially two major limitations on the research in this dissertation. First, the IMPLAN SAM may be an imperfect representation of the Florida economy due to the particular regionalization process applied to the BEA Input-Output (I-O) matrix. Even thought the I-O matrix which is called the use matrix in the SAM is only one section of the total structure, it is crucial for the conclusions in this dissertation. There are three methods that IMPLAN applies to scale the national I-O matrix for sub-regions. The user chooses between a method based on regional purchase coefficients, supply-demand pooling or locations quotients. The default regional purchase coefficient method was used. A major issue with this procedure is its assumption of a common technology among diverse areas. This criticism could be leveled against any use of the IMPLAN system for economic impact modeling. However, the widespread use of IMPLAN in the private and academic fields for estimating the impact of economic activity in terms of employment, income and production metrics has provided valuable information to decision making processes.

The second limitation is that the CGE model is characterized by a closed factor market which is a restrictive assumption for the Florida economy. In the study of the impact of the reduction in federal defense spending in California using IMPLAN data done by Hoffmann,

Robinson, et al., (1996) there was a significant difference between the assumption of a closed and open factor market. The overall economic effect of the open factor market model was less that the closed factor market model as impacted workers moved out of the state. Similar differences in the results would be anticipated with an open labor market model used in this dissertation. The closed labor model can be described as an application of a national model which is in line with Mieszkowski's theory of the incidence of property tax. The model simulation results are the local effects of the tax policy. One possible difference between the application of a quasi national model and a model with open factor markets would be a smaller change in the substitution toward owner-occupied housing.

An objective of further research would be to relax the restriction of fixed factor markets and compare the results between the different specifications. Future research could also include the simulation and analysis of alternative tax instruments. Converting the current CGE model into a dynamic one has been mentioned in earlier chapters. Such a model would allow for the study of the pattern of change in the housing stock, factor inputs and income distribution over time. Finally, another direction for future research could be to break out governmental services and public goods which are included in the other services aggregate sector and treat them as a separate sector. This would permit the additional investigation of tax policy. Ad valorem tax could be considered as a user charge for public services and the marginal cost of funds could be calculated and used in the evaluation of public policy.

APPENDIX A
AGGREGATE IMPLAN SAM, 2003

Table A-1: Aggregate IMPLAN SAM, 2003

	Industry	Commodity	Labor	Capital	Indirect taxes	Households	Federal govt	State/local govt	Enterprises	Investment	Trade	Total
Industry		687,416									223,568	910,984
Commodity	217,456					317,335	26,321	69,389		73,092		703,594
Labor	350,578											350,578
Capital	154,760											154,760
Indirect taxes	42,597											42,597
Households		95	311,388	54,907		14,742	79,219	6,835	34,424	22,160	562	524,332
Federal govt		107	37,800	101	4,452	1227	30,059		9,526	79,582	115	162,967
State/local govt		13,888	547	-36	38,146	3935	13,196	37,636	5,587	11,087	1,145	125,130
Enterprises				50,275			2,176	5				52,456
Investment		2,088		70,333		58810			2,919	321	63,218	197,688
Trade	145,593		843	-20,820		128,283	11,995	11,265		11,447	25	288,632
Total	910,984	703,594	350,578	154,760	42,597	524,332	162,967	125,130	52,456	197,688	288,632	3,513,717

All values are in millions of dollars Source: IMPLAN

APPENDIX B
DETAILED IMPLAN SAM, 2003

Table B-1: Detailed IMPLAN SAM, 2003

	NRM	CNS	MNF	TRD	TUT	FNI	REL	OCC	PBS	EHS	LHS	SRV
NRM												
CNS												
MNF												
TRD												
TUT												
INF												
FNI												
REL												
PBS												
EHS												
LHS												
SRV												
NRM	9.2	0.4	16.5	0.0	6.8	0.0	0.5	0.0	1.8	0.1	1.3	2.4
CNS	0.1	0.6	1.6	1.7	1.2	1.1	5.1	3.7	3.8	2.5	2.8	5.3
MNF	1.9	50.5	102.0	8.1	5.4	0.6	1.5	3.2	20.8	21.7	19.9	20.9
TRD	2.0	68.3	56.1	13.0	7.0	0.8	2.5	5.6	18.9	10.2	14.7	15.0
TUT	2.3	16.3	39.2	21.3	35.5	6.2	15.2	0.6	30.6	13.8	14.9	18.5
FNI	1.0	12.6	13.6	12.4	9.0	110.9	10.2	20.5	21.2	11.1	8.2	10.9
REL	1.9	4.0	4.3	24.4	4.6	10.5	32.1	9.3	39.8	33.6	18.2	22.3
OCC												
PBS	2.9	60.7	83.1	87.5	33.4	36.7	45.5	12.5	258.4	62.1	32.4	53.1
EHS	0.0	0.1	0.3	0.4	0.4	0.1	0.1		1.2	6.5	0.3	0.4
LHS	0.2	1.5	5.4	4.3	4.4	4.3	2.6		19.7	8.9	9.1	3.6
SRV	2.3	11.7	22.2	9.7	6.4	6.7	3.1	4.3	34.0	8.5	9.9	13.7
LAB	37	278	221	468	167	232	82		710	396	199	716
CAP	29	55	103	158	92	173	212	294	187	49	67	128
HH1												
HH10												
HH15												
HH25												
HH35												
HH50												
HH75												
HH100												
HH150												
FED	0.3	0.4	0.9	16.5	2.5	1.7	6.8	6.4	3.2	0.6	3.5	1.8
STL	2.3	3.6	7.6	141.2	21.2	14.9	58.1	55.1	27.4	4.7	29.9	15.4
INV	9.3	5.3	20.5	0.0	14.2	0.0	0.3	0.3	1.5	0.1	3.4	4.4
NRM	0.1	0.6	1.5	1.6	1.0	1.0	4.3	1.5	3.5	2.3	2.6	4.4
CNS	12.6	180.1	273.7	19.9	33.8	3.0	4.7	8.8	56.2	46.7	55.7	66.6
MNF	0.2	6.1	7.0	1.8	3.1	0.8	0.2	0.5	4.4	1.0	1.5	3.6
TRD	0.6	4.9	13.6	7.3	16.9	2.8	3.5	0.1	12.8	5.3	4.1	6.7
TUT	0.5	6.0	6.3	5.7	4.4	54.1	4.9	10.1	9.8	5.2	3.8	5.0
FNI	0.8	1.7	1.8	10.5	2.0	4.5	13.8	4.0	17.1	14.4	7.8	9.5
REL												
OCC	0.7	12.4	27.3	26.3	10.9	10.1	11.9	2.3	106.0	19.8	10.9	17.7
PBS	0.0	0.0	0.1	0.2	0.2	0.0	0.0		0.4	1.0	0.1	0.1
EHS	0.1	0.3	1.0	0.8	0.6	0.8	0.5		5.5	1.3	3.6	1.0
LHS	0.5	2.2	3.8	1.6	0.9	1.4	0.5	2.0	5.7	1.4	1.6	1.9
SRV	0.3	0.4	0.9	16.5	2.5	1.7	6.8	6.4	3.2	0.6	3.5	1.8

	NRM	CNS	MNF	TRD	TUT	FNI	REL	OCC	PBS	EHS	LHS	SRV	LAB	CAP
NRM	50.9		2.9								0.1			
CNS		777.5												
MNF	0.0		494.4						5.1					
TRD				871.2										
TUT	0.1				337.8							0.5		
FNI						464.4						25.0		
REL							333.3							
OCC								444.8						
PBS	0.2		0.7						1040.0	0.5				
EHS										675.1				
LHS							1.1		1.6		353.8			
SRV				0.5	48.2	0.3	7.4		0.3		0.6	935.9		
NRM														
CNS														
MNF														
TRD														
TUT														
FNI														
REL														
OCC														
PBS														
EHS														
LHS														
SRV														
LAB														
CAP														
HH1													29.2	5.3
HH10													51.4	7.8
HH15													176.9	31.6
HH25													260.0	48.8
HH35													450.1	95.8
HH50													783.2	131.1
HH75													472.0	142.5
HH100													469.8	120.9
HH150													429.6	95.7
FED													378.0	96.3
STL													5.5	55.5
INV														716.3
NRM														
CNS														
MNF														
TRD														
TUT														
INF														
FNI														
REL														
PBS														
EHS														
LHS														
SRV														

	HH1	HH10	HH15	HH25	HH35	HH50	HH75	HH100	HH150	FED	STL	INV
NRM												
CNS												
MNF												
TRD												
TUT												
FNI												
REL												
OCC												
PBS												
EHS												
LHS												
SRV												
NRM	0.6	0.5	1.1	1.3	2.0	2.4	1.6	1.4	1.1	-0.4	0.0	0.4
CNS										35.6	126.3	586.0
MNF	7.6	6.1	13.1	15.1	23.8	26.8	15.6	13.7	11.0	37.7	17.0	53.8
TRD	35.1	25.9	55.9	67.1	118.1	139.3	81.1	71.2	57.1	1.7	8.7	-3.6
TUT	8.9	6.9	14.8	16.2	23.1	27.8	16.5	14.5	11.6	5.4	22.7	3.5
FNI	7.6	7.2	15.5	21.4	40.8	48.6	29.6	26.0	20.9	0.0	5.7	
REL	10.4	7.2	15.5	17.2	21.9	15.8	5.4	4.7	3.8	1.0	8.5	25.3
OCC	15.6	12.5	26.9	31.1	68.9	100.0	73.5	64.5	51.7			
PBS	8.2	6.7	14.5	16.7	26.3	32.8	20.6	18.1	14.5	37.6	36.6	46.0
EHS	45.4	34.3	73.9	78.9	116.7	145.8	108.0	94.9	76.1	2.6	-110.8	0.0
LHS	10.7	9.7	20.9	27.1	50.8	63.7	42.9	37.7	30.2	0.9	-4.1	0.0
SRV	10.9	8.9	19.1	24.0	36.5	47.6	38.2	33.6	26.9	140.0	444.4	-1.3
LAB												
CAP												
HH1	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.5	22.3	2.8	167.4
HH10	0.1	0.0	0.1	0.1	0.1	0.3	0.3	0.5	0.9	63.0	3.3	51.1
HH15	0.2	0.1	0.2	0.3	0.5	0.9	1.1	1.8	3.0	151.6	19.0	
HH25	0.4	0.2	0.3	0.5	0.7	1.3	1.6	2.6	4.5	143.6	36.7	
HH35	0.6	0.3	0.6	0.8	1.3	2.3	2.9	4.5	7.7	117.7	49.5	3.0
HH50	1.1	0.5	1.0	1.5	2.2	4.1	5.0	7.9	13.5	78.6	46.5	
HH75	0.7	0.3	0.6	0.9	1.4	2.5	3.0	4.8	8.2	29.9	27.8	
HH100	0.7	0.3	0.6	0.9	1.4	2.5	3.0	4.8	8.2	14.7	19.5	
HH150	0.6	0.3	0.6	0.8	1.2	2.3	2.8	4.4	7.5	9.3	30.3	
FED	0.0	0.1	0.3	0.4	1.2	3.0	2.0	2.7	2.7	300.6		795.8
STL	0.1	0.3	1.2	1.8	5.0	11.0	6.4	7.2	6.4	315.2	323.8	110.9
INV	-1.5	-2.2	-3.8	39.3	-28.1	135.7	68.8	81.9	98.3	0.0	16.2	3.2
NRM	0.7	0.6	1.2	1.4	2.1	2.5	1.5	1.3	1.1	0.2	1.2	18.1
CNS										23.4	8.7	
MNF	36.3	29.2	63.8	77.5	126.0	145.9	88.8	77.3	65.6	79.8	64.7	
TRD	3.6	3.0	6.4	7.7	13.8	15.4	8.8	7.7	6.2	0.1	1.0	124.5
TUT	2.8	2.1	4.6	5.2	7.4	9.5	6.4	5.6	4.5	1.8	6.6	72.7
FNI	3.6	3.4	7.3	10.1	19.3	23.1	14.2	12.5	10.0	0.0	5.2	20.2
REL	4.5	3.1	6.6	7.4	9.4	6.8	2.3	2.0	1.6	0.4	3.7	124.3
OCC												0.0
PBS	5.1	4.1	8.9	10.7	17.3	21.4	13.7	12.1	9.7	12.6	17.1	365.4
EHS	5.1	4.3	9.3	9.7	13.4	18.4	15.1	13.2	10.6	0.6	1.3	
LHS	1.7	1.6	3.4	4.3	7.6	9.8	7.1	6.3	5.0	0.2	1.3	156.8
SRV	1.7	1.7	3.6	4.6	6.1	7.9	6.9	6.0	4.8	0.7	1.9	139.0

	NRM	CNS	MNF	TRD	TUT	FNI	REL	OCC	PBS	EHS	LHS	SRV
NRM	63.9		0.2								0.1	
CNS		5.7										
MNF	0.5		532.6						1.1			
TRD				171.3								
TUT	0.0				146.0							0.1
FNI						177.3						11.2
REL							188.9					
OCC								0.0				
PBS	0.0		0.8						559.2	0.1		
EHS										52.0		
LHS							0.6		0.3		168.0	
SRV				0.0	6.0	0.1	4.2		0.0		0.1	145.2
NRM												
CNS												
MNF												
TRD												
TUT												
INF												
FNI												
REL												
PBS												
EHS												
LHS												
SRV												
LAB												
CAP												
HH1			0.1									0.4
HH10			0.1									0.3
HH15			0.2									0.5
HH25			0.2									0.5
HH35			0.4									0.7
HH50			0.4									0.7
HH75			0.2									0.3
HH100			0.2									0.3
HH150			0.1									0.2
FED	0.3		0.0	0.1		0.0			0.0			0.7
STL	1.7		1.3	0.2		0.3			0.6	3.2	4.1	
INV	25.0	50.9	1079.8	56.8	55.8	66.8	66.3	0.0	193.4	48.0	48.3	47.5
NRM												
CNS												
MNF												
TRD												
TUT												
FNI												
REL												
OCC												
PBS												
EHS												
LHS												
SRV												

APPENDIX C
IMPLAN INDIRECT BUSINESS TAXES

Table C-1: IMPLAN indirect business taxes

	Indirect bus tax	
Federal government	Excise taxes	2693
	Custom duty	844
	Fed nontaxes	915
State & local govt	Sales tax	18196
	Property tax	14370
	Motor vehicle lic	354
	Severance tax	38
	Other taxes	3333
	S/l nontaxes	1855

All values are in Millions of Dollars Source: IMPLAN

APPENDIX D
NAICS CATEGORIES

Table D-1: NAICS categories

Model sector	Abbreviation
Natural resources & mining	NRM
Construction	CNS
Manufacturing	MNF
Trade	TRD
Transportation & utilities	TUT
Financial activities	FNI
Real estate	REL
Owner occupied housing	OCC
Professional & business services	PBS
Education & health services	EHS
Leisure & hospitality services	LHS

APPENDIX E
JUST AND TAXABLE VALUE BY USECODE

Table E-1: Just and taxable value by usecode

Usecode	Description	Count	Just Value	Taxable Value
0	Vacant residential	1,705,370	70,207,645,797	68,873,754,110
1	Single family	4,234,581	854,600,759,530	566,241,081,361
2	Mobile homes	442,858	24,773,944,993	14,793,710,669
3	Multi-family - 10+ units	14,126	44,980,935,352	43,698,225,831
4	Condominium	1,479,155	272,540,727,113	218,464,164,260
5	Cooperatives	41,593	3,954,968,490	3,023,690,206
6	Retirement homes	1,044	2,323,865,744	1,876,600,810
7	Miscellaneous residential	17,953	1,532,992,213	1,465,878,457
8	Multi-family - < 10 units	156,143	31,469,330,697	27,317,406,587
9	Undefined	657	4,917,867	3,218,133
10	Vacant commercial	82,107	16,885,153,432	16,359,792,123
11	Stores, one story	38,892	22,958,290,738	22,770,663,078
12	Mixed use - store & office, etc.	21,484	7,273,321,089	6,875,603,221
13	Department stores	831	4,187,517,730	4,180,989,836
14	Supermarkets	2,540	2,309,595,305	2,305,993,057
15	Regional shopping centers	487	8,123,305,532	8,022,103,790
16	Community shopping centers	6,562	18,048,684,143	18,024,988,435
17	Office buildings - non-professional services, one story	26,111	11,717,142,785	11,357,638,424
18	Office buildings - non-professional services, multi story	8,881	23,434,034,340	22,829,420,893
19	Professional services buildings	15,345	10,137,687,255	9,434,867,202
20	Airports, bus terminals, marine terminals, piers, marinas	1,369	1,953,107,001	1,038,310,381
21	Restaurants, cafeterias	7,895	4,890,819,217	4,870,953,079
22	Drive-in restaurants	4,353	2,778,529,527	2,771,469,588
23	Financial institutions	4,303	4,658,881,287	4,646,311,046
24	Insurance company offices	307	215,938,437	214,226,919
25	Repair service shops (excluding automotive)	4,969	1,188,090,985	1,180,983,218
26	Undefined	3,876	2,152,360,993	2,147,238,226
27	Undefined	15,471	8,174,769,795	8,108,141,598
28	Parking lots, mobile home parks	13,510	8,593,431,725	8,278,469,082
29	Wholesale outlets, produce houses, manufacturing outlets	879	612,837,149	608,205,548
30	Florist, greenhouses	449	94,023,754	90,631,067
31	Drive-in theaters, open stadiums	37	173,952,610	139,463,486
32	Enclosed theaters, enclosed auditoriums	219	638,846,600	512,116,272
33	Nightclubs, cocktail lounges, bars	2,125	741,525,251	726,616,023
34	Bowling alleys, skating rinks, pool halls, enclosed arenas	545	760,861,057	581,687,466
35	Tourist attractions, permanent exhibits, other entertainment facilities, fairgrounds (private)	929	3,456,082,772	3,359,579,836
36	Camps	537	544,129,813	484,332,959
37	Race tracks: horse, auto, or dog	131	311,978,754	308,227,109
38	Golf courses, driving ranges	3,212	3,857,842,005	3,718,248,284
39	Hotels, motels	6,380	20,858,293,804	20,577,706,264
40	Vacant industrial	18,502	4,085,191,977	3,933,986,533
41	Light manufacturing, small equipment manufacturing plants, small machine shops, instrument manufacturing, print plants	15,960	10,098,426,191	9,965,151,374
42	Heavy industrial, heavy equipment manufacturing, large machine shops, foundries, steel fabricating plants, auto or aircraft plants	762	1,856,005,511	1,578,256,332
43	Lumber yards, sawmills, planning mills	586	460,184,278	451,769,669
44	Packing plants: fruit & vegetable, meat packing plants	616	566,231,297	564,733,147
45	Canneries, fruit & vegetable, bottlers & brewers distilleries, wineries	106	381,115,996	380,105,891

Usecode	Description	Count	Just Value	Taxable Value
46	Other food processing, candy factories, bakeries, potato chip factories	355	381,093,915	378,820,253
47	Mineral processing, phosphate processing, cement plants, refineries, clay plants, rock & gravel plants	940	663,477,690	660,914,044
48	Warehousing, distribution terminals, trucking terminals, van & storage warehousing	34,664	28,059,680,486	27,630,078,133
49	Open storage, new & used building supplies, junk yards, auto wrecking, fuel storage, equipment & material storage	3,789	999,594,157	979,869,273
50	Improved agricultural	25,744	5,499,266,567	1,992,982,200
51	Cropland soil capability class i	7,515	1,935,972,663	401,711,914
52	Cropland soil capability class ii	8,886	1,545,078,403	319,427,005
53	Cropland soil capability class iii	8,228	4,159,033,313	908,310,659
54	Timberland - site index 90 and above	7,485	1,590,765,355	265,492,030
55	Timberland - site index 80 to 89	21,635	4,346,362,151	592,117,648
56	Timberland - site index 70 to 79	24,298	3,913,021,553	595,305,497
57	Timberland - site index 60 to 69	7,003	1,638,918,520	183,491,891
58	Timberland - site index 50 to 59	2,511	384,523,573	53,755,837
59	Timberland not classified by site index to pines	5,944	1,029,771,282	130,649,489
60	Grazing land soil capability class i	32,772	11,079,567,528	1,352,466,811
61	Grazing land soil capability class ii	15,365	4,694,843,930	709,614,728
62	Grazing land soil capability class iii	7,347	2,800,072,009	460,982,865
63	Grazing land soil capability class iv	13,931	4,074,355,920	698,996,666
64	Grazing land soil capability class v	1,575	1,025,482,685	65,861,990
65	Grazing land soil capability class vi	1,443	395,278,175	66,129,626
66	Orchard groves, citrus, etc.	21,951	8,088,401,381	1,981,238,158
67	Poultry, bees, tropical fish, rabbits, etc.	896	227,480,008	90,545,511
68	Dairies, feed lots	2,762	1,288,569,301	494,970,554
69	Ornamentals, miscellaneous agricultural	9,055	2,573,803,887	781,015,136
70	Vacant institutional	5,201	527,604,306	49,291,338
71	Churches	24,838	14,410,542,430	272,196,749
72	Private schools & colleges	3,598	4,336,873,935	744,669,816
73	Privately owned hospitals	809	5,675,766,329	2,611,161,627
74	Homes for the aged	4,597	3,918,865,219	2,291,612,071
75	Orphanages, other non-profit or charitable services	7,192	1,784,496,950	133,279,499
76	Mortuaries, cemeteries, crematoriums	2,839	1,020,781,084	519,957,611
77	Clubs, lodges, union halls	5,866	2,054,297,663	800,376,039
78	Sanitariums, convalescent & rest homes	511	1,348,009,766	1,005,399,945
79	Cultural organizations, facilities	830	626,218,057	28,128,440
80	Undefined - reserved for future use	2,992	823,745,903	35,454,446
81	Military	436	2,744,947,676	161,477
82	Forest, parks, recreational areas	31,962	7,301,146,829	36,542,208
83	Public county schools - include all property of board of public instruction	6,381	18,092,004,095	24,916,512
84	Colleges	491	5,483,469,131	22,905,580
85	Hospitals	460	3,433,336,630	323,959,618
86	Counties (other than public schools, colleges, hospitals)	47,760	25,615,311,332	207,229,666
87	State other than military, forests, parks, recreational areas, colleges, hospitals	65,369	13,217,439,099	58,881,549
88	Federal other than military, forests, parks, recreational areas, hospitals, colleges	20,867	11,138,536,533	63,245,514
89	Municipal other than parks, recreational areas, colleges, hospitals	35,573	15,919,784,019	271,580,364
90	Leasehold interests (government owned property leased by a non-governmental lessee)	2,435	3,059,879,068	1,544,942,505

Usecode	Description	Count	Just Value	Taxable Value
91	Utility, gas & electricity, telephone & telegraph, locally assessed railroads, water & sewer service, pipelines, canals, radio/tv communication	11,109	4,347,111,741	3,236,868,726
92	Mining lands, petroleum lands, or gas lands	1,127	257,587,866	253,164,548
93	Subsurface rights	32,527	186,063,942	165,050,325
94	Right-of-way, streets, roads, irrigation channel, ditch, etc.	24,232	528,461,347	48,418,396
95	Rivers & lakes, submerged lands	9,148	149,322,642	39,798,095
96	Sewage disposal, solid waste, borrow pits, drainage reservoirs, waste lands, marsh, sand dunes, swamps	14,797	298,738,733	88,572,963
97	Outdoor recreational or park land subject to classified use assessment	14,138	204,560,157	82,343,828
98	Centrally assessed	1,522	120,778,314	21,517,970
99	Acreage not zoned agricultural	125,824	10,340,376,443	9,673,475,888

Source: 2005 Florida Department of Revenue

APPENDIX F
DEPARTMENT OF REVENUE TO NAICS CROSSWALK

Table F-1: Department of Revenue to NAICS Crosswalk

NAICS sectors	Department of Revenue
Natural resources and mining	47, 50 to 69
Construction	42
Manufacturing	41 to 46
Trade	10 to 16, 26 to 30
Transportation and utilities	20, 48, 49, 91
Financial activities	23, 24
Owner occupied housing, real estate	0 to 9
Professional and business services	17 to 19
Education and health services	72 to 75, 78, 83 to 85
Leisure and hospitality services	21, 22, 31 to 39
Other services	25, 71, 76, 77, 79 to 82, 86 to 89

APPENDIX G
IMPLAN GENERAL EQUILIBRIUM MODEL PROGRAM

```
$TITLE  IMPLAN General Equilibrium Model

$ONTEXT
$MODEL:IMPLAN

$SECTORS:
      YC(S)                      ! Sectoral supply -- CET for export and domestic
      Y(S)                       ! Sectoral production
      AH(G,HH)$AH0(G,HH)         ! Household Armington
      AG(G,PUB)$AG0(G,PUB)       ! Government Armington
      AI(G)$AI0(G)               ! Investment Armington
      X(G)                       ! Commodity export
      M(G)                       ! Commodity import
      GOV(PUB)                   ! Public output
      INV$I0                     ! Investment
      C(HH)$C0(HH)               ! Consumption

$COMMODITIES:
      PY(S)                      ! Sectoral output price index
      PAH(G,HH)$AH0(G,HH)        ! Household Armington
      PAG(G,PUB)$AG0(G,PUB)      ! Government Armington
      PAI(G)$AI0(G)              ! Investment Armington
      PI$I0                      ! Investment
      PG(PUB)                    ! Government
      PL                         ! Labor wages
      RK                         ! Capital return
      PFX                        ! Balance of payments constraint
      PD(G)                      ! Domestic supply price
      PX(G)                      ! Export supply price
      PM(G)                      ! Import demand price
      PC(HH)                     ! Utility price index

$CONSUMERS:
      RA(HH)                     ! Instititutional income
      GOVT(PUB)                  ! Government
      BANK                       ! Investment

$AUXILIARY:
      TAU                        ! Tax multipliers



*       CET activity:
$PROD:YC(S)   t:1    G.TL(t):4
```

```
      O:PD(G)        Q:MAKE(S,G)        G.TL:
      O:PX(G)        Q:SEXPRT(S,G)      G.TL:
       I:PY(S)       Q:(SUM(G,MAKE(S,G)+SEXPRT(S,G)))

*      Production activity:
$PROD:Y(S) s:0  VA:1  G.TL:4
      O:PY(S)        Q:(SUM(G,MAKE(S,G)+SEXPRT(S,G)))
+      A:GOVT("FED")  T:TX("FED",S)
+      A:GOVT("STL")  N:TAU$TX("STL",S)  M:TX("STL",S)$TX("STL",S)
      I:PD(G)         Q:USE(G,S)                 G.TL:
      I:PM(G)         Q:SIMPRT(G,S)              G.TL:
      I:PL            Q:ld0(s)      VA:
      I:RK            Q:KD0(S)   P:PT("STL",S)     A:GOVT("STL")
+     T:TF("STL",S)    VA:

*      Final demand by institutions modeled as Cobb-Douglas:
$PROD:AH(G,HH)$AH0(G,HH)      s:1
      O:PAH(G,HH)$AH0(G,HH)   Q:AH0(G,HH)
      I:PD(G)                 Q:DH0(G,HH)
      I:PM(G)                 Q:MH0(G,HH)

*      Final demand by institutions modeled as Cobb-Douglas:
$PROD:AG(G,PUB)$AG0(G,PUB)      s:1
      O:PAG(G,PUB)      Q:(MAX(AG0(G,PUB),0))
      I:PAG(G,PUB)      Q:(MAX(-AG0(G,PUB),0))
      I:PD(G)           Q:(MAX(DG0(G,PUB),0))
      O:PD(G)           Q:(MAX(-DG0(G,PUB),0))
      I:PM(G)           Q:(MAX(MG0(G,PUB),0))
      O:PM(G)           Q:(MAX(-MG0(G,PUB),0))

*      Final demand by institutions modeled as Cobb-Douglas:
$PROD:AI(G)$AI0(G)      s:1
      O:PAI(G)        Q:(MAX(AI0(G),0))
      I:PAI(G)        Q:(MAX(-AI0(G),0))
      I:PD(G)         Q:(MAX(DI0(G),0))
      O:PD(G)         Q:(MAX(-DI0(G),0))
      I:PM(G)         Q:MI0(G)

*      Final demand by institutions modeled as Cobb-Douglas:
$PROD:C(HH)$C0(HH)    s:1  h:sigmah
      O:PC(HH)         Q:C0(HH)
      I:PAH(G,HH)    Q:AH0(G,HH)         h:$HS(G)


$PROD:GOV(PUB)        s:1
      O:PG(PUB)         Q:(MAX(G0(PUB),0))
```

```
      I:PG(PUB)            Q:(MAX(-G0(PUB),0))
      I:PAG(G,PUB)       Q:(MAX(AG0(G,PUB),0))
      O:PAG(G,PUB)      Q:(MAX(-AG0(G,PUB),0))

**       Investment:
$PROD:INV$I0
      O:PI             Q:I0
      I:PAI(G)        Q:AI0(G)

*       Commodity trade (fixed export and import prices):
$PROD:X(G)
      O:PFX           Q:(X0(G)+SUM(HH,XH0(HH,G))+SUM(PUB,XG0(PUB,G))+XI0(G))
      I:PX(G)         Q:(X0(G)+SUM(HH,XH0(HH,G))+SUM(PUB,XG0(PUB,G))+XI0(G))

$PROD:M(G)      s:1
      O:PM(G)        Q:(M0(G)+SUM(HH,MH0(G,HH))+SUM(PUB,MG0(G,PUB))+MI0(G))
      I:PFX            Q:(M0(G)+SUM(HH,MH0(G,HH))+SUM(PUB,MG0(G,PUB))+MI0(G))

*       Income balance for institutions:
$DEMAND:RA(HH)
      E:PL              Q:le0(HH)
      E:RK              Q:ke0(HH)
      E:PX(G)         Q:XH0(HH,G)
      E:PFX             Q:( TRN_HH(HH)+SUM(PUB,TRN_HH_PUB(HH,PUB)))
      E:PFX             Q:(-SUM(PUB,PTAX(PUB,HH)))
      E:PFX             Q:(-SAV_HH(HH))
      D:PC(HH)        Q:C0(HH)

$DEMAND:GOVT(PUB)
      E:PL            Q:tl0(pub)
      E:RK            Q:tk0(pub)
      E:PX(G)        Q:XG0(PUB,G)
      E:PFX          Q:( SUM(HH,PTAX(PUB,HH))+SUM(P_B, TRNSFER(PUB,P_B)))
      E:PFX          Q:(-SUM(HH,TRN_HH_PUB(HH,PUB))-SUM(P_B,TRNSFER(P_B,PUB)))
      E:PFX          Q:(-SAV_PUB(PUB))
      D:PG(PUB)    Q:G0(PUB)


$DEMAND:BANK
      E:RK          Q:depr0
      E:PX(G)      Q:XI0(G)
      E:PFX         Q:(SUM(HH,SAV_HH(HH)) + SUM(PUB,SAV_PUB(PUB)))
      D:PI           Q:I0

$CONSTRAINT:TAU
*        GOVT("GOV")  =e= GOV("GOV")*Q0("GOV")*PGOV("GOV");
```

```
      GOV("STL") =E= 1;

$OFFTEXT
$SYSINCLUDE mpsgeset IMPLAN

tau.l = 1;
tau.lo = -inf;
GOV.FX("FED") = GOV.L("FED");

IMPLAN.ITERLIM = 0;
$INCLUDE IMPLAN.GEN
SOLVE IMPLAN USING MCP;
IMPLAN.ITERLIM = 10000;

** scenario one
*TF("STL","OCC") = 0;

** scenario two
*TF('STL',s)  = ITAX('STL',S)/FD('cap',s) ;
*TF("STL",HS) = 0;

** scenario three
*TF("STL",S) = 0;

$INCLUDE IMPLAN.GEN
SOLVE IMPLAN USING MCP;
```

LIST OF REFERENCES

Aaron, H.J. *Who Pays the Property Tax: A New View*. Washington, D. C., The Brookings Institution, 1975.

Arrow, K.J. "General Economic Equilibrium: Purpose, Analytic Techniques, Collective Choice." *Amer. Econ. Rev.* 64(1974):253-272.

Arrow, K.J. and F. Hahn *General Competitive Analysis*. San Francisco, Holden-Day. 1971.

Berck, P., E. Goland, et al. *Dynamic Revenue Analysis for California*. Sacramento, Financial and Economic Research, Department of Finance, 1996.

Berliner, U. "Have and Have-Nots: Income Inequality in America." National Public Radio (Feburary 2007).

Blake, D.R. "Property Tax Incidence: An Alternate View." *Land Econ.* 55(Nov. 1979):521-531.

----------. "Property Tax Incidence: Reply." *Land Econ.* 57(Aug. 1981):473-475.

Bradford, D.F., Ed. *Distributional Analysis of Tax Policy*. Washington D. C., The AEI Press, 1995.

Budiyanti, R. *Application of General Equilibrium Modeling for Measuring Regional Economic and Welfare Impacts of Quality Changes in Sport Fishing in Oklahama*. Department of Agricultural Economics Stillwater, Olkahama State University. Doctor of Philosophy**,** 212(1990).

Debreu, G. *Theory of Value*. New York, Wiley. 1959.

Dew-Becker, I. and R. J. Gordon. *Where Did the Productivity Growth Go? Inflation Dynamics and the Distribution of Income*. Brookings Papers on Economic Activity. B. I. Press, Brookings Institution, 2005.

Economic Policy Institute/Center on Budget and Policy Priorities. *Despite Past Boom Times, Income Gaps Have Widened in 45 States Over The Past Twenty Years*. Washington D.C., 2002.

Fisher, R.C. *State and Local Public Finance: institutions, theory, policy, 2nd ed.*, Richard D. Irwin, 1996.

Ginsburgh, V. and M. Keyzer *The Structure of Applied General Equilibrium Models*. Cambridge, The MIT Press, 1997.

Gunning, J.W. and M.A. Keyzer, Eds. *Applied General Equilibrium Models for Policy Analysis*. Handbook of Development Economics, Elsevier Science, 1995.

Hamilton, B.W. "Capitalization of intrajurisdictional differences in local tax prices." *American Economic Review* 66(December 1975):743-753.

Hanson, K. and S. Vogel. *A CGE Model for a Regional SAM from IMPRO*. Washington, D.C., Economic Research Service, USDA, 1998.

----------. "A Note on linking the IMPRO 2.0 SAM data files for 1996 to a CGE model." Washington, D.C., Economic Research Service, UDSA, 2000.

Harberger, A.C. The Corporation Income Tax: An Empirical Apprasial. *Tax Revision Compendium* 1. H. C. o. W. a. Means. Washington D. C., House Committee on Ways and Means, 86th Congress**,** 1959.

----------. "The Incidence of Corporation Income Tax." *J. of Pol. Econ.* 70(June 1962):215-240.

----------. *Efficiency Effects of Taxes on Income from Capital*. Symposium on Business Taxation, Detroit, Wayne State University. 1966.

Hassett, K.A. and R.G. Hubbard, Eds. *Inequality and Tax Policy*. Washington D. C., The AEI Press, 2001.

Hoffmann, S., S. Robinson, et al. "The Role of Defense Cuts in the California Recession: Computable General Equilibrium Models and Interstate Factor Mobility." *J. of Reg. Sci.* 36(November 1996):571-595.

Julia-Wise, R., S.C. Cooke, et al. "A Computable General Equilibrium Analysis of a Property Tax Limitation Initiative in Idaho." *Land Econ.* 78(May 2002):207-227.

Katzner, D.W. *The Walrasian Vision of the Microeconomy*. Ann Arbor, University of Michigan Press, 1989.

Kehoe, P.J. and T.J. Kehoe "A Primer on Static Applied General Equilibrium Models." *Fed. Res. Bank of Minn. Quart. Rev.* 18(Winter 1994):2-16.

Kim, J. "Growth of regional economy and income inequality: county-level evidence from Florida, USA." *App. Econ.* 36(February 2004):173-183.

Koh, Y.K. *Analysis of Oklahama's boom and bust economy by means of a CGE model*. Department of Agricultural Economics. Stillwater, Oklahoma State University. Doctor of Philosophy**,** 186(1991).

Kraybill, D.S. and D.Y. Pai. *Documentation for a Computable General Equilibrium Model of Ohio*, Department of Agricultural Economics, Ohio State University, 1995.

Levy, F. Distribution of Income. *The Concise Encyclopedia of Economics*, The Library of Economics and Liberty, 2002.

Lofgren, H., R.L. Harris, et al. *A Standard Computable General Equilibrium (CGE) Model in GAMS*. Washington, D.C., Trade and Macroeconomics Division, International Food Policy Research Institute, 2001.

Lynch, R.G. "Estimates of Income and Income Inequality in the United States and in Each of the Fifty States: 1998-1999." *J. of Reg. Sci.* 43(August 2003):571-581.

Mathiesen, L. “Computation of economic equilibria by a sequence of linear complementarity problems.” *Math. Prog. Study* 23 (1985).

Mieszkowski, P. "The property tax: An excise tax or a profits tax?" *J. of Pub. Econ.* 1(April 1972):73-96.

Minnesota IMPLAN Group, Inc. *IMPLAN Professional User Guide, Analysis Guide, Data Guide.* Stillwater, 2000.

Musgrave, R.A. *The Theory of Public Finance: A Study in Public Economy*. New York: McGraw-Hill Book Co., 1959.

Partridge, M.D. and D.S. Rickman "Regional Computable General Equilibrium Modeling: A Survey and Critical Appraisal." *Int. Reg. Sci. Rev.* 21(December 1998):205-248.

Raimondo, H. J. *Economics of State and Local Government*. Westport, Connecticut, Praeger Publishers, 1992.

Robinson, S.M. Kilkenny, et al. *The USDA/ERS Computable General Equilibrium (CGE) Model of the United States*. Washington, Agricultural and Rural Economy Division Economic Research Service, 1990.

Rutherford, T.F. *Tools for Building National Economic Models Using State-Level IMPLAN Social Accounts*. Department of Economics, University of Colorado, 1995 (revised 2004).

Rutherford, T.F. and M.K. Light. *A General Equilibrium Model for Tax Policy Analysis in Colombia*, Colombian National Department of Planning, 2001.

Rutherford, T. and S. Paltsev. *From an Input-Output Table to a General Equilibrium Model: Assessing the Excess Burden of Indirect Taxes in Russia*. Boulder, Department of Economics University of Colorado, 1999.

Scarf, H. "The Approximation of Fixed Points of a Continuous Mapping." SIAM *J. on App. Math.* 15 (September 1967). 1328-1243.

Scarf, H. and T. Hansen. *The Computation of Economic Equilibria*. New Haven, Yale University Press, 1973.

Senate Finance and Taxation Committee. *2005 Florida Tax Handbook*. Florida State Senate, Tallahassee, Florida, 2005

Seung, C.K. *A Dynamic General Equilibrium Analysis of State Tax Incentives for Economic Development*. Department of Agricultural Economics, Ohio State University. Doctor of Philosophy**:** 153(1996).

Seung, C.K. and D.S. Kraybill. "Tax Incentives in an Economy with Public Goods." *Growth and Change.* 30(Winter 1999):128-147.

----------. "The Effects of Infrastructure Investment: A Two-Sector Dynamic Computable General Equilibrium Analysis For Ohio." *Int. Reg. Sci. Rev.* 24(April 2001):261-281.

Shoven, J.B. and J. Whalley. "Applied General-Equilibrium Models of Taxation and International Trade: An Introduction and Survey." *J. of Econ. Lit.* 22(September 1984):1007-1051.

----------. *Applying General Equilibrium*. Cambridge, Cambridge University Press, 1992.

Starr, R. M. *General Equilibrium Theory: An Introduction*. Cambridge, Cambridge University Press, 1997.

Stodick, L., D. Holland, et al. *Documentation for the Idaho-Washington CGE Model*, School of Economic Sciences Washington State University, 2004.

Vargas, E., D. Schreiner, et al. *Computable General Equilibrium Modeling for Regional Analysis*, Regional Research Institute West Virginia University, 1996.

Waters, E.C., D.W. Holland, et al. "Economic Impact of a Property Tax Limitation: A Computable General Equilibrium Analysis of Oregon's Measure 5." *Land Econ.* 73(February 1997):72-89.

Wheelan, C. Why Income Inequality Matters**:** Yahoo Finance, Yahoo, 2007.

Zodrow, G.R. "The Property Tax as a Capital Tax: A Room with Three Views." *Nat. Tax J.* 54(March 2001):139-156.

----------. "The New View of the Property Tax: A Reformulation." *Reg. Sci. and Urb. Econ.* 16(August 1986):309-327.

BIOGRAPHICAL SKETCH

A native of West Palm Beach, Florida, Mike O'Connell obtained his B.A. in philosophy from the University of Florida in 1972. After a 15-year career in banking culminating in a position of vice president and focusing on property appraisal and community reinvestment, Mr. O'Connell returned to the University of Florida to pursue an M.A. in economics which he received in from the Warrington School of Business in1991.

His professional career with the State of Florida has included work with the Department of Revenue, the Agency for Workforce Innovation (formerly the Department of Labor) and the Department of Community Affairs. He currently works for American Express as a senior econometrician. He has used his extensive knowledge of economics, finance, and research techniques to provide a wide variety of economic analyses to specific projects. These include short- and long-term economic forecasting of the economy using advanced statistical and econometric techniques and regional economic analysis using economic impact modeling software such as REMI and IMPLAN. He has coordinated large projects with other departments and agencies and. presented findings at state and national workshops and seminars. He also incorporates the use of ArcView and ArcGIS geographic information systems for economic analysis.