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# The Economic Effects of Replacing the Property Tax with a Sales or Income Tax: A Computable General Equilibrium Approach

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**Abstract:**

With the most recent wave of property tax restructuring in the U.S., policy makers have considered the possibility of replacing the property tax. In this analysis we use data for Indiana and a short-run computable general equilibrium model to examine the effects of replacing the property tax with a sales or income tax. We find that replacing the property tax with a sales or income tax has a relatively small effect on aggregate economic variables. Aggregate output in the state decreases by 2 to 3 percent. Larger effects are apparent when analyzing household groups and industry sectors. Replacing the property tax with a sales or income tax decreases household income by over three percent with the income tax being most regressive. Replacing the property tax has a negative effect on sales revenue for most industry sectors with retail sales and several other sectors experiencing large (over five percent) decreases.

**Keywords:** property tax, sales tax, income tax, computable general equilibrium models

**JEL Classification Codes**: H71 State and Local Taxation, Subsidies, Revenue; C68 Computable General Equilibrium Models

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**The Economic Effects of Replacing the Property Tax with a Sales or Income Tax: A Computable General Equilibrium Approach**

The property tax is perennially the most unpopular state or local tax. Yet, all states continue to have some form of property tax at the local level, and the property tax continues to finance 45.25 percent of U.S. local government budgets from own source revenue (taxes, fees, and charges) in 2005-06.[1] This is a decrease from 68.95 percent in 1962.[2] There is much variation among local governments in their reliance on the property tax. In 2005-06 Connecticut raised 83.47 percent of own source revenue from the property tax while Alabama raised only 18.28 percent.

With the most recent wave of property tax restructuring in the U.S., policy makers have considered the possibility of replacing the property tax. For example, in Georgia the General Assembly considered replacing the property tax with state grants in 2007 (Sjoquist 2007a, 2007b). In Oregon there is a movement to replace the property tax with a sales tax. In Indiana policy makers have examined replacing the property tax with increased sales or income taxes.[3] Few studies have focused on the economic effects of such a policy change.

The purpose of this analysis is to examine the effects of a revenue neutral replacement of local property taxes with a state-level sales or income tax. We use a regional computable general equilibrium framework and data from Indiana to examine the effects of these tax changes on output, household disposable income, and various industry sectors. We do not consider the mechanism through which sales or income tax revenue would be redistributed to local governments.

[1] Calculated from U.S. Census Bureau. State and Local Government Finances 2005-06.
[2] Calculated from 1962 Census of Governments, Compendium of Government Finances.
[3] See http://www.advanceamerica.com/index.php and Indiana Commission on State Tax and Financing Policy 2007 final report http://www.in.gov/legislative/interim/committee/2007/committees/stfp.html for more details.

Regional Computable General Equilibrium (CGE) models have been used to examine a variety of policy initiatives. See Partridge and Rickman (1998, 2007) for a survey. A limited body of literature has used Computable General Equilibrium (CGE) models to analyze the impacts of property tax changes. Waters, Holland, and Weber (1997) examine the impact of Oregon's Measure 5, a property tax limit passed in 1990 and find output and income increase after the limitation is passed with high income households benefitting more than low income households. They also find that state and local government expenditures and revenue decrease substantially. Julia-Wise, Cooke, and Holland (2002) examine the general equilibrium effects of an initiative to reduce property taxes by 50 percent in Idaho and find that the property tax reduction would increase economic activity.

A related literature has examine the efficiency and equity effects of land value taxes. Land value taxes (also called dual-rate property taxes) are a particular type of property tax where land is taxed at a higher rate than the capital improvements located on the land. One of the potential benefits of such a tax is to encourage capital improvements. Much of this literature has focused on measuring the efficiency gains associated with a land value tax. Follain and Miyake (1986) examine replacing the Jamaican income tax with a land value tax or a capital value tax and find that welfare gains associated with a land value tax are over 60 percent of GNP assuming an open economy. DiMasi (1987) estimates a general equilibrium model in which land rents are taxed more heavily than capital values and finds that this tax structure results in substantial welfare gains as much as 6.6 percent of tax revenues. Tideman, Akobundu, Johns and Wutthicharoen (2002) implement a dynamic general equilibrium model to estimate the decrease in excess burden resulting due to small shifts from broad-based taxes to a land tax. They find

that shifting taxes from labor and capital to land increases efficiency by 6.6 to 9.9 percent of net domestic product under the most conservative assumptions.

Finally, a few studies have examined the general equilibrium effects of alternative local tax structures. Nechyba (1997) examines the prevalence of property taxes as a funding source for local government using a CGE model where local property taxes are reduced through the introduction of state grants to local government funded through a uniform income tax rate to avoid migration. He reports that property taxes are the dominant local tax strategy and decreasing the reliance on property taxes typically reduces income, property values, wealth and the provision of local public goods in communities. In a theoretical treatment examining alternative tax regimes (property tax or income tax) with majority voting in a local economy Pogodzinski and Sjoquist (1993) show that the level of public goods is different under the alternative tax regimes and that if consumers have identical preferences but differing levels of endogenous income, wealthy individuals are better off under a property tax while lower income individuals are better off under an income tax.

Our analysis extends the literature in three ways – first we examine the effects of replacing property tax revenue with another tax. We know of no other analysis that has examined the effects of replacing the property tax with other sources of revenue. Second, this analysis provides insight into the effects of alternative tax regimes on economic activity. Third, our model includes more detailed disaggregation of household and industry sectors than has previously been considered. The detailed disaggregation of industry sectors allows us to examine shifts in sales and employment among sectors.

Our model includes nine household income groups, and 44 industry sectors based on the 3-digit NAICS code with further disaggregation of some sectors, such as groceries from the food

sector, pharmaceutical manufacturing from chemical manufacturing, apartment from real estate, other taxable services out of other services (non-taxable). See Appendix A for the list of sectors. There are four major tax categories that we emphasize in the model: business property tax, household property tax, state and local household income tax, and sales tax. The first two categories are original to this model and are further explained in the "Data" Section. We are able to examine the shift in tax burden among households at different income levels, the effects on sales of different industry sectors, the effects on aggregate factor returns, and the effects on state and local government revenue, gross regional product, and output. We also conduct examine long-run results by changing the factor closures.

Our analysis proceeds as follows. The next section provides a brief analysis of expected general equilibrium effects of replacing the property tax with sales or income taxes. We then present results from the CGE model. The following section discusses long-run results, and the final section offers conclusions.

**General equilibrium effects of replacing the property tax**

The general equilibrium approach allows the economic response of markets and factors of production to a tax change to be examined. We examine three scenarios. The first two scenarios are the budget neutral effects of replacing the property tax with a higher individual income tax (SIM1) *or* sales tax (SIM2), so the expected effects of no property tax will be offset by the effects of a higher income tax or a higher sales tax. Since the change is budget neutral, local government budgets and the associated production is held constant. Only the sources of revenue change. The third scenario removes the property tax with no revenue replacement (SIM3). This scenario is not budget neutral: Local government budgets are reduced. The reduction is equal to the amount of property taxes previously collected. Household disposable

income increases since households are no longer paying property taxes. Through the computable general equilibrium analysis, we are able to provide insight into which households and which industry sectors fare better or worse under each tax regime and the overall effects on economic activity. Our focus is on how replacing the property tax affects total output in the state, capital investment, the distribution of household income, the value of output (sales) for various industries, factor returns, and employment. The expected effects of replacing the property tax are discussed below.

Replacing the property tax (reducing it to zero) will affect output in two ways. First, individuals will face additional income tax payments or sales tax payments when property tax revenue is replaced with these revenue sources. In addition, taxable income will increase since property tax deductions and expenses associated with property will decrease, thereby increasing state and federal personal and corporate income tax collections. As a result individuals will face higher state and federal income tax and sales tax payments. For some households sales or income tax payments under the new regime will be higher than property tax payments and spending and associated output will decline. Second, businesses will potentially benefit from replacing the property tax with individual income or sales taxes since they do not pay sales taxes on intermediate inputs, and we hold the corporate income tax rate constant. Removing the property tax will lower business costs which is expected to increase economic activity. However, these lower costs are conteracted by lower government production – fewer public goods – if the property tax is not replaced with another revenue source. Businesses will pay higher sales tax on goods purchased for final consumption which will increase costs of production.[4] So the net effect on output depends on whether costs under the new tax regimes are

[4] We recognize that in reality some businesses pay sales tax on intermediate goods.

lower than costs under the property tax regime. The sales tax increase affects households more directly than firms, because some firms can pass the tax on to consumers.[5]

Replacing the property tax is expected to affect the wage and distribution of household income in the following ways: In our short run model, labor is assumed to be perfectly elastic and gross (aggregate) wage is adjustable. Our model allows labor migration and changes in employment status (unemployed to employed or vice versa) in response to changes in demand. The overall return to labor will be adjusted according to the quantity demanded of output from each sector and the gross wage since the sectoral wages are fixed. Under these assumptions workers in some sectors will face lower labor returns, but some sectors will face higher labor returns. Workers in industrial sectors with high property tax burdens before the tax regime shift will experience an increase in labor return. Reducing property taxes to zero will increase disposable income for property owners and renters translating into greater spending and larger sales tax collections. However, this increase in disposable income will be reduced by higher individual income or sales taxes. The welfare effects on households will depend on whether they pay higher income and/or sales tax under the new regime than they paid in under the old regime with the property tax. The effects are likely to be regressive since lower income households are likely to pay more income or sales tax under the new tax regimes than property tax under the original regime.

Capital in industrial sectors with high property tax burdens before the elimination of the property tax will experience an increase in capital returns since their output price will decline, due to the lower cost, which will lead to an dincrease in the demand for their output. However,

[5] The ability of firms to pass sales taxes onto consumers depends on the relative price elasticities of supply and demand for the firms output.

the overall return to capital will depend on the overall output quantity demanded in the economy and the gross rental rate.

The expected effects on industry sales depend on how each tax affects the price of industry output. A higher sales tax will reduce the demand for taxable goods (such as retail goods) in the state offsetting the sales tax revenues. The sales tax increase negatively affects the volume of sales more than the income tax increase because under the sales tax increase firms are reacting to both reduced consumer demand and increased costs because the entire tax can not be passed to consumers.

Removing the property tax will lower the cost of capital investment, so we expect that over time capital investment (plant and equipment) and the return to capital will increase in the state and that there will be a substitution of capital for labor in the production process. Removing the property tax reduces the cost of property ownership and increases the demand for property which will increase property values. We do not explicitly capture these effects in our static short run model.

Replacing the property tax will potentially have large effects on border areas since we assume that border states retain their property tax systems. Residents of border counties would have the option of shopping and living in the border state to avoid part of the increased sales and income tax burdens. We do not explicitly capture these effects although they are included in the total employment effects simulated through the CGE model. The total employment effect in the model also captures the intersectoral movement of workers and unemployed workers reentering the labor market as the demand for labor in each industry changes after the shocks.

The ultimate effect on economic activity of replacing the property tax with a sale or income tax depends on whether the positive effects from removing the property tax or the

negative effects of the sales or income taxes dominate. We expect that there will be differential effects on sectors and households that had high (versus low) property taxes in the original scenario, sectors that depend on government spending, whether the sector is sales taxable, and the treatment of household income.

**The Model**

Our CGE model is developed based on the Washington-Idaho CGE model by Holland, Stodick, and Devadoss (2004) with further alterations in the government (institutional) block for detailed tax analysis.[6] The structure of the Washington-Idaho model is similar to the standard CGE model constructed by Löfgren (2000) and Gilbert (2002, 2003). The model can be created using the Social Accounting Matrix (SAM) data from IMPLAN, and run by using GAMS (General Algebraic Modeling System) software with PATH solver. The model is a policy analysis model rather than a forecasting model. It is designed to estimate how production, consumption, prices, and trade in a region would have been different relative to the model's base year if parameters or exogenous variables representing productivity, consumer demand, trade, or taxation had been different (Holland et al. 2004).

The CGE model explicitly captures the behavior of various agents (households, firms, government, and rest of the world), the institutional framework (fiscal system and transfer mechanisms), and the market clearing processes (prices and quantities). The models recognizes that an exogenous change that affects any one part of the economy can produce repercussions throughout the system, thus they are preferable to partial equilibrium models for understanding the impact of exogenous shocks and changes in relative prices. They provide an internally

[6] The authors thank Professor David Holland for sharing the GAMS code of Washington Biofuels CGE Model, from which this CGE model has been adapted.

consistent representation of the economic structure through the specification of a system of simultaneous equations following the Walrasian general equilibrium system.

The CGE model built for this study comprises the Price block, the Production and Commodity block, the Institution block, and the System Constraint block. The price block includes specifications for regional-foreign import price, regional-domestic import price, regional-foreign export price, regional-domestic export price, aggregate or composite demand price, aggregate supply or composite supply price, activity price, and value-added price.

The production and commodity block specifies a Leontief/constant elasticity of substitution (CES) production function, factor demand, intermediate input demand, output conversion function, Armington commodity composite supply, import-domestic demand ratio, composite supply for nonimported commodities, output transformation/constant elasticity of transformation (CET) equation, and export-domestic supply ratio. In addition it includes the output transformation for nonexported commodities, the rest-of-the-U.S. (RUS) and the rest-of-the-world (ROW) export demand function, Armington export composite equation, ROW-RUS export ratio, Armington import composite equation, and ROW-RUS import ratio.

The institutional block comprises equations for factor income, gross household income, net household income, household consumption demand, investment demand, federal government revenue, federal government expenditure, state and local government revenue, state and local government expenditure, and indirect taxes. State and local government revenue is the sum of income taxes from households, household property tax, business property tax, investment income, sales tax, other indirect tax receipts, transfer from federal government, transfer within state and local government, transfer from factors, revenue from institutional make, and payments from foreigners. State and local government expenditures include government spending,

subsidies, transfer to households, transfer within state and local government, and payments to foreigners. Note that the transfer within the state and local government is a transfer from revenue for non-education purchase to education purchase and this causes duplicate revenue and expenditures of $13.9 billion. However, this duplication does not affect the simulation results.

The final block, system constraints, defines the constraints that are satisfied by the economy as a whole without being considered by its individual agents. The block encompasses the micro constraints that apply to individual markets for factors and commodities, and the macro constraints that apply to the balance-of-payments and the saving-investment balance. The factor market equilibrium requires that the sum of the factors used in each sector equals the total endowment. In the commodity market equilibrium, the quantity of a commodity supplied equals the quantity demanded for intermediate input use, household consumption, government consumption, and investment. The balance-of-payments equation states that the sum of export earnings, household transfers from foreigners, government transfers from foreigners, and capital inflow is equal to import spending, factor income transfer to foreigners, and institutional transfer to foreigners. Savings include household, government, and foreign savings. Investment includes commodity, institutional, and foreign investments. Finally, we set the numeraire equal to the exchange rate so that the consumer price index (CPI) and other prices are allowed to adjust. The advantage of fixing the exchange rate is that it allows us to focus more on changes in the CPI and less on all other various price changes in the economy.

## Data, Closure, Elasticities, and Calibration

### *Data*

The model uses the data from the 2006 Indiana Social Accounting Matrix (SAM) produced by IMPLAN. The original IMPLAN SAM is disaggregated into 509 production or

commodity sectors and 21 factor and final demand sectors. For our CGE model, production sectors are aggregated into 44 activities and 44 commodities, two primary factors of production (labor and capital), two indirect business tax sectors (business property tax and other indirect business taxes), and twenty final demand sectors (institutions, investment, and trade), nine household sectors based on income levels, three sectors of federal government (military purchases, non-military purchase, and non-military investment), five sectors of state and local governments (household property tax, household income tax, other non-education purchases, education purchases, and non-education investment), one saving-investment sector (enterprises, gross private fixed investment, and inventory adjustment combined), and two trading sectors (domestic trade (RUS), and foreign trade (ROW)).[7]

Since the model is used to analyze state and local government taxes, more emphasis is placed on state and local government sectors. We separate the business property taxes from other indirect business taxes, which are normally aggregated together in a typical regional CGE model that does not focus on tax policy. In addition, we extract the household property tax from the indirect business taxes of owner occupied dwelling sector, which is a special sector created to calculate the imputed rent. The treatment of household income and sales taxes are similar to other mainstream regional CGE models. Household income taxes are separated into the federal household income tax and state and local household income tax.

Sales tax is collected on domestic commodity demand from household consumption but not from the business consumption. Because of the fixed data structure of the SAM available from IMPLAN, the sales tax rate must be set as zero percent in the base year and the amount of

[7] The use of 2006 Indiana SAM is reasonable here since the level of Indiana economy in 2006 could be a better representation for the 2009-2010 economy after the impacts of the 2008-2009 financial and economic crises. The contracted economy in 2009 and a possible slow growth in 2010 should leave the Indiana economy close to the end of 2006 level.

sales tax collected in the base year cannot be directly calculated. This does not mean that sales tax were not paid but that sales tax is included in household consumption in the base year. By imposing a change in sales tax rate (not the final rate) as a shock to the model, it is able to calculate the value of sales tax by multiplying the change in sales tax rate with household consumption at a price level. Setting the sales tax rate to zero in the base year allows us to select which sectors are taxable and which are not (if sales tax rate is set to six percent in the base run, sales tax would be imposed on all sectors according to the sales tax equation, and the results would be misleading). See Table A in the appendix for a list of taxable and nontaxable (exempt) sectors for the sales tax. The rationale for dividing industries into taxable and nontaxable sectore is that comsumers react differently to price changes on taxable and nontaxable goods and services. Taxable goods usually have elastic price elasticity of demand, and consumers tend to substitute or ration when prices increase. Nontaxable goods are necessities (eg. groceries and prescription drugs) or location-bound services (eg. Education, hospitals, and real estate agents) by nature, thus they are usually inelastic and could not be substituted easily. Because of these assumptions, we set elasticities differently for these two groups of goods and services in our model. The division also reflects the reality in Indiana. All sectors in the nontaxable group are currently not taxed under the state's sales tax.

*Closure*

The assumptions and analysis used in this CGE model generate short-run results (as opposed to long-run) due to the fact that in the capital closure, capital supply is fixed, capital demand and the gross rental rate are allowed to adjust. Because capital is not allowed to enter or leave the economy in the short-run, the quantity of capital demanded by each sector can only be allowed to move from/to other sectors and the total capital demand remain equal to the total

capital supply. Since our model is built as a static model, we focus initially on the short- to medium-run effects. We discuss a long-run scenario below.

In the short-run labor closure, labor is set to be mobile and supply is perfectly elastic. Negative employment means that there are unemployed workers. Positive employment means that there is either in-migration or unemployed workers are hired. The gross wage rate is allowed to adjust, but the sectoral wage rates remain fixed. In the saving-investment closure, we fix both saving and investment and allow CPI to change. In the two balance-of-payment closures, we allow the foreign savings (foreigners investing in the state) to adjust in the rest-of-word closure, and also allow the rest-of-the-U.S. (RUS) savings (RUS investing in the state) to adjust in its closure. The exchange rate is therefore fixed in these two closures, so it becomes a numeraire.

*Elasticities*

In their literature review of regional CGE modeling Partridge and Rickman (1998, 2007) emphasize the greater degrees of openness in regional economies relative to national or international economies. Therefore, the trade elasticities for a regional CGE model should be higher and cover a broader range of goods and services than those found in national or international models. However, the constant elasticity of substitution (CES) can be small in specialized sectors because regions may be more specialized in production. In our model, we set the elasticities based on whether or not the sectors are taxable or nontaxable, not based on whether or not Indiana has specialization in production. Other studies (such as Julia-Wise, Cooke and Holland 2002) have divided industry sectors into tradeable and nontradeable. While this may be appropriate for national or international CGE models, at the regional level most sectors are tradeable. We do not follow this delineation in the the model instead using taxable and nontaxable sectors. From the consumers perspective a higher sales tax increase the prices of

taxable goods and services. For goods with relatively inelastic demand, consumers will not travel outside of the state to buy these goods, which is reflected in the assigned elasticities of substitution. Table 1 summarizes the elasticity assumptions used in the model.

The elasticity of substitution between capital and labor is assumed to be 0.99. Thus, the CES part of the production function closely mimics the Cobb-Douglas production function. The imperfect substitution between goods produced in the state and imported goods, and between ROW imports and RUS imports allows us to set the elasticity of substitution between goods produced in the state and imported goods at 2.0, and between ROW imports and RUS imports at 1.35 for taxable sectors.[8] This is to emphasize the greater degrees of openness in regional economies relative to national or international economies. The elasticity of transformation (CET) is set at 2.0 to differentiate the goods for in-state use and foreign exports, and at 1.35 for ROW and RUS. The Armington and transformation elasticities for nontaxable sectors are set at close to one based on the assumption of non-substitutability discussed previously. Unitary income elasticity is assumed in the demand function. Supply elasticity for labor is assumed perfectly elastic to complement the perfectly elastic labor closure. Supply elasticity for capital is set at 0.5 to reflect the fixed supply capital closure.

[Table 1 here.]

**Simulation Design**

As explained above, we estimate three simulations (table 2). The revenue neutral state income tax rate was 6.615 percent to replace the property tax with this tax (SIM1). The current state income tax rate is 3.4 percent, regardless of income level. The revenue neutral sales tax rate is 20.12 percent (SIM2). This sales tax rate is substantially higher than previous estimates because the CGE model incorporates the decrease in demand for sales taxable goods resuling

[8] Based on the average U.S. Armington elasticities found in Gallaway, et al (2003).

from the higher sales tax rate. Earlier studies employ point elasticity estimates of the tax. The elasticity of the sales tax over such a large rate change is unlikely to be linear, and as a consequence the rate estimated by other studies in Indiana report much smaller revenue neutral tax rates. The difference is significant, with the Indiana Legislative Services Agency (2007) and Hicks (2007) report revenue neutral rates of roughly 13 percent. All estimates are substantially higher than the 6 percent sales tax rate applicable in 2006.[9] The final simulation (SIM3) examines eliminating the property tax with no revenue replacement.

[Table 2 here.]

**Results**

Fiscal and Aggregate Effects

Table 3 details the fiscal impact of replacing the property tax. State and local government revenue would decrease by $2.4 billion from household property taxes and almost $5.8 billion from business property taxes. Replacing the property taxes with a higher individual income tax increases state and local income tax revenue by $8.4 billion or 155.6 percent. Replacing the property tax with a higher sales tax increases sales tax revenue by $8.5 billion.

Replacing the property tax with a sales or income tax has a moderate effect on Gross Regional Product (GRP), the dollar value of all final goods and services produced in the state. GRP decreases by $6.6 billion (-2.8%) when the income tax replaces the property tax. Replacing the property tax with a sales tax also has a moderate negative effect on GRP (-$6.3 billion or -2.66%). The higher sales and income tax rates will lower sales (table 6).

GRP decreases by $6.9 billion (-2.91%) when the property tax is removed with no revenue replacement. Household spending and government spending have different effects on

[9] The sales tax rate was increased to 7 percent in July 2008 as part of the 2008 property tax restructuring HEA 1001 (P.L. 146-2008).

the economy. Partridge and Rickman (1998) note that early regional CGE models generally omitted the potential benefits of government expenditures in attracting firms and households, implicitly assuming that taxes only induce deadweight economic losses. The provision of public infrastructure influences regional economic growth. So, taxes used to finance increased public infrastructure investment lead to increases state employment growth and corresponding increases output. Lower revenues affect the availability and quality of publicly provided goods such as schools and infrastructure. Other studies have confirmed this relationship. Dalenburg, Partridge and Rickman (1998) found that investment in public highways and other public capital had a positive impact on state employment growth. Gabe and Bell (2004) show that businesses are more likely to locate in municipalities with high spending on public goods and services even if these expenditures are financed with higher local taxes.

[Table 3 here.]

Effects on Household Income

Table 4 shows the effects of the tax changes on net household income for households with different income levels. Replacing the property tax with a higher income tax (SIM1) decreases household disposable income by $6.2 billion (3.47 percent). There are two reasons for this. First, households will pay higher income taxes, which reduces their net income. Households in the lower income ranges are more likely to contain less skilled workers and experience greater decreases in net income since the increase in income taxes is likely to be higher than the decrease in property taxes. This is reflected in the larger percent decrease in income for lower income households. Second, replacing the property tax will increase household taxable income and income tax payments because real estate taxes are no longer deducted from taxable income. In our simulation households with incomes below $10,000 are

excluded from the income tax and experience a small gain in income.[10] Other households experience a decrease in income indicating that income tax payments increase by more than property taxes decrease for each income group. The policy is regressive in that the lower income groups experience larger declines in income (in percentage terms) than higher income households.

Replacing the property tax with a sales tax (SIM2) decreases household income by almost $6.4 billion (3.56 percent). The effect is somewhat regressive because all households face the same sales tax rate and lower income households will pay more sales tax than they paid in property taxes under the original regime. Households with incomes between 25,000 and 34,999 experience the largest decrease in net income in percentage terms, and households at the bottom of the income distribution experience larger decreases in net income than households at the top. Households in the lower income groups spend more of their income on taxable goods and are less likely to own property, so they will not benefit explicitly from the reduction in property taxes.

The third simulation which removes the property tax but does not replace that revenue increases the income of all household groups for a total increase of $1.7 billion (0.95 percent). Households with incomes in the $75,000 to $99,999 range benefit the most in terms of the percentage increase in income. These higher income households own more property and pay higher property taxes but they also pay high income taxes and therefore benefit disproportionately when the property tax is removed without revenue replacement.

[10] We exclude households with income less than $10,000 from the income tax because after deductions and exemptions households in this income group are unlikely to owe state income tax.

The ultimate effect on households will depend on whether they pay higher sales or income tax under the new regine than property taxes under the original regime. For most households, the higher income and sales tax payments outweigh the reduction in property taxes. [Table 4 here.]

Effect on Income and Sales Tax Payments

Table 5 shows the change in each household group's state and local income tax payment under each simulation. The largest impact occurs when the property tax is replaced with a higher state income tax. The effect is regressive in that lower income households experience the largest percent increase in income tax payments (again because of the flat rate of 6.615 percent). Replacing the property tax with a higher sales tax also has a small negative effect on income tax collections through the multiplier effect as households spend less when sales tax is higher which decreases income for other economic agents. Removing the property tax with no revenue replacement has a moderate negative effect on state and local income tax payments. If property tax revenue is not replaced with another funding source, then state and local government budgets will be dramataically reduced (-13 percent, table 3).

[Table 5 here.]

Effect on Output

Table 6 shows how the options for replacing the property tax will affect the value of output, i.e. the value of production or sales revenue for industry sectors. The value of output represents intermediate inputs plus value-added (i.e. returns to labor and capital or regional production) on the supply side, and represents regional sales (in-state sales) plus exports (out-of-state sales) on the demand side. The overall effect of replacing the the property tax with an income or sales tax is similar. Each option reduces total sales by 2.83 and 3.12 percent,

respectively, and has a negative effect on most industry sectors. Replacing the property tax with a higher income tax or sales tax reduces household disposable income and ultimately business sales. Under the third simulation, removing property taxes with no revenue replacement decreases government spending and associated sales by almost 10 percent.

Each tax regime has differing impacts on industry sectors. As consumers modify their choices in response to the differing tax regimes there are intersectoral shifts in the value of output sold. Replacing the property tax with the income tax (SIM1) has a negative effect on sales in all sectors. Construction is the only sector that has a slightly negative value of output in SIM1, probably due to the stable government spending in the revenue neutral scenarios. Government spending is a large share of construction output. However, the largest decreases in sales occur with the higher sales tax (SIM2). Exceptions are industries in the nontaxable sector which have the lowest decreases or slightly positive under SIM2.

The general finding is that replacing the property tax in any of these scenarios will decrease overall sales and cause shifts in sales among industries in the short- to medium-run. All sectors show negative growth when the property tax is replaced with a higher income tax. Retail, restaurants, and processed food are expecially hard hit with the higher sales tax (SIM2). All sectors, except health services, education, art and entertainment, crops, processed food, and retail trade are negative when the property tax is removed with no revenue replacement which suggests that most sales are sensitive to the provision of local government goods, especially construction and construction materials such as metals). The positive effect (or less negative effect on retail and food related sectors in simulation 3 is likely related to the higher disposable income of households when property taxes are removed and not replaced.

In our model industries are separated into two groups for the sales tax: taxable and nontaxable sectors. Replacing the property tax with a sales tax impacts firms more directly. Sales of most taxable sectors decrease less in SIM1 than in SIM2. Sales of all nontaxable sectors, except management, decrease less in SIM2, or even show small sales growth, than in SIM1. These results suggest that firms prefer that the government tax household income at a higher rate rather than increasing sales tax rates, except when the sales are nontaxable. The results in table 6 also show that in sales taxable sectors, sales decrease the least in SIM3 when the property tax is removed with no revenue replacement. These results are expected since households would increase their consumption as property taxes are removed and not replaced with another tax. However, in aggregate the increase in household consumption is not big enough to offset the decline in sales due to the lower government expenditures and transfers.

[Table 6 here.]

Effect on Factor Returns

Table 7 shows how changes in the tax regime affect factor returns. The return to labor is the product of the quantity of labor hired, the aggregate wage, and a wage distortion factor which is basically a weight for each sectoral wage. The sectoral wages are fixed for each industry, but the aggregate wage is allowed to adjust. The quantity of labor supplied and demanded varies. The return to capital is calculated similarly, but because the model is a static, short-run model, the capital supply is fixed and capital demand is allowed to move among industries. The aggregate rental rate is allowed to adjust, while the rental rate for each industry is fixed.

The lower returns to labor in all simulations results, in part, from the higher mobility of labor in a regional setting. In SIM1 and SIM 3, the aggregate wage rate increases and this attracts workers (including in-migration and the previously unemployed) to sectors that initially had high

property taxes. However, because the largest shifts accrue to those sectors with low (lower than average) wages primarily retail, apartments, restaurants and other services nontaxable, the overall return to labor decreases. In SIM2, the aggregate wage rate decreases and unemployment occurs. Workers are attracted more to non sales taxable sectors than sectors that initially had high property taxes. Though there is unemployment and a decline in wage rate, there are more workers who end up working in a high wage sectors, such as pharmaceutical, finance, wholesale trade, grocery, and government sectors. This makes the overall labor return become less negative than in SIM1 and SIM3.

Removing the property tax is expected to increase capital investment in the state and increase the return to capital over time. Here we examine the short-run capital use and its return, not the expected new capital that would come into the state because of the lower property tax. We examine a long-run scenario below. The capital return in the short-run is usually determmined by the aggregate rental rate. Since the aggregate rental rate declines in SIM1 and SIM3, the capital return also declines in SIM1 and SIM3. The aggregate rental rate increases in SIM2 and causes the capital return to increase in SIM2. The aggregate rental rate declines in SIM1 and SIM3 because less capital is demanded in sectors which face lower demand for their output, however, because the capital supply remains constant the pressure is put on the rental rate to decrease. In SIM2, the higher aggregate rental rate is accociated with the production expansion of high wage sectors.

The lower factor returns under SIM3 where the property tax is removed without revenue replacement is the largest effect of the three simulations and likely reflects lower returns to capital and labor resulting from decreased local government production affecting private production. There are large increases in the returns to capital in some sectors (utilities,

wholesale, retail, apartments) but these are offset by decreases in returns to capital in other sectors (government, construction, most manufacturing sectors). The relatively large decrease in labor returns occurs because of shifts to low wage sectors, primarily retail.[11] In SIM3 sectors that receive high shares of businesses from the government, such as construction, or sectors that supply materials to construction, such as wood and primary metal, all have relatively large decreases in returns to factors due to the negative consequences related to the decrease in local government revenue. Replacing the property tax with an income or sales tax results in the increase in employment of over 21,000 jobs.

Sectors with high effective property tax rates (property tax divided by total output) increase payments to labor and capital in SIM1 and SIM3. Sectors with low property tax rates are worse off when the property tax is replaced and decrease payments to labor and capital (decrease less in SIM3).

There are differences in the changes to factor returns depending on whether the industry sector had high property taxes in the base run or is sales taxable. For sales taxable sectors, the returns to factors are higher (or decrease less) in SIM1 than in SIM2 because firms are better off when households pay income taxes in SIM1 than higher sales tax in SIM2. Labor supply is perfectly elastic so workers bear the burden of the higher income tax. In contrast, firms are likely to bear part of the burden of the higher sales tax.

[Table 7 here.]

Effect on Household Utility

Equivalent Variation is interpreted as the payment the household requires to return to the original tax regime -- the existence of property taxes with the original income or sales tax rates

[11] Tables showing the change in quantity of labor (capital) demanded by sector and the change in labor (capital) returns by sector are available from the authors.

(Tresch 1981, 524). In the simulation replacing the property tax with a higher income tax (SIM1), households in the lowest income grouping are better off, the typical household in this income group would have to be paid $312 to return to the original tax regime (table 8). In contrast households earning $10,000 or more would be willing to pay $2,500 to $3,400 per household depending on the household group to return to the original tax regime because they pay more income tax under the new regime than they paid in property tax under the old regime

If the property tax is replaced with a sales tax, each household group is worse off and willing to pay to avoid the new regime, higher sales tax and no property tax. On average, households in the highest income group are willing to pay the most.

The broad conclusion from table 8 is that households are worse off when the property tax is replaced with a higher income or sales tax. With the exception of the lowest income grouping that is exempt from the income tax, every other household income group would prefer the original tax regime with property tax and lower sales or income taxes. Under simulation 3 when property taxes are removed and that revenue is not replaced, all household groups are better off. Equivalent variation does not measure the effect on households of changes in the quality of government services provided.

[Table 8 here.]

**Long-run Effects**

We also run each simulation under a long-run closure to simulate the effects on the economy over time (table 9). Both capital and labor demand and supply should be variable in the long run (Löfgren, H., 2002). The wage rate and rental rate are likely to remain fixed because factor costs should come back to the original equilibrium level in the long run after going

through some adjustments. We allow investment to be driven by savings, so investment increases as firms adjust over the long run.

The long-run results show that the revenue neutral replacement of the property tax with an income or sales tax (SIM1.1 and SIM2.1) produce similar results as the short run. However, slight reductions in the income or sales tax rates (SIM1.2 and 2.2) have a positive effect on the state's economy. We reduce the income tax rate from 6.615 percent to 6 percent and the sales tax rate from 20.12 percent to 16 percent, and results show that GRP increases 4.83 percent in the former and 11.14 percent in the later due to the increase in demand for goods and services and investment as households and firms have more disposable income. In addition, in the long run the government's budget will return to the original baserun level (SIM1.2 and SIM2.2). In simulation 3, the positive effects are more obvious since the tax cut with out revenue replacement positively effects the economy in the long run.

Both demand for capital and labor increase when the income or sales tax rate is reduced (SIM1.2 and SIM2.2) and when there is no revenue replacement (SIM3.1) as firms need more of these factors for production. Capital and labor supply thus increase in response to the demand. There is also growth in total net household income in these simulations. As in the short run, the growth is higher for upper income household groups. In SIM1.2 the lower income household groups are worse off with the higher income tax rates. Households in total pay more federal income tax to the government than in the short run because they are better off in the long run and because employment has increased. Businesses in total pay more indirect business taxes to the government because of the business expansion. Output increases in all industrial sectors with the largest increases occurring in construction and related sectors.

[Table 9 here.]

## Conclusions and Implications for Tax Policy

Over the past half century the role of the property tax as a funding source for local government has diminished due to legislative changes to state and local tax structures, yet the property tax continues to be a contentious mechanism for financing local government. In this paper we implement a computable general equilibrium model using data from Indiana to investigate the economic effects of replacing the property tax with a sales tax, an income tax, or not replacing the revenue in the short- to medium-run. The revenue neutral replacement of the property tax with a higher individual income tax requires an increase in the income tax rate from 3.4 percent to 6.615 percent. The increase in the sales tax rate is even more substantial from 6 percent to 20.12 percent.

Despite the large increases in income or sales tax rates to replace the property tax, we find relatively small impacts on aggregate economic measures which suggests that the source of local government funding is not particularly important. The value of output produced in the state (gross regional product) decreases by $6 to 7 billion (2 to 3 percent).

An examination of specific sectors of the economy indicates that replacing the property tax with an income tax has a more substantial effect on household income decreasing disposable household income by $6.4 billion (3.6 percent). The policy is regressive in that lower income households experience larger percentage declines in income. Replacing the property tax with a sales tax has a similar effect decreasing household income by 3.5 percent and is also regressive. Calculations of equivalent variation suggest that most households are better off under the current a property tax system than replacing the property tax with a sales or income tax.

Replacing the property tax with an income or sales tax also has substantial effects on various industry sectors. Overall, the value of output decreases by 2 to 3 percent when replacing

the property tax with a sales or income tax or with no revenue replacement. For specific industries there are much larger declines. For example, replacing property tax revenue with sales tax revenue would decrease retail sales by 9.78 percent.

Replacing or removing the property tax leads to substantial shifts in labor to lower wage sectors leading and to a decline in labor returns in the short run. Under a long-run scenario with small reductions in the sales tax rate or income tax rate that are still revenue neutral, factor returns, employment, household income, and sales increase.

While this study offers a useful tool and substantial detail in its simulation results, there are weaknesses. In particular, this model does not clearly differentiate between leakages of economic activity due to sales tax rates in border counties. Second, the timing of impacts is not clear. As with any CGE, the adjustment speed is unkown. In a policy setting the speed of adjustment is critical for states wrestling with revenue changes resulting from changes to property, sales or income taxes. While the model isolates the effects of replacing the property tax, it does not incorporate the impact of changing economic conditions like the current recession.

## Tables

*Table 1:*

| **Elasticities** | **Taxable sectors** | **Non-taxable sectors** |
|---|---|---|
| Elasticity of substitution for production (substitution between labor and capital) | 0.99 | 0.99 |
| Elasticity of substitution (Armington) between Indiana output and imports | 2.0 | 0.99 |
| Elasticity of transformation (CET) between in-state demand and foreign exports | 2.0 | 0.99 |
| Elasticity of substitution (armington) between ROW imports and RUS imports | 1.35 | 0.99 |
| Elasticity of transformation (CET) between ROW and RUS for exports | 1.35 | 0.99 |
| Income elasticity | 1.0 | 1.0 |
| Supply elasticity for labor | 2.0 | 2.0 |
| Supply elasticity for capital | 0.5 | 0.5 |

*Table 2:*

| **Simulations** | **Description** |
|---|---|
| SIM0 | Base Run |
| SIM1 | Eliminating business and household property taxes, increasing state and local government household income tax rate for all household groups to 6.615 percent to be revenue neutral, except HHD1 remains as base run |
| SIM2 | Eliminating business and household property taxes, increasing sales tax rate of all commodities to 20.12 percent to be revenue neutral, except for commodities in these sectors: grocery, pharmacy, wholesale trade, transportation, information, finance and insurance, real estate, professional services, management, administration, education, health care and social assistance, art and entertainment, hotel and accommodation, other non taxable services, and public administration and special sectors |
| SIM3 | Eliminating business and household property taxes with no revenue replacement |

*Table 3: Fiscal and Aggregate Effects of Replacing the Property Tax*

| $ millions | Base Run | SIM1 Income tax | Change | SIM2 Sales Tax | Change | SIM3 No Rev Repl | Change |
|---|---|---|---|---|---|---|---|
| State and local governments revenue | 62,718 | 62,718 | 0 (0%) | 62,718 | 0 (0%) | 54,411 | -8,307 (-13.3%) |
| State and local governments revenue from household property tax | 2,446 | 0 | -2,446 (-100%) | 0 | -2,446 (-100%) | 0 | -2,446 (-100%) |
| State and local governments revenue from business property tax | 5,786 | 0 | -5,786 (-100%) | 0 | -5,786 (-100%) | 0 | -5,786 (-100%) |
| State and local governments revenue from household income tax | 5,416 | 13,848 | 8,432 (155.7%) | 5,412 | -4 (-0.07%) | 5,397 | -19 (-0.36%) |
| Change in state and local governments revenue from change in sales tax | n/a | 0 | - | 8,540 | 8,540 | 0 | - |
| State and local governments revenue from other indirect business taxes | 6,233 | 6,037 | -196.3 (-3.15%) | 5,931 | -301.6 (-4.8%) | 6,177 | -56 (-0.9%) |
| Federal government revenue from household income tax | 16,547 | 16,491 | -55.1 (-0.33%) | 16,534 | -12.3 (-0.07%) | 16,488 | -58.8 (-0.36%) |
| Gross Regional Product | 238,282 | 231,620 | -6,663 (-2.80%) | 231,946 | -6,336 (-2.66%) | 231,346 | -6,936 (-2.91%) |
| Rest-of-the-U.S. investing in Indiana | 0.00 | 868.3 | 868.3 | 1,297 | 1,297 | 566.1 | 566.1 |
| Rest-of-the-World investing in Indiana | 24,558 | 24,159 | -398.9 (-1.62%) | 23,244 | -1,314 (-5.35%) | 24,349 | -208.9 (-0.85%) |
| CPI | 1.0000 | 1.00028 | | 1.0003 | | 1.00019 | |

*Table 4: Effect on the Distribution of Household Income*

| | Base Run net household income ($ millions) | Change in net household income* ($ millions) | | |
|---|---|---|---|---|
| | | SIM1 Income tax | SIM2 Sales tax | SIM3 No revenue replacement |
| HHD1 (income less than $10,000) | 7,692.79 | 62.04 (0.81%) | -277.26 (-3.60%) | 61.65 (0.80%) |
| HHD2 ($10,000 to $14,999) | 6,652.28 | -364.97 (-5.49%) | -236.59 (-3.56%) | 49.27 (0.74%) |
| HHD3 ($15,000 to 24,999) | 14,404.35 | -761.43 (-5.29%) | -511.83 (-3.55%) | 97.10 (0.67%) |
| HHD4 ($25,000 to $34,999) | 17,490.87 | -925.39 (-5.29%) | -683.93 (-3.91%) | 100.30 (0.57%) |
| HHD5 ($35,000 to $49,999) | 30,803.59 | -1,301.47 (-4.23%) | -1,181.29 (-3.83%) | 286.11 (0.93%) |
| HHD6 ($50,000 to $74,999) | 42,129.11 | -1,248.65 (-2.96%) | -1,527.86 (-3.63%) | 431.44 (1.02%) |
| HHD7 ($75,000 to $99,999) | 27,633.81 | -862.39 (-3.12%) | -889.43 (-3.22%) | 327.09 (1.18%) |
| HHD8 ($100,000 to $149,999) | 20,944.70 | -515.02 (-2.46%) | -678.43 (-3.24%) | 239.29 (1.14%) |
| HHD9 ($150,000 plus) | 11,455.12 | -296.54 (-2.59%) | -386.14 (-3.37%) | 113.98 (1.00%) |
| **Total** | **179,206.60** | **-6,213.81 (-3.47%)** | **-6,372.75 (-3.56%)** | **1,706.23 (0.95%)** |

*Gross household income less household income taxes, savings, inter-household transfers, and overseas transfers.
Sales tax is deducted from gross household income in case of SIM2. See appendix for details of SIM2.

*Table 5: Effect on State and Local Income Tax Payments*

| | Base Run total state & local income tax paid ($ millions) | Change in total state & local income tax paid ($ millions) | | |
|---|---|---|---|---|
| | | SIM1 Income tax | SIM2 Sales tax | SIM3 No revenue replacement |
| HHD1 (income less than $10,000) | 20.90 | -0.01<br>-0.06% | 0.00<br>-0.01% | -0.01<br>-0.06% |
| HHD2 ($10,000 to $14,999) | 40.96 | 418.80<br>1,022.46% | -0.01<br>-0.03% | -0.06<br>-0.15% |
| HHD3 ($15,000 to 24,999) | 143.37 | 867.47<br>605.06% | -0.07<br>-0.05% | -0.34<br>-0.24% |
| HHD4 ($25,000 to $34,999) | 218.00 | 1,136.27<br>521.22% | -0.12<br>-0.06% | -0.59<br>-0.27% |
| HHD5 ($35,000 to $49,000) | 666.26 | 1,604.99<br>240.89% | -0.45<br>-0.07% | -2.02<br>-0.30% |
| HHD6 ($50,000 to $74,999) | 1,702.41 | 1,802.71<br>105.89% | -1.44<br>-0.08% | -6.55<br>-0.39% |
| HHD7 ($75,000 to $99,999) | 1,004.36 | 1,277.93<br>127.24% | -0.79<br>-0.08% | -3.60<br>-0.36% |
| HHD8 ($100,000 to $149,999) | 1,002.33 | 827.52<br>82.56% | -0.84<br>-0.08% | -3.85<br>-0.38% |
| HHD9 ($150,000 plus) | 617.82 | 496.41<br>80.35% | -0.53<br>-0.09% | -2.43<br>-0.39% |
| Total | 5,416.41 | 8,432.08<br>155.68% | -4.25<br>-0.08% | -19.45<br>-0.36% |

*Table 6: Value of Output (Domestic sales plus exports)*

| | Value of output (sales) ($ millions) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Base Run | SIM1 Income Tax | % change | SIM2 Sales Tax | % change | SIM3 No revenue replacement | % change |
| CROPS-A | 3,716.77 | 3,592.60 | -3.34 | 3,388.19 | -8.84 | 3,929.09 | 5.71 |
| ANIMAL-A | 2,023.67 | 1,957.21 | -3.28 | 1,977.37 | -2.29 | 2,018.06 | -0.28 |
| MISCAG-A | 681.44 | 660.35 | -3.10 | 640.26 | -6.04 | 677.69 | -0.55 |
| MINING-A# | 2,853.35 | 2,763.95 | -3.13 | 2,684.37 | -5.92 | 2,783.37 | -2.45 |
| UTIL-A# | 8,975.74 | 8,691.46 | -3.17 | 8,341.70 | -7.06 | 8,739.67 | -2.63 |
| CONST-A* | 25,784.66 | 25,728.95 | -0.22 | 25,731.80 | -0.21 | 24,540.75 | -4.82 |
| GROC-A* | 11,895.87 | 11,504.36 | -3.29 | 11,746.52 | -1.26 | 11,852.37 | -0.37 |
| OTHFOOD-A | 5,758.97 | 5,498.50 | -4.52 | 5,126.15 | -10.99 | 6,000.81 | 4.20 |
| TEXTLEAT-A | 1,159.45 | 1,122.63 | -3.17 | 1,056.25 | -8.90 | 1,151.56 | -0.68 |
| WOOD-A | 3,681.85 | 3,634.77 | -1.28 | 3,614.04 | -1.84 | 3,579.85 | -2.77 |
| PAPER-A | 3,944.43 | 3,390.29 | -14.05 | 3,304.69 | -16.22 | 3,593.39 | -8.90 |
| PRINTING-A | 1,751.16 | 1,698.11 | -3.03 | 1,688.65 | -3.57 | 1,652.01 | -5.66 |
| PETROCOAL-A | 13,717.08 | 13,337.59 | -2.77 | 12,972.03 | -5.43 | 13,299.89 | -3.04 |
| CHEMICAL-A | 11,414.67 | 11,061.26 | -3.10 | 10,877.81 | -4.70 | 11,186.71 | -2.00 |
| PHARMA-A* | 18,177.10 | 17,581.58 | -3.28 | 18,261.04 | 0.46 | 17,982.34 | -1.07 |
| PLASRUB-A | 10,261.82 | 9,984.41 | -2.70 | 9,892.77 | -3.60 | 10,020.95 | -2.35 |
| NONMEMIN-A | 4,122.30 | 4,027.20 | -2.31 | 3,987.41 | -3.27 | 3,986.04 | -3.31 |
| PRIMMETAL-A | 28,868.49 | 27,515.85 | -4.69 | 26,928.72 | -6.72 | 28,177.77 | -2.39 |
| FABMETAL-A | 11,873.50 | 11,541.01 | -2.80 | 11,416.62 | -3.85 | 11,512.66 | -3.04 |
| MACHINE-A | 16,320.91 | 16,091.64 | -1.40 | 16,002.55 | -1.95 | 16,007.00 | -1.92 |
| COMPELECT-A | 8,923.52 | 8,743.14 | -2.02 | 8,551.99 | -4.16 | 8,776.73 | -1.64 |
| ELECAPPL-A | 4,016.01 | 3,909.95 | -2.64 | 3,827.23 | -4.70 | 3,915.84 | -2.49 |
| TRANSEQUI-A | 59,106.57 | 57,562.48 | -2.61 | 56,654.47 | -4.15 | 57,283.34 | -3.08 |
| FURNITURE-A | 4,454.82 | 4,411.96 | -0.96 | 4,330.11 | -2.80 | 4,408.59 | -1.04 |
| MISCNTMFG-A* | 5,174.82 | 5,109.17 | -1.27 | 5,181.21 | 0.12 | 5,131.04 | -0.85 |
| MISCELMFG-A | 1,958.08 | 1,894.26 | -3.26 | 1,800.11 | -8.07 | 1,930.10 | -1.43 |
| WHOLTRAD-A*, # | 20,740.07 | 20,125.20 | -2.96 | 20,259.19 | -2.32 | 20,464.67 | -1.33 |
| RETTRAD-A# | 23,927.80 | 23,176.02 | -3.14 | 21,586.91 | -9.78 | 24,009.10 | 0.34 |
| TRANS-A* | 18,226.75 | 17,663.83 | -3.09 | 17,692.56 | -2.93 | 17,844.60 | -2.10 |
| INFORM-A# | 8,550.73 | 8,297.61 | -2.96 | 7,978.95 | -6.69 | 8,402.89 | -1.73 |
| FINANCE-A*, # | 22,570.60 | 21,853.02 | -3.18 | 22,435.73 | -0.60 | 22,336.86 | -1.04 |
| APART-A*, # | 3,905.40 | 3,781.81 | -3.16 | 3,846.76 | -1.50 | 3,864.23 | -1.05 |
| ESTATE-A*, # | 10,042.48 | 9,724.67 | -3.16 | 9,891.68 | -1.50 | 9,936.61 | -1.05 |
| PROF-A* | 19,265.60 | 18,761.03 | -2.62 | 18,798.88 | -2.42 | 18,790.74 | -2.46 |
| MANAGE-A* | 5,140.93 | 4,979.68 | -3.14 | 4,937.29 | -3.96 | 5,064.76 | -1.48 |
| ADMIN-A* | 10,059.50 | 9,786.43 | -2.71 | 9,863.58 | -1.95 | 9,771.06 | -2.87 |
| EDUC-A* | 5,230.28 | 5,060.92 | -3.24 | 5,278.86 | 0.93 | 5,240.39 | 0.19 |
| HEALTH-A* | 34,076.10 | 32,899.20 | -3.45 | 34,479.19 | 1.18 | 34,351.60 | 0.81 |
| ART-A*, # | 4,381.80 | 4,233.91 | -3.37 | 4,372.42 | -0.21 | 4,390.60 | 0.20 |
| HOTEL-A# | 1,625.65 | 1,576.58 | -3.02 | 1,516.25 | -6.73 | 1,598.40 | -1.68 |
| REST-A# | 10,700.70 | 10,343.12 | -3.34 | 9,670.00 | -9.63 | 10,700.24 | 0.00 |
| OTHST-A | 2,579.28 | 2,504.07 | -2.92 | 2,427.93 | -5.87 | 2,526.22 | -2.06 |
| OTHSNT-A*, # | 13,323.27 | 12,904.88 | -3.14 | 13,215.39 | -0.81 | 13,157.37 | -1.25 |
| GOVSPE-A* | 44,488.78 | 43,769.61 | -1.62 | 44,683.63 | 0.44 | 40,258.04 | -9.51 |
| **TOTAL** | **529,452.77** | **514,456.27** | **-2.83** | **512,919.27** | **-3.12** | **516,846.03** | **-2.38** |

* non sales taxable sectors, #sectors which pay high property taxes in the base run (more than 1 percent of its total output)

*Table 7: Change in Factor Returns and Employment*

| | **Base run** | **SIM1** Income tax | **SIM2** Sales Tax | **SIM3** No replacement |
|---|---|---|---|---|
| LABOR ($ million) | 139,131.21 | -608.66 | -269.38 | -727.43 |
| (Percent) | | (-0.44%) | (-0.19%) | (-0.52%) |
| CAPITAL ($ million) | 85,289.55 | -13.48 | 110.41 | -349.88 |
| (Percent) | | (-0.02%) | (0.13%) | (-0.41%) |
| Increase in Employment (persons) | 3,647,356 | 4,642 | -1,618 | 21,429 |
| (Percent) | | (0.13%) | (0.04%) | (0.59%) |

*Table 8: Equivalent Variation under each tax regime ($ per household)*

| | SIM1<br>Income Tax | SIM2<br>Sales Tax | SIM3<br>No Replacement |
|---|---|---|---|
| HHD1 (income less than $10,000) | 311.54 | -1,529.78 | 315.81 |
| HHD2 ($10,000 to $14,999) | -2,576.86 | -1,765.12 | 340.58 |
| HHD3 ($15,000 to 24,999) | -2,539.35 | -1,803.43 | 316.47 |
| HHD4 ($25,000 to $34,999) | -3,110.58 | -2,418.37 | 327.65 |
| HHD5 ($35,000 to $49,000) | -3,346.36 | -3,197.49 | 718.49 |
| HHD6 ($50,000 to $74,999) | -2,487.00 | -3,203.81 | 835.09 |
| HHD7 ($75,000 to $99,999) | -2,980.56 | -3,256.74 | 1,095.93 |
| HHD8 ($100,000 to $149,999) | -2,455.37 | -3,416.97 | 1,102.43 |
| HHD9 ($150,000 plus) | -3,042.39 | -4,176.72 | 1,126.83 |
| Average | **-2,571.22** | **-2,781.11** | **686.34** |

Table 9: Summary of Long-run effects (capital and labor are variable)

| $ million | Base run | SIM1.1 | Change | SIM1.2 | Change | SIM2.1 | Change | SIM2.2 | Change | SIM3.1 | Change |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Income tax rate at 6.615% (same as short run) | | Income tax rate at 6% | | Sales tax rate at 20.1216% (same as short run) | | Sales tax rate at 16% | | No revenue replacement | |
| State and local governments revenue | 62,718 | 62,718 | 0 | 62,718 | 0 | 62,718 | 0 | 62,718 | 0 | 62,718 | 0 |
| State and local governments revenue from household property tax | 2,446 | 0 | -2,446 | 0 | -2,446 | 0 | -2,446 | 0 | -2,446 | 0 | -2,446 |
| State and local governments revenue from business property tax | 5,786 | 0 | -5,786 | 0 | -5,786 | 0 | -5,786 | 0 | -5,786 | 0 | -5,786 |
| State and local governments revenue from household income tax | 5,416 | 13,847 | 8,431<br>155.7% | 13,280 | 7,864<br>145.2% | 5,411 | -5<br>-0.10% | 6,004 | 588<br>10.85% | 8,496 | 3,080<br>56.86% |
| Change in state and local governments revenue from change in sales tax | n/a | 0 | 0 | | | 8,538 | 8,538 | 6,896 | 6,896 | 0 | 0 |
| State and local governments revenue from other indirect business taxes | 6,233 | 6,039 | -194<br>-3.1% | 6,518 | 286<br>4.58% | 5,935 | -298<br>-4.78% | 6,825 | 592<br>9.50% | 10,566 | 4,333<br>69.52% |
| Federal government revenue from household income tax | 16,547 | 16,490 | -57<br>-0.34% | 17,494 | 947<br>5.73% | 16,530 | -17<br>-0.10% | 18,343 | 1,797<br>10.86% | 25,966 | 9,419<br>56.92% |
| Gross Regional Product | 238,282 | 231,620 | -6,662<br>-2.8% | 249,781 | 11,499<br>4.83% | 231,936 | -6,346<br>-2.66% | 264,829 | 26,547<br>11.14% | 403,058 | 164,776<br>69.15% |
| Return to Labor ($ million) | 139,131 | 138,490 | -642<br>-0.46% | 149,608 | 10,477<br>7.53% | 138,780 | -352<br>-0.25% | 158,895 | 19,763<br>14.20% | 243,431 | 104,299<br>74.96% |
| Return to Capital ($ million) | 85,289 | 85,305 | 17<br>0.02% | 91,727 | 6,438<br>7.55% | 85,466 | 178<br>0.21% | 97,091 | 11,802<br>13.84% | 145,937 | 60,648<br>71.11% |
| Employment (persons) | 3,647,356 | 3,651,194 | 3,838<br>0.11% | 3,934,546 | 287,190<br>7.87% | 3,641,825 | -5,530<br>-0.15% | 4,157,677 | 510,321<br>13.99% | 6,325,641 | 2,678,286<br>73.43% |
| Net Household Income ($ million)* | 179,207 | 172,976 | -6,230<br>-3.48% | 183,753 | 4,546<br>2.54% | 181,329 | 2,122<br>1.18% | 199,281 | 20,074<br>11.20% | 274,723 | 95,517<br>53.30% |
| Value of Output (Sales) $ million* | 529,453 | 514,892 | -14,561<br>-2.75% | 558,119 | 28,666<br>5.41% | 513,256 | -16,197<br>-3.06% | 592,012 | 62,559<br>11.82% | 922,987 | 393,534<br>74.33% |

## Appendix A

Table A1: List of Sectors

| | Sector | Details |
|---|---|---|
| 1 | CROPS-A | Crop production |
| 2 | ANIMAL-A | Animal production |
| 3 | MISCAG-A | Logging, forestry, fishing, hunting, trapping, and agricultural support |
| 4 | MINING-A# | Mining and quarrying |
| 5 | UTIL-A# | Utilities |
| 6 | CONST-A* | Construction |
| 7 | GROC-A* | Groceriess |
| 8 | OTHFOOD-A | Other processed food |
| 9 | TEXTLEAT-A | Textile and leather product manufacturing |
| 10 | WOOD-A | Wood product manufacturing |
| 11 | PAPER-A | Paper manufacturing |
| 12 | PRINTING-A | Printing and related support activities |
| 13 | PETROCOAL-A | Petroleum and coal product manufacturing |
| 14 | CHEMICAL-A | Chemical manufacturing |
| 15 | PHARMA-A* | Pharmaceutical and medical manufacturing |
| 16 | PLASRUB-A | Plastics and rubber product manufacturing |
| 17 | NONMEMIN-A | Nonmetallic mineral product manufacturing |
| 18 | PRIMMETAL-A | Primary metal manufacturing |
| 19 | FABMETAL-A | Fabricated metal product manufacturing |
| 20 | MACHINE-A | Machinery manufacturing |
| 21 | COMPELECT-A | Computer electronic electrical equipment manufacturing |
| 22 | ELECAPPL-A | Electrical equipment appliance and component manufacturing |
| 23 | TRANSEQUI-A | Transportation equipment manufacturing |
| 24 | FURNITURE-A | Furniture and related product manufacturing |
| 25 | MISCNTMFG-A* | Miscellaneous non-sales taxable manufacturing |
| 26 | MISCELMFG-A | Miscellaneous sales taxable manufacturing |
| 27 | WHOLTRAD-A*, # | Wholesale trade |
| 28 | RETTRAD-A# | Retail trade |
| 29 | TRANS-A* | Transportation and warehousing |
| 30 | INFORM-A# | Information |
| 31 | FINANCE-A*, # | Finance and insurance |
| 32 | APART-A*, # | Apartment |
| 33 | ESTATE-A*, # | Real estate, rental, and leasing |
| 34 | PROF-A* | Professional scientific technical services |
| 35 | MANAGE-A* | Management of companies and enterprises |
| 36 | ADMIN-A* | Administrative and support, and waste management and remediation |
| 37 | EDUC-A* | Educational services |
| 38 | HEALTH-A* | Health care and social assistance |
| 39 | ART-A*, # | Art, entertainment, and recreation |
| 40 | HOTEL-A# | Hotel and accommodation |
| 41 | REST-A# | Restaurants |
| 42 | OTHST-A | Other services sales taxable |
| 43 | OTHSNT-A*, # | Other services non-sales taxable |
| 44 | GOVSPE-A* | Public Administration and special sectors |

* nontaxable sectors, #sectors which pay high property taxes in the base run (more than 1 percent of its total output)

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