Regionalism, Federalism, and Taxation: A Food and Farm Perspective. By Patrick Canning and Marinos Tsigas. Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1882.

Abstract

This report documents an applied general equilibrium model of the United States. The model features explicit treatment of Federal, State, and local taxes and is segmented into 10 distinct subregions. These subregions engage in inter- and intraregional trade, as well as international trade. Each region is distinguished by its unique composition of industries, capital markets, and patterns of trade. Regional data developed for calibrating the model are discussed and several tax policy reform simulations demonstrate the modeling capabilities.

Keywords: Cost of capital, fiscal policy, marginal effective tax rate, regional applied general equilibrium, regional household welfare, State and Federal taxation and reform.

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Summary

In the United States, the tax system is multilayered. It includes a central Federal tax system and State and other local tax systems. Reform of these systems has always been part of the national economic policy debate. In this report, we document a model developed to assess the economic effects of taxation in the United States, and we simulate a tax reform to illustrate its multiple effects on economic performance in different regions. While the model is economywide, special attention is given to regional economies, food and farm industries, and the food consumer.

For modeling purposes, we segmented the U.S. economy into 10 distinct economic regions, and the model accounts for regional economic performance and regional household well-being. Prominent features of the model include the explicit treatment of local, State, and Federal taxes and the existence of several subnational regions that engage in inter- and intraregional trade, as well as in international trade. Each region is distinguished by its unique composition of industries, disposition of capital factor markets, and patterns of trade. These distinguishing characteristics also create a unique relationship in each region with the U.S. tax system.

Some stylized facts about tax burdens on primary factors of production in our 1994 tax year simulations are noteworthy. Concerning effective marginal tax burdens at the Federal level, agriculture is the most lightly taxed nonresidential industry, while food manufacturing is among the most highly taxed industries. Regionally, the Delta and Northeastern States realized the lowest effective marginal Federal tax rates on farm capital, while the Appalachian and Southeastern States have the highest effective marginal Federal taxes on food manufacturing capital. Concerning effective marginal tax burdens among State governments, agriculture is the most heavily taxed nonresidential industry, while food manufacturing is near the bottom. The highest food manufacturing State effective marginal rates are in the Northeast and Lake States, while the lowest are in the Southeast and Appalachian States.

Tables and figures in the report present detailed information on the value of different capital inputs used in production for each industry, recognizing the possibility of 15 distinct types of production inputs. The 10 U.S. regions and a region representing the rest of the world each engage in the production of seven products (capital-intensive agriculture, other agriculture, capital-intensive food manufacturing, other food manufacturing, capital-intensive other manufacturing, other manufacturing, and other industry output). These products can be traced to a far more detailed list of goods and services produced by industry and consumed by private households. The model allocates production, consumption, and tax burdens of the products to regional industries and households in proportions consistent with the more detailed array of goods and services actually produced and consumed. The 11 regions, 7 products, and 15 primary factors of production lead to more than 1,000 distinct primary factor tax wedges. With trade taxation also represented, as well as household taxation, a comprehensive account of the multiple impacts from taxation is obtained.

The complexity and diversity of industry, households, and the tax system lead to many different consequences from taxation. With multiple tax policies and multiple levels of government administering tax policy, many conflicting and complementing effects of these taxes are realized to varying degrees across industries, households, and regions. Current tax policy and several variations of fundamental tax reform are considered and found to affect magnitudes and distributions of several economic indexes. These effects varied across regional households, inter- and intraregional industry aggregates, asset portfolios, terms of regional and international trade, and relative consumer price and consumption patterns. The report concludes with a comprehensive analysis and breakdown of these effects, along with consideration of alternative tax reform scenarios (unilateral Federal reform and harmonized Federal and State tax reform). Regional economies, food and farm industries, and food consumers are featured in these discussions. These simulations, while not intended to represent specific reform proposal scenarios, do effectively demonstrate the extensive analytical capabilities made available with this new modeling resource.

Regionalism, Federalism, and Taxation
A Food and Farm Perspective

Patrick Canning
Marinos Tsigas

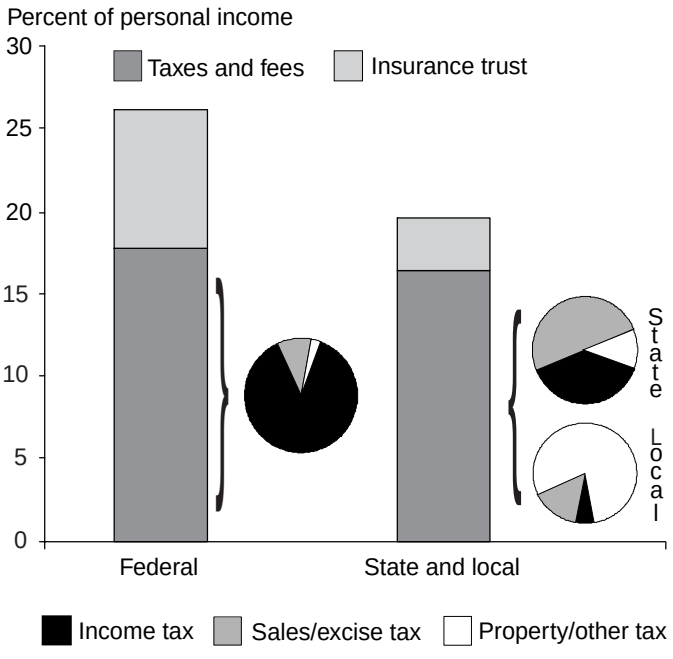
Introduction

With no public policy having more profound effects on markets than taxation, the Economic Research Service has developed an adaptation of the prevailing economywide modeling framework used for examining tax policies. This adaptation makes prominent, salient features of food and farm industries and their markets, features generally obscured in applied economywide tax models. A characteristic of food markets is the geographic fixity of primary factors in production, including suitable farmland, regional climate conditions, natural resource base, and proximity to primary upstream industry. These geographic elements motivate the modeling assumptions employed in the model that we present.

In the United States, the tax and social insurance systems are multilayered. They include a central Federal, State, and local tax and insurance trust systems. Combined Federal and State taxes, charges, and miscellaneous fees are estimated at 34.1 percent of personal income in 1994. In addition, the Federal and State insurance trust collections amounted to 11.4 percent of personal income (fig. 1). The most extensive source of revenues at the Federal level is the income tax, at 90 percent of total tax revenues and nearly 40 percent of total revenue. The Federal insurance trust (primarily social security and medicare) produces one-third of all Federal revenues. Among State governments, taxes account for more than 70 percent of own-source general revenues (taxes plus insurance trust). Income and wealth taxes are a smaller share of State tax revenues, around 40 percent, while roughly half of State tax revenues are raised through sales and excise taxes. Three-quarters of local tax revenues come from annual property taxation. There are no annual Federal property taxes, and under 10 percent of Federal taxes are sales and excise taxes. At 12 percent, the State insurance trust (mostly employee retirement) is not as significant a revenue source as in the Federal budget.

Reform of the tax system, to address inefficiencies it creates, has always been part of the national economic policy debate. By "inefficiencies," we are referring to the alterations in relative prices for factors of production and consumption caused by a tax system that creates unequal burdens on different factors. The Federal tax system was reformed, in various degrees, in 1986, 1993, and 1997. Currently, there are proposals for fundamental

Figure 1
Disposition of public revenues, 1994



Source: American Council on Intergovernmental Relations.

change in the tax system. In this report, we document a model develped to assess the economic effects of taxation reform in the United States, and we simulate a generic tax reform to illustrate its multiple effects on economic performance in different regions. While the model is economywide, we give special attention to regional economies, food and farm industries, and the food consumer.

There are significant regional dimensions to tax policy initiatives, and region-specific policies are likely to have significant effects in other regions. Prominent features of our work include the explicit treatment of local, State, and Federal taxes and the existence of several subnational regions that engage in inter- and intraregional trade, as well as in international trade. We use a multiregional, applied general equilibrium model of the U.S. economy. Each region is distinguished by its unique composition of industries, disposition of capital factor markets, and patterns of both intra- and interregional trade. These characteristics create a unique relationship in each region with the tax system.

We seek to represent the multiple inefficiencies in each economic region in the tax system, stemming from the differential treatment of primary factors of production. We represent the distortionary effects on industry capital, as well as the capital/labor decisions, taking into account that industry employs a heterogeneous capital portfolio.[1] Within each region, misallocations of primary factors across industry aggregates are also represented, and while intersector mobility between corporate, noncorporate, and residential capital is precluded, the tax treatment of each sector is captured and will affect resource allocation decisions. Similarly, financial characteristics of each industry and across industry aggregates are represented exogenously, along with macroeconomic assumptions such as real interest rates and inflation expectations. These factors affect tax incidence in capital factor markets.

At the household level, the allocation of income between present and future consumption is represented, and the tax system affects this decision through the differential tax treatment of consumption and savings in each regional household, the latter stemming from the tax treatment of investment goods. While tax policy can affect labor supply decisions, we hold fixed each region's supply of labor, and thus ignore any such supply response.

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[1]Because the model represents the intermediate-run scenario, the industry-level decisions, such as capital portfolios and labor/capital ratios do not translate to the regional totals, since each labor and capital aggregate is fixed within each region. The longrun results are foreshadowed in the model by tracking the international investment flows (see the "Macroeconomic Closure" subsection).

Background

Food and farm industries add 4.9 percent to the value produced by the employment of capital in domestic (nonresidential) industry. Yet in some regions, such as the Appalachian (9.5 percent), Corn Belt (6.7 percent), Lake States (8.0 percent), and Northern Plains (10.5 percent), the productive capital in food and farm industries contributes significantly to the returns from regional investment in business capital (fig. 2). Capital intensity, measured as the value-added ratios of capital to labor (U.S. Department of Commerce, Bureau of Economic Analysis, 1994), is higher in farming (1.0) and food manufacturing (1.4) than in other manufacturing (0.6) and all other nonresidential industry (0.8).

Since the work of Harberger, it has been widely understood that taxation of capital income creates significant distortionary effects. Studies since 1981 (Goulder and Thalmann; Fullterton and Henderson; and Summers) found comparable burdens from the non-neutral tax treatment of heterogeneous capital. Other factors, such as inflation (Feldstein) and real interest rates (Boadway, Bruce, and Mintz; and Gravelle), have also been shown to have distortionary effects on relative prices in factor markets. Fiscal policy instruments significant in farming and rural areas, including cost-share policy for specific investments and the rural development programs, which may include cost-share arrangements and subsidized credit, have direct consequences on factor-use decisions that relate to the tax-inclusive cost of capital.

Evidence of real effects from taxation in agriculture has been extensively documented in the applied research literature (Carman). This evidence indicates significant incentive effects from the income tax system on investment (LeBlanc and Hrubovcak; and Sisson), while general equilibrium accounts of farm and food tax incidence (Boyd and Newman; and Hertel and Tsigas) have found substantial effects on agriculture and food prices. The Tax Reform Act of 1986 generally created substantial efficiency benefits from a leveling of tax wedges on heterogeneous capital factor markets.

Figure 2
USDA farm production regions

However, in agriculture, this leveling reduced investment incentives, particularly in the use of farm machinery, primarily due to the repeal of the investment tax credit (LeBlanc, Hrubovcak, Durst, and Conway). Macroeconomic factors affecting the tax system have produced significant structural change in the factor portfolios of farmers (Canning and Leathers).

Calls for fundamental reform, ranging from a flat income tax to a national retail sales tax, have gained important political allies. Along with goals such as simplicity and fairness, many elements of these proposals are intended to rectify inefficiencies of taxation on industrial factor incomes. If effects of these policy reforms are comparable to those found in past reforms, it would be of considerable value to trace out these effects among the many economic entities that comprise the national economy, such as those measured by geographic, demographic, sectoral, and industrial disaggregation. Such an effort would provide a richer economic context to an is of targeted Federal program initiatives, and allow for an assessment of the relative effects in the farm and food economy from a fundamental reform of the tax system.

Comprehensive reform of the Federal tax code does not necessarily imply a harmonized reform of regional fiscal policies. Economists have observed (Nechyba) that a combination of logistic and strategic advantage requires regional and subregional governments to rely on different tax instruments to finance localized budget demands. The data support this finding. The importance of this is that economic simulation of tax policy reform not incorporating these salient features of fiscal federalism imposes a *de facto* harmonization of Federal and regional tax policy. Empirical work, however, indicates such harmonization may be infeasible, or at the very least, not a foregone conclusion. As data in this report show, the difference between unilateral and harmonized tax reform on tax incidence is not trivial.

Overview of a U.S. Multi-Regional Applied General Equilibrium Model

An applied general equilibrium (AGE) approach is appropriate for this analysis because changes in tax policy affect all industries of the economy at different rates. Furthermore tax changes affect disposable income and final demand. A multiregional framework is appropriate because State and Federal tax systems have very different effects, and thus tax reform is expected to have different consequences for different regions. Because there are close economic links between U.S. regions, it is appropriate to assess tax reform in a national framework.

Our general equilibrium approach is based on assumptions that are common in the literature (perfect competition, constant returns to scale, and full employment of resources). Also, our analysis is of a comparative static nature with medium-term economic adjustments. Our model is closely related to static AGE models already available for the analysis of international trade (for reviews, see Shoven and Whalley, 1984 and 1992; Francois and Shiells; and Hertel, Ianchovichina, and McDonald). Each regional economy, including the rest-of-the-world (ROW) region, is specified with demand and production structures. Subject to transportation costs, each U.S. region engages in commodity trade with other U.S. regions and the ROW region. Commodity prices are determined by market clearing through intraregional, interregional, and international trade.

To formulate a theoretically consistent quantitative model of those economic linkages, we are forced to reduce the dimensions of the problem. In particular, our regional and commodity specifications are shown in figure 2 and table 1. There are 10 aggregate regions representing the U.S. economy and the rest-of-the-world region representing all foreign economies. In terms of industry, there are seven aggregate industries (and commodities). Each of the three broad industries (agriculture, food processing, and manufacturing) includes a distinction between high-capital-intensity and low-capital-intensity industries. For example, grain production is represented by our high-capital agricultural industry. A seventh industry category represents all other economic activity. In terms of factor endowments, we specify 15 primary factors: farmland (noncorporate business), labor, shelter, and six types of capital (corporate and noncorporate). Labor and shelter are allocated to the residential sector.[2] To capture important differences in taxation,

[2]This specification obscures that shares of income from shelter are subject to corporate and noncorporate taxation. We do factor in these tax provisions, but choose to allocate only shelter to this sector.

Table 1—Commodity specification

Agriculture	**Manufacturing**	**Other industries**
Nongrain crops	Fabricated metal products	Coal
Other livestock	Leather, etc.	Construction
Wool	Lumber	Fisheries
	Machinery and equipment	Forestry
Agriculture, high capital	Nonferrous metals	Oil and gas
Grains	Nonmetallic minerals	Other minerals
Paddy rice and wheat	Other manufacturing	Water, gas, electricity
	Petroleum and coal	Trade and transportation
Food processing	Primary ferrous metals	Ownership of dwellings
Meat products	Pulp paper, etc.	Other services (government)
Milk products	Textiles	Other services (private
Other food products	Transport equipment industries	
Processed rice	Wearing apparel	
Food processing, high capital	**Manufacturing, high capital**	
Beverages and tobacco	Chemicals, rubbers, plastics	

we specify three sectors: corporate business, noncorporate business, and residential sectors. These sectors are used to classify and allocate all regional factor endowments for taxation.[3]

Some earlier analyses using multiregional AGE models were conducted by Kimbel and Harisson; Jones and Whalley, 1988, 1989, and 1990; Morgan, Mutti, and Partridge; Kraybill, Johnson, and Orden; and Buckley. Kimbell and Harisson developed a tax model to explore the effects of Proposition 13, using a California/rest-of-the-United States multi-industry framework. Their model allowed for complete mobility and substitution of some factor inputs, but no changes in interregional commodity flow patterns and without transportation costs.

Jones and Whalley (1988, 1989, and 1990) developed a multiregional AGE model for Canada. Their model has six Canadian regions and a rest-of-the-world region, 13 industries, and a combination of partially mobile and immobile primary factors. A notable mobile factor is labor, which may change its region of use and relocate its consumption to this new location. Labor is assumed to be internationally immobile, interindustry mobile, but interregionally partially mobile. The goods produced in each region were treated as qualitatively different from similar commodities produced either in other regions or abroad. Because of historical patterns of interregional trade subsidies and tariffs in Canada, the Jones/Whalley model did not include interregional transportation costs explicitly.

Morgan, Mutti, and Partridge developed a six-region general equilibrium model of the United States to assess the potential longrun effects of State, local, and Federal tax policies on output and the allocation of factors across regions and industries. At the most disaggregated level, the regionally differentiated traded goods were treated as highly substitutable but unique products. Transportation costs were ignored. Capital was assumed to be perfectly mobile across regions and industry, and it was reallocated until a common aftertax return emerges. The availability of labor in a region was assumed to be a function of real wages offered in that region relative to real wages available elsewhere.

[3]More specifically, these sectors are used for purposes of determining marginal factor tax rates, without implication of where the burden of this tax falls.

Kraybill, Johnson, and Orden developed a two-region AGE model of the United States with five industry aggregates. Primary factor endowments (capital) are fixed at the regional (industry) level, as are regional government expenditures. Trade flows, including interregional domestic trade, are determined by relative prices and structural rigidities. They found that certain industries, including agriculture, bear a disproportionate burden of adjustment to macroeconomic imbalances, relative to other industries. The authors conclude that national level industry analysis underestimates such costs.

Buckley developed an interregional AGE model of the United States with three regions and five industries. The study differed from other multiregional AGE models in the explicit specification of intra- and interregional transportation and wholesaling services for bilateral trade in goods by industry. Buckley concluded that, relative to other approaches, the AGE's explicit specification provided a more focused description of the spatial economic effects that result from changes in economic conditions, such as transportation costs.

In this report, we present a multiregional AGE model, and we perform simulations of fundamental tax reform. The strengths of our approach are recent estimates of relevant tax policy instruments at the Federal and State/regional level and a theoretically consistent general equilibrium framework that builds on earlier works in this area. We focus on the comparative static implications of taxation under the assumption that the regional distribution of productive resources does not change. Improvements to this work may endogenize the level of productive resources (through savings and investment in a dynamic framework) or the regional distribution of some productive resources (through interregional migration).

Structure of the AGE Model

Each regional economy consists of several economic agents. First, a super-household, which is a combined public and private household (Hertel), supplies all primary factor services in the region and maximizes utility to determine commodity demands. Utility for the super-household comes from three general sources: private consumption financed by

personal income, public consumption financed by Federal and regional government transfers, and regional savings. The concept of a super-household is convenient because it allows us to measure consistently the change in regional welfare. A second agent class encompasses the cost-minimizing industries that employ primary factor services and use intermediate products to produce commodities, each industry producing a single commodity. A third agent is a regional government that collects taxes from economic activity in the region. Finally, the U.S. Federal Government collects taxes from economic activity in all U.S. regions.

Regional income for the super-household consists of returns to primary factors (personal income), net regional taxes, and a transfer of funds from the U.S. Federal Government. The regional household saves part of its income and spends the rest to purchase private and public goods. By assuming that regional and Federal public goods are optimally supplied, we can focus on inefficiencies created by taxation.

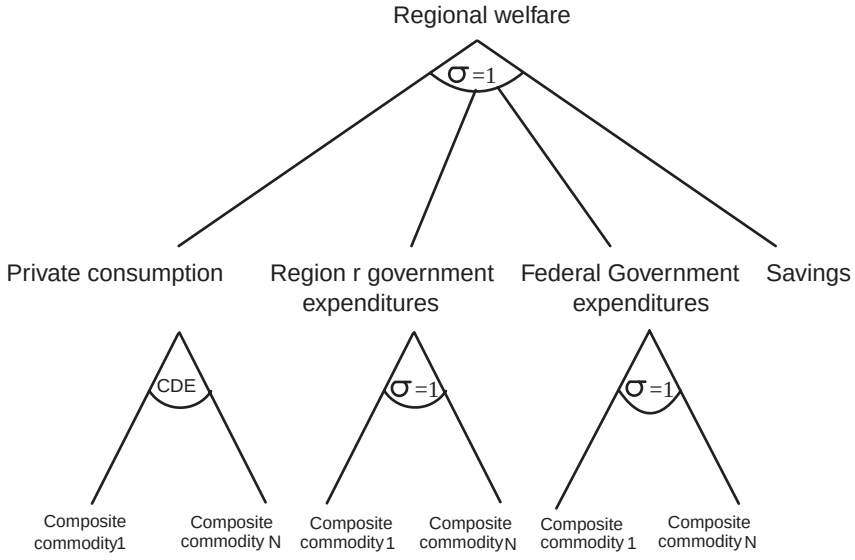
Welfare and Household Behavior

Figure 3 outlines a two-level utility tree for households in each region of the model. It is assumed that preferences are separable, which allows partitioning utility and commodities in subgroups that can be described independently of quantities in other groups. Thus overall utility may be expressed as a function of subutilities, which in turn have more subgroupings within them. The utility tree in figure 3 consists mostly of constant elasticity of substitution (CES) functions.

At the top of the utility tree (fig. 3), the concept of a super-household is implemented to model household decisions regarding expenditures and savings and to provide a theoretically consistent and comprehensive measure of welfare. The regional welfare implications of changes in exogenous variables, like tax policies, will be exactly reflected by changes in regional welfare. Regional welfare is derived from four components: private household expenditures, regional and Federal expenditures for public goods, and savings. In particular, each super-household maximizes utility subject to a regional income constraint. In the U.S. regions of the model, there are two types of public goods: regional/State and Federal. In the ROW, there is only one type of public good. It is assumed that the simulations we perform do not change the allocation of regional income across private and public goods, and savings.[4]

[4]This assumption is implemented by applying a Cobb-Douglas function to describe substitutions between the four components of welfare (in this case, the Allen partial elasticity of substitution, σ, is equal to *1*, and budget shares are constant).

Figure 3
Modeling of household welfare and expenditures



CDE: Constant difference in elasticities. σ: Partial elasticity of substitution in CES.

Household demands are determined separately for the two composite commodities. First, it is assumed that substitutions between composite public good commodities (Federal versus regional public goods) can be described with Cobb-Douglas functions. This simply implies that the relative expenditures between the regional and Federal composite commodities remain constant. Second, private household (that is, consumer) demands for composite commodities are based on the constant differences of elasticities (CDE) expenditure function.[5] The CDE specification allows for more flexibility in specifying varying degrees of substitution between consumer goods purchases. This specification is also less restrictive in how one specifies correlations between household wealth and private goods consumption patterns. For example, holding the relative price of all consumption goods constant, an increase in household wealth can lead to different rates of increase in each composite private good commodity, such as a less-than-proportionate increase in food consumption, and a more-than-proportionate increase in nonfood manufactured goods.

[5]The CDE expenditure function was developed by Hanoch (1975 and 1978), discussed by Surry (1989 and 1993), and implemented in AGE models by Hertel et al. (1991), and Hertel.

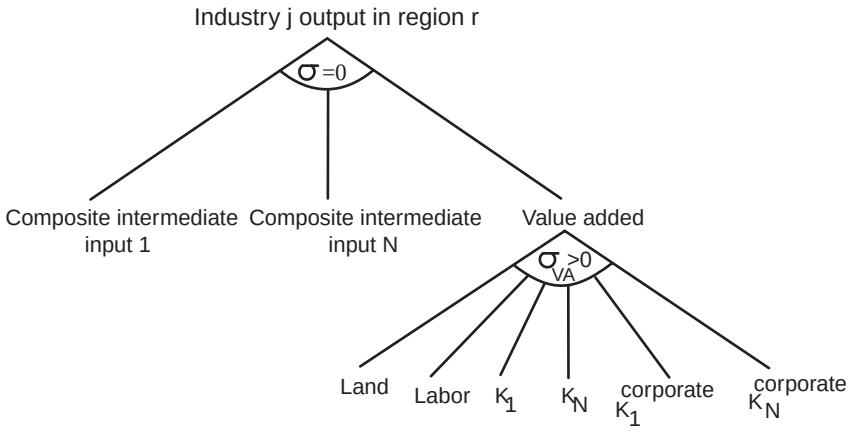
Industrial Demands

Producing industries demand two types of inputs: primary factors and intermediate inputs. The model treatment of substitution between inputs is outlined in the production tree in figure 4. The primary factor composite is a CES aggregate of land (where appropriate), labor, and several capital types. The CES, or constant elasticity of substitution, allows for substitution between factors of production in response to changes in relative factor prices. The elasticity of substitution between primary factors, σ_{VA}, is industry specific. There is no substitution between the primary factor composite and intermediate inputs (that is, a Leontief technology is assumed).

Interregional and International Trade

The main feature of the model treatment of trade is that intermediate (and final demand) users of commodities are assumed to treat imports from different sources as imperfect substitutes, that is, the Armington assumption is applied (Armington, 1969a and 1969b). Thus, demands reflect cost minimization across within-region and out-of-region sources of supply. One advantage of the Armington specification is that it allows one to account for the two empirical observations that, even at a very

Figure 4
Modeling of input substitutions in production



σ: Partial elasticity of substitution in constant elasticity of substitution technology.

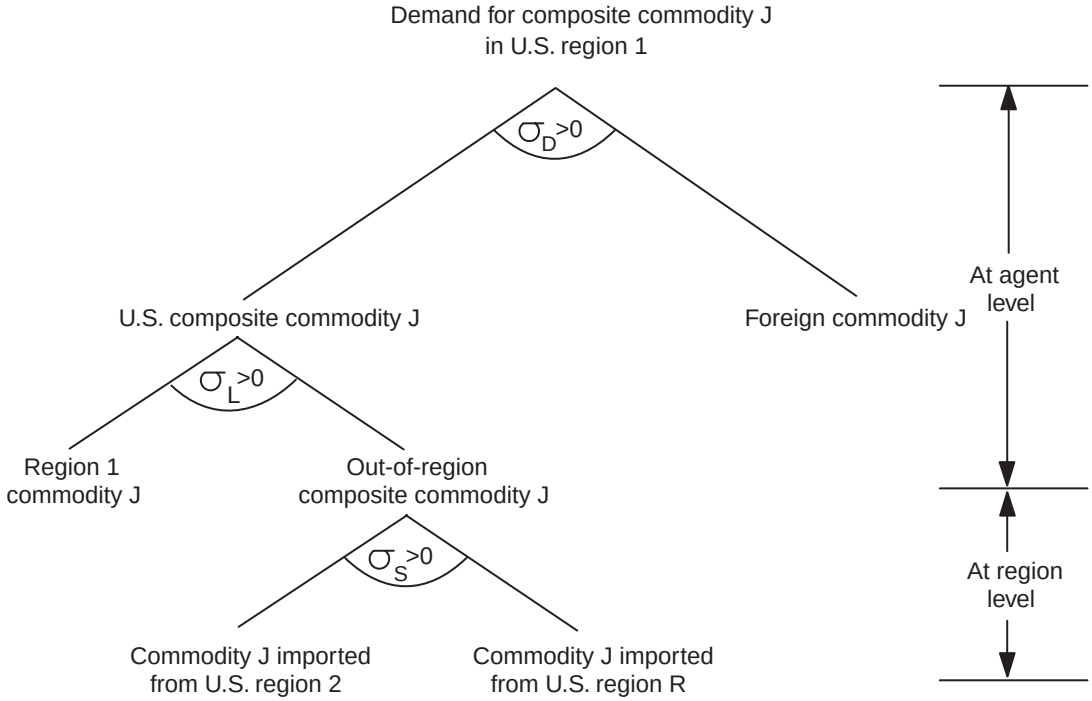
disaggregated commodity level, economies import and export the same commodity and that most commodities are produced in all economies. The Armington assumption also allows for differing degrees of substitution between foreign and domestic goods across different commodities and for changes in relative prices of imported goods.

In figure 5, the elasticity of substitution $\sigma_L > 0$ determines the degree of substitution that occurs between within-region and out-of-region composite commodities. Within-region commodities are produced in the region. Out-of-region composite commodities are aggregates of imports from all other U.S. regions. Out-of-region and within-region varieties of the same commodity are aggregated to a domestic composite commodity. The elasticity of substitution $\sigma_D > 0$ determines the degree of substitution between the domestic composite variety and its foreign counterpart. This yields composite commodities for each commodity in the model. The top two levels in figure 5 implement the Armington assumption at the agent level. At the lowest level, the elasticity of substitution σ_S determines the degree of substitution across other regional sources of supply for each commodity. Substitutions at this level apply for the regional economy as a whole. Elasticities σ_D, σ_L, and σ_S are commodity specific.

The values of the substitution elasticities in figure 5 are important for model results on regional effects of policies. Elasticities of substitution between foreign imports and the domestic composite commodity (elasticity σ_D) largely determine the U.S. national import price elasticities of demand for each commodity. These elasticities determine the extent to which policies cause changes in the composition between foreign and U.S. domestic sources of supply, and thus they influence the national terms of trade. The values of elasticities of substitution between within-region and out-of-region varieties (elasticity σ_L) largely determine the extent to which a region's terms of trade improve or deteriorate due to a policy change. In addition to trade elasticities of substitution, the extent of trade and trade patterns also influences effects on terms of trade.

For each international transaction, there is a set of *ad valorem* tax (or subsidy) rates and therefore a set of world and regional prices. From an exporter's

Figure 5
Modeling of the Armington assumption



σ : Partial elasticity of substitution in constant elasticity of substitution technology.

point of view, the market price of a commodity will be different from its free on board (FOB) price when the exporting region gives an export subsidy. When the shipment of commodity reaches its region of destination, its customs, insurance, and freight (CIF) price may be different from its FOB price due to transportation costs. From the importer's point of view, the CIF price of an imported commodity may be different from its market price, in the importing region, due to import tariffs levied by the importing region.

There are two more aspects of the model that affect the interregional and international linkages in the model. First, a global industry demands services from each regional transportation services industry to provide a composite service used for transporting commodities across regions (Hertel). In value terms, each region's relative contribution to the global transportation industry does not change due to the simulation performed. It is also assumed that transportation services are required in fixed proportions with the quantity of a particular commodity shipped along a particular route.

Macroeconomic Closure

As in most comparative static AGE models, we face the problem of determining investment. In non-neoclassical closures, investment is fixed, and another variable adjusts to obtain a solution to the model. In this model, we apply a neoclassical closure: there is no independent investment relationship; investment simply accommodates any change in savings. Instead of applying this closure at the regional level, however, we apply this closure at the global level, using the concept of a global industry that intermediates between savings and investment. In each region, aggregate investment is represented by the output of a new capital goods industry. The global savings-investment industry has a portfolio of regional investments offered to regional households to satisfy their demand for savings. Globally, the sum of investment expenditures cannot be greater than the sum of household savings.

Regarding the regional composition of investment, the model offers two alternative allocation specifications. The first allocation specification assumes that the regional composition of global capital stock will not change due to the simulation performed. The second specification assumes that there is a negative relationship between the expected regional rate of return on capital and the amount of investment undertaken in a region. The global savings-investment industry manipulates this relationship until rates of return are equalized across regions. In the simulations that we perform at the end of this report, the second specification is applied and we examine the sensitivity of selected results to the investment allocation specification.

Primary Factor Mobility

Each region has a fixed endowment of land, labor, and capital assets. Labor services and services flowing from existing capital stocks are assumed to be mobile between industries, but region specific. This implies that all industries in a region face the same market price for labor services and the same market price for capital services. Regarding land, our approach allows for changes in industrial patterns of land use, but land rent differentials across industries are sustained. This assumption is implemented with a system of land supply functions derived from a constant elasticity of transformation function, with an elasticity of transformation $\sigma_T<0$.

Policies

A number of factors led to our choice of the 1994 tax policy and disposition of primary industrial factor markets for our base year. This is a tax year in which the significant reforms of the Revenue Reconciliation Act of 1993 were in place, most notably the changes in upper marginal tax brackets. The base year also immediately follows the year that the 1992 Economic Census and 1992 Census of Agriculture were enumerated, providing us with an extensive data resource based on surveys conducted in the year just prior to our year of analysis.

To encompass the multiple inefficiencies of the U.S. tax system, we employ linear tax instruments. This approach allows us to reconcile the total budget accounts for our tax base year of 1994, while explicitly modeling the marginal incentive effects of taxation. The relative size of the public sector directly affects the regional measures of welfare, as does the differential tax treatment of primary production factors and industry output.

Each regional household is endowed with all primary factors of regional production (fig. 6). All compensation that flows to these factors from regional industry (Level III) are owned by the household. All sources of taxation that fall on the personal income tax base (including property and output taxes) are explicitly modeled at their marginal effective rates, so the personal income tax depicted in Level V of figure 6 is a nondistorting intercept term, which forces the overall income tax rate to equal the actual 1994 rate on the relevant income tax base. Mathematically, if the total income tax base, $TB = \sum_{i=1}^{I} tb_i$, is taxed as the sum of I linear factor tax instruments and one *ad valorem* output tax instrument, total income tax revenue (T) equals $\left[\sum_{i=1}^{I} (a_i + b_i tb_i) + cTB\right]$ where a_i is the intercept (generally negative) of the linear factor tax, b_i is the slope (marginal effective tax rate) of the linear factor tax, and c is the flat output tax rate across all industry output.[6] Notice that linear factor taxes are progressive average taxes, which we calibrate to actual average tax rates, but that also reflect the marginal tax incidence on the factor income. It is straightforward to show that total tax revenue can be restated as,

$$T = \left[\frac{\sum_{i=1}^{I} a_i + cTB}{TB(1-\bar{b}_i)}\right] \text{x } TB(1-\bar{b}_i) + \sum_{i=1}^{I} b_i(tb_i),$$

where $\bar{b}_i$ is the weighted average marginal effective tax rate on factor incomes. Relating this to Level V in figure 6, the quotient within the squared brackets of the above equation is the personal income tax rate depicted in Level V, while the net of tax personal income depicted across Level IV of figure 6 is equal to $TB(1-\bar{b}_i)$ in the above equation. As depicted in figure 8, the b_i are marginal effective factor taxes, while tb_i are the gross of tax factor incomes.

The private household uses all the net proceeds (Level VI) to purchase consumption and investment goods (Level VII). This consumption/savings decision is determined by the relative prices of the two activities, based on a Cobb-Douglas preference specification. The decision to consume subjects the household to an *ad valorem* consumption tax, while the decision to save is indirectly subject to a tax on the price of savings (Level VIII).[7] The relative tax rates on consumption and investment goods will affect the household decision, and thus affect the level of household welfare (Level VIII). The consumption depicted in figure 6 is carried over to figure 7. For exposition, assume the final good on the top of figure 6 is the only good consumed by this household, and arbitrarily place this household in region *1* of a two-region U.S. economy. As depicted in figure 4, this consumer good is a composite of industrial output from domestic regions and the rest of the world. Moving to the bottom center of figure 7, note that for any industry *i* in region *1*, industrial output is directed to four areas (downstream industry within region *1*, downstream industry in other domestic regions, downstream international industry, final good markets). All industry *i* output shipped to international downstream industry may be taxed at the border, and this is treated as a separate border tax base. All domestically produced industrial output used in consumer goods are subject to an industry output tax, and all international industrial output used in consumer goods purchased by U.S. consumers is subject to a U.S. border tax. These taxes are represented in the model as *ad valorem* taxes and, except for border taxes, are assumed to be transmitted backward to the factor owners. It is assumed that no taxes are levied on shipments of industrial output to domestic downstream industries. Each region's tax burden on output includes Federal and State excise taxes and other fees that are proportional to output.

Industrial shipment proceeds must be allocated to factors of production.[8] This is depicted in figure 8. Payments to upstream industry for intermediate factors of production become part of the gross proceeds of industry *j*. Gross payments to labor lead

[6]Due to the level of industry aggregation, output taxes are viewed as nondistorting in this model, and so are modeled as an *ad valorem* tax on all output.

[7]In the model, the price of savings is the numeraire. The purchasing power of savings is the weighted average price of investment goods, which are in turn affected by factor and output taxes.

[8]Compensation of factors and from customers must be determined simultaneously. The sequential description here is arbitrary.

Figure 6

Sources of income and taxes from household capital and labor endowments

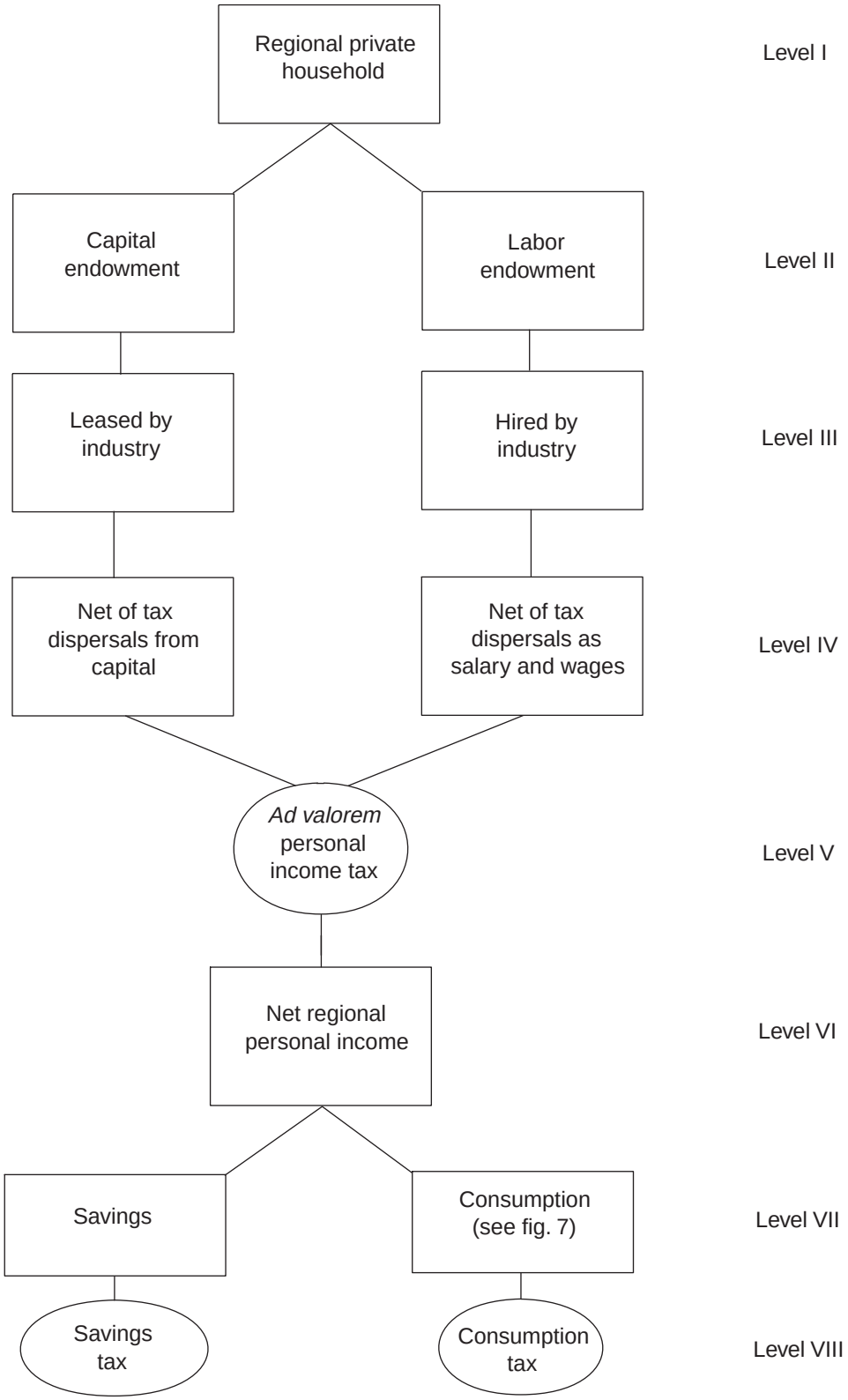
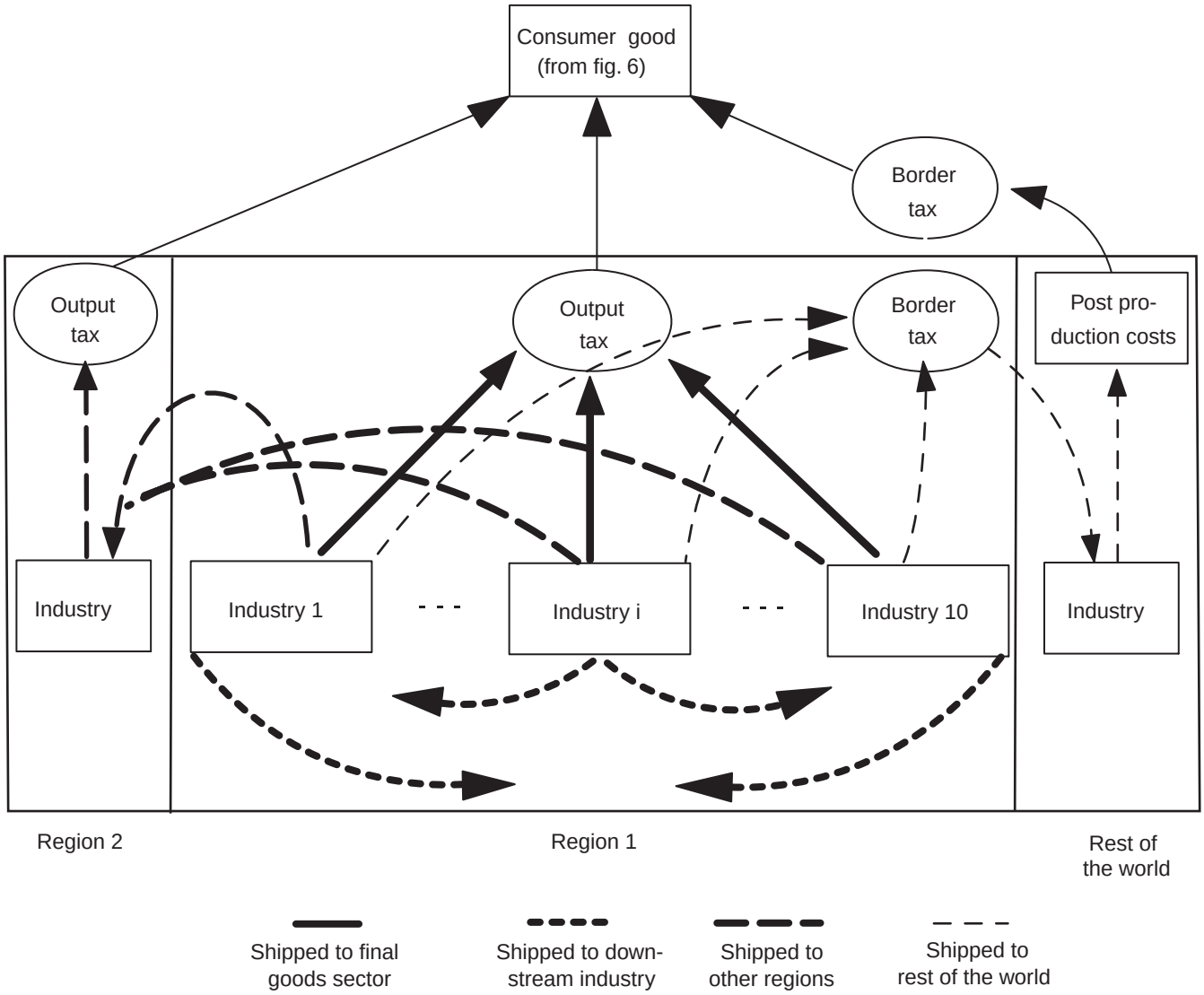


Figure 7
Sources of tax revenue in the industry/final-goods linkage

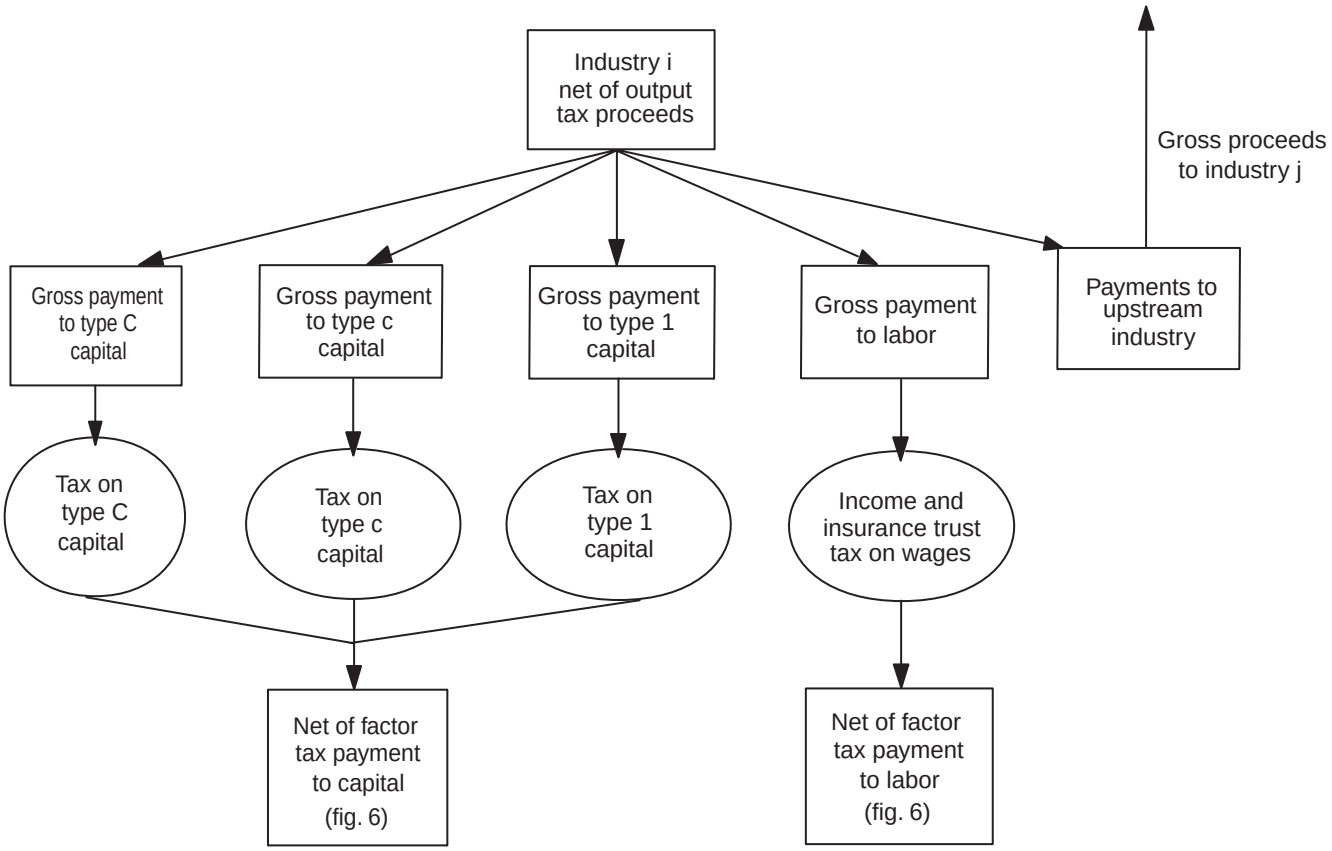


to a tax burden on industry *i* to cover Federal and State taxes, both for labor income and to cover Federal and State insurance trusts. This is represented as an *ad valorem* tax in the model, with a rate that reflects the weighted average marginal tax burden on regional labor income.[9] In other words, it is one of the b_i introduced at the beginning of this "Policies" subsection.

While a single *ad valorem* tax on labor income is sufficient for calibration of the base year model, it is important to note that the labor factor tax has two components—income taxes and insurance trust taxes. These two tax instruments are computed separately and are additive at the margin. The purpose of this accounting procedure becomes more evident when we carry out tax reform simulations, since no serious tax reform scenarios propose harmonizing the insurance trust tax with other tax instruments. Our approach will be to leave the insurance trust tax, which is a pure wage tax, in place in all reform simulations not directly involving social security and/or medicare reform.

[9]One dollar of wage income is distributed to regional households in proportion to their existing wage income. Based on 1993 Federal and State income and insurance trust tax rules, new proceeds of these taxes from this dollar of income is divided by 100 to arrive at an average marginal wage tax rate.

Figure 8
Sources of tax revenue in industry factor markets



What is not paid to labor and intermediates is paid to capital. In the model, there are 14 different classifications of capital, and for each type of capital in each region and for each of the 7 industry aggregates, there is a unique marginal tax rate, or a unique b_i. The method and measurement of these tax rates are discussed in the Taxation section and further explained in the appendix. The fact that each factor tax rate may be unique means the relative use of factors will be different from a scenario of no tax on factor incomes. Capital proceeds are allocated to each type of capital consistent with the requirement that net rates of return to the factor owner of each type of capital are equal. After factor taxes are deducted from industry proceeds, the net of factor tax payments to labor and capital is paid to factor owners, depicted in Level V of figure 6.

Public Expenditures

Government expenditures remain proportionally fixed to personal income. Since the budget shares of each government entity reflect household preferences, and because public and private consumption utilities are separable in the utility function, the cost-minimizing expenditures for each public good also remain proportionally fixed. In revenue-neutral tax simulations, public savings will vary inversely with the public good price index, nationally and regionally. This result is obtained in the model through both regional and U.S. Federal Government transfers of tax proceeds in fixed amounts to regional households.

Accounting Relationships

The model has a number of accounting relationships: market clearing for traded commodities and primary factor services, zero profit conditions, and income constraints for households. It is these economywide and global relationships that differentiate a partial from a general equilibrium model. One of these accounting relationships will be automatically satisfied when all the other accounting relationships are satisfied. This relationship is not included in the model, and the corresponding price is the numeraire

in the model. In this model, the accounting relationship that is automatically met is that the sum of regional investment must equal the sum of regional savings. Therefore, the numeraire is the price of savings.

In the tax reform simulations that we perform in this bulletin, we require that the amount of taxes collected by the Federal and/or each regional government does not change. These government budget conditions are a part of the macroeconomic closure of the model.

The Database

To implement the model outlined in this section, initial equilibrium data and parameter values must be specified. The next two subsections describe the procedures applied to build a micro-consistent regional data set for the United States and the ROW, and the parameter values specified.

For each producing industry and household in the model, there are three separate vectors with expenditures, at agent prices: one for commodities produced within the region, one for composite commodities produced outside the region, and one for foreign imports. For each producing industry, there is also a vector with payments to primary factors. Corresponding vectors have data for these transactions evaluated at market prices. The sum of all payments for intermediate inputs and primary factors, at agent prices, gives the value of an industry's costs. The sum of expenditures by demanders, at market prices, shows total sales of commodities produced within the region and total exports. The sum of these two items gives total sales for a commodity. Total costs of each regional industry must equal total sales of the corresponding commodity produced within the region.

The trade data record bilateral trade flows between all regions and for all commodities. For each bilateral trade flow, there are four measures. Two measures are from the exporter's perspective: one evaluates exports at domestic market prices, and the other evaluates exports at world prices (FOB prices). The difference between these two measures is any export tax or subsidy. The other two measures are from the importer's perspective: one evaluates imports at world prices (CIF price), and the other evaluates imports at domestic market prices. The difference between the two measures is any import tariff duties. The difference between CIF and FOB values is due to transportation costs.

The 1987 input-output (IO) table of the U.S. economy (U.S. Department of Commerce, Bureau of Economic Analysis, 1994), the State-level employment statistics (U.S. Department of Commerce, Bureau of Economic Analysis, 1998b), and the State capital accounts (see the appendix) are the major building blocks in assembling regional economic accounts. To derive producer accounts for each U.S. State, statistics on employment by State were used along with our State capital accounts, and the assumption that for each industry/commodity, average output per unit of value added is the same across States. National private household expenditures are prorated across States using statistics on total personal income, by State (U.S. Department of Commerce, Bureau of Economic Analysis, 1999). U.S. national gross investment, by industry, was prorated across States using the computed State-level industrial output.

The IO table provides foreign import and export statistics for the U.S. economy as a whole. Two additional sources of information were used to describe trade linkages between U.S. States and those between U.S. States and the ROW. One of them is the Commodity Flow Survey statistics on interstate trade flows for commodities (U.S. Department of Transportation, Bureau of Transportation Statistics), and the other is the State Merchandise Export statistics (U.S. Department of Commerce, International Trade Administration). Both of those data sets are published at a very aggregated commodity specification. Therefore, it was necessary to prorate the trade data across commodities using regional production information. For the commodities not covered by the trade statistics, we assumed that regional trade patterns were similar to those for total trade.

The commodity flow survey provided the data for the value of shipments and ton-miles traveled by commodity for State of origin and the value of total shipments and ton-miles traveled by State of destination for State of origin. From the latter data, the composition of total exports by State of destination for State of origin may be computed.

Assuming that this composition is the same for all commodities, the data sources allow construction of bilateral trade flow matrices by commodity. Similarly, average ton-miles shipped for every trade transaction (that is, by commodity, State of origin, and State of destination) were computed. These data along with information on U.S. industry expenditures on transportation costs (from the IO table) allow construction of transportation cost information by commodity and trade route. Percentage transportation costs for international trade were obtained from the GTAP database (Gehlhar et al.).

The State merchandise export statistics provide the data for exports from the States to the ROW. For commodity aggregates for which the State export data do not have information, U.S. national exports were prorated across States.

The protection data refer to trade between the States and the ROW and are derived from the GTAP database (Gehlhar et al.). Those protection data include: (1) bilateral import tariffs derived from the original country submissions to the GATT for the Uruguay Round negotiations, (2) the Multi-Fiber Arrangement, (3) antidumping duties levied by Canada, the European Union, and the United States, (4) export subsidies for agricultural commodities, and (5) import nontariff barriers for agricultural and food commodities. The database also has import tariffs from the Uruguay Round agreement of the GATT.

Behavioral Parameters

In addition to the domestic and interregional data, the model requires specification of the behavioral parameters discussed in the "Welfare and Household Behavior" subsection. These parameters describe for each region utility-maximizing opportunities available to households, cost-minimizing opportunities available to producers, and import demands. Values for these parameters have been adopted from the SALTER (Jomini et al.) and GTAP (Huff et al.) modeling frameworks.

Demand systems for private households are based on CDE expenditure function. Ideally, one should obtain econometric estimates of the CDE parameters. However, it is rather difficult to estimate a CDE consumer demand system. Instead, the CDE is calibrated to price and income elasticities of demand from the econometric literature. This requires implementation of a calibration procedure outlined in Hertel et al. (1991) and Huff et al.

The first and second sections in table 2 show the demand elasticities for the private household in the model. As described in the "Welfare and Household Behavior" subsection, the elasticities in table 2 are based on the CDE functional form and are a function of the underlying CDE parameters and budget shares in the initial equilibrium. The substitution elasticities in table 2 show the Allen partial elasticities for the CES functions that describe substitutions among primary factor services in value added (see the "Industrial Demands" subsection) and in trade (see the "Interregional and International Trade" subsection).

The Intermediate Run

Policy simulations in the model assume a sufficient passage of time for existing production capacity within each economic region to be reallocated among industries. Reallocation exploits differential rates of return resulting from changes in parameter values. While this interindustry mobility can occur within each economic region, no such mobility exists across regions or between asset types (for example, transforming tractors into computers).

To motivate this intermediate-run scenario, we focus on capital factor markets. We have representation of four broad categories of capital—office machines, heavy machinery, transportation equipment, and industrial plants—each existing in the corporate and noncorporate form.[10] To maintain the production capacity made possible by this capital, a combination of regional public and private infrastructure must be in place to accommodate and service plant and machinery capacity and replace worn-out capital.

If a new fiscal policy regime were put in place (or some other change in economic conditions) that had differential effects across industry, sectors, capital types, and regions, we postulate a distinct ordering

[10]We will ignore land, utility plants, and residential structures in this discussion.

of industrial response. Starting from the end, assuming the new policy regime is perceived to be permanent, public and private sectors in regions that enjoy a distinct advantage in the new regime are likely to take measures to attract to their region (or in response to the attraction of their region) new investment capital so as to have in place a greater infrastructure for maintenance of higher capital (and labor) capacity. In the model, this possibility is addressed in our closure assumptions in the form of an international investment arbiter that allocates global savings regionally using one of two possible arbitration rules. This flow of funds foreshadows longrun effects of policy changes but has no real effects on regional production capacity. This is consistent with our assumption of asset fixity at the regional level, and a survey of industrial location research literature substantiates this assumption. For example, Blair and Premus conducted a literature survey that summarizes the prevalent empirical findings: "[M]ost local growth is attributable to differential growth rates of existing facilities. … The complete shutdown of a plant in one area in order to relocate to another area is rare" (p. 74). Global savings is directed to purchases of current specific industrial output in regions proportional to the planned future expansions (or retractions—for example, investment less than current period capital consumption).

Table 2—Model elasticities and parameters

Elasticities	Agriculture	Food	Manufacturing	Other industry	Agriculture, high capital	Food, high capital	Manufacturing, high capital
Compensated own-price elasticities:							
Appalachian	-0.09	-0.05	-0.76	-0.22	-0.01	-0.68	-0.88
Corn Belt	-0.09	-0.06	-0.76	-0.20	-0.01	-0.70	-0.87
Delta States	-0.07	-0.06	-0.72	-0.23	-0.01	-0.70	-0.86
Lake States	-0.09	-0.05	-0.76	-0.20	-0.01	-0.70	-0.89
Mountain	-0.08	-0.05	-0.77	-0.19	-0.02	-0.70	-0.88
Northeast	-0.09	-0.04	-0.76	-0.20	-0.01	-0.70	-0.90
Northern Plains	-0.08	-0.05	-0.76	-0.20	-0.02	-0.71	-0.88
Pacific	-0.08	-0.04	-0.79	-0.17	-0.01	-0.69	-0.88
Southeast	-0.09	-0.04	-0.75	-0.21	-0.01	-0.70	-0.88
Southern Plains	-0.09	-0.06	-0.73	-0.22	-0.01	-0.70	-0.87
Rest of world	-0.16	-0.17	-0.81	-0.19	-0.03	-0.51	-0.65
Income elasticities:							
Appalachian	0.65	0.62	1.03	1.04	0.60	0.98	1.06
Corn Belt	0.69	0.67	1.02	1.03	0.65	0.98	1.06
Delta States	0.68	0.66	1.02	1.03	0.64	0.98	1.06
Lake States	0.62	0.69	1.03	1.04	0.56	0.97	1.07
Mountain	0.65	0.63	1.02	1.03	0.61	0.97	1.06
Northeast	0.54	0.52	1.03	1.04	0.48	0.96	1.07
Northern Plains	0.55	0.54	1.03	1.04	0.51	0.96	1.07
Pacific	0.63	0.61	1.02	1.03	0.59	0.97	1.06
Southeast	0.57	0.54	1.03	1.04	0.52	0.97	1.07
Southern Plains	0.66	0.64	1.03	1.03	0.62	0.98	1.06
Rest of world	0.48	0.33	1.05	1.10	0.16	0.90	1.17
Substitution elasticities:							
S	10.33	8.80	12.68	9.21	8.80	12.40	7.60
L	5.10	4.40	6.12	3.96	4.40	6.20	3.80
D	2.53	2.20	3.13	1.99	2.20	3.10	1.90
VA	0.56	1.12	1.26	1.38	0.56	1.12	1.26

We assume that the passage of time required to get investment capital up and running is similar to the passage of time it takes to convert existing tractors into computers, or *vice versa*. Without taking this statement too literally, we simply mean that our broadly defined capital aggregates are sluggishly convertible. The same heavy machinery plant that produces farm tractors also produces construction cranes, and can transform tractor production to crane production timelessly, but with transformation limitations. On the other hand, current period shifts in regional demand for computer chips must be met using the region's office equipment capacity infrastructure, not through transformed heavy machinery capacity. Our partitioning of capital type aggregates is intended to reflect distinct operation infrastructure associated with each asset category.

Corporate, noncorporate, and residential capital cannot be transformed across sectors. This assumption is motivated by two factors. First, as noted in Fullerton and Henderson, many decisions related to incorporation and unincorporation reflect risk preferences and size considerations, and such factors are not explicitly represented in our model. Also, there is a paucity of regional data on corporate capital location, so it is difficult to make assertions about their mobility within a region, although we can allocate corporate capital regionally. As will be evident when we carry out policy simulations, even when national intersectoral shifts are small, regional level changes can be significant, and we chose to avoid the possibility of large regional intersectoral shifts in factors of production in our interpretation of the intermediate run. There is some theoretical justification for this assumption, as is often pointed out in the economic debates on the effect of capital gains taxation reform (see Auten and Cordes). Many have theoretically and empirically challenged the assertion that higher aftertax rates of return on corporate capital necessarily lead to higher rates of savings allocated to the corporate sector.

While each assumption employed in our representation of the intermediate run is subject to anecdotal counter examples, we believe that, collectively, they are an accurate representation of the intermediate response by economic agents to changes in economic factors. Further, our closure techniques provide a detailed foreshadowing of the longrun response, as would be explicitly captured in a dynamic policy simulation framework.

PC Implementation of the Model

To implement the model on a personal computer and perform simulations, a simulation program has been developed based on the GEMPACK suite of software (Harrison and Pearson). GEMPACK is designed to solve nonlinear economic models like this one. In particular, the model has been implemented in its linearized representation, and a solution consists of percentage changes in relative prices and quantities. GEMPACK obtains multistep solutions: a shock is broken up into several smaller pieces and, at each step, the linearized equations are solved for these smaller shocks. After each step, the data and price and income elasticities are recalculated to take into account the changes from the previous step. In general, the more steps a shock is broken into, the more accurate the solution will be. Pearson shows formally how a GEMPACK solution based on the linearized representation of a model can be as accurate as a solution of the underlying nonlinear model (Harrison and Pearson, appendix B; and Hertel, Horridge, and Pearson).

Disposition of Industries and Primary Factors of Production

Measurement of tax incidence from applied general equilibrium tax analysis is usually obtained using industry and factor market delineations with polar factor input requirements—capital versus labor intensive, durable versus short-lived capital, business sector versus owner-occupied housing, corporate versus non-corporate industry. We employ this criteria with refinements designed to emphasize the food and farm industries, and to use the most advantageous interpretation of primary data sources. Using procedures described in the following subsection, we classify industry as follows: capital-intensive farms, other farms, capital-intensive food manufacturing, other food manufacturers, capital-intensive nonfood manufacturing, other nonfood manufacturing, and services, mines, and trade (all other industry).

All value added produced by industry is either labor or capital. Capital is heterogeneous, and our data are based on 14 distinct aggregations from 54 classifications of capital types, as defined in BEA detailed wealth accounts (U.S. Department of Commerce, Bureau of Economic Analysis, 1998). These 14 aggregates include both corporate and noncorporate classifications. The purpose of this distinction is to capture the tax differential due to the corporate tax wedge. One industry, services, mines, and trade, employs both corporate and noncorporate capital, while all other industry aggregates employ either all corporate or all noncorporate capital. The six corporate-owned assets are computers/office equipment, service and furnishing equipment, heavy machinery, transportation equipment, industrial plants, and utility plants. Noncorporate enterprise also owns these six asset aggregates, as well as farmland. Finally, residential shelter (which is a hybrid of both corporate and noncorporate owned), along with labor services, complete the list of 15 possible primary factor inputs available to industry.

Industry Classification

The national input-output accounts describe the value added by capital and labor in nearly 500 U.S. industry aggregates. All industry output is tradable and must be produced in all regions. For this condition to hold, aggregate groupings of industry output in all regions must be developed. We, therefore, map the industrial aggregates into these 35 industry categories (table 1), and determine the capital and labor value added. Based on the ratio of total capital value added per worker in each industry and using a procedure for identifying exotic values within a known distribution (Hoaglin, Iglewicz, and Tukey), we determine that three special capital-intensive industries will be explicitly represented in the numerical model: cash grain farms; tobacco and beverages; and chemical, rubber, and plastic manufacturing. All other industry is grouped as follows: farms; food manufacturers; nonfood manufacturers; and services, mines, and trade. Two other capital-intensive industries—construction, and owner-occupied shelter—are grouped with the services, mines, and trade industry.

Labor

Labor does have some special classifications in the tax code—for example, employees over 65 years in age, certain handicaps, marital status, and veterans' preferences. Most of these can be treated with explicit accounts of labor dispositions in regional markets. Industry bias in these characteristics has not been convincingly demonstrated, so our approach is to model the representative worker for each regional industry, such that firm-level labor is homogeneous, while industry and regional labor is heterogeneous, strictly due to tax treatments.

Capital

Among the most complicated aspects of the Federal tax code are the special provisions for the ownership of business capital. Most of this complication involves owner claims of capital depreciation over a given tax year—a real expense to capital owners, but difficult to quantify. While there are countless different types and uses of business capital, and even more rates of wear and tear on this capital, there are six cost-recovery periods in the tax code (plus a few special other classifications), one of which each asset must follow for claims of cost recovery. A number of economic studies have been conducted to

Table 3--Regional factor shares of industry value added, by capital type and labor

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu-facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc-tion	Owner-occupied shelter
				Percent of industry value added					
Appalachian:									
Corporate--									
Computers/office equipment	0	0	0.672	3.083	1.262	2.809	0.586	0.105	0
Service and furnishing equipment	0	0	0.429	1.833	0.488	0.316	0.251	0.080	0
Heavy machinery	0	0	5.717	32.342	7.822	13.309	0.645	3.436	0
Transportation equipment	0	0	0.321	2.176	0.307	0.259	0.565	2.235	0
Industrial plants	0	0	2.714	12.469	3.988	5.416	2.083	1.350	0
Utility plants	0	0	0	0	0	0	0.731	0.021	0
Noncorporate--									
Computers/office equipment	0.042	0.008	0	0	0	0	0.218	0.045	0
Service and furnishing equipment	0.001	0	0	0	0	0	0.123	0.034	0
Heavy machinery	2.710	0.433	0	0	0	0	0.227	1.457	0
Transportation equipment	0.989	0.113	0	0	0	0	0.286	0.949	0
Industrial plants	0.941	0.115	0	0	0	0	1.029	0.581	0
Utility plants	0	0	0	0	0	0	0.100	0.004	0
Farmland	4.477	1.074	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.869	0	9.121
Labor services	8.211	3.665	9.136	35.559	10.031	14.417	8.179	0	0
Corn Belt:									
Corporate--									
Computers/office equipment	0	0	1.683	0.646	1.961	2.322	1.024	0.148	0
Service and furnishing equipment	0	0	1.075	0.412	0.615	0.282	0.446	0.114	0
Heavy machinery	0	0	14.322	5.543	12.690	12.488	0.888	4.861	0
Transportation equipment	0	0	0.805	0.314	0.441	0.245	1.052	3.165	0
Industrial plants	0	0	6.779	2.661	5.942	6.588	3.699	1.769	0
Utility plants	0	0	0	0	0	0	1.218	0.025	0
Noncorporate--									
Computers/office equipment	0.090	0.183	0	0	0	0	0.374	0.064	0
Service and furnishing equipment	0.003	0.006	0	0	0	0	0.215	0.049	0
Heavy machinery	5.665	9.684	0	0	0	0	0.317	2.062	0
Transportation equipment	1.675	2.561	0	0	0	0	0.495	1.343	0
Industrial plants	1.873	2.671	0	0	0	0	1.805	0.763	0
Utility plants	0	0	0	0	0	0	0.085	0.005	0
Farmland	10.042	24.325	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	1.411	0	14.703
Labor services	11.293	39.020	19.792	9.645	18.750	19.733	13.861	0	0
Delta States:									
Corporate--									
Computers/office equipment	0	0	0.326	0.114	0.424	1.092	0.215	0.034	0
Service and furnishing equipment	0	0	0.208	0.073	0.162	0.119	0.092	0.023	0
Heavy machinery	0	0	2.773	0.974	2.962	4.932	0.267	0.920	0
Transportation equipment	0	0	0.156	0.055	0.114	0.096	0.215	0.592	0
Industrial plants	0	0	1.672	0.533	1.384	1.253	0.766	0.308	0
Utility plants	0	0	0	0	0	0	0.610	0.207	0
Noncorporate--									
Computers/office equipment	0.022	0.013	0	0	0	0	0.082	0.013	0
Service and furnishing equipment	0.001	0	0	0	0	0	0.044	0.009	0
Heavy machinery	1.269	0.585	0	0	0	0	0.077	0.384	0
Transportation equipment	0.397	0.200	0	0	0	0	0.098	0.249	0
Industrial plants	0.388	0.185	0	0	0	0	0.370	0.124	0
Utility plants	0	0	0	0	0	0	0.082	0.043	0
Farmland	2.723	1.734	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.314	0	2.908
Labor services	4.273	3.088	4.497	1.698	2.887	5.179	2.655	0	0

Continued--

Table 3--Regional factor shares of industry value added, by capital type and labor--Continued

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu- facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc- tion	Owner-occupied shelter
				Percent of industry value added					
Lake States:									
Corporate--									
Computers/office equipment	0	0	0.933	0.387	0.876	0.480	0.475	0.088	0
Service and furnishing equipment	0	0	0.596	0.247	0.299	0.065	0.222	0.068	0
Heavy machinery	0	0	7.938	3.292	5.973	3.046	0.402	2.931	0
Transportation equipment	0	0	0.446	0.185	0.227	0.060	0.475	1.909	0
Industrial plants	0	0	4.763	1.623	2.479	1.130	1.778	0.982	0
Utility plants	0	0	0	0	0	0	0.496	0.011	0
Noncorporate--									
Computers/office equipment	0.047	0.033	0	0	0	0	0.189	0.038	0
Service and furnishing equipment	0.002	0.001	0	0	0	0	0.110	0.029	0
Heavy machinery	2.974	1.743	0	0	0	0	0.155	1.244	0
Transportation equipment	0.838	0.456	0	0	0	0	0.248	0.810	0
Industrial plants	1.031	0.466	0	0	0	0	0.886	0.421	0
Utility plants	0	0	0.	0.	0	0	0.041	0.002	0
Farmland	5.213	4.362	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.681	0	8.034
Labor services	7.926	9.844	10.097	4.898	11.266	8.092	6.867	0	0
Mountain:									
Corporate--									
Computers/office equipment	0	0	0.245	0.229	0.383	0.271	0.455	0.073	0
Service and furnishing equipment	0	0	0.157	0.146	0.107	0.029	0.182	0.053	0
Heavy machinery	0	0	2.086	1.949	1.917	1.204	0.496	2.186	0
Transportation equipment	0	0	0.117	0.110	0.079	0.023	0.419	1.419	0
Industrial plants	0	0	1.226	0.740	1.027	0.459	1.663	0.973	0
Utility plants	0	0	0	0	0	0	0.705	0.107	0
Noncorporate--									
Computers/office equipment	0.041	0.044	0	0	0	0	0.167	0.031	0
Service and furnishing equipment	0.001	0.002	0	0	0	0	0.089	0.023	0
Heavy machinery	2.448	2.387	0	0	0	0	0.170	0.924	0
Transportation equipment	0.690	0.611	0	0	0	0	0.208	0.601	0
Industrial plants	0.803	0.581	0	0	0	0	0.828	0.420	0
Utility plants	0	0	0	0	0	0	0.092	0.022	0
Farmland	4.960	5.942	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.641	0	5.408
Labor services	7.088	6.516	3.799	5.765	3.807	1.132	5.621	0	0
Northeast:									
Corporate--									
Computers/office equipment	0	0	0.874	0.467	2.075	2.032	2.013	0.236	0
Service and furnishing equipment	0	0	0.558	0.297	0.654	0.233	0.847	0.181	0
Heavy machinery	0	0	7.440	4.012	10.484	9.969	1.352	7.755	0
Transportation equipment	0	0	0.418	0.228	0.422	0.195	1.600	5.051	0
Industrial plants	0	0	2.924	1.427	3.450	4.662	7.314	2.949	0
Utility plants	0	0	0	0	0	0	1.772	0.013	0
Noncorporate--									
Computers/office equipment	0.032	0.005	0	0	0	0	0.742	0.102	0
Service and furnishing equipment	0.001	0	0	0	0	0	0.434	0.078	0
Heavy machinery	2.387	0.277	0	0	0	0	0.545	3.291	0
Transportation equipment	0.707	0.074	0	0	0	0	0.867	2.144	0
Industrial plants	0.891	0.077	0	0	0	0	3.728	1.272	0
Utility plants	0	0	0	0	0	0	0.138	0.003	0
Farmland	2.885	0.676	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	3.398	0	24.752
Labor services	8.052	2.319	15.640	11.938	20.581	21.416	26.660	0	0

Continued--

Table 3--Regional factor shares of industry value added, by capital type and labor--Continued

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu- facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc- tion	Owner-occupied shelter
				Percent of industry value added					
Northern Plains:									
Corporate--									
Computers/office equipment	0	0	0.357	0.032	0.369	0.151	0.148	0.027	0
Service and furnishing equipment	0	0	0.228	0.020	0.090	0.019	0.060	0.020	0
Heavy machinery	0	0	3.037	0.274	1.658	0.861	0.134	0.887	0
Transportation equipment	0	0	0.171	0.015	0.062	0.017	0.139	0.577	0
Industrial plants	0	0	1.442	0.077	1.249	0.559	0.497	0.283	0
Utility plants	0	0	0	0	0	0	0.239	0.025	0
Noncorporate--									
Computers/office equipment	0.046	0.128	0	0	0	0	0.052	0.011	0
Service and furnishing equipment	0.002	0.004	0	0	0	0	0.029	0.009	0
Heavy machinery	2.554	6.843	0	0	0	0	0.052	0.376	0
Transportation equipment	0.696	1.764	0	0	0	0	0.066	0.245	0
Industrial plants	0.740	1.720	0	0	0	0	0.241	0.120	0
Utility plants	0	0	0.	0.	0	0	0.045	0.005	0
Farmland	5.911	17.137	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.214	0	1.980
Labor services	7.067	22.387	6.545	0.799	1.811	1.547	1.856	0	0
Pacific:									
Corporate--									
Computers/office equipment	0	0	0.735	0.465	1.102	0.568	1.202	0.143	0
Service and furnishing equipment	0	0	0.469	0.297	0.378	0.069	0.518	0.104	0
Heavy machinery	0	0	6.257	3.961	6.224	3.050	0.909	4.266	0
Transportation equipment	0	0	0.352	0.223	0.276	0.060	1.116	2.775	0
Industrial plants	0	0	3.023	1.689	1.760	0.551	4.330	1.899	0
Utility plants	0	0	0	0	0	0	1.122	0.134	0
Noncorporate--									
Computers/office equipment	0.064	0.015	0	0	0	0	0.498	0.062	0
Service and furnishing equipment	0.002	0.001	0	0	0	0	0.262	0.045	0
Heavy machinery	3.785	0.812	0	0	0	0	0.436	1.807	0
Transportation equipment	1.101	0.221	0	0	0	0	0.618	1.177	0
Industrial plants	1.510	0.212	0	0	0	0	2.238	0.829	0
Utility plants	0	0	0	0	0	0	0.208	0.028	0
Farmland	7.393	2.059	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	2.548	0	14.899
Labor services	26.186	5.318	15.334	12.927	15.863	8.209	16.329	0	0
Southern Plains:									
Corporate--									
Computers/office equipment	0	0	0.494	0.359	0.723	1.282	0.783	0.087	0
Service and furnishing equipment	0	0	0.316	0.229	0.219	0.144	0.305	0.059	0
Heavy machinery	0	0	4.207	3.055	4.081	6.076	0.809	2.372	0
Transportation equipment	0	0	0.236	0.172	0.164	0.118	0.690	1.530	0
Industrial plants	0	0	2.060	1.237	1.287	1.333	2.920	1.001	0
Utility plants	0	0	0	0	0	0	2.065	0.438	0
Noncorporate--									
Computers/office equipment	0.050	0.032	0	0	0	0	0.293	0.034	0
Service and furnishing equipment	0.002	0.001	0	0	0	0	0.148	0.024	0
Heavy machinery	3.194	1.672	0	0	0	0	0.266	0.994	0
Transportation equipment	0.960	0.446	0	0	0	0	0.312	0.644	0
Industrial plants	1.084	0.428	0	0	0	0	1.422	0.416	0
Utility plants	0	0	0	0	0	0	0.326	0.091	0
Farmland	5.435	4.251	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.975	0	7.339
Labor services	8.312	5.805	6.794	6.060	6.248	10.450	7.845	0	0

Continued--

Table 3--Regional factor shares of industry value added, by capital type and labor--Continued

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu- facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc- tion	Owner-occupied shelter
				Percent of industry value added					
Southeast:									
Corporate--									
Computers/office equipment	0	0	0.438	0.595	0.787	1.196	0.796	0.110	0
Service and furnishing equipment	0	0	0.279	0.363	0.350	0.138	0.330	0.082	0
Heavy machinery	0	0	3.724	5.822	5.805	5.890	0.650	3.373	0
Transportation equipment	0	0	0.209	0.372	0.212	0.115	0.684	2.197	0
Industrial plants	0	0	1.592	2.177	2.188	2.417	2.751	1.546	0
Utility plants	0	0	0	0	0	0	0.877	0.011	0
Noncorporate--									
Computers/office equipment	0.029	0.003	0	0	0	0	0.294	0.049	0
Service and furnishing equipment	0.001	0	0	0	0	0	0.165	0.035	0
Heavy machinery	1.801	0.159	0	0	0	0	0.258	1.431	0
Transportation equipment	0.589	0.042	0	0	0	0	0.369	0.933	0
Industrial plants	0.645	0.045	0	0	0	0	1.396	0.678	0
Utility plants	0	0	0.	0.	0	0	0.093	0.002	0
Farmland	3.148	0.380	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	1.101	0	10.855
Labor services	11.594	2.037	8.367	10.712	8.756	9.823	10.126	0	0
United States:									
Corporate--									
Computers/office equipment	0	0	6.757	6.378	9.963	12.202	7.698	1.050	0
Service and furnishing equipment	0	0	4.314	3.918	3.364	1.414	3.253	0.784	0
Heavy machinery	0	0	57.503	61.223	59.617	60.826	6.552	32.985	0
Transportation equipment	0	0	3.232	3.848	2.303	1.189	6.954	21.449	0
Industrial plants	0	0	28.194	24.633	24.753	24.369	27.801	13.060	0
Utility plants	0	0	0	0	0	0	9.835	0.991	0
Noncorporate--									
Computers/office equipment	0.463	0.463	0	0	0	0	2.911	0.449	0
Service and furnishing equipment	0.016	0.016	0	0	0	0	1.618	0.335	0
Heavy machinery	28.787	24.595	0	0	0	0	2.504	13.971	0
Transportation equipment	8.642	6.487	0	0	0	0	3.569	9.095	0
Industrial plants	9.905	6.499	0	0	0	0	13.943	5.624	0
Utility plants	0	0	0	0	0	0	1.210	0.207	0
Farmland	52.187	61.940	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	12.153	0	100.000
Labor services	100.000	100.000	100.000	100.000	100.000	100.000	100.000	0	0

measure economic rates of wear and tear for many different forms of capital. For our purposes, we have adopted the work of Hulten and Wykoff, with adaptations reported in Jorgenson and Yun. This work provides a geometric rate of capital decay for the 50 different classifications of business capital plus residential structures, as reported in the annual detailed wealth accounts at the BEA. We use this information in forming heterogeneous accounts of business and residential capital. The appendix describes the regional heterogeneous industry capital accounts.

Capital and Labor Disposition

The disposition of an industry's primary factors of production affects tax rates on that industry. A number of factors are important, and in this section we examine the regional and industrial dimensions of factor-use dispositions. A longitudinal dissection of factor-use disposition will show regional primary factor (row) shares of national industry value added by industry (column), where capital and labor factors are distinguished. A latitudinal dissection will show industry (column) shares of each regional factor of production (row) total value added.

Table 3 presents the regional primary factor shares of industry value added. When we exclude the United States as a region, each column sums to a value of 100 for heterogeneous capital and labor, and each column entry represents a percentage of U.S. total value added, by industry, for either capital or labor. For example, 39 percent of labor services in U.S. cash grain production was in the Corn Belt States, while 25 percent of capital value added in the owner-occupied shelter industry came from Northeastern States.

At the bottom of table 3, we report the United States as a region. Because labor and capital are treated separately, all industries that use labor show values of 100, indicating that 100 percent of U.S. labor by industry is located in the U.S. region. For capital, this U.S. region shows the disposition of capital, by type, in each industry. The figures show that all nonresidential industries using corporate capital are most heavily leveraged in the use of heavy machinery, except services, mines, and trade (the largest industry). The only purely noncorporate industry is cash grain and other farming. For these industries, farmland is the most heavily leveraged asset, particularly in cash grain farms. Noncash grain farms are more likely to substitute plant and heavy machinery for land in their operation.

We explicitly recognize the regional dispositions of industry capital portfolios, but make no attempt to endogenize the determinants of industry location. Some stylized facts are noteworthy. The regional disposition of farm industries is largely intuitive; climate, weather, and resource characteristics limit the range of commodity options within a given geographic region. For example, cotton is a warm-weather plant, so commercial cotton production is limited to Southern States. Wheat thrives in cooler climates, hence its more northerly concentration. Citrus production, an uncharacteristically labor-intensive industry, is almost exclusively in the warm sunny climates of Florida and California. Agriculture, in general, is a land-intensive industry, so tends to be concentrated in areas with more favorable land cost conditions (rural areas). Many food manufactures have strong incentives to locate near their primary upstream industry (farms) when freshness or transportation costs of the preprocessed product is a significant factor. Examples of other industry-location determinants include strength of regional labor unions, proximity to markets and transportation, supply of skilled or unskilled labor, regional demographic and taxation characteristics, historical chance, agglomeration economies, and dissemination of transportation barriers.[11]

Each of these factors, while not explicitly addressed, may play a role in the calibration of the model, since empirical accounts of relative factor prices, input utilizations, and regional consumption patterns must be reconciled with general equilibrium. This is done through calibration of weighting parameters for both supply and demand function specifications. So, for example, a particular region that has a disproportionate elderly population may bias their consumption bundle, and our regional data will reflect this. While we have no explicit account of age demographics, the resulting model calibration will produce a weighting parameter that favors a consumption bundle likely to be more reflective of the preferences of a more aged population. Another way we address this issue is through our

[11] A review of this literature is presented in Blair and Premus, and a recent application is Ellison and Glaeser.

development of competing closure assumptions in the model (see "Macroeconomic Closure" subsection in the previous section). Depending on which closure assumption we employ, our model will reflect the public finance effects of regional industry locations, due to a firm's propensity to target (or not) new capital investment based on differential regional rates of return.

Regional and industrial variations in the disposition of capital exist. For example, although computers remain a small share of industrial capital portfolios, the chemical, rubber, and plastic industry spends approximately $1 in every $8 on such equipment, while construction industries spend about $1 in every $100. Farms are the only employers of land, and cash grain farms are 20 percent more dependent on land than other farms. Other farms substitute plant and heavy machinery for land, relative to cash grain farms. Another very important distinction of the farm industry is that it does not use corporate capital and competes only with service, mines, and trade and construction industries for the use of noncorporate capital. The most important farm factor is land, and there is no competition for this factor.

Within a given industry aggregate, the relative use of primary factors is uniform across regions. If we rank the cost shares from highest to lowest for each of the primary factors in each of the nine nonresidential industries, the U.S. average ranking is nearly the same as all regional rankings, give or take a ranking of 1. In fact, the only exception to this result is for the cost shares of utility plants. In the Delta and Southern Plains regions, utility plants have unusually prominent cost shares among primary factors in service, mines, and trade and construction industry aggregates.

Changing the perspective of factor disposition to industry shares of primary factor employment, table 4 presents column shares of row totals, such that each row sums to 100. Due to the extremely broad classification of the services, mines, and trade industry, it is the number one employer of most forms of capital in all regions. It is the number one corporate employer of computers, service and furnishing equipment, industrial plants, and utility plants, in every region, and the number two employer of corporate transportation equipment (behind construction industries) in every region. The only type of capital for which the service, mines, and trade industry is neither the top nor second largest employer is heavy corporate machinery (except in the Mountain region, where it is the second largest employer).

Either manufacturing or construction is the number one employer of heavy corporate machinery in each region, while construction is the top employer of noncorporate heavy machinery in every region. The ordinal ranking of farms and cash grain farms is virtually the same in every region: the smallest two employers of noncorporate capital and the only employers of farmland. Cash grain farms are most prominent in the Corn Belt and Northern Plains regions. The only region where farms are a significant employer of capital is in the Northern Plains, where farms employ more than 12 percent of noncorporate heavy machinery.

One industry that does show some regional variation in ranking as an employer of capital is the food industry. Food manufacturers are number three in the use of labor services and most forms of corporate capital in the Northern Plains. Food manufacturers are also major employers of capital in the Lake States, Corn Belt, and Delta States. Food, beverages, and tobacco employ about 15 percent of heavy corporate machinery in the Appalachian region and over 10 percent in the Corn Belt, Lake States, and Northern Plains. Food manufacturers are also a large employer of corporate service and furnishing equipment in the Northern Plains. The per capita concentration of primary factor employment for food manufacturing is depicted in figure 9. The levels represent regional values relative to the Northern Plains region, which has the highest per capita production of manufactured food. A concentration of such employment in the upper Midwest is quite evident, indicating that a disproportionate share of manufactured food is produced in the Corn Belt, Lake States, and Northern Plains.

Overall, nearly half of all capital and 70 percent of the services from labor are employed in services, mines, and shelter, and with construction, two-thirds of all capital. Most of the remaining labor services are used in manufacturing. Food and farm industries are small employers of capital and labor services.

Table 4--Regional industry shares of factor value added, by capital type and labor

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu-facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc-tion	Owner-occupied shelter
				Percent of industry value added					
Appalachian:									
Corporate--									
Computers/office equipment	0	0	2.816	4.657	25.711	16.723	46.295	3.797	0
Service and furnishing equipment	0	0	4.599	7.081	25.439	4.807	50.636	7.437	0
Heavy machinery	0	0	4.924	10.040	32.740	16.280	10.461	25.554	0
Transportation equipment	0	0	0.976	2.383	4.541	1.118	32.331	58.650	0
Industrial plants	0	0	3.187	5.276	22.752	9.030	46.067	13.688	0
Utility plants	0	0	0	0	0	0	98.670	1.330	0
Noncorporate--									
Computers/office equipment	0.138	0.006	0	0	0	0	91.193	8.664	0
Service and furnishing equipment	0.008	0	0	0	0	0	88.604	11.388	0
Heavy machinery	2.298	0.077	0	0	0	0	24.770	72.855	0
Transportation equipment	1.056	0.025	0	0	0	0	39.213	59.706	0
Industrial plants	0.561	0.014	0	0	0	0	78.971	20.453	0
Utility plants	0	0	0	0	0	0	97.985	2.015	0
Farmland	95.205	4.796	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	28.344	0	71.656
Labor services	0.373	0.016	1.998	1.689	26.407	5.144	64.373	0	0
Corn Belt:									
Corporate--									
Computers/office equipment	0	0	4.766	0.660	26.992	9.337	54.626	3.620	0
Service and furnishing equipment	0	0	7.682	1.061	21.377	2.864	60.010	7.007	0
Heavy machinery	0	0	9.275	1.294	39.935	11.484	10.834	27.179	0
Transportation equipment	0	0	1.593	0.224	4.236	0.689	39.191	54.067	0
Industrial plants	0	0	5.179	0.733	22.058	7.147	53.215	11.669	0
Utility plants	0	0	0	0	0	0	99.080	0.920	0
Noncorporate--									
Computers/office equipment	0.172	0.074	0	0	0	0	92.526	7.229	0
Service and furnishing equipment	0.010	0.004	0	0	0	0	90.619	9.367	0
Heavy machinery	3.330	1.195	0	0	0	0	23.970	71.505	0
Transportation equipment	1.154	0.370	0	0	0	0	43.904	54.572	0
Industrial plants	0.670	0.201	0	0	0	0	83.041	16.089	0
Utility plants	0	0	0	0	0	0	97.288	2.712	0
Farmland	66.285	33.715	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	28.491	0	71.509
Labor services	0.300	0.097	2.532	0.268	28.871	4.119	63.814	0	0
Delta States:									
Corporate--									
Computers/office equipment	0	0	3.912	0.495	24.757	18.618	48.686	3.532	0
Service and furnishing equipment	0	0	6.679	0.845	25.256	5.439	55.490	6.291	0
Heavy machinery	0	0	7.395	0.936	38.388	18.676	13.421	21.184	0
Transportation equipment	0	0	1.555	0.197	5.537	1.355	40.326	51.030	0
Industrial plants	0	0	6.090	0.700	24.491	6.480	52.554	9.685	0
Utility plants	0	0	0	0	0	0	86.544	13.456	0
Noncorporate--									
Computers/office equipment	0.196	0.023	0	0	0	0	92.963	6.818	0
Service and furnishing equipment	0.012	0.001	0	0	0	0	91.125	8.861	0
Heavy machinery	3.730	0.361	0	0	0	0	29.242	66.667	0
Transportation equipment	1.428	0.151	0	0	0	0	45.545	52.875	0
Industrial plants	0.700	0.070	0	0	0	0	85.990	13.240	0
Utility plants	0	0	0	0	0	0	80.626	19.374	0
Farmland	88.205	11.795	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	30.941	0	69.059
Labor services	0.614	0.041	3.111	0.255	24.038	5.845	66.096	0	0

Continued--

Table 4--Regional industry shares of factor value added, by capital type and labor--Continued

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu- facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc- tion	Owner-occupied shelter
				Percent of industry value added					
Lake States:									
Corporate--									
Computers/office equipment	0	0	5.935	0.887	27.095	4.334	56.938	4.810	0
Service and furnishing equipment	0	0	8.510	1.272	20.791	1.317	59.750	8.360	0
Heavy machinery	0	0	10.534	1.574	38.521	5.741	10.047	33.582	0
Transportation equipment	0	0	1.644	0.246	4.063	0.316	32.980	60.750	0
Industrial plants	0	0	7.812	0.959	19.759	2.632	54.934	13.903	0
Utility plants	0	0	0	0	0	0	98.952	1.048	0
Non-corporate--									
Computers/office equipment	0.176	0.026	0	0	0	0	91.485	8.313	0
Service and furnishing equipment	0.010	0.001	0	0	0	0	89.274	10.714	0
Heavy machinery	3.076	0.379	0	0	0	0	20.647	75.898	0
Transportation equipment	1.039	0.119	0	0	0	0	39.596	59.246	0
Industrial plants	0.736	0.070	0	0	0	0	81.446	17.747	0
Utility plants	0	0	0.	0.	0	0	97.425	2.575	0
Farmland	85.058	14.942	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	26.039	0	73.961
Labor services	0.402	0.047	2.470	0.260	33.161	3.229	60.431	0	0
Mountain:									
Corporate--									
Computers/office equipment	0	0	2.082	0.701	15.818	3.267	72.756	5.375	0
Service and furnishing equipment	0	0	3.359	1.131	11.169	0.893	73.605	9.844	0
Heavy machinery	0	0	4.963	1.671	22.163	4.066	22.240	44.898	0
Transportation equipment	0	0	0.566	0.191	1.843	0.160	38.080	59.160	0
Industrial plants	0	0	2.615	0.569	10.651	1.392	66.840	17.934	0
Utility plants	0	0	0	0	0	0	93.525	6.475	0
Non-corporate--									
Computers/office equipment	0.177	0.040	0	0	0	0	91.865	7.919	0
Service and furnishing equipment	0.011	0.002	0	0	0	0	89.432	10.554	0
Heavy machinery	3.086	0.632		0	0	0	27.591	68.691	0
Transportation equipment	1.095	0.203	0	0	0	0	42.449	56.253	0
Industrial plants	0.607	0.092	0	0	0	0	80.568	18.732	0
Utility plants	0	0	0	0	0	0	90.015	9.985	0
Farmland	79.902	20.098	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	32.987	0	67.013
Labor services	0.574	0.049	1.481	0.488	17.857	0.720	78.832	0	0
Northeast:									
Corporate--									
Computers/office equipment	0	0	1.620	0.312	18.684	5.348	70.268	3.768	0
Service and furnishing equipment	0	0	2.574	0.494	14.649	1.527	73.552	7.204	0
Heavy machinery	0	0	4.471	0.869	30.616	8.507	15.298	40.239	0
Transportation equipment	0	0	0.546	0.107	2.677	0.361	39.348	56.961	0
Industrial plants	0	0	1.538	0.271	8.822	3.484	72.487	13.398	0
Utility plants	0	0	0	0	0	0	99.674	0.326	0
Non-corporate--									
Computers/office equipment	0.031	0.001	0	0	0	0	94.058	5.910	0
Service and furnishing equipment	0.002	0	0	0	0	0	92.423	7.575	0
Heavy machinery	0.895	0.022	0	0	0	0	26.292	72.791	0
Transportation equipment	0.296	0.006	0	0	0	0	46.711	52.987	0
Industrial plants	0.160	0.003	0	0	0	0	86.335	13.502	0
Utility plants	0	0	0	0	0	0	99.128	0.872	0
Farmland	95.312	4.688	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	36.300	0	63.700
Labor services	0.132	0.004	1.239	0.205	19.629	2.769	76.021	0	0

Continued--

Table 4--Regional industry shares of factor value added, by capital type and labor--Continued

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu-facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc-tion	Owner-occupied shelter
				Percent of industry value added					
Northern Plains:									
Corporate--									
Computers/office equipment	0	0	6.622	0.215	33.252	3.968	51.658	4.286	0
Service and furnishing equipment	0	0	11.324	0.367	21.833	1.343	56.341	8.792	0
Heavy machinery	0	0	13.432	0.436	35.637	5.410	11.196	33.888	0
Transportation equipment	0	0	2.106	0.068	3.730	0.298	32.323	61.476	0
Industrial plants	0	0	7.163	0.137	30.135	3.940	46.484	12.140	0
Utility plants	0	0	0	0	0	0	95.455	4.545	0
Noncorporate--									
Computers/office equipment	0.616	0.359	0	0	0	0	90.163	8.863	0
Service and furnishing equipment	0.037	0.021	0	0	0	0	87.928	12.014	0
Heavy machinery	7.769	4.371	0	0	0	0	20.398	67.462	0
Transportation equipment	2.894	1.541	0	0	0	0	35.506	60.059	0
Industrial plants	1.890	0.923	0	0	0	0	79.120	18.067	0
Utility plants	0	0	0.	0.	0	0	94.969	5.031	0
Farmland	62.158	37.842	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	30.954	0	69.046
Labor services	1.471	0.435	6.563	0.174	21.850	2.531	66.976	0	0
Pacific:									
Corporate--									
Computers/office equipment	0	0	2.377	0.542	17.310	2.609	73.169	3.993	0
Service and furnishing equipment	0	0	3.564	0.813	13.947	0.743	74.105	6.828	0
Heavy machinery	0	0	6.504	1.484	31.434	4.502	17.791	38.286	0
Transportation equipment	0	0	0.751	0.171	2.858	0.182	44.881	51.157	0
Industrial plants	0	0	2.726	0.549	7.710	0.706	73.522	14.787	0
Utility plants	0	0	0	0	0	0	94.823	5.177	0
Noncorporate--									
Computers/office equipment	0.095	0.005	0	0	0	0	94.497	5.404	0
Service and furnishing equipment	0.006	0	0	0	0	0	92.700	7.293	0
Heavy machinery	2.272	0.102	0	0	0	0	33.655	63.971	0
Transportation equipment	0.733	0.031	0	0	0	0	52.993	46.243	0
Industrial plants	0.446	0.013	0	0	0	0	85.090	14.451	0
Utility plants	0	0	0	0	0	0	94.225	5.775	0
Farmland	94.475	5.525	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	41.519	0	58.481
Labor services	0.667	0.013	1.880	0.344	23.409	1.642	72.045	0	0
Southern Plains:									
Corporate--									
Computers/office equipment	0	0	2.303	0.602	16.372	8.482	68.747	3.493	0
Service and furnishing equipment	0	0	3.985	1.042	13.460	2.584	72.532	6.396	0
Heavy machinery	0	0	6.055	1.585	28.543	12.420	21.921	29.476	0
Transportation equipment	0	0	0.861	0.225	2.900	0.612	47.305	48.097	0
Industrial plants	0	0	2.772	0.600	8.419	2.548	74.024	11.637	0
Utility plants	0	0	0	0	0	0	91.130	8.870	0
Noncorporate--									
Computers/office equipment	0.125	0.017	0	0	0	0	94.763	5.095	0
Service and furnishing equipment	0.008	0.001	0	0	0	0	93.003	6.987	0
Heavy machinery	3.314	0.364	0	0	0	0	35.496	60.826	0
Transportation equipment	1.211	0.118	0	0	0	0	50.718	47.953	0
Industrial plants	0.519	0.043	0	0	0	0	87.678	11.760	0
Utility plants	0	0	0	0	0	0	88.617	11.383	0
Farmland	85.891	14.109	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	35.547	0	64.453
Labor services	0.449	0.029	1.767	0.342	19.558	4.434	73.421	0	0

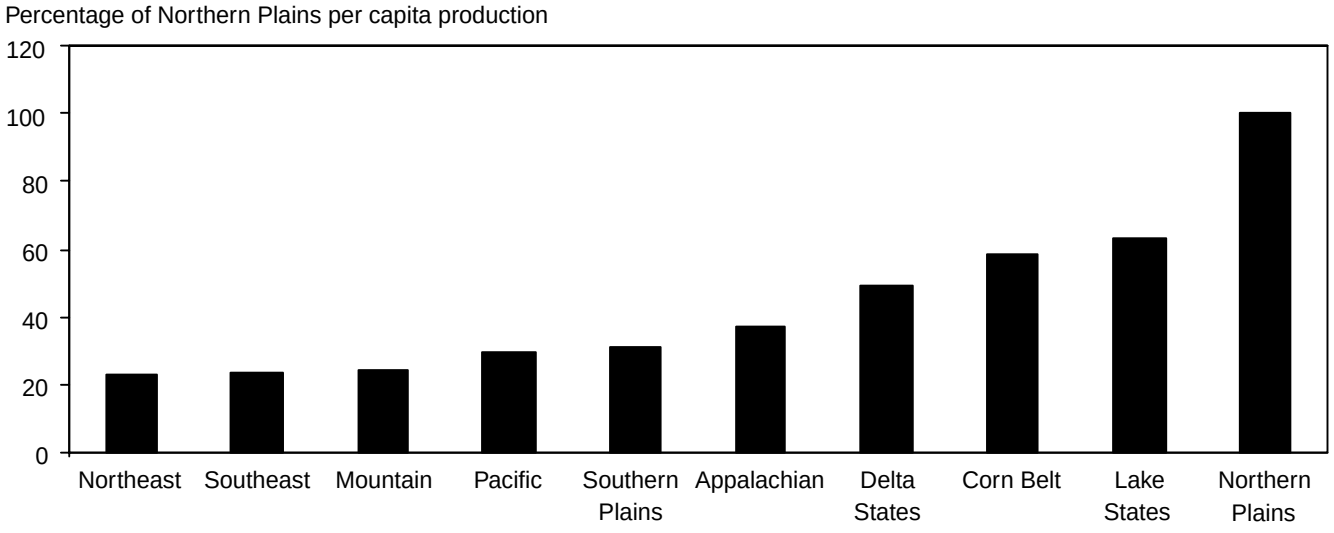
Continued--

Table 4--Regional industry shares of factor value added, by capital type and labor--Continued

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu-facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc-tion	Owner-occupied shelter
				Percent of industry value added					
Southeast:									
Corporate--									
Computers/office equipment	0	0	1.979	0.970	17.284	7.679	67.785	4.303	0
Service and furnishing equipment	0	0	3.029	1.419	18.453	2.119	67.323	7.656	0
Heavy machinery	0	0	4.446	2.505	33.681	9.987	14.610	34.771	0
Transportation equipment	0	0	0.627	0.401	3.087	0.489	38.591	56.805	0
Industrial plants	0	0	1.950	0.961	13.031	4.206	63.498	16.354	0
Utility plants	0	0	0	0	0	0	99.450	0.550	0
Noncorporate--									
Computers/office equipment	0.071	0.002	0	0	0	0	92.880	7.048	0
Service and furnishing equipment	0.004	0	0	0	0	0	91.007	8.989	0
Heavy machinery	1.507	0.028	0	0	0	0	27.827	70.638	0
Transportation equipment	0.571	0.009	0	0	0	0	46.082	53.338	0
Industrial plants	0.293	0.004	0	0	0	0	81.549	18.154	0
Utility plants	0	0	0.	0.	0	0	98.926	1.074	0
Farmland	97.525	2.475	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	29.634	0	70.366
Labor services	0.482	0.008	1.677	0.466	21.123	3.212	73.032	0	0
United States:									
Capital services	0.368	0.077	2.511	0.905	12.203	3.566	47.295	21.683	11.393
Labor services	0.406	0.038	1.957	0.425	23.555	3.193	70.426	0	0

Figure 9

Regional per capita food manufacturing production



Owners of capital have an economic incentive to diversify their capital holdings. When capital held in one form is earning a higher rate of return than capital held in other forms, owners have incentive to expand their holdings of the former through diminished holdings of the latter and investments in the former. This incentive will remain until rates of return are equal across all capital holdings. We denote this equal rate of return as the reservation rate (r). The presence of taxes, however, means that the owner must achieve a higher gross rate of return, called a hurdle rate (h), to ensure that the net of tax rate achieves its reservation value. The difference between the hurdle rate and the reservation rate is the tax wedge, and the marginal effective tax rate on income from capital is measured as the ratio of this wedge and the hurdle rate (t^m).

Two important results concerning the measure of the marginal effective tax rate are that, in general, it can be significantly different from the statutory rate of taxation, and the effective rate associated with income from capital often varies significantly for capital of different durabilities, statutory tax lives, patterns of ownership, or geographic locations. The marginal effective tax rate also adjusts with changes in macroeconomic factors, such as revised inflationary expectations and changing reservation values. Since each of these factors is explicitly represented in our modeling framework (some exogenously specified), this section presents a summary of tax rates on marginal income from capital, based on the structure of aggregation presented in table 2.

The fundamental principles of capital theory were refined by Hall and Jorgenson to where information on capital stock (price and quantity) can be directly converted to measures of the flow of services from capital in the process of production. The focal point of this methodology is the user cost of capital, which represents the market price of capital services. When the user cost of capital is adapted to account for the incentive effects created by a tax system, which drives a wedge between buyer and seller price of capital services (see King and Fullerton), it is possible to measure the marginal effective tax rate on income from capital. While this measure is data intensive, it is also intuitive and transparent. Readers interested in this methodology can refer to "Computing the Marginal Effective Tax Rate on Income From Capital," in the appendix.

Comparisons of Federal Marginal Tax Rates on Income From Capital and Labor

We computed the tax rates on the 15 primary factors used in the model for each of the 7 industry aggregates in each production region. Table 5 presents the results for the Federal factor taxes, providing further breakdowns of "other" industry for construction of owner-occupied shelter. The well-known corporate wedge is quite evident in the table. For example, the overall U.S. average tax on corporate income from computers and office equipment by the service, mining, and trade industry is more than double that for noncorporate income (0.14) from the same machinery. The overall tax on capital by industry has a standard deviation of 38.3 percent of the mean tax on capital. The largest standard deviation across industries by type of capital is for both corporate and noncorporate plants and for owned versus leased residential shelter. The standard deviation of the tax in labor across industries is 2.1 percent of the mean tax on labor income. Food manufacturers face a 38-percent marginal Federal tax rate on capital income, while farms face around a 21-percent marginal tax on capital. All other industries have tax rates between these two extremes and are heavily skewed toward the higher end. In services, mines, and trade and farm industries, labor is taxed more than capital at the margin when the insurance trust is factored in, while all other industries face higher taxes on capital.

This national disposition of factor taxes gives a glimpse of potential resource allocation issues associated with Federal fiscal policies. With labor uniformly taxed across industry, any reform of tax rules to a more neutral system should not lead to major migration of labor across industry. At another level, however, industries that have lower taxes on labor will face higher rates after reform, since the insurance trust tax would not be part of such reform. This result would lead these industries to replace some of their labor services with capital. The nearly 40 percent standard deviation of industry capital

Table 5--Federal primary factor tax wedges, by industry, region, and factor type

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu-facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc-tion	Owner-occupied shelter
					Taxes per dollar of value added				
Appalachian:									
Corporate--									
Computers/office equipment	0	0	0.368	0.363	0.352	0.367	0.348	0.381	0
Service and furnishing equipment	0	0	0.368	0.373	0.374	0.366	0.384	0.368	0
Heavy machinery	0	0	0.377	0.380	0.379	0.360	0.357	0.372	0
Transportation equipment	0	0	0.435	0.439	0.434	0.437	0.426	0.428	0
Industrial plants	0	0	0.440	0.445	0.440	0.441	0.390	0.421	0
Utility plants	0	0	0	0	0	0	0.288	0.174	0
Noncorporate--									
Computers/office equipment	0.152	0.151	0	0	0	0	0.178	0.197	0
Service and furnishing equipment	0.131	0.130	0	0	0	0	0.203	0.184	0
Heavy machinery	0.157	0.151	0	0	0	0	0.182	0.190	0
Transportation equipment	0.183	0.183	0	0	0	0	0.250	0.246	0
Industrial plants	0.085	0.084	0	0	0	0	0.206	0.233	0
Utility plants	0	0	0	0	0	0	0.118	-0.002	0
Farmland	0.268	0.268	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.221	0	0.039
Labor services[1]	0.344	0.341	0.339	0.335	0.338	0.340	0.338	0	0
Corn Belt:									
Corporate--									
Computers/office equipment	0	0	0.350	0.343	0.331	0.346	0.322	0.356	0
Service and furnishing equipment	0	0	0.352	0.345	0.349	0.346	0.359	0.344	0
Heavy machinery	0	0	0.360	0.353	0.360	0.346	0.332	0.348	0
Transportation equipment	0	0	0.420	0.415	0.415	0.419	0.398	0.406	0
Industrial plants	0	0	0.426	0.420	0.420	0.423	0.366	0.397	0
Utility plants	0	0	0	0	0	0	0.256	0.159	0
Noncorporate--									
Computers/office equipment	0.150	0.147	0	0	0	0	0.144	0.164	0
Service and furnishing equipment	0.125	0.122	0	0	0	0	0.169	0.151	0
Heavy machinery	0.152	0.145	0	0	0	0	0.156	0.157	0
Transportation equipment	0.188	0.186	0	0	0	0	0.219	0.217	0
Industrial plants	0.067	0.064	0	0	0	0	0.173	0.199	0
Utility plants	0	0	0	0	0	0	0.067	-0.022	0
Farmland	0.267	0.268	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.218	0	0.041
Labor services[1]	0.342	0.344	0.333	0.334	0.335	0.336	0.337	0	0
Delta States:									
Corporate--									
Computers/office equipment	0	0	0.340	0.338	0.331	0.332	0.311	0.338	0
Service and furnishing equipment	0	0	0.341	0.339	0.350	0.332	0.348	0.331	0
Heavy machinery	0	0	0.349	0.347	0.352	0.324	0.315	0.336	0
Transportation equipment	0	0	0.411	0.410	0.413	0.409	0.383	0.395	0
Industrial plants	0	0	0.418	0.415	0.421	0.418	0.358	0.388	0
Utility plants	0	0	0	0	0	0	0.193	0.132	0
Noncorporate--									
Computers/office equipment	0.078	0.090	0	0	0	0	0.128	0.146	0
Service and furnishing equipment	0.049	0.062	0	0	0	0	0.156	0.135	0
Heavy machinery	0.090	0.094	0	0	0	0	0.135	0.142	0
Transportation equipment	0.121	0.132	0	0	0	0	0.203	0.206	0
Industrial plants	-0.019	-0.003	0	0	0	0	0.159	0.188	0
Utility plants	0	0	0	0	0	0	-0.040	-0.066	0
Farmland	0.272	0.271	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.218	0	0.033
Labor services[1]	0.356	0.356	0.344	0.346	0.344	0.346	0.346	0	0

Table 5--Federal primary factor tax wedges, by industry, region, and factor type--Continued

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu-facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc-tion	Owner-occupied shelter
					Taxes per dollar of value added				
Lake States:									
Corporate--									
Computers/office equipment	0	0	0.358	0.360	0.345	0.360	0.336	0.369	0
Service and furnishing equipment	0	0	0.359	0.362	0.363	0.360	0.372	0.356	0
Heavy machinery	0	0	0.367	0.369	0.373	0.366	0.345	0.360	0
Transportation equipment	0	0	0.427	0.429	0.427	0.434	0.418	0.418	0
Industrial plants	0	0	0.432	0.434	0.433	0.433	0.378	0.410	0
Utility plants	0	0	0	0	0	0	0.278	0.164	0
Noncorporate--									
Computers/office equipment	0.208	0.210	0	0	0	0	0.154	0.175	0
Service and furnishing equipment	0.188	0.189	0	0	0	0	0.179	0.161	0
Heavy machinery	0.210	0.208	0	0	0	0	0.164	0.168	0
Transportation equipment	0.237	0.241	0	0	0	0	0.230	0.227	0
Industrial plants	0.141	0.146	0	0	0	0	0.182	0.210	0
Utility plants	0	0	0.	0.	0	0	0.096	-0.030	0
Farmland	0.262	0.262	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.219	0	0.038
Labor services[1]	0.325	0.325	0.334	0.333	0.339	0.341	0.339	0	0
Mountain:									
Corporate--									
Computers/office equipment	0	0	0.353	0.353	0.336	0.357	0.325	0.359	0
Service and furnishing equipment	0	0	0.354	0.354	0.356	0.356	0.363	0.349	0
Heavy machinery	0	0	0.363	0.363	0.367	0.346	0.337	0.353	0
Transportation equipment	0	0	0.425	0.425	0.424	0.433	0.412	0.412	0
Industrial plants	0	0	0.430	0.431	0.431	0.431	0.373	0.403	0
Utility plants	0	0	0	0	0	0	0.224	0.144	0
Noncorporate--									
Computers/office equipment	0.156	0.162	0	0	0	0	0.142	0.162	0
Service and furnishing equipment	0.125	0.133	0	0	0	0	0.168	0.151	0
Heavy machinery	0.165	0.164	0	0	0	0	0.151	0.157	0
Transportation equipment	0.202	0.205	0	0	0	0	0.221	0.218	0
Industrial plants	0.053	0.069	0	0	0	0	0.174	0.201	0
Utility plants	0	0	0	0	0	0	0.035	-0.053	0
Farmland	0.280	0.276	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.219	0	0.036
Labor services[1]	0.379	0.371	0.342	0.347	0.340	0.342	0.342	0	0
Northeast:									
Corporate--									
Computers/office equipment	0	0	0.341	0.345	0.325	0.344	0.318	0.351	0
Service and furnishing equipment	0	0	0.342	0.346	0.347	0.343	0.356	0.338	0
Heavy machinery	0	0	0.351	0.354	0.354	0.339	0.329	0.343	0
Transportation equipment	0	0	0.410	0.414	0.413	0.415	0.402	0.401	0
Industrial plants	0	0	0.413	0.417	0.413	0.417	0.365	0.392	0
Utility plants	0	0	0	0	0	0	0.246	0.157	0
Noncorporate--									
Computers/office equipment	0.064	0.089	0	0	0	0	0.144	0.162	0
Service and furnishing equipment	0.035	0.062	0	0	0	0	0.169	0.149	0
Heavy machinery	0.068	0.091	0	0	0	0	0.156	0.155	0
Transportation equipment	0.105	0.129	0	0	0	0	0.219	0.215	0
Industrial plants	-0.041	0	0	0	0	0	0.174	0.198	0
Utility plants	0	0	0	0	0	0	0.071	-0.025	0
Farmland	0.277	0.275	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.218	0	0.044
Labor services[1]	0.371	0.367	0.335	0.330	0.334	0.332	0.331	0	0

Table 5--Federal primary factor tax wedges, by industry, region, and factor type--Continued

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu-facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc-tion	Owner-occupied shelter
					Taxes per dollar of value added				
Northern Plains:									
Corporate--									
Computers/office equipment	0	0	0.346	0.351	0.333	0.356	0.322	0.360	0
Service and furnishing equipment	0	0	0.347	0.352	0.355	0.357	0.363	0.346	0
Heavy machinery	0	0	0.356	0.361	0.368	0.360	0.333	0.351	0
Transportation equipment	0	0	0.419	0.424	0.427	0.432	0.405	0.413	0
Industrial plants	0	0	0.418	0.422	0.433	0.437	0.370	0.403	0
Utility plants	0	0	0	0	0	0	0.212	0.143	0
Noncorporate--									
Computers/office equipment	0.170	0.163	0	0	0	0	0.131	0.154	0
Service and furnishing equipment	0.149	0.142	0	0	0	0	0.160	0.139	0
Heavy machinery	0.173	0.164	0	0	0	0	0.134	0.146	0
Transportation equipment	0.202	0.196	0	0	0	0	0.212	0.209	0
Industrial plants	0.102	0.098	0	0	0	0	0.163	0.191	0
Utility plants	0	0	0.	0.	0	0	0.034	-0.058	0
Farmland	0.264	0.263	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.219	0	0.036
Labor services[1]	0.330	0.329	0.340	0.341	0.340	0.339	0.342	0	0
Pacific:									
Corporate--									
Computers/office equipment	0	0	0.345	0.342	0.327	0.339	0.317	0.353	0
Service and furnishing equipment	0	0	0.347	0.344	0.348	0.340	0.354	0.342	0
Heavy machinery	0	0	0.355	0.352	0.355	0.339	0.333	0.345	0
Transportation equipment	0	0	0.417	0.413	0.413	0.414	0.400	0.405	0
Industrial plants	0	0	0.425	0.420	0.423	0.418	0.362	0.393	0
Utility plants	0	0	0	0	0	0	0.220	0.160	0
Noncorporate--									
Computers/office equipment	0.148	0.129	0	0	0	0	0.139	0.159	0
Service and furnishing equipment	0.116	0.097	0	0	0	0	0.165	0.148	0
Heavy machinery	0.157	0.133	0	0	0	0	0.150	0.153	0
Transportation equipment	0.198	0.179	0	0	0	0	0.217	0.216	0
Industrial plants	0.042	0.020	0	0	0	0	0.170	0.196	0
Utility plants	0	0	0	0	0	0	0.058	-0.030	0
Farmland	0.280	0.278	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.219	0	0.030
Labor services[1]	0.384	0.377	0.348	0.349	0.349	0.350	0.348	0	0
Southern Plains:									
Corporate--									
Computers/office equipment	0	0	0.345	0.345	0.331	0.342	0.314	0.349	0
Service and furnishing equipment	0	0	0.346	0.346	0.352	0.342	0.355	0.341	0
Heavy machinery	0	0	0.356	0.356	0.357	0.335	0.326	0.345	0
Transportation equipment	0	0	0.422	0.422	0.420	0.423	0.397	0.408	0
Industrial plants	0	0	0.427	0.427	0.428	0.425	0.373	0.399	0
Utility plants	0	0	0	0	0	0	0.174	0.131	0
Noncorporate--									
Computers/office equipment	0.130	0.143	0	0	0	0	0.109	0.135	0
Service and furnishing equipment	0.104	0.119	0	0	0	0	0.141	0.123	0
Heavy machinery	0.137	0.144	0	0	0	0	0.123	0.130	0
Transportation equipment	0.168	0.176	0	0	0	0	0.199	0.200	0
Industrial plants	0.051	0.067	0	0	0	0	0.153	0.177	0
Utility plants	0	0	0	0	0	0	-0.060	-0.086	0
Farmland	0.277	0.271	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.220	0	0.019
Labor services[1]	0.371	0.368	0.363	0.361	0.361	0.364	0.362	0	0

Table 5--Federal primary factor tax wedges, by industry, region, and factor type--Continued

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu-facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc-tion	Owner-occupied shelter
				Taxes per $ of value added					
Southeast:									
Corporate--									
Computers/office equipment	0	0	0.336	0.330	0.325	0.337	0.307	0.345	0
Service and furnishing equipment	0	0	0.337	0.338	0.346	0.337	0.349	0.333	0
Heavy machinery	0	0	0.346	0.347	0.350	0.333	0.318	0.337	0
Transportation equipment	0	0	0.410	0.411	0.411	0.414	0.396	0.398	0
Industrial plants	0	0	0.416	0.417	0.416	0.412	0.354	0.386	0
Utility plants	0	0	0	0	0	0	0.235	0.115	0
Noncorporate--									
Computers/office equipment	0.098	0.131	0	0	0	0	0.125	0.146	0
Service and furnishing equipment	0.067	0.103	0	0	0	0	0.154	0.133	0
Heavy machinery	0.106	0.135	0	0	0	0	0.135	0.138	0
Transportation equipment	0.145	0.173	0	0	0	0	0.208	0.206	0
Industrial plants	-0.013	0.038	0	0	0	0	0.155	0.184	0
Utility plants	0	0	0	0.	0	0	0.072	-0.099	0
Farmland	0.274	0.272	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.219	0	0.024
Labor services[1]	0.375	0.360	0.352	0.354	0.350	0.346	0.356	0	0
United States:									
Corporate--									
Computers/office equipment	0	0	0.349	0.353	0.333	0.349	0.321	0.356	0
Service and furnishing equipment	0	0	0.351	0.359	0.354	0.348	0.359	0.344	0
Heavy machinery	0	0	0.359	0.368	0.361	0.345	0.332	0.349	0
Transportation equipment	0	0	0.420	0.429	0.419	0.422	0.403	0.408	0
Industrial plants	0	0	0.426	0.434	0.425	0.425	0.367	0.398	0
Utility plants	0	0	0	0	0	0	0.227	0.139	0
Noncorporate--									
Computers/office equipment	0.144	0.154	0	0	0	0	0.140	0.162	0
Service and furnishing equipment	0.117	0.130	0	0	0	0	0.167	0.150	0
Heavy machinery	0.148	0.154	0	0	0	0	0.151	0.156	0
Transportation equipment	0.181	0.191	0	0	0	0	0.219	0.218	0
Industrial plants	0.054	0.076	0	0	0	0	0.171	0.199	0
Utility plants	0	0	0	0	0	0	0.026	-0.065	0
Farmland	0.272	0.268	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.219	0	0.036
Labor services[1]	0.363	0.345	0.341	0.341	0.341	0.342	0.342	0	0
All sectors--									
Capital services	0.206	0.222	0.379	0.385	0.375	0.366	0.288	0.316	0.036
Value added services	0.288	0.262	0.362	0.371	0.353	0.354	0.322	0.316	0.036

[1]Rate includes Federal insurance trust wage tax.

taxes around the industry mean capital tax rate indicates that the Federal capital tax drives significant amounts of capital out of higher taxed industry and into industry with less efficient uses for this capital.

Regional variations largely mirror the national figures, but some trends do stand out. For example, noncorporate capital taxes in the Northeast show far more variation than in tax rates across regions. Every type of noncorporate capital except farmland has a standard deviation of tax rates across industries of between 30 and 209 percent of the (unweighted) mean tax rate. The Northeast also has an unusually high standard deviation on labor tax rates across industry at 5 percent of mean. The Northeast, Southeast, and Southern Plains regions show the highest overall variation of tax rates across industries, but no region is significantly different in such variation from the national average. All manufacturing, food and nonfood, is more heavily taxed than other industries in every region. This is due to the pure corporate nature of this industry.

Comparisons of Regional Marginal Tax Rates on Income From Capital and Labor

Regional taxation of primary industrial factors is in stark contrast to Federal taxation (table 6). Agriculture is the most heavily taxed industry by regional governments, with marginal tax incidence on capital averaging 12 percent overall and marginal tax incidence for labor averaging 9 percent overall. Beverages and tobacco are the most lightly factor-taxed industries by regional governments. Aside from the reversal of favoritism, the overall level of taxation on industry capital is surprisingly high. The reason for these high marginal rates is that property taxation, a major tax instrument of regional governments, uses value as its tax base, while the fact that it is administered annually means that this tax effectively falls on annual capital income. With value of capital stock several times the value of annual capital rents, clearly a low property tax rate is converted into a much higher capital income tax rate. If we exclude leased residential structures from the services, mines, and trade industry, we find that no other industry faces an overall U.S. average capital tax rate of more than 9.4 percent. Farms also face a significant plant/equipment tax wedge, with farm buildings taxed significantly less than farm equipment. For other industry, no such wedge exists.

Overall variation of taxation across industries is slightly lower than at the Federal level. Other than farms, there is a fairly uniform tax rate across industries. Labor is taxed at a uniform rate and, unlike at the Federal level, residential shelter is heavily taxed by regional governments. Conspicuously absent from regional tax policy is the existence of a corporate tax wedge.

What is not evident from the national average numbers is the fact that regional variation of factor taxation is significant. In every region, either a farm or food industry has the highest marginal tax rate on capital income. While most regions tax farms at a higher rate than they do other industries, the Delta States are an exception. With very low overall tax rates in the Delta, farms are taxed at a lower rate than three of the other six industries. Cash grain farms rank third in taxation in the Lake States and Southeast. Otherwise, cash grain and other farms rank 1 or 2 in taxation in all other regions. The overall level of taxation in agriculture ranges from 4.6 percent in the Delta to 18.8 percent in Northeastern States. In the Northeast, the marginal tax rate on capital (0.188) is actually higher than the Federal marginal rate (0.145). The Delta and Mountain regions are the only two areas where the marginal tax on labor is higher than on capital. In each region, land and buildings are taxed at a lower rate than other equipment.

In 6 of the 10 regions, food manufacturers are ranked between 4 and 6 in marginal tax burden on capital income. Notable exceptions include the Delta States, where food manufacturers are taxed more heavily than any other industry, and the Pacific States, where they are the most lightly taxed industry.

Table 6--Regional primary factor tax wedges, by industry, region, and factor type

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu-facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc-tion	Owner-occupied shelter
				Taxes per dollar of value added					
Appalachian:									
Corporate--									
Computers/office equipment	0	0	0.052	0.058	0.051	0.054	0.051	0.055	0
Service and furnishing equipment	0	0	0.052	0.059	0.053	0.054	0.054	0.054	0
Heavy machinery	0	0	0.054	0.061	0.053	0.053	0.051	0.054	0
Transportation equipment	0	0	0.058	0.065	0.058	0.060	0.058	0.060	0
Industrial plants	0	0	0.052	0.058	0.054	0.056	0.051	0.055	0
Utility plants	0	0	0	0	0	0	0.036	0.005	0
Noncorporate--									
Computers/office equipment	0.101	0.096	0	0	0	0	0.031	0.035	0
Service and furnishing equipment	0.102	0.097	0	0	0	0	0.033	0.033	0
Heavy machinery	0.104	0.097	0	0	0	0	0.029	0.034	0
Transportation equipment	0.101	0.095	0	0	0	0	0.039	0.041	0
Industrial plants	-0.017	-0.016	0	0	0	0	0.028	0.033	0
Utility plants	0	0	0	0	0	0	0.012	-0.036	0
Farmland	0.060	0.060	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.080	0	0.078
Labor services[1]	0.099	0.097	0.088	0.101	0.090	0.085	0.090	0	0
Corn Belt:									
Corporate--									
Computers/office equipment	0	0	0.081	0.077	0.087	0.079	0.080	0.085	0
Service and furnishing equipment	0	0	0.081	0.076	0.087	0.080	0.083	0.083	0
Heavy machinery	0	0	0.082	0.077	0.089	0.081	0.082	0.084	0
Transportation equipment	0	0	0.083	0.079	0.091	0.084	0.084	0.086	0
Industrial plants	0	0	0.097	0.091	0.100	0.088	0.100	0.101	0
Utility plants	0	0	0	0	0	0	0.098	0.108	0
Noncorporate--									
Computers/office equipment	0.171	0.179	0	0	0	0	0.074	0.075	0
Service and furnishing equipment	0.175	0.185	0	0	0	0	0.074	0.074	0
Heavy machinery	0.172	0.181	0	0	0	0	0.075	0.075	0
Transportation equipment	0.164	0.171	0	0	0	0	0.075	0.076	0
Industrial plants	0.069	0.081	0	0	0	0	0.112	0.108	0
Utility plants	0	0	0	0	0	0	0.114	0.137	0
Farmland	0.097	0.102	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.129	0	0.150
Labor services	0.097	0.091	0.091	0.095	0.091	0.090	0.089	0	0
Delta States:									
Corporate--									
Computers/office equipment	0	0	0.049	0.045	0.047	0.039	0.036	0.042	0
Service and furnishing equipment	0	0	0.048	0.045	0.049	0.039	0.044	0.042	0
Heavy machinery	0	0	0.051	0.048	0.050	0.038	0.036	0.043	0
Transportation equipment	0	0	0.059	0.056	0.057	0.052	0.049	0.053	0
Industrial plants	0	0	0.062	0.062	0.060	0.057	0.053	0.058	0
Utility plants	0	0	0	0	0	0	0.022	0.008	0
Noncorporate--									
Computers/office equipment	0.053	0.055	0	0	0	0	-0.013	-0.006	0
Service and furnishing equipment	0.049	0.051	0	0	0	0	-0.006	-0.008	0
Heavy machinery	0.056	0.056	0	0	0	0	-0.014	-0.006	0
Transportation equipment	0.060	0.059	0	0	0	0	0.006	0.009	0
Industrial plants	-0.049	-0.052	0	0	0	0	0.015	0.021	0
Utility plants	0	0	0	0	0	0	-0.021	-0.026	0
Farmland	0.053	0.056	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.058	0	0.041
Labor services	0.098	0.100	0.096	0.092	0.094	0.091	0.092	0	0

See footnote at end of table.

Continued--

Table 6--Regional primary factor tax wedges, by industry, region, and factor type--Continued

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu- facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc- tion	Owner-occupied shelter
					Taxes per dollar of value added				
Lakes States:									
Corporate--									
Computers/office equipment	0	0	0.085	0.086	0.085	0.096	0.093	0.089	0
Service and furnishing equipment	0	0	0.084	0.085	0.087	0.095	0.089	0.089	0
Heavy machinery	0	0	0.085	0.086	0.088	0.095	0.093	0.089	0
Transportation equipment	0	0	0.084	0.084	0.085	0.087	0.086	0.086	0
Industrial plants	0	0	0.131	0.138	0.138	0.141	0.161	0.151	0
Utility plants	0	0	0	0	0	0	0.203	0.317	0
Noncorporate--									
Computers/office equipment	0.196	0.173	0	0	0	0	0.122	0.115	0
Service and furnishing equipment	0.200	0.176	0	0	0	0	0.120	0.115	0
Heavy machinery	0.205	0.173	0	0	0	0	0.123	0.115	0
Transportation equipment	0.199	0.168	0	0	0	0	0.119	0.113	0
Industrial plants	0.171	0.115	0	0	0	0	0.245	0.233	0
Utility plants	0	0	0.	0.	0	0	0.272	0.459	0
Farmland	0.168	0.154	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.268	0	0.346
Labor services	0.105	0.108	0.105	0.104	0.099	0.098	0.101	0	0
Mountain:									
Corporate--									
Computers/office equipment	0	0	0.047	0.072	0.062	0.041	0.066	0.064	0
Service and furnishing equipment	0	0	0.047	0.071	0.060	0.042	0.064	0.063	0
Heavy machinery	0	0	0.048	0.072	0.060	0.043	0.058	0.063	0
Transportation equipment	0	0	0.049	0.068	0.060	0.042	0.064	0.064	0
Industrial plants	0	0	0.053	0.071	0.082	0.050	0.081	0.088	0
Utility plants	0	0	0	0	0	0	0.088	0.041	0
Noncorporate--									
Computers/office equipment	0.138	0.133	0	0	0	0	0.071	0.067	0
Service and furnishing equipment	0.142	0.134	0	0	0	0	0.071	0.067	0
Heavy machinery	0.139	0.134	0	0	0	0	0.066	0.068	0
Transportation equipment	0.134	0.131	0	0	0	0	0.072	0.070	0
Industrial plants	0.029	-0.016	0	0	0	0	0.100	0.114	0
Utility plants	0	0	0	0	0	0	0.108	0.033	0
Farmland	0.085	0.087	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.135	0	0.150
Labor services	0.100	0.109	0.101	0.091	0.095	0.084	0.089	0	0
Northeast:									
Corporate--									
Computers/office equipment	0	0	0.124	0.116	0.122	0.129	0.123	0.115	0
Service and furnishing equipment	0	0	0.124	0.116	0.123	0.129	0.120	0.115	0
Heavy machinery	0	0	0.124	0.117	0.122	0.129	0.121	0.116	0
Transportation equipment	0	0	0.123	0.115	0.121	0.125	0.119	0.115	0
Industrial plants	0	0	0.127	0.119	0.127	0.138	0.122	0.114	0
Utility plants	0	0	0	0	0	0	0.124	0.131	0
Noncorporate--									
Computers/office equipment	0.273	0.238	0	0	0	0	0.141	0.127	0
Service and furnishing equipment	0.283	0.246	0	0	0	0	0.139	0.127	0
Heavy machinery	0.275	0.238	0	0	0	0	0.140	0.128	0
Transportation equipment	0.259	0.227	0	0	0	0	0.135	0.125	0
Industrial plants	0.113	0.098	0	0	0	0	0.146	0.127	0
Utility plants	0	0	0	0	0	0	0.170	0.176	0
Farmland	0.121	0.114	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.177	0	0.192
Labor services	0.106	0.103	0.101	0.106	0.103	0.101	0.109	0	0

See footnote at end of table.

Continued--

Table 6--Regional primary factor tax wedges, by industry, region, and factor type--Continued

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu- facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc- tion	Owner-occupied shelter
					Taxes per dollar of value added				
Northern Plains:									
Corporate--									
Computers/office equipment	0	0	0.046	0.040	0.045	0.034	0.039	0.039	0
Service and furnishing equipment	0	0	0.046	0.040	0.043	0.033	0.041	0.039	0
Heavy machinery	0	0	0.046	0.040	0.042	0.034	0.038	0.040	0
Transportation equipment	0	0	0.048	0.041	0.042	0.036	0.042	0.039	0
Industrial plants	0	0	0.102	0.086	0.064	0.028	0.064	0.061	0
Utility plants	0	0	0	0	0	0	0.056	0.040	0
Noncorporate--									
Computers/office equipment	0.144	0.147	0	0	0	0	0.052	0.054	0
Service and furnishing equipment	0.148	0.151	0	0	0	0	0.053	0.052	0
Heavy machinery	0.144	0.148	0	0	0	0	0.052	0.054	0
Transportation equipment	0.138	0.142	0	0	0	0	0.058	0.059	0
Industrial plants	0.082	0.070	0	0	0	0	0.103	0.099	0
Utility plants	0	0	0.	0.	0	0	0.120	0.042	0
Farmland	0.109	0.103	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.125	0	0.144
Labor services	0.091	0.088	0.094	0.095	0.099	0.104	0.093	0	0
Pacific:									
Corporate--									
Computers/office equipment	0	0	0.076	0.078	0.077	0.080	0.076	0.076	0
Service and furnishing equipment	0	0	0.075	0.078	0.078	0.079	0.078	0.075	0
Heavy machinery	0	0	0.077	0.079	0.078	0.080	0.076	0.076	0
Transportation equipment	0	0	0.076	0.080	0.079	0.082	0.079	0.077	0
Industrial plants	0	0	0.078	0.083	0.078	0.083	0.083	0.082	0
Utility plants	0	0	0	0	0	0	0.082	0.104	0
Noncorporate--									
Computers/office equipment	0.181	0.214	0	0	0	0	0.074	0.076	0
Service and furnishing equipment	0.188	0.224	0	0	0	0	0.073	0.075	0
Heavy machinery	0.183	0.214	0	0	0	0	0.077	0.077	0
Transportation equipment	0.173	0.197	0	0	0	0	0.078	0.079	0
Industrial plants	0.037	0.078	0	0	0	0	0.085	0.086	0
Utility plants	0	0	0	0	0	0	0.103	0.144	0
Farmland	0.091	0.088	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.116	0	0.131
Labor services	0.106	0.091	0.097	0.101	0.098	0.102	0.100	0	0
Southern Plains:									
Corporate--									
Computers/office equipment	0	0	0.042	0.042	0.041	0.044	0.046	0.042	0
Service and furnishing equipment	0	0	0.042	0.041	0.040	0.043	0.041	0.043	0
Heavy machinery	0	0	0.041	0.041	0.040	0.045	0.044	0.043	0
Transportation equipment	0	0	0.035	0.035	0.035	0.035	0.038	0.037	0
Industrial plants	0	0	0.050	0.050	0.049	0.051	0.058	0.055	0
Utility plants	0	0	0	0	0	0	0.091	0.100	0
Noncorporate--									
Computers/office equipment	0.143	0.119	0	0	0	0	0.078	0.076	0
Service and furnishing equipment	0.150	0.123	0	0	0	0	0.074	0.078	0
Heavy machinery	0.139	0.118	0	0	0	0	0.077	0.077	0
Transportation equipment	0.132	0.115	0	0	0	0	0.067	0.067	0
Industrial plants	0.080	0.058	0	0	0	0	0.107	0.106	0
Utility plants	0	0	0	0	0	0	0.154	0.163	0
Farmland	0.066	0.066	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.098	0	0.144
Labor services	0.055	0.058	0.048	0.050	0.050	0.045	0.048	0	0

See footnote at end of table.

Continued--

Table 6--Regional primary factor tax wedges, by industry, region, and factor type--Continued

Region/ factor	Farms	Cash grains	Food	Beverages, tobacco	Manu- facturing	Chemicals, rubber, plastic	Services, mines, trade	Construc- tion	Owner-occupied shelter
					Taxes per dollar of value added				
Southeast:									
Corporate--									
Computers/office equipment	0	0	0.108	0.113	0.094	0.078	0.123	0.120	0
Service and furnishing equipment	0	0	0.107	0.112	0.087	0.077	0.119	0.120	0
Heavy machinery	0	0	0.107	0.110	0.087	0.078	0.114	0.119	0
Transportation equipment	0	0	0.100	0.100	0.086	0.077	0.111	0.111	0
Industrial plants	0	0	0.064	0.065	0.059	0.057	0.081	0.084	0
Utility plants	0	0	0	0	0	0	0.070	0.035	0
Noncorporate--									
Computers/office equipment	0.267	0.206	0	0	0	0	0.166	0.162	0
Service and furnishing equipment	0.280	0.213	0	0	0	0	0.160	0.163	0
Heavy machinery	0.266	0.206	0	0	0	0	0.157	0.160	0
Transportation equipment	0.238	0.196	0	0	0	0	0.144	0.145	0
Industrial plants	0.049	-0.005	0	0	0	0	0.087	0.091	0
Utility plants	0	0	0.	0.	0	0	0.075	0.018	0
Farmland	0.065	0.065	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.099	0	0.121
Labor services	0.065	0.093	0.080	0.076	0.082	0.088	0.069	0	0
United States:									
Corporate--									
Computers/office equipment	0	0	0.078	0.072	0.081	0.074	0.087	0.084	0
Service and furnishing equipment	0	0	0.078	0.072	0.081	0.074	0.087	0.084	0
Heavy machinery	0	0	0.079	0.072	0.081	0.075	0.081	0.085	0
Transportation equipment	0	0	0.078	0.073	0.082	0.076	0.084	0.084	0
Industrial plants	0	0	0.090	0.073	0.088	0.084	0.094	0.092	0
Utility plants	0	0	0	0	0	0	0.091	0.074	0
Noncorporate--									
Computers/office equipment	0.167	0.158	0	0	0	0	0.098	0.092	0
Service and furnishing equipment	0.172	0.163	0	0	0	0	0.097	0.092	0
Heavy machinery	0.171	0.160	0	0	0	0	0.093	0.093	0
Transportation equipment	0.161	0.152	0	0	0	0	0.094	0.091	0
Industrial plants	0.064	0.064	0	0	0	0	0.113	0.107	0
Utility plants	0	0	0	0	0	0	0.114	0.101	0
Farmland	0.094	0.099	0	0	0	0	0	0	0
Residential--									
Shelter	0	0	0	0	0	0	0.137	0	0.160
Labor services[1]	0.094	0.092	0.092	0.095	0.092	0.089	0.092	0	0
All sectors--									
Capital services	0.119	0.116	0.082	0.072	0.083	0.077	0.094	0.088	0.160
Value added services	0.106	0.108	0.086	0.080	0.089	0.082	0.093	0.088	0.160

[1]Rate includes State insurance trust wage tax.

Simulated Effects of Comprehensive Tax Reform in the United States

At this point, it is useful to perform a comprehensive tax reform simulation and examine its consequences for endogenous variables in our model. In this simulation, factor tax rates are *flattened.* This simulation should not be confused with any of the flat tax proposals under consideration. The purpose of this simulation is to consider the implications to industrial composition and welfare of unequal factor taxation and the interregional terms of trade effects that occur in a robust, regionalized, open economy.

Specification of Simulation

Our simulation of comprehensive tax reform in the United States is specified as follows. Both Federal and State/regional insurance trust taxes (for example, social security) on wages remain unchanged at their 1994 rates. Border taxes (import tariffs and export subsidies on international trade) also remain unchanged. All other tax instruments in the model are eliminated and replaced with a flat (equal rates on all primary factors) *ad valorem* tax on all primary industry factors: land, depreciable assets, shelter, and labor. The rate of this flat tax is endogenously determined, so that the new tax regime is revenue neutral.

The effects of this simulation are decomposed using three different simulations. First, we simulate Federal tax reform only, such that all State/regional tax policies remain intact. Second, we simulate State/regional tax reform, such that Federal tax instruments are not changed. Third, we simulate simultaneous Federal and State/regional revenue-neutral tax reform.

Overview of Tax Policy Change

The effects of our simulation will be largely determined by the magnitude of the tax rates that will be flattened, and the relative level of each affected primary factor, industry, and regional economy within the national economy. In this section, we provide an aggregate analysis of the relevant Federal and State/regional tax rates to prepare the reader for the simulation results presented in the next section.

The flat rate of Federal factor taxes at the industry level that generates the same amount of taxes for the Federal Government is 21.99 percent (last row in table 7). In our simulations, labor contributions to the Federal insurance trust fund (for example, social security) remain at 10.17 percent, in addition to the 21.99-percent income tax. Thus, in our simulation, the overall rate (including labor trust fund contributions) of primary factor taxation is 28 percent.

The flat rate of State/regional factor taxation at the industry level that generates the same amount of taxes for each State/regional government is given in the last row in table 8. In our simulations, labor contributions to State insurance trust funds remain at 3.99 percent, in addition to the tax rates in the last row in table 8.

Table 7 shows that Federal tax rates increase for most agricultural industries, which suggests that for the United States as a whole, resources would leave agriculture. However, the regional implications for agricultural output may be different from the national outcome. For example, tax rates for agriculture in the Delta and Northeast regions increase the most in the United States, while tax rates for agriculture in the Lake States, Mountain, and Pacific regions increase the least. We expect agricultural industries in the Delta and Northeast regions to decline. Agricultural industry in the Lake States, Mountain, and Pacific regions are expected to expand. Federal tax rates are cut for food processing and manufacturing industries, with tax cuts in food processing being larger than the tax cuts in manufacturing (table 7). However, production costs in food processing may not decline that much because agricultural prices are expected to increase (due to increased taxes on agriculture). For example, food processing in the Appalachian region will face the biggest tax cuts. Thus, we expect food processing in the Appalachian region to expand substantially. However, agriculture in the Appalachian region (and elsewhere) will face substantial tax increases, which will raise costs to food processing.

Table 7—Overall Federal tax rates of primary factors, by industry and region

Tax policy/ industry	North-east	Appala-chian	South-east	Lake States	Corn Belt	Delta States	Northern Plains	Southern Plains	Moun-tain	Pacific
					Percent					
Overall tax rates, including social security:										
Agriculture	20.42	23.83	24.11	25.89	23.67	20.23	24.35	22.49	25.25	24.86
Capital-intensive agriculture	21.86	23.61	24.42	25.94	23.66	20.65	24.02	23.49	25.23	24.19
Processed foods	35.26	36.92	36.98	36.29	35.86	35.63	35.74	35.91	36.63	36.38
Capital-intensive processed foods	35.82	38.42	37.07	37.20	36.27	36.24	36.40	36.14	37.06	36.40
Manufacturing	34.49	35.94	36.39	35.59	34.94	35.48	35.75	35.56	35.64	35.50
Capital-intensive manufacturing	34.81	36.18	35.63	36.17	35.44	34.32	36.39	35.02	35.64	34.98
All other industries	28.85	30.12	29.03	30.02	29.06	27.80	29.39	28.80	29.46	29.95
Industry-level average	30.38	32.00	30.45	31.67	30.91	29.24	30.50	29.70	30.49	30.34
Industry/household	26.08	32.54	26.92	29.32	29.52	26.39	31.20	25.52	26.57	24.86
Flat tax, industry level:										
Including social security tax	28.12	28.12	28.12	28.12	28.12	28.12	28.12	28.12	28.12	28.12
Excluding social security tax	21.99	21.99	21.99	21.99	21.99	21.99	21.99	21.99	21.99	21.99

Table 8—Overall State/regional tax rates of primary factors, by industry and region

Tax policy/ industry	North-east	Appala-chian	South-east	Lake States	Corn Belt	Delta States	Northern Plains	Southern Plains	Moun-tain	Pacific
					Percent					
Overall tax rates, including labor insurance tax:										
Agriculture	15.91	8.16	8.57	15.46	11.80	6.19	11.11	12.08	10.28	11.84
Capital-intensive agriculture	14.75	8.03	7.97	13.92	12.14	6.29	10.97	11.43	10.35	12.83
Processed foods	11.45	6.89	4.56	10.20	8.81	7.73	7.63	8.88	7.12	8.51
Capital-intensive processed foods	11.43	6.79	4.46	10.12	8.42	6.19	6.06	9.27	7.67	8.56
Manufacturing	11.06	7.57	4.69	9.93	9.13	7.62	8.06	8.16	8.37	9.04
Capital-intensive manufacturing	11.82	6.82	4.53	10.20	8.60	6.36	6.53	7.94	6.13	8.98
All other industries	12.37	7.10	6.33	13.44	9.53	6.13	8.21	8.97	8.82	9.51
Industry-level average	12.06	7.19	6.00	12.40	9.39	6.41	8.26	8.87	8.70	9.42
Flat tax, industry level:										
Including labor insurance tax	13.52	11.69	10.67	13.39	11.05	10.58	11.41	10.65	11.77	12.19
Excluding labor insurance tax	11.32	9.58	8.66	11.13	8.90	8.54	9.27	8.67	9.72	10.09

Table 9—Tax reform at Federal and State/regional levels

Tax policy/ industry	North-east	Appala-chian	South-east	Lake States	Corn Belt	Delta States	Northern Plains	Southern Plains	Moun-tain	Pacific	U.S.	ROW
						Percent						
Output change:												
Agriculture	-0.33	-2.59	0.33	1.18	0.14	-2.11	-0.59	0.22	0.80	3.73	0.40	-0.07
Capital-intensive agriculture	-1.92	-5.40	-1.01	-1.24	0.19	-3.61	-1.22	-0.95	0.60	2.55	-0.58	-0.09
Processed food	0.88	-2.12	0.06	-0.73	-0.46	0.50	-0.40	1.12	0.31	2.30	0.10	-0.01
Capital-intensive processed food	-0.33	3.89	0.21	-2.15	-3.42	1.54	-2.47	1.36	2.07	3.12	1.12	-0.06
Manufacturing	1.04	-3.38	-0.29	-1.13	-0.48	1.40	-1.99	1.31	0.93	2.11	0.01	0.06
Capital-intensive manufacturing	2.82	-2.56	-0.45	0.96	-0.78	-0.49	-1.76	0.55	-2.19	2.10	0.22	0.10
All other industries	-0.46	1.28	0.07	0.38	0.30	-0.20	0.55	-0.20	-0.15	-0.69	-0.05	-0.01
Factor price change:												
Land	2.23	1.61	5.45	6.60	4.78	0.36	6.39	0.36	3.95	7.96	NA	-0.43
Labor	-6.78	2.40	-2.59	-5.48	-2.95	0.11	1.54	-5.69	-3.61	-4.69	NA	-0.25
Capital	4.75	10.67	4.88	9.38	7.49	0.77	7.53	2.56	4.00	0.97	NA	-0.25
Welfare effects:												
Terms of trade change	-0.08	0.34	0.08	0.06	0.08	-0.01	0.17	-0.08	0.10	-0.21	NA	-0.18
Income change	-1.11	3.79	0.37	0.77	1.23	-0.18	2.66	-1.24	-0.18	-1.68	NA	-0.25
Welfare change	-0.93	3.19	0.24	0.64	0.97	-0.21	2.09	-0.94	-0.19	-1.35	NA	-0.05
						Billion dollars						
Welfare index:												
Equivalent variation	-11.36	15.13	1.02	2.27	7.22	-0.27	2.15	-2.79	-0.41	-11.34	1.62	-1.07

NA = Not applicable.

Table 8 shows that agriculture in most regions will face a cut in State/regional taxes. Exceptions to this are the agricultural industries in the Appalachian, Southeast, Delta, and Mountain regions. In particular, agriculture in the Delta and Appalachian regions will face the largest increase in State/regional taxes, which suggests that agriculture in those two regions will decline. The tax cuts for agriculture in the Northeast and Lake States are larger than in any other region, suggesting that agriculture will expand in those two regions.

Simulated Effects of Tax Reform

Table 9 shows selected simulation results from tax reform at both the Federal and State/regional levels. As expected, agricultural output declines the most in the Appalachian and Delta regions, while agriculture expands in the Pacific region. For the United States, output for high-capital agriculture declines by 0.58 percent, while output for the other agricultural industry expands by 0.40 percent. Food processing expands in the Pacific region as well as in the Delta, Southern Plains, and Mountain regions. For the United States, high-capital food processing expands by 1.12 percent, and the other food-processing industry expands by 0.10 percent.

High-capital manufacturing expands by 0.22 percent for the United States, while the other manufacturing industry expands by 0.01 percent. Manufacturing expands in the Northeast and Pacific regions, and significantly declines in the Appalachian. The "all other" industry declines by 0.05 percent for the United States.

In our model, welfare effects arise due to allocative efficiency gains from nondistortionary taxation, terms-of-trade changes, and changes in the regional contributions to Federal tax collections. The amount of Federal taxes raised in each region changes because the level of Federal tax rates changes. Thus, under tax reform, some regions may contribute more to the Federal budget, and others may contribute less to the Federal budget.

Table 9 shows that the regions experiencing the largest (in percentage terms) welfare effects from

Table 10—Tax reform at Federal level

Tax policy/ industry	North-east	Appal-achian	South-east	Lake States	Corn Belt	Delta States	Northern Plains	Southern Plains	Moun-tain	Pacific	U.S.	ROW
						Percent						
Output change:												
Agriculture	-3.06	-2.90	0.73	0.57	-0.70	-1.64	-0.98	0.26	1.50	1.66	-0.26	0.14
Capital-intensive agriculture	-2.49	-4.58	1.33	1.10	-1.22	-1.27	-0.80	1.14	2.13	0.99	-0.46	0.15
Processed food	1.25	-1.80	0.36	-0.95	-0.26	-0.23	-2.38	-0.34	0.19	2.15	-0.01	-0.01
Capital-intensive processed food	1.10	-0.41	1.21	-1.31	-0.98	0.81	-2.58	1.15	0.81	2.20	0.55	-0.10
Manufacturing	1.37	-2.98	0.53	-0.92	-1.08	1.04	-2.30	1.37	0.60	2.53	0.14	-0.11
Capital-intensive manufacturing	1.00	-2.03	-0.04	0.22	-0.16	-0.05	-0.43	0.97	0.58	0.78	0.06	-0.04
All other industries	-0.48	1.24	-0.13	0.34	0.44	-0.14	0.75	-0.21	-0.14	-0.72	-0.06	0.02
Factor price change:												
Land	-1.49	0.80	4.29	3.58	2.40	1.59	3.42	4.03	5.34	3.94	NA	0.27
Labor	-4.25	0.62	-1.41	-1.90	-1.37	-2.15	0.99	-2.75	-3.15	-4.18	NA	-0.08
Capital	0.91	8.12	-0.19	4.39	4.32	-0.17	5.39	-1.40	1.05	-1.41	NA	-0.08
Welfare effects:												
Terms of trade change	-0.09	0.29	-0.02	0.07	0.09	-0.02	0.28	-0.12	0.03	-0.23	NA	-0.04
Income change	-0.92	3.48	-0.24	1.12	1.39	-0.49	2.65	-1.18	-0.36	-1.73	NA	-0.08
Welfare change	-0.82	2.93	-0.24	0.84	1.14	-0.44	2.16	-0.92	-0.32	-1.42	NA	-0.02
						Billion dollars						
Welfare index:												
Equivalent variation	-10.05	13.87	-1.01	3.01	8.53	-0.57	2.23	-2.74	-0.68	-11.95	0.62	-0.34

NA—Not applicable.

flattening tax rates are the Appalachian, Northern Plains, Southern Plains, and Pacific regions. In particular, the Appalachian and Northern Plains regions gain in welfare by 3.19 and 2.09 percent, respectively. The Pacific and Southern Plains regions, however, lose in welfare by 1.35 and 0.94 percent, respectively. In monetary terms, the Appalachian region gains $15.1 billion, while the Pacific and Northeast regions lose $11.3 billion (1987 dollars) each.

The Appalachian region benefits the most from this simulation because allocative efficiency gains are augmented with a significant improvement in its terms of trade (+0.34 percent) and a reduction in the amount of Federal taxes. The Pacific and Northeast regions lose in welfare because efficiency gains are eroded by deterioration in terms of trade and increased Federal taxes.

The second to last row in table 7 suggests which regions contribute more (or less) to Federal taxes under reform. The Appalachian region's contribution to Federal taxes will decline, as its overall factor tax rate declines from 32.54 to 28 percent. Regions that experience an increase in their Federal taxes (Northeast, Southeast, Delta, Southern Plains, Mountain, and Pacific) tend to lose in welfare from tax reform. Among those regions, only the Southeast gains in welfare ($1 billion) because tax reform at the Federal level is not so important for the Southeast.

Tables 10 and 11 decompose the results of flattening tax rates into components. The results suggest Federal tax reform drives the welfare implications of the combined simulation. The only exception to this result is in the Southeast, which gains $2.3 billion in welfare from reform at the State/regional level but loses $1 billion from reform at the Federal level.

The national welfare effect of flattening tax rates at the Federal and State/regional level is equal to $1,621 million (that is, the sum of regional welfare effects in monetary terms in table 9). Reform at the Federal level increases national welfare by $623 million (table 10), whereas reform at the State level increases welfare by $1,036 million (table 11). This

Table 11—Tax reform at State/regional level

Tax policy/ industry	North-east	Appala-chian	South-east	Lake States	Corn Belt	Delta States	Northern Plains	Southern Plains	Moun-tain	Pacific	U.S.	ROW
						Percent						
Output change:												
Agriculture	2.69	0.27	-0.44	0.59	0.87	-0.41	0.37	-0.05	-0.67	2.13	0.67	-0.20
Capital-intensive agriculture	0.49	-0.97	-2.39	-2.39	1.38	-2.34	-0.47	-2.05	-1.48	1.48	-0.15	-0.24
Processed foods	-0.34	-0.36	-0.36	0.17	-0.19	0.82	1.95	1.48	0.12	0.19	0.11	0
Capital-intensive processed foods	-1.38	3.52	-1.05	-0.92	-2.44	0.81	0.03	0.22	1.24	0.95	0.59	0.05
Manufacturing	-0.29	-0.47	-0.92	-0.32	0.62	0.47	0.20	-0.03	0.30	-0.37	-0.14	0.17
Capital-intensive manufacturing	1.85	-0.57	-0.47	0.70	-0.61	-0.37	-1.39	-0.38	-2.76	1.35	0.17	0.15
All other industries	0	0.07	0.22	0.08	-0.15	-0.09	-0.18	0	0	0.01	0.01	-0.03
Factor price change:												
Land	3.58	0.69	1.02	2.85	2.30	-1.12	2.80	-3.54	-1.31	3.97	NA	-0.69
Labor	-2.64	1.78	-1.17	-3.63	-1.60	2.29	0.57	-3.04	-0.46	-0.54	NA	-0.18
Capital	3.97	2.42	5.43	5.38	3.15	0.80	2.29	4.11	3.12	2.53	NA	-0.18
Welfare effects:												
Terms of trade change	0	0.06	0.11	0	-0.01	0	-0.10	0.04	0.07	0.01	NA	-0.14
Income change	-0.24	0.39	0.68	-0.24	-0.18	0.19	0.12	-0.08	0.20	0	NA	-0.18
Welfare change	-0.14	0.34	0.53	-0.12	-0.19	0.13	0.02	-0.04	0.13	0.04	NA	-0.04
						Billion dollars						
Welfare index:												
Equivalent variation	-1.72	1.62	2.23	-0.43	-1.41	0.17	0.02	-0.11	0.28	0.33	1.04	-0.77

NA—Not applicable.

is a striking result, since it shows that Federal reform dominates State reforms regionally, but the overall benefits of State reforms are larger. This can be explained by a number of factors, which we will only briefly consider.

Federal reform creates a leveling of factor taxes nationally, but shifts overall burdens regionally. Thus, some regions realize a higher tax burden, even as their allocative efficiency of factor use is improved. Since primary factors of production are regionally immobile, the Federal reform creates a new allocative inefficiency, that of geographic allocation.[12] No such result occurs in the State reforms, since relative regional burdens remain fixed.

Table 9 shows that tax reform causes the overall rent received by owners of capital assets (excluding land) to increase in all U.S. regions. As a result, the rate of return (that is, capital rent over price of new capital goods) also increases in those regions. Investment is sensitive to rates of return, and an optimal allocation of investment is achieved when investors in all regions experience the same percentage increase in expected rates of return to capital. Returns to land also increase in all U.S. regions, but less than capital rents (except in the Pacific region), while returns to labor decline in most U.S. regions. These results reflect the fact that flattening of factor taxes shifts the overall burden of taxation toward income from labor services.

Tables 10 and 11 show that the agricultural implications of Federal tax reform are different from those of tax reform at the State/regional level. For the Nation as a whole, Federal tax reform leads to a reallocation of resources from agriculture to other industries. Reform at the State/regional level leads to a decline only in capital-intensive agriculture.

[12]This helps explain how overall welfare effects of Federal tax reform in the model are small, compared with similar reform simulations examined in national models, such as Fullerton and Henderson. A longrun dynamic model would produce greater welfare effects.

Table 12—Tax reform at the Federal and State/regional level, sensitivity analysis of selected results, trade elasticities at 4 x base values

Tax policy/ industry	North-east	Appala-chian	South-east	Lake States	Corn Belt	Delta States	Northern Plains	Southern Plains	Moun-tain	Pacific	U.S.	ROW
						Percent						
Output change:												
Agriculture	-1.42	-2.58	0.59	2.55	0.37	-3.82	0.70	-0.73	1.16	4.48	0.61	-0.09
Capital-intensive agriculture	-2.31	-5.81	-1.76	-1.82	1.19	-5.47	-0.70	-2.58	0.79	3.11	-0.35	-0.11
Processed foods	0.46	-3.19	0.31	-2.08	-0.66	1.37	2.26	2.44	-0.90	2.88	0.04	-0.04
Capital-intensive processed foods	-6.55	14.85	-0.12	-7.43	-11.80	2.05	-6.65	0.63	5.96	3.66	2.28	-0.03
Manufacturing	0.17	-3.26	-0.07	-1.57	0.73	3.08	-1.14	0.76	2.10	1.45	0.04	0
Capital-intensive manufacturing	6.94	-4.79	-1.35	5.22	-1.71	-4.17	-3.16	-2.35	-10.55	2.46	0.24	0.05
All other industries	-0.37	1.02	0.06	0.43	0.05	-0.31	0.11	-0.04	-0.22	-0.57	-0.07	0.01
Factor price change:												
Land	0.15	0.80	5.86	8.31	5.99	-3.68	8.17	-1.88	4.72	10.09	NA	-0.43
Labor	-6.67	1.74	-2.66	-5.61	-3.04	0.22	1.14	-5.48	-3.53	-4.44	NA	-0.21
Capital	4.93	10.25	4.78	9.25	7.21	0.79	7.10	2.82	4.01	1.30	NA	-0.21
Welfare effects:												
Terms of trade change	-0.01	0.11	0.07	0.01	0.02	0.02	0.01	0.03	0.10	-0.04	NA	-0.15
Income change	-1.00	3.37	0.31	0.68	1.09	-0.15	2.36	-1.06	-0.14	-1.44	NA	-0.21
Welfare change	-0.90	3.07	0.24	0.61	0.93	-0.19	2.01	-0.88	-0.21	-1.30	NA	-0.04
						Billion dollars						
Welfare index:												
Equivalent variation	-11.04	14.53	1.01	2.19	6.94	-0.24	2.07	-2.63	-0.44	-10.91	1.47	-0.89

NA = Not applicable.

Sensitivity Analysis

Tables 12 and 13 show sensitivity analysis regarding our trade and allocation of investment specifications. Implementation of the Armington assumptions may artificially insulate U.S. regions from both the national market and international markets. Table 12 shows changes in selected variables due to tax reform under larger trade elasticities. In particular, the elasticities σ_D and σ_L (see fig. 5) are assigned four times the values in their base specification. Larger values for those two sets of elasticities imply that importers in all regions, including the ROW, will be more sensitive to relative price changes when they consider their sources of U.S.-produced commodities. Thus, importers will tend to import more from U.S. regions where relative commodity prices decline due to tax reform. With higher trade elasticities, we expect exports from some regions to change considerably more due to tax reform. Total regional imports, however, are not expected to change more in this simulation because they are an aggregate of imports from all regions. Furthermore, more price-sensitive imports from U.S. regions will result in U.S. commodity prices changing by more similar amounts. The results in table 12 show that, for some regions and commodities, output changes are considerably different from those in the base simulation in table 9. Changes in the terms of trade are smaller in the simulation with larger trade elasticities. The welfare implications of tax reform under the higher trade elasticities illustrate the significance of terms of trade in our welfare measure. Regions that enjoy better (worse) terms of trade in this simulation experience an increase (decline) in their welfare. With higher trade elasticities, tax reform leads to a decline in overall welfare improvement for the United States; welfare gains decline from $1,621 million (table 9) to $1,467 million (table 11).

As we have discussed in the "Macroeconomic Closure" section, the model offers two alternative specifications about the regional composition of

Table 13—Tax reform at Federal and State/regional level, sensitivity analysis of selected results, alternative investment allocation

Tax policy/ industry	North-east	Appala-chian	South-east	Lake States	Corn Belt	Delta States	Northern Plains	Southern Plains	Moun-tain	Pacific	U.S.	ROW
						Percent						
Output change:												
Agriculture	-0.50-	2.57	0.22	0.93	-0.12	-2.56	-0.80	-0.11	0.58	3.33	0.15	-0.12
Capital-intensive agriculture	-0.58	-4.22	-0.43	-0.06	0.66	-2.67	-0.79	-0.34	1.00	3.95	0.10	-0.14
Processed foods	0.83	-1.94	-0.01	-0.71	-0.48	0.23	-0.41	0.86	0.14	1.86	0.02	-0.05
Capital-intensive processed foods	-0.39	3.61	0.13	-2.13	-3.36	1.31	-2.48	1.12	1.86	2.61	0.95	-0.12
Manufacturing	1.15	-2.99	-0.25	-0.92	-0.33	1.16	-1.83	1.21	0.93	1.92	0.10	-0.07
Capital-intensive manufacturing	2.43	-2.52	-0.64	0.85	-0.93	-0.89	-1.79	-0.22	-2.45	1.60	-0.04	-0.03
All other industries	-0.47	1.16	0.07	0.31	0.26	-0.11	0.51	-0.16	-0.14	-0.62	-0.06	0.03
Factor price change:												
Land	2.31	1.88	5.22	7.00	4.92	-0.12	6.62	0.22	3.85	7.48	NA	-0.40
Labor	-6.8	2.30	-2.62	-5.54	-3.00	0.11	1.48	-5.69	-3.62	-4.64	NA	-0.09
Capital	4.71	10.53	4.84	9.29	7.42	0.78	7.46	2.57	3.99	1.04	NA	-0.09
Welfare effects:												
Terms of trade change	-0.01	0.29	0.07	0.03	0.05	-0.01	0.14	-0.09	0.08	-0.20	NA	-0.04
Income change	-1.14	3.69	0.34	0.71	1.17	-0.19	2.60	-1.25	-0.20	-1.64	NA	-0.09
Welfare change	-0.95	3.15	0.22	0.61	0.94	-0.23	2.06	-0.95	-0.22	-1.36	NA	-0.01
						Billion dollars						
Welfare index:												
Equivalent variation	-11.58	14.93	0.94	2.18	7.00	-0.30	2.12	-2.84	-0.47	-11.41	0.59	-0.16

NA—Not applicable.

investment activity. The specification that we applied in our simulation assumes that there is a negative relationship between the expected regional rate of return on capital and the amount of investment undertaken in a region. The model manipulates this relationship until rates of return are equalized across regions. In this section, we apply an alternative investment allocation specification where it is assumed that the regional composition of global capital stock will not change due to the simulation performed (that is, the regional allocation of investment is not sensitive to changes in returns to investment).

Table 13 shows that tax reform, under this investment allocation, causes capital rents in the Delta and Southern Plains regions to increase by more than under the alternative investment allocation specification (table 9). As a result, the rate of return (that is, capital rent over price of new capital goods) increases more in those regions. When investment is sensitive to rates of return, more (less) investment will flow into regions where the relative expected rate of return increases (declines). An equilibrium is reached when all regions experience the same change in expected rates of return. Thus, less investment is undertaken in those two regions in this simulation than in the base simulation. The regional welfare implications of tax reform do not change considerably for U.S. regions when the allocation of investment is changed. The United States, however, experiences a welfare gain of $586 million, which is smaller than the U.S. welfare improvement in the base simulation. This result stems from our alternative investment rule which will not produce an increased share of international investment flows to the United States, even though tax reform produces more favorable relative returns on U.S. investment goods.

Conclusion

By dividing the U.S. economy into regions, we notice that the public sector is multi-tiered, and the structure of each tier, as well as the interaction among the different levels of government, can have profound effects on equity and efficiency of the market economy. We have explicitly modeled the size of the public sector and significant features of what has been called the technological externality elements of the tax system.

With this modeling framework, the analyst can create up to 51 distinct economic regions in the U.S. economy, with 10 regions examined in this report. Each region has seven distinct industrial outputs and consumer goods. Industries employ as many as nine different primary factors of production, with several factors in corporate and noncorporate legal forms. Incorporation and unincorporation decisions are exogenous, so corporate and noncorporate factors remain fixed. Primary factors of production are perfectly mobile within a region but cannot leave the region. Industry output is tradable, both within the region and with other domestic regions and abroad. The price of output produced in a region reflects the industry-level costs of production and taxes, while the prices of industry output and consumer goods from other domestic regions reflect the same factors, plus transportation costs, which are determined endogenously. Regional tax bases include factor income, industry output, personal income, and personal consumption. The level of Federal and regional taxation is fixed at an exogenous level, consistent with 1994 Federal budget figures. The Federal tax bases are the same as regional tax bases, plus a border tax program.

Some important stylized facts emerged regarding the disposition of regional primary factors and regional State and Federal tax incidence. Notably, the smallness of food and farm industries nationwide obscures the fact that, in several regions, value added from capital in food and farm industries expands the capital income of these regions by between 7 and 11 percent. The primary competitor for noncorporate factors of production with agriculture is the services, mines, and trade and construction industries, which use both corporate and noncorporate capital. Food manufacturers face these same competitors, plus other manufacturers. Food and farm industries are the most capital intensive, with capital/labor value-added ratios ranging from 1.0 to 1.4, compared with 0.6 to 0.8 in other industries. Farmland is by far the most important factor of farm production, particularly for cash grain farms, and farms face no outside industry competition for their land. Food manufacturers are most reliant on heavy machinery for production. Food and farm industries are major employers of heavy machinery in the Northern Plains, Lake States, and Appalachian regions.

Two important findings on tax incidence emerged in this report. Farms are a favored industry, in terms of taxation at the Federal level. In every region, farms have the most lightly taxed factors of all industries. In every region except the Delta, farms are the most highly taxed industry by regional governments, and in the Northeast, regional marginal taxation of farm factors exceeds Federal marginal taxation. Overall, there are disparities in tax rates between labor and capital, between types and legal forms of capital, between industries, and between regions. Similar disparities exist between consumption and savings decisions, and across regional households on their personal income. The surprisingly high incidence of regional factor taxation indicates that effects of reforming the tax system depend on whether it is a harmonized reform of Federal and regional tax systems, or if it is unilateral reform of one or the other layer of government.

While tax reform analysis was not the subject of this report, we did carry out a generic transformation of the U.S. tax system, a flattening of factor taxes. These results clearly indicate the multiple dimensions of economic response to fiscal policy. Notably, relative tax burden disparities, including intersectoral, interregional, and intertemporal, have profound implications on resource allocation and distribution of welfare. Yet terms of trade, resource scarcities, and international investment flows can have conflicting effects on many economic indicators. This substantiates the assertion that an applied general equilibrium framework is ideally suited for assessing fiscal policy effects on food producers and consumers.

Like any research program, developments and refinements to this research are ongoing. We are focusing on the representation of labor services in the model and refining our account of regional sales taxes and regional and national excise taxes. Regarding labor services, two improvements are underway. First, efforts are underway to allocate labor value added between skilled and unskilled labor units. Also, an explicit account of the noncorporate, proprietorship, hired labor force will be made to refine our measurements of labor income and wage tax rates by industry. Regarding sales and excise taxes, our assumption that these taxes do not discriminate against any consumer good or producer good is clearly in error. Some regions exempt taxes on goods such as retail sales of food and prescription drugs, and some regions target output taxes, such as severance, tobacco, and alcohol. Such accounts, however great or small, will be a part of future editions to the model data set. As mentioned previously, an extension to a dynamic modeling framework would enhance our ability to account for the effects of taxation on the interregional and international flow of investment capital. Plans to extend the model and data in this area are also underway. An important part of this extension is the ability to specify a nonunitary price-elastic demand for investment goods (supply of savings). Other extensions and refinements will be determined by the types of applications for which the model is employed.

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Appendix

Derivation of Regional Primary Factor Accounts

The disposition of industrial inputs and outputs that characterizes the general equilibrium we calibrate in our model replicates the input/output data of the 1987 National Income and Product Accounts (NIPA) of the United States. Our regionalized accounts are produced in a manner consistent with the structure of technology we present in this report. Specifically, production functions are linear homogeneous, with a Leontief aggregation of value-added and intermediate inputs. This Leontief structure is unique to each input/output industry but is unvaried across regions. By developing State-level value-added cost share accounts for each input/output industry, we can use these features of the model to allocate industrial output to regions. This appendix describes the development of our State value-added accounts.

Agriculture

There are 32 4-digit SIC farm commodity classifications (SIC4), and 17 I/O farm industries in the 1987 NIPA accounts (io87). With a few of the 32 SIC commodities appearing in several I/O industries, there are a total of 39 unique SIC4/io87 combinations. Our premise is that once farm production is classified into 39 commodities, the value-added cost shares do not vary by State.

First we obtain direct estimates for value-added payments to land in each of the 39 io87/SIC4 industries. Each of the 39 industries is classified as crop or pasture land users. Using multiple sources,[13] and checking for consistency of sources, we obtained acres harvested for each industry and computed the product of acreage and national weighted average rental rates (either dry cropland or pasture, since irrigation rents go to capital), where the weights were State-level industry-specific cash receipts. This gives us national rental land payments for each commodity. To get the same for capital, we must benchmark our capital estimates to these land estimates.

Unpublished USDA data on 1993 State-level market values for land, tractors, autos, trucks, machinery, and buildings were obtained, and this represents over 99 percent of farm capital (U.S. Department of Commerce, Bureau of Economic Analysis, 1998a). These data gave us State-level cost shares, which we used to compute the U.S. total for land value. We allocated this value to each of the 39 agricultural industries, based on their share of national cash rents. We then allocated to each State, based on State shares of cash receipts.

Each capital type is allocated a value for each commodity, based on the statewide cost share ratios. This implies, for example, that for every commodity in a given State, the tractor-to-land cost share ratio is the same. The result is State cost share estimates for each commodity broken into land and five types of capital. We compute a national weighted average value for relative cost shares, where the weights are again State-level cash receipts. This way, those States where a particular crop is important, and thus has more influence on statewide average cost share profiles, is given more weight in forming a national commodity-specific capital cost share profile.

We now have national cost share estimates of the 39 agricultural commodities. For each of the 17 io87 farm industries, the subset of 39 SIC4 belonging to that industry are allocated NIPA capital value added in

[13]Acres harvested are from SIC's 111-139—USDA, NASS (1995); SIC 161—USDA, ERS (1998a); SIC's 171-181—USDA, ERS (1998b); and SIC's 211-279—USDOC, Census Bureau (1990). Cash rental rates are from USDA, ERS (1997a), and unpublished USDA data. Cash receipts are from USDA, ERS (1997b).

proportion to cost shares, and these are allocated to States, based on cash receipts. A final refinement is that national (U.S. Department of Commerce, Bureau of Economic Analysis, 1998a) accounts indicate that 0.9 percent of farm capital is nonagriculture specific (for example, computers and furniture). We assume that a farm operation uses this capital in a fixed proportion to their total farm capital and prorates each commodity cost share estimate accordingly. The result is 39 unique cost share profiles allocated to States in proportion to cash receipts. National value added in each io87 industry conforms to NIPA control totals. Labor payments are allocated from io87 industries to SIC4 in proportion to cash receipts, so capital to labor ratios are the same for all SIC4 within an io87 industry.

Manufacturing

A high level of industrial detail is provided in the NIPA value-added accounts of the manufacturing industry. Net plant value added and net equipment value added are allocated to each io87/SIC4 industry at the U.S. level. From the 1992 Census of Manufacturing, we obtained gross value of plant and gross value of equipment for each SIC4. When no SIC4 data were available, we obtained the value for the corresponding three-digit SIC. We converted these values to net values, using 1992 net-to-gross value ratios for plant and equipment for each of the corresponding two-digit SIC's, based on U.S. Department of Comme rce, Bureau of Economic Analysis (BEA) data. This allows the allocations of io87 industry capital value-added data into plant and equipment value-added. Using State-level data from the county business patterns (CBP) wages data set, we allocated labor, plant, and equipment value added to each State io87/SIC4 manufacturing industry.

Based on special tabulations of unpublished Census of Manufacturing data at the Center for Economic Studies (CES), we computed State-level data on the share of plant value and the share of equipment value for each of the 20 major manufacturing industry groupings (2-digit SIC). Using this information, all State-level plant and equipment value for the io87/SIC4 industry are summed to their respective major industry State totals, and the ratio of this value to the value of the applying CES share tabulations to NIPA value-added measures by major industry groupings is used to adjust plant and equipment values accordingly.

To summarize, direct estimates of labor value added for each State io87/SIC4 industry is computed using the CBP data set and NIPA accounts. Direct estimates of U.S. plant and equipment value added for each io87/SIC4 industry are computed using published Census of Manufacturing data, BEA major industry group net-to-gross value ratios, and the NIPA capital value-added accounts. These are allocated to States by holding constant the national plant/equipment/labor cost share ratios, at the SIC4/io87 industry level. Finally, these cost share ratios are changed at the State-level, using direct State plant and equipment value data based on CES tabulations. These estimates are then prorated to ensure national io87 capital and labor value-added totals are reconciled.

In a final step, equipment value added is allocated in proportion to the shares of each of 27 equipment types reflected in the corresponding major industry grouping, as in the annual fixed reproducible tangible wealth accounts published by the BEA (1998a) and similarly for each of 23 plant classifications.

Construction

Construction industry value added is exclusively from capital. The economic census of construction provides SIC4 detail for most construction industries, including national estimates of gross plant and equipment value and State estimates of gross value of capital. Combining this information with the NIPA value-added accounts and BEA data on net-to-gross plant and equipment value ratios in the construction industry, we first allocate value added to each national io2/SIC4 construction industry into plant and equipment. We then allocate each national industry total to the States, based on net capital value shares for each minor industry classification. Finally, BEA data are used to share out plant and equipment value into

several different types of capital. While each State's plant/equipment value-added ratios may be unique, the allocation of each share into asset types is uniform across all States.

Mining

The Economic Census provides little detail beyond that given in the NIPA accounts, but there is national level detail by SIC4 for total gross value of capital. This is used to allocate national capital value added in mining io87 aggregates to each of the io87/SIC4 minor industries. Using the county business patterns data, these data are allocated to States in proportion to each State's shares of total salary and wages in each industry. Capital is then allocated among the different asset types based on BEA data. The State-level shares are common across all States.

Other Business Industries

All remaining industries are generally labor-intensive. Because the county business patterns data allow a direct means of allocating io87 national data to States, we do so while holding constant the national capital/labor value-added ratios for each io87/SIC4 industry. Finally, we allocate capital between the 50-BEA type classifications, corresponding to the relevant major industry grouping of each io87/SIC4 industry.

Residential Housing

The tax treatment of owner-occupied versus rental dwellings is very different. Further, corporate housing is subject to different tax laws. The imputed rental value of owner-occupied housing is explicitly represented in the NIPA accounts, and a portion of the capital value added in real estate industries of the NIPA accounts is from tenant-occupied residential housing. We allocated these national accounts to the States as follows.

The national stock value of owner-occupied shelter and tenant dwellings is reported, along with business capital, in the BEA fixed reproducible wealth data series (1998a). Using data of the Annual Housing Vacancy Survey (U.S. Department of Commerce, Bureau of the Census, 1998), and State-level personal income data (BEA, 1999), national housing wealth is allocated to States. For each State, owner occupancy rates are multiplied by total household units to derive total State household owner-occupied units. The residual is total State tenant units. By summing the number of owner-occupied units over all States and Washington, DC, and dividing by BEA national owner-occupied dwelling value, we derive a national average value per owner-occupied dwelling. By doing the same for tenant dwellings and taking the ratio of these values, we imputed the national average ratio for owner-occupied to tenant dwelling unit price and denote this in the O/T ratio.

Next, we assumed annual residential housing budgets are a common share of personal income in all regions and allocated total dwelling value to the States. Using the O/T ratio to convert owner-occupied units into tenant equivalent units, we allocated State dwelling value to tenant dwellings proportional to tenant dwelling share of total dwelling equivalent units. This value is allocated to the appropriate io87 industry when cost share ratios are employed. The national BEA tenant dwelling account also is broken down into corporate and noncorporate shares, and this ratio is also held constant across States (corporate housing shares are quite small). Finally, that which is not tenant dwelling value belongs to the owner-occupied residential io87 industry. Each State is allocated imputed rental value added in proportion to dwelling values.

Computing the Marginal Effective Tax Rate on Income From Capital

We begin with a measure of market value for capital stock. With no loss in generality, we will define a unit of capital, in any form, to be the amount supplied at a market price of one monetary unit, for example, $1. Ownership of this single unit of capital affords the owner a predetermined tax allowance that represents a real value to a firm or household. However, this value is realized over an extended period of time, which we call the tax life of the asset. Tax allowances depend on a number of factors, including the financial profile of the household or firm, the nature of the capital owned, and the sector in which the owner will be operating this capital. All of these factors can be described in an allowance function of the form:

$$A = b_1 A_z + b_2 t + b_3, \tag{1}$$

where b_1 represents the percentage of new investment subject to a depreciation allowance schedule, A_z is the present discounted value of total depreciation allowances over the tax life of the asset (assuming full investment is depreciable), b_2 represents the percentage of investment that can be fully expensed in the year of investment, t is the marginal statutory rate of income taxation the capital owner faces, and b_3 represents the percentage of investment subsidized by the government.[14] As the thick legal volumes describing State and Federal tax code indicate, the details required to compute equation 1 are too numerous to summarize here.[15] A numerical example will serve this purpose.

Once the value of special tax allowances is determined, this value can be deducted from the $1 purchase price and the residual is the effective market price of ownerships:

$$C = 1 - A. \tag{2}$$

The hurdle rate (h) that we must determine will equal the residual of the annual revenue from employing this unit of capital (R), net of the real economic depreciation to the productive capacity of this capital over the production year (d), or $h = R\text{-}d$. Note that the depreciation measure d is independent of the depreciation tax allowance A_z. Tax rules are such that the gross of tax income R is the tax base and the depreciation allowance becomes a fixed income to the proprietor. That is, net of tax income is equal to $(1\text{-}t)\times R$, instead of $(1\text{-}t)\times h$.

In the theory of capital, real investment is viewed as permanent. This implies that the owner will anticipate a stream of income from this capital, which will grow annually at the rate of output price inflation, e^{π}, and will incur annual depreciation costs, e^{d}. If we denote as e^{ρ} the subjective discount rate that leads to indifference between income next period and income now, then the present discounted value of this permanent stream of capital income is valued at (see Silberberg):

$$V = \int_0^{\infty} \left[(1-t)R - w\right] e^{-(\rho + d - \pi)}\, dt \quad = \quad \frac{\left[(1-t)(h+d) - w\right]}{\rho + d - \pi}, \tag{3}$$

where w is the rate of property taxation. In equilibrium, an asset's value (equation 3) is equal to its purchase price (equation 2). This result allows us to derive an expression for the hurdle rate:

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[14]This report presents statewide aggregates, so b_1 is determined as the percentage of new investment in a State by investors who have exceeded their maximum annual expensing limit and b_2 equals $1\text{-}b_1$.

[15]A rigorous explanation of the computations described in this section is presented in Canning and Rhoades.

$$h = (1\text{-}t)^{-1} \times [(1\text{-}A) \times (\rho + d - \pi)] + w - d. \quad (4)$$

Based on financial profiles of the asset owner, we can determine the appropriate marginal tax rates, *t* and *w*. With knowledge of the type of asset, there are economic estimates of the value for the annual rate of depreciation, *d*. For the discount rate, the value assumed depends on the manner of financing. For debt, it is the opportunity cost of borrowed funds or the interest rate for borrowing (*I*), net of tax deductions on interest payments, $\rho = I * (1\text{-}t)$. For equity-financed investments (retained earnings if corporate ownership), we use $\rho = I * (1\text{-}m)/(1\text{-}k)$, where *m* is the marginal tax rate on interest income of the asset owner and *k* is the effective rate of taxation on capital gains. For corporations, this reflects the investor's tradeoff between receiving interest payments from issuing debt on a competitive alternative investment, with a net of tax return equal to $(1\text{-}m)*I$, and increasing the value of corporate stock, subject to taxation at a deferment-adjusted rate for capital gains, $(1\text{-}z)*\rho$. For corporate-owned capital, another finance option is through issuance of new shares of corporate stock, which requires a dividend yield equal to the opportunity cost of savings, so we have $\rho = I$.[16] Since *I* and ρ now have an exact relationship, we have reduced our unknowns to three (*h*, *r*, and *I*).

From here, we choose to exogenously specify an equilibrium real rate of return to savings (0.035), and adopt the Fischer equation, which states that nominal interest rates on savings equal the real rate plus the expected annual rate of inflation, $I = 0.035 + \pi$. Using Feldstein's rule of thumb, we set π equal to the average annual rate of general price inflation over the previous three observed values. We can now define the value for the reservation rate of return:

$$r = (1\text{-}m) \times (0.035+\pi) - \pi. \quad (5)$$

All that remains is to determine the appropriate tax provisions to use in equation 1, plug the solution for *A* into equation 4, and calculate the marginal effective tax rate on income from capital as:

$$t^m = (h\text{-}r)/h. \quad (6)$$

The value of t^m measures the share of all marginal capital income paid to meet the tax liability. Calculating A_z is somewhat complicated. Most forms of farm capital are allowed 150 percent of the straight-line depreciation of a declining balance, with a switch to straight-line depreciation at the most advantageous period for the taxpayer (rental dwellings are required to be depreciated on a straight-line basis). A midyear-purchase assumption rule (midmonth for some buildings, and first or third quarter for other assets) allows only partial depreciation in the year of purchase and the final year of depreciation. Optimal switch to straight-line depreciation is at one-third of the asset's tax life (rounded to the nearest half-year interval). Total value of the depreciation allowance over the asset's tax life is:

$$A_z = [1.5/L] * \sum_{t=0}^{0.5} (1+\rho)^{-t} + (1.5/L - 1.5^2/2L^2) * \sum_{j=0}^{L/3.0-1.5} [(L-1.5)/L]^j * \sum_{k=j+0.5}^{j+1.5} (1+\rho)^k$$
$$+ [(L-0.75)/L] * [(L-1.5)/L]^{L/3-0.5} * (3/2L) * \sum_{i=L/3}^{L} [(1+\rho)^i] x\ \tau, \quad (7)$$

were *L* is the asset's tax life. This is the discrete time version of equation 6.5 in King and Fullerton.

[16]For corporate capital, we adopt the traditional view that new investment is financed by equal parts of each financing method. For farm capital, debt and equity shares are based on the State-level primary USDA data of these ratios. Noncorporate, nonfarm households are assumed to finance in the same ratio as farm households.