Public Finance Review
http://pfr.sagepub.com/

The Avoidable Excess Burden of Broad-Based U.S. Taxes

Nicolaus Tideman, Ebere Akobundu, Andrew Johns and Prapaiporn Wutthicharoen

Public Finance Review 2002 30: 416
DOI: 10.1177/109114210203000506

The online version of this article can be found at:
http://pfr.sagepub.com/content/30/5/416

Published by:
SAGE
http://www.sagepublications.com

The excess burden of taxes can be reduced by shifting taxes from labor and capital onto land and by replacing progressive taxes with proportional taxes. This article uses a dynamic general equilibrium model to develop estimates of the magnitudes of reduction in excess burden that can be achieved in the United States by (1) incrementally shifting revenue from five broad-based taxes to land, (2) replacing the current progressive income tax with a flat tax, and (3) shifting as much taxation as possible to land.

THE AVOIDABLE EXCESS BURDEN OF BROAD-BASED U.S. TAXES

NICOLAUS TIDEMAN
EBERE AKOBUNDU
ANDREW JOHNS
PRAPAIPORN WUTTHICHAROEN
Virginia Polytechnic Institute and State University

1. INTRODUCTION

Taxes create "excess burdens" or economic inefficiency when they induce taxpayers to substitute untaxed activities for taxed ones. Except for taxes that offset negative externalities, economists generally favor broad-based taxes (such as taxes on income or sales) over taxes on individual commodities. This is because broad-based taxes offer fewer opportunities for taxpayers to substitute untaxed activities for taxed ones, so that they generally produce less excess burden per dollar of tax revenue.

There are two ways in which even broad-based taxes produce excess burdens. First, because broad-based taxes are not imposed on leisure, they induce taxpayers to substitute leisure for work. Second, because they are imposed on the returns to saving, they induce taxpayers to substitute consumption for saving. It is possible to avoid distorting the saving/consumption decision by imposing a tax that falls uniformly on consumption in all time periods while exempting the return

PUBLIC FINANCE REVIEW, Vol. 30 No. 5, September 2002 416-441

to saving. However, raising a given amount of revenue will then require a greater distortion of the work/leisure decision.

There are two categories of taxes that generate no excess burden. The first category consists of taxes that internalize externalities such as air pollution. Although such taxes induce taxpayers to substitute untaxed activities for taxed ones, they improve efficiency because they provide incentives to reduce activities that are harmful. The second category of taxes that have no excess burden is "noncontingent" taxes. A tax is noncontingent if its amount is independent of any action that the taxpayer might take. This independence implies that such taxes do not induce taxpayers to substitute untaxed activities for taxed ones. Noncontingent taxes (sometimes called "lump-sum" taxes) are described as "neutral" because they do not produce economic distortions. The land component of a property tax is neutral as long as taxpayers are confident that future taxes will not be so high as to make it unprofitable to hold title to land.

Because a tax on land can help to offset market imperfections, it can be better than neutral (Tideman 1999). One way that a land tax can improve efficiency is by discouraging inefficient land speculation. If everyone had perfect foresight, it would be impossible for anyone to make a profit from speculating in land. When foresight varies among people, those who believe they have superior foresight may conclude that there are opportunities for positive expected profits from speculating in land, and because futures markets in land do not exist, a person must hold land to speculate in it.

It is imaginable that land speculation would contribute to economic efficiency by preventing premature land development. However, there are two reasons for believing that speculation in land reduces economic efficiency. First, the necessity of holding land to speculate in it means that the most profitable speculation is one that combines holding land with the management of its current use. But this requires dual expertise. Opportunities for land speculation induce people to hold land even when they are not the ones who can manage land most profitably in its current best use.

Second, land speculation provides opportunities for the winner's curse to operate. This is the phenomenon that the highest bid for an object of uncertain value will come from the person who has made the greatest overestimate of its value (Milgrom and Weber 1982). The one- and two-story buildings that are pervasive in the downtown areas of large U.S. cities represent an underuse of valuable land that can best be explained as a result of land being held by persons who believe that they are likely to make a speculative killing if they continue to hold it for a few more years. If they give up and sell, the new buyers tend to be speculators as well.

An increase in the tax on land value lowers the selling price of land, thereby replacing the implicit cost of foregoing a current return on land with the explicit (and psychologically more urgent) cost of a tax bill. The reduced selling price of land also reduces the potential gain from land speculation. For this reason, a tax on land tends to reduce land speculation and thereby reduce the inefficiencies caused by the winner's curse and by having those who wish to speculate in land manage its current use. An early version of this argument can be found in Brown (1927).

Taxing land also mitigates imperfections in lending markets. Because lending markets are imperfect, some people have higher discount rates than others. The present value of an increase in future taxes on land is greater for a person with a low discount rate than for a person with a high discount rate. Therefore, a tax on land reduces the bid prices for land of those with low discount rates by more than it reduces the bid prices of those with high discount rates. Because those with high discount rates get greater returns from their assets, the resulting movement of land into their hands improves efficiency (Gaffney 1961, 1973).

This article uses a dynamic general equilibrium model to quantify the efficiency gains that can be achieved in the United States by substituting a marginal increase in the tax on land for other taxes. The model is also used to estimate the efficiency gains from substituting a flat income tax for the current progressive income tax, as well as the gains from substituting taxes on land for as many current taxes as possible.

Our model has some characteristics in common with earlier models that were developed by Auerbach, Kotlikoff, and Skinner (1983); Ballard, Shoven, and Whalley (1985); Jorgenson and Yun (1991); and Nechyba (2001). Like the first three papers, we study the economic effects of taxes through a dynamic general equilibrium model of intertemporal maximization by producers and consumers, in which taxes affect the prices that economic actors take into account when maximizing profits and utility. (Nechyba employs a comparative static model.) Like all of the above except Ballard, Shoven, and Whalley, we assume that there is a single representative agent and that production consists of a single private good and a single public good. (Ballard, Shoven, and Whalley have 12 types of agents and 19 private goods.) Like Ballard, Shoven, and Whalley, as well as Jorgenson and Yun, we assume that the representative agent maximizes utility over an infinite horizon. (Auerbach, Kotlikoff, and Skinner assumed that their agents had overlapping life spans of 55 years; time does not enter explicitly into Nechyba's analysis.) Like Nechyba, we distinguish land and capital as separate factors of production. The other three papers incorporate both land and capital into what the authors call capital. Like the models in the first three papers above, our model takes no account of space or regional variations; implicitly, all production is assumed to occur in the same place. Nechyba has a separate model for each state in the United States, which is treated as an open economy. We and the other authors use closed models.

2. THE MODEL

Our model employs a production function with three factors of production: land (T), labor (L), and capital (K). The production function is a symmetric constant elasticity of substitution (CES) function,

$$Q = c^{(t-2000)}\left(a_1 T^{\alpha} + a_2 L^{\alpha} + a_3 K^{\alpha}\right)^{(1/\alpha)}, \tag{1}$$

where τ is the year and $c^{(\tau - 2000)}$ represents the impact of technological advance. The parameter α is related to the elasticity of substitution in production, σ_1, by the equation $\alpha = 1 - 1/\sigma_1$. We assume that there is one infinitely lived household, with a growth rate that follows a linear approximation of population growth under the middle census projection for U.S. population. A constant proportion of the members of this household works. The household receives utility in a given period from three goods: private goods per worker (V), public goods per worker (B), and leisure per worker (Z). The within-period utility function is a symmetric CES function,

$$C = (b_1 V^{\beta} + b_2 B^{\beta} + b_3 Z^{\beta})^{(1/\beta)}, \tag{2}$$

and the household's intertemporal utility function is also CES:

$$U = \left[\sum_{\tau = 2000}^{\infty} \delta^{(\tau - 2000)} C_{\tau}^{\gamma} \right]^{(1/\gamma)}. \tag{3}$$

The quantity of land that is employed in any year reflects the response of land speculation to taxes on land. The percentage of available land that is used is given by

$$T = e^{\phi}$$

where n is the percentage of land rent that is collected by the property tax and *f* is chosen to yield an estimate of current land efficiency under current taxes.

To select a value for σ_1, we draw on literature that has sought to estimate the elasticity of substitution between labor and capital. The work of Arrow et al. (1961) on the CES production function generated many publications in the 1960s and 1970s that attempted to estimate the elasticity of substitution in production. Early time-series work (Kendrick and Sato 1963; Bodkin and Klein 1967; Berndt 1976; Kalt 1978) and cross-sectional work (Solow 1964; Griliches 1967; Dhrymes and Zarembka 1970; Paraskevopoulos 1979) offered estimates in the range of 0.47 to 1.00. More recent data and work (Chung 1987; Cronin, Colleran, and Gold 1997; Rowthorn 1999; Boskin and Lau 2000) suggest estimates ranging from 0.70 to 0.86. After reviewing this literature, we chose a value of 0.8 for σ_1, which corresponds to $\alpha = -0.25$.

Estimates for the annual rate of technical progress between the early 1970s and late 1980s tended to be about 0.3% (Barro 1998; Bernard and Jones 1996). Between the early 1980s and late 1990s, the estimates for the annual rate of technical progress increased to about 1.5% (Boskin and Lau 2000; Bernanke and Gurkaynak 2001). The former estimate is a rather low rate of technical progress, whereas the latter estimate is relatively high. After considering this range of estimates, we decided that a figure of 1% for the annual rate of technical progress was reasonable. This estimate corresponds to a parameter value of $c = 1.01$.

The parameter β is equal to $1 - 1/\sigma_2$, where σ_2 is the within-period elasticity of substitution in consumption between any two of private goods, public goods, and leisure. We found few attempts in the literature to estimate the substitutability between goods and leisure. Auerbach, Kotlikoff, and Skinner (1983) estimated the elasticity of substitution between private goods and leisure to be 0.8. The one comparable study that we found (Ghez and Becker 1975) estimated the elasticity of substitution between goods and leisure to be 0.83. On this basis, we decided that a value of 0.8 for σ_2 is reasonable.

The parameter γ is equal to $1 - 1/\sigma_3$, where σ_3 is the intertemporal elasticity of substitution. The intertemporal elasticity of substitution in consumption has been estimated more frequently, and the estimates provide a reasonable consensus among economists about the range of plausible values of this parameter. Auerbach, Kotlikoff, and Skinner (1983) estimated σ_3 to be 0.25. Previous empirical work cited in their paper estimated σ_3 to lie, in one study, between 0.13 and 0.41; in another study, between 0.56 and 0.75; and in a third, between 0.07 and 0.35. On the basis of these estimates, we decided that 0.375 is a reasonable value for σ_3.

Alogoskoufis (1987) showed that the within-period elasticity of substitution is always greater than the intertemporal elasticity of substitution. This implies that the value chosen for γ should be significantly below that chosen for β, as is the case here.

A sensitivity analysis (reported later) reveals little model sensitivity to variations in these parameter values. Thus, the model conclusions are not likely to be affected significantly by the uncertainty concerning the values of these parameters.

The production function and the within-period utility function are calibrated from data for the U.S. economy for 2000. This calibration provides a ratio, γ, of marginal utility to price that must prevail for private goods and leisure for all future time periods. (If it did not prevail, then the assumption that a household maximizes its intertemporal utility would be incorrect.) Private goods produced in 2000 and used for investment provide a numeraire. The level of the public good is not optimized but rather is assumed to be whatever can be provided by the taxes that are currently levied.

The marginal products of land, labor, and capital specify pretax rent, wages, and interest, respectively. The quantity of labor that is supplied in any future period is in equilibrium when the ratio of the marginal utility of leisure to the price of leisure (the wage after marginal taxes) is equal to γ. Consumption of private goods in any future period is in equilibrium when the ratio of the marginal utility of private goods in that period to the price of private goods in that period [(1 + consumption taxes), discounted to that period at the return to capital after marginal taxes] is equal to γ.

The intertemporal utility function is calibrated by estimating the unique value of the discount factor, δ, for which the saving rate appears to approach a horizontal asymptote after 30 years of simulation. This solution approach obviates the need to be concerned with the value of the final stock of capital and land.

Any change in taxes produces a new equilibrium path, which is found by identifying a γ' for which the saving rate approaches neither positive infinity nor negative infinity when work and saving follow paths on which the ratio of marginal utility to price, for private goods and leisure in all periods after the reform occurs, takes the value γ'.

One way in which the calculations for the model differ from most previous models is that it is solved on a spreadsheet.

3. CALIBRATION

The appendix shows the data for the U.S. economy that were used to calibrate the model. Most of the data come from the National Income and Product Accounts (NIPA), published by the Commerce Department's Bureau of Economic Analysis (http://www.bea.doc.gov/bea/dn1.htm). The value of private assets was estimated from the 1998 Survey of Consumer Finances that is published by the Federal Reserve System (http://www.federalreserve.gov/pubs/oss/oss2/98/scf98home.html). The figure for 1998 (the most recent year for which figures were available when we collected our data) was adjusted to an estimate for 2000 on the basis of the change in net domestic product

(NDP). The value of land is estimated as the value of assets minus the value of reproducible capital. Average and marginal tax rates for labor and assets were estimated on the basis of *Statistics of Income* data for 1998 that are published by the Internal Revenue Service (http://www.irs.gov/taxstats/display/0,,i1%3D40%26genericld%3D16840,00.html). The ratio of maximum labor to current effort is based on a comparison of actual hours worked with an assumed maximum of 16 hours per day, 7 days per week. Because there are no data on land efficiency, the estimate of current land efficiency is purely impressionistic. Data on the Social Security system come from the Social Security Administration (http://www.ssa.gov/statistics/cos/pdf/2000/1a1.pdf).

The model is closed by allocating the statistical discrepancy and net exports. The income of proprietors is allocated between labor and assets in proportion to the shares of labor and assets in all other income. Asset income is allocated between capital and land on the basis of the ratio of (the value of capital) to (the product of the value of land and the assumed efficiency with which land is used). Thus, if land and capital have the same value and land is used with an efficiency of one half, then we assume that two thirds of asset income is a return to capital and one third is a return to land.

To compute the share, h, of social insurance payments that are taxes rather than payments for benefits, we aggregate Feldstein and Samwick's (1992) data into an overall average tax rate of 7.37% for Old Age and Survivor's Insurance (OASI). Because the OASI tax rate at the time of their calculations was 10.7%, this implies that 68.9% of OASI payments are taxes. We assume that this ratio applies to all social insurance payments, so that $h = 0.689$. We take account of the proportion of earnings that exceed the Social Security maximum tax base to compute that, at the margin, 56.2% of social insurance payments are tax.

We allocate income taxes between taxes on labor and on assets on the basis of computed tax rates and the allocation of income between labor and assets. Property taxes are allocated between land and capital on the basis of the assumed shares of land and capital in income. If property tax assessments were perfectly accurate, then it would be more appropriate to allocate taxes in proportion to the value of land and capital. Our practice thus reflects a belief that land is systematically underassessed in proportion to its underuse.

TABLE 1: Tax Facts

Tax	*Symbol*	*Base Description*	*Base ($ billions)*	*Revenue ($ billions)*	*Average Rate (%)*	*Marginal Rate (%)*
Property tax on improvements	*i*	Capital income after depreciation	1,512.0	148.9	9.85	9.85
Property tax on land and natural resources	*n*	Realized rent	1,010.6	99.5	9.85	9.85
Profits tax	*f*	Asset income less property taxes	2,274.2	246.1	10.82	10.82
Individual income tax on assets	*w*	Asset income less property and profits taxes	2,028.1	442.6	21.82	30.19
Individual income tax on labor	*g*	Labor income less employers' social insurance	5,765.2	776.7	13.47	23.60
Social insurance tax on employers	*r*	Labor income less employers' social insurance	5,765.2	236.8	4.11	3.35
Social insurance tax on employees	*e*	Labor income less employers' social insurance	5,765.2	246.4	4.27	3.49
Sales tax	*s*	Consumption less sales taxes	6,134.6	321.5	5.24	5.24
Excise taxes	*x*	Consumption less sales and excise taxes	6,064.8	69.8	1.15	0.00
Customs and other taxes	*c*	Net domestic product less all factor taxes	6,434.6	41.8	0.65	0.65

Based on NIPA data, our model aggregates all federal, state, and local taxes into 10 taxes, with bases, revenue, and rates in 2000 as shown in Table 1.

The tax bases are derived from NIPA figures, and the revenue figures come directly from NIPA, except that we allocated the property tax as described and allocated the income tax between assets and labor based on IRS data from *Statistics of Income*. The difference between the income tax rates on assets and labor arises not directly from the tax code but indirectly from the combination of progressivity in the income tax and the fact that people who receive asset returns have higher incomes on average than those who receive labor incomes.

The average tax rates are computed as tax revenue divided by the tax base. There are five taxes for which the marginal rate is different from the average rate: the individual income taxes on assets and on labor, which are progressive; the social insurance taxes on employers and employees, which are regressive because Social Security taxes have an upper limit; and excise taxes, which are shown as having a zero marginal tax rate because we treat excise taxes as Pigouvian taxes that internalize externalities, so that they yield government revenue but do not cause distortions. (We treat marginal tax rates as the measure of the distortions caused by taxes.) We estimate the ratio of the average tax rate on labor to the average tax rate on assets, as well as the ratio of the marginal tax rate to the average tax rate on labor income and on asset income, from the 1998 *Statistics of Income*. We estimate the proportion of income that is subject to Social Security taxes on the margin from data provided by the Social Security Administration.

To study the consequences of changing individual taxes, we computed the taxes sequentially, with some taxes being deducted from what would otherwise be the base of other taxes. Thus, property taxes are levied first and are deducted from the base of the profits tax. Both property taxes and profits taxes are deducted from the base of income taxes, and all factor taxes are deducted from the base of customs and other taxes. For labor income, the base is compensation of employees less employer contributions to social insurance; income taxes and both employer and employee contributions to social insurance are applied to this base. On the basis of this framework, we aggregate the tax rates into an overall tax on land income (t), an overall tax on labor income (l), an overall tax on capital income (k), and a consumption tax (p), using the following equations:

$$t = 1 - (1 - n)(1 - f)(1 - w)(1 - m), \quad (4)$$

$$l = 1 - (1 - (g + r + e)/(1 + r/h)(1 - m), \quad (5)$$

$$k = 1 - (1 - i)(1 - f)(1 - w)(1 - m), \quad (6)$$

$$p = s + x + sx. \quad (7)$$

Because this is an inquiry into the consequences of broad-based taxes, we treat taxes as falling uniformly on their bases and ignore the fact that sales taxes are levied at different rates in different states, that some items are exempt from sales taxes, that profits taxes fall on equity financing and not on debt financing, and similar nonuniformities of taxes. An analysis that took these nonuniformities into account could be expected to generate greater estimates of excess burdens of taxes because there would be more opportunities to substitute untaxed activities for taxed ones.

4. IMPACTS OF SMALL TAX SHIFTS

We explore the consequences of five small tax shifts that preserve both the quantity of public goods that are provided (NIPA government consumption plus the product of government capital) and the level of private goods provided by the government (public revenue less the sum of NIPA government consumption and government investment). The offsetting tax increase for each tax reduction is an increase in the percentage of income from land that is collected by the property tax by one percentage point, from 9.85% to 10.85%. The five taxes that we separately decrease are shown in Table 2.

The variations in the reductions arise from the combination of two factors. First, the smaller the initial tax base, the larger the reduction that is possible. Second, the larger the increase in the tax base that is induced by the tax shift, the larger the reduction that is possible. The letters in the column “Impacts” indicate which of Equations (4) through (7) are affected by the tax reduction.

TABLE 2: Modeled Small Tax Reductions

			Reductions in Rates (%)				
	Current Rates (%)		*Average*		*Marginal*		
Tax	*Average*	*Marginal*	*Minimum*	*Maximum*	*Minimum*	*Maximum*	*Impacts*
Property tax on improvements	9.85	9.85	1.28	1.34	1.28	1.34	*k*
Profits tax	10.82	10.82	0.65	0.69	0.65	0.69	*t, k*
Individual income tax							
Assets	21.82	30.19	0.28	0.31	0.39	0.43	*t, k*
Labor	13.47	23.60	0.18	0.19	0.31	0.33	*l*
Social insurance	8.38	6.84	0.13	0.14	0.13	0.14	*l*
Sales tax	5.24	5.24	0.27	0.29	0.27	0.29	*p*

We model the reduction in the income tax as a change by the same proportion in average and marginal tax rates on labor income and asset income. We model a change in the social insurance tax as a reduction of the same absolute amount in the average and marginal taxes, as would occur if the reduction were applied to the tax that finances Medicare.

The tax rates vary during the course of the modeled period of tax reform, taking whatever value is necessary to yield the same level of public goods and publicly provided private goods as the prereform taxes. This is not the same as preserving the level of government revenue because we assume that government-owned capital also provides public goods, and both the quantity of government capital and the marginal product of government capital (assumed to be the same as the marginal product of private capital) can vary with the choice of taxes.

Table 2 shows that only very slight changes in taxes are needed over the course of 30 years to match the levels of public goods and publicly provided private goods of current taxes.

We report six measures of the impact of taxes on the economy:

- the percentage change in the wage after (average) taxes,
- the percentage change in work effort,
- the percentage change in the rate of return to saving after (average) taxes,

- the percentage change in saving,
- the percentage change in consumption, and
- the annual "net gain" as a percentage of net domestic product.

We compute each year's net gain as the answer to the question, "How much of this year's increase in saving would need to be converted to consumption of private goods to attain the same index of consumption (as a function of public goods, private goods, and leisure) as is attained this year under current taxes?" What is left of the increase in saving is the net gain.

The six measures of impact of the five small tax shifts are shown in Figures 1 through 6. (While the reported calculations were done for 30 years, the figures show effects for 40 years because some relationships change between 30 and 40 years.) The differences in the impacts of the tax changes can be traced to the fact that some tax shifts have their direct effects on saving, some have their direct effects on working, and some have their direct effects on both. In addition, when tax shifts affect asset income, some affect both capital income and land income, and some affect only capital income. Finally, a reduction in the income tax has an additional impact because of the fact that the marginal harm that is caused by any tax is roughly proportional to its marginal rate. Because the income tax is progressive, its marginal rate is greater than its average rate, so that proportional reductions in average and marginal income tax rates reduce marginal rates by more than average rates, giving reductions in the income tax extra impact.

The impacts on real wages are shown in Figure 1. The tax shift with the greatest initial impact on real wages is the shift from the social insurance tax to the land tax. However, the taxes with a significant impact on savings—the profit tax, the income tax, and especially the improvement component of the property tax—have impacts that grow more rapidly over time, so that after about 15 years, the shift from the income tax is the shift with the greatest impact on wages. After 30 years, the shift from the improvement tax is the shift with the greatest impact on wages. This happens because increases in the stock of capital increase the marginal product of labor, thereby increasing the marginal product of labor, which is reflected in wages. At all times, the sales tax and the profit tax are dominated by the social insurance tax in impact on wages.

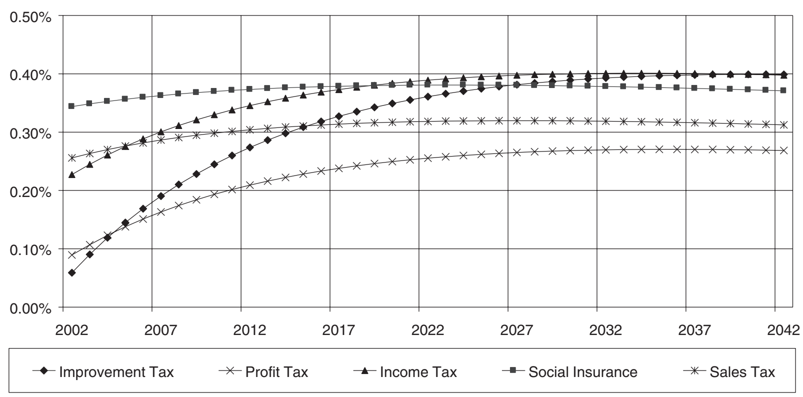

Figure 1: Percentage Change in Real Wage After Tax When Specified Taxes Are Reduced as Permitted by Increasing Land Rent Taxation by 1 Percentage Point

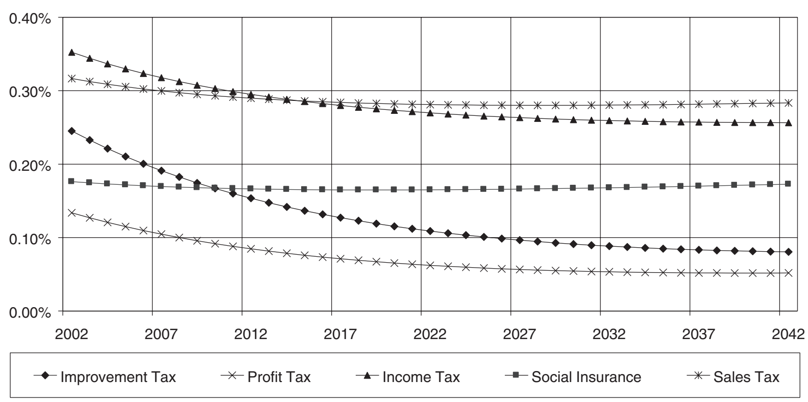

Figure 2: Percentage Change in Effort Per Worker When Specified Taxes Are Reduced as Permitted by Increasing Land Rent Taxation by 1 Percentage Point

The impacts of small tax shifts on percentage changes in work effort are shown in Figure 2. The shifts with the greatest impacts on work effort are from the income tax and the sales tax. There is no clear relationship between these effects and changes in well-being because impacts on work effort combine income and substitution effects that work in opposite directions. A rise in the real wage has a substitution

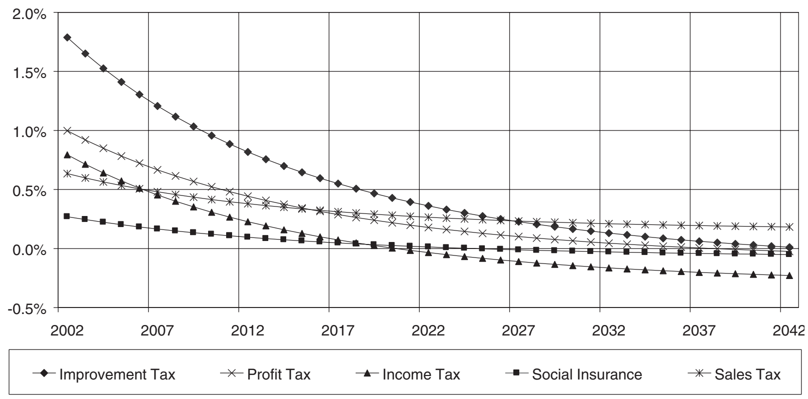

Figure 3: Percentage Change in Return to Capital After Tax When Specified Taxes Are Reduced as Permitted by Increasing Land Rent Taxation by 1 Percentage Point

effect that leads to more work, but the improved economic efficiency from the tax shifts has an income effect that lead to less work. The income effect is the reason that the impacts on work effort fall over time, and they fall more rapidly when taxes on saving are reduced, leading to income that rises more rapidly over time.

Figure 3 shows the impact of the small tax shifts on the return to capital after taxes. (An example of a 1% increase in the return to capital is an increase from 4% to 4.04%, not from 4% to 5%.) On average, the percentage changes in returns to capital are greater than the percentage changes in wages. This is a result of the fact that capital absorbs a smaller share of NDP, so that when a tax reduction of a given dollar size is concentrated there, it has a greater percentage impact on price. A tax shift from the improvement component of the property tax to land has the greatest impact on the return to capital. A shift from the social insurance tax has a small indirect impact on the return to capital despite affecting only labor directly because it induces people to work harder, which increases the marginal product of capital. Other tax reductions have intermediate initial effects. The long-run effects of tax shifts on the return to capital after taxes are smaller and more uniform.

Impacts of the small tax shifts on the amount of saving are shown in Figure 4. As with impacts on the return to saving, the impacts on the

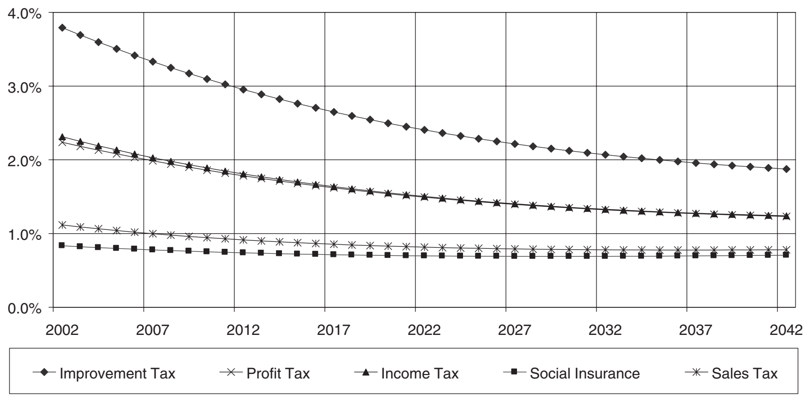

Figure 4: Percentage Change in Total Saving When Specified Taxes Are Reduced as Permitted by Increasing Land Rent Taxation by 1 Percentage Point

amount of saving are much greater on average than the impacts on work effort. Where the initial impacts on work effort ranged from 0.11% to 0.32%, the initial impacts on saving range from 0.47% to 3.44%. This is partly because the percentage changes in returns to savings are greater than the percentage changes in wages after taxes. But it is also partly because the income effect complements the substitution effect rather than working against it, as is the case with work effort. A shift away from the improvement component of the property tax has the greatest impact on the amount of saving. Shifts away from the property tax and the profit tax have intermediate impacts. Shifts away from the sales tax and the social insurance tax have the smallest impacts.

Figure 5 shows the impacts on consumption. Here, *consumption* means the quantity computed in Equation (2) that is a function of public goods, private goods, and leisure. It is an index of utility gained in an individual period and is the year's argument of the intertemporal utility function [Equation (3)]. If a tax shift yields more consumption than another in all time periods, then it is better for consumers. If a tax shift yields more consumption in some periods and another yields more consumption in other periods, then the question of which is better is likely to depend on the discount rate. By this criterion, a tax

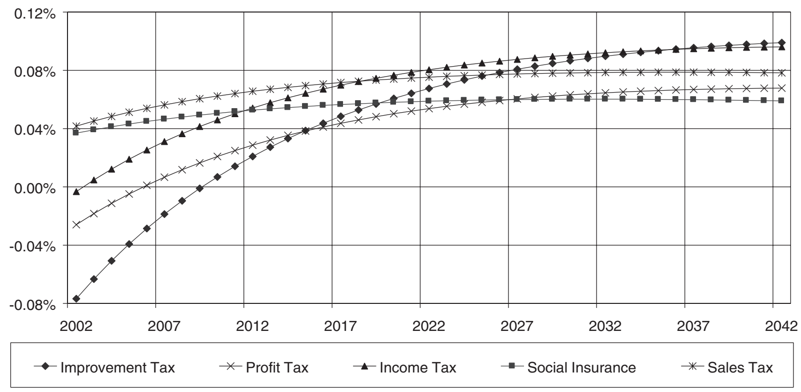

Figure 5: Percentage Change in Consumption When Specified Taxes Are Reduced as Permitted by Increasing Land Rent Taxation by 1 Percentage Point

shift away from the income tax appears to be unambiguously better than a tax shift away from the profit tax, and a tax shift away from the sales tax appears to be unambiguously better than a tax shift away from the social insurance tax. For the first 17 years that are modeled, a shift away from the sales tax provides the most consumption. After 17 years, a shift away from the income tax provides more consumption Beyond 43 years the shift away from the tax on improvements provides the most comsumption.

Net gain per dollar of tax shifted to land is shown in Figure 6. As mentioned previously, net gain in each year is measured as that part of the increase in saving in the year that would not be needed to keep consumption constant. For all of the small tax shifts, the net gain per dollar of tax shift starts between \$1.25 and \$1.75 and rises to a value between \$1.30 and \$2.45 after 30 years. For the first 5 years, a shift of taxes from the income tax has the greatest net benefit. After that, a shift from the tax on improvements has the greatest net benefit. The particular advantage of shifting the income tax is that this reduces the extra excess burden of the progressivity of the income tax. The particular advantage of reducing the tax on improvements is that this has the greatest positive impact on saving, and greater saving produces a greater stock of capital, which raises wages.

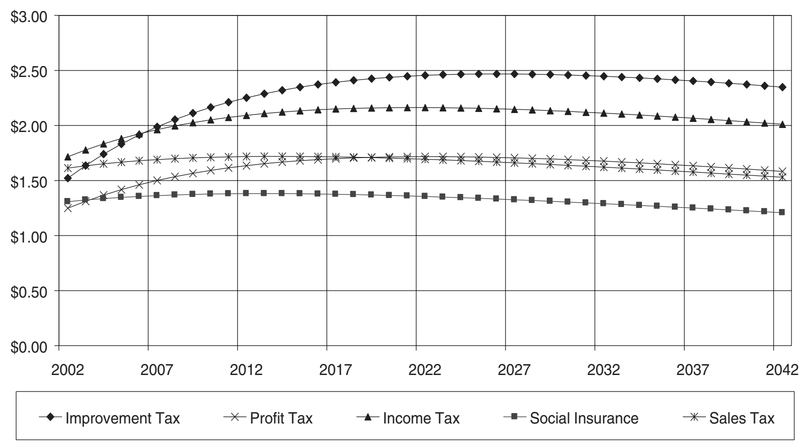

Figure 6: Net Gain Per Dollar of Tax Shift From Specified Taxes to Land Rent Taxation

5. IMPACTS OF LARGE TAX SHIFTS

In this section, we describe the economic effects of two large changes. The first of these is the replacement of the present progressive income tax with a flat tax on all income at the rate required to preserve present levels of public goods and publicly provided private goods. The required rate of the flat income tax increases from 13.01% initially to 13.22% after 30 years. The second large tax shift is an increase in the land tax to 90% of the rental value of land, combined with the elimination of the improvement component of the property tax, elimination of the tax on profits, elimination of the sales tax, elimination of import duties, and transformation of the income tax into a flat tax on all income at the rate required to preserve present levels of public goods and publicly provided private goods. The required rate of this tax starts at 7.65%, increases to 7.72% after 3 years, and then falls continuously to 7.18% after 30 years.

The impacts of these large tax shifts are not graphed with the others because the scale of their impacts dwarfs the other impacts. They are shown instead in Table 3.

Our analysis says that the introduction of a flat income tax would increase the incentive to work by so much at the margin that it would

TABLE 3: Impacts of Large Tax Shifts (in percentages)

	Δ Wage After Tax		*Δ Work Effort*		*Δ Interest Rate After Tax*	
	2002	*2032*	*2002*	*2032*	*2002*	*2032*
Flat income tax	–3.21	2.57	11.44	8.37	20.71	–7.71
Maximal land tax	13.45	35.09	27.80	18.92	102.4	2.49
	Δ Saving		*Δ Consumption*		*Net Benefit as % of Net Domestic Product*	
	2002	*2032*	*2002*	*2032*	*2002*	*2032*
Flat income tax	68.30	33.92	–1.61	1.62	2.49	5.54
Maximal land tax	219.5	115.1	–2.01	7.72	14.57	26.17

initially lower the wage after tax by 3.21%. But with work effort increasing by 11.44%, workers' pay would rise initially by 7.86%. After 30 years of a flat income tax, wages would be 2.57% higher than with existing taxes, and work effort would be 8.37% higher, producing an increase of 11.16% in workers' incomes. Because asset returns have higher average taxes than labor returns under the progressive tax system of the United States, a flat income tax has a much bigger impact on saving than on work. In its first year, it raises the interest rate after average taxes by 20.71% (not 20.76 percentage points!). Saving in the first year rises by 68.30%. After 30 years, income and saving have increased by so much that the interest rate after tax falls by 7.71% compared to current taxes, but saving is still 33.92% higher than under current taxes because people are so much richer. The effect on consumption is a reduction of 1.61% in the first year (because saving is so highly stimulated) and an increase of 1.62% after 30 years. The net benefit as a percentage of NDP is 2.49% in the first year and 5.54% after 30 years. In real 2000 dollars, this is $223 billion in the first year, rising to $849 billion in the 31st year.

Our maximal land tax permits the elimination of the improvements portion of the property tax, the profits tax, the sales tax, and import duties, along with a reduction of the income tax to a flat tax at a rate that varies between 7.72% and 7.18%. This raises the wage after tax by 13.45% in the first year and by 35.09% after 30 years. Work effort increases by 27.80% in the first year and by 18.92% after 30 years, so that workers' pay increases by 45.0% in the first year and by 60.6% after 30 years. The interest rate after taxes rises by 102.4% in the first year and by 2.49% after 30 years. The amount of saving rises by 219.5% compared to existing taxes in the first year and by 115.1% after 30 years. Consumption falls by 2.01% in the first year because the incentive to save is so great, and it rises by 7.72% after 30 years. The net benefit as a percentage of NDP is 14.6% in the first year and 26.2% after 30 years. In real 2000 dollars, this is $1,308 billion in the first year and $4,008 billion in the 31st year.

6. SENSITIVITY ANALYSES

In this section, we report the impacts on the analysis of employing alternative values for some of the data and parameters. To avoid a surfeit of information, we present Table 4 to show only the percentage changes in net benefits in 2002 and 2032 that result from employing alternative assumptions.

Table 4 reveals that the model is only slightly sensitive to variations in assumptions about elasticities of substitution and the rate of technological progress. Among these parameters, the greatest short-run sensitivity is to the elasticity of substitution in consumption, and the largest change is only 13%. The greatest long-run sensitivity is to the technological factor, where the effects after 30 years range from 15% to 24%.

The model is more sensitive to the value of land, the value of capital, and the current efficiency with which land is used. Reducing the value of land by one third reduces the short-run net benefits of most tax shifts by about 20% and the long-run benefits by about 15%. Increasing the value of land by one third increases the short-run net benefits of most tax shifts by about 15% and the long-run benefits by about 5% to 10%. There are two exceptions to these generalizations. The short-run net benefits of a shift to a flat income tax are relatively insensitive to the value of land, but the long-run net benefits are noticeably greater when the value of land is lower. The long-run benefits of the maximal land tax are also relatively insensitive the value of land.

TABLE 4: Percentage Change in Net Benefits in 2002, 2032 Under Alternative Assumptions

	Tax Reform						
Alternative Assumption	*Improvements*	*Profit*	*Income*	*Social Insurance*	*Sales*	*Flat Tax*	*Maximal Land Tax*
Elasticity of substitution in production = .65	0, –10	2, –7	2, –6	5, 4	4, 2	–8, –21	–2, –9
Elasticity of substitution in production = .95	1, 13	–1, 9	–1, 8	–3, –2	–3, –1	6, 21	1, 11
Technical factor = 1.005	–2, –19	–1, –17	–1, –16	–1, –15	–1, –16	–1, –16	–1, –16
Technical factor = 1.015	2, 24	1, 21	1, 19	1, 18	1, 19	1, 19	1, 19
Elasticity of substitution in consumption = .65	–3, –14	–3, –11	–10, –18	–8, –14	–12, –18	–12, –16	–6, –14
Elasticity of substitution in consumption = .95	3, 14	3, 11	10, 20	8, 15	13, 20	12, 16	6, 14
Intertemporal elasticity of substitution = .25	–7, 1	–5, 1	–5, 0	–1, 2	–2, 2	–7, –3	–2, –1
Intertemporal elasticity of substitution = .50	6, 1	4, –1	4, 0	1, –1	2, –1	6, 1	1, 1
Land value reduced by one third	–24, –16	–20, –9	–19, –11	–21, –16	–20, –15	6, 21	–16, –4
Land value increased by one third	19, 11	14, 4	14, 5	15, 11	15, 10	–5, –14	12, 2
Capital reduced by 25%	20, 0	15, –2	18, 1	18, 9	20, 7	1, –16	17, 2
Capital increased by 25%	–14, –4	–12, –1	–13, –3	–13, –8	–14, –7	–2, 11	–12, –3
Land efficiency = 25%	6, 14	19, 37	10, 28	15, 32	10, 26	10, 36	15, 24
Land efficiency = 75%	–24, –25	–37, –43	–27, –35	–34, –44	–28, –37	–7, –19	–37, –33

Reducing the value of capital by 25% has an effect comparable to the effect of increasing the value of land by one third, and increasing the value of capital by 25% has about two thirds of the effect of reducing the value of land by one third. The flat tax is again an exception, where there is little effect in the short run, and in the long run the effect varies with the value of capital. Once again, the long-run benefits of the maximal land tax are relatively insensitive to the initial value of capital.

Reducing the initial land efficiency from 50% to 25% increases the short-run net benefits of tax shifts by about 10% and the long-run benefits by about 30%. Increasing the initial land efficiency to 75% reduces most of the short-run and long-run net benefits of the modeled tax shift by about 30%.

On the basis of the previous results, we designed a “worst case,” in which all of the tested parameters were moved to the ends of their ranges that gave the lowest net benefits of shifting taxes to land. The elasticities of substitution in production and consumption were set to 0.65. The intertemporal elasticity of substitution was set to 0.25. The technological change parameter was set to 1.005. Land value was reduced by one third, and capital was increased by 25%. Finally, the initial land efficiency was set at 75%. With these parameters, the benefit of a flat income tax was reduced by 27% in the short run and by 37% in the long run. The benefits of shifting taxes to land were reduced by 55% to 57% in the short run and by 55% to 65% in the long run. For the maximal land tax, this still left a net gain of $591 billion in the first year (6.6% of NDP) and $1,784 billion in the 31st year (9.9% of NDP).

7. CONCLUSION

Significant increases in the efficiency of the U.S. economy could be attained by flattening the income tax and by shifting taxes from labor and capital to land. In the short run, the greatest increase in after-tax wages is achieved by shifting taxes from wages to land. In the long run, the greatest increase in wages is achieved by shifting taxes from capital to land. Uncertainty about the value of land and current land efficiency creates significant uncertainty about the magnitude of the efficiency gains that might be achieved. But even if pessimistic estimates of parameter values are used, the potential gains start at 6.6% of NDP per year and rise to 9.9% of NDP per year after 30 years.

APPENDIX
Economic Data for the United States for 2000
(billions of dollars; millions of persons)

	Total	*Government*	*Private*
Gross domestic product	9,872.9	1,084.2	8,788.7
– Depreciation	1,241.3	180.2	1,061.1
Equals net domestic product	8,631.6	904	7,727.6
Employees' compensation	5,715.2	904	4,811.2
+ Proprietors' income	715		715
+ Rental income	141.6		141.6
+ Corporate profits	876.4		876.4
+ Net interest	532.7		532.7
Equals national income	7,980.9		7,076.9
+ Indirect business taxes	762.7		762.7
+ Business transfer payments	43.9		43.9
– Statistical discrepancy	–130.4		–130.4
– (Subsidies – current surplus of government enterprises)	–37.6		–37.6
Equals net national product	8,619.5		7,715.5
– Income receipts from the rest of the world	–384.2		–384.2
+ Income payments to the rest of the world	396.3		396.3
Equals net domestic product	8,631.6		7,727.6
Value of assets			52,980.1
– Value of capital	28,414.5	5,742.6	22,671.9
Equals value of land			30,308.2
Gross investment	2,085.8	318.3	1,767.5
Net investment	844.5	138.1	706.4
Total compensation	5,715.2	904	4,811.2
Wage and salary accruals	4,837.2	768.4	4,068.8
Employers' contribution to social insurance	343.8		
Other labor income	534.2		
Labor force	140.863		
Employment	135.208	20.681	114.527
Hours per week	34.5		

(continued)

APPENDIX (continued)

	Total	*Government*	*Private*
Personal consumption expenditure	6,728.4		
+ Gross private domestic investment	1,767.5		
+ Net exports	–364		
+ Government consumption and gross investment	1741		
Equals gross domestic product	9,872.9		
Population growth rate in 2000	0.009071		
Annual change in population growth rate	–0.000047		

	Average	*Marginal*
Average and marginal income tax rates		
Labor	0.1345	0.2356
Assets	0.2179	0.3014
Specified economic parameters		
Elasticity of substitution in production	0.8	
Rate of autonomous technical progress	0.01	
Maximum labor as multiple of current effort	3.25	
Elasticity of substitution between goods and leisure	0.8	
Intertemporal elasticity of substitution	0.375	
Current land efficiency	0.5	
Public revenue		
Property taxes	248.4	
Corporation profit tax	246.1	
Income taxes	1,219.3	
Social insurance	701.5	
Excise taxes	69.8	
Customs duties	21.1	
Sales taxes	321.5	
Other taxes	20.7	
Total taxes	2,848.4	
Federal reserve profit	25.3	
Nontaxes	150.1	
Total	3,023.8	
Social Security facts		
Old Age and Survivors' Insurance (OASI) tax revenue	371.2	
Limit for OASI tax	68,400	
OASI tax rate	0.107	
% of labor income covered by OASI taxes	0.924	
Persons with maximum taxed earnings	9,323	
% of covered income that is taxed	0.845	
% of OASI payment that is tax	0.689	

REFERENCES

Alogoskoufis, George S. 1987. On intertemporal elasticity of substitution and aggregate labor supply. *Journal of Political Economy* 95 (5): 938-60.

Arrow, Kenneth, Hollis B. Chenery, Bagicha Minhas, and Robert M. Solow. 1961. Capital-labor substitution and economic efficiency. *Review of Economics and Statistics* 43:225-50.

Auerbach, A. J., L. J. Kotlikoff, and J. Skinner. 1983. The efficiency gains from dynamic tax reform. *International Economic Review* 24 (1): 81-100.

Ballard, C. L., J. B. Shoven, and J. Whalley. 1985. The total welfare cost of the US tax system. *National Tax Journal* 38:125-40.

Barro, Robert J. 1998. Notes on growth accounting. NBER working paper no. 6654, Cambridge, MA.

Bernanke, Ben S., and Refet S. Gurkaynak. 2001. Is growth exogenous? Taking Mankiw, Romer, and Weil seriously. NBER working paper no. 8365, Cambridge, MA.

Bernard, Andrew B., and Charles I. Jones. 1996. Productivity across industries and countries: Time series theory and evidence. *Review of Economics and Statistics* 78:135-46.

Berndt, Ernst R. 1976. Reconciling alternative estimates of the elasticity of substitution. *Review of Economics and Statistics* 58:59-68.

Bodkin, Ronald G., and Lawrence R. Klein. 1967. Nonlinear estimation of aggregate production functions. *Review of Economics and Statistics* 49:28-44.

Boskin, Michael J., and Lawrence J. Lau. 2000. Generalized Solow-neutral technical progress and postwar economic growth. NBER working paper no. 8023, Cambridge, MA.

Brown, Harry G. 1927. Land speculation and land-value taxation. *Journal of Political Economy* 35:390-402.

Chung, Jae Wan. 1987. On the estimation of factor substitution in the translog model. *Review of Economics and Statistics* 69:409-17.

Cronin, Francis J., Elisabeth Colleran, and Mark Gold. 1997. Telecommunications, factor substitution and economic growth. *Contemporary Economic Policy* 15:21-31.

Dhrymes, Phoebus J., and Paul Zarembka. 1970. Elasticities of substitution for two-digit manufacturing industries: A correction. *Review of Economics and Statistics* 52:115-17.

Feldstein, Martin, and Andrew Samwick. 1992. Social Security rules and marginal tax rates. *National Tax Journal* 45:1-22.

Gaffney, M. Mason. 1961. Ground rent and the allocation of land among firms. In *Rent theory: Problems and practices*, edited by F. Miller, 30-49, 74-82. Columbia: University of Missouri.

———. 1973. Tax reform to release land. In *Modernizing urban land policy*, edited by M. Clawson, 115-52. Baltimore: Johns Hopkins University Press.

Ghez, Gilbert R., and Gary S. Becker. 1975. *The allocation of time and goods over the life cycle*. New York: Columbia University Press.

Griliches, Zvi. 1967. Production functions in manufacturing: Some preliminary results. In *The theory and empirical analysis of production: Studies in income and wealth*, edited by M. Brown, 275-322. New York: Columbia University Press.

Jorgenson, Dale W., and Kun-Young Yun. 1991. The excess burden of taxation in the United States. *Journal of Accounting, Auditing & Finance* 6 (4): 506-7.

Kalt, Joseph P. 1978. Technological change and factor substitution in the United States: 1929-1967. *International Economic Review* 19:761-75.

Kendrick, John W., and Ryuzo Sato. 1963. Factor prices, productivity and economic growth. *American Economic Review* 53:974-1003.

Milgrom, Paul, and Robert J. Weber. 1982. A theory of auctions and competitive bidding. *Econometrica* 50:1089-122.

Nechyba, Thomas J. 2001. Prospects for land rent taxes in state and local tax reforms. Working paper, Lincoln Institute of Land Policy, Cambridge, MA.

Paraskevopoulos, Christos C. 1979. Alternative estimates of the elasticity of substitution: An inter-metropolitan CES production function analysis of US manufacturing industries, 1958-1972. *Review of Economics and Statistics* 61:439-42.

Rowthorn, Robert. 1999. Unemployment, capital-labor substitution, and economic growth. Working paper of the International Monetary Fund, Washington, DC.

Solow, Robert. 1964. Capital, labor and income in manufacturing. In *The behavior of income shares: Selected theoretical and empirical issues*, 101-28. NBER Studies in Income and Wealth, no. 27. Princeton, NJ: Princeton University Press.

Tideman, Nicolaus. 1999. Taxing land is better than neutral: Land taxes, land speculation and the timing of development. In *Land-value taxation: The equitable and efficient source of public finance*, edited by Ken Wenzer, 109-33. Armonk, NY: M. E. Sharpe.

Nicolaus Tideman is a professor of economics at Virginia Polytechnic Institute and State University. Ebere Akobundu, Andrew Johns, and Prapaiporn Wutthicharoen are graduate students at Virginia Polytechnic Institute and State University.