CORPORATE INCOME TAXATION AND U.S. ECONOMIC GROWTH

by

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1. Introduction

In June 2001 President George W. Bush signed the Economic Growth and Tax Relief and Reconciliation Act into law, initiating a ten-year program of tax reductions in personal taxes. In January 2003 the President authorized the Jobs and Growth Tax Relief Reconciliation Act of 2003, substantially reducing taxes on business income. The tax legislation of 2001 and 2003 led to major reductions in federal revenue. In January 2005 President Bush convened the President's Advisory Panel on Tax Reform. The Panel presented its report, "SIMPLE, FAIR, & PRO-GROWTH: Proposals to Fix America's Tax System" in November 2005. The tax reform proposals of the President's Advisory Panel are designed to be "revenue-neutral", so that federal revenue would not be affected.

Pamela Olson, U.S. Treasury's top tax official in 2002, emphasized revenue neutrality in a memorandum to then-Secretary Paul O'Neill, "Tax Reform Materials." [1] This was an important objective of the Tax Reform Act of 1986 and insulated the two-year debate over tax reform in the mid-1980's from the contentious issue of the federal deficit. Olson divided the Treasury's tax reform programs between short-run measures to simplify the tax code and long-run proposals to reform the tax system. It is important to emphasize that there is no conflict between these goals. Somewhat paradoxically, tax simplification is necessarily complex, since it would eliminate many, but not all, of the myriad special provisions of tax law affecting particular transactions. By contrast tax reform is relatively straightforward.[2]

The major objective of tax reform is to remove barriers to efficient capital allocation. These arise from disparities in the tax treatment of different forms of capital income. The centerpiece of the Bush Administration's 2003

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[1] Pamela F. Olson, "Tax Reform Materials," Washington, U.S. Department of the Treasury, November 7, 2002.

[2] A comprehensive review of current proposals for tax reform is presented in Alan J. Auerbach and Kevin A. Hasset, "TOWARD FUNDAMENTAL TAX REFORM," Washington, The AEI Press, 2005.

tax cuts on business income was the reduction of taxes on dividend income at the individual level. This helped to mitigate one of the most glaring deficiencies of the U.S. tax system, namely, double taxation of corporate income. In the U.S., as in most other countries, corporate income is taxed, first, through the corporate income tax and, second, through individual taxes on corporate distributions, such as dividends. Non-corporate income is taxed only at the individual level. The President's Advisory Panel [3] has identified substantial differences between the tax treatment of corporate income and the treatment of non-corporate income that remained after the 2003 tax cuts.

The Bush Administration's tax legislation in 2001 and 2003 failed to address a second major barrier to efficient capital allocation. This is the exclusion of owner-occupied housing from the tax base. Income for non-corporate business is taxed at the individual level and corporate income is taxed at both corporate and individual levels. However, income from owner-occupied housing is not taxed at either level. Jorgenson and Yun (2001) have shown that any tax reform that leaves owner-occupied housing untaxed would sacrifice most of the economic gains. President Bush's instructions to the Advisory Panel on Tax Reform included "preservation of incentives for home ownership", language intended to preserve the tax-free status of owner-occupied housing. This nullified most of the potential economic gains from tax reform at the outset.

The challenge for tax reform is to eliminate the barriers to efficient capital allocation arising from the corporate income tax and the exclusion of owner-occupied housing from the tax base. One way of meeting this challenge is to shift the tax base from income to consumption. This approach would eliminate individual and corporate income taxes altogether and replace income tax revenues by revenue from a consumption tax. The President's Advisory Panel has emphasized that the U.S. tax system is a hybrid of income and consumption taxes. For example, contributions to qualified retirement plans and earnings on accumulated assets are exempt from the individual income tax. Withdrawals from pension plans to finance consumption are subject to the tax, so that pensions are taxed as consumption, not income.

During the 1990's the Committee on Ways and Means of the U.S. House of Representatives held extensive hearings on proposals to shift the federal tax base from income to consumption. The proposals included replacing individual and corporate income taxes by a European-style value-added tax,

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[3]Figure 5.5, page 71.

the Hall-Rabushka Flat Tax, or a National Retail Sales Tax. With Australia's adoption of a value-added tax in 1999, the U.S. remains the only industrialized country without such a tax. All three proposals were considered by the President's Advisory Panel before settling on the Growth and Investment Tax Plan, a consumption tax proposal based on David Bradford's (2004) X-Tax and closely related to the Flat Tax.

One potential advantage of a consumption tax is a low marginal rate, the rate that applies to the last dollar of consumption. If all of consumption could be included in the tax base, a revenue-neutral tax rate would be relatively low, providing powerful new incentives for work and saving. However, making a consumption tax progressive by excluding substantial portions of consumption from the tax base would considerably increase the marginal rate. One popular proposal for replacing the existing income tax system by a consumption tax, the Hall-Rabushka Flat Tax, would reduce the marginal rate to only 19%. However, a revenue-neutral Flat Tax that includes state and local as well as federal taxes would require a much higher rate of 29%. A National Retail Sales Tax with the same progressivity as the Flat Tax would require an average sales tax rate of 34% and a marginal rate of 45%, combining state and local with federal sales taxes!

The purpose of shifting the tax base from income to consumption is to remove income from new investments from the tax base. As these investments grow, taxation of income from capital is gradually eliminated. This is a drastic, but effective, way of equalizing the treatment of capital income from corporations, non-corporate businesses, and owner-occupied housing. The Achilles heel of proposals to shift the tax base from income to consumption, at least so far, is the redistribution of tax burden. Recipients of income from property, including corporate bonds and shares, are generally much more affluent that recipients of income from work. Excluding property-type income from the tax base would radically shift the burden of taxation from the rich to the poor.

A second approach to removing barriers to efficient capital allocation is to reform the existing income tax system. The President's Advisory Panel has presented a Simplified Income Tax Plan that would eliminate double taxation of corporate income. Although the corporate income tax would remain, distributions of income subject to the tax, such as dividends, would be exempt from the individual income tax. Integration of the individual and corporate income tax systems had been proposed by the Treasury (1992)in a widely cited study, "INTEGRATION OF THE INDIVIDUAL AND CORPORATE INCOME TAX SYSTEMS: Taxing Business Income Once." The

Advisory Panel [4] points out that the Simplifed Income Tax Plan would have only a modest impact on disparities in the tax treatment of corporate and non-corporate income. More important, it would exacerbate differences between the tax treatment of business income and the treatment of income from owner-occupied housing.

A more effective method for equalizing the treatment of different forms of capital income is Efficient Taxation of Income, proposed by Jorgenson and Yun (2005). This would avoid a wrenching shift in tax burdens by the simple expedient of introducing different tax rates for property-type income and earned income from work. Earned income would be taxed at a flat rate of 10.9%, while property-type income would be taxed at 30.8%. Precisely the same distinction between earned and property-type income existed in the U.S. tax code between 1969 and 1982, so that no new tax loop holes would be created.

The key to Efficient Taxation of Income is a system of investment tax credits that would equalize tax burdens on all sources of business income. Each dollar of new investment would generate a credit against taxes on business income. The rates for these tax credits would be chosen to equalize burdens. The average tax credits for corporations would be 4% on equipment and 19% on structures. Noncorporate businesses would receive smaller credits of 0.5% on equipment and 8% on structures.

It is critically important to equalize tax burdens on business and household assets, including housing and consumers' durables like automobiles. Efficient Taxation of Income would include a system of prepayments of future taxes on household assets. These prepayments would be collected on new investments by households at the time of purchase. The prepayments would be collected by car dealers, real estate developers, and other providers and included in the prices paid by households. The prepayment rates would be 7% on new durables and 32% on new housing. This new source of revenue would precisely offset the new tax credits for business investment, preserving revenue neutrality.

What are the gains from tax reform? This requires an answer to the question: How much extra wealth would be required to purchase the additional consumption of goods and services, as well as leisure, made possible by the reform? This is the appropriate yardstick for comparing alternative tax reform proposals, since consumption rather than investment is the objective of all economic activity.

In Section 2 we estimate that gains to consumption from Efficient Taxa-

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[4]Figure 5.5, page 71.

tion of Income would be equivalent to the addition of 19 cents to every dollar of U.S. national wealth. The total gains would be a whopping $4.9 trillion! By comparison GDP was $8.1 trillion and National Wealth was $25.4 trillion in 1997, the base year for this comparison. By contrast the additional wealth gernated by corporate tax integration, the core of the Advisory Panel's Simplified Income Tax Plan, would be only $250 billion, slightly more than 5% of the gains from Efficient Taxation of Income.

The extra wealth generated by Efficient Taxation of Income encapsulates the gains in consumption made possible by shifting investment to higher-yielding assets. Instituting new investment tax credits would stimulate investment, especially in the corporate sector. These gains also reflect elevated investment levels and more rapid economic growth. The resulting surge in economic activity would raise both earned income from work and property-type income and stimulate consumption.

Efficient Taxation of Income would also have a much greater impact than a revenue-neutral version of the Flat Tax. In Section 3 we estimate that the Flat Tax would yield $2.1 trillion in additional wealth, less than half the gains from Efficient Taxation of Income of $4.9 trillion. Although the Advisory Panel's Growth and Investment Tax Plan is similar to the Flat Tax, the gains would be further diminished by the Panel's introduction of a substantial tax subsidy to owner-occupied housing; this is not included in the Flat Tax.

In Section 4 we conclude that tax reform proposals, like cherry blossoms, are hardy perennials of the Washington scene. Occasionaly, a new approach to tax reform appears and changes the course of the debate. President Reagan's proposal of May 1985 is the most recent example of a new approach to tax reform. Like Efficient Taxation of Income, this retained the income tax rather than shifting to a consumption tax. This is still the most rewarding direction for reform.

2. Income Tax Reform

In order to evaluate the economic impact of alternative tax reform proposals, we employ a dynamic general equilibrium model.[5] The economy is characterized by a price system that clears markets for labor and capital services and consumption and investment goods. These prices link past and future through markets for investment goods and capital services. Assets are accumulated through past investments, while asset prices equal the present values of future capital services. Consumption must satisfy conditions for optimality of the household sector under perfect foresight. Similarly, investment must satisfy requirements for asset accumulation.

We employ our dynamic general equilibrium model to simulate the economic impact of proposals to reform the taxation of capital income. We have designed a computational algorithm for determining the future time path of the U.S. economy, following reform. This algorithm is composed of two parts. We first solve for the unique steady state of the economy corresponding to our reference tax policy, the Tax Policy of 1996. We then determine the unique transition path between the initial state of the economy and the steady state. This is the base case for our analysis of changes in tax policy.

The second part of our algorithm is to solve our model for the unique transition path of the U.S. economy after tax reform. We first consider the elimination of differences in tax burdens among classes of assets and sectors of the economy. Altogether we consider ten alternative programs for reforming the taxation of capital income. We also consider the cost of progressivity in the taxation of labor income by comparing the existing graduated labor income tax with a flat labor income tax.

We compare the level of social welfare associated with present and future consumption under tax reform with the welfare level in the base case. We translate these welfare comparisons into monetary terms by introducing an equivalent variation in wealth. This gives the additional wealth required to achieve the new time path of consumption resulting from tax reform. Using the equivalent variation in wealth, we translate the differences in consumption into monetary terms.

In order to evaluate the economic impact of alternative tax reforms we require a reference economy to serve as a benchmark. We take the U.S. economy under the tax laws effective in 1996 as the point of reference. We use this as the standard to capture the fact that the Bush Administration's tax cuts of 2001 and 2003 are scheduled to "sunset" within a ten-year

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[5]This model updates the dynamic general equilibrium model presented in Jorgenson and Yun (1990). Additional details are given by Jorgenson and Yun (2001).

budget window. Under provisions of this legislation the tax cuts would be replaced by the pre-existing tax system. The most notorious example of these provisions is the abolition of the Estate Tax in 2010, followed by its re-institution in 2011. We take January 1, 1997, as the starting point for all the simulations we consider. The most important role of this initial year is to determine the scale of the economy. This particular choice has the added advantage that it precedes the "dot-com" bubble of the late 1990's, as well as the Bush tax cuts.

The simulated dynamic path of the reference economy is the "base case" for our analysis of the economic impact of alternative tax reforms. We describe the construction of the base case by presenting the exogenous variables that are common to all the simulations we consider. The stock variables determined by the initial year are the total time endowment, capital stock, and the claims on the government and the rest of the world. In our simulations these variables are set at their historical values. Specifically, in 1997 the time endowment was $17,571 billion, capital stock was $25,847 billion, and government debt was $3,784 billion.

After 1997, we assume that the distribution of individuals among the categories distinguished by age, sex, and level of education will stabilize and hence the quality of time endowment, leisure, and the labor employed in the various sectors of the economy will not change. This implies that the growth rate of the total effective time endowment will be the same as the growth rate of population. We assume that population will grow at an annual rate of one percent per year and the efficiency of labor improves at the rate of productivity growth.

In table 2.1 we present the tax rates that describe the U.S. tax system in 1996. These include the marginal tax rates on individual capital income, the corporate income tax rate, the marginal tax rate on labor income and the average tax rate on personal income. The tax rates also include sales and property taxes, personal non-taxes, and wealth taxes.

Capital consumption allowances are permitted only for corporate and noncorporate business sectors. In table 2.2 we give the present values of these allowances for short-lived and long-lived assets under alternative rates of inflation. We begin the calculation of the capital consumption allowances with the statutory depreciation schedules. We employ the after-tax nominal interest rate for discounting depreciation allowances.

In our model, the time horizon of the household sector is infinite, so that the model is consistent with a wide range of steady-state configurations of the economy. From a practical point of view, this implies that the steady-state can be very different from the initial conditions. We estimate the economic impact of the alternative tax reform proposals under four alternative methods for adjusting tax revenues. The adjustment of tax revenues is necessary to keep the government's real budgetary position on the same path as in the base case economy. This approach ensures that the government budget does not affect the measured economic impact either through expenditures or through budget deficits or surpluses.

Under the 1996 tax law, inflation increases the tax burden of corporate assets faster than that of noncorporate assets and the burden of noncorporate assets faster than that of household assets. But inflation has mixed effects on the absolute size of the intersectoral tax wedges where the tax wedges have negative sign. Table 2.3 shows the impact of inflation on the performance of the U.S. economy under the 1996 tax law. An increase in the rate of inflation reduces welfare under a lump sum tax adjustment, but enhances welfare under labor income tax, sales tax, and individual income tax adjustments.

The economic impact of tax distortions can be measured through the improvements in economic welfare when the tax wedges are eliminated. We first analyze the impact of distortions resulting from the taxation of income from capital. We consider the elimination of tax wedges among assets and among sectors. We also consider the eliminate of wedges between rates of return before and after taxes. Specifically, we measure the gains from the following changes in the 1996 tax system:

1. Eliminate tax wedges between short-lived and long-lived assets within each sector.

2. Eliminate tax wedges between short-lived and long-lived assets in the business sector — corporate and noncorporate.

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Table 2.1 Inflation and tax rates (1996)

1. Marginal Tax Rates on Individual Capital Income

Inflation Rate	0.0	0.04	0.08
t_q^e	0.20166	0.20203	0.20228
t_m^e	0.28786	0.28786	0.28786
t_h^e	0.28786	0.28786	0.28786
t_q^g	0.05589	0.05589	0.05589
t_m^g	0.07196	0.07196	0.07196
t_h^g	0.00000	0.00000	0.00000
t_q^d	0.17096	0.18228	0.18971
t_m^d	0.22480	0.23003	0.23346
t_h^d	0.26910	0.26917	0.26921
t_g^d	0.19893	0.20252	0.20488

2. Corporate Income Tax Rate

t_q	0.38799

3. Marginal Tax Rate on Labor Income

t_L^m	0.26447

4. Average Tax Rate on Personal Income

t_L^a	0.12657
t_e^a	0.18304
t_d^a	0.18304

5. Sales Tax

t_C	0.05800
t_I	0.05800

6. Property Tax

t_q^p	0.01201
t_m^p	0.01137
t_h^p	0.00912

7. Others

t_t	0.00675
t_w	0.00083

Notation:

Note : We set $t_h^e = t_m^e$ and $t_h^g = 0$.

t_q^e, t_m^e, t_h^e: Average marginal tax rates of individual income accruing to corporate, noncorporate and household equities, respectively.

t_q^g, t_m^g, t_h^g: Average marginal tax rates of capital gains accruing to corporate, noncorporate and household equities, respectively.

t_q^d, t_m^d, t_h^d, t_g^d: Average marginal tax rats of interest income accruing to corporate, noncorporate, household, and government debts, respectively.

t_q: Corporate income tax rate (federal + state and local).

Table 2.1 continued

t_L^m:	Average marginal tax rate of labor income.
t_L^a:	Average tax rate of labor income.
t_e^a, t_d^a:	Average tax rates of personal capital income from equity and debt.
t_c, t_I:	Sales tax rates of consumption and investment goods.
t_q^p, t_m^p, t_h^p:	Property tax rates of corporate, noncorporate and household assets, respectively.
t_t:	Rate of personal non-taxes.
t_w:	Effective rate of wealth taxation.

Table 2.2 Present value of capital consumption allowances (1996)

Inflation rate	Corporate		Noncorporate	
	Short	Long	Short	Long
0.00	0.9299	0.5418	0.9347	0.4962
0.04	0.8801	0.4574	0.8878	0.3909
0.08	0.8360	0.3982	0.8460	0.3197

Table 2.3 Welfare effects of inflation under the law (billions of 1997 dollars)

Rate of inflation	Revenue adjustment	Welfare effect
0%	Lump sum tax	482.4
	Labor income tax	−89.5
	Sales tax	−96.8
	Individual income tax	−89.2
4%	Lump sum tax	0.0
	Labor income tax	0.0
	Sales tax	0.0
	Individual income tax	0.0
8%	Lump sum tax	−407.0
	Labor income tax	15.6
	Sales tax	31.6
	Individual income tax	19.0

Note: In 1997, the national wealth (beginning of the year) and GDP were $25,378 and $8,111 billion dollars, respectively.

Table 2.4 Steady state of the base case (rate of inflation: 4%)

| | Corporate | | Noncorporate | | Household | |
	Short	Long	Short	Long	Short	Long
w	0.0868	0.2430	0.0178	0.2076	0.0968	0.3480
z	0.8801	0.4574	0.8878	0.3909	0.0000	0.0000
δ	0.1367	0.0175	0.1533	0.0112	0.1918	0.0107
PKS	0.2211	0.1066	0.2276	0.0849	0.2486	0.0602

Notations:
w: Share of capital stock
z: Present value of consumption allowances
δ: Economic depreciation rate
PKS: Price of capital services

3. Eliminate tax wedges for short-lived and long-lived assets among all sectors—corporate, noncorporate, and household.

4. Eliminate all tax wedges in the business sector.

5. Eliminate all tax wedges in the private sector.

6. Corporate tax integration.

7. Eliminate taxation of income from capital.

8. Eliminate capital income taxes and the sales tax on investment goods.

9. Eliminate capital income taxes and property taxes.

10. Eliminate capital income taxes, the sales tax on investment goods, and property taxes.

In order to eliminate tax wedges among asset categories, we set the social rates of return to be equal. The social rate of return is the rate of return before all taxes, adjusted for inflation. This is calculated by substracting the rate of depreciation from the price of capital services. The social rate of return includes the inflation-adjusted rate of return after all taxes, together with the tax burdens due to corporate income taxes, individual income taxes, and property taxes. The tax burdens are partly offset

by capital consumption allowances. We equalize social rates of return by assigning an appropriate investment tax credit to each category of assets.

Table 2.4 shows the present values of capital consumption allowances z and the rates of economic depreciation δ. It also shows the steady-state allocation of capital stock w and prices of capital services PKS for the base case corresponding to the 1996 tax system. The tax credits required for the first six sets of changes in the 1996 tax system given above are presented in panel 2 of table 2.5, along with the corresponding social rates of return and effective tax rates. For comparison base case figures are presented in panel 1.

In the first tax change we equalize the social rates of return to short-lived and long-lived assets within each sector. There is, of course, no tax wedge between assets within the household sector, since no tax is levied on household sector income and property tax rates are the same for short-lived and long-lived assets. In this reform the tax wedges among corporate, non-corporate, and household sectors are maintained. In the second tax change we equalize social rates of return for a given category of assets between the corporate and noncorporate sectors. However, the tax wedges between assets within a sector remain the same. The third tax reform extends the equalization of social rates of return to assets in the household sector.

In the fourth tax change both all tax wedges within the business sector are removed; in the fifth tax change this is extended to the household sector. This leads to efficient allocation of capital within each time period and is the first component of Efficient Taxation of Income, discussed below. We implement the first five tax reforms listed above by equalizing social rates of return on different categories of assets. We set these rates of return at the average values in the steady state of the base case corresponding to the 1996 tax law. This assures that the resulting tax change will be approximately revenue neutral.

Our sixth program for reforming the income tax system is corporate tax integration. This tax change closely resembles the President's Advisory Panel's Simplified Income Tax Plan and was originally proposed by the Treasury (1992). Corporate tax integration is achieved by setting social rates of return for short-lived and long-lived assets in the corporate sector equal to their values in the noncorporate sector. The resulting shortfall in tax revenue must be eliminated by increasing other taxes in order to achieve revenue neutrality. Unlike Efficient Taxation of Income, the Simplified Income Tax Plan does not remove tax wedges between business and household sectors.

In the seventh through tenth tax changes described above we evaluate the potential welfare gains from the elimination of tax wedges between rates

of return before and after taxes. These are determined by capital income taxes, sales taxes on investment goods, and property taxes. The seventh tax change eliminates taxation of capital income for both individuals and corporations. We then proceed step-by-step to eliminate the tax wedges. In the eighth tax change we eliminate the sales tax on investment goods, as well as capital income taxes. In the ninth tax change we also eliminate property taxes. Finally, in the tenth change we eliminate capital income taxes and sales taxes on investment goods, as well as property taxes.

The welfare effects of the ten tax reform proposals are summarized in table 2.6. We begin with simulations based on a lump sum tax adjustment to achieve revenue neutrality. A lump sum tax is a purely hypothetical non-distorting tax that is implemented by adjusting the budget constraints of household and government sectors to achieve revenue neutrality. This serves as a standard of comparison for evaluating the adjustment of more realistic distorting taxes, such as labor income taxes, sales taxes, and individual income taxes. We find that the welfare gain from the elimination of the tax wedges within sectors is $182.1 billion. Under lump sum tax adjustment, elimination of tax wedges between the corporate and noncorporate assets yields a welfare gain of $45.1 billion.

The economic impact our third tax reform proposal demonstrates the large gain in welfare from eliminating tax wedges between the business and household sectors. This is intuitively plausible, given the size of the tax wedges between business and household assets. The estimated gain is $1,616.8 billion. By contrast the welfare gain from eliminating all tax wedges among business assets alone is $127.6 billion. The welfare gain from the fifth simulation, eliminating all the tax wedges among sectors and assets and leading to efficient allocation of capital within each time period is estimated to be $1,692.7 billion. Most of this can be attributed to the elimination of tax wedges between business and household sectors, as in the third simulation.

The sixth simulation, corporate tax integration, is the key to the Advisory Panel's Simplified Income Tax Plan. In this simulation we eliminate tax wedges between the assets in the corporate and noncorporate assets by setting the social rates of return of corporate assets to be equal to the corresponding rates of return on noncorporate assets. The tax burdens on the corporate assets are unambiguously reduced without an offsetting increase in other marginal tax rates. The estimated welfare gains from this experiment are $1,067.4 billion. These welfare gains are slightly more than half of those attainable by eliminating all tax wedges among sectors and assets.

In the first six simulations we have focused on the distortionary effects of tax wedges among sectors and assets. In the following four simulations, we estimate the welfare cost of tax distortions resulting from wedges between before- and after-tax rates of return. We eliminate the distortions caused by the taxes on capital income, including property taxes and sales taxes on investment goods. In the seventh simulation we set the effective tax rates on all forms of capital equal to be zero. Social rates of return are not equalized across sectors, due to the differences in the debt/asset ratios and the property tax rates.

We find that elimination of capital income taxes at both individual and corporate levels generates a welfare gain of $2.691.5 billion. Eliminating sales taxes on investment goods as well increases this gain to $3,367.4 billion. Eliminating capital income taxes and property taxes produces a gain of $3,723.2, while eliminating taxes on investments goods as well generates a gain of $4,309.0 billion. If we start with the 1996 Tax Law and eliminate all of these tax wedges, the welfare gain is as large 53.1% of the U.S. GDP and 16.8% of the private national wealth in 1997.

Table 2.6 shows that the magnitudes of welfare gains under the distortionary tax adjustments are substantially different from those under the lump sum tax adjustment. Since the elimination of tax wedges is not revenue

Table 2.5 Elimination of interasset and intersectoral tax wedges (rate of inflation: 4%

	Corporate		Noncorporate		Household	
	Short	Long	Short	Long	Short	Long
1. Base Case						
$\sigma - \pi$	0.0789	0.0884	0.0681	0.0733	0.0491	0.0491
e	0.3983	0.4625	0.3240	0.3715	0.1223	0.1223
k	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

2. Alternative Policies

(1) *No interasset wedges: Corporate and noncorporate sectors*

	Short	Long	Short	Long	Short	Long
$\sigma - \pi$	0.0859	0.0859	0.0729	0.0729	0.0491	0.0491
e	0.4470	0.4470	0.3680	0.3680	0.1223	0.1223
k	−0.0219	0.0216	-0.0163	0.0049	0.0000	0.0000

(2) *No intersector wedges: Corporate and noncorporate sectors*

	Short	Long	Short	Long	Short	Long
$\sigma - \pi$	0.0771	0.0814	0.0771	0.0814	0.0491	0.0491
e	0.3840	0.4167	0.4025	0.4342	0.1223	0.1223
k	0.0058	0.0604	−0.0308	−0.0981	0.0000	0.0000

(3) *No intersector wedges: All sectors*

	Short	Long	Short	Long	Short	Long
$\sigma - \pi$	0.0636	0.0673	0.0636	0.0673	0.0636	0.0673
e	0.2538	0.2947	0.2762	0.3159	0.3227	0.3599
k	0.0481	0.1829	0.0155	0.0718	−0.0600	−0.3392

(4) *No interasset and intersector wedges: All assets, corporate and noncorporate sectors*

	Short	Long	Short	Long	Short	Long
$\sigma - \pi$	0.0806	0.0806	0.0806	0.0806	0.0491	0.0491
e	0.4108	0.4108	0.4285	0.4285	0.1223	0.1223
k	−0.0053	0.0675	−0.0429	−0.0883	0.0000	0.0000

(5) *No interasset and intersector wedges: All assets, all sectors*

	Short	Long	Short	Long	Short	Long
$\sigma - \pi$	0.0666	0.0666	0.0666	0.0666	0.0666	0.0666
e	0.2868	0.2868	0.3083	0.3083	0.3528	0.3528
k	0.0388	0.1893	0.0053	0.0808	−0.0722	−0.3253

(6) *Corporate tax integration*

	Short	Long	Short	Long	Short	Long
$\sigma - \pi$	0.0681	0.0733	0.0681	0.0733	0.0491	0.0491
e	0.3030	0.3520	0.3240	0.3715	0.1223	0.1223
k	0.0340	0.1311	0.0000	0.0000	0.0000	0.0000

Notes :

$\sigma - \pi$: Social rate of return

e: Effective tax rate

k: Investment tax credit

π: Rate of inflation

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Table 2.6 Welfare effects of tax distortion: 1996 tax law (billions of 1997 dollars)

| Eliminated wedges and method | Welfare effect | |
of revenue adjustment	Additive	Proportional
(1) *Within Sector Interasset Distortion*		
Lump sum tax adjustment	182.1	182.1
Labor income tax adjustment	193.4	266.5
Sales tax adjustment	185.5	185.5
Individual income tax adjustment	184.6	252.0
(2) *Intersector Distortion: Corporate and Noncorporate Sectors*		
Lump sum tax adjustment	45.1	45.1
Labor income tax adjustment	–25.3	–59.0
Sales tax adjustment	–31.4	–31.4
Individual income tax adjustment	–32.2	–48.4
(3) *Intersector Distortion: All Sectors*		
Lump sum tax adjustment	1616.8	1616.8
Labor income tax adjustment	1716.8	1906.8
Sales tax adjustment	1709.5	1709.5
Individual income tax adjustment	1701.5	1849.6
(4) *Interasset and Intersector Distortion: Corporate and Noncorporate Sectors, All Assets*		
Lump sum tax adjustment	127.6	127.6
Labor income tax adjustment	80.4	67.0
Sales tax adjustment	70.5	70.5
Individual income tax adjustment	70.1	72.3
(5) *Interasset and Intersector Distortion: All sectors, All Assets*		
Lump sum tax adjustment	1692.7	1692.7
Labor income tax adjustment	1810.2	2015.0
Sales tax adjustment	1800.3	1800.3
Individual income tax adjustment	1789.6	1949.9
(6) *Corporate Tax Integration (Set $\sigma^q = \sigma^m$)*		
Lump sum tax adjustment	1067.4	1067.4
Labor income tax adjustment	282.8	–976.2
Sales tax adjustment	250.3	250.3
Individual income tax adjustment	280.4	–595.2
(7) *Capital Income Taxes (Business and Personal)*		
Lump sum tax adjustment	2691.5	2691.4
Labor income tax adjustment	362.9	–5480.2
Sales tax adjustment	493.0	493.0
Individual income tax adjustment	362.9	–5480.2

Table 2.6 continued

Eliminated wedges and method of revenue adjustment	Welfare effect	
	Additive	Proportional
(8) *Capital Income Taxes and Sales Tax on Investment Goods*		
Lump sum tax adjustment	3367.4	3367.4
Labor income tax adjustment	383.6	−8957.9
Sales tax adjustment	710.2	710.3
Individual income tax adjustment	383.6	−8957.9
(9) *Capital Income Taxes and Property Taxes*		
Lump sum tax adjustment	3723.2	3723.3
Labor income tax adjustment	−1085.0	—
Sales tax adjustment	-554.0	−554.0
Individual income tax adjustment	−1085.0	—
(10) *Capital Income Taxes, Sales Tax on Investment Goods, and Property Taxes*		
Lump sum tax adjustment	4309.5	4309.3
Labor income tax adjustment	−1101.0	—
Sales tax adjustment	−237.8	−237.9
Individual income tax adjustment	−1101.0	—

Notes:

1. Inflation is fixed at 4% per year

2. Under the additive tax adjustment, the average and marginal tax rates of labor income and the average tax rates of individual capital income are adjusted in the same percentage points. The marginal tax rates of individual capital income are adjusted in the same proportion as the marginal tax rate of labor income.

3. Under the proportional tax adjustment, average and marginal tax rates are adjusted in the same proportion.

neutral, changes in tax rates to generate the missing revenue can produce significant substitution effects. For this reason the welfare effects of alternative tax reforms are very sensitive to the choice of the method for revenue adjustment. These effects are most sensitive to the choice between lump sum tax adjustment and the distortionary tax adjustments. The results are also somewhat sensitive to choices among the distortionary tax adjustments, especially when the size of the required revenue is large.

Lowering marginal tax rates and broadening the tax base is a successful strategy for improving the efficiency of capital allocation. When eliminating tax wedges implies tax cuts at the relevant margins, welfare gains under distortionary tax adjustments are substantially smaller than the gains under lump sum tax adjustment. In this case the welfare gains under lump sum tax adjustment are best interpreted as the upper bounds. The intuition behind these observations are straightforward. The welfare losses associated with tax distortions increases more than proportionally with the required revenue increase.

The estimated welfare gains from the elimination of the tax wedges between before- and after-tax rates of return is in the range of $2,691.5–4,309.0 billion. This suggests that the potential welfare gain from replacing the current income taxes with consumption-based taxes is potentially very large. At the same time, welfare gains under the distortionary tax adjustments are much smaller, indicating that improvements in the efficiency of resource allocation can be best achieved by reducing distortions among assets and sectors.

Our final simulation is intended to measure the distortions associated with progressivity of the tax on labor income. This produces marginal tax rates far in excess of average tax rates. Our point of departure is the elimination of all tax distortions in panel (5) of table 2.6. In table 2.7, we replace the progressive labor income tax by a flat labor income tax with the same average tax rate. Under a lump sum tax adjustment this generates a welfare gain of $4,585.9 billion. We conclude that elimination of the progressive labor income tax, together with elimination of all tax wedges among sectors and assets would produce the largest welfare gains of all the tax changes we have considered. These gains are even larger with distortionary tax adjustments. The lower marginal tax rate on labor income improves resource allocation and allows the marginal rates of the taxes used to adjust revenue to be lowered.

Table 2.7 describes the new approach to tax reform that we call Efficient Taxation of Income. This would avoid a drastic shift in tax burdens by introducing different tax rates for property-type income and earned income

Table 2.7 Welfare cost of labor tax progressivity under efficient capital allocation (billions of 1997 dollars)

| Revenue adjustment | Progressive | | Proportional |
	Additive	Proportional	Additive
Lump sum tax	1692.7	1692.7	4585.9
Labor income tax	1810.2	2015.0	4823.0
Sales tax	1800.3	1800.3	4899.9
Individual income tax	1789.6	1949.9	4857.8

Notes:

1. Inflation is fixed at 4% per year.

2. Under the additive tax adjustment, the average and marginal tax rates of labor income and the average tax rates of individual capital income are adjusted in the same percentage points. The marginal tax rates of individual capital income are adjusted in the same proportion as the marginal tax rate of labor income.

3. Under the proportional tax adjustment, average and marginal tax rates are adjusted in the same proportion.

4. The figures for the progressive labor income tax are the same as in panel (5) of table 2.8.

5. Under the proportional labor income tax, additive and proportional tax adjustments are equivalent.

from work—a distinction that existed in the U.S. tax code between 1969 and 1982. Earned income would be taxed at a flat rate of 10.9%, while property-type income would be taxed at 30.8%. An important advantage of Efficient Taxation of Income is that income would be defined exactly as in the existing tax code, so that no cumbersome transition rules would be required.

The key to Efficient Taxation of Income is the system of investment tax credits presented in table 2.5 that would equalize tax burdens on all sources of business income. The average tax credits for corporations would be 4% on equipment and 19% on structures. Noncorporate businesses would receive smaller credits of 0.5% on equipment and 8% on structures. In order to equalize tax burdens on business and household assets, prepayments of taxes on new investments by households would be required. The prepayment rates given in table 2.5 would be 7% on new durables and 32% on new housing. The new revenue would precisely offset the tax credits for business investment, preserving revenue neutrality.

Under Efficient Taxation of Income individuals would continue to file the familiar Form 1040 for individual income, while corporations would file corporate income tax returns. Deductions from taxable income, as well as tax credits and exemptions, would be unaffected. Businesses would continue to claim depreciation on past investments, as well as tax deductions for interest paid on debt. Mortgage interest and property taxes would be deductible from individual income for tax purposes. The tax treatment of Social Security and Medicare, as well as private pension funds, would be unchanged. Pension plans would be unaffected and the pension fund industry would not be eviscerated.

An important feature of Efficient Taxation of Income is that owners of existing homes and consumer durables would be deemed to have prepaid all taxes at the time of their original purchase. No additional taxes would be imposed on housing or durables already in the hands of households. This is essential for enactment, since 68% of households own their homes. Home owners are also voters who can express their concerns about new taxes on existing homes at the ballot box.

It is important to emphasize that prepayments would apply only to new investments in owner-occupied housing and consumers' durables. These prepayments are essential to protect property values after tax reform is enacted. The cost of new housing reflects the cost of capital to businesses, including the taxes paid on capital income. These taxes would be reduced sharply for corporations and substantially for non-corporate businesses. Without tax prepayments in place, the price of new housing would plummet. This

price decline would gradually erode the price structure for existing housing, leading to capital losses for home owners. Instead most home owners could anticipate a modest capital gain from the introduction of Efficient Taxation of Income.

A second point to emphasize is that tax credits for new investments in structures by corporations and non-corporate businesses would apply to new rental housing. These credits would provide incentives for real estate developers to expand the construction of rental housing. The added supply of rental housing would provide existing renters with more attractive and affordable options. It would also substantially reduce housing costs for newly formed households.

In summary, Efficient Taxation of Income would preserve all the features of the existing tax code that have been carefully crafted by generations of lawmakers since adoption of the Federal income tax in 1913. At the same time this new approach to tax reform would remedy the conspicuous deficiencies in our income tax system. These arise from differential taxation of corporate income and exclusion of owner-occupied housing, as well as consumers' durables, from the income tax base. We turn next to tax reforms that would shift the tax base from income to consumption.

3. Consumption Tax Proposals

In the United States proposals to replace income by consumption as a tax base were revived during the 1990s. These included the Hall-Rabushka (1983, 1995) Flat Tax, a European-style consumption-based value added tax, and a comprehensive National Retail Sales Tax. We compare the economic impact of these proposals, taking the 1996 Tax Law as a point of departure. In particular, we consider impact of the Hall-Rabushka Proposal and the closely related Armey-Shelby Proposal. Both proposals are similar to the Growth and Investment Plan of the President's Advisory Panel (2005). We also consider the economic impact of replacing the existing tax system by alternative versions of a National Retail Sales Tax.

A useful starting point for the definition of the consumption base is Personal Consumption Expenditures (PCE) as defined in the U.S. National Income and Product Accounts (NIPA). However, the taxation of services poses significant administrative problems, reviewed in the U.S. Treasury (1984) monograph on the value-added tax. First, PCE includes the rental equivalent value of owner-occupied housing, but does not include the services of consumers' durables. Both are substantial in magnitude, but could be taxed by the "prepayment method" described by Bradford (1986). In this approach, taxes on the consumption of services would be prepaid by including investment rather than consumption in the tax base, as in Efficient Taxation of Income.

The prepayment of taxes on services of owner-occupied housing is an important feature of proposals to substitute a consumption tax for existing income taxes. At the time the substitution takes place, all owner-occupiers would be treated as having prepaid all future taxes on the services of their dwellings. This is equivalent to excluding mortgage interest from the tax base, as well as returns to equity, which might be taxed upon the sale of a residence with no corresponding purchase of residential property of equal or greater value. Of course, this argument is vulnerable to the specious criticism that home owners should be allowed to deduct mortgage deduction twice—first when they are deemed to have paid all future taxes and, again, when tax liabilities are actually assessed on consumption.

Under the prepayment method, purchases of consumers' durables by households for their own use would be subject to tax. These would include automobiles, appliances, home furnishings, and the like. In addition, new construction of owner- occupied housing would be subject to tax, as would sales of existing renter-occupied housing to owner occupiers. These are political sensitive issues and it is important to be clear about the implications

of prepayment as the debate proceeds. Housing and consumers' durables must be included in the tax base in order to reap the substantial economic benefits of substituting consumption for income as a basis for taxation.

Other purchases of services that are especially problematical under a consumption tax would include services provided by nonprofit institutions, such as schools and colleges, hospitals, and religious and eleemosynary institutions. The traditional, tax-favored status of these forms of consumption would be tenaciously defended by recipients of the services and, even more tenaciously, by the providers. For example, elegant, and sometimes persuasive arguments can be made that schools and colleges provide services that represent investment in human capital rather than consumption. However, consumption of the resulting enhancements in human capital often takes the form of leisure time, which would remain the principal untaxed form of consumption. Taxes could be prepaid by including educational services in the tax base.

Finally, any definition of a consumption tax base must distinguish between consumption for personal and business purposes. Ongoing disputes over exclusion of home offices, business-provided automobiles, equipment, and clothing, as well as business-related lodging, entertainment, and meals would continue to plague tax officials, the entertainment and hospitality industries, and users of expense accounts. In short, substitution of a consumption tax for the existing income tax system would not eliminate the practical issues that arise from the necessity of distinguishing between business and personal activities in defining consumption. However, these issues are common to income and consumption taxes.

The first issue that will surface in the tax reform debate is *progressivity* or use of the tax system to redistribute economic resources. We consider alternative tax reform proposals that differ in their impact on the distribution of resources. However, our simulations are limited to the efficiency impacts of these proposals.[6] One of our most important findings is that redistribution through tax policy is very costly in terms of efficiency. Unfortunately, there is no agreed-upon economic methodology for trading off efficiency and equity. It is, nonetheless, important to quantify the impact of alternative tax policies on the efficiency of resource allocation.

The second issue to be debated is *fiscal federalism*, or the role of state and

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[6]For distributional effects of the Simplified Income Tax and Growth Investment Tax Plans, see President's Advisory Panel (2005), Figure 6.5, p. 136, and Figure 7.4, p. 175. For an alternative perspective on these distributional effects, see Burman and Gale (2006), esp. pp. 1365-1366. An overview of distributional effects of taxation is presented by Hasset and Hubbard (2001).

local governments. Since state and local income taxes usually employ the same tax bases as the corresponding federal taxes, it is reasonable to assume that substitution of a consumption tax for income taxes at the federal level would be accompanied by similar substitutions at the state and local level. For simplicity, we consider the economic effect of substitutions at all levels simultaneously.

The third issue in the debate will be the impact of the *federal deficit*. Nearly two decades of economic debate over this issue have failed to produce a clear resolution. No doubt this dispute will continue to occupy the next generation of fiscal economists, as it has the previous generation. An effective device for insulating the discussion of fundamental tax reform from the budget debate is to limit consideration to revenue-neutral proposals. This device was critical to the eventual enactment of the Tax Reform Act of 1986. We share the belief of the President's Advisory Panel that revenue-neutrality essential to progress in the debate over fundamental tax reform.

3.1 Tax Reform Proposals

The "subtraction method" for implementing a consumption tax is the basis for the ingenious Flat Tax proposed by Hall and Rabushka (1995). The Hall-Rabushka(HR) proposal divides tax collections between firms and households. Firms would expense the cost of all purchases from other businesses, including purchases of investment goods, as in the subtraction method for implementing a consumption tax. However, firms would also deduct all purchases of labor services, so that labor compensation—wages and salaries, health insurance, pension contributions, and other supplements— would be taxed at the individual level. This facilitates the introduction of personal allowances for low-income taxpayers in order to achieve progressivity.

Taxation of business firms under the HR proposal is different from the current income tax system in three ways. First, a flat rate is applied to the tax base, hence the identification of this proposal as a Flat Tax. Second, interest paid by the firm is no longer deducted from the tax base. Third, investment spending is recovered through immediate write-offs rather than depreciation over time, so that the effective tax rate on new investments is zero. The inclusion of interest payments in the tax base eliminates the differential tax treatment of debt and equity, insuring the financial neutrality of the tax system. These features of the Flat Tax have been incorporated into the President's Advisory Panel's Growth and Investment Plan.

The federal tax rate proposed by HR is 19% for both businesses and individuals. However, if unused depreciation from capital accumulation predating the tax reform is allowed as a deduction from the tax base, the tax rate would rise to 20.1%. Personal allowances under the Hall-Rabushka proposal for 1995 are $16,500 for married taxpayers filing jointly, $14,000 for head of household, and $9,500 for single taxpayers. The allowance for each dependent is $4,500. A family of four with two adults filing jointly, for example, would be entitled to a deduction of $25,500. Personal allowances are indexed to the Consumer Price Index .[7]

The Armey-Shelby (AS) proposal, introduced in the 104th Congress by Representative Richard Armey and Senator Dick Shelby, is best considered as a variant of the HR Flat Tax proposal. The principal differences between HR and AS are the Flat Tax rate and the level of personal allowances. The AS Flat Tax rate is 20% for the first two years and 17% thereafter. Compared with the HR tax rate of 19%, the AS rate is higher during the first two years by one percentage point, but lower by two percentage points thereafter. Personal allowances under AS are $21,400 for married taxpayers filing jointly, $14,000 for head of household, and $10,700 for single taxpayers. The allowance for each dependent is $5,000, so that a family of our with two adults filing jointly would be entitled to a deduction of $31,400.

The AS proposal is more generous to the taxpayer than the HR proposal in the sense that the Flat Tax rate is lower after the first two years and the family allowances are higher. The natural question is, would the AS proposal achieve revenue-neutrality? Since Hall and Rabushka have calibrated their proposal to the National Income and Product Accounts of 1993 and set the Flat Tax rate to make the HR proposal revenue-neutral, it is clear that tax revenue under the AS would fall short of the level required for neutrality. We will show, however, that neither proposal would achieve revenue neutrality.

A proposal for replacing the income tax system with a National Retail Sales Tax has been introduced by Representatives Dan Schaefer, Bill Tauzin (ST), and others.[8] The ST proposal replaces personal and corporate income taxes, estate and gift taxes, and some excise taxes with a 15% national retail sales tax on a tax-inclusive consumption base. On this definition the tax base would include sales tax revenues as well as the value of retail sales to consumers. The tax rate would, obviously, be lower on a tax-inclusive basis than a tax-exclusive basis, that is, where the sales tax base excludes the

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[7]Hall-Rabushka, 1995, p. 144.

[8]The ST proposal was first introduced in the 104-th Congress of 1996, and again in the 105-th Congress in 1997. See Schaefer (1997).

tax revenues. The tax rate under the ST proposal would be 17.6% on a tax-exclusive base. The ST proposal allows for a family consumption refund for qualified family units in order to achieve progressivity.[9]

Americans for Fair Taxation (AFT) have advanced an alternative proposal for a National Retail Sales Tax. The AFT proposal replaces personal and corporate income taxes, estate and gift taxes, and the payroll tax with a 23% national retail sales tax on a tax-inclusive base or 29.9% on a tax exclusive base. The AFT proposal is more ambitious than the ST proposal in that it replaces the payroll tax, used to fund entitlements such as Social Security and Medicare, as well as the income tax system. This has two important implications. The first is that the unfunded liabilities of the entitlement systems would ultimately have to be funded through the sales tax. The second is that a revenue-neutral tax rate would be very high. The AFT proposal has been introduced as legislation by Representative John Linder (2005) and numerous co-sponsors, and is the subject of a best-selling book by Linder and Neal Boortz.[10]

Gale (2005) estimates that, assuming perfect compliance and no politically motivated erosion of the statutory tax base, the tax-exclusive sales tax rate has to be 44% for the AFT proposal to achieve revenue-neutrality, while the tax-inclusive rate has to be 31%. Comparison of these tax rates with the proposed rates of 17.6% and 29.9% reveals the dimensions of the potential revenue shortfall. Furthermore, if state and local income taxes are replaced along with the federal taxes, the tax rates have to be about 30% higher.

A very high tax rate of the National Retail Sales Tax provides powerful incentives for tax evasion and renders effective tax administration difficult. Although it is possible to mitigate compliance problems, controlling the erosion of the tax base within a tolerable limit appears to be more problematical.[11] To achieve revenue neutrality through a National Retail Sales Tax, we consider a number of alternatives to the ST and AFT proposals.

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[9]The refund is equal to the tax-inclusive tax rate times the lesser of the poverty level and the wage and salary income of the family unit.

[10]Neal Boortz and John Linder, "THE FAIRTAX BOOK: Saying Goodbye to the Income Tax and the IRS," New York, HarperCollins, 2005.

[11]On tax evasion under a consumption tax, see Murray (1997) and Mikesell (1997). To deal with the complicance problem Zodrow (1999) proposes withholding at the manufacturing and wholesale level, bringing the NRST closer to a VAT. To reduce the administative burden and insure the deduction of investment spending, he proposes a "business tax rebate" for inputs that can be used for both business and personal purposes. The purchaser of such an input would pay the tax at the time of the purchase, but business purchasers would be eligible for a tax rebate.

In all of these alternatives, new investment would be excluded from the tax base. We first construct a prototype NRST and then develop alternative proposals by varying the degree of progressivity and the division of revenues between a labor income tax and a sales tax. Both the sales tax and the labor income tax may be flat, that is, proportional to the tax base, or may be made progressive by introducing a system of family allowances.

3.2 Modeling the Tax Reform Proposals

We maintain the role of the property tax in the existing U.S. tax system in all of our simulations. However, we consider alternative treatments of existing sales taxes on consumption and investment goods. The key tax parameter of the HR and AS proposals is the Flat Tax rate. If investment is expensed, the effective tax rate on new investment is zero, whatever the Flat Tax rate, so that the choice of this rate does not affect inter-temporal resource allocation. On the other hand, the Flat Tax rate plays a very important role in the labor-leisure choice by households. It also affects the tax burden on capital assets already accumulated at the time of the tax reform

Provided that the value added by a business firm is greater than its compensation for labor input, the marginal and average tax rates are the same as the statutory flat rate. However, a substantial proportion of households are exempt from taxation due to personal allowances. For tax-exempt households, the average tax rate is zero. We represent the distribution of marginal tax rates between zero and the Flat Tax rate by the average marginal tax rate for labor income. At the same time, we measure the average tax burden on labor income by the average tax rate.

Under the HR proposal the statutory Flat Tax rate is 19%. Under the AS proposal a Flat Tax rate of 20% applies in the first two years after the tax reform, followed by a lower rate of 17% thereafter. These rates are chosen in order to replace federal tax revenues. In our model all three levels of government—federal, state, and local—are combined into a single government sector. If the federal income tax is replaced by a Flat Tax, we assume that the state and local income taxes are also replaced by a Flat Tax. In addition, we assume that the state and local Flat Tax is deductible at the federal level. We then calibrate the Flat Tax system to 1996 federal and state and local income tax revenues.

The average marginal tax rate for labor income is defined as a weighted average of the marginal tax rates of individual taxpayers, where the share of labor income for each taxpayer in total labor income is used as the weight. The average tax rate is simply the total tax revenue divided by total labor

income. Using the same National Income and Product Accounts for 1993 as Hall and Rabushka [12], we estimate that the average labor income tax rate is 0.0855 for the HR Flat Tax proposal.

In order to determine the average marginal tax rates for the HR and AS proposals on a consistent basis, we require the distribution of labor income by the marginal tax rate of the individual taxpayer. We use the 1996 Current Population Survey to estimate the average and the average marginal tax rates on labor income for both the HR and AS Flat Tax proposals.[13] We find that the average tax rates on labor income at the federal level are 0.1232 for HR and 0.0961 for AS, and the corresponding average marginal tax rates are 0.1797 and 0.1551, respectively.

In order to determine the average marginal tax rate on labor income for the government sector as a whole, we follow the same procedure as in calculating the marginal rate. In place of the corporate income tax revenues, we use the individual income tax revenues for 1996. The results are that the average marginal tax rate is 0.2114 for HR and 0.1834 for AS. The corresponding figure for the Tax Law of 1996 is 0.2645.[14] Our estimate of the average tax rate is 0.1202 for HR and 0.0938 for AS. These figures may be compared with the corresponding figure of 0.1266 for the 1996 Tax Law,

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[12]1995, p. 57, table 3.1

[13]Suppose there are H taxable units indexed by h, $h = 1, \ldots, H$. Let W_k and A_k be the labor income and personal exemptions of taxable unit h. Then the average tax rate at the federal level, t_L^{af}, and the corresponding average marginal tax rate, t_L^{mf}, are defined as

$$t_L^{af} = \frac{\sum_{W_h - A_h > 0} (W_h - A_h) t_F^f}{\sum_{j=1}^{H} W_h} \ , \quad t_L^{mf} = \frac{\sum_{W_h - A_h > 0} W_h \cdot t_F^f}{\sum_{h=1}^{H} W_h}$$

where t_F^f is the statutory federal flat tax rate applicable to labor. We assume that married couples file jointly. We are indebted to. M.S. Ho for these calculations. For more details, see Ho and Stiroh (1998).

[14]We could have used a similar approach for estimating the average tax rates for the government sector. However, in order to reflect the realities of tax administration, we estimate the average tax rate, t_L^a, as

$$t_L^a = \frac{t_L^{af} \cdot t_{P96}^a}{t_{P96}^{af}} \ ,$$

where t_{P96}^a is the average tax rate of individual income in 1996 and t_{P96}^{af} is the average federal tax rate on individual income in the same year. Note that t_{P96}^{af} is estimated from a sample of tax returns in the Statistics of Income and t_L^{af} is based on the data from the Current Population Survey for 1996. We estimate that $t_{P96}^a = 0.1411$ and $t_{P96}^{af} = 0.1445$, based on the U.S. National Income and Product Accounts. This procedure adjusts the average tax rate of labor income for less than perfect tax compliance and administration.

or with the federal tax rate of 0.0855 estimated by Hall and Rabushka.

We can summarize the tax rates as follows:

Hall-Rabushka

Business tax rate, average and marginal: 0.2164
Labor income tax rate, marginal: 0.2114
Labor income tax rate, average: 0.1202

Armey-Shelby

Business tax rate, average and marginal: 0.1943
Labor income tax rate, marginal: 0.1834
Labor income tax rate, average: 0.0938

Tax Law of 1996

Corporate income tax rate: 0.3880
Labor income tax rate, marginal: 0.2645
Labor income tax rate, average: 0.1266

We develop a number of alternative plans for the NRST by combining a sales tax on consumption and a labor income tax. Taxation of capital income is eliminated in these plans. Although the existing sales taxes on investment spending may or may not be abolished as part of tax reform, we prefer the policies with no sales taxes on investment. As before, property taxes are left unchanged in our simulations. The alternative proposals differ in progressivity. They also differ in the division of revenue-raising roles between the sales tax and the labor income tax. This division has the effect of altering the relative tax burden between labor income and capital accumulated prior to the tax reform.

In order to develop alternative plans, we first construct a prototype sales tax and a prototype labor income tax. The labor income tax is based on the HR Flat Tax proposal. The sales tax is a Flat Tax rate with personal exemptions. We set the proportion of total exemptions in retail sales equal to the proportion of total exemptions in HR, which is 0.3516. Assuming that the federal sales tax rate is 17% as in Aaron and Gale (1996), table 1.1, we estimate that the corresponding average tax rate is 11.02%. In order to represent the current sales taxes, used mainly by the state and local governments, we add a Flat Tax of 5.8% to the progressive tax system we have derived. At this point, we have a progressive NRST with a marginal tax rate of 22.80% and an average tax rate of 16.82%.

We construct eight alternative NRST plans. Each plan consists of two parts—a sales tax and a labor income tax. The first two plans are limited to a sales tax, while the last two consist of a labor income tax alone.[15] Although these two plans are not sales taxes in the usual sense, they provide benchmarks for analyzing the economic impacts of the NRST plans. We evaluate the efficiency of resource allocation under all of the eight plans.

In Plan 1, a progressive NRST replaces the capital and labor income taxes. Since the revenue requirement is very large in relation to the sales tax base, we start with marginal and average tax rates twice as high as those of the prototype consumption tax, that is, a marginal rate of 0.4560 and an average rate of 0.3365. These sales tax rates serve as the starting values for our simulations, but are adjusted to achieve revenue neutrality. In Plan 2, we remove the progressivity from the sales tax of Plan 1 and set the marginal tax rate equal to the average tax rate.

In Plan 3, we introduce a prototype labor income tax from the HR Flat Tax proposal and combine this with a prototype sales tax with the progressivity removed. As a consequence, the sales tax is flat while the labor income tax has the same progressivity as HR. Compared with Plan 1, the role of the sales tax as an instrument for tax collection and redistribution is substantially reduced. Specifically, we set the average sales tax rate at 0.1682, the marginal labor income tax rate at 0.2114 and the average labor income tax rate at 0.1202.

In Plan 4, we replace the current income tax system with the combination of a flat sales tax and a flat labor income tax. Since no attempt is made to achieve progressivity, this plan would be politically unpopular. On the other hand, the efficiency loss is minimal, so that Plan 4 provides a useful benchmark for evaluation of the potential cost of trading off efficiency against equity. The sales tax rate is set at the average tax rate of the prototype NRST 0.1682 and the labor income tax rate is set at the average tax rate of the HR proposal 0.1202.

Plan 5 combines a progressive sales tax with a flat labor income tax. The sales tax rates are the same as in the prototype sales tax plan and the rate of the labor income tax is set at the average tax rate of the HR proposal. Plan 6 combines the prototype sales tax with the labor income tax of the HR proposal. Since both segments of the plan are progressive, the sacrifice of efficiency may be substantial.

In Plan 7, the labor income tax is flat and there is no sales tax. The

[15]The equivalence of consumption and labor income taxes is discussed, for example, by Jorgenson and Yun (2001), Section 8.4, pp. 353-364.

average and the average marginal tax rates of labor income are equal. Since all the tax revenue is raised by the tax on labor, we start with a labor income tax rate of 0.2404, twice that of the HR Flat Tax proposal. Finally, in Plan 8, we introduce an element of progressivity into Plan 7 by setting the average marginal tax rate of labor income at 0.4228, twice the level in the HR proposal.

Business investment is expensed in the HR and AS Flat Tax proposals. In the NRST proposals new investment in owner-occupied residential housing and consumers' durables is taxed as consumption. This is equivalent to prepayment of taxes on the services of household capital. To represent the Flat Tax proposals of HR and AS and the various NRST plans, we first determine the allocation of gross private investment among the three private sectors–corporate, noncorporate, and household. To determine the investment in each of these sectors, we first allocate investment among asset categories in proportion to capital stock. This is equivalent to assuming that the capital stocks in the three private sectors grow at the same rate. We then add the value of economic depreciation to obtain gross investment.

We preserve revenue neutrality by requiring the government sector to follow the same time paths of real spending and government debt under all tax reform proposals. We also fix the time path of the claims on the rest of the world. These assumptions are necessary to separate the economic impacts of alternative tax policies from the effects of changes in the government budget and the balance of payments. Government revenues must be adjusted through changes in the tax policy instruments in order to satisfy the government budget constraints in every period along the transition path to a steady state.

In some simulations we take Flat Tax rate in the HR and AS proposals or the sales tax or labor income tax rates in the NRST plans to be fixed and vary other taxes in order to meet the government budget constraints. In other simulations we vary the tax rates themselves to meet these constraints, so that the rates we have derived serve only as starting values. For example, in the case of the HR and AS proposals, the simulation with adjustment of average and marginal Flat Tax rates in the same proportion, will generate a configuration of the tax system that is revenue neutral. Similarly, in the analysis of an NRST plans, adjustment of the sales tax and the labor income tax rates achieves revenue neutrality. In the sales tax adjustment, the average and marginal sales rates are adjusted in the same proportion; in the labor income tax adjustment, average and marginal labor income tax rates are adjusted similarly.

In the HR and AS proposals the effective tax rate on new investment is

zero, reducing the tax wedge between returns to investors and earnings of savers. The remaining distortion between investment and savings decisions is due to property taxes and sales taxes on investment goods. In the NRST all taxes on capital income are abolished and the sales tax on investment goods is abolished as well in some of the alternatives we consider. The only remaining source of tax distortions is the property tax. In the HR and AS Flat Tax proposals, the labor income tax is the only tax, other than property tax, that is collected directly from the household sector. Hence, we allow the property tax as a deduction from labor income.

Investment spending on household assets is included in the sales tax base under the NRST. The most important type of investment spending is the purchase of owner-occupied housing. We model the sales tax on household investment by imposing taxes on sales to the household sector. At the same time we increase the price of capital services by the amount of the sales tax. This is equivalent to prepayment of the consumption tax on household capital services.

3.3 Welfare Impacts of Fundamental Tax Reform

Table 3.1 summarizes the key tax parameters of the fundamental tax reform proposals and tables 3.2a and 3.2b report the estimated welfare effects. In table 3.2a, we present two sets of results. In the first set of simulations the corporate and individual income taxes of 1996 are replaced by the HR or AS Flat Tax, while sales taxes on consumption and investment goods remain unchanged (column 2). In the second set of simulations we replace the sales taxes as well, so that marginal and average consumption taxes, as well as taxes on investment are zero. In the these simulations, all tax distortions, except for the property tax, are eliminated.

The initial Flat Tax rates both the HR and the AS proposals fall short of revenue neutrality. The welfare impact of these proposals depends on the tax instrument chosen for raising the necessary revenue. If sales taxes on consumption goods and investment goods are maintained, the welfare gains are in the ranges of $2.06–3.64 trillion for HR and $1.23–4.17 trillion for AS, measured in 1996 dollars. Converted into annual flows at the long run real private rate of return of 4.45%, the welfare gains are in the range of $92–162 billion for HR and $55–186 billion for AS. The largest welfare gains are obtained when a purely hypothetical lump sum tax is used to compensate for the revenue shortfall. Since the lump sum tax is not available in practice, the welfare gains for the lump sum tax adjustment may be interpreted as the potential gains in welfare from a Flat Tax proposal.

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Table 3.1 Tax parameters of fundamental tax reform proposals—Lump sum tax adjustment, central cases

Tax Reform Proposal and Welfare Effect	t_q or t_F	t_L^m	t_L^a	t_C	t_C^a	t_I
1. Base Case						
(1) Tax Law of 1996	0.3880	0.2645	0.1265	0.0580	0.0580	0.0580
2. Flat Tax						
(1) Hall-Rabushka	0.2164	0.2114	0.1202	0.0580	0.0580	0.0580
(2) Armey-Shelby	0.1943	0.1834	0.0938	0.0580	0.0580	0.0580
3. National Retail Sales Tax						
(1) Progressive Sales Tax and No Labor Income Tax	0.0	0.0	0.0	0.4560	0.3365	0.0
(2) Proportional Sales Tax and No Labor Income Tax	0.0	0.0	0.0	0.3365	0.3365	0.0
(3) Proportional Sales Tax and Progressive Labor Income Tax	0.0	0.2114	0.1202	0.1682	0.1682	0.0
(4) Proportional Sales Tax and Proportional Labor Income Tax	0.0	0.1202	0.1202	0.1682	0.1682	0.0
(5) Progressive Sales Tax and Proportional Labor Income Tax	0.0	0.1202	0.1202	0.2280	0.1682	0.0
(6) Progressive Sales Tax and Progressive Labor Income Tax	0.0	0.2114	0.1202	0.2280	0.1682	0.0
(7) No Sales Tax, Proportional and Labor Income Tax	0.0	0.2404	0.2404	0.0	0.0	0.0
(8) No Sales Tax, Progressive Labor Income Tax	0.0	0.4228	0.2404	0.0	0.0	0.0

Notes:

1. In the central case, $t_C = t_C^a = t_I = 0.058$ for the flat tax (HR and AS), and $t_I = 0$ for the NRST.

2. In the cases of flat tax adjustment, the values of t_F, t_L^m, and t_L^a in the table are used as the starting values for iteration. Similarly for sales tax and labor income tax adjustment.

t_F: flat tax rate

t_L^m: average marginal tax rate of labor income

t_L^a: average tax rate of labor income

t_C: average marginal tax rate of retail sales

t_C^a: average tax rate of retail sales

t_I: sales tax rate of investment spending

Table 3.2a Welfare effects of fundamental tax reform—Flat tax (billions of 1997 dollars)

Tax reform proposal and revenue adjustment	Welfare effect	
	$t_C = t_C^a = t_I = 0.058$	$t_C = t_C^a = t_I = 0$
1. *Hall-Rabushka*		
Lump sum tax	3637.3	4991.6
Flat tax	2056.2	814.9
Sales taxes	2582.2	—
Flat tax and sales taxes	2240.1	—
2. *Armey-Shelby*		
Lump sum tax	4173.0	5392.2
Flat tax	1229.3	−756.0
Sales taxes	2476.2	—
Flat tax and sales taxes	1772.7	—

Note: Inflation is fixed at 4% per year.

t_C: Marginal sales tax rate of consumption goods

t_C^a: Average sales tax rate of consumption goods

t_I: Flat sales tax rate of investment goods

Table 3.2b Welfare effects of fundamental tax reform—National Retail Sales Tax (billions of 1997 dollars)

Tax reform proposal and revenue adjustment	Welfare effect	
	$t_I = 0.058$	$t_I = 0$
1. *Grad Sales, no Labor Income Tax*		
Lump sum tax	1830.1	2583.9
Labor income tax	—	—
Sales taxes	3268.5	3323.6
Labor income tax and sales taxes	—	—
2. *Flat Sales, no Labor Income Tax*		
Lump sum tax	3500.8	4115.6
Labor income tax	—	—
Sales taxes	4540.8	4686.8
Labor income tax and sales taxes	—	—
3. *Flat Sales Tax, Graduated Labor Income Tax*		
Lump sum tax	1924.0	2678.3
Labor income tax	3413.0	3086.9
Sales taxes	2686.1	2871.3
Labor income tax and sales taxes	2992.9	2965.8
4. *Flat Sales, Flat Labor Income Tax*		
Lump sum tax	3838.3	4427.8
Labor income tax	4504.9	4697.3
Sales taxes	4545.5	4696.5
Labor income tax and sales taxes	4530.8	4697.3
5. *Graduated Sales Tax, Flat Labor Income Tax*		
Lump sum tax	2965.1	3633.8
Labor income tax	3666.8	3868.9
Sales taxes	3888.8	3946.0
Labor income tax and sales taxes	3796.9	3910.1
6. *Graduated Sales Tax, Graduated Labor Income Tax*		
Lump sum tax	769.3	1609.3
Labor income tax	2233.3	1802.7
Sales taxes	1694.0	1737.5
Labor income tax and sales taxes	1921.3	1766.5
7. *No Sales, Flat Labor Income Tax*		
Lump sum tax	4106.1	4664.3
Labor income tax	4354.6	4527.8
Sales taxes	—	—
Labor income tax and sales taxes	—	—
8. *No Sales, Graduated Labor Tax*		
Lump sum tax	–1806.8	–818.2
Labor income tax	–2869.3	–4447.9
Sales taxes	—	—
Labor income tax and sales taxes	—	—

Note: 1. Inflation is fixed at 4% per year.

t_I: Rate on investment goods

If both income taxes and sales taxes are replaced by a Flat Tax and a lump sum tax is used to compensate for the revenue shortfall, the welfare gains are very substantial, $3.64 trillion for HR and $4.17 trillion for AS. If sales taxes, as well as corporate and individual income taxes, are replaced with a Flat Tax and a lump sum tax is used to raise the additional revenue, the gains are even larger, almost $5 trillion for HR and $5.39 trillion for AS.

The welfare gains from the Flat Tax proposals are lower when distorting taxes are increased to meet the revenue requirement. The actual welfare gain depends critically on the taxes that are replaced and the tax distortions introduced to meet the revenue requirement. If the Flat Tax rate is adjusted to make up the revenue shortfall, substitution of the HR Flat Tax for corporate and individual income taxes would produce a welfare gain of only $2.06 trillion. If sales taxes are also replaced the gain falls to $0.81 trillion. The corresponding welfare gains for the AS Flat Tax are $1.23 trillion for replacement of income taxes and a negative $0.76 trillion for replacement of sales taxes as well. These results imply that the distortions resulting from the Flat Tax are far worse than those from sales taxes.

The most interesting cases in table 3.2a are the simulations where personal allowances are held fixed and the Flat Tax rate is adjusted to make up lost revenue. The welfare gains are $2.06 trillion for the HR proposal and $1.23 trillion for the AS proposal. The reason for the relatively poor performance of the AS proposal is the higher marginal tax rate on labor. Recall that that the HR proposal has a higher tax rate than the AS proposal. However, given the revenue requirements imposed by fixed time paths of government debt and real government spending, the more generous personal allowances in the AS proposal imply a higher tax rate.[16]

The President's Advisory Panel has proposed a Growth and Investment Tax Plan that would permit the expensing of business investment and disallow interest deductions from corporate income. These features are similar to those of the HR and AS proposals. However, the Growth and Investment Tax Plan would retain mortgage interest tax deductions at the individual level, introducing a substantial subsidy for owner-occupied housing.[17] This has the advantage of preserving incentives for home ownership, as requested by President Bush. However, it eviscerates the equalization of tax burdens on corporate and non-corporate assets and owner-occupied housing associated with consumption taxes, such as the HR and AS Flat Tax proposals.

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[16]A high flat tax rate implies a heavy lump sum tax on "old" capital, offsetting the distorting effects of the tax on labor.

[17]See President's Advisory Panel (2005), Figure 7.3, p. 165.

Table 3.2b reports the welfare effects of the six plans for replacing the corporate and individual income taxes with an NRST and the two additional plans for replacing income taxes with a labor income tax. We present two sets of simulations—one with the sales tax on investment goods and the other without. First, note that the case without a sales tax on investment goods is more in the spirit of the NRST, which exempts sales of investment goods from taxation. Unsurprisingly, the cases with sales taxes on investment removed are generally more efficient than those with sales taxes unchanged at the historical rate of 0.058.

Second, in Plans 1 through 6 a sales tax is included as a part of the replacement tax policy; the tax parameters in panel 3 of table 3.1, together with sales taxes on investment goods generate revenue surpluses and require either a negative lump sum tax or a decrease in tax rates. This explains the fact that welfare gains under the lump sum tax adjustment are lower than under other tax adjustments.[18] Third, except for Plan 8 and possibly for Plan 6, the welfare gains are impressive. Plan 4 with flat sales and labor income taxes and no tax on investment goods attains a welfare gain of $4.70 trillion, more than five times the corresponding gain for the HR Flat Tax proposal. However, Plan 2 and Plan 7 are not far behind in terms of gains in welfare. Finally, the welfare gains attainable with the progressive Plans 1, 3, 5 are also much higher than those of the HR and AS Flat Tax proposals.

A second set of comparisons highly relevant to deliberations about tax reform is the cost of progressivity. One of the most attractive features of the HR and AS Flat Tax proposals is the possibility of introducing a system of family allowances in order to preserve the progressivity of the existing U.S. tax system. Plan 1 for the NRST also retains this feature of the tax system, but generates welfare gains of $3.32 trillion, exceeding those of the HR Flat Tax proposal by more than fifty percent. Of course, a sales tax could be employed to compensate for the revenue shortfall of the HR Flat Tax, reducing the difference between the two proposals. However, the NRST is clearly superior to the Flat Tax as an approach to tax reform when both retain an element of progressivity.

The costs of progressivity can be ascertained by comparing the welfare gains between Plan 1, a progressive sales tax, with Plan 2, a flat sales tax. With no sales tax on investment goods and adjustment of the sales tax on consumption goods to achieve revenue neutrality, the gain in welfare from eliminating progressivity is $1.36 trillion. When this is added to the welfare

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[18]Revenue shortfalls occur in Plan 7 with $t_I = 0$ and Plan 8 with either $t_I = 0.058$ or $TI = 0$.

gain of a progressive sales tax of \$3.32 trillion, the overall gain is \$4.69 trillion. Similar comparisons can be made between Plan 3 with a flat sales tax and a progressive labor income tax and Plan 4 with flat sales and labor income taxes. The welfare gains from eliminating progressivity are \$1.61 trillion when the labor income tax is used to achieve revenue neutrality and \$1.83 trillion when the sales tax is used for this purpose. Other comparisons between progressive and flat versions of the NRST given in table 3.2 generate estimates of the cost of progressivity that are similar in magnitude.

Since tax wedges distort resource allocation, a critical requirement for a fair comparison among alternative tax reform proposals is that all proposals must raise the same amount of revenue. It is well known that the ST and AFT sales tax proposals fail to achieve revenue neutrality and tax rates must be increased substantially above the levels proposed by the authors of the plans.[19]. The authors of the HR Flat Tax proposal have calibrated their tax rates to the National Income and Product Account for 1993 in such a way that the resulting tax regime is revenue neutral. It is clear that the AS proposal falls short of revenue neutrality because it is more generous in personal allowances and applies a lower tax rate than the HR proposal. As it turns out, however, the HR proposal also raises too little revenue to be neutral.

Based on the federal Flat Tax rate proposed by Hall and Rabushka, we have estimated three tax rates under the assumption that the state and local income taxes are also replaced by a Flat Tax. Specifically, we start with the Flat Tax rate 0.2164, the marginal tax rate on labor income 0.2114, and the average tax rate on labor income 0.1202 (see table 3.1). In order to meet the government sector revenue requirement, these tax rates must be increased by a factor of 0.27–0.33 (column 5, table 3.3). It follows that the statutory federal Flat Tax rate must be increased from 19% to 24–25%. The problem is even severe with the AS proposal, where the tax rates must be increased by a factor of 0.60–0.67 (column 9, table 3.3), implying that the proposed federal Flat Tax rate must be increased from 17% to 27–28%.

The need for a major upward adjustment in the Flat Tax rate conflicts with the claim by Hall and Rabushka that their proposal is designed to be revenue neutral. The explanation is that the data set employed by Hall and Rabushka, the U.S. National Income and Product Accounts of 1993, was

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[19]For example, see Aaron and Gale (1996) and Gale (2005)

Table 3.3 Transition paths of tax rates: Flat taxes ($t_C = t_C^a = t_I = 0.058$)

	1. Hall-Rabushka				2. Armey-Shelby			
Year	t_F	t_L^a	t_L^m	ADJ	t_F	t_L^a	t_L^m	ADJ
1	0.2872	0.1595	0.2805	0.3273	0.3244	0.1566	0.3063	0.6699
2	0.2872	0.1595	0.2805	0.3272	0.3244	0.1566	0.3063	0.6700
3	0.2871	0.1595	0.2805	0.3270	0.3244	0.1566	0.3062	0.6698
4	0.2870	0.1594	0.2804	0.3266	0.3243	0.1565	0.3062	0.6694
5	0.2869	0.1594	0.2803	0.3260	0.3242	0.1565	0.3061	0.6688
6	0.2868	0.1593	0.2801	0.3254	0.3241	0.1564	0.3059	0.6680
7	0.2866	0.1592	0.2800	0.3246	0.3239	0.1563	0.3058	0.6672
8	0.2864	0.1591	0.2798	0.3237	0.3237	0.1562	0.3056	0.6661
9	0.2862	0.1590	0.2796	0.3227	0.3234	0.1561	0.3053	0.6649
10	0.2860	0.1589	0.2794	0.3217	0.3232	0.1560	0.3051	0.6637
12	0.2854	0.1586	0.2788	0.3192	0.3226	0.1557	0.3046	0.6606
14	0.2849	0.1583	0.2783	0.3167	0.3220	0.1554	0.3040	0.6576
16	0.2843	0.1579	0.2777	0.3139	0.3213	0.1551	0.3034	0.6541
18	0.2837	0.1576	0.2771	0.3109	0.3206	0.1548	0.3027	0.6504
20	0.2830	0.1572	0.2764	0.3078	0.3199	0.1544	0.3020	0.6465
25	0.2812	0.1562	0.2747	0.2997	0.3179	0.1534	0.3001	0.6364
30	0.2782	0.1545	0.2717	0.2857	0.3144	0.1518	0.2968	0.6185
35	0.2774	0.1541	0.2710	0.2822	0.3136	0.1514	0.2960	0.6142
40	0.2754	0.1530	0.2690	0.2729	0.3113	0.1502	0.2938	0.6022
45	0.2756	0.1531	0.2692	0.2738	0.3115	0.1504	0.2941	0.6035
50	0.2758	0.1532	0.2694	0.2745	0.3117	0.1504	0.2942	0.6042
60	0.2759	0.1532	0.2695	0.2751	0.3118	0.1505	0.2944	0.6050
70	0.2760	0.1533	0.2696	0.2753	0.3119	0.1505	0.2944	0.6053
80	0.2760	0.1533	0.2696	0.2754	0.3119	0.1505	0.2944	0.6054
90	0.2760	0.1533	0.2696	0.2753	0.3119	0.1505	0.2944	0.6053
100	0.2759	0.1532	0.2695	0.2749	0.3118	0.1505	0.2943	0.6048

Note: The flat tax rate is adjusted for revenue neutrality.

t_C: Marginal sales tax rate on consumption goods

t_C^a: Average sales tax rate on consumption goods

t_I: Sales tax rate on investment goods

t_F: Flat tax rate of the business sector

t_L^m: Marginal tax rate on labor income

t_L^a: Average tax rate on labor income

ADJ: Adjustment factor for tax rates

generated under a tax system with a significant tax burden on capital.[20] Unsurprisingly, they found a large tax base in the business sector. Although the Flat Tax imposes a lump sum tax on "old" capital accumulated before the tax reform, the Flat Tax does not impose any tax burden on "new" capital accumulated through investment after the reform. The tax base of the business portion of the tax shrinks dramatically and a large revenue shortfall emerges, requiring an increase in the Flat Tax rate.

From the point of view of efficiency the most attractive approach to tax reform we have considered is Plan 4 for the NRST, which combines a flat sales tax with a flat labor income tax and eliminates sales taxes on investment goods. In panel 3 of table 3.4 we see that this requires an initial sales tax rate of 15.9 percent and a labor income tax rate of 11.3 percent with both rates gradually declining over time. The welfare gain would be diminished relatively little by shifting the burden toward the labor income tax, as in Plan 7. The combination of an NRST collected at the retail level and a labor income tax collected as at present would be administratively attractive and would generate welfare gains amounting to more than half of the gross domestic product in 1997, the benchmark year for our simulations.

4. Conclusion

Our first conclusion is that the most substantial gains from tax reform are associated with equalizing tax burdens on all assets and all sectors. These gains produce a better balance of the tax burden between household assets, especially owner-occupied residential real estate, and business assets, especially plant and equipment in the corporate sector. Combining this with a proportional tax on labor income, Efficient Taxation of Income produces the largest welfare gains of any tax reform proposal that we consider. Since the definitions of individual and corporate income would be unchanged, no cumbersome transition rules would be required. Efficient Taxation of Income could be enacted today and implemented tomorrow.

Integration of corporate and individual income taxes is a key objective of the President Advisory Panel's Simplifed Income Tax Plan. The purpose of this approach to tax reform is to eliminate the double taxation

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[20]In 1993, the corporate income taxes were $138.3 billion for the Federal Government and $26.9 billion for the state and local governments. In the same year, the Federal Government collected $508.1 billion of income tax from individuals and the state and local governments collected $124.2 billion.

Table 3.4. Transition paths of tax rates: National retail sales tax

	Plan 1. Progressive Sales Tax No Labor Income Tax $(t_F = t_L^a = t_L^m = t_I = 0.0)$		Plan 2. Flat Sales Tax No Labor Income Tax $(t_F = t_L^a = t_L^m = t_I = 0.0)$	Plan 4. Flat Sales Tax Flat Labor Income Tax $(t_F = t_I = 0.0)$	
Year	t_C^a	t_C	$t_C^a = t_C$	$t_L^a = t_L^m$	$t_C = t_C^a$
1	0.2976	0.4034	0.2874	0.1132	0.1585
2	0.2977	0.4035	0.2875	0.1132	0.1584
3	0.2978	0.4036	0.2875	0.1132	0.1584
4	0.2978	0.4036	0.2875	0.1131	0.1583
5	0.2978	0.4036	0.2874	0.1131	0.1583
6	0.2978	0.4036	0.2874	0.1131	0.1582
7	0.2977	0.4035	0.2873	0.1130	0.1582
8	0.2977	0.4034	0.2872	0.1130	0.1581
9	0.2976	0.4033	0.2871	0.1129	0.1580
10	0.2975	0.4032	0.2870	0.1128	0.1579
12	0.2972	0.4028	0.2867	0.1127	0.1577
14	0.2970	0.4025	0.2864	0.1125	0.1575
16	0.2966	0.4020	0.2861	0.1124	0.1573
18	0.2963	0.4015	0.2858	0.1122	0.1570
20	0.2959	0.4010	0.2854	0.1120	0.1568
25	0.2948	0.3996	0.2843	0.1115	0.1561
30	0.2948	0.3996	0.2843	0.1111	0.1555
35	0.2944	0.3990	0.2838	0.1109	0.1552
40	0.2951	0.4000	0.2844	0.1108	0.1550
45	0.2953	0.4003	0.2846	0.1108	0.1551
50	0.2954	0.4004	0.2847	0.1109	0.1552
60	0.2956	0.4006	0.2848	0.1109	0.1552
70	0.2956	0.4007	0.2849	0.1109	0.1553
80	0.2957	0.4007	0.2849	0.1109	0.1553
90	0.2956	0.4007	0.2849	0.1109	0.1552
100	0.2959	0.4011	0.2851	0.1110	0.1553

Note: For revenue neutrality, the sales tax rate is adjusted for Plans 1 and 2.

For Plans 4 and 5, both the sales tax and the labor income tax rates are adjusted in the same proportion.

Notations:
   t_C: Marginal sales tax rate on consumption goods
   t_C^a: Average sales tax rate on consumption goods
   t_I: Sales tax rate on investment goods
   t_F: Flat tax rate of the business sector
   t_L^m: Marginal tax rate on labor income
   t_L^q: Average tax rate on labor income

Table 3.4 (continued) Transition paths of tax rates: National retail sales tax

Plan 5. Progressive Sales Tax   Plan 7. Flat Labor Income Tax

of corporate income. The Jobs and Growth Tax Relief Reconciliation Act of 2003 attempted to reduce the burden imposed by double taxation of corporate income and this was the subject of an important report by the Treasury (1992). Unfortunately, the economic impact of corporate and individual tax integration is relatively modest. The Advisory Panel's plan would leave a substantial tax wedge between corporate and noncorporate income and would actually increase the wedge between business income and owner-occupied housing.

During the 1990s, tax reformers have renewed their interest in replacing income by consumption as the basis for taxation. We have shown that the most popular Flat Tax proposals for achieving this objective would generate substantial welfare benefits. The Hall-Rabushka Flat Tax proposal is superior to the Armey-Shelby variant, mainly because of the lower tax rates required under the HR Flat Tax. The Advisory Panel's Growth and Investment Plan would follow the subtraction approach to consumption taxation for business income employed by Hall and Rabushka. However, this Plan would introduce a substantial tax subsidy for owner-occupied housing and would fail to achieve the benefits of equalizing the tax burdens on business assets and owner-occupied housing.

A National Retail Sales Tax with the same progressivity as the HR Flat Tax would produce welfare gains that are fifty percent higher. This progressive NRST would, however, require a marginal sales tax rate of around 40% and an average sales tax rate of more than 28% in order to achieve revenue neutrality. This would generate substantial incentives for tax evasion and erosion of the tax base, boosting the required marginal and average tax rates even further. The Advisory Panel's selection of the subtraction method of the Flat Tax for implementing its consumption tax proposal undoubtedly reflects the administrative issues associated with a progressive NRST.

The cost of maintaining a progressive rate structure within the framework of the National Retail Sales Tax is very large. This is due to the increase in the marginal tax rate on consumption required to compensation for the loss of portions of the tax base that are required to achieve progressivity. However, the benefits of a National Retail Sales Tax with a flat rate structure are double those of a Flat Tax. These welfare gains are nearly comparable with the largest gains from Efficient Taxation of Income.

Our final objective is to evaluate the cost of capital as a practical guide to reform of taxation and government spending. Our primary focus is U.S. tax policy, since the cost of capital has been used much more extensively in the U.S. than other countries. Auerbach and Jorgenson (1980) introduced the key concept, the social rate of return, early in the debate over the U.S.

Economic Recovery Tax Act of 1981. They showed that the tax policy changes of the early 1980s, especially the 1981 Tax Act, increased barriers to efficient allocation of capital.

By contrast we showed that the Tax Reform Act of 1986 substantially reduced barriers to efficiency.[21] The erosion of the income tax base to provide incentives for investment and saving was arrested through vigorous and far-reaching reforms. Incentives were sharply curtailed and efforts were made to equalize marginal effective tax rates among assets. The shift toward consumption and away from income as a tax base was reversed.

The cost of capital approach has also proved its usefulness in pointing the direction for future tax reforms. For this purpose information about the cost of capital must be combined with estimates of the substitutability among different types of outputs and inputs by businesses and households. Our overall conclusion is that the cost of capital and the closely related concept of the social rate of return have provided an important intellectual impetus for tax reform.

The new frontier for analysis of tax and spending programs is to combine the cost of capital and the social rate of return with estimates of substitution possibilities by businesses and households. This combination makes it possible to evaluate alternative tax reforms programs in terms of economic welfare. We have illustrated this approach for a variety of fundamental tax reforms. Our hope is that these illustrations will serve as an inspiration and a guide for policy makers who share our goal of making the allocation of capital within a market economy more efficient.

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[21]Jorgenson and Yun (1990) and Yun (2000).

Appendix: Elasticities and Non-Tax Parameters

The estimated values of the parameters in our models of consumer and producer behavior provide important information on the responses of consumers and producers to changes in tax policy. In this section we supplement this information by deriving price elasticities of demand and supply implied by our parameter estimates, including the compensated price elasticity of supply for labor services. We also provide elasticities of substitution in consumption and production, including the intertemporal elasticity of substitution, a constant parameter in our model of consumer behavior.

A.1 *Consumer Behavior*

In our model for consumer behavior the quantity index of full consumption is an index of consumer welfare. The compensated demand functions for the three components of full consumption are obtained by solving the share equations

$$v_D = \alpha_{PD} + B_{PD} \ln PD$$

$$v_H = \alpha_{PH} + B_{PH} \ln PH.$$

for the quantities demanded as functions of full consumption and the prices. As an illustration, we consider the compensated demand for consumption goods:

$$C = F \cdot \frac{PF}{PC} v_C ,$$

where v_C is the share of consumption goods in full consumption. We obtain the compensated own-price elasticity of demand for consumption goods, say ϵ_{CC}:

$$\epsilon_{CC} = v_C + \frac{\beta_{CC}}{v_C} - 1 .$$

Similarly, we obtain the cross-price elasticities of demand:

$$\epsilon_{CL} = v_{LJ} + \frac{\beta_{CL}}{v_C} ,$$

$$\epsilon_{CH} = v_{HD} + \frac{\beta_{CH}}{v_C} ,$$

where ϵ_{CL} is the elasticity of demand for consumption goods with respect to the price of leisure and ϵ_{CH} is the elasticity of demand with respect to the price of household capital services. We calculate similar own-price and cross-price elasticities of demand for leisure and household capital services, using

pooled estimates for our model of consumer behavior and average shares for the period 1970–1996. The results are presented in panel 2 of table A.1

Table A.1 Elasticities of consumer behavior

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1. Basic Information

    A. *Average shares 1970–1996*

        $v_C = 0.24120$

        $v_{LJ} = 0.68263$

        $v_{HD} = 0.07617$

        $v_{HS} = 0.56948$

    B. *Second-order coefficients*

        $\beta_{CC} = 0.10580$

        $\beta_{CL} = -0.097349$

        $\beta_{CH} = -0.0084549$

        $\beta_{LL} = 0.14657$

        $\beta_{LH} = -0.049217$

        $\beta_{HH} = 0.057672$

        $\beta_{SS}^{H} = 0.161082$

2. Compensated Elasticities

    (with constant full consumption)

    A. *Elasticities of demand*

        $\epsilon_{CC} = -0.32015$

        $\epsilon_{CL} = 0.27904$

        $\epsilon_{CH} = 0.041112$

        $\epsilon_{LC} = 0.098596$

        $\epsilon_{LL} = -0.10266$

        $\epsilon_{LH} = 0.0040659$

        $\epsilon_{HC} = 0.13020$

        $\epsilon_{HL} = 0.036441$

        $\epsilon_{HH} = -0.16664$

    B. *Elasticity of labor supply*

        $\epsilon_{LL}^{S} = 0.31653$

3. Elasticity of Intertemporal Substitution

        $\sigma^{-1} = 0.39145$

4. Elasticities of Intratemporal Substitution

        $e_{CL} = -0.40907$

        $e_{CH} = -0.26597$

        $e_{LH} = -0.16753$

$$e_{HD} = -0.34299$$

The average share of leisure is more than sixty-eight percent of full consumption, while the share of consumption goods and services is slightly more than twenty-four percent and the share of household capital services is around seven and a half percent. The own-price elasticity of demand for consumption goods and services is around a third, while the own-price elasticity of demand for leisure is only 0.10 and the elasticity of demand for capital services is 0.17. Cross-elasticities of demand are substantial, especially the cross-elasticity of demand for goods with respect to the price of leisure of 0.28; the three commodity groups are substitutes rather than complements.

The compensated elasticity of labor supply is, perhaps, a more familiar parameter than the elasticity of demand for leisure. To derive the compensated elasticity of labor supply, we first consider the following identity for the value of the time endowment $PLH \cdot LH$:

$$PLH \cdot LH - PLJ \cdot LJ = (1 - t_L^m)(PLD \cdot LD + PLG \cdot LG + PLE \cdot LE + PLR \cdot LR) .$$

Defining the value of labor supply $PL \cdot L$ as follows:

$$PL \cdot L = PLD \cdot LD + PLG \cdot LG + PLE \cdot LE + PLR \cdot LR ,$$

we obtain:
$$PLH \cdot LH - PLJ \cdot LJ = (1 - t_L^m)PL \cdot L .$$

Under the assumption that relative prices of the time endowment, leisure, labor supply, and the components of labor demand are fixed, we obtain the following expression for the compensated elasticity of labor supply, say ϵ_{LL}^S,

$$\epsilon_{LL}^S = -\epsilon_{LL} \frac{PLJ \cdot LJ}{PLH \cdot LH - PLJ \cdot LJ} . \tag{1}$$

We employ the average ratio of the values of leisure and labor supply for the period 1970–1996 in estimating this elasticity; the result, given at the bottom of panel 2, table A.1, is 0.31653. The elasticity of intertemporal substitution in consumption is the inverse of σ, estimated from the transition equation for full consumption

$$\ln \frac{F_t}{F_{t-1}} = \frac{1}{\sigma}[\ln(1 + r_t) - \ln(1 + \tilde{r}] + \epsilon_{F_t}, \quad t = 1, 2, \ldots, T .$$

The estimate of this elasticity, reported in panel 3 of table A.1, is 0.39145. This parameter describes the rate of adjustment of full consumption to the difference between the real private rate of return and its long-run equilibrium value.

The elasticity of substitution between two consumption goods is defined as the ratio of the proportional change in the ratio of the quantities consumed relative to the proportional change in the corresponding price ratio. The prices of other components are held constant, while the quantities are allowed to adjust to relative price changes. Our estimates of elasticities of substitution are based on parameter values from the pooled estimation of the model of consumer behavior, using average shares for the 1970–1996 period.

We first consider substitution between consumption goods and leisure. Using the share equation for consumption goods we can express the elasticity of substitution, say e_{CL}, as follows:

$$e_{CL} = -1 + \frac{\partial \ln v_C}{\partial \ln \left(\frac{PC}{PLJ} \right)} - \frac{\partial \ln v_{LJ}}{\partial \ln \left(\frac{PC}{PLJ} \right)} \ .$$

Since we are holding the price of household capital services PHD constant, we can rewrite this elasticity in the form:

$$e_{CL} = -1 + \frac{\beta_{CC}}{v_C} - \frac{\beta_{CL}}{v_{LJ}} - \left(\frac{\beta_{CH}}{v_C} - \frac{\beta_{LH}}{v_{LJ}} \right) \left(\frac{\partial \ln PLJ}{\partial \ln \frac{PC}{PLJ}} \right) \ .$$

Differentiating $\ln \left(\frac{PF}{PLJ} \right)$ with respect to $\partial \ln \left(\frac{PC}{PLJ} \right)$ while holding PF and PHD constant, we obtain

$$\frac{\partial \ln PLJ}{\partial \ln \left(\frac{PC}{PLJ} \right)} = \frac{v_C}{v_{HD} - 1} \ .$$

Substituting this expression into our formula for the elasticity of substitution, we obtain:

$$e_{CL} = (\epsilon_{CC} - \epsilon_{LC}) - (\epsilon_{CH} - \epsilon_{LH}) \frac{v_C}{v_{HD} - 1} \ . \tag{2}$$

Similarly

$$e_{CH} = (\epsilon_{CC} - \epsilon_{HC}) - (\epsilon_{CL} - \epsilon_{HL}) \frac{v_C}{v_{LJ} - 1} \ ,$$

and

$$e_{LH} = (\epsilon_{LL} - \epsilon_{HL}) - (\epsilon_{LC} - \epsilon_{HC}) \frac{v_{LJ}}{v_C - 1} \ .$$

We report estimates of the elasticities of substitution in panel 4 of table A.1. By definition these elasticities are symmetric. The elasticity of substitution between the services of the long-lived and short-lived household assets e_{HD} can be derived along similar lines and estimates are presented at the bottom of panel 4, table A.1. All of these elasticities are considerably less than one, so that the corresponding value shares rise with an increase in price.

A.2 *Producer Behavior*

As in our model of consumer behavior, we can define elasticities of substitution in production by allowing the relative quantities to adjust to changes in relative prices, while holding the prices of other inputs and outputs constant. We derive the formulas for the elasticities of substitution in production and estimate these elasticities, based on parameter values from the pooled estimation of our model of producer behavior and the average value shares for the 1970–1996 period.

We first consider the elasticity of substitution between labor input and consumption goods output, defined as[22]

$$e_{CL} = -1 + \frac{\partial \ln v_{CS}}{\partial \ln(PCS/PLD)} \ ,$$

where the other prices—PIS, PQD, PMD—are held constant. Making use of the share equation for the output of consumption goods, this elasticity of substitution can be rewritten as:

$$e_{CL} = -1 + \frac{1}{v_{CS}} \, \beta_{CC} \, \frac{\partial \ln PCS}{\partial \ln(PCS/PLD)} \ ,$$

where

$$\frac{\partial \ln PCS}{\partial \ln(PCS/PLD)} = \frac{1}{1 - v_{CS}} \ ,$$

so that

$$e_{CL} = -1 + \frac{\beta_{CC}}{v_{CS}(1 - v_{CS})} \ . \tag{3}$$

Similarly, we can derive elasticities of substitution between labor input and investment goods output and between labor and capital services inputs from corporate and noncorporate assets:

$$e_{IL} = -1 + \frac{\beta_{II}}{v_{IS}(1 - v_{IS})} \ ,$$

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[22]We treat inputs and outputs symmetrically and do not distinguish among substitution between outputs, and transformation from inputs to outputs.

$$e_{QL} = -1 + \frac{\beta_{QQ}}{v_{QD}(1 - v_{QD})} \ ,$$

$$e_{ML} = -1 + \frac{\beta_{MM}}{v_{MD}(1 - v_{MD})} \ .$$

The formulas for the elasticities of substitution between outputs and inputs other than labor can be derived along the same lines as for substitution in consumption. It is convenient at this point to introduce symbols for price elasticities of factor demand and product supply, for example:

$$\epsilon_{II} = v_{IS} + \frac{\beta_{II}}{v_{IS}} - 1 \ , \tag{4}$$

and

$$\epsilon_{IC} = v_{CS} + \frac{\beta_{IC}}{v_{IS}} \ .$$

As an illustration, the elasticity of substitution between consumption and investment goods outputs is defined by

$$e_{CI} = -1 + \frac{\partial \ln v_{CS}}{\partial \ln(PCS/PIS)} - \frac{\partial \ln v_{IS}}{\partial \ln(PCS/PIS)} \ .$$

Holding the prices PQD and PMD constant, we can rewrite this elasticity as follows:

$$e_{CI} = (\epsilon_{CC} - \epsilon_{IC}) - (\epsilon_{CQ} + \epsilon_{CM} - \epsilon_{IQ} - \epsilon_{IM})\frac{\partial \ln PIS}{\partial \ln(PCS/PIS)} \ ,$$

where

$$\frac{\partial \ln PIS}{\partial \ln(PCS/PIS)} = -\frac{v_{CS}}{v_{CS} + v_{IS}} \ .$$

Table A.2 Elasticities of producer behavior

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1. Basic Information

    A. Average shares

        $v_{CS} = 0.94256$

        $v_{IS} = 0.50597$

        $v_{QD} = -0.30931$

        $v_{MD} = -0.13897$

        $v_{QS} = 0.41891$

        $v_{MS} = 0.20617$

    B. Second-order coefficients

        $\beta_{CC} = 0.67559$

        $\beta_{CI} = -0.58758$

        $\beta_{CQ} = -0.035933$

        $\beta_{CM} = -0.052074$

        $\beta_{II} = 0.28858$

        $\beta_{IQ} = 0.21940$

        $\beta_{IM} = 0.079597$

        $\beta_{QQ} = -0.20393$

        $\beta_{QM} = 0.020463$

        $\beta_{MM} = -0.047986$

        $\beta_{SS}^{Q} = -0.081301$

        $\beta_{SS}^{M} = 0.11168$

2. Elasticities of Substitution

e_{CL}	11.47882
e_{IL}	0.15449
e_{QL}	−0.49644
e_{ML}	−0.69683
e_{CI}	0.43277
e_{CQ}	−0.25525
e_{CM}	−0.58933
e_{IQ}	−2.43209
e_{IM}	−1.17369
e_{QM}	−0.46605
e_{QD}	−1.33399
e_{MD}	−0.31762

We report the results in panel 2 of table A.2. We also give the elasticities of substitution between the capital services from the short-lived and long-lived assets in the corporate and noncorporate sectors, e_{QD} and e_{MD}. The relative value shares of labor and the two capital inputs rise with a price increase if these elasticities of substitution are less than unity and fall with

a price increase if the elasticities are greater than unity. The elasticities of substitution among inputs are less than unity; for example, the elasticities of substitution between labor and corporate capital and between the two types of capital are around a half, while the elasticity of substitution between labor and noncorporate capital is about 0.7.

A.3 *Non-Tax Parameters*

We conclude this section by assigning values to the parameters of our dynamic general equilibrium model of the U.S. economy that cannot be estimated from our econometric models of consumer and producer behavior. These include the ratio of government expenditures to gross domestic product, $SGOV$, the share of unemployed labor time in total labor supply, SLU, and the shares of government expenditures, net of interest payments on government debt—SCG, SIG, SLG, SEL, SER. These parameters are given in the first three panels of table A.3.

The next group of parameters includes the proportions of labor employed by government enterprises and net exports of labor services to the total labor supply—SLE and SLR. It also includes the production of consumption goods by government enterprises as a proportion of the total consumption goods produced by the business sector, SCE. Finally, it includes net exports of consumption goods as a proportion of the total domestic demand for consumption goods, SCR, and net exports of investment goods as a proportion of the total domestic production of investment goods, SIR. This group of parameters is given in the fourth and fifth panels of table A.3.

The third group of parameters includes the dividend pay-out ratio of the corporate sector, α, the debt/asset ratios of the corporate, noncorporate, and household sectors, β_q, β_m, and β_h, and the real interest rate. This group of parameters is given in the sixth panel of table A.3. The parameters—$SGOV$, SCR, SIR—are used to calibrate the size of government debt and claims on the rest of the world in the steady state of our model of the U.S. economy. All other parameter values are set at the averages for the sample period, 1970–1996.

Table A.3 Non-tax parameters

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1. Size of Government
    SGOV = 0.2132   government expenditure including debt service/gross domestic product

2. Unemployment
    SLU = 0.0   share of unemployed time in total labor supply

3. Allocation of Government Expenditure, Net of Interest Payments (1970–1996 averages)

SCG = 0.1738	share of consumption goods
SIG = 0.1837	share of investment goods
SLG = 0.4889	share of labor services
SEL = 0.1450	share of transfer payments
SER = 0.0085	share of transfer to foreigners

4. Government Enterprises (1970–1996 averages)

SLE = 0.0198	share of labor used by government enterprises
SCE = 0.0298	ratio of consumption goods produced by government enterprises and the private sector

5. Export—Import

$SCR = -0.0103$	net export of consumption goods as a fraction of total domestic demand for consumption goods
$SIR = 0.0128$	net export of investment goods as a fraction of total domestic production of investment goods
$SLR = -0.0001$	share of exported labor

6. Financial Variables (1970–1996 averages)

$\alpha = 0.42620$	dividend payout ratio
$\beta_q = 0.16524$	debt/capital ratio in the corporate sector
$\beta_m = 0.19798$	debt/capital ratio in the non-corporate sector
$\beta_h = 0.28647$	debt/capital ratio in the household sector
$i_0 = 0.048604$	real interest rate

7. Other Parameters

LH = 17571	total time endowment in efficiency units of 1997
$n = 0.01$	growth rate of time endowment

8. Wealth Composition (steady state)
Government Debt/GDP = 0.20

Claims on the Rest of the World/GDP = 0.10

Table A.3 continued

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9. Rates of Economic Depreciation (1996 values)

$\delta_q^S = 0.1367$ short-lived corporate asset
$\delta_q^L = 0.0175$ long-lived corporate asset
$\delta_m^S = 0.1533$ short-lived non-corporate asset
$\delta_m^L = 0.0112$ long-lived non-corporate asset
$\delta_h^S = 0.1918$ short-lived household asset
$\delta_h^L = 0.0107$ long-lived household asset

10. Prices of Assets and Investment Goods (1997 values)

$PK_{QS} = 4.8798$ short-lived corporate asset
$PK_{QL} = 10.5343$ long-lived corporate asset
$PK_{MS} = 4.8316$ short-lived non-corporate asset
$PK_{ML} = 12.5564$ long-lived non-corporate asset
$PK_{HS} = 4.3224$ short-lived household asset
$PK_{HL} = 15.6756$ long-lived household asset
$PI = 1.0683$ investment goods

11. Relative Prices of Labor (1980–1996 averages, relative to PLD)

$A_{LH} = 1.0101$ time endowment (before tax)
$A_{LJ} = 1.0044$ leisure (before tax)
$A_{LG} = 1.0049$ labor employed in general government
$A_{LE} = 0.9824$ labor employed in government enterprises
$A_{LR} = 1.0$ exported labor (assumption)
$A_{LU} = 1.0$ unemployed time (assumption)

The fourth group of parameters is given in panels 7 and 8 of table A.3. These are important determinants of the size and rate of growth of the U.S. economy. These include the time endowment, LH, and its growth rate, n. They also include steady-state values of government debt and claims on the rest of the world, relative to the U.S. gross domestic product. The time endowment is set at the historical value in 1997; the growth of the time endowment reflects the growth of population as well as changes in the quality of labor.[23]

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[23]Changes in the quality of the time endowment are due to changes in the composition in the population by age, sex, education, and class of employment. We define separate quality indexes for the time endowment, leisure, labor employed in the business, government, government enterprises, and rest-of-the-world sectors. Further details are given by Jorgenson, Ho, and Stiroh (2005).

During our sample period, 1970–1996, the average annual growth rate of the U.S. time endowment was 1.72 percent per year. However, we assume that population growth and changes in labor quality will decline in the future and set the growth rate, n, at one percent per year. The initial values of the quantity indexes of the capital stock, government debt, and claims on the rest of the world are set at their historical values in 1997. This procedure guarantees that the size of our simulated economy is equal to that of the U.S. economy in 1997.

The ratio of government debt to the U.S. gross domestic product has shown a distinct downward trend after the two World Wars. The recent increase in this ratio may be seen as an aberration from the longer-term perspective. Accordingly, we set the steady-state ratio of government debt to the gross domestic product at 0.2, close to the post-war low. On similar grounds we set the steady-state ratio of the U.S. claims on the rest of the world to the gross domestic product at 0.10. We treat the paths of government debt and claims on the rest of the world as exogenous.

Our fifth group of parameters includes the rates of economic depreciation. We distinguish among corporate, noncorporate and household sectors and two types of assets, short-lived and long-lived, within each sector. For the corporate and noncorporate sectors the short-lived asset includes producers' durable equipment, while the long-lived asset includes structures, inventories, and land. For the household sector the short-lived asset includes thirteen types of consumers' durables, while the long-lived asset includes structures and land.

The rates of economic depreciation of the six classes of assets, two classes within each of the three sectors, are weighted averages of their components with capital stocks at the end of 1996 as weights. For example, the rate of economic depreciation of the long-lived corporate asset is the average depreciation rate of twenty-three categories of non-residential structures, residential structures, non-farm inventories, and land employed in the corporate sector. Economic depreciation rates for the six categories of assets are shown in panel 9 of table A.3.

Finally, we present two sets of relative prices in panels 10 and 11 of table A.3. The relative prices of the six categories of assets in the corporate, noncorporate, and household sectors and the price of investment goods are the first of these. We set the relative prices of the six categories of assets and investment goods at their 1996 values, adjusted for the inflation of 1997. The relative prices of the time endowment, leisure, and labor employed in the various sectors of the economy and the rest of the world are set at historical averages for the period 1980–1996.

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