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The Importance of Asymmetric Tax Policy and Dangers of Aggregation

Existing tax policies have many complex features that make distinctions across goods, factors, and financial structures that distort economic allocations. Their importance is ignored when tax policy is summarized by an "effective" tax rate. In fact, the losses due to asymmetries are often larger than the losses due to the level of taxation.

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THE U.S. ECONOMY is complex system with firms of various kinds producing many goods and selling them to many kinds of consumers. However, the U.S. tax system is even more complex, creating artificial asymmetries in the economy. This complexity and heterogeneity is often ignored in economic analysis, even though many studies show that the complexity of the system is as important, and sometimes more important, than any summary index of tax policy. This paper outlines simple models where the substantive implications of important questions depend heavily on the level of disaggregation used when modeling the tax system. We will combine a discussion of past papers that bear on these issues and a presentation of more recent analyses . While the simple models used below cannot be regarded as reliable models the U.S. tax code, they certainly show that any reliable analysis would be far less aggregated than those we often see used today.

Since WWII, the U.S. tax system has been based on the principles of an income tax. Its intellectual foundation lies in the Haig–Simons approach to income taxation—define income properly and tax it. However, economists over the past 40 years have increasingly argued against this focus and instead support a consumption base for taxation. There have been two themes. First, the many deviations from the simple Haig–Simons formula present in the U.S. tax code greatly increases the deadweight

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loss of taxation. Second, the focus of tax structure should be on productive efficiency more than on defining income.

The key issue is the taxation of savings and investment.[1] Many theoretical analyses have argued for a zero long-run capital income tax rate. Early arguments, such as Feldstein (1978), Atkinson and Sandmo (1980), and Auerbach (1979), relied heavily on separability assumptions and identical agents in each cohort. Judd (1985) proved that the optimal long-run capital income tax rate is zero even when tastes are not separable and agents have different tastes and abilities. Others have explored taxation issues in models of economic growth. Eaton (1981) showed that capital income taxation reduces an economy's long-run growth rate, and Hamilton (1987) demonstrated that asymmetric treatment of different kinds of investment has a high efficiency cost. Judd (1999) generalized the analysis in Judd (1985) to include human capital investment, government expenditure, and various forms of growth. The key intuition is that any asset income taxation implies an exploding equivalent consumption tax distortion that clearly violates the inverse elasticity rule for optimal taxation. All of these analyses argue strongly against taxation of asset income in the long run.

The increasingly robust theoretical case against asset income taxation has been supplemented by estimates of how much the economy would benefit from tax reform. Studies, such as Jorgenson and Yun (1990) and Auerbach (1989), show that switching to consumption taxation would significantly increase savings and labor supply and improve productivity. Jones, Manuelli, and Rossi (1993) use computed examples to show that asset income taxation should be small even in the intermediate run. Both theoretical and empirical work show that a pure income tax system is far from best in terms of aggregate output.

The U.S. tax system has also evolved into a hybrid system combining features of income and consumption taxation,[2] but the presence of the corporate income tax and the limited nature of savings incentives still gives the current tax system a strong income tax flavor. Most economists agree that moving completely to consumption taxation would improve aggregate productivity and income in the long run. Problems arise when we look at transition and distributional issues. Some critics have argued that equity considerations and transition problems related to changes in asset prices blunt the case for a complete move to consumption taxation and make it politically less viable. In particular, the elimination of many middle-class tax deductions reduces middle-class support for tax reform. Possible adverse impacts on asset prices may make some individuals, particularly the elderly, worse off than under the current tax system. Any debate on tax reform will consider the trade-offs between the long-run benefits and the short-run transition problems.

1. We must immediately clear up a semantic problem that can arise in discussing the taxation and nontaxation of asset income. In this paper, any comment on whether a tax system taxes asset income implicitly refers to the effective tax rate on new investment. In this sense, the current tax system taxes asset income, but the Hall–Rabushka flat tax and most other consumption tax proposals do not tax asset income.

2. See Aaron et al. (1988) for a descriptions of the problems of a hybrid tax system.

The complexity of the tax system is aggravated by the complexity of a dynamic economy. In this paper, we explore the implications of adding imperfect competition, risky assets, and human capital formation to the standard analysis. Any analysis, including that in this paper, must make many simplifications. We focus on simple models that are natural for initial analyses of tax reforms but are far from any serious analysis of the U.S. tax system. Now that we understand the implications of tax reform in a competitive economy, we should extend our models and make them more realistic. It is natural to include imperfect competition, risky assets, and human capital in tax analysis, since it is difficult to imagine a modern dynamic economy without these features.

We motivate these considerations by reviewing some basic ideas from public economics and industrial organization. In particular, we present the inverse elasticity and production efficiency results from optimal tax theory, use them to analyze the inefficiencies of conventional income tax, and discuss interactions between taxation and imperfect competition. Conventional discussions focus on the distinction between income and consumption taxation. We argue that there is really no distinction between income and consumption taxation, since income taxation is really a special pattern of consumption taxation. More precisely, we argue that income taxation is a particularly bad form of consumption taxation violating basic rules for a good tax system. This paper argues that the focus should instead be on the taxation of consumption today versus consumption tomorrow, and on the taxation of intermediate goods versus the taxation of final consumption goods. This focus helps explain old results and point in useful new directions.

First, there are many tax-like distortions in the private sector. When economics professors teach competitive economic theory, they often use the example of thousands of farmers producing some agricultural product, and correctly argue that no individual producer has any impact over the price of his crop. This competitive paradigm is the one usually employed in tax reform analysis. While the competitive model may have been a valid simplification in 1811, it is certainly not in the modern high-technology U.S. economy of 2011. Today, imperfect competition and oligopolistic interactions provide a more appropriate description of much of the economy and are particularly appropriate when discussing capital goods and innovations that are sources of economic growth. Some of the ideas of competitive theories still hold. In particular, competitive forces in oligopolistic sectors may reduce profits to competitive returns and prices to average cost. However, we expect prices to exceed marginal cost. Efficiency and welfare is determined by the relation between price and marginal cost, not price and average cost. This wedge between price and marginal cost is essentially a tax, even when it is generated by the private economy.

We show that the presence of imperfect competition strengthens the case for consumption taxation, since it increases our estimates of the aggregate efficiency gains of tax reform. In fact, we show that estimates of the discounted welfare gains from switching to a consumption tax are at least doubled for central estimates of the critical parameters, and the estimates of the long-run gains are even greater.

Second, risk is usually ignored in tax analysis. This is potentially an important problem since the current income tax discriminates against risky equity investment in favor of safe debt investments. This discrimination appears to violate optimal taxation principles: if both risky and safe assets produce income for future consumption, why should the tax system discriminate between alternative investment strategies? Consumption taxation would eliminate this discrimination, improving both the allocation of capital and incentives to save. Even some partial reforms would be of substantial value. We show that eliminating the debt-equity distinction in the tax code may by itself achieve half the benefits of moving completely to a consumption tax.

Third, tax analyses usually focus on labor supply and physical capital formation. Since human capital is more important than physical capital in a modern economy, this is a serious limitation. Many economists argue that the current tax and education system puts little tax burden on human capital formation, a position that would seem to justify the focus on physical capital taxation. We make two points. First, we show that adding human capital formation to our analysis increases the estimated benefits from tax reform even if human capital investment incentives are undistorted. Second, we argue against the conventional view, pointing to the large amount of educational expenditures, both private and public, which would be included in the tax base by most tax reform proposals. This fact violates the consumption tax principle since a true consumption tax would define the tax base to be output minus all investment expenditures.

1. TWO PRINCIPLES OF OPTIMAL TAXATION

This section presents the conceptual foundation for our arguments. Any tax system will produce distortions and damage economic performance. The task of policymakers is to choose a tax policy that produces the least damaging pattern of distortions. This task is particularly difficult in a dynamic economy where one needs to trade-off distortions today against their future consequences.

The arguments in this paper rely on two basic results from optimal tax theory plus an argument from monopolistic competition theory. First, the inverse elasticity rule[3] argues that the tax on a good should be inversely proportional to its demand and supply elasticities. We show how to apply that rule to dynamic contexts, and why an income tax is a particularly inefficient kind of consumption tax.

Second, the productive efficiency principle of Diamond and Mirrlees (1971) argues against the differential taxation of intermediate goods and factors, such as capital and labor. The current tax system discriminates in favor of capital in the form of owner-occupied housing and against capital used to produce other goods. It also treats human capital and physical capital differently even though both are essentially intermediate

3. See Atkinson and Stiglitz (1972) and Atkinson and Sandmo (1980) for formal presentations of optimal taxation theory.

goods. Financial structure is also a type of intermediate good since debt and equity have no direct consumption value, but the current U.S. tax system discriminates against equity and in favor of debt. The productive efficiency principle helps us understand what a true consumption tax would look like and why deviations from the productive efficiency principle are so damaging to economic efficiency.

1.1 The Inverse Elasticity Rule and Asset Income Taxation

The inverse elasticity rule says that the optimal tax on a commodity is inversely proportional to its demand elasticity.[4] The inverse elasticity rule may seem to have little application to discussions of income taxation and savings. However, it is the best way to view income taxation. Consider the dynamic case where one chooses consumption of goods and leisure at different dates. Income taxation implies a pattern of distortions across consumption and leisure at various dates. For example, if we save some money at time 0 for consumption at time t, then a tax on investment income essentially taxes consumption at time t. Suppose r is the before-tax interest rate, and τ is the interest tax rate. The social cost of one unit of consumption at time t in units of the time 0 good is $(1 + r)^{-t}$ and the after-tax price is $(1 + (1 - \tau)r)^{-t}$. This implies a tax distortion between *MRS*, the marginal rate of substitution between time t consumption and time 0 consumption, and *MRT*, the corresponding marginal rate of transformation, equal to

$$\frac{MRS}{MRT} = \left(\frac{1+r}{1+(1-\tau)r}\right)^t. \tag{1}$$

This distortion is the same as if we taxed consumption at time t at the rate

$$\tau_c^* = \left(\frac{1+r}{1+(1-\tau)r}\right)^t - 1. \tag{2}$$

The key fact illustrated by this formula is that the commodity tax equivalent is exploding exponentially in time.

The exponential explosion in (2) appears dramatic, but we need to check that it is quantitatively important over a reasonable horizon. Table 1 displays the consumption tax equivalents, τ_c^*, for various combinations of r and τ. We see that the results depend substantially on the magnitude of r. For $r = 0.01$, the mean real return on safe assets, the effects are small. For example, even a 50% tax on interest income implies only a 22% tax on consumption tax 40 years hence compared to a 0.1% tax on consumption a year away. However, the situation is much different when $r = 0.10$. When $\tau = 0.3$ (which is less than the tax rate on equity-financed capital), the effective consumption tax over a 1-year horizon is 3%, but it is 59% over a 10-year horizon, and a whopping 543% over a 40-year horizon! It is hard to imagine any government passing

4. We ignore supply elasticities in this discussion, since they are not as relevant for our applications of the inverse elasticity idea.

TABLE 1

CONSUMPTION TAX EQUIVALENTS, τ_c^*

r	τ	t					
		1	5	10	20	30	40
0.01	10	0.1	0.5	1	2	3	4
	30	0.3	1	3	6	9	13
	50	0.5	2	5	20	16	22
0.10	10	1	5	10	20	31	44
	30	3	15	32	74	129	202
	50	5	26	59	154	304	543

a 59% sales tax in 2008, but that is effectively what we do to many investors if we continue with an income tax system between 1998 and 2008.

The implications of this analysis are clear. If utility is separable across time and between consumption and leisure, and the elasticity of demand for consumption does not change over time, the best tax system would have a constant commodity tax equivalent. This can be accomplished by a constant consumption tax. However, any nonzero asset income tax produces substantial violations.

While Table 1 focuses on special cases, the result is robust. The results in Judd (1985, 1999) show that the optimal tax on asset income is zero in the long run, even when preferences are far more general than those used in dynamic tax analyses. The key idea is that exploding consumption tax rates are not efficient and that the explosion is quantitatively important.

This result is not just an aggregate result assuming everyone is the same. It is true for each individual if his tastes do not change significantly over time. Therefore, even if tastes vary across individuals, each individual will prefer a constant consumption tax over an income tax that extracts the same revenue from him.

The distinction between factor income taxation and commodity taxation is misleading, since there is no explosive growth to distortions with wage income taxation. If τ_L is a constant wage tax and τ_K a constant interest rate tax, the *MRS*/*MRT* distortion between time 0 consumption and time t leisure is

$$\left(\frac{MRS}{MRT}\right)_{c_0,\ell_t} = \left(\frac{1}{1-\tau_L}\right)\left(\frac{1+r}{1+(1-\tau_K)r}\right)^t . \tag{3}$$

Equation (3) represents how taxes distort decisions to sacrifice consumption at time 0 to gain extra leisure at time t. This distortion also grows over time but only because of the interest rate tax. Wage taxation does not aggravate the distortions in savings but asset income taxation does aggravate distortions between consumption and leisure at different dates.

Our commodity tax interpretation of factor income taxation and the inverse elasticity rule reveal many features of factor taxation. This approach shows us how distortionary asset income taxation is, and hints at the value of removing it from tax systems.

1.2 The Productive Efficiency Principle

The second important principle is the Diamond–Mirrlees (1971) result about productive efficiency. The essential argument is that a tax system may unavoidably cause distortions in consumption, but there is no need to also force the economy to produce that output in an inefficient fashion. The chief implication of the Diamond–Mirrlees efficiency result is that an optimal tax system would tax only final goods, not intermediate goods.

For example, we may want to tax clothing and meat, but we do not want to tax sewing machines and meat storage lockers. If we taxed sewing machines, clothing producers would substitute away from mechanical production and toward labor-intensive methods, reducing the productivity of the economy. Even if we wanted to tax clothing more heavily than meat, any differential treatment of sewing machines and meat storage lockers would just distort the allocation of capital. Taxes on sewing machines and meat lockers are all ultimately paid by consumers in any case. It is better to rely on direct taxation of clothing and meat consumption and allow the production of both to proceed undistorted by taxation of capital inputs.

The productive efficiency principle applies to any analysis of income taxation, since capital goods are intermediate goods. In fact, taxation of capital goods is equivalent to sales taxation of intermediate goods. This can be seen by noting, for example, that a 100% sales tax on capital equipment is equivalent to a 50% tax on the income flow from that capital equipment. Since intermediate good taxation will generally reduce the productivity of an economy, capital income taxation will likely produce similar factor distortions, particularly if there are many capital goods.

When we combine the productive efficiency principle with the inverse elasticity principle, we arrive at a strong case against capital income taxation. Differential taxation of capital goods will produce inefficiencies in the allocation of productive inputs. A uniform tax on capital inputs may not distort allocation but will effectively create an exploding consumption tax as illustrated in Table 1. Therefore, an optimal tax structure would tax only final goods.

The productive efficiency principle is well recognized in tax reform arguments. One of the key benefits from consumption taxation is the elimination of differential taxation across various capital goods; see Auerbach (1989) and Goulder and Thalmann (1993) for recent examinations of the importance of productive efficiency.

The Diamond–Mirrlees principle does rely on special assumptions, leading some to argue against its relevance in tax discussions. Two provisos immediately come to mind. First, Diamond and Mirrlees assume each commodity is taxed at a separate rate. The inverse elasticity rule argues for a different tax on all goods, whereas consumption tax proposals actually propose a single tax rate. While this may appear to be a serious difficulty, we will ignore it. This approach is supported by the arguments in Balcer et al. (1983). They show that while an optimal commodity tax system would have very different rates across goods, there is little welfare difference between that tax system and a revenue-equivalent flat tax. Given the extra complexity and administrative cost of a tax system that charges different tax rates on different goods, it seems sensible to stay with a uniform consumption tax.

Second, the productive efficiency result also assumes that all pure profits are taxed away, whereas pure profits are not taxed away in the current tax system nor in any proposed reform. In fact, the drop in marginal rates from most reforms would reduce the taxation of pure rents. We will show that this is also not a serious impediment to applying the production efficiency principle when we consider plausible estimates for tastes and technology.

This Diamond–Mirrlees productive efficiency principle provides us with a theoretical basis for consumption taxation. However, it also tells us that we need to pay careful attention to what is an intermediate good and what is a final good. This distinction will play a critical role below in our discussions of various tax issues.

2. TAXATION IN A SIMPLE DYNAMIC COMPETITIVE MODEL

We will use some standard analysis to illustrate the significant benefits of moving away from asset income taxation and toward consumption taxation. We assume the simple growth model used in Judd (1987). Judd uses the simple representative agent aggregate growth model where output is produced by capital and labor and is divided allocated to consumption and investment with no adjustment costs. We assume a Cobb–Douglas production function with capital share 0.25. We assume an additively separable utility function where the compensated elasticity of labor supply equals $\eta > 0$, and that the consumption demand elasticity[5] is $\gamma > 0$. We assume a proportional tax on labor (capital) income at a rate of τ_L (τ_K).

Table 2 displays the marginal efficiency cost of various tax changes for various values of γ and η. We assume that the economy begins with one tax policy and makes small changes in labor or capital income taxation, or introduces a small investment tax credit (ITC) applied to all investment. We do not explicitly include a consumption tax, but an increase in an ITC has the same effect of reducing the effective tax on new capital without reducing the taxation of old capital. For example, the flat tax proposes expensing of capital expenditures, a measure that is equivalent to a large ITC. These three policy tools cover many of the policy options used in the past and proposed for the future.

We first examine the case where $\tau_L = \tau_K = 0.3$ and the economy is at the steady state at the initial time. We then examine the case where the economy begins with $\tau_L = 0.4$ and $\tau_K = 0.5$. MEB_L is the marginal loss of utility (measured in dollars) per dollar of revenue raised if τ_L is increased. MEB_K (MEB_{ITC}) is the corresponding

5. See Judd 1987, for a long list of empirically estimated labor supply elasticities and labor tax rates used there to compute MEB.

TABLE 2

EFFICIENCY COSTS OF VARIOUS POLICY CHANGES

		$\tau_L = 0.3,\ \tau_K = 0.3$			$\tau_L = 0.4,\ \tau_K = 0.5$		
γ	η	MEB_L	MEB_K	MEB_{ITC}	MEB_L	MEB_K	MEB_{ITC}
0.1	0.1	0.02	0.15	0.46	0.04	0.38	1.1
0.1	0.4	0.04	0.21	0.72	0.07	0.51	1.8
0.1	1.0	0.05	0.25	0.99	0.08	0.62	2.5
0.5	0.1	0.04	0.36	1.9	0.07	1.3	−15.0
0.5	0.4	0.11	0.42	2.6	0.21	1.5	−9.8
0.5	1.0	0.19	0.48	4.0	0.35	1.7	−7.3
2.0	0.1	0.05	0.69	−240.0	0.09	5.8	−2.8
2.0	0.4	0.20	0.91	−6.9	0.39	22.0	−2.4
2.0	1.0	0.50	1.3	−3.5	1.19	−11.0	−2.0

index for increases in τ_K (an ITC). The *MEB* indices in Table 2 are discounted present values that include the transition process from one tax policy regime to another. We expect the $MEB > 0$ since we expect that any tax policy change that raises revenues will reduce utility; however, $MEB < 0$ is possible in severely distorted systems, such as when tax rate increases decreases both revenue and utility.

Table 2 illustrates several important points. First, we do not have a good quantitative grasp of the welfare costs of tax changes. The values of critical parameters used in Table 2 are all in the range of existing empirical estimates. It is difficult to choose among the empirical estimates of γ and η, since they differ in terms of data sets and estimation strategy. The typical calibration approach would argue vigorously for one particular parameter choice and ignore others. I am skeptical about our ability to make such choices given the noisy data we have and the enormous gap between this simple model and the far more complex real world.

Second, Table 2 shows us that the simple growth model clearly ranks alternative tax policy changes even when we do not have good information about elasticities. In all cases in Table 2, replacing capital income taxation with labor income taxation would improve welfare, usually by a substantial amount relative to the revenue shift. Furthermore, changes that focus on encouraging new investment, such as the ITC, are particularly effective in improving economic performance with small revenue loss. In fact, MEB_{ITC} is sometimes negative, implying that an increase in the ITC would raise revenues because the extra capital income tax revenue on the new capital and the extra wage taxation from the higher wages would pay for the costs of the ITC. An increase in the ITC is similar to the introduction of a flat tax. Both reduce taxation of new investment but do not reduce the tax burden on old capital. In fact, the flat tax can be viewed as an income tax at rate τ and plus an ITC at rate τ and no depreciation allowances.

Third, the more elastic the labor supply, the greater the difference between MEB_L and MEB_K. A static perspective suggests that the relative costs of labor and capital income taxation depend on the elasticities of savings and labor supply, and that as the labor supply elasticity increased, the welfare cost of labor taxation relative to capital income taxation would rise. The opposite is true in Table 2 where both MEB_K and MEB_{ITC} rise even more rapidly than MEB_L as we increase labor supply elasticity, η. The resolution of this puzzle lies in our *MRS*/*MRT* distortion expressions above in (1) and (3). These expressions tell us that asset income taxation implies an exploding distortion for both consumption and leisure demand. As the labor supply elasticity rises, the importance of this labor market distortion also rises, and the total distortion due to asset income taxation rises.

The $\tau_L = \tau_K = 0.3$ case for the initial tax policy is low relative to the current U.S. tax system. The case of $\tau_L = 0.4$ and $\tau_K = 0.5$ is closer to the conventional description of the tax system before 1981 but is not generally considered descriptive of the current tax system. Of course, the welfare benefits of tax reduction are much greater when we begin with higher tax rates. We will also see that the $\tau_L = 0.4$ and $\tau_K = 0.5$ scenario is actually plausible when we consider the impact of imperfect competition.

The robustness of the results in Table 2 is surprising since we normally expect the results from computational general equilibrium to depend critically on the elasticity parameters. The magnitudes of the *MEB* indices do depend on elasticity values, but the ranking of alternative policies does not. This indicates that something fundamental is behind the results. We argue that the critical facts come from optimal tax theory: taxation of asset income corresponds to exploding commodity taxation but labor taxation and consumption taxation do not.

2.1 Implications for Tax Reform

Before continuing, we will summarize our theoretical arguments. It is important to do this since our results strongly contradict the standard intuition used by many in the tax reform literature. Gravelle's (1994) discussion of the welfare effects of consumption versus capital income taxation is a good statement of the commonsense approach. She asserts (Gravelle 1994, p. 31)

> Theory does not tell us, *a priori*, whether eliminating capital income taxes will increase overall efficiency, since it reduces one distortion at the price of increasing another. . . . The efficiency effects depend on assumptions about behavioral effects. If individuals are relatively unwilling to substitute consumption over time and relatively willing to substitute leisure for consumption of goods, then a significant tax on capital income would constitute part of an optimal tax system. These behavioral effects are difficult to estimate empirically.

This intuition is a natural one. Its references to substitution propensities appear to invoke the inverse elasticity rule we also invoke, and argues that we must accept trade-offs among various distortions. However, the arguments we have made do not make any qualifications concerning the relative elasticity of intertemporal substitution and labor supply. Separability assumptions were made in some earlier analyses, but even those assumptions are absent in Judd (1985). Many of the analyses arguing for no long-run taxation of capital assume a constant intertemporal elasticity of consumption, but that focus is not restrictive. Table 1 shows that even a small capital income tax implies rapidly exploding consumption tax equivalents, and there is no evidence that individual consumption elasticities vary enough to make such a tax policy efficient. Plausible values for consumption demand and labor supply elasticities offer no support for asset income taxation in the long run.

This discussion ignores the transition process, but there again we find no evidence supporting asset income taxation on efficiency grounds. Table 2 in fact shows the opposite. The gaps $MEB_{ITC} - MEB_L$ and $MEB_K - MEB_L$ represent the efficiency gain from increasing labor taxation and using the revenues to finance an increase in the ITC or a decrease in capital income taxation. Table 2 shows that this gain increases as we increase our estimate of the elasticity of labor supply. As the elasticity of labor supply increases, it is more valuable to increase *labor* income taxation and reduce *capital* income taxation, even when we consider the transition process.

The theoretical case against capital income taxation in favor of consumption taxation is much stronger than conventionally thought. There are qualifiers, of course. For example, Hubbard and Judd (1986) show that asset income taxation may be desirable when capital markets are imperfect . The intuition there is straightforward: capital income taxation may be useful if it is a substitute for missing capital markets. However, these findings are sensitive to the nature of market incompleteness. It is unclear if those considerations can justify observed capital income tax rates. For example, it is difficult to imagine that liquidity constraints could justify a corporate income tax. It is also plausible that capital market failures can be dealt with better through more modest adjustments of a consumption tax.

2.2 *What Is the Tax Rate on Capital?*

When we examine the simple model more closely, we see that it is unclear what tax rate to use. There is a common perception that the United States relies heavily on the taxation of capital for its revenues. For example, Mendoza, Razin, and Tesar (1994) argue that the average capital income tax rate in the United States is generally above 40%. This assessment is often used in macro models of tax policy. In contrast, the public finance literature comes to a quite different conclusion. Indeed, Gordon and Slemrod (1988) showed that the was no significant revenue raised for the U.S. federal government through the taxation of capital. The difference arises from a more detailed analysis of distinct tax instruments. A follow-up study, Gordon, Kalambokidis, and Slemrod (2004), shows that this remains the case for the United States.

The key to the differences between the macro and public finance analyses is the detailed accounting used in the latter. For example, deduction of mortgage interest is, when combined with the nontaxation of income from owner-occupied housing, effectively a subsidy to formation of housing capital. Public finance studies will explicit measure this subsidy, along with the fact that the individuals who use this deduction tend to be in the higher marginal tax brackets. Macro studies rely instead on national income data, which are not so finely disaggregated. Furthermore, the net revenue from capital taxation is reduced by tax arbitrage; that is, high-tax individuals deduct interest paid on debt where the interest payments go to individuals in low tax brackets. See Gordon and Slemrod (1988) for a discussion of these and other details.

The great difference between these views of the taxation of capital will produce vastly different results. For example, if we were to assume a capital income tax rate of zero in the simple model, then the excess burdens of tax increases would be small. However, using the average tax rate would be a serious mistake because almost all forms of capital face tax distortions, some due to positive taxation and some from explicit or implicit subsidies. Therefore, a tax system with zero average tax rate on capital will still substantially distort the economy. In general, we will argue below that the variation in tax rates is more damaging than the level of taxation. We will see how much more in examples below.

2.3 Are We on the Wrong Side of the Laffer Curve?

One popular question that economists ask is "will a cut in tax rates result in more revenue?" If one uses the simple aggregate growth model described above, and examine the impact of only cuts in labor and capital income taxes on revenues, Table 2 shows that increasing the tax rates will increase revenue. Only when initial factor income tax rates are large will one get the opposite result.

The results in Table 2 show how unreliable this approach is. Table 2 shows that the impact on revenue from changing the ITC is not similar to an increase in factor income taxation. In fact, increasing the ITC will often result in an increase in revenues. If one were using an average tax rate (or even average marginal tax rate) approach that ignored the distinction between an ITC and capital income tax, the results would not capture important differences. Therefore, even for the simplest question of what happens to tax revenues, one cannot use an aggregated approach.

3. THE HIGH COST OF ASYMMETRIC RATES

The inverse elasticity rule says that the optimal tax on a commodity is inversely proportional to its demand elasticity.[6] This comes from the basic Harberger formula relating the efficiency cost of taxing a good and its elasticity of demand.[7] Suppose

6. A more complete analysis would include the role of the elasticity of supply; more precisely, the optimal tax would be proportional to $\eta_D^{-1} + \eta_S{}^{-1}$ where η_D (η_S) is the elasticity of demand (supply). In this study, I take a long-run perspective, in which case it is appropriate to assume that the long-run supply curve is flat. In many industries, we expect significant increasing returns to scale and learning curve effects, in which case the long-run supply curve is falling. We do not examine that case here since the necessary dynamic models are much more complex than the ones we use in this study.

7. Our simple intuitive formula assumes that tax rates are small and ignores cross-elasticities in demand. However, the inverse elasticity formula turns out to be surprisingly good as a rule of thumb.

that a good is taxed at the rate τ, its demand is Q, and its elasticity of demand is η. If it is the only good taxed, then tax revenue is τQ and the efficiency cost of the tax, called the *excess burden* and denoted *EB*, is $\frac{1}{2}\eta\tau^2 Q$. The extra efficiency cost per dollar of extra revenue is called the *marginal excess burden* and denoted *MEB*, is $\eta\tau$. The *EB* and *MEB* indices will serve as the crucial tools for us in expressing the efficiency cost of a tax. If there are two goods where good i had elasticity of demand η_i, tax τ_i, and demand Q_i, then the total efficiency cost is $\frac{1}{2}\eta_1\tau_1^2 Q_1 + \frac{1}{2}\eta_2\tau_2^2 Q_2$ and the total revenue is $\eta\tau_1 Q_1 + \eta\tau_2 Q_2$. The tax system that minimizes efficiency costs for a given revenue target would choose taxes so that the *MEB* is equated across taxes; in this simple case, this implies that $\eta_1\tau_1 = \eta_2\tau_2$, or

$$\frac{\tau_1}{\tau_2} = \frac{\eta_2}{\eta_1},$$

which says that the optimal tax on a good is inversely proportional to its elasticity of demand.

The inverse elasticity rule has many implications for capital income taxation. First, any capital income tax will raise the price of goods using that kind of capital. To see this more precisely, consider the case of an industry where firms use a fixed coefficient technology requiring α dollars of capital per dollar of output. Suppose before-tax unit cost is normalized to one, the capital income of the firm is taxed at rate τ_K, output is taxed at rate τ_c, and demand displays a constant elasticity of demand equal to η. The result will have buyers paying $(1+\alpha\tau_K)(1+\tau_c)$. For small levels of taxation, we obtain the following Harberger-style expressions for price, p, revenues, *REV*, excess burden, *EB*, and marginal excess burden, *MEB*, will be

$$\begin{aligned}
p &\approx 1 + \alpha\tau_K + \tau_c \\
REV &\approx (\tau_c + \alpha\tau_K)\,(1 - \eta\,(\tau_c + \alpha\tau_K)) \\
EB &\approx \tfrac{1}{2}\eta\,(\tau_c + \alpha\tau_K)^2 \\
MEB &\approx \tfrac{1}{2}\eta\,(\tau_c + \alpha\tau_K)\,.
\end{aligned}$$

In general, output, prices, and revenues would be the same as if there were no tax on capital and the tax on purchases were $\tau_c^* = \tau_c + \alpha\tau_K + \alpha\tau_c\tau_K$. Therefore, in this example with fixed coefficients technology, a tax on capital income at rate τ_K is identical in its effects to a sales tax on the output.

The inverse elasticity rule says that some goods, the ones with low elasticity of demand, should be taxed more than others. However, there is no reason to believe that different types of capital are matched with final goods with different elasticities of demand. Any misalignment will essentially produce inefficient consumption taxation. The Diamond–Mirrlees (1971) result about productive efficiency is a strong statement about the importance of productive efficiency. The essential argument is that a tax system will unavoidably cause distortions in consumption of final goods by consumers since some things, such as leisure, cannot be taxed but many other goods will be taxed. Any tax system will affect an economy's output. However, Diamond and Mirrlees

(1971) tell us that there is no need to also force the economy to produce that output in an inefficient fashion. The chief implication of the Diamond–Mirrlees efficiency result is that an optimal tax system would tax only final goods, not intermediate goods.

The productive efficiency principle applies to any analysis of income taxation, since capital goods are intermediate goods. In fact, from the point of view of a business, any tax on capital income (net of depreciation) is equivalent to a sales tax on the purchase of the capital that produces that income. Suppose that a firm faces a 50% tax rate. This essentially says that the government owns half of any capital after the business buys it. Therefore, a firm that pays two dollars for capital receives only the income from the capital purchased with one dollar. His situation is the same as if he paid no income tax but instead spent one dollar on capital, and gave the government another dollar in the form of a 100% sales tax. Since intermediate good taxation will generally reduce the productivity of an economy, capital income taxation will likely produce similar factor distortions, such as a reduced demand for labor. Also if there are many capital goods taxed at different tax rates, businesses will switch to using the less taxed forms of capital.

To illustrate the importance of these production distortions, we return to our simple example above except this time assume that the production function is Cobb–Douglas with capital share α. In this case, a Harberger-style analysis shows for small tax rates price, revenue, and excess burden are

$$\begin{aligned} p &\approx 1 + \alpha\tau_K + \tau_c \\ REV &\approx (\tau_c + \alpha\tau_K)(1 - (\eta - 1)\alpha\tau_K - \eta\tau_c) \\ EB &\approx \tfrac{1}{2}\left((1-\alpha)\alpha\tau_K^2 + \eta(\tau_c + \alpha\tau_K)^2\right). \end{aligned}$$

Here, we see that both the *EB* and *MEB* are greater due to the capital–labor substitution effect. Moreover, the formula for *EB* illustrates the importance of taxing only consumption. If $\tau_K = 0$, then revenue and excess burden depend only on the elasticity of demand and the consumption tax rate. However, if $\tau_K > 0$ then *EB* will depend on the technology as well as demand. This dependence on technology violates the production efficiency principle.

Heterogeneous taxation of capital also produces a bias toward using forms of capital that are less burdened by a tax. Suppose that a firm uses three kinds of capital with output described by a CRTS Cobb–Douglas production function. Suppose that the income from each type of capital is subject to different tax rates due to the corporate and personal income tax systems. This variation can be large, as would be the case, for example, of a firm that rents its factory buildings from a noncorporate firm but uses equity to finance its machinery. Next suppose that there is a fixed total supply of capital that will be allocated to the alternative forms of capital; this describes the situation in a dynamic economy over a short period of time. If we assume equal shares for all types of capital, we get a Harberger-style expression for the impact of tax asymmetries. Suppose that the three types of capital are taxed at rates τ, $\tau + v$, and $\tau - v$. Then, we find

$$\begin{aligned} OUTPUT &= 1 - \frac{2}{3}\frac{v^2}{(1-\tau)^2} \\ REVENUE &= \tau\ OUTPUT \end{aligned} \tag{4}$$

implying that as the variation in tax rates, v, increases, both output and revenue fall! This implies that if there is any deviation from uniform taxation, both economic output and tax revenue could be increased by equalizing the tax rates. The surprising simple but strong result depends on the Cobb–Douglas production function: factor shares will be invariant to the tax rate, implying that the tax base will be a constant share of output, implying that any deviation from productive efficiency will reduce output and revenue. However, these results would be overturned only by dramatically reducing the elasticity of substitution across different types of capital.

The productive inefficiency of the corporate income tax and the distortion to final goods consumption are the key features of Harberger-style of models. We now go beyond the conventional framework by adding considerations of imperfect competition, innovation, and risk, elements that we will show are equally if not more important when studying real-world taxation.

4. IMPERFECT COMPETITION AND TAXATION

Another critical idea we use is that taxation decisions of the government and the distortions produced by imperfect competition in the private sector are similar in their implications. A firm that charges a price above marginal cost is effectively acting as a tax collector. Any national consumption or income tax is imposed on top of any private sector distortions. This accumulation of distortions will substantially affect our estimates of the burden of taxes and our relative evaluation of consumption and income tax systems.

We will rely heavily on this analogy between taxation by the government and markups arising from imperfect competition. This analogy is particularly appropriate in the case of patents. The holder of a patent is not necessarily a monopoly producer. In fact, many patent holders do not produce their product. The key feature of a patent is that the patent holder can impose a tax on the purchase of the patented good, either directly through producing the good and charging a price in excess of marginal cost, or indirectly through a royalty. These distortions reduce economic efficiency and lead to underproduction of the patented good but are justified by the incentives they create for innovation. Without the rents produced by a patent, an innovator may not have sufficient incentive to undertake the fixed costs of research and development, a situation leading to an even worse situation of no production of a desirable product.

Therefore, even though patent monopolies reduce efficiency just like taxes do, we do not want to destroy the rents they create.

The patent monopoly story is the simplest one we can use to illustrate the key arguments, but our points are more robust and apply to any context where firms charge a price in excess of marginal cost. In many cases, these markups occur due to product differentiation and increasing returns to scale, situations that share many features of a patent monopoly even if there is no formal property right. Our analysis revolves around the presence of a markup of price over marginal cost, whether it arises from patent monopoly, an oligopoly of differentiated competitors, or some other form of imperfect competition.

Markups may also occur due to collusion or corruption, but that is the concern and responsibility of antitrust policy. Our arguments apply to imperfect competition that remains after appropriate application of antitrust laws. We do not argue that tax policy is a substitute for antitrust policy. Instead, we argue that tax policy should take notice of the fact that imperfect competition is an important part of any modern economy.

Joan Robinson (1934) noticed these facts and argued that a good tax policy would use subsidies to bring buyer price down to social marginal cost. She also argued that this policy would have some undesirable effects, since it would increase monopoly profits and likely be regressive in its impact on income distribution. Since it would be difficult to tax away these extra profits, she did not endorse such an approach.

We argue that these distributional concerns are not important in the U.S. economy. In modern dynamic economies, it is difficult for a firm to maintain large monopoly rents. High profits encourage entry by imitators. We used to think of IBM as a firm with large market power before it was hit by competition from competing producers of personal computers and workstations. For many firms, the current profits arising from setting prices above marginal costs are necessary to recover R&D costs and other fixed costs of production. This view of monopolistic competition is supported by Hall (1988) who finds that there is little evidence of supernormal returns to firms even though he finds that prices substantially exceed marginal costs.

Before continuing, we should note the limited way in which we will use these imperfect competition ideas. The key idea here is that preexisting distortions increase the efficiency cost of governmental taxation, even if tax policy is not used to fine-tune those distortions. We will see below how this limited argument strengthens the case for consumption taxation.

Tax reform analyses usually assume perfect competition in all markets. This is not a good description of a modern economy. While no one would disagree with this assertion, it is not immediately clear how this affects tax policy evaluation. We argue that the presence of imperfect competition strengthens the case for consumption taxation.

The basic idea we pursue here is a combination of two well-known ideas. First, we use the Robinson argument that subsidies can be used to offset the distortions if a lump-sum tax is available. At first that seems to be of limited usefulness since it would imply that most goods would be subsidized, leaving one to wonder what is left to tax to finance these subsidies as well as normal expenditures. Second, Diamond and Mirrlees (1971) tell us that only final goods should be taxed, not intermediate goods. Since markups are similar to taxation, this indicates that the final *net* tax on intermediate goods should be zero, no matter what the impact on final good taxation. In combination, these principles indicate that final goods should be taxed to finance corrective subsidies of any intermediate good, including capital goods, which is sold at a price above marginal cost.

We use this controversial assertion in a very limited way. The pure theoretical argument ignores many practical difficulties. It would be impractical to construct the perfect corrective policy, and we do not advocate any attempt to do so. We make much more limited use of this argument. We emphasize that if it would be optimal to reduce price–cost margins for intermediate goods, then it is surely not a good idea to impose taxes that aggravate price–cost margins for intermediate goods. In a competitive world, a small tax on intermediate goods may cause only small damage to the economy's efficiency. In a world with imperfect competition in intermediate goods industries, even a small tax on intermediate goods could cause substantial damage.

Since asset income taxes are equivalent to intermediate good taxes, this shows that small asset income taxes can create large efficiency losses. This observation strengthens the case for switching away from tax systems, such as conventional income taxation, which aggravate the distortions of imperfect competition, and toward consumption tax policies.

4.1 A Simple Model of Imperfect Competition

Judd (1995) examines a simple dynamic model that formally establishes our argument in a model using a few key assumptions. First, there is a fixed number of goods, all of which are produced in a monopolistically competitive market. Since the number of goods is fixed, marginal increases in demand results in pure profits for all firms. Each good can be used for both consumption and investment, and each of these goods is used in the production of all goods. Judd uses a representative agent model with elastic labor supply.

We assume that pure profits are taxed at the rate τ_Π and that income on marginal physical investment is taxed at rate τ_D. One interpretation is that the equityholders of each firm owns a patent on its good and uses debt to finance any physical investment. In equilibrium, the return on equity is the pure rent associated with holding the patent, and debtholders receive the marginal product of the physical investment. Therefore, dividend income is taxed at both the corporate and personal levels, but the debt-financed physical capital income is taxed only at the personal level.

The cost of capital with imperfect competition in capital goods markets. We next illustrate how the social cost of capital is altered by a combination of income taxation and imperfect competition. The cost of capital is determined by the usual arbitrage condition. Suppose that a firm is contemplating buying one more unit of capital with

TABLE 3

Effective Total Tax Rates

τ_D: / m:	0.1	0.2	0.3	0.5
0.05	0.14	0.24	0.33	0.52
0.10	0.18	0.27	0.36	0.54
0.20	0.25	0.33	0.42	0.58
0.30	0.31	0.38	0.46	0.62

a social marginal cost of production equal to 1. Because of the markup m by the producer of the capital good, the investing firm pays $1 + m$ for the unit of capital. Suppose that the marginal product of capital is MPK. Assume that the firm's bondholders pay a tax τ_D on the earnings from this investment and receive an after-tax return of $\bar{r}$ on alternative investments. Investment will continue until the after-tax return (we assume no depreciation) from a one unit investment, $MPK(1 - \tau_D)$, equals the opportunity cost of the investment, $\bar{r}(1 + m)$. In equilibrium, the level of investment is determined by

$$MPK = \bar{r}\frac{1+m}{1-\tau_D}. \tag{5}$$

If $m = 0$, (5) is the usual cost of capital formula. In the presence of monopolistic competition, the upstream markup of m on the purchase of capital goods acts in the same way as the downstream taxation of interest income.

To illustrate the combined effects of taxation and imperfect competition, we derive an effective combined tax rate. The situation in (5) is as if there were no markup and the tax on interest income were equal to τ^* where

$$\tau^* = 1 - \frac{1-\tau_D}{1+m} = \tau_D + \frac{m}{1+m}(1-\tau_D). \tag{6}$$

Table 3 presents values for the total effective tax rate τ^* for various values of the explicit tax τ_D and the margin m. For small tax rates and margins, the total effective tax rate is the sum $\tau_D + m$. At larger rates, τ^* is less than $\tau_D + m$, but presence of the margin m still substantially increases the total distortion. For example, the presence of a 30% margin causes the total tax rate to be 38% if $\tau_D = 0.20$.

With the concept of effective total tax in (6), we can see how our earlier arguments apply. First, since markups on capital goods distorts investment just as an interest tax would, they produce the same kind of exploding distortion in (2) that occurs under an interest tax. A uniform markup on capital goods violates the inverse elasticity principle just as a constant asset income tax does.

Second, incorporating imperfect competition into our analysis forces us to reconsider the level playing field arguments. The conventional wisdom, based on perfect competition assumptions, is that the 1986 tax changes eliminated most of the

TABLE 4
OPTIMAL TAX RATES

MEB: *m*:	0.2	0.5	1.0	2.0
0.05	0.04	0.04	0.03	0.02
0.10	0.09	0.07	0.06	0.05
0.20	0.17	0.15	0.12	0.09
0.30	0.26	0.22	0.18	0.14

differential taxation of capital goods; Auerbach (1989) is an example of such a study. Even if the explicit income taxes do not discriminate among alternative capital goods, the total effective tax rate τ^* will vary across goods to the extent that their margins vary. Studies such as Hall (1988) and Domowitz, Petersen, and Hubbard (1986) both indicate substantial variance in margins among capital goods. Since the welfare costs of taxation are increasing in the variance of inappropriate distortions, our neglect of heterogeneous markups make our results conservative estimates of the inefficiency associated with capital income taxation.

Optimal tax policy. We next illustrate what the presence of imperfect competition implies for optimal tax policy. We assume in this exercise that one can determine the markups and use them for policy purposes. This is not a realistic assumption since it is difficult to measure markups with great precision. The purpose of this exercise is to illustrate how important imperfect competition can be in determining optimal policy.

When pure profits are taxed at rate τ_Π, Judd (1995) shows that the long-run optimal choice for τ_D is

$$\tau_D^{opt} = -m\frac{1 + \tau_\Pi \, MEB}{1 + MEB}, \tag{7}$$

where m is the markup of price over marginal cost and *MEB* is again the marginal efficiency cost of taxation. If the efficiency cost of taxation is zero then the optimal tax completely neutralizes the monopolistic price distortion. This repeats the Robinson finding. As in Diamond–Mirrlees, the optimal tax rate on profits, τ_Π, is 100%, and the optimal policy eliminates the monopolistic price distortion.

While our optimal tax formula (7) is simple, it is not immediately clear that the desirable subsidy is economically significant when we use reasonable values for the markup m, the profits tax τ_Π, and the marginal excess burden *MEB*. We assume $m \in [0.1, 0.3]$ as suggested by our discussion of price–cost margins. The range for *MEB* is taken from Table 2. A key fact is that the equilibrium in our monopolistic competition analysis is essentially the same as for the competitive model used in Table 2 where τ^* from (6) is used as the total effective tax rate on capital income. Table 4 shows that even if *MEB* is large, the optimal tax substantially reduces the monopolistic distortion. In Table 4, we assume that $\tau_\Pi = 0.2$, as proposed in the flat tax; we arrive at similar conclusions if we use the pure profits tax rate implicit in any other major tax reform proposal.

Table 4 illustrates a number of points. First, the optimal subsidy is nontrivial in most cases. This shows how a system that puts no tax on asset income would still suffer a substantial distortion relative to the ideal. Second, we find that the productive efficiency principle[8] is still a good indication of optimal policy even though the profits tax is far less than desired by Diamond–Mirrlees. Third, the desire for productive efficiency is strong even in cases where the marginal efficiency cost of taxation is high. The efficiency cost may be high because the revenue need is large or because the elasticity of labor supply is high. In either case, tax policy should still focus on policies that do not aggravate the preexisting distortions from imperfect competition.

The policy implied by Table 4 is impractical. However, the results in Table 4 indicate how far any income tax system is from optimal. Table 4 also indicates how concerns about the taxation of pure profits are of far less importance than the goal of eliminating productive and intertemporal distortions.

4.2 Benefits of Switching to Consumption Taxation

We next give a quantitative estimate of how monopolistic competition affects our estimates of the gains from switching to a consumption tax. We continue to use the model in Judd (1995). We find that the estimated benefits of switching to a flat consumption tax are substantially increased when we include the presence of imperfect competition.

Since price–cost margins are essentially the same as taxes, we can use the results in Table 2 to draw inferences about the benefits of small tax policy changes. Suppose that capital goods are sold at 20% above marginal cost. We also will assume that there are labor market imperfections such as labor unions that cause wage costs to be 10% higher. Then even if the explicit taxes are $\tau_L = \tau_K = 0.3$ initially, the economy really begins with $\tau_L = 0.4$ and $\tau_K = 0.5$ when we change tax policy. The $\tau_L = .4$, $\tau_K = 0.5$ case in Table 2 then displays the efficiency impact of alternative tax changes if all marginal profits are taxed away. We see that the marginal benefits of reducing asset income taxation are substantially increased, being at least doubled and often at least tripled. The magnitudes are uncertain since we do not know the values of the critical taste parameters, but the impact of imperfect competition is clear and substantial for any standard estimate.

Table 2 examined small changes. We next examine large changes in tax policy. Table 5 reports the total welfare gain of replacing all income taxation with consumption taxation. Table 5 measures this gain by expressing that percentage change in consumption that is equal to the change in welfare from the tax change.

8. Points about productive efficiency would be better demonstrated in a model with heterogeneous capital goods. The more general analysis in Judd (1995) indicates that these conclusions are strongly supported in such models.

TABLE 5
WELFARE GAIN (% OF CONSUMPTION)

τ_K : γ	m	0.15	0.25	0.35
0.25	0.0	0.12	0.38	0.84
	0.1	0.37	0.79	1.41
	0.2	0.54	1.08	1.81
0.5	0.0	0.19	0.59	1.30
	0.1	0.57	1.21	2.16
	0.2	0.81	1.62	2.74
1.1	0.0	0.24	0.76	1.67
	0.1	0.72	1.54	2.75
	0.2	1.00	2.04	3.46

For example, in the case of $\gamma = 0.25$, $m = 0$, and $\tau_K = 0.15$, we find that the welfare gain from the switch is equal to an immediate and permanent 0.12% increase in consumption.[9] Table 5 examines capital income[10] tax rates of 15%, 25%, and 35%. The rate τ_K represents the marginal tax rate, not the average rate, since the distortion depends on the marginal tax rate. We examine markups of 0%, 10%, and 20%. We assume that depreciation is 5% per year and that capital share is 25%.

Table 5 shows that the presence of a markup substantially increases the benefits of switching to a consumption tax. In fact, the presence of just a 10% markup often doubles the welfare gain relative to the perfect competition case. Again, we find that these gains are substantial for any estimate of the critical parameters.

Imperfect competition is a fact of a modern economy and should be included in any tax analysis. Capital goods users are already paying a tax when they buy capital produced in oligopolistic markets. While it may not be feasible to relieve that tax burden through tinkering with the tax code, we should still recognize that this private tax means that further taxation of capital goods substantially damages economic efficiency and makes it more valuable to move to consumption taxation.

5. RISK AND TAX REFORM

Investment is generally risky, but risk is often ignored in tax reform analyses. This section uses Hamilton's (1987) general equilibrium analysis of the taxation of risky assets to make some basic points. First, we find that asymmetric treatment of risky

9. This quantity is small but typical for competitive model. An alternative way to express the welfare gain is to report the ratio of welfare gain to the revenue or revenue change. However, that index is sensitive to the presence of details such as the standard deduction. The index we use is a cleaner way to express the welfare gains that allow us to ignore details that are not relevant for us.

10. We ignore labor taxation since labor is inelastically supplied in our simple analysis. However, the presence of a wage tax with elastic labor supply generally increases the welfare costs of taxation. Hence, our results are conservative estimates of welfare costs.

assets will affect the equilibrium portfolio of the economy. While this is expected, we do this to emphasize the importance of general equilibrium effects since partial equilibrium analyses lead to contrary conclusions. Second, we emphasize Hamilton's finding that there should be no differential taxation of risky and safe assets. This example indicates that a goal of tax reform should be to eliminate any distortion between safe and risky investments. Third, we analyze the utility–revenue trade-off available to policymakers and demonstrate the importance of incorporating risk in our analysis.

5.1 Asset Returns and Risk

The most important fact about asset returns in the United States is that the annual pretax real return to individuals on equity investments has averaged 7% with a standard deviation of 20%, and the mean real return on safe assets has been 1%. Corporate tax adjustments imply that both mean and variance should be 20–40% higher for the risky asset to approximate the opportunities offered to society. The extra return to risky equity is consistent with standard asset pricing theory, but the magnitude is difficult to explain; see Kocherlakota (1996) for a discussion of asset pricing puzzles. The empirical puzzles surrounding asset pricing makes any tax analysis difficult to execute. Even so, we find that including risk in our analysis strengthens the case for consumption taxation.

5.2 Treatment of Risk in the U.S. Income Tax System

The U.S. tax system appears to discriminate against risky assets and in favor of safe assets. This discrimination depends on the type of investment and the manner in which an investor holds it. If an asset is held in a defined contribution pension account, there is no taxation at the personal level. Corporate debt, a relatively safe asset is deducted at the corporate level, implying no taxation of any income generated by such assets. However, income generated by equity investments is taxed at the firm level through the corporate income tax.

For assets held outside of pension accounts, we need to include personal income taxation. At the personal level, dividends and interest income are taxed at the same rate and capital gains have often been taxed at a lower rate. Since the corporate income tax rate is close to or exceeds the personal tax rate, it appears that risky equity investment held outside of tax-favored accounts is taxed at a higher rate than safe debt. These observations indicate that the current U.S. income tax system produces substantial discrimination against risky assets and the investments behind them no matter how they are held by investors.

5.3 Hamilton's Model of Risk and Asset Taxation

There have been many analyses of taxation and risk. Domar and Musgrave (1944) argue that an income tax increases risk taking in the economy. However, the Domar–Musgrave result is substantially altered when the risky revenue flow is passed through the government, onto private agents, and affect private risk taking. Eaton (1981) and Hamilton (1986) have analyzed theoretical issues concerning tax systems and risk taking.

Unfortunately, risk is generally absent from quantitative analyses of taxation. This is not surprising since it is difficult to incorporate risk in dynamic general equilibrium analysis. It is also unclear how we should calibrate any such model, since we do not understand why there is such a large gap between the mean return of safe and risky assets. However, we should not totally ignore risk in tax reform analyses. We use Hamilton's (1986) model to examine the impact of differential taxation since it focuses on the most basic elements of asset allocation and risk. It allows us to compare consumption taxation, uniform income taxation, and differential income taxation all in one model.

The Hamilton (1986) analysis assumed that there is one good used for both consumption and investments. There are two types of capital investments, one with a risky return and the other with a safe return. We assume that net income from risky capital is taxed at rate τ_Z and net income from safe assets is taxed at rate τ_R. We assume that agents have a constant relative risk aversion utility function[11] and discount the future at rate 4% per year. We assume that all revenues are rebated lump sum to investors. This is a common assumption we make to abstract from government expenditure policies. In this stochastic context, this assumption takes on added importance. If revenues were destroyed, then, as Domar and Musgrave (1944) have argued, a constant income tax would shift investment toward the risky asset. However, we find that assumption to be unrealistic since government expenditures do not immediately react to revenue shocks. The essential idea behind this assumption is that current revenue shocks lead either to tax cuts in the future, or to increases in government expenditures on goods that are good substitutes for private consumption. We do not argue that this is the most valid specification of actual policies, but use it because it is one that allows us to examine the critical issues without modeling fine details of government expenditure policies.

Hamilton (1987) examined optimal income taxation in such models. He showed that the optimal constant tax policy is to have equal tax rates for safe and risky assets. We will use Hamilton's model to examine the global trade-offs between utility and revenue for several nonoptimal policies, and estimate the gain from moving to the optimal policy. We examine several numerical cases. First, we assume that the risky asset has a mean return of 10% and a standard deviation of 25%, and that the safe asset has a mean return of 1%. Figure 1 displays important features for relative risk aversion of 10 (corresponding to $\gamma = 0.1$ in Table 2). This may appear to imply a large risk aversion. However, some implications are reasonable. In particular, the standard deviations of consumption and output are about 1%, which is close to observed values. Furthermore, conventional parameterizations of returns an utility imply a net negative investment in the safe asset; therefore, in order for our examples to have the

11. More precisely, we assume $u(c) = c^{1-1/\gamma}/(1 - 1/\gamma)$, where γ is also the intertemporal elasticity of consumption used in Table 2.

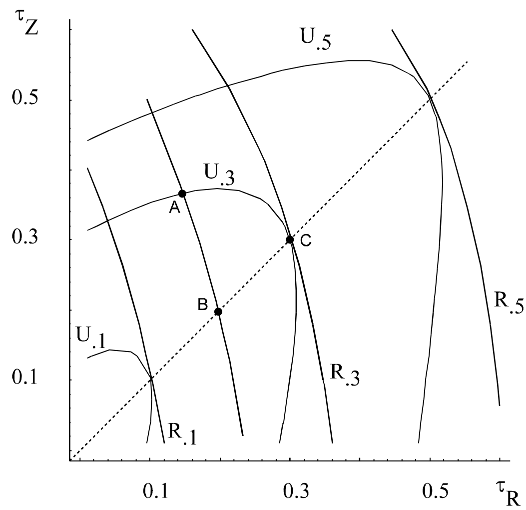

FIG. 1. Isorevenue and Isoutility Curves in Tax Rate Space.

safe asset held in positive amounts, we need increase the risk premium and/or risk aversion. In any case, we have recalculated the examples below for alternative means and variances, and find that the qualitative points are unchanged.

Figure 1 presents two types of curves relating the tax on the safe asset, τ_R, and the tax on the risky asset, τ_Z. The curves $U_{0.1}$, $U_{0.3}$, and $U_{0.5}$, are isoutility curves corresponding to the cases where $\tau_R = \tau_Z = 0.1, 0.3, 0.5$. That is, any combination of taxes along $U_{0.1}$ produce the same expected utility as the tax policy $\tau_R = \tau_Z = 0.1$. Expected utility is greater as we move south and west. Similarly, $R_{0.1}$, $R_{0.3}$, and $R_{0.5}$, are the isorevenue curves corresponding to the cases where $\tau_R = \tau_Z = 0.1, 0.3, 0.5$. The dotted line is the 45° line. Revenue increases as we move east and north. A consumption tax is represented at the origin where $\tau_R = \tau_Z = 0$. Note that the isorevenue and isoutility curves are tangent along the 45° line, implying that the optimal policy is one of equal tax rates as predicted by Hamilton.

While the optimality implications of Figure 1 correspond to theory, the global trade-offs are strange. Note that revenue is relatively insensitive to changes in the tax on the risky asset. This is not too surprising since most wealth is in the safe asset in Figure 1. More surprising is the shape of the isoutility curves away from the optimal policy. We see that if the tax rate on safe assets is much smaller than the tax rate on risky assets, an increase in tax rates can keep utility unchanged or even improve utility!

These features of Figure 1 show the importance of including uncertainty explicitly into our analysis. The normal procedure is to take the average pre- and posttax returns and insert them into formulas for utility and revenue in a deterministic model.

TABLE 6

EXCESS BURDEN OF TAXATION WITH RISKY ASSETS

γ	τ_Z	τ_R	MEB_R	MEB_Z	MEB_K	DB_R	TB
0.5	0.1	0.1	−0.10	−0.061	−0.056	0	−0.025
	0.4	0.1	−1.90	−0.510	−0.580	−0.11	−0.220
0.1	0.1	0.1	−0.01	−0.011	−0.002	0	−0.005
	0.4	0.1	0.01	−0.120	−0.037	−0.022	−0.029

This approximation could not predict the shape of the isoutility curves and cannot study the cost of asymmetric rates.

We can use Figure 1 to make some assessments about the value of converting to consumption taxation and of other less radical reforms. In Figure 1, a constant consumption tax is effectively a lump-sum tax, since there are is no labor supply decision. We proceed under the assumption that Figure 1 approximates the welfare gain if labor supply were slightly elastic. Suppose that $\tau_R = 0.15$ and $\tau_Z = 0.35$, the situation at point *A*. The utility-maximizing policy raising the same revenue is at *C*, implying a small reduction in the tax on risky investments and a larger increase in taxation of safe assets. The optimal revenue neutral change is to move to point *B*, where utility is higher. The move from *A* to a consumption tax can be decomposed into two moves, first to a revenue neutral change to a uniform tax at *B* and then to the origin in Figure 1.

Analyses that ignore the differential taxation of assets will miss the utility gain associated from eliminating nonuniformities, such as the move from *A* to *B*. This gain would be achieved even if we just integrated corporate and individual taxation. When we add this feature to the analysis, we find another benefit from moving to consumption taxation.

Table 6 displays the welfare cost of taxation in the Hamilton model of risk and taxation. We assume that safe assets are taxed at a rate $\tau_R = 0.1$, and that risky assets are taxed at the rates $\tau_Z = 0.1$, 0.4. MEB_R is the marginal excess burden of increasing τ_R, measured as the change in certainty equivalent consumption per dollar of revenue change. MEB_Z (MEB_K) is the marginal excess burden associated with raising a dollar of revenue by a small increase in the taxation of risky asset income (all asset income). We also compute the value of large changes in taxation. To do this, we compute the change in the certainty equivalent of utility, measured in the equivalent constant consumption flow. We compare this to the certainty equivalent of the change in revenue flow. The differential burden DB_R is the value per dollar of revenue change of eliminating differential taxation. *TB* is the total burden of the initial system of taxation per dollar of revenue.

If $\tau_Z = \tau_R = 0.1$ then safe and risky assets are taxed symmetrically. The total burden is small. However, the marginal burden of introducing any asymmetry is higher than the marginal burden of a uniform increase. In the $\gamma = 0.5$ column, the total burden of taxation is 2.5 cents, and the marginal burden of asset taxation is

5.6 cents. However, the marginal burden of raising the tax on risky assets only is 6.1 cents. When we examine the asymmetric case of $\tau_Z = 0.4$ and $\tau_R = 0.1$, the results are more striking. The gain from eliminating all asset income taxation is 22 cents per dollar of revenue, but the gain of eliminating just the asymmetric treatment, holding fixed total revenue, is 11 cents per dollar of initial revenue. The benefits of reducing asymmetries increases substantially in this case. These observations even apply to those who hold their equity in 401(k) accounts or similar pension savings accounts. Individual investors still pay taxes on their risky assets through the corporate income tax. In reality, a U.S. taxpayer faces three asset categories—debt, equity, housing—even if he has all financial assets in tax-favored accounts.

The asymmetric tax treatment of assets produces a substantial burden on investors in the Hamilton model. We have examined just one particular model of taxation and risk, but it is a natural one to study. Further investigation of alternative models would be fruitful, but there is no reason to suspect that the results would be different. The main intuition is clear: if the elasticity of demand for consumption is the same across all states (as is assumed in Hamilton), there is no rationale for asymmetric treatment of income across states. The asymmetric treatment of assets by the U.S. tax code only reduces the efficiency of the U.S. economy.

6. TAX POLICY AND HUMAN CAPITAL FORMATION

Human capital is the most important determinant of wealth and income for most individuals and any modern economy. However, income tax analyses devote less effort to understanding the taxation of human capital than the taxation of physical capital and labor supply. A separate treatment is necessary since human capital is neither just capital nor is it just a feature of the labor supply. We show that human capital considerations strengthen the case for consumption taxation, essentially it increases the elasticity of effective labor supply and increases the responsiveness of output to asset income. We also show how it raises new issues about how we should implement a consumption tax.

6.1 Optimal Taxation of Human Capital and Education Investments

Education and other investments in human capital[12] present special problems for tax analysis. Education is an investment good since it increases labor productivity, but it may also have a consumption value. Diamond–Mirrlees (1971) argue for taxing final goods but against taxation of intermediate goods. Since human capital appears to be a mixture of labor supply, investment, and consumption, the implications of these ideas for human capital are unclear.

12. There are many forms of investment in human capital. We will focus on education and on-the-job training, since they are most relevant for tax analyses. Other forms of human capital investment, such as child care and medical care, are even more difficult to analyze.

Judd (1999) examines these issues in a dynamic general equilibrium model. He assumes that individuals invest in both financial assets, A (which finance physical capital, k), and human capital, H. During his life, he earns $\bar{r}A$ in asset income where $\bar{r}$ is the after-tax return on financial assets. He also earns $\overline{w}L(H, n)$ in labor income where $L(H, n)$ is effective units of labor input if he works n hours and his human capital is H, and $\overline{w}$ is the after-tax wage for a unit of effective labor. He allocates savings between financial investments and human capital investment, x. Human capital investments equal x and earn tax credits at the rate s, implying a net cost of $x(1 - s)$. The aggregate production function is $f(k, L(H, n))$ where f is a standard constant returns to scale production function.

The incorporation of human capital in this problem generates a tension. If we think of human capital as capital then the logic in Judd (1985) argues for no taxation of human capital. That leaves labor income as the only tax in the long run. However, it is difficult to tax labor income without distorting human capital investments. Judd (1999) shows that if H does not affect utility then human capital is purely an intermediate good and there should be no net taxation on the return of human capital investment, only taxation of hours of labor supply. This can be implemented by taxing labor income but allowing immediate deduction of all human capital investment expenditures. These results follow exactly the logic of Diamond and Mirrlees (1971).[13]

6.2 *Is Education Only an Intermediate Good?*

If H is only an intermediate good, then all human capital investments should be expensed. But if H directly affects utility then the analysis in Judd (1999) shows that we want a positive tax on human capital returns. Many components of an education appear to have substantial consumption value. Music appreciation courses in school help one enjoy symphonies and operas later in life. Sometimes the educational activity itself has both productive value and aesthetic value. For example, mathematics courses, such as calculus, algebra, and topology, not only teach the student highly productive skills but also introduce the student to the beauty of mathematics and the joy of solving math problems.

We can get evidence about the character of education by comparing financial returns of alternative assets. If education has a lower financial return than comparable financial assets, then human capital must be producing some nonpecuniary utility returns, is partly a consumption good, and should be taxed. This issue has been addressed somewhat in the literature. Becker (1976) argues that years of education and corporate equity have roughly the same mean financial return.[14] Becker argued

13. There have been other analyses of human capital and taxation in economic growth models. Jones, Manuelli, and Rossi (1993) argue that there should be no taxation of anything in the long run. This extreme result arises due to special functional form assumptions made in order to arrive at a model with a constant growth rate in consumption and all forms of investment. Judd (1999) examines a strictly more general model.

14. These are estimates of the social return to education, including any social expenditure as well as the direct monetary and time inputs students. While there has been much effort to refine the estimates of the

(implicitly assuming that education has no final good value) that this showed that there was no underinvestment in education.

Becker's (1976) comparison with equity raises the question of why education has as high a risk premium as equity. Previously, some economists had argued that there was underinvestment since the return on education exceeded the return on bonds. Unfortunately, there has been little empirical work on this that considers the risky dimensions of human capital returns. Wage income may move with corporate profits, but wages are less cyclical than profits. Furthermore, the price of risk for human capital depends on the relationship between profits and the *marginal* impact of human capital investment on wage riskiness. Since less educated workers are more likely to experience unemployment during a recession, education appears to reduce one's exposure to systematic risk. Therefore, the price of risk to be attached to human capital investments appears to be smaller than that associated with corporate equity. In any case, comparisons with financial assets do not indicate excessive investment in years of education or do they indicate any consumption component to education. We will proceed under the assumption that education is purely an intermediate good.

6.3 The Tax Treatment of Human Capital Investments

The U.S. tax code takes a mixed approach to human capital. On-the-job training and a student's own time are both effectively deductible, while expenditures, such as tuition and books, are generally not deductible. Since on-the-job training and students' time comprise most personal direct expenditures on human capital investments, some have argued that the U.S. tax system treats human capital well; see Boskin (1977) for a discussion of this issue.

However, the picture is more complex. The typical analysis treats the large expenditures made by state and local governments on education as subsidies. The Tiebout theory of excludable local publicly provided goods argues against this view. Local and state education expenditures are financed largely by local and state taxation and controlled largely by local and state political entities. The Tiebout view argues that the costs of education are capitalized in the value of land and that public education expenditures are effectively equivalent to private expenditures. The Tiebout view combined with our optimal tax analysis argues that all education expenditures, public and private, should be deducted from the tax base.

A pure subsidy view of education is also contradicted by the presence of rationing. Many college students pay tuition far less than the true cost, but only if they meet certain standards. A pure subsidy view ignores the nonprice rationing associated with higher education and the nonprice costs that are incurred by students competing for those subsidies.

The issue of how to treat educational expenditures is not a minor consideration. In fact, 1990 total expenditures on education (other than Federal aid) was $370 billion

return to years of education, the Becker findings are in the middle range of current estimates, particularly if one adds fringe benefits and other nonwage benefits of education.

compared to $576 billion in gross investment in nonresidential fixed capital. Treating educational expenditures as consumption is similar to taking away all cost recovery from equipment investment, a proposal that would not be regarded as minor.

The Tiebout model is an extreme one, but the main point is robust. In general, the idea is that citizens of most communities decide to finance the education of their children together through local taxes. In any rational model of political decision making, these expenditures will respond to their after-tax cost. Feldstein and Metcalf (1987) offer evidence that local expenditures are affected by federal income tax rules. To the extent that state and local tax deductions affect investment in human capital, some deduction is desirable.

This is currently accomplished partially in the current tax code through the deductibility of state and local income and property taxes in the federal income tax, but this affects only a part of educational expenditures. Some parents pay substantial nondeductible tuition to send their children to private schools. Also, itemization is more common among high-income families, implying a regressive tax on human capital accumulation. The consumption tax principle plus the intermediate good view of human capital argues for the deductibility of all public and private expenditures in all communities.

The flat tax (see Hall and Rabushka 1983), consumption tax (see Bradford 1986), hybrid tax of McLure and Zodrow (1996), U.S. tax (see Weidenbaum 1996), and value added tax (VAT) and national sales tax proposals all argue for a consumption tax but define "consumption" as income minus investment in physical capital only. The various tax proposals differ little on their treatment of human capital investments. The Hall–Rabushka–Armey–Forbes flat tax proposals clearly allow few deductions for educational investments other than on-the-job training; the sales tax and VAT proposals are similar. The U.S. tax allows limited deductibility of some educational expenses. All would eliminate the deduction for state and local taxation that finances most educational expenditures. On the other hand, the flat tax would reduce the tax rate on labor income, improving incentives for human capital investment.

It is not immediately clear if the current consumption tax proposals hurt or help human capital formation relative to the current tax system. However, it is clear that the treatment of human capital is important.

7. CONCLUSIONS

A common practice in dynamic economic analysis of tax policy is to use "average" tax rates on labor and capital income to represent the tax system. This approach ignores the fact that the key feature of the U.S. tax system is not the taxation of capital, but rather the differential taxation of various kinds of capital. We show that these asymmetries produce large efficiency costs, and that much would be gained by moving to consumption taxation. Our examples were simple ones well known in the public finance literature, and each example was far simpler than the U.S. tax code. The importance of asymmetries in those simple models show that we cannot trust highly aggregated analyses of taxation. Future work must look at models that embrace the full complexity of both the economy and the tax system.

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