Transition Costs of Fundamental Tax Reform

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Contents

declines in housing prices would be short-lived because housing starts would drop and thus lower the overall stock of housing capital, Bruce and Holtz-Eakin go a step further. In their setup, the elimination of the deduction for mortgage interest need not lead to a sharp decline in housing prices, even in the short run.

They present a simple, intuitive example for such a result. Suppose that the United States switched to a 20 percent national sales tax and—just to keep the example clean—nobody claimed the deduction for mortgage interest under the old system. When the sales tax went into effect, individuals would pay a 20 percent tax when they bought a new house, but no tax if they bought a "used" house. The price of "used" houses must then rise by 20 percent. Whether such an effect would be empirically important would, of course, depend on the magnitude of the effect on mortgage interest and the impact on the existing stock of housing. Bruce and Holtz-Eakin conclude that the two effects approximately cancel each other and that housing prices would probably not decline significantly after a fundamental tax reform.

Although commentaries on each chapter outline important qualifications, taken together the essays suggest that the case for transition relief to homeowners and firms may be weaker than expected. In that case, even if the complications explored by Judd were ignored, the gains from fundamental tax reform would be significant. If imperfect competition, risk, and the formation of human capital were also important real-world considerations, then the gains of fundamental reform might be even higher.

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2

The Impact of Tax Reform in Modern Dynamic Economies

Kenneth L. Judd

Since World War II, the tax policy in the United States has been based on the principles of an income tax. Its intellectual foundation lies in the Haig-Simons approach to the taxation of income: define income properly and tax it. However, economists over the past thirty years have increasingly argued for moving away from the taxation of income and toward the taxation of consumption. Debates on tax reform often focus on the choice between taxing income and taxing consumption

The key issue is the taxation of savings and investment.[1] Many theoretical analyses have argued for a zero long-run tax rate on capital income. Early arguments—such as those made by Feldstein (1978), Atkinson and Sandmo (1980), Auerbach (1979), and Diamond (1973)—relied heavily on assumptions of separability and on identical agents in each cohort. Judd (1985b) proved that the optimal long-run tax rate on capital income is zero even when tastes are not separable and when agents have different tastes and abilities. Others have explored taxation issues in models of economic growth. Eaton (1981) showed that taxation of capital income reduces an economy's long-run

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growth rate; Hamilton (1987) demonstrated that the asymmetric treatment of different kinds of investment has a high efficiency cost. Judd (1999) generalized the Judd (1985b) analysis to include investment in human capital, government expenditure, and various forms of growth. All these analyses argue strongly against taxation of asset income in the long run.

Estimates of benefits to the economy from tax reform have supplemented the increasingly robust theoretical case against the taxation of asset income. Studies such as Jorgenson and Yun 1990 and Auerbach 1996 show that switching to consumption taxation would significantly increase savings and the labor supply and would improve productivity. Computed examples in Jones, Manuelli, and Rossi 1993 show that the effects on asset income should be minimal even in the intermediate run. Both theoretical and empirical work demonstrates that a pure income tax system is far from the best for aggregate output.

The U.S. tax system has evolved into a hybrid system combining features of income and consumption taxation,[2] but the corporate income tax and the limited nature of savings incentives still give the current 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 concerning issues of the transition process and distribution. Some critics have argued that considerations of equity and problems of transition 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 problems of transition.

This study examines the conceptual basis for a consumption tax and introduces many features of a modern economy that have been ignored in analyses of tax reform but substantially strengthen the case for switching completely to consumption taxation. Despite the theoretical literature, some authors (for example, Gravelle 1994) still assert that the efficient taxation of capital depends on the relative elasticities of consumption demand and the labor supply. This chapter reviews the theory behind the consumption tax and shows that the case against capital taxation and for consumption taxation is surprisingly robust and does not depend on unknowable, technical details of the economy. The conceptual foundation leads to other aspects of consumption and capital taxation, in particular the implications of adding imperfect competition, risky assets, and the formation of human capital to the standard analysis. Any analysis, including this one, must make many simplifications: ignoring those elements was natural for the initial analyses of tax reforms. 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—it is difficult to imagine a modern dynamic economy without these features.

Unsurprisingly, adding imperfect competition, risky assets, and human capital affects our results, but this study argues that incorporating these elements substantially strengthens the case for a consumption tax. First, including these elements of a modern economy materially increases the estimates of the gains to long-run productivity. Interactions between taxation and imperfect competition increase the welfare cost of income taxation. The current U.S. tax system discriminates against risky assets; this study shows that any tax reform that would eliminate this feature would produce significant gains in efficiency. Including human capital in the analysis increases the welfare gains from eliminating the taxation of income on new investment.

Second, the extra considerations reduce problems during transition. The incorporation of imperfect competition moderates, possibly even reverses, adverse movements in asset prices. That change, plus a detailed view of U.S. demographics, reduces the problems of protecting older individuals who may not live long enough to enjoy the long-run benefits of tax reform. The incorporation of human capital also suggests new ways, consistent with the principle of a consumption tax, to compensate the middle class for the elimination of current deductions.

Some basic ideas from public economics and industrial organization prompt those considerations. In particular, this study presents basic results from optimal tax theory, uses them to analyze the inefficiencies of conventional income tax, and discusses interactions between taxation and imperfect competition. The usual discussions focus on the distinction between income and consumption taxation. But there is no distinction between income and consumption taxation: income taxation is really a special pattern of consumption taxation. More precisely, income taxation is a particularly inefficient form of consumption taxation, one that violates basic rules for a sound tax system. The focus should instead be on the taxation of consumption today relative to consumption tomorrow and on the taxation of intermediate goods relative to final consumption goods. The change in focus helps to explain old results and to point in useful new directions.

First, many taxlike distortions exist in the private sector. When teaching competitive economic theory, economics professors often use the example of the hundreds of thousands of farmers producing an agricultural product and correctly argue that no individual producer has any impact on the price of his crop. Tax reform analysis usually employs this competitive paradigm. Although the competitive model may have been a valid simplification in 1800, it is certainly not in the modern industrial high-technology U.S. economy of 2000. 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.

Parts 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. The relationship between price and marginal cost, not price and average cost, determines efficiency and welfare. This wedge between price and marginal cost is essentially a tax, even when generated by the private economy.

This chapter shows that the presence of imperfect competition strengthens the case for consumption taxation because it increases the estimates of the aggregate gains in efficiency from tax reform. In fact, 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, tax analysis usually ignores risk. Such neglect can become a major problem because the current income tax discriminates against risky equity investment in favor of safe debt investments. Such discrimination appears to violate principles of optimal taxation: 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 and would thereby improve both the allocation of capital and the incentives to save. Even some partial reforms would have substantial value. This study shows 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 the labor supply and the formation of physical capital. Because human capital is more important than physical capital in a modern economy, the limitation is serious. Many economists argue that the current tax and education systems put little tax burden on the formation of human capital; that position would seem to justify the focus on the taxation of physical capital. This chapter makes two points. First, adding the formation of human capital to the analysis increases the estimated benefits from tax reform even if the incentives for investment in human capital are undistorted. Second, the study argues against the conventional view by pointing to the large amount of educational expenditures, both private and public, that most proposals for tax reform would include in the tax base. The inclusion violates the principle of a consumption tax because a true consumption tax would define the tax base as output minus all investment expenditures.

These three considerations—imperfect competition, risk, and the accumulation of human capital—all indicate that consumption taxation is even more beneficial, both in the long run and during transition, than generally argued. Such presentations initially ignore the impact of distribution. Two important points relate to concerns about distribution. First, some analyses argue that the elderly may lose from tax reform. A switch to consumption taxation may cause them to pay new taxes on their wealth either directly or implicitly through a decline in asset values. In particular, Gravelle (1995) predicts a 20–30 percent fall in stock prices if the Hall-Rabushka flat tax is passed. Such arguments typically assume perfect competition, whereby no firms earn any economic rents. Although farms and other small businesses may be competitive, they are not part of anybody's stock portfolio. It is difficult to view firms such as Microsoft, GM, and Boeing as perfectly competitive price takers. Their CEOs would not last long in their jobs if they were satisfied with normal profits and did not pursue opportunities to earn extranormal profits for their shareholders. Thus, this study argues that any predictions of collapses in asset prices are blunted, possibly even reversed, when an analysis includes imperfect competition. The presence of imperfect competition implies that firms earn pure profits on extra production and that the increase in future output induced by the flat tax (or any other consumption tax) would cause asset prices to rise immediately. The increase in asset prices would allow elderly asset holders to participate at once in the future benefits of tax reform and would make tax reform more uniformly beneficial across the generations.

Second, many middle-class families would lose from tax reform because of the loss of deductions for home mortgage interest and for state and local taxes. Some economists propose keeping the deduction for mortgage interest to avoid middle-class losses and to get that group to join the political coalition for a consumption tax. But retention of those deductions would substantially reduce the potential gains in efficiency from tax reform because the current bias against nonresidential business investment would continue. An alternative adjustment in tax reform proposals would allow the deductibility of some educational expenditures. The deduction would mitigate the issue of distribution since the adjustment could be aimed at middle-class taxpayers but would not deviate from the principle of a consumption tax.

Many proposals for a consumption tax have been put forward, including those described in Bradford 1986, Hall and Rabushka 1983, McLure and Zodrow 1996, and Weidenbaum 1996. Consumption tax principles also apply to any proposal for a value-added tax (VAT) or a national sales tax (NST) because either would eliminate the taxation of income on new investment. This analysis does not focus on any one proposal since the arguments for consumption taxation made here apply to all of them. Other proposals argue for eliminating the double taxation of equity income through the integration of individual and corporate taxation, thereby eliminating the asymmetric treatment of equity and debt assets (see Treasury 1992). Many of the results here also apply to those proposals because the focus is on the taxation of capital income. Similarly, the arguments in this chapter apply to features of more conventional tinkering with the tax code, such as the reintroduction of the investment tax credit. The results here show the importance of including imperfect competition, risk, and the formation of human capital to the analysis of any tax reform proposal.

The case for consumption taxation is strong and is even strengthened by including those features that make our economy a modern and technologi-

cally advanced one. Recognition of those elements should help us achieve substantive tax reform.

Evaluating Alternative Tax Systems

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

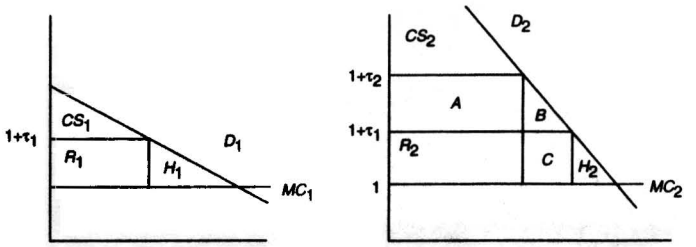
The arguments in this chapter rely on two basic results from optimal tax theory plus an argument from monopolistic competition theory. First, the inverse elasticity rule argues that the tax on a good should be inversely proportional to its demand and supply elasticities.[3] This study shows how to apply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

Second, the Diamond and Mirrlees principle of productive efficiency argues against the taxation of intermediate goods, such as capital. The current tax system discriminates in favor of capital in the form of owner-occupied housing and against capital used to produce other goods. The system also treats human capital and physical capital differently even though both are essentially intermediate goods. Financial structure is also a type of intermediate good because debt and equity have no direct consumption value, but the current tax system discriminates against equity and in favor of debt. The principle of productive efficiency helps us understand what a true consumption tax would look like and why deviations from the principle of productive efficiency are so damaging to economic efficiency.

Third, this study displays similarities between taxation and imperfect competition. Any firm with some control over the price that it charges for its goods will charge a price in excess of marginal cost. That gap is similar to a tax. Recognizing the presence of imperfect competition is similar to recognizing the presence of other taxing authorities. The presence of these other "taxes" significantly affects our view of the government's taxes.

Inverse Elasticity Rule and Taxation of Asset Income. The inverse elasticity rule says that the optimal tax on a commodity is inversely proportional to its demand elasticity.[4] The two demand curves displayed in figure 2–1 illustrate this. Both goods are assumed to have a constant unit marginal cost. The demand curve for good 1 in the left half of figure 2–1 displays the impact of a tax equal to τ_1. The box R_1 is the revenue raised by the tax, CS_1, the consumer surplus, and H_1, the efficiency cost of the tax. Demand for good 2, displayed in the right half of figure 2–1, is assumed to be less elastic. If we imposed the same tax rate of τ_1 on good 2, the revenue is R_2, and the welfare cost is H_2. Because the demand for good 2 is less elastic, the optimal policy is to tax good 2 at a higher rate, say τ_2. The higher tax increases revenue by

FIGURE 2–1
Rule of Inverse Elasticity



an amount equal to the area in box A minus the area in box C. The extra efficiency cost is $B + C$. The objective is to equate the marginal cost of a higher tax per dollar of revenue across different goods. That is accomplished by imposing higher taxes on the less elastically demanded goods. In figure 2–1 we would set the tax on good 1 at τ_1 and choose a higher tax of τ_2 on good 2.

Although the inverse elasticity rule may not seem to apply to discussions of income taxation and savings, it is the best way to view income taxation. Suppose that the different goods in figure 2–1 represent the consumption of goods and leisure at different dates. Income taxation implies a pattern of distortion 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 that r is the before-tax interest rate and t is the tax rate on interest. 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

$$\frac{MRS}{MRT} \qquad \left(\frac{1+r}{1+(1-\tau)r}\right)^{t} \tag{2–1}$$

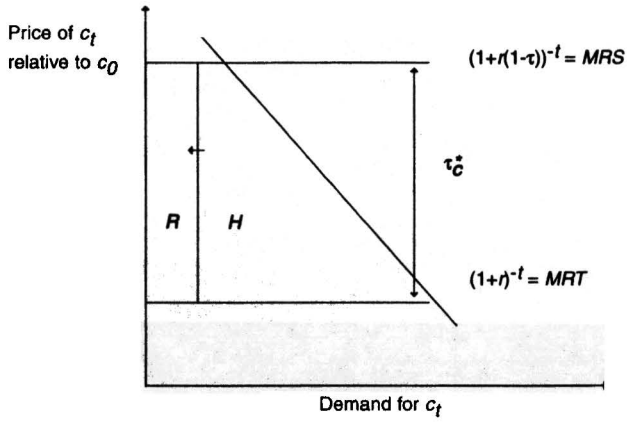
This distortion is the same as if we taxed consumption at time t at the rate

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

Most important, the commodity tax equivalent here is exploding exponentially in time.

The situation is displayed in figure 2–2 with the demand for the time t consumption good relative to some untaxed good c_0 (such as time 0 leisure). This

FIGURE 2–2
Commodity Tax Equivalents of Taxation of Asset Income



income tax is equivalent to a commodity tax on time t consumption equal to τ_c^* per unit of the time t good. We make the common assumption that the consumption demand curves are identical and independent across time and are not affected by leisure. The optimal tax system would impose the same tax on consumption at each different time. Instead, a constant positive interest tax is equivalent to an exponentially growing tax on time t consumption and thereby strongly violates the rule of inverse elasticity. In figure 2–2, as t increases, the deadweight loss triangle, H, grows more rapidly than the revenue box, R.

The exponential explosion in equation 2–2 appears dramatic, but we need to check that it is quantitatively important over a reasonable horizon. Table 2–1 displays the consumption tax equivalents, τ_c^*, for various combinations of r and τ. The results depend substantially on the magnitude of r. For $r = .01$, the mean real return on safe assets, the effects are small. For example, even a 50 percent tax on interest income implies only a 22 percent tax on consumption in forty years, compared with a 0.1 percent tax on consumption a year away. However, the situation is much different when $r = .10$. When $\tau = .3$ (which is less than the tax rate on equity-financed capital), the effective consumption tax over a one-year horizon is 3 percent, but it is 59 percent over a ten-year horizon and a whopping 543 percent over a forty-year horizon. It is hard to imagine any government passing a 59 percent sales tax in 2008, but that is effectively what we do to many investors if we continue with an income tax system into 2008.

The implications of this analysis are clear. If utility is separable across time and between consumption and leisure, and if the elasticity of demand for consumption does not change over time, the best tax system would have an

TABLE 2–1
Consumption Tax Equivalents, τ^*_c

		t					
	τ	1	5	10	20	30	40
01	10	0.1	5	1	2	3	4
	30	0.3	1	3	6	9	13
	50	0.5	2	5	20	16	22
10	10	1	5	10	20	31	44
	30	3	15	32	74	129	202
	50	5	26	59	154	304	543

equivalent of a constant commodity tax. A constant tax on consumption could accomplish that. However, any nonzero tax on asset income produces substantial violations.

While the exposition above focuses on special cases, the result is robust. Judd (1985b, 1999) shows 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. Most important, exploding tax rates on consumption are not efficient, and the explosion is quantitatively important.

The result does not assume that everyone is the same. The result holds 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 to an income tax that extracts the same revenue from him.

The inverse elasticity rule argues for a different tax on all goods, whereas proposals for a consumption tax actually prefer a single tax rate. While the difference may appear to be a serious difficulty, we will ignore it here. This approach is supported by the arguments of Balcer and his colleagues (1983). They show that while an optimal commodity tax system would have very different rates across goods, a revenue-equivalent flat tax is almost as good. Given the extra complexity and administrative cost of a tax system that charges different tax rates on different goods, a uniform consumption tax seems sensible.

The analysis does not necessarily imply that there should be no taxation of asset income. Suppose that tastes depend on age. If we assume that the elasticity of demand for consumption fell with age in just the right way, then a constant interest rate tax would be optimal; this result would require the

demand curve in figure 2–2 for the time t good to become less elastic as t increases. Such an age-dependence could result with just the right interaction between consumption demand and leisure. However, advocates of taxing asset income apparently do not use this approach.[5] Such arguments must be fragile; our knowledge of the critical elasticities is too imprecise for such a purpose. In any case, it is hard to imagine demand elasticities changing enough to justify substantial taxation of asset income. In particular, table 2–1 tells us that to justify a 30 percent income tax if $r = 0.1$ over a twenty-year horizon, we would need consumption elasticity to fall by a factor of 25 over those twenty years—a rather implausible situation. Therefore, the case of constant elasticity is a reasonable one to use.

The distinction between the taxation of factor income and the taxation of commodities is misleading because none of the problems in figure 2–2 apply to taxation of wage income. If τ_L is a constant tax on wages and τ_K a constant rate tax on interest income, the *MRS/MRT* distortion between time 0 consumption and time t leisure is

$$\left(\frac{MRS}{MRT}\right)_{c_0,l_t} = \left(\frac{1}{1-\tau_L}\right)\left(\frac{1+r}{1+(1-\tau_K)r}\right)^t. \qquad (2\text{–}3)$$

Equation 2–3 represents how taxes distort decisions to sacrifice consumption at time 0 to gain extra leisure at time t. The distortion grows over time but only because of the interest income tax. The taxation of wages does not aggravate the distortions in savings, but taxation of asset income does aggravate distortions between consumption and leisure at different dates.

Commodity taxation and the inverse elasticity rule reveal many features of factor taxation. That view shows us how distortionary the taxation of asset income is and hints at the value of removing it from tax systems.

Productive Efficiency. The second important principle is the Diamond-Mirrlees result about productive efficiency. The essential argument is that a tax system may unavoidably cause distortions in consumption, but there is no need to force the economy to produce that output in an inefficient fashion. Primarily, the Diamond-Mirrlees result implies 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 and would thereby reduce 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 merely distort the allocation of capital. In any case, consumers would ultimately pay the taxes on sewing machines and meat lockers. Direct taxation of clothing and meat consumption would allow the production of both to proceed undistorted by the taxation of capital inputs.

The principle of productive efficiency applies to any analysis of income taxation, as capital goods are intermediate goods. In fact, the taxation of capital goods is equivalent to sales taxation of intermediate goods. For example, a 100 percent sales tax on capital equipment is equivalent to a 50 percent tax on the income flow from that capital equipment. Because the taxation of intermediate goods would generally reduce the productivity of an economy, the taxation of capital income would likely produce similar factor distortions, particularly if there were many capital goods.

Combining the principle of productive efficiency with the principle of inverse elasticity produces a strong case against the taxation of capital income. The differential taxation of capital goods would produce inefficiencies in the allocation of productive inputs. A uniform tax on capital inputs might not distort allocation but would effectively create an exploding consumption tax, as illustrated in table 2–1. Therefore, an optimal tax structure would tax only final goods.

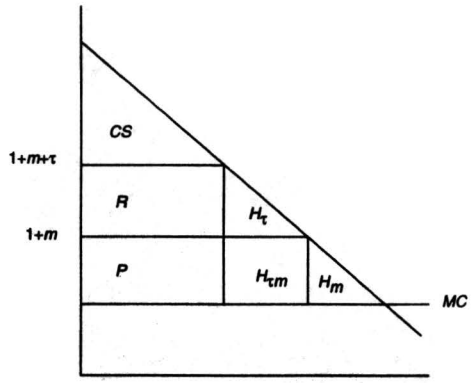
Arguments for tax reform recognize the principle of productive efficiency. One of the key benefits from consumption taxation is the elimination of differential taxation across various capital goods (see Auerbach 1989 and Goulder and Thalmann 1993 for recent examinations of the importance of productive efficiency). The changes in 1986 attempted to create uniform taxation across capital goods. Auerbach (1989) argues that any optimal deviations are small under perfect competition.

Because the Diamond-Mirrlees principle does rely on special assumptions, some argue against its relevance in tax discussions. Two provisos immediately come to mind. First, Diamond and Mirrlees assume that each commodity is taxed at a separate rate. Again, as above, that is not a serious problem. Although Balcer and his colleagues (1983) did not consider a general equilibrium case where intermediate goods could be taxed, their conclusion—that uniform taxation is almost as good as the optimal nonuniform tax—seems robust. Second, the result from productive efficiency also assumes that all pure profits are taxed away, whereas pure profits are not taxed away in the current tax system or in any proposed reform. In fact, the drop in marginal rates from most reforms would reduce the taxation of pure rents. This chapter shows that the result is not a serious impediment to applying the production efficiency principle when we use estimates for tastes and technology.

The Diamond-Mirrlees principle of productive efficiency provides a theoretical basis for consumption taxation. However, the principle also tells us that we need to pay careful attention to what is an intermediate good and what is a final good. The distinction plays a critical role in the following discussion of human capital.

Imperfect Competition and Taxation. The third idea used in this study is that government decisions about taxation and the distortions produced by imperfect competition in the private sector have similar implications. A firm that charges a price above marginal cost is effectively acting as a tax collector.

FIGURE 2–3
Taxation and Monopolistic Competition



Any national consumption or income tax is imposed on top of any distortions in the private sector. The accumulation of distortions substantially affects estimates of the burden of taxes and the relative evaluation of consumption and income tax systems.

The key principles are displayed in figure 2–3. Suppose that a good is not sold at its marginal cost, equal to 1 in figure 2–3, but is sold at a marked-up price, $1 + m$. The markup can arise and be sustained for many reasons. The producer may have market power because of large fixed costs of entry or because his product is differentiated from the products of competitors. Alternatively, the producer may hold a patent, which makes him a legal monopolist.

Any markup above marginal cost acts essentially as a tax. In figure 2–3, H_m is the efficiency cost of such a markup, just as H_1 and H_2 were the efficiency costs of taxation in figure 2–1. The box $P + H_{\tau m}$ is the monopolists' "tax revenue," consisting of profits in excess of economic costs. The economic effect of any markup is similar to that of taxation since both cause the buyer to pay a price in excess of the true marginal cost. These two cases differ in who receives the markup: the government in the case of a tax and a private firm in the case of a markup. Both taxation and markups create efficiency losses and rents.

This work relies heavily on the analogy between taxation by the government and markups arising from imperfect competition. The 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. Those distortions reduce economic efficiency and lead to underproduction of the patented good, but are justified by the incentives that they create for innovation. Without the rents produced by a patent, an innovator would not have sufficient incentive to undertake the fixed costs of research and development; that situation could lead to an even worse condition of no production of a desirable product. Therefore, even though patent monopolies reduce efficiency just as taxes do, we would not want to destroy the rents that they create.

The story of the patent monopoly is the simplest one to illustrate the key arguments, but the arguments are robust and apply to any context in which firms charge a price in excess of marginal cost. In many cases, these markups occur because of product differentiation and increasing returns to scale, conditions that share many features of a patent monopoly even without a formal property right. This study revolves around the presence of a markup of price over marginal cost, whether it arises from patent monopoly, an oligopoly of differentiated competitors, or another form of imperfect competition.

Markups may also occur because of collusion or corruption, but those matters are the concern and responsibility of antitrust policy. The arguments here apply to imperfect competition that remains after appropriate application of antitrust laws. I do not argue that tax policy is a substitute for antitrust policy. Instead, I argue that tax policy should take notice that imperfect competition is an important part of any modern economy.

Suppose that we introduce a tax τ into an imperfectly competitive market. The buyer now pays both the markup and the tax, resulting in a total price of $1 + m + \tau$. The $m + \tau$ portion acts as a tax, raising the price above the marginal cost and producing revenues now for the government. In this case, the government's revenue is the box R, and the firm's profits are P. The tax τ causes the monopolist to lose profits and causes the consumers to lose H_τ in consumer surplus. The cost of the tax is not just a triangle of consumer surplus but also a box $H_{\tau m}$ of pure profits. The efficiency cost of the tax is now larger relative to the revenue raised because of the preexisting distortion.

Joan Robinson (1934) noticed those facts and argued that a good tax policy would use subsidies to bring buyer price down to a social marginal cost. That argument would imply that in figure 2–3 we would want to pay the buyer a subsidy equal to the markup m. Robinson also argued that the policy would have some undesirable effects because it would increase monopoly profits and would likely be regressive in its impact on income distribution. Because taxing away those extra profits would be difficult, 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, a firm has difficulty in maintaining large monopoly rents. High profits encourage entry by imitators. We thought of IBM as a firm with large market power before it was hit by competition from 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. Hall (1986) supports such a view of monopolistic competition; he finds scant evidence of supernormal returns to firms even though he finds that prices substantially exceed marginal costs.

This study makes limited use of the ideas of imperfect competition. The key idea is that preexisting distortions increase the efficiency cost of government taxation, even if tax policy is not used to fine-tune those distortions. We see below how this limited argument strengthens the case for consumption taxation.

Taxation in a Simple Dynamic Competitive Model. Some standard analyses can illustrate the significant benefits of moving away from the taxation of income asset and toward the taxation of consumption. We assume the simple growth model in Judd 1987. Most important, output is produced by capital and labor and is divided into consumption and investment. There are no adjustment costs. We use the representative agent paradigm. We assume a Cobb-Douglas production function with capital share of .25. We also assume that the labor supply has a compensated elasticity[6] equal to $\eta > 0$, that the consumption demand elasticity is $\gamma > 0$, and that tastes are separable between consumption and leisure. We assume a proportional tax on labor income at a rate of τ_L and a proportional tax on capital income at rate τ_K.

Table 2–2 displays the marginal efficiency cost of various tax changes for values of γ and η. We assume that the economy begins with one tax policy and makes minor changes in the taxation of labor or capital income 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 the expensing of capital expenditures, a measure equivalent to a large ITC. The three policy tools cover most policy options used in the past and proposed for the future.

We first examine the case where $\tau_L = \tau_K = .3$ initially, and then we examine the case where the economy begins with $\tau_L = .4$ and $\tau_K = .5$. 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 index for increases in τ_K (an ITC). The MEB indexes in table 2–2 are discounted present values that include the transition process from one tax policy regime to another. We expect the $MEB > 0$ because we expect that any change in tax policy that raises revenues will reduce utility; however, $MEB < 0$ is possible in severely distorted systems.

Table 2–2 illustrates several important points. First, we do not have an adequate quantitative grasp of the welfare costs of tax changes. The values of critical parameters used in table 2–2 are all in the range of existing empirical estimates. Choosing among the empirical estimates of γ and η is difficult because they have different data sets and estimation strategies. The typical approach to calibration would vigorously argue for one particular parameter choice and would ignore others. I am skeptical about our ability to make such

TABLE 2–2

Efficiency Costs of Various Policy Changes

		$\tau_L = .3, \tau_K = .3$			$\tau_L = .4, \tau_K = .5$		
γ	η	MEB_L	MEB_K	MEB_{ITC}	MEB_L	MEB_K	MEB_{ITC}
1							
1	.4						1.8
1	1.0						2.5
5	.1						-15
.5	.4						-9.8
.5	1.0						-7.3
2.0	.1						-2.8
2.0	.4						-2.4
2.0	1.0		1.3				2.0

choices, given the noisy data available and the enormous gap between any model and the far more complex real world.

Second, table 2–2 shows that we do not need good estimates to rank alternative changes in tax policy. In all cases in table 2–2, replacing the taxation of capital income with the taxation of labor income would improve welfare, usually by a substantial amount relative to the revenue shift. Furthermore, changes that focus on encouraging new investment, such as an ITC, are particularly effective in improving economic performance with only a slight loss in revenue. In fact, MEB_{ITC} is sometimes negative; in such cases, an increase in an ITC would raise revenues because the extra revenue from the tax on new capital and the extra taxation from the higher wages would pay for the costs of the investment tax credit. An increase in an ITC is similar to the introduction of a flat tax. Both would reduce the taxation of new investment but would not reduce the tax burden on old capital. Indeed, the flat tax can be viewed as an income tax at rate τ plus an ITC at rate τ without depreciation allowances.

Third, the more elastic the labor supply is, the greater the difference between MEB_L and MEB_K. A static perspective suggests that the relative costs of the taxation of labor and of capital income depend on the elasticities of savings and the labor supply and that as the elasticity of the labor supply increased, the welfare cost of the taxation of labor relative to the taxation of capital income would rise. The opposite is true in table 2–2, where both MEB_K and MEB_{ITC} rise even more rapidly than MEB_L as we increase the elasticity of the labor supply, η. The resolution of the puzzle lies in the *MRS/MRT* distor-

tion expressions, equations 2–1 and 2–3. According to those equations, the taxation of asset income implies an exploding distortion for both consumption and leisure demand. As the elasticity of the labor supply rises, the importance of this distortion in the labor market also rises because the taxation of asset income rises.

The case of $\tau_L = \tau_K = .3$ for the initial tax policy is less taxing than current tax rates. The case of $\tau_L = .4$ and $\tau_K = .5$ is closer to the conventional description of the tax system before 1981, but it 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 also see that the scenario of $\tau_L = .4$ and $\tau_K = .5$ is actually plausible with the impact of imperfect competition.

The robustness of the results in table 2–2 is surprising because we normally expect results from computational general equilibrium to depend critically on the elasticity parameters. The magnitudes of the *MEB* indexes do depend on elasticity values, but the ranking of alternative policies does not. Some fundamental principle is present here. We argue that the critical facts come from optimal tax theory: the taxation of asset income corresponds to exploding commodity taxation, but the taxation of labor and the taxation of consumption do not.

Optimal Tax Theory and Tax Reform. Before continuing, it is important to summarize the theoretical arguments used here because the results strongly contradict the standard intuition used by many analysts in the tax reform literature.

Gravelle's (1994) comparison of the welfare effects of consumption taxation and of capital income taxation is a good statement of the commonsense approach. She asserts that

> 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. (p. 31)

This intuition is a natural one. Its references to substitution propensities appear to invoke the inverse elasticity rule, also invoked here, and argue that we must accept trade-offs among various distortions. However, the arguments of this chapter do not make any qualifications concerning the relative elasticity of intertemporal substitution and the labor supply. Some earlier analyses made assumptions of separability, but even those assumptions are absent in

Judd 1985b. Many analyses arguing against long-run taxation of capital assume a constant intertemporal elasticity of consumption, but that focus is not restrictive. Table 2–1 shows that even a small tax on capital income 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 elasticities in consumption demand and in the labor supply offer no support for the taxation of asset income in the long run.

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

The theoretical case against the taxation of capital income in favor of the taxation of consumption is much stronger than conventionally thought. There are qualifiers, of course. Hubbard and Judd (1986, 1988) show that the taxation of asset income may be desirable when capital markets are imperfect. The intuition there is straightforward: the taxation of capital income may be useful if it is a substitute for missing capital markets. However, those findings are sensitive to the nature of market incompleteness. It is unclear if those considerations can justify observed tax rates on capital income. For example, it is difficult to imagine that liquidity constraints could justify the corporate income tax. Capital market failures might be better resolved through more modest adjustments of a consumption tax.

We have so far considered the choice between consumption and income taxation in the simplest possible model: perfect capital markets, perfect competition, no risk, and only physical capital and raw labor inputs. We now deviate from this simple model and show that the case for consumption taxation is strengthened.

Imperfect Competition and the Benefits of Consumption Taxation

Tax reform analyses usually assume perfect competition in all markets. But that condition is not a valid description of a modern economy. Although no one would disagree with that assertion, the implications for tax policy are not immediately clear. This chapter argues that the presence of imperfect competition strengthens the case for consumption taxation.

Basically, let us pursue an intuitive combination of two well-known ideas.

First is the Robinson argument that subsidies can be used to offset the distortions if a lump-sum tax is available. At first, that position seems to have limited usefulness because it would imply that most goods would be subsidized—what would be 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, then the final net tax on intermediate goods should be zero, no matter what the impact on the taxation of final goods. In combination, these principles indicate that final goods should be taxed to finance corrective subsidies of any intermediate goods, including capital goods, sold at a price above marginal cost.

This study makes only a limited use of that controversial assertion. The pure theoretical argument ignores many practical difficulties, and it would be impractical to construct the perfect corrective policy. Our theory still has practical consequences: if reducing price-cost margins for intermediate goods were optimal, then imposing taxes that aggravated price-cost margins for intermediate goods could not be a sensible idea. In a competitive world, a low tax on intermediate goods may cause only minimal damage to the economy's efficiency. In a world with imperfect competition in intermediate-goods industries, even a low tax on intermediate goods could cause substantial damage.

Because taxes on asset income are equivalent to taxes on intermediate goods, low taxes on asset income can create major losses in efficiency. That possibility strengthens the case for switching away from tax systems, such as the conventional taxation on income, that aggravate the distortions of imperfect competition, and toward consumption tax policies.

Financing Social Fixed Costs and Taxation. The results here may at first appear strange and in conflict with the principles of free-market economics. Before giving a more concrete analysis, this chapter presents a simple example of fixed costs in production, with the application of the Diamond-Mirrlees model and a comparison of its prescriptions with the actual financing of fixed costs.

Suppose that one capital good, call it computers, has a constant unit cost after some large fixed cost is paid for, say, R&D. That good cannot be produced in a perfectly competitive market because a price equal to marginal cost will not allow the firm to recover the initial fixed costs. Some deviation from competitive pricing must finance this fixed cost. The Diamond-Mirrlees principle says that the optimal way to finance the fixed cost for computers is to tax final goods only. The pattern of the taxation of final goods is governed by the inverse elasticity rule, not by the goods using computers in their manufacture.

Compare that example with how we actually finance fixed costs, such as R&D expenditures. The computer manufacturer needs to limit competition so that it can charge a markup over marginal cost sufficient to finance the fixed cost. The economies of scale may be sufficient to deter entry, or perhaps the computer manufacturer can get a patent on computers. How market power is attained is not particularly important, but some form of market power is necessary.

The need to deviate from perfect competition to create the proper incentives for innovation has long been recognized. The U.S. Constitution specifically recognizes the need "to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries." Patents and copyrights create market power and are valuable instruments to encourage innovation. Because innovation is an important policy concern of government, it is natural for tax policy to be designed to avoid any interference with innovation policy.

The analysis here has avoided any explicit modeling of innovation. Innovation in a dynamic world has been modeled in many ways (see Judd 1985a for an example and Barro and Sala-I-Martin 1995 for a review of the literature). For the sake of simplicity, this chapter assumes that tax policy has no impact on innovation. If endogenous innovation were included, then moving to a consumption tax would increase innovation in capital goods and would further increase the estimates of the gains from consumption tax reform. The differences would be sensitive to details that are difficult to estimate. This chapter takes a more conservative approach with the sole focus on the distortions of imperfect competition and the price-cost margins, which are easier to estimate.

The incidence of market power in a patent or similar system of protection for intellectual property would probably differ greatly from the incidence of the distortions in the ideal Diamond-Mirrlees scheme. Only computer users would pay the markup in computers. Those users would substitute away from computers and toward alternative intermediate goods. The markup in computer prices would most affect those final goods that used computers in their production. An inefficient pattern of distortions across final goods would result because those computer-intensive products might not be the ones taxed in an optimal Diamond-Mirrlees scheme. The impossibility of attaining the perfect Diamond-Mirrlees set of distortions only strengthens the case here because the excessive burden imposed by imperfect competition on intermediate goods would only be further aggravated by any taxation of capital income.

Economic growth requires the creation of some incentives for innovation. The patent and copyright systems succeed in that, but they create distortions in the private sectors. Therefore, tax policy in a modern economy operates in a world already distorted by other "taxes." We will see that this insight has important consequences for the value of consumption taxation.

Empirical Evidence on Imperfect Competition. Let us examine the evidence that there is significant imperfect competition. Many studies have considered the gap between prices and marginal costs. Furthermore, the empirical literature on industrial organization contains some industry-specific studies on price-cost margins. The studies also estimate price-cost

margins in the 20 percent range for some capital goods (see, for example, Appelbaum 1982). Both Hall (1986) and Domowitz, Hubbard, and Petersen (1988) indicate that the margins in the equipment sectors are substantial, generally 15– 40 percent of the price. There is little reason to doubt the presence of significant economies of scale and significant deviations of price over marginal cost. Even a lower estimate of 10 percent is sizable: it is equivalent to a 10 percent sales tax on such equipment.

Fortunately, the discussion here does not rely critically on these estimates of price-cost margins, especially for investment goods. In particular, R&D expenditures in 1990 equaled 9.2 percent of sales for machinery and 4.7 percent for electrical equipment. Learning curves also produce increasing returns to scale that act essentially as a fixed initial cost. Those considerations plus a conservative estimate of economies of scale and other long-run fixed costs put us in a range relevant for these policy discussions. Therefore, even under conservative readings of the empirical evidence, the importance of imperfect competition appears substantial.

A Simple Model of Imperfect Competition. A simple dynamic model examined in Judd 1997 formally establishes the argument here. It makes a few key assumptions. First, the number of goods, all produced in a monopolistically competitive market, is fixed. Thus, marginal increases in demand result in pure profits for all firms. Each good can be used for both consumption and investment, and each good is used in the production of all goods. The representative agent model in Judd 1997 also assumes an 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 equity holders of each firm own a patent on its good and use debt to finance any physical investment. In equilibrium, the return on equity is the pure rent associated with holding the patent, and debt holders receive the marginal product of the physical investment. Therefore, dividend income is subject to taxation at the corporate and individual levels, but the debt-financed physical capital income is taxed only at the personal level.

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 a social marginal cost of production equal to 1. Because of the markup m charged 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

TABLE 2–3
Effective Total Tax Rates

	τ_D			
m	1	2	3	5
05	14	24	33	52
10	18	27	36	54
20	25	33	42	58
30	31	38	46	62

$$MPK = \bar{r}\ \frac{1 + m}{1 - \tau_D}\ . \qquad (2–4)$$

If $m = 0$, equation 2–4 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 equation 2–4 behaves as if there were no markup and as though the tax on interest income were equal to τ^* where

$$\tau^* = 1 - \frac{1 - \tau_D}{1 + m} = \tau_D + \frac{m}{1 + m}\ (1 - \tau_D)\,. \qquad (2–5)$$

Table 2–3 presents values for the total effective tax rate τ^* for various values of the explicit tax τ_D and the margin m. For low tax rates and margins, the total effective tax rate is the sum $\tau_D + m$. At greater 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 percent margin causes the total tax rate to be 38 percent if $\tau_D = .20$.

With the concept of effective total tax in equation 2–5, we can see how our earlier arguments apply. First, because markups on capital goods distort investment just as an interest tax would, they produce the same kind of exploding distortion in equation 2–2 that incurs under an interest tax. A uniform markup on capital goods violates the inverse elasticity principle just as a constant tax on asset income does.

Second, incorporating imperfect competition into our analysis forces us to reconsider the arguments regarding the level playing field. According to con-

ventional wisdom, based on assumptions of perfect competition, the 1986 tax changes eliminated most of the 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 1986 and Domowitz, Hubbard, and Petersen 1986 indicate substantial variance in margins among capital goods. Because the welfare costs of taxation are increasing in the variance of inappropriate distortions, our neglect of heterogeneous markups makes our results conservative estimates of the inefficiency associated with the taxation of capital income.

Optimal tax policy. This section illustrates 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—although this is not a realistic assumption because of the difficulty in measuring markups with great precision. The purpose of this exercise is to illustrate how much the presence of markups could affect the optimal policy. The results strongly indicate how important imperfect competition is.

When pure profits are taxed at rate τ_π, Judd 1997 shows that the long-run optimal choice for τ_D is

$$\tau_D^{opt} = -m \frac{1 + \tau_\pi MEB}{1 + MEB} \qquad (2\text{–}6)$$

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. The result repeats the Robinson finding. As in Diamond-Mirrlees, the optimal tax rate on profits, τ_π, is 100 percent, and the optimal policy eliminates the monopolistic price distortion.

Although our optimal tax formula (equation 2–6) 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 $m \in [.1, .3]$, as suggested by our discussion of price-cost margins. The range for *MEB* is taken from table 2–2. A key fact is that the equilibrium in our monopolistic competition analysis is essentially the same as for the competitive model used in table 2–2 where τ^* from equation 2–5 is used as the total effective tax rate on capital income.

Table 2–4 shows that even if *MEB* is large, the optimal tax substantially reduces the monopolistic distortion. In that table we assume that $\tau_\pi = .2$, as proposed in the flat tax; we arrive at similar conclusions if we use the tax rate on pure profits implicit in any other major tax reform proposal.

Table 2–4 illustrates several points. First, the optimal subsidy is nontrivial in most cases. A system that puts no tax on asset income would still suffer a substantial distortion relative to the ideal. Second, the basic implications of optimal tax theory hold even though the profits tax is far less than desired by

TABLE 2–4
Optimal Tax Rates

	MEB			
m	2	5	1.0	2.0
.05	-.04	-.04	-.03	-.02
.10	-.09	-.07	-.06	-.05
.20	-.17	-.15	-.12	-.09
.30	-.26	-.22	-.18	-.14

Diamond-Mirrlees.[7] Third, the desire for productive efficiency is strong even when 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 the 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 2–4 is impractical. However, the results indicate how far from optimal any income tax system is. The table also indicates how concerns about the taxation of pure profits are of far less importance than the goal of eliminating productive and intertemporal distortions.

Benefits of Switching to Consumption Taxation. Continuing with the model in Judd 1997, this section gives a quantitative estimate of how monopolistic competition affects the estimated gains from switching to a consumption tax. The estimated benefits of switching to a flat consumption tax are substantially increased with the presence of imperfect competition.

Because price-cost margins are essentially the same as taxes, we can use the results in table 2–2 to draw inferences about the benefits of minor changes in the tax policy. Suppose that capital goods are sold at 20 percent above marginal cost. We also assume that there are labor market imperfections, such as labor unions, that cause wage costs to be 10 percent higher. Then, even if the explicit taxes are $\tau_L = \tau_K = .3$ initially, the economy really begins with $\tau_L = .4$ and $\tau_K = .5$ when we change the tax policy. The $\tau_L = .4$, $\tau_K = .5$ case in table 2–2 then displays the efficiency impact of alternative tax changes if all marginal profits are taxed away. The marginal benefits of reducing taxation on asset income are substantially increased—being at least doubled and often at least tripled. The magnitudes are uncertain because the values of the critical taste parameters are unknown, but the impact of imperfect competition is clear and substantial for any standard estimate.

Table 2–2 examines marginal changes. We next examine major changes in tax policy. Table 2–5 presents the total welfare gain from replacing all income taxation with consumption taxation. Table 2–5 reports the percentage change

TABLE 2–5
Welfare Gain
(percent of consumption)

		τ_K		
γ	m	.15	.25	.35
.25	.0	.12	.38	.84
	.1	.37	.79	1.41
	.2	.54	1.08	1.81
.5	.0	.19	.59	1.30
	.1	. 57	1.21	2.16
	.2	.81	1.62	2.74
1.1	.0	.24	.76	1.67
	.1	.72	1.54	2.75
	.2	1.00	2.04	3.46

in consumption equal to the change in welfare from the tax change. For example, when $\gamma = .25$, $m = 0$, and $\tau_K = .15$, the welfare gain from the switch is equal to an immediate and permanent .12 percent increase in consumption.[8] Table 2–5 examines tax rates of 15 percent, 25 percent, and 35 percent on capital income.[9] The rate τ_K represents the marginal tax rate, not the average rate, because the distortion depends on the marginal tax rate. We examine markups of 0 percent, 10 percent, and 20 percent. We assume depreciation at 5 percent per year and the capital share at 25 percent.

Table 2–5 shows that a markup substantially increases the benefits of switching to a consumption tax. In fact, just a 10 percent markup often doubles the welfare gain relative to the situation with perfect competition. Again, these gains are substantial for any estimate of the critical parameters.

Implications of Asset Pricing. There is substantial interest in the implications of tax reform on the pricing of assets. In particular, a move to a consumption tax would remove the tax burden on new capital but would continue taxing old capital. In a perfectly competitive world, where output depends on labor and physical capital alone, competition from new capital could lower the market value of old capital. Gravelle (1995) estimates that the Hall-Rabushka flat tax would cause a 20–30 percent fall in the stock market. If true, this important issue would create opposition to tax reform.

Gravelle's estimate assumes perfect competition. However, it is unrealistic

to assume that most equity wealth is associated with perfectly competitive firms. The value of many firms consists not only of physical capital but also of intellectual capital. The value of computer software firms such as Microsoft and pharmaceutical firms such as Pfizer comes from their patents and copyrights, not from their physical plants. Patents and copyrights, as well as the costs of imitation, make competitive entry difficult. Although lower tax rates may spur new innovation, the R&D process takes time and has only delayed effects on the profits of incumbents.

Many firms are combinations of physical capital and intellectual capital. Tax reform would reduce the cost of physical capital to each firm and would thereby cause more competition among firms and lower prices. However, if a firm initially charged a price in excess of marginal cost, the increase in demand would increase profits. Predictions about asset prices need to be changed for an imperfectly competitive world. The tax analogy is again apt. Firms with market power essentially impose a tax on their customers. If the government reduced taxes on a firm's customers, then one would expect the firm to gain through increased demand for its product. For example, if the tax τ in figure 2–3 were eliminated, the firm's profits would increase by the box $H_{\tau m}$. The gain in profits would not exist for perfectly competitive producers and is ignored in analyses of changes in asset prices that assume perfect competition in the product markets.[10]

The intuition is clear and is similar to the situation of multiple tax jurisdictions. If the federal income tax were repealed and were replaced with lump-sum taxation, then output would rise, and revenues from state income taxes would rise. The same would be true when the producers imposed a tax on their customers; a more efficient U.S. tax system would increase the average firm's sales and would increase the revenue from the "tax" that it imposed on customers through the gap between price and marginal cost. For a private firm, these extra revenues, current and future, would immediately be capitalized in the firm's value.

Although the magnitude of those changes is not as clear, the impact in an open economy is: if interest rates do not change, then an increase in future profit flows will immediately increase asset values. However, a radical change in U.S. tax policy might produce changes in interest rates in our closed-economy model. We need to investigate that possibility to establish the robustness of our general claim that the impact of a consumption tax on asset prices is positively affected by the presence of imperfect competition.

We include that situation explicitly in the model in Judd 1997 with an inelastic labor supply. Essentially, we assume that all goods, final and intermediate, have a common markup, m. A reduction in the tax on capital income would cause an immediate increase in investment and a gradual increase in aggregate output. The share of output devoted to consumption and final goods would fluctuate, but that variation would not affect aggregate asset val-

ues because we assume that all goods have the same markup.[11]

Table 2–6 reports the initial impact on the aggregate market value of equity if we replace an income tax with a labor income tax in the model of Judd 1997. In such a tax system, the value of a firm would be equal to the replacement value of its assets if there were no adjustment costs (as we assume) and if product markets were perfectly competitive. We assume that the economy is initially in the steady state associated with a tax rate τ_K on all asset income. We also assume that fixed costs of production are so high that there are no extranormal profits in the initial steady state. We examine three cases for the intertemporal elasticity of substitution, γ, two values for the initial income tax rate, τ_K, and two possible values of the markup, m.

According to table 2–6, a transition to a labor tax or a lump-sum tax would result in an increase in asset values. The impact would be slight in the cases of small γ because of the slow adjustment in consumption and investment. The case of nearly log utility ($\gamma = 1.1$) and a modest markup of 20 percent implies that the value of a firm would rise by 13 percent if the marginal tax on equity capital were 35 percent. If a firm were financed half by debt and half by equity, all increased value would go to equity holders; the situation implies a 26 percent increase in the stock market value.

A flat tax would produce different results, but its implications are clear. If the flat tax rate were 20 percent, then the value of a perfectly competitive firm would fall by 20 percent because the expensing provisions would create a 20 percent wedge between the value of old and new capital. Gravelle (1995) makes this point. However, the change in the value of a noncompetitive firm would still be increased by the extra pure profits that it would earn. The net change would be equal to the value in table 2–6 minus 20 percent. Similar arguments apply to the case of a VAT or a national sales tax.

In all cases in table 2–6, imperfect competition reduces the negative impacts of consumption taxation on the welfare of those, like some elderly, who sell assets to finance consumption. Lyon and Merrill (chapter 3 in this volume) discuss the implications of asset prices in greater detail. They make similar points but do not consider equilibrium impacts on sales and interest rates. Their arguments further reduce any possible fall in asset prices. The simpler general equilibrium model used here explores the importance of imperfect competition and ignores many other elements considered by Lyon and Merrill. The arguments made here and in Lyon and Merrill reinforce each other and argue strongly against the pessimistic views in Gravelle 1995.

Imperfect Competition and Tax Reform. Imperfect competition is a fact in a modern economy and should be included in any tax analysis. Such competition provides incentives for innovation. Users of capital goods are already paying a tax to finance that investment. While relieving that tax burden may not be feasible through tinkering with the tax code, this private tax means that further taxation of capital goods would substantially damage economic efficiency. The private tax enhances the value of a move to consumption taxation.

TABLE 2–6
Initial Increase in Firm Value
from a Wage Tax
(in percent)

		τ_K		
γ	m	.15	.25	.35
.2	.1	1.1	2.0	3.1
	.2	1.8	3.3	5.2
	.3	2.3	4.4	6.8
.5	.1	1.8	3.3	5.4
	.2	3.0	5.7	9.3
	.3	4.1	7.8	12.9
1.1	.1	2.4	4.5	7.5
	.2	4.1	8.0	13.3
	.3	5.7	11.3	19.1

Imperfect competition also ameliorates any negative impact on asset prices because the increase in production increases pure profits. Including imperfect competition in this analysis improves the predictions for long-run growth, the benefits during transition, and the immediate impact on asset prices.

Risk and Tax Reform

Investment is generally risky, but tax reform analyses often ignore risk. This section uses Hamilton's (1987) general equilibrium analysis of the taxation of risky assets to make some basic points. First, the asymmetric treatment of risky assets will affect the equilibrium portfolio of the economy. Although expected, that finding emphasizes the importance of general equilibrium effects because partial equilibrium analyses lead to contrary conclusions. Second, Hamilton's finding that there should be no differential taxation of risky and safe assets indicates that a goal of tax reform should be the elimination of 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 an analysis.

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 percent with a standard deviation of 20 percent, and the mean real return on safe assets has been 1 percent. Corporate tax adjustments imply that both mean and variance should be 20–40 percent higher for the risky asset to approximate the opportunities offered to society. The extra return to risky equity is consistent with the standard theory of asset pricing, but the magnitude is difficult to explain (see Kocherlakota 1996 for a discussion of asset-pricing puzzles). The empirical puzzles surrounding asset pricing make any tax analysis difficult to execute. Even so, including risk in the analysis strengthens the case for consumption taxation.

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. The discrimination depends on the type of investment and the manner in which an investor holds it. An asset held in a defined-contribution pension account is not taxed at the personal level. Corporate debt, a relatively safe asset, is deducted at the corporate level, with the implication that income generated by such assets is not taxed. However, income generated by equity investments is taxed at the firm level through taxes on corporate income.

For assets held outside of pension accounts, we need to include the taxation of personal income. At the personal level, dividends and interest income are taxed at the same rate, but capital gains have often been taxed at a lower rate. Because the tax rate on corporate income is close to or exceeds the tax rate on personal income, investment in a risky equity held outside tax-favored accounts is apparently taxed at a higher rate than safe debt. Those observations indicate that the current income tax system produces substantial discrimination against risky assets and the investments behind them, no matter how they are held by investors. Hubbard (1993) reviews conventional treatments of these issues.

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 position is substantially altered in a general equilibrium context because many risks that a government faces will ultimately be passed on to private agents. Eaton (1981), Gordon (1985), Hamilton (1987), and Kaplow (1994) have also analyzed theoretical issues concerning tax systems and risk taking.

Unfortunately, quantitative analyses of taxation generally ignore risk—unsurprisingly, because incorporating risk in dynamic general equilibrium analysis is difficult. It is also unclear how we should calibrate any such model: 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 (1987) model to examine the impact of differential taxation because it focuses on the most basic elements of asset allocation and risk. The model allows us to compare consumption taxation, uniform income taxation, and differential income taxation in one model.

We assume that two types of investment projects exist. We assume that the net income from risky assets is taxed at rate τ_Z and the income from the safe assets is taxed at rate τ_R. We assume that agents have a constant relative risk-aversion utility function[12] and discount the future at the rate of 4 percent per year.

Further, we assume that all revenues are rebated lump sum to investors. We make the common assumption to abstract from government expenditures policies. In this stochastic context, the assumption takes on added importance. If revenues were destroyed, then a constant income tax, as Domar and Musgrave (1994) have argued, would shift investment toward the risky asset. However, we find that assumption unrealistic—government expenditures do not immediately react to revenue shocks. The essential idea behind the assumption is that current revenue shocks lead either to tax cuts or to an increase in government expenditures on goods that are appropriate 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 an examination of the critical issues without modeling fine details of government expenditure policies.

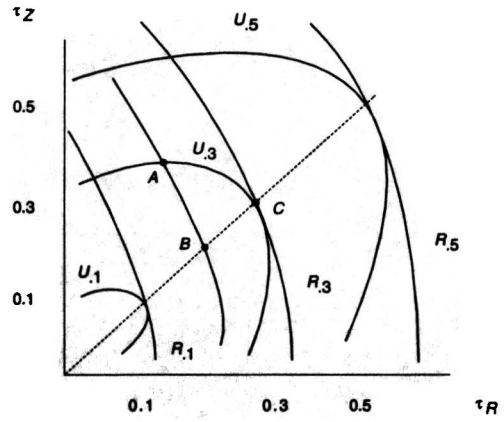
Utility and Revenue. We use Hamilton's model to examine the trade-off between utility and revenue. We examine several numerical cases. First, we assume that the risky asset has a mean return of 10 percent and a standard deviation of 25 percent and that the safe asset has a mean return of 1 percent. We do not defend this particular assumption. In any case, after the examples below have been recalculated for alternative means and variances, we find that the qualitative points are unchanged.

Hamilton (1987) examines optimal income taxation in such models. He shows that the optimal constant tax policy has equal tax rates for safe and risky assets. We examine the global trade-offs among various nonoptimal tax policies.

Figure 2–4 displays important features for relative risk aversion of 10 (corresponding to $\gamma = .1$ in table 2–2). The case may appear to imply great risk aversion. However, some implications are reasonable. In particular, the standard deviations of consumption and output are about 1 percent, which is close to observed values.

Figure 2–4 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 $U_{.1}$, $U_{.3}$, and $U_{.5}$ are isoutility curves corresponding to the cases where $\tau_R = \tau_Z = .1, .3, .5$. That is, any combination of taxes along $U_{.1}$ produces the same expected utility as the tax policy $\tau_R = \tau_Z = .1$. Expected utility is greater as we move south and west. Similarly, $R_{.1}$, $R_{.3}$, and $R_{.5}$ are the isorevenue curves corresponding to the cases where $\tau_R = \tau_Z = .1, .3, .5$. The dotted line is the 45-degree line. Revenue increases as we move east and north. A consumption tax is represented at the origin where $\tau_R = \tau_Z = 0$. The isorevenue and isoutility curves are tangent along the 45-degree line; the placement implies that the optimal policy is one

FIGURE 2–4
Revenue and Welfare Trade-Offs with Asset Taxation



of equal tax rates, as Hamilton proved.

Although the optimality results of figure 2–4 correspond to theory, the global trade-offs are strange. Revenue is relatively insensitive to changes in the tax on risky assets. This is not too surprising because most wealth in figure 2–4 is in safe assets. More surprising is the shape of the isoutility curves away from the optimal policy. If the tax rate on safe assets is much less than the tax rate on risky assets, an increase in tax rates can keep utility unchanged or can even improve utility.

Those features of figure 2–4 show the importance of explicitly including uncertainty in the analysis. The normal procedure would insert the average pretax and post-tax returns into formulas for utility and revenue in a deterministic model. The approximation would incorrectly predict the shape of the isoutility curves because it would predict a uniform fall in utility as tax rates rise.

We can use figure 2–4 to make some assessments about the value of converting to consumption taxation and of implementing other, less radical reforms. In figure 2–4, a constant tax on consumption is effectively a lump-sum tax because there is no decision about the labor supply. We proceed under the assumption that figure 2–4 approximates the welfare gain if the labor supply were slightly elastic. Suppose that $\tau_R = .15$ and $\tau_Z = .35$, the situation at point *A*. The utility-maximizing policy raising the same revenue, at *C*, implies a slight reduction in the tax on risky investments and a greater increase in the tax on 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 2–4.

Analyses that ignore the differential taxation of assets miss the utility gain associated with eliminating nonuniformities, such as the move from *A* to *B*.

TABLE 2–7
Excess Burden of Taxation with Risky Assets

γ	τ_Z	τ_R	MEB_R	MEB_Z	MEB_K	DB_R	TB
.5							
1							

That gain would be achieved even if we just integrated corporate and individual taxation. When we add that feature to the analysis, we find another benefit from moving to consumption taxation.

Table 2–7 displays the welfare cost of taxation in the Hamilton model of risk and taxation. We examine the case of $\mu = .10$, $\sigma = .25$, and $r = .01$. We assume that safe assets are taxed at a rate $\tau_R = .1$ and that risky assets are taxed at the rates $\tau_Z = .1, .4$. MEB_R is the marginal excess burden of increasing τ_R, measured as the change in the certainty equivalent for consumption per dollar of change in revenue. MEB_Z (MEB_K) is the marginal excess burden associated with raising a dollar of revenue by a slight increase in the taxation of income from risky assets (all assets). We also compute the value of major changes in taxation. To do so, we compute the change in utility, measured by the certainty equivalent of constant consumption flow. We compare that with the certainty equivalent of the change in revenue flow. The differential burden DB_R is the value per dollar of change in revenue from eliminating differential taxation. *TB* is the total burden of the initial system of taxation per dollar of revenue.

If $\tau_Z = \tau_R = .1$, safe and risky assets are treated symmetrically, and 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 $\gamma = .5$ row, 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 $\tau_Z = .4$ and $\tau_R = .1$, the results are more striking. The gain from eliminating all taxation of asset income 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 increase substantially in that case.

Those observations apply even 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, and housing—even if all

financial assets are 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 might 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 assumed in Hamilton), no rationale exists for the 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.

Tax Policy and Formation of Human Capital

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

Optimal Taxation of Investments in Human Capital and Education. Investments in education and in other aspects of human capital present special problems for tax analysis.[13] Education is an investment good because it increases labor productivity, but it may also have a consumption value. Diamond and Mirrlees (1971) argue for taxing final goods but not intermediate goods. Because human capital appears to be a mixture of the labor supply, investment, and consumption, the implications of the Diamond-Mirrlees position for human capital are unclear.

Judd 1999 examines the issues in a dynamic, general equilibrium model. The study assumes that an individual invests in both financial assets, A (which finance physical capital, k), and human capital, H. Over a lifetime, the investor earns $\bar{r}A$ in asset income where $\bar{r}$ is the after-tax return on financial assets. He also earns $\bar{w}\ L(H,n)$ in labor income where $L(H,n)$ is the effective units of labor input if he works n hours, his human capital is H, and $\bar{w}$ is the after-tax wage for a unit of effective labor. The investor allocates savings between financial investments and investments in human capital, x. Investments in human capital equal to x earn tax credits at rate s and have 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 1985b argues against the taxation of human capital. That position leaves labor income as the only source of tax revenue in the long run. However, it is difficult to tax labor income without distorting investments in human capital. Judd 1999 shows that if human capital does not affect utility, then there should be no net taxation on the return of investment in human capital, only taxation of the hours of the labor supply. That approach can be implemented by taxing labor income while allowing the immediate deduction of all expenditures for investment in human capital. The results follow exactly the logic of Diamond and Mirrlees.[14]

Is Education Only an Intermediate Good? If H is only an intermediate good, then all investments in human capital should be expensed. But if H is also a final good—that is, $u_h > 0$—the 1999 Judd study shows that we want a positive tax on returns to human capital. Many components of an education appear to have substantial consumption value. Music appreciation courses help one enjoy symphonies and operas later. Sometimes the educational activity itself has both a productive value and an 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.

Comparing the financial returns of alternative assets can provide evidence about the character of education. 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. The literature has addressed the issue. Becker (1976) argues that years of education and corporate equity have roughly the same mean financial return.[15] He further argues (implicitly assuming that education has no final good value) that the parity shows no underinvestment in education.

Becker's comparison with equity raises the question of why education has as high a risk premium as equity. Some economists had argued that underinvestment existed because the return on education exceeded the return on bonds. Unfortunately, scant empirical work addresses those issues. 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; the marginal impact of investment on human capital depends on wage riskiness. Because less educated workers are more likely to experience unemployment during a recession, education appears to reduce exposure to systematic risk. Therefore, the price of risk attached to investments in human capital appears to be less than that associated with corporate equity. In any case, comparisons with financial assets do not indicate excessive investment in years of education, nor do they indicate any consumption component to education. We proceed under the assumption that education is purely an intermediate good.

Importance of Human Capital. We next illustrate the quantitative importance of human capital for tax analyses. We consider a special case of the model

described above. We assume that $L(H, n) = H^{\phi}n$ and $f(k, L) = k^{\alpha}L^{1-\alpha}$. If $\phi = 0$, we have a conventional model with only physical capital. We assume $0 < \phi < 1$, with the implication of decreasing returns to investments in human capital. As in table 2–2, let $\gamma > 0$ be the elasticity of substitution in consumption and $\eta > 0$ the elasticity of the labor supply. We highlight the importance of human capital to tax analysis by computing the elasticity of long-run output with respect to the tax and subsidy rates. More precisely, we report the percentage change in long-run output, denoted by ε_K, ε_L, and ε_s, in response to a 1 percent change in net-of-tax rates $1 - \tau_K$ and $1 - \tau_L$ on physical capital and labor income and to $1 - s$, the after-tax cost of investments in human capital.

Table 2–8 reports those elasticities for various values of the critical parameters. We assume that the level of investment in human capital equals half of investment in physical capital, a conservative choice. We choose ϕ to be .1 or .3. The choice $\phi = .3$ implies that a 10 percent increase in accumulated investments in human capital results in a 3 percent rise in wages, again a conservative choice. Otherwise, we choose values for γ and η similar to those in table 2–2.

Table 2–8 shows the importance of including human capital in the analysis. First, long-run output is sensitive to the treatment of investments in human capital. Even when $\phi = .1$, a 10 percent change in $1 - s$ alters steady-state output by about 1 percent, and the sensitivity can be half as much as the sensitivity of output to changes in the tax on labor. When $\phi = .3$, changes in the treatment of investments in human capital are as important as changes in the treatment of labor and capital income. The presence of human capital means that the supply of effective labor $H^{\phi}n$ is more elastic than if human capital had no marginal value. The increase in the elasticity of the labor supply increases the responsiveness of output to the taxation of asset income and the efficiency cost of the taxation of capital income.

Table 2–8 also shows that adding human capital to the analysis increases the benefits from a consumption tax. The sensitivity of output to τ_K when $\phi = .3$ is higher than when $\phi = .1$. As human capital becomes more important, the benefits from reducing the taxation of capital income increase.

To understand the impact of human capital, we examine the allocation of total capital across human and physical capital. The equilibrium allocation ratio is given by

$$\frac{H}{k} = \frac{\phi}{\alpha} \frac{1}{1-\tau_K} \frac{1-\tau_L}{1-s} \qquad (2\text{–}7)$$

Equation 2–7 shows that all three tax policy tools affect the H/k ratio in quantitatively symmetric fashions.

Equation 2–7 also indicates that new issues arise when we convert from the taxation of income to the taxation of consumption. In an efficient allocation, H/k should just equal ϕ/α, the relative coefficients for factor shares of human and physical capital. According to Diamond and Mirrlees, an optimal tax policy would not deviate from that. If we have an income tax whereby $\tau_K = \tau_L$ but

TABLE 2–8
Elasticity of Long-Run Output to Net-of-Tax Rates

		$\phi = .1$			$\phi = .3$		
γ	η	ε_K	ε_L	ε_S,	ε_L	ε_K	ε_S
5	1	51	21		75		
5	5	41	36		55		
1		29	12		36		

investments in human capital are not expensed ($s = 0$), then the H/k ratio is efficient. However, the inverse elasticity rule says that τ_K should be zero. If we just set $\tau_K = 0$, the resulting H/k ratio would not be efficient. Efficiency would be restored if we set $s = \tau_L$, with the implication that investments in human capital should be expensed.

Tax Treatment of Investments in Human Capital. 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, although expenditures such as tuition and books are generally not. Because on-the-job training and students' time are the bulk of the personal, direct expenditures on investments in human capital, some have argued that the tax system treats human capital well (see Boskin 1977 and Heckman 1976 for discussions 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 goods that are publicly provided argues against this view. Local and state expenditures on education are financed primarily by local and state taxation and controlled primarily by local and state political entities. The Tiebout view contends that the costs of education are capitalized in the value of land and that public expenditures on education are effectively equivalent to private expenditures. The Tiebout view combined with this chapter's optimal tax analysis argues that all education expenditures, public and private, should be deducted from the tax base.

The presence of rationing also contradicts a pure subsidy view of education. Many college students pay tuition that is 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 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) were $370 billion, compared with $576 billion in gross investment in nonresidential fixed capital. Treating educational expenditures as consumption is

similar to taking away all cost recovery from investment in equipment, a proposal that would not be regarded as minor.

Although the Tiebout model is extreme, the main point is robust. In general, the citizens of most communities decide to finance the education of their children together through local taxes. In any rational model of political decisionmaking, these expenditures respond to their after-tax cost. Feldstein and Metcalf (1987) offer evidence that federal income tax rules affect local expenditures; the finding supports the approach taken here. To the extent that state and local tax deductions affect investment in human capital, some deduction is desirable.

The current federal tax code has some effect on that investment through the deductibility of state and local taxes on income and property, but that deductibility includes only a part of educational expenditures. Some parents pay substantial nondeductible tuition to send their children to private schools. The high frequency of itemization among high-income families implies a regressive tax on the accumulation of human capital. The principle of a consumption tax plus the view of human capital as an intermediate good argues for the deductibility of all such public and private expenditures in all communities.

The flat tax (see Hall and Rabushka 1983), the consumption tax (see Bradford 1986), the hybrid tax of McLure and Zodrow (1996), the USA tax (see Weidenbaum 1996), and proposals for a value-added and a national sales tax all argue for a consumption tax but define *consumption* as *income minus investment in physical capital only.* The various tax proposals differ little in their treatment of investments in human capital. The Hall-Rabushka-Armey-Forbes proposals for a flat tax would clearly allow few deductions for educational investments other than on-the-job training; the sales tax and VAT proposals are similar. The USA tax would allow limited deductibility of some educational expenses. All would eliminate the deduction for state and local taxation, which finances most educational expenditures. Conversely, the flat tax would reduce the tax rate on labor income and would thereby improve incentives for investment in human capital, as indicated in equation 2–7.

It is not immediately clear whether the current proposals for a consumption tax would hurt or would help the formation of human capital relative to the current tax system. However, the treatment of human capital is clearly important. Even if reform by means of a consumption tax did not help human capital directly, the inclusion of human capital would strengthen the case for reducing the tax burden on investment in general, as shown in table 2–8.

Distributional Concerns

This chapter has focused on aggregate output and investment and has ignored concerns about distribution. But we should address these concerns. They are not as severe as they might appear, however, and the issues regarding human capital that were addressed in the previous section suggest ways to ameliorate some of those concerns.

Workers versus Capitalists. A key feature of most of the radical tax reforms is the elimination of taxation on new investment and the reduction of taxation on the current capital stock. As a replacement, taxation on wage income and on consumption would account for much of the predicted increase in investment and output. A shift to wage taxation would seem to hurt workers. The counterargument is that the increase in capital accumulation would increase worker productivity and wages, with greater worker welfare as a result. Opponents of a consumption tax often dismiss that process as weak, slow, and indirect.

Optimal tax theory presents a strong argument for eliminating the taxation of investment income. The preceding discussion argued why the taxation of asset income damages aggregate productivity over the long run. The argument holds when we consider the impact on workers and capitalists. Judd 1985b shows that even if the government were in control of tax policy and gave workers all receipts from the taxation of asset income, it would still not tax asset income in the long run. Permanently distorting the accumulation of assets would not benefit workers because the major effect of long-run taxation of assets is the reduction of total investment and labor productivity.

The optimal tax results may appear to be solely long-run results, with little impact on the foreseeable future. We next investigate the transition process of tax reform by asking how capitalists and workers would share in tax reform with a small change in the current tax structure. Assuming that the economy[17] is in the steady state with a tax rate of τ_K on capital income and a tax credit of θ for investment,[18] table 2–9 (taken from Judd 1984) computes the change in revenue and wages from a small decrease in τ_K or a small increase in θ, with increases in wage or consumption taxation to finance any shortfall in revenue. Each dR (dW) entry in table 2–9 is the change, measured in the percentage of capital income, in the present value of the revenue from taxes on capital income, (present value of wage income), caused by a 1 percent change in τ_K or θ. If there were no change in savings, dR would equal 1 and dW would equal 0. We examine values for γ, the intertemporal elasticity of substitution in consumption, and for α, the elasticity of substitution between capital and labor. We assume that τ_K is initially either .3 or .5. We assume that θ is initially .05, representing the presence of an explicit ITC or accelerated depreciation.

The results in table 2–9 address many issues. The values for γ and σ substantially affect the magnitudes of the revenue changes. However, we do see some patterns. First, the impact on wages is often substantial. It is slight only when γ is small; those cases occur when the transition process is slow. In the other cases, a 1 percentage point decrease in τ_K or a 1 percentage point increase in θ increases wages by 0.4–1.4 percent of total capital income, a substantial change. Also, wages are affected almost equally by a 1 percent change

TABLE 2–9
Disaggregated Effects of Small Tax Changes

		$\tau_K = .3$				$\tau_K = .5$			
		Decrease τ_K		Increase θ		Decrease τ_K		Increase θ	
σ	γ		dW	dR	dW			dR	dW
7	1.00	-1.02	93	50	1.10	1.05	1.35	-.52	1.33
	.25	-1.01	60	-.49	.70	1.03	.87	-.51	.85
1.0	1.00	-.91	85	-.38	1.00	-.79	1.24	-.28	1.22
	25	-.95	50	-.42	59	-.88	.74	-.36	.72
1.3	1.00	-.83	79	-.27	93	58	1.16	06	1.13
	.25	-.90	44	37	52	77	64	-.25	.62

in either τ_K or θ. Second, changes in θ affect total revenue less than changes in τ_K. Therefore, an ITC is a much more potent tool for increasing wages and labor productivity—unsurprisingly, because an ITC affects only new investment, whereas reductions in τ_K reduce taxation of old capital as well as new investment. Table 2–9 shows that an ITC can produce the same improvement for wages at substantially less loss in revenue.

Third, increases in an ITC could be close to self-financing. The dR numbers in table 2–9 consider only revenue from taxes on capital income. When we add a reasonable tax rate for wages, we find that total revenues may rise when we increase θ. For example, consider the first line. If $\tau_K = .3$ initially, then a marginal increase in θ raises before-tax wage income by \$1.10 for every \$0.50 of revenue loss from the taxation of capital income. If the marginal tax rate on labor income were .45, the extra labor tax revenue would equal \$0.50, and there would be no net loss in revenue. A labor tax rate of .45, which is larger than the current taxation of labor, implies that some increase in the taxation of labor would be necessary to balance the budget. If $\tau_K = .5$ initially, the second set of columns indicates that we need only a .35 marginal tax rate on labor income (a plausible description of the current tax system if we include Social Security taxes) for ITC increases to be self-financing. The possibility of self-financing ITC increases is not unusual in table 2–9. In the case of Cobb-Douglas technology ($\sigma = 1$) and log utility ($\gamma = 1.$), we need at most a .38 marginal tax rate on labor income in the example of the low initial tax rate. Self-financing decreases in τ_K are much more unusual and are plausible only with a high elasticity of substitution between capital and labor.

In any case, the substantial improvement in before-tax wages means that only a small increase in the tax rate on consumption or wages would balance the budget. More important, even if workers had to pay for an ITC increase, they would almost always be better off because dR is usually less than dW. Only when γ is substantially less than the values in table 2–9 does the revenue loss exceed the wage increases. Conversely, that situation is less likely, albeit not implausible, for reductions in τ_K.

The analysis in Judd 1984 is biased in favor of consumption taxation because of the absence of adjustment costs. However, the estimates in table 2–9 are conservative; they ignore the elements of imperfect competition, which this chapter has argued are important. In particular, if we include imperfect competition in our analysis, the $\tau_K = .5$ case in table 2–9 becomes the more relevant initial condition because table 2–3 showed that imperfect competition substantially increases the effective total tax rate on capital income.

Issues concerning distribution are important in the argument for the taxation of consumption. We have seen that the productivity-enhancing properties of even a small movement toward consumption taxation would have beneficial effects for most taxpayers, even when we consider the transition process.

Old versus Young. This chapter has used representative agent models of the economy. The approach ignores intergenerational effects by assuming that all agents live "forever" and are, effectively, the same age. An alternative paradigm often used in tax analysis is the overlapping-generations (OG) approach. Theoretical analyses such as Atkinson and Sandmo 1980 have used two-period OG models. Other studies such as Auerbach and Kotlikoff 1987 have used a version in which agents live for fifty-five periods. In such a world, people differ in age, wealth, and planning horizons. Any tax reform could affect different cohorts differently and affect future generations differently from current generations. The OG approach allows an analysis of generational issues ignored in representative agent models. We next compare these approaches and the importance of intergenerational elements for tax policy analysis.

The representative agent approach is arguably a good approximation for questions of aggregate dynamics. The issue is not that representative agent analyses literally assume that agents live forever or that agents have perfectly altruistic attitudes toward their children. The real question for aggregate analysis is the relative planning horizon of the typical agent, the flexibility in his dynamic behavior, and his view of the future. Compare, for example, the classic two-period OG model of Samuelson and the typical Auerbach-Kotlikoff (AK) model. In the Samuelson model, each agent lives for only two periods, youth and old age. If we were to interpret the Samuelson model, we would have to say that each agent at age twenty chooses a constant consumption demand and labor supply for twenty-five years, and then at age forty-five the individual can change those levels to others that are constant for

the next twenty-five years or so. Such inflexibility is clearly unrealistic. In the AK version, each agent is economically active for fifty-five distinct periods (modeling ages twenty through seventy-five) and can change consumption and labor decisions each year. The extra flexibility in the AK version makes it a much more realistic model. The extra flexibility produces much more sensible descriptions of the transition process after a tax reform and allows us to use empirical analyses that similarly assume annual or similarly frequent observations of agents' decisions.

The key difference between the AK model and a representative agent model is the length of the life of the typical agent. But the importance of that difference is not clear, given the level of discounting typically used. Both Auerbach and Kotlikoff and those who use representative agent models assume that agents discount the future at an annual rate of 4 percent or thereabouts. Implicitly, then, a young person at age twenty treats a dollar at age seventy-five as being equal to 12 cents at age twenty. The utility derived between ages twenty and seventy-five is 88 percent of lifetime utility for an infinitely lived agent and 100 percent of lifetime utility in the AK model in the absence of a bequest motive.

The representative agent and AK models predict similar aggregate output and dynamics. For any fixed utility function and production function, the two models differ, but we know neither tastes nor technology with precision. The ranges of predictions of the two models are similar once we examine the wide range of empirically sensible specifications for taste and technology.

The major difference lies in the implications for specific individuals. The undisputed advantage of the AK model is its utility for analyses of intergenerational distribution. Using the AK model, Auerbach (1996) raises important concerns about the intergenerational impact of tax reform. A transition to a consumption tax would cause older taxpayers to pay a new tax on their accumulated savings (either through consumption taxation of the proceeds of asset sales or through a fall in the market value of their assets), but they would not live long enough to enjoy the benefits.

How we should interpret the Auerbach 1996 results is unclear. Consider the demographic structure of the AK model. It assumes that everyone dies at age seventy-five. These demographic assumptions are inaccurate on two accounts. First, death is an uncertain process,[19] many people live longer than seventy-five years. Table 2–10 compares life expectancies in the AK model and in the United States. In fact, in the United States, a seventy-five-year-old has a life expectancy of eleven years, not one. When an AK model says that a seventy-five-year-old loses from a tax reform because of a drop in asset prices, that loss presumably occurs because his life expectancy is just one year. If that AK model predicts that anyone younger than sixty gains, that is presumably because anyone with more than a fifteen-year life expectancy gains and that those people gain because any immediate short-run loss is balanced by gains over the following fifteen years. When we translate this interpretation to U.S.

TABLE 2–10
Life Expectancy in AK Model and the United.States

	AK Model		U.S. Adult Population	
Age	Life expectancy	Fraction older	Life expectancy	Fraction older
21	32	25.1	.29	
16	24	21.1	.23	
11	16	17.4	.18	
7	13	16.1	.16	
6	.08	14.1	.13	
1	.01	11.0	.08	
NA	NA	8.3	.04	
NA	NA	6.1	.02	

SOURCE: Commerce 1988, table 119.

demographics, the AK model apparently predicts that anyone younger than sixty-seven gains because a sixty-seven-year-old has about a sixteen-year life expectancy in the United States.

The second, and more important, difference between the AK demographic specifications and U.S. demographics is the distribution of life expectancy. Suppose that the AK model predicts that all individuals older than sixty suffer financial losses. That segment encompasses 24 percent of the population, a sizable voting bloc. Auerbach (1996) argues that transition relief to compensate those individuals would substantially limit the possible long-run gains from tax reform. That conclusion is not surprising, given the many individuals who would be harmed. Also, the AK analysis assumes that a large fraction of the population would be substantially harmed. For example, 8 percent of the population in the AK model have less than a six-year life expectancy. Compensating them would be particularly difficult because the available horizon is so short.

The U.S. demographic situation is not as grim and does not present as great a challenge to relief efforts during transition. More precisely, only those older than sixty-seven have less than a sixteen-year life expectancy, and they constitute only 16 percent of the population, not the 24 percent in the AK analysis. The smaller size of the affected population would make it easier to construct compensatory policies. Also, far fewer are substantially affected. For example, those with only a six-year life expectancy would likely suffer greater

losses than the average loser; they make up 8 percent of the population in the AK model but only 2 percent in the United States.

The issue becomes even more ambiguous when we add marriage to the analysis. For example, suppose that a husband and a wife each have a life expectancy of fifteen years. If some altruism exists between husband and wife, then the effective household life expectancy is greater than fifteen.

Our analysis of asset prices with imperfect competition is also relevant here. When we add imperfect competition to the analysis, the switch to a tax on consumption would reduce asset prices by less because of the increase in pure profits to producers. We should consider other implications of tax reform. Auerbach (1996) assumes that capital gains are taxed in an accrued fashion. In reality, older taxpayers would hold considerable amounts of equity with large unrealized gains. Reform by a consumption tax would mean forgiving the unpaid taxes on those unrealized capital gains. In fact, by integrating the reduction in the taxation of capital gains with any reasonable fall in asset prices, an older taxpayer might enjoy a gain in disposable income.

Both the representative agent and the overlapping-generations models are highly stylized, with important differences in their demographic structure. Overlapping-generations models can analyze issues of intergenerational incidence. However, those incidence results would be sensitive to the demographic and tax policy details. The conclusions of analyses such as Auerbach 1996 seem overly pessimistic.

Middle-Income versus Upper-Income. One of the unfortunate features of many proposals for a consumption tax is the relatively slight gain for middle-income groups, whereas upper-income groups gain much more in the short run. The reasons are clear. Middle-income taxpayers lose key deductions, such as the ones for home mortgage interest and state and local taxes. The reduction in the taxation of asset income is of less value to them because most of their assets are already in tax-favored vehicles, such as owner-occupied housing and pension funds. Their ability to shelter asset income is growing under the current system as we increase the scope, size, and liquidity of those special accounts. Upper-income groups benefit more from the rate reductions and the elimination of asset-income taxation because their savings exceed the contribution limits of pension accounts.

Reform proposals for a consumption tax need to be altered to form the necessary political coalition. One alternative is to keep the deduction for mortgage interest, but that adjustment would be bad news for resource allocation. One of the primary benefits of the flat tax and similar proposals would be the elimination of the current bias toward housing investment and against nonresidential business fixed investment. Because the housing stock is roughly the same size as other forms of capital, such a reallocation of investment would substantially improve economic efficiency in the long run. If we maintained the deduction for mortgage interest in the long run, we would be losing one of the primary benefits of the flat tax.

TABLE 2–11
Major Tax Expenditures, 1998
(estimated billions of dollars)

Home mortgage interest deductions	51.2
State and local taxes deductions	
Owner-occupied housing	17.7
Other nonbusiness deductions	32.1

SOURCE: Commerce 1998, table 544.

An alternative is to allow some deductions for state and local taxes, possibly tied to educational expenditures. That adjustment would redirect some tax relief to the middle class and would be no worse in terms of simplicity than allowing some form of deduction for mortgage interest. The incidence would be similar to the deduction of mortgage interest because both are strongly related to income. Allowing some deductions tied to education would be consistent with the principles of consumption taxation, whereas the deduction for mortgage interest clearly violates the conceptual foundations of consumption taxation.

Table 2–11 displays the estimated costs to tax revenue from various deductions in the current tax system. The revenue cost from the deduction for home mortgage interest roughly equals the revenue loss from the deductions by households for state and local taxes. The size of these tax expenditures reflects the current marginal tax rate. The actual revenue loss would be less under a flat tax with a marginal rate of 20 percent or less. The deductions for mortgage interest and for state and local taxes appear to have roughly the same budgetary consequences. They probably have similar impacts on distribution. The benefits of the deduction for mortgage interest is perhaps more focused on the middle class because the deduction is capped and because the top income groups spend less of their income on housing than the middle class. Of course, any deduction for mortgage interest included in a proposal for a modified flat tax would probably also be capped, with the implication that a cap on deductions for state and local taxes would add no greater complexity than a capped deduction for mortgage interest.

This chapter has focused on the educational expenditures of state and local government. Although education is the major expenditure of state and local government, a deduction tied to those expenditures would be smaller than the current deduction for state and local taxes. This study has argued that education is an intermediate good whether financed privately or through local governmental entities, and that its tax treatment should not depend on the organizational form

that individuals decide to use. This argument suggests that we ask the same question of other public services, such as police, fire, and the judicial system. If they are intermediate goods, then they too should be excluded from a base for a consumption tax.

A far more detailed examination is needed of the nature and the allocation of goods provided by local governments. Such an analysis should produce proposals that deal with the problems of transition and distribution without deviating much from the underlying goals of consumption taxation.

Conclusions

Economists have argued that switching to a consumption tax would generate large long-run gains, although some have argued that difficult problems regarding distribution and transition would occur. Earlier arguments have been unduly pessimistic because they have ignored many important elements. Including some features of the U.S. economy that make it modern and technologically advanced (such as imperfect competition, the accumulation of human capital, and risk) substantially strengthens the case for a consumption tax.

Imperfect competition—a ubiquitous feature of a modern economy—acts as a tax on the U.S. economy. This study has shown that the feature is particularly damaging in the investment goods sector. Innovation in intermediate goods is financed by allowing imperfect competition in the industries that produce intermediate goods. Such imperfect competition reduces the productive efficiency of the economy. Any tax on capital income inflicts even more damage on the incentive of the economy to make desirable investments. This chapter has shown that the gains from eliminating the tax burden on capital income are particularly great.

The current tax system discriminates against risk-taking because equity-financed investments pay more taxes than debt-financed investments. That bias has no rational purpose and distorts the allocation of capital. Analyses that ignore that feature of the current tax system substantially underestimate the value of moving to a consumption tax or of more modest integration proposals.

Human capital is an important part of any modern economy and makes labor productivity more sensitive to tax policy. Moving to a tax on consumption would not only increase investment in physical capital but would also increase wages and the incentive to invest in education and other forms of human capital—and would thus produce an even greater increase in long-run output.

Those considerations dramatically affect the estimates of the benefits of moving to a tax on consumption. Overall, incorporating those elements into an analysis would easily double and often triple estimates of the long-run benefits. Those new considerations would also help with the problems of transition. The effects of imperfect competition would push up stock market values and would reduce any adverse effects of tax reform for older taxpayers. This chapter also argues that a realistic view of life expectancy would likewise alleviate concerns about intergenerational equity. When we consider the role of education as an investment, we see that deductions for educational expenditures may be used to reduce middle-class losses from tax reform without continuing the inefficient preference for owner-occupied housing.

At a more fundamental level, this study argues that a proper understanding of tax systems shows that an income tax is a particularly bad form of taxation and that the current tax system violates most principles of sound tax policy. The choice of tax systems is an important and difficult one, but the case for efficient taxation of consumption, as embodied in various current proposals, is strong and growing stronger.

Notes

1. A semantic problem can arise in discussing the taxation and nontaxation of asset income. In this chapter, 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 proposals for a consumption tax do not tax asset income.
2. See Aaron, Galper, and Pechman 1988 for a description of the problems of a hybrid tax system.
3. See Atkinson and Stiglitz 1972 and Atkinson and Sandmo 1980 for formal presentations of optimal taxation theory.
4. This chapter ignores supply elasticities because they are not as relevant for these applications of the inverse elasticity rule.
5. Simulations of tax policy analysis may stumble on this if they assume tastes that lead to time-varying elasticities of consumption demand.
6. See Judd 1987 for a long list of empirically estimated elasticities of the labor supply and tax rates of labor used there to compute *MEB*.
7. A model with heterogeneous capital goods would demonstrate better points about productive efficiency. The more general analysis in Judd 1997 indicates that such models strongly support those conclusions.
8. The quantity is small but typical for competitive models. 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 details such as the standard deduction. The index used in this chapter is a cleaner way to express the welfare gains, and it allows us to ignore irrelevant details.
9. Labor taxation is ignored because labor is inelastically supplied in this simple analysis. However, the presence of a wage tax with an elastic labor supply generally increases the welfare costs of taxation. Hence, this study's results are conservative estimates of welfare costs.

10. We always assume perfect competition in financial markets. We argue that no firm embodies a substantial share of all outstanding equity and no firm offers a substantially unique risk opportunity.

11. In a richer model, different firms would sell different goods and would experience different changes in asset prices. For example, those firms specializing in capital goods would experience an immediate increase in demand whereas those specializing in consumer goods would lose sales because the consumption share of output falls in the short run. However, the assumption that all investors are well diversified permits a focus on aggregate values of assets.

12. More precisely, we assume $u(c) = \frac{c^{1-1/\gamma}}{}$

where γ is also the intertemporal elasticity of consumption used in Table 2–2.

13. Many forms of investment in human capital exist. This chapter focuses on education and on-the-job training because 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.

14. There have been other analyses of human capital and taxation in economic growth models. Jones, Manuelli, and Rossi (1997) argue that there should be no taxation of anything in the long run. That extreme position arises from special assumptions about functional form made 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.

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

16. These parameter values are also conservative when compared with a common assumption of $\phi = 1$ in the endogenous growth literature.

17. As in table 2–2, we assume a representative agent model with an inelastic labor supply.

18. The investment tax credit proxies for any investment incentive above economic depreciation. In particular, the credit proxies for accelerated depreciation as well as an explicit ITC. We assume here that the ITC is on all investment, not just equipment. The assumption is consistent with the nature of proposals for a consumption tax.

19. This chapter assumes that there is an actuarially fair annuity market. If such markets did not exist, then an income tax may be desirable as a way to share life-expectancy risk. In general, when capital markets are not perfect, income taxation may dominate consumption taxation. See Hubbard and Judd 1986, 1987, and 1988 for analyses of taxation with capital market imperfections. Future work should integrate the considerations of Hubbard and Judd with the concerns of this chapter to determine the relative strength of the conflicting forces.

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