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**The Transition to Consumption
Taxation, Part 1: The Impact
on Existing Capital**

Alan D. Viard

**Gasoline and Crude Oil Prices:
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**Financial Statements and Reality:
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The Transition to Consumption Taxation, Part I: The Impact on Existing Capital

Alan D. Viard

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Alan Viard reviews the transitional impact on existing capital from replacing the income tax with a consumption tax. This replacement generally reduces the real value of existing capital because it does not receive the tax relief given to new investment. If the income and consumption taxes had stylized forms and capital were produced without adjustment costs, the proportional decline would equal the consumption tax rate—a 25 percent tax would uniformly reduce the value of existing capital by 25 percent.

Under more realistic assumptions, however, the actual decline is likely to be smaller and less uniform and some types of capital may even increase in value. The burden on owners of existing capital is also mitigated because the tax reform increases the rate of return they earn from reinvestment.

Gasoline and Crude Oil Prices: Why the Asymmetry?

Stephen P. A. Brown and Mine K. Yücel

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Many consumers complain that gasoline and crude oil prices have an asymmetric relationship in which gasoline prices rise more quickly when crude oil prices are rising than they fall when crude oil prices are falling. Many also regard the asymmetry they observe as evidence of market power in the petroleum industry. Most previous research provides econometric evidence of the asymmetry, confirming at least part of what consumers suspect. In this article Stephen Brown and Mine Yücel extend the inquiry by examining the market conditions underlying the asymmetric relationship between gasoline and crude oil prices. They find the observed asymmetry is unlikely to be the result of monopoly power. The remaining explanations for the asymmetry suggest that policies to prevent an asymmetric relationship between gasoline and crude oil prices are likely to reduce economic efficiency.

Financial Statements and Reality: Do Troubled Banks Tell All?

Jeffery W. Gunther and Robert R. Moore

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Each quarter, banks file a call report, or Report of Condition and Income, containing hundreds of accounting items pertaining to their financial condition. This article analyzes call report revisions to assess the extent to which regulatory exams promote accurate data. The findings indicate banks with new or emerging difficulties often significantly underreport these problems, intentionally or not. In addition, the findings point to a significant role for exams in uncovering financial problems and ensuring bank accounting statements reflect them. To the extent the loan-loss accounting in call reports is widely used to assess loan quality, these results support the view that exams are important in the public dissemination of accurate information on banks' financial condition.

The Transition to Consumption Taxation, Part I: The Impact on Existing Capital

Alan D. Viard

T*his article discusses only the impact of tax reform on the real value of the capital stock. Part 2, which will appear in a future issue of Economic and Financial Review, will examine the effects on the valuation of outstanding debt and the resulting distributional implications.*

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Many tax reform proposals call for replacing the individual and corporate income taxes with a consumption tax. Supporters contend that such a reform would increase national saving, boosting future income and consumption. They also argue that consumption taxation is fairer and simpler than income taxation. An extensive literature discusses the wide-ranging transitional effects of such a reform, particularly the potential devaluation of the capital stock in existence on the reform date. In this article, I review and synthesize this literature.

The effects on the capital stock's real value arise from the differences in how the income and consumption taxes treat investment. A stylized income tax applies to gross output minus depreciation, while a stylized consumption tax applies to gross output minus gross investment. In other words, the income tax allows a deduction only as the investment depreciates, while the consumption tax allows new investment to be deducted immediately. As explained below, the consumption tax eliminates the net tax burden on (marginal) investments because the savings from the initial deduction offset the taxes on the subsequent output. Since the switch to a consumption tax removes the tax penalty on new investment, it is likely to expand the capital stock.

However, the timing of the consumption tax—an initial deduction offset by subsequent taxes—has unfavorable implications for the existing capital stock on the date of the reform. This capital is subject to the future taxes but does not receive the tax deduction granted to new investment because the deduction was unavailable when the capital was produced. This capital also loses the depreciation deductions the income tax system provides. The introduction of the consumption tax therefore tends to reduce the real value of the existing capital stock.

Assuming the income and consumption taxes have stylized forms and capital is produced without adjustment costs, the real value of the initial capital stock is reduced uniformly by a proportion equal to the consumption tax rate. In this simplified analysis, a 25 percent consumption tax reduces the real value of all capital by 25 percent. However, the tax reform is likely to increase after-tax rates of return, which benefits the owners of existing wealth. The decline in value can be mitigated by transition relief (such as maintaining depreciation deductions), at the cost of a higher tax rate on current and future workers.

I show that under more realistic assumptions, the decline in the real value of the initial

capital stock is likely to be smaller in aggregate, but less uniform, than the simplified analysis suggests. Consumer-owned capital and government-owned capital escape the decline in value because they receive special treatment under consumption tax proposals. Also, tax reform forgives the deferred income tax liabilities that many types of capital currently face, which mitigates or potentially reverses the decline in their real value. Furthermore, tax reform is likely to increase investment in most types of capital, which in the presence of adjustment costs drives up the price of new capital and mitigates the decline in the value of existing capital. However, tax reform is likely to reduce investment in types of capital that are fully or partly exempt from federal income tax, driving down their value.

The combined effect of these factors is that some types of capital experience little or no decline in value or even rise in value, while other types experience significant declines. In many cases, the magnitudes are uncertain.

I begin by comparing income and consumption taxes, with particular attention to their treatment of investment. I explain how the timing of the consumption tax tends to cause a decline in the real value of the initial capital stock and present the simplified analysis, concluding that the proportional decline equals the tax rate. I then describe the implications of special treatment for consumer and government capital, deferred income tax liabilities, and adjustment costs and summarize the overall impact.

COMPARISON OF INCOME AND CONSUMPTION TAXES

I use a simple economic model to compare income and consumption taxes. I assume that there is no risk or uncertainty and that the economy is closed to international trade and investment. Gross output is produced from labor and capital in accordance with a production function that may vary over time, $F(K_t, L_t, t)$. Since output and income are identical in this closed economy, I use the terms interchangeably.

Output can be used as the economy's single consumption good or as capital. At each date t , gross output is divided between consumption and gross investment (production of new capital),

$$(1) \quad F(K_t, L_t, t) = Y_t = C_t + I_t.$$

Since saving is equal to investment in this closed economy, I use the terms interchange-

ably. Capital is the result of any current production that allows an increase in future output and includes intangible investments, such as research and development.

In my initial simplified analysis, I assume that capital can be produced at a constant marginal cost (in terms of consumption goods) and that there are no adjustment costs associated with investment. An unlimited number of units of new capital can be produced, with each costing one unit of consumption. Conversely, any unit of existing capital can be converted back into one unit of consumption. Because capital does not become more expensive as more is produced, the supply of capital goods is infinitely elastic. I also assume that new capital is economically identical to, and therefore a perfect substitute for, existing capital. I modify these assumptions below.

I assume that capital depreciates at an annual geometric rate δ . One unit of current investment increases the capital stock n years later by $\exp(-\delta n)$ units. The equation of motion for the capital stock is

$$(2) \quad \dot{K}_t = I_t - \delta K_t,$$

where the dot denotes rate of change.

The annual after-tax real rate of return demanded by the savers who supply funds to the firm is r . To simplify notation, I assume that r is constant over time. The wage rate demanded at date t by households supplying labor to the firm is w_t .

In this closed economy, aggregate wealth equals the value of the aggregate capital stock. The combined value of the debt and equity each firm issues must equal the value of its capital. Some households may issue debt to each other, but this does not change aggregate wealth since the lending household's asset is offset by the borrowing household's liability. Therefore, the impact of tax reform on the real value of the capital stock also determines its impact on real aggregate wealth.

However, the distribution of the wealth changes among households depends on how tax reform affects the real value of firms' and households' outstanding debt. If the real value of debt is unchanged, changes in the value of a firm's capital are borne solely by its equity holders as residual claimants and there are no wealth effects for households borrowing and lending to each other. But if the real value of outstanding debt changes, part of the change in the value of capital is shifted to firms' debt holders and wealth is also transferred between borrowing and lending households. This article

discusses only the impact of tax reform on the real value of the capital stock. Part 2, which will appear in a future issue of *Economic and Financial Review*, will examine the effects on the valuation of outstanding debt and the resulting distributional implications.

I now consider the treatment of labor supply and investment under the different tax structures. It is simplest to assume that tax revenues are rebated back to households.

Labor Supply and Investment Under Stylized Income Tax

In my initial simplified analysis, I consider a pure, or stylized, income tax that accurately measures and taxes net income. The base of this stylized income tax is $Y - \delta K$, gross output minus the depreciation of capital. The tax allows depreciation deductions that match true economic depreciation, δK , and provides no tax credits. Corporate dividends, corporate retained earnings, and the capital income of noncorporate firms are taxed uniformly. A single tax rate applies to all households, although there may be a refundable exemption to provide relief for poorer households. I later consider a somewhat more realistic description of the federal income tax that reflects the deferred liabilities it imposes on many types of capital.

A well-established principle of public finance states that in a stylized model of this type, it makes no difference whether taxes are collected from buyers or from sellers. It is simplest to assume that a single firm carries out all production and that the income tax is collected from this firm. If $\tau_{y,t}$ is the income tax rate at time t , the firm's tax liability is

$$(3) \quad T_t = \tau_{y,t}[F(K_t, L_t, t) - \delta K_t].$$

The firm chooses the quantity of labor L and gross investment I to maximize the present discounted value of $Y - wL - I - T$, which is its payment to the savers who provide its funds,

$$(4) \quad \text{Max} \int_{t=0}^{\infty} \exp(-rt) \left[(1 - \tau_{y,t})F(K_t, L_t, t) + \tau_{y,t}\delta K_t - w_t L_t - I_t \right] dt,$$

subject to the constraints of Equations 1 and 2.

The first-order condition for labor is

$$(5) \quad F_{L,t} = \frac{w_t}{1 - \tau_{y,t}}.$$

With no taxes, the marginal product of labor equals the wage rate. With income taxation, the marginal product is higher than the wage rate, reflecting a distortion in the trade-off between work and leisure.

The first-order condition for investment can be derived from the following analysis. Consider a small deviation that increases the capital stock by one unit at date t , followed at time $t + dt$ by an increase in consumption that returns the capital stock to its original path. The investment at date t reduces consumption by one unit. Between t and $t + dt$, the additional unit of capital depreciates to $1 - (\delta dt)$ units but produces $F_{K,t}dt$ units of output, on which taxes of $\tau_{y,t}(F_{K,t} - \delta)dt$ are paid. Consumption at date $t + dt$ is $1 + (F_{K,t} - \delta)(1 - \tau_{y,t})dt$ units. Since the firm cannot have an incentive to deviate from the optimal path, the consumption gained at $t + dt$ must be $1 + (rdt)$ times greater than that sacrificed at date t , which requires

$$(6) \quad F_{K,t} = \delta + \frac{r}{1 - \tau_{y,t}}.$$

It is easy to show that if savers demand a time-varying rate of return, a condition of this form holds at each instant using the contemporaneous rate of return. Also, with several types of capital, each decaying at a different (geometric) rate, a condition of this form holds separately for each type.

With no taxes, the firm invests until the pretax rate of return, $F_K - \delta$ (marginal product minus depreciation), equals savers' required after-tax rate of return. With income taxation, however, this pretax return exceeds savers' required after-tax rate of return. This wedge between pretax and after-tax returns reflects an economic distortion between consumption and saving, which is widely viewed as a major disadvantage of the income tax. As shown below, a constant-rate consumption tax avoids this distortion.

Real Value of Capital Under Stylized Income Tax

I next examine the real value of capital, which I define as the number of units of consumption its owner(s) can obtain by selling one unit of capital and consuming the after-tax proceeds. I show that under the maintained assumptions, this value is always unity in the no-tax economy and under the stylized income tax, regardless of the age of the capital and the income tax rate.¹

This result follows from a simple arbitrage relationship. With no adjustment costs and constant costs of capital production, one unit of new capital can be obtained at an opportunity cost of one unit of consumption and is therefore worth one unit of consumption. One unit of existing capital—for example, the surviving remnant of $\exp(\delta n)$ units of investment made n

years ago—must have the same value as the unit of new capital because both units have the same marginal product and, under the stylized income tax, are subject to the same taxes. Their marginal products are the same because old and new capital are perfect substitutes in production. Each unit of capital, new or old, bears the same tax, $\tau_{y,t}(F_{K,t} - \delta)$, at each date t .

A different calculation confirms that each unit of capital is worth one unit of consumption. The value of each unit of capital must equal the present discounted value of its after-tax cash flows. From Equation 6, the after-tax cash flow (marginal product minus tax liability) is

$$(7) \quad F_{K,t} - \tau_{y,t}(F_{K,t} - \delta) = r + \delta.$$

For each unit of existing capital, this cash flow declines at rate δ as the unit depreciates. So the present value (discounted at rate r) of future cash flow is

$$(8) \quad V = \int_{t=0}^{\infty} \exp(-rt)(r + \delta) \exp(-\delta t) dt \\ = \frac{r + \delta}{r + \delta} = 1.$$

The real value of capital is always unity under the stylized income tax, regardless of the tax rate or fluctuations in the production function. The after-tax cash flow remains equal to $r + \delta$, due to changes in the quantity of capital (which alter its marginal product) or changes in the after-tax rate of return. Due to the infinite supply elasticity, fluctuations in the production function or changes in the income tax rate alter the quantity of capital or after-tax returns but not the real value of each unit. Since this result also holds for a zero tax rate, adoption or repeal of the income tax does not change the real value of capital.

Labor Supply and Investment Under Stylized Consumption Tax

I now consider the effects of a stylized consumption tax. The tax base is consumption, which equals gross output minus gross investment, $Y - I$, in accordance with Equation 1. The stylized consumption tax differs from the stylized income tax solely in deducting gross investment rather than depreciation from gross output. In other words, the firm may deduct capital investment costs immediately rather than as the capital depreciates. Many economists have noted that an income tax can be transformed into a consumption tax simply by replacing depreciation allowances with expensing, which is an immediate deduction for investment costs.²

The difference between this base and the income tax base $Y - \delta K$ is net-of-depreciation investment $I - \delta K$, which, from Equation 2, equals the change in the capital stock. In the United States and other growing economies, the capital stock increases over time, so net investment is positive and consumption is lower than income. A stylized consumption tax requires a higher tax rate than a stylized income tax to meet a given revenue target.

In an economy with multiple firms, a consumption tax can be collected in different ways. A retail sales tax is collected solely from the firm that sells to the consumer, while a value-added tax is collected from firms at different stages of the production process. A flat tax is similar to the value-added tax but is collected partly from firms' workers. A personal consumption tax (sometimes called a personal expenditures tax or a consumed-income tax) is collected from consumers. Koenig and Huffman (1998, 25–26), Congressional Budget Office (1997, 7–22), Gillis, Mieszkowski, and Zodrow (1996), McLure and Zodrow (1996), Slemrod (1996), Auerbach (1996, 43–46), Gravelle (1996a, 1423–28), and Joint Committee on Taxation (1995, 51–52, 57–58) describe and compare these different methods of imposing a consumption tax. Part 2 of this series will examine the differing implications of these taxes for the real value of outstanding debt and for the distribution of wealth changes across households.

However, since these taxes have economically similar effects on the real value of capital and aggregate wealth, I do not distinguish them here. I again assume the tax is collected from the representative firm. Letting τ_c denote the consumption tax rate,³ which is assumed to be constant over time, the firm's tax liability is

$$(9) \quad T_t = \tau_c[F(K_t, L_t, t) - I_t].$$

The firm again chooses the quantity of labor L and gross investment I to maximize the present discounted value of $Y - wL - I - T$,

$$(10) \quad \text{Max} \int_{t=0}^{\infty} \exp(-rt) \left\{ \begin{array}{l} (1 - \tau_c)[F(K_t, L_t, t)] \\ - [I_t] - w_t L_t \end{array} \right\} dt,$$

subject to Equations 1 and 2.

The first-order condition for labor is unchanged from Equation 5, except that the consumption tax rate replaces the income tax rate,

$$(11) \quad F_{L,t} = \frac{w_t}{1 - \tau_c}.$$

However, the first-order condition for investment takes a different form. Again, consider a small deviation that increases the capital stock by one unit at date t , followed at date $t + dt$ by an increase in consumption that returns the capital stock to its original path. The investment of one unit at date t provides tax savings of τ_c , so after-tax consumption falls by only $(1 - \tau_c)$. Between t and $t + dt$, the initial unit of capital depreciates to $1 - (\delta dt)$ units but produces $F_{K,t}dt$ units of output. Pretax consumption at date $t + dt$ is $1 + (F_{K,t} - \delta)dt$ units, and after-tax consumption is $(1 - \tau_c)[1 + (F_{K,t} - \delta)dt]$. Around the optimal path, the consumption gained at date $t + dt$ must be $1 + (rdt)$ times greater than that sacrificed at date t , which requires $(1 - \tau_c)[1 + (F_{K,t} - \delta)dt] = (1 - \tau_c)[1 + (rdt)]$ or

$$(12) \quad F_{K,t} = \delta + r.$$

Unlike the income tax, the constant-rate consumption tax does not impose a net tax burden on the marginal new investment. The tax savings from expensing exactly offset (in present discounted value) the taxes on the subsequent cash flows. The reason is that the marginal unit of investment generates cash flows with a present discounted value of exactly one unit. Because there is no net tax burden, the pretax rate of return equals savers' required after-tax rate of return, as in the no-tax economy. Unlike the income tax, the constant-rate consumption tax does not distort the investment decision.⁴

Because it removes the wedge between pretax and after-tax returns, the replacement of the income tax by a constant-rate consumption tax has major economic implications. It either reduces the marginal product of capital or increases the net return savers receive, or both. In the long run, both effects are likely to occur, as after-tax returns rise to prompt more saving and the resulting expansion of the capital stock drives down the marginal product. The breakdown depends on the elasticity of investment with respect to rates of return (the rate at which marginal product declines as the capital stock expands) and the corresponding elasticity of saving.

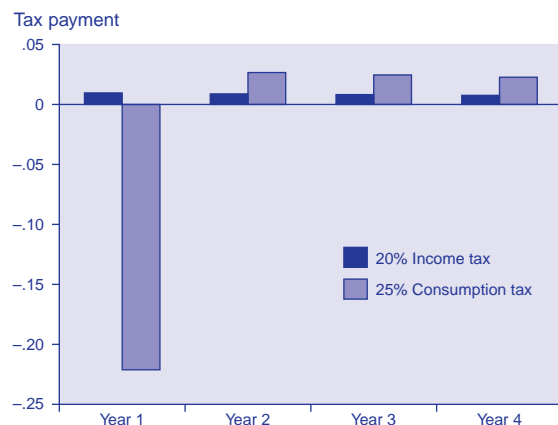
Consider an example in which the depreciation rate is 0.08. Assume that savers' required rate of return does not vary in response to tax changes and always equals 0.04. If the actual U.S. individual and corporate income taxes were of the stylized form assumed in this simplified analysis, a tax rate of about 20 percent or slightly higher would be sufficient to raise cur-

rent revenues and provide a significant refundable exemption. I compare this income tax with a 25 percent consumption tax, which would raise approximately the same revenue, with a similar refundable exemption.⁵ I use these values— $\delta = 0.08$, $r = 0.04$ (both before and after tax reform), $\tau_y = 0.2$, $\tau_c = 0.25$ —as a standard example throughout this article. In the no-tax economy, the equilibrium marginal product is 0.12. With the 20 percent income tax, the marginal product is 0.13, in accordance with Equation 6; the pretax rate of return is 0.05; and the tax payment is 0.01. With the 25 percent consumption tax, the marginal product is 0.12, in accordance with Equation 12. Since the consumption tax payment is 0.03, the after-tax cash flow is 0.09.

Using these parameters, Figure 1 illustrates the source and timing of the consumption tax's favorable treatment of a marginal new investment. The figure compares the time paths of the income and consumption tax payments that result from one additional unit of gross investment, with no later change in gross investment. The difference in timing is dramatic. The income tax payment at each point in the life of the investment is positive, declining as the capital depreciates. The initial consumption tax payment is negative, but subsequent payments are positive and three times larger than under the income tax (because the tax rate is higher and depreciation is not deductible). As I explain below, this timing difference plays a crucial role in the transition between the two tax systems.

One other effect of the consumption tax should be mentioned. If the firm makes inframarginal investments that generate pure profits

Figure 1
Tax Payments Resulting from
One Unit of Gross Investment



NOTE: $\delta = .08$; both before and after tax reform, $r = .04$.

(cash flows with present discounted value greater than initial investment costs), the consumption tax takes a fraction τ_c of the profits. However, since the firm still retains $(1 - \tau_c)$ of the pure profits and an investment with any pure profits is worth making, the tax does not deter any of these investments. (The income tax, in addition to taking τ_y of the pretax return to the marginal investment, also takes τ_y of any pure profits generated by inframarginal investments.)⁶

The consumption and income taxes have different effects on investment incentives. I now show that they also have different effects on the real value of capital.

Real Value of Capital Under Stylized Consumption Tax

The expensing provided by the consumption tax reduces the real value of each unit of capital to $(1 - \tau_c)$ units of consumption. The opportunity cost of an additional unit of new capital is now $(1 - \tau_c)$ units of consumption because the investment provides τ_c in tax savings. Conversely, since converting a unit of capital into one unit of consumption triggers a tax payment of τ_c , the net yield of such a conversion is now only $(1 - \tau_c)$.

The reduction in the real value of capital is confirmed by a reduction in the present discounted value of its cash flows. From Equation 12, the marginal product of each unit of capital is $r + \delta$, so the after-tax cash flow is $(1 - \tau_c)(r + \delta)$. With depreciation rate δ and discount rate r , the present discounted value of each unit's cash flow is

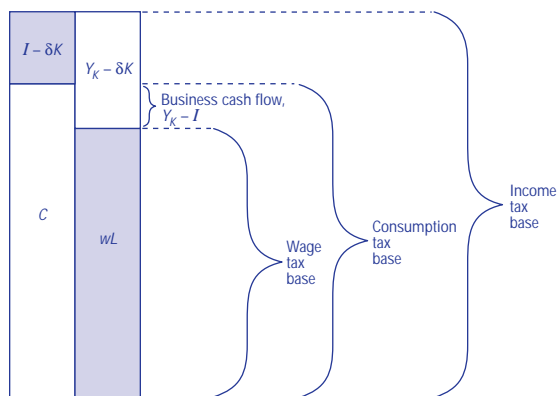
$$(13) \quad V = \int_{t=0}^{\infty} \exp(-rt)[(1 - \tau_c)(r + \delta)]\exp(-\delta_t) dt \\ = \frac{(1 - \tau_c)(r + \delta)}{r + \delta} = 1 - \tau_c.$$

The timing of the consumption tax causes the lower value of capital. Tax savings at the date of investment offset τ_c units of the investment costs. For the marginal investment, the subsequent after-tax cash flows (which must offset the remainder of the costs) have a value of only $1 - \tau_c$ units. Each unit of existing capital has already received the initial tax savings and has only $1 - \tau_c$ units of remaining value.

Decomposing the Income and Consumption Taxes

The above analysis indicates that income and consumption taxes are similar in one respect but different in two others. Both taxes distort the labor supply decision by driving a wedge between the marginal product of labor

Figure 2
Relationship of Tax Bases



and the wage rates workers demand. However, the income tax creates an additional distortion by driving a wedge between the pretax and after-tax rates of return on investment, while the consumption tax does not. Also, the consumption tax depresses the value of capital below its pretax replacement cost, while the income tax does not.

A decomposition of the taxes helps clarify their similarities and differences. Define gross capital income as gross income minus wages,

$$(14) \quad Y_{K,t} = Y_t - w_t L_t.$$

The stylized income tax consists of a tax on wages, wL , plus a tax on net-of-depreciation capital income, $Y_K - \delta K$. The consumption tax can also be decomposed. Combining Equations 1 and 14 reveals that consumption equals wages plus capital income minus investment,

$$(15) \quad C_t = w_t L + (Y_{K,t} - I_t).$$

The excess of capital income over investment is called business cash flow because it is the portion of capital (or business) income that is not used to produce new capital and that is distributed (flows back) to savers. Business cash flow measures capital's net contribution to consumption (the output it produces minus the portion reinvested to produce it). Equation 15 states that consumption equals wages plus business cash flow. If business cash flow is positive, as in the United States, capital is productive, permitting consumption to exceed wages.⁷ A consumption tax is a wage tax plus a business-cash-flow tax.⁸

Figure 2 shows the relationship of these quantities. Because cash flow is positive, wages are lower than consumption. Because net investment is positive, as noted above, consumption is lower than net income.

Since the income and consumption taxes both include a wage tax, it is useful to consider its properties. The wage tax drives a wedge between the pretax product of labor and the after-tax wage rate and distorts the labor supply decision. This explains why the income and consumption taxes both have this effect.

However, the wage tax has no effect on the investment decision or on the value of capital. An addition to Figure 1 charting the wage tax payments triggered by an additional unit of gross investment would show zero at every date. The initial investment does not change the wage tax, since output produced by labor is taxed whether it is used as consumption or as capital. The subsequent output the investment generates is untaxed, because the wage tax applies only to the marginal product of labor, not capital. Each unit of capital is still worth one unit of consumption.

The effects of the income and consumption taxes on investment and the value of capital therefore arise from their net-capital-income-tax and business-cash-flow-tax components rather than their common wage-tax component. A net-capital-income tax creates an investment distortion by imposing a tax burden on the marginal new investment. In contrast, a constant-rate business-cash-flow tax creates no distortion because it imposes zero present-discounted-value burden on the marginal new investment. With a constant rate, a cash-flow tax is a lump-sum tax that does not distort economic decisions.

Since business cash flow is positive and substantial, the cash-flow tax raises significant revenue. The tax is lump sum because this revenue is not raised from labor or (in present discounted value, on the margin) from new investment, the two economic activities that can be distorted in this model. Where then does the revenue come from? As noted above, the tax collects revenue from any pure profits generated by inframarginal new investments; a tax on pure profits has long been recognized as lump sum. But the bulk of the revenue is collected from the capital stock in existence when the tax is introduced. It is well known that a tax on existing capital is also lump sum. I now describe the effects on existing capital in more detail.

SIMPLIFIED ANALYSIS OF THE TRANSITION

The above analysis permits a simple description of the transitional effects of repealing a stylized income tax and introducing a consumption tax. The change is assumed to be unexpected. Under the stated assumptions, the

real value of the existing capital stock declines by a proportion equal to the consumption tax rate. This result has been widely noted and can be regarded as canonical.⁹

Real Value of Capital Declines by Proportion Equal to Tax Rate

Each unit of capital is worth one unit of consumption under the stylized income tax and $(1 - \tau_c)$ units under the stylized consumption tax. The tax reform therefore causes the real value of capital to decline by proportion τ_c . For example, the introduction of a 25 percent consumption tax reduces the value of existing capital by 25 percent.

Many believe the switch to a consumption tax reduces the value of existing capital because it increases the taxes on that capital. As explained below, this belief is largely incorrect. However, it is useful to consider the change in the tax burden on existing capital. These taxes are likely to increase, largely because depreciation is no longer deductible. Also, if the tax reform is revenue-neutral, the stylized consumption tax rate is higher than the stylized income tax rate was. (The tax increase can be readily seen in Figure 1.) For any capital already in existence on the reform date, the tax payments increase due to the midstream change.

Nevertheless, the devaluation of existing capital does not occur because it is taxed more heavily under the consumption tax than it was under the income tax. The decline in value equals the consumption tax rate, regardless of whether any income tax previously existed or what was done with it. For example, repealing a 90 percent income tax and adopting a 25 percent consumption tax (with spending cuts financing the revenue shortfall) reduces the tax burden on existing capital. Yet in this simplified analysis, the real value of existing capital still declines by 25 percent.

Instead, the existing capital stock is devalued because it is taxed more heavily than new investment. Existing capital declines in value either when it is subjected to a tax increase from which new capital is spared or when it is excluded from a tax cut given to new capital. The relative treatment of existing and new capital is crucial because they are perfect substitutes for each other in production and have the same marginal product.

For new investment to remain viable under an income tax, the tax payments on it must be offset by a marginal product that exceeds savers' required returns, as stated in Equation 6. Since existing capital is a perfect

substitute for new capital, it also enjoys this higher marginal product (or lower required rate of return). Therefore, the introduction of an income tax or an increase in its rate does not affect the value of existing capital. The marginal product or the required return or both change so that cash flow remains equal to $r + \delta$, which ensures the value remains equal to unity.

Under the consumption tax, however, Equation 12 makes clear that the future tax payments from new investments are *not* offset by a marginal product that exceeds savers' required rate of return. Instead, they are offset by the tax deduction granted on the date of investment. Since this tax deduction is not given to the existing capital stock, it receives no offset for its future tax payments and its value declines.

This point can be clarified by returning to the standard example, in which $\delta = 0.08$, $r = 0.04$ (both before and after tax reform), $\tau_y = 0.2$, and $\tau_c = 0.25$. Column A of Table 1 shows that with the income tax, the marginal product is 0.13 and the tax payment is 0.01, so the after-tax cash flow is 0.12. As shown in column B, when the consumption tax replaces the income tax, the capital stock expands until the marginal product falls from 0.13 to 0.12. The consumption tax payment from each unit of capital is 0.03, so the after-tax cash flow is 0.09.

The 25 percent decline in the value of capital reflects the 25 percent decline in the after-tax cash flow, from 0.12 to 0.09. Of the 0.03 decline in after-tax cash flow, 0.02 is due to higher tax payments. Tax payments rise from 0.01 to 0.03, due to the higher consumption tax rate and the loss of depreciation allowances. The other 0.01 of the decline in after-tax cash flow is due to the decline in pretax marginal product, which is an equilibrium response to the tax cut for new investment. The annual tax burden on new investment under the income tax is 0.01, but the effective annual burden under the consumption tax is zero because expensing offsets the 0.03 annual tax payment. With an unchanged after-tax rate of return, the 0.01 effective tax reduction causes an expansion of the capital stock that reduces the pretax marginal product by 0.01. In this case, two-thirds of the reduction in value is due to a tax increase on existing capital; because new investment is spared this increase, there is no offsetting increase in the equilibrium pretax marginal product. The other one-third is due to the exclusion of existing capital from a tax cut given to new investment—a tax cut that

Table 1
Effect of Tax Reform on Existing Capital

	(A) 20 percent income tax ($\tau_y = .2$)	(B) 25 percent consumption tax ($\tau_c = .25$)	(C) 90 percent income tax ($\tau_y = .9$)
Marginal product, F_K	.13	.12	.48
Pretax rate of return, $F_K - \delta$	.05	.04	.40
Tax payment T	.01	.03	.36
After-tax cash flow, $F_K - T$	.12	.09	.12
Present value, $(F_K - T)/(r + \delta)$	1.00	.75	1.00

Income tax: $F_K = \delta + [r/(1 - \tau_y)]$; $T = \tau_y(F_K - \delta)$
Consumption tax: $F_K = \delta + r$; $T = \tau_c F_K$

NOTE: $\delta = .08$; both before and after tax reform, $r = .04$.

drives down the equilibrium pretax marginal product and thereby reduces the value of existing capital.

Column C shows the outcome with a 90 percent income tax. Replacing this onerous income tax with a 25 percent consumption tax provides a large tax cut of 0.33 to existing capital, reducing annual payments from 0.36 to 0.03. However, it grants an even larger tax cut of 0.36 to new investment. (Its annual tax burden is 0.36 under the income tax but is effectively zero under the consumption tax, due to expensing.) In equilibrium, this 0.36 tax reduction causes the capital stock to expand until the marginal product falls from 0.48 to 0.12. Due to the 0.36 decline in marginal product, the after-tax cash flow from existing capital falls by 0.03 despite the 0.33 tax cut.

Regardless of the rate of the income tax being replaced, the tax disparity between existing capital and new investment is 0.03, which is 25 percent of pretax marginal product. The value of the existing capital therefore always declines by 25 percent.

For simplicity, this standard example makes the extreme assumption that tax reform does not change the after-tax rate of return, which remains equal to 0.04, while the capital stock expands to drive the pretax rate of return down to that value. Realistically, savers may demand a higher after-tax return to provide the additional funds required for this expansion. However, this does not alter the conclusion that the real value of existing capital falls by 25 percent. Consider the opposite assumption, in which the pretax return remains equal to 0.05, while the after-tax return rises to this value. (This extreme is also unrealistic since the higher after-tax return is likely to prompt additional saving, which expands the capital stock

and reduces the pretax rate of return.) The marginal product is 0.13, the consumption tax payment is 0.0325, and the after-tax cash flow is 0.0975. Although this cash flow is higher than in the standard example, it must be discounted at a higher after-tax rate of return. The value of each unit of capital is

$$\begin{aligned} & \int_{t=0}^{\infty} \exp(-.05t) (.0975) \exp(-.08t) dt \\ &= \frac{.0975}{.13} = .75. \end{aligned}$$

It can be seen that intermediate, more realistic assumptions about the rate of return also yield the same result.

Although these different assumptions about after-tax returns result in the same value of capital, they have different implications for the well-being of wealth holders.

Wealth Holders Benefit from Higher After-Tax Rates of Return

The real value of the capital stock (aggregate wealth) is not the only factor affecting the well-being of its owners. This value merely measures the consumption the owners can obtain by immediately liquidating their wealth. Since most wealth holders do not intend to consume their entire wealth immediately, their well-being also depends on the future rates of return they will earn.

As discussed above, tax reform is likely to cause after-tax returns to rise and pretax returns to fall. The former effect is likely to be larger in the short run because it takes time for additional new investment to expand the capital stock and drive down pretax returns. Therefore, wealth holders are likely to enjoy significantly higher after-tax returns for some time. Koenig and Huffman (1998), Congressional Budget Office (1997), Auerbach (1996), and Auerbach and Kotlikoff (1987, 66) provide quantitative estimates.

For most wealth holders, the increase in net returns mitigates the effects of switching to a consumption tax. Consider a household with initial wealth W that intends to consume at a level rate over the next H years. If the after-tax return is r , it consumes at an annual rate of

$$\frac{Wr}{1 - \exp(-rH)}.$$

If the annual after-tax real return is initially 0.04, a household with initial wealth equal to 100 units of consumption and a forty-year horizon consumes 5.01 units per year. If tax reform reduces its real wealth from 100 to 75 units but raises the annual after-tax real return from 0.04

to 0.05, the household's annual consumption falls to 4.34 units. Consumption declines only 13 percent, not 25 percent. More dramatically, consider a household that consumes nothing for H years after the tax system changes and then splurges by consuming $W \exp(rH)$. With the above parameters, a household that plans to wait forty years can consume 554 units under the consumption tax, an increase of 12 percent from the 495 units available under the income tax. Some wealth holders, therefore, may support the adoption of a consumption tax, despite the reduction in the value of their wealth. Of course, the rare household that consumes its entire wealth immediately after tax reform is unaffected by future returns and suffers the full 25 percent reduction in consumption.¹⁰

The rise in after-tax returns is due to the repeal of the income tax rather than the introduction of the consumption tax. If the consumption tax is introduced as a supplement to the income tax (or as a replacement for a wage tax), rates of return do not increase and all wealth holders suffer a proportional decline in consumption equal to the tax rate.

Effects of Transition Relief

Some consumption tax proposals call for transition relief to mitigate or offset the decline in the real value of existing capital. A simple approach is to remove the business-cash-flow-tax component of the consumption tax and impose only a wage tax. Since the wage tax has an even narrower base than the consumption tax (*Figure 2*), a higher rate is necessary to raise the same revenue, which imposes a heavier burden on workers. Workers finance transition relief for the owners of existing capital (and any investors who receive pure profits). The higher tax rate also exacerbates the labor supply distortion; since the cash-flow tax is lump sum, its removal offers no offsetting efficiency gains.

As described above, a wage tax imposes zero tax payments on investment at every date. It does not distort the investment decision, and the real value of capital remains equal to unity. Replacing the income tax with a wage tax therefore leaves the value of existing capital unchanged. Existing capital escapes any decline in value because it receives the same tax reduction given to new investment. The effects of a wage tax (for any rate) are shown in column C of Table 2 for the standard example, in which $\delta = 0.08$ and $r = 0.04$, both before and after tax reform. Columns A and B are repeated from Table 1 to show the effects of the 20 percent income tax and 25 percent consumption tax.

Table 2
Effect of Transition Relief on Existing Capital

	(A) 20 percent income tax ($\tau_y = .2$)	(B) 25 percent consumption tax ($\tau_c = .25$)	(C) Wage tax (any rate)	(D) Depreciation relief ($\tau_c = .25$)
Marginal product, F_K	.13	.12	.12	.12
Pretax rate of return, $F_K - \delta$	.05	.04	.04	.04
Tax payment T	.01	.03	.00	.01
After-tax cash flow, $F_K - T$	.12	.09	.12	.11
Present value, $(F_K - T)/(r + \delta)$	1.00	.75	1.00	.917

Income tax: $F_K = \delta + [r/(1 - \tau_y)]$; $T = \tau_y(F_K - \delta)$

Consumption tax: $F_K = \delta + r$; $T = \tau_c F_K$

Wage tax: $F_K = \delta + r$; $T = 0$

Depreciation relief: $F_K = \delta + r$; $T = \tau_c(F_K - \delta)$

NOTE: $\delta = .08$; both before and after tax reform, $r = .04$.

Since replacing the income tax with a wage tax increases after-tax rates of return while leaving the real value of wealth unchanged, it improves the well-being of wealth holders.¹¹

A more modest (and more common) proposal allows firms to deduct the depreciation allowances on existing capital that they would have deducted under the income tax. The revenue loss from this relief also raises the tax rate required to meet a given revenue target, which exacerbates the labor supply distortion and increases the burden on workers and any investors with pure profits. However, these effects are smaller than under the wage-tax option.

This transition relief is insufficient to avoid a decline in real value. As shown in column D of Table 2, the provision of depreciation allowances (with the consumption tax rate still equal to 25 percent, for simplicity) results, for these parameters, in a tax liability of 0.01 on existing capital, the same as under the 20 percent income tax. (With higher depreciation rates, it results in a tax reduction; with lower depreciation, tax reform still increases tax liability but by less than without relief.) However, the pretax marginal product of capital still declines by 0.01, the equilibrium response to the 0.01 tax cut for new investment, so the after-tax cash flow falls from 0.12 to 0.11. Existing capital still declines in value, though only by 8 percent rather than 25 percent.

As emphasized above, existing capital declines in value if its tax treatment deteriorates relative to new investment. Maintaining depreciation deductions for existing capital is insuffi-

cient to prevent its devaluation because this treatment is less generous than the expensing provided for new investment. In general, it can be shown that existing capital declines in value by $\tau_c r / (r + \delta)$ under this policy rather than by the τ_c that occurs without transition relief. This form of transition relief is therefore more favorable to short-lived types of capital (those with high δ).¹²

Limitations of Simplified Analysis

Several aspects of this simplified analysis are unrealistic. The analysis does not reflect the special treatment capital owned by consumers and state and local governments would receive under consumption tax proposals. Also, the stylized income tax system does not accurately represent the U.S. income tax and the assumed production technology is unrealistic. The remainder of this article extends the analysis to address these limitations.

EXTENSION 1: SPECIAL TREATMENT OF CONSUMER AND GOVERNMENT CAPITAL

The simplified analysis assumes that all production is done by a single firm and is treated uniformly within each tax system. However, consumers and state and local governments, rather than private business firms, own significant portions of the U.S. capital stock.¹³ Consumer capital includes owner-occupied homes and consumer durable goods; government capital includes public buildings and roads. These

types of capital are currently taxed differently than they would be under a stylized income tax, and they would be taxed differently under major consumption tax proposals than they would be under a stylized consumption tax. Because of this different treatment, they escape the decline in value other capital experiences on the reform date.

Under the stylized income tax, the marginal product of this capital is taxed and its depreciation is deducted. Under the stylized consumption tax, the marginal product of this capital is taxed and new production of such capital is deducted. The marginal product of consumer capital is its imputed rental value; the marginal product of government capital is the imputed value of the public services it produces. However, valuation difficulties arise because these services are not sold in the marketplace; consumers do not pay rent to themselves, and governments generally provide public services without charge. Consumers and recipients of public services receive the capital income in-kind rather than as cash payments.

Whether due to these valuation difficulties or other reasons, neither the current income tax system nor leading consumption tax proposals follow the stylized treatments described above. The current system and the proposals take the same approach to consumer and government production, treating these sectors as they would be treated by a wage tax. The current system exempts them from the net-capital-income tax, and the proposals exempt them from the business-cash-flow tax.

At a private golf course, the income tax applies to both the wages of course employees and the net capital income the course generates. At a municipal golf course, however, the federal income tax applies only to the employees' wages. The gross capital income of the course is not taxed, and depreciation is not deducted. For a rental housing unit, the income tax applies both to the wages of the landlord's employees and the landlord's net-of-depreciation capital income. For an owner-occupied home, the income tax applies only to the wages of workers who perform services (such as plumbers and carpenters).¹⁴ The home's imputed rental income is not taxed, and depreciation is not deducted.

Similarly, proposed consumption taxes apply to both the wages of the private course's employees and the course's business cash flow, its gross capital income minus new investment. At the municipal course, however, the proposed taxes apply only to the wages of course em-

ployees. The course's gross capital income is not taxed, and construction costs of new courses are not deductible. For rental housing, both wages and business cash flow are taxed. For owner-occupied housing, only wages are taxed. Imputed rental is not taxed, and new home construction costs are not deductible.

One way to describe this treatment is that the production of consumer and government capital is treated as if it were consumption and the actual consumption subsequently produced by this capital is ignored. Any "consumption" tax that taxes investment as if it were consumption and exempts the output produced by capital is simply a wage tax; only wages remain if business cash flow (capital income minus investment) is removed from the consumption tax base.

Because wages in these sectors are taxed in the same way as in the rest of the economy, the income and consumption taxes affect labor supply in these sectors in the manner indicated by the general first-order conditions, Equations 5 and 11. Under the income tax, these sectors' exemption from the tax on net capital income causes a misallocation of capital. Since capital income is untaxed in these sectors, the marginal product of capital is $\delta + r$.¹⁵ However, the marginal product is $\delta + [r/(1 - \tau_y)]$ elsewhere, in accordance with Equation 6. Pretax rates of return are higher for rental housing and private golf courses than for owner-occupied housing and municipal golf courses, implying that total output increases if capital is shifted from the latter to the former.

The consequences of the disparate treatment are less problematic under the consumption tax. Since the business-cash-flow tax is lump sum, its uneven application across sectors does not distort investment decisions. The marginal product of capital is $r + \delta$ throughout the economy, in accordance with Equation 12. To be sure, the rental payments on a new rental home are taxed, while the imputed rental of a new owner-occupied home is not. However, the construction costs of the new rental home are deductible, while those of the new owner-occupied home are not. Since the present discounted value of the rentals equals the construction costs (for the marginal home), the present discounted value of the tax burden is zero in each case. Treating the original production as consumption misstates the timing of consumption but not its present discounted value.¹⁶

Nevertheless, the disparate treatment has important implications for the value of consumer and government capital existing on the

reform date. Since the value of capital is unity under a wage tax, tax reform causes no decline in value. On the reform date, owner-occupied homes and municipal golf courses escape the decline in value experienced by rental housing and private golf courses.¹⁷ Any pure profits generated by inframarginal investments of consumers and state and local governments also escape taxation.

Of course, the exemption of consumer and state and local government capital from the cash-flow tax reduces consumption tax revenue. A higher tax rate is necessary to meet any given revenue requirement, which exacerbates the labor supply distortion and increases the tax burden on workers, owners of other types of existing capital, and any investors who receive pure profits from other types of capital.

EXTENSION 2: INCOME TAX DEFERRAL

The simplified analysis assumes that the income tax is a stylized tax that measures income accurately and treats old and new capital neutrally. Under such a tax, the value of capital equals its replacement cost. However, under more realistic assumptions about the timing of the income tax, many types of capital are already worth less than replacement cost. Replacing the income tax with a consumption tax therefore causes a smaller reduction in (or may even increase) the real value of existing capital.

Income Tax Deferral Reduces the Real Value of Capital

As explained above, the differing impact of the stylized income and consumption taxes on the real value of capital result from differences in their timing. The stylized income tax collects the same tax from each unit of capital regardless of age, while the consumption tax grants an initial tax deduction offset by subsequent taxes (recall Figure 1). Unlike the stylized income tax, the consumption tax is a deferred tax.

However, as detailed below, the federal income tax system frequently imposes heavier burdens on old capital than on new investment. I show that this tax deferral reduces the real value of capital below unity. A tax reform that combines the introduction of a consumption tax with repeal of the income tax reduces the value of existing capital by less than the simplified analysis concludes. In some cases, the value of existing capital may increase.

Consider the standard example of a 20 percent income tax on a type of capital with a 0.08 depreciation rate, when the required after-

tax return is 0.04. Suppose instead that this type of capital is tax exempt for the first 5.776 years after it is produced and thereafter is subject to a 40 percent tax on its subsequent income. Since this system imposes the same tax burden (in present discounted value) as the 20 percent income tax, the effective tax rate is 20 percent.¹⁸ The equilibrium pretax return is still 0.05, and the marginal product is still 0.13. Since all units of capital, regardless of age, are perfect substitutes in production, they all have this marginal product.

However, the after-tax cash flow varies with age. It is 0.13 for each unit of capital that is less than 5.776 years old. Each unit of older capital faces a tax of 0.4 (0.05), or 0.02, and has an after-tax cash flow of 0.11. Due to this age-varying treatment, the value of capital also varies with age. Consider a unit of capital that is more than 5.776 years old. Since its after-tax marginal product is permanently 0.11, its real value (with a depreciation rate of 0.08 and a discount rate of 0.04) is $0.11/0.12$, or 0.917.

Newly produced capital has an opportunity cost of one unit of consumption and, by the familiar arbitrage argument, is worth one unit of consumption. But capital that is older than 5.776 years is worth only 0.917 units of consumption.¹⁹ The new capital is worth more because it still has 5.776 tax-free years left, while the older capital does not. It can also be shown that the real value of capital gradually falls from 1 to 0.917 during its first 5.776 years as it uses up its tax-free period.

Since the stylized income tax (which imposes the same tax on capital of all ages) does not reduce value, the devaluation arises solely from the fact that the tax burden is greater in the later part of the investment's life. It is helpful to view the deferred taxes as a liability the owners of capital owe the government. The economic burden of the tax system is 0.01 at all ages, since marginal product always exceeds $r + \delta$ by this amount. During the tax-free period, the owners effectively borrow from the government. Later, when they are paying 0.02, they effectively service this loan. The outstanding liability reduces the value of the capital. Indeed, the same effect could be achieved by imposing the 20 percent uniform tax and making an explicit loan. The capital, encumbered by the debt, would be worth less than unity.

This devaluation has implications for the effects of tax reform. Replacing the income tax with a 25 percent consumption tax reduces the value of each unit of existing capital (that is more than 5.776 years old) by only 18 percent,

from 0.917 to 0.75. Income tax repeal effectively forgives the deferred tax liability and increases the value of the capital, partly offsetting the 25 percent decline caused by the introduction of the consumption tax.

Therefore, to the extent current income taxes are imposed on a deferred basis, capital is already valued at less than replacement cost and the replacement of the income tax by a consumption tax has a smaller impact than the previous analysis suggests. If the devaluation under the income tax is sufficiently large, the switch to consumption taxation may even raise the real value of existing capital.

Note that the offsetting rise in value is due to the repeal of the income tax (and its associated deferred liabilities) rather than the introduction of the consumption tax. If a consumption tax is introduced as a supplement to the income tax (or as a replacement for a wage tax), the value of existing capital still declines by a proportion equal to the consumption tax rate, as in the simplified analysis. Similarly, if the consumption tax rate is subsequently raised to meet an increase in revenue needs, the real value of existing capital still declines by a proportion equal to the rate increase.

As described below, numerous instances of deferred taxation exist in the current system. Front-loaded investment and saving incentives result in deferred taxation. Also, under one theory of corporate financial policy, the taxation of corporate dividends at a higher rate than retained corporate earnings results in tax deferral.

Front-Loaded Investment Incentives

Front-loaded investment incentives include expensing, investment tax credits, and accelerated depreciation.²⁰ Current income tax law allows the cost of some investments to be expensed (as all investment would be under a consumption tax) rather than depreciated. Most intangible investments—such as research and development, worker training, and business planning—can be expensed. Small businesses are allowed to expense \$20,000 (scheduled to rise to \$25,000 by 2003) of equipment investment per year. Each unit of expensed capital is worth $(1 - \tau_y)$ under the income tax, so the net change resulting from tax reform is $(\tau_y - \tau_c)$.

In some instances, the income tax allows a credit against tax liability equal to a fraction k of investment costs when the investment is made. Each unit of capital then has a value of about $(1 - k)$, depending on how depreciation allowances are adjusted to account for the credit. Although the general credit for equipment investment was abolished in 1986, U.S. tax

law still provides a 20 percent credit for research and experimentation, a 10 percent credit for business equipment that uses solar or geothermal energy, and a 10 percent to 20 percent credit for rehabilitation of historic structures.

Under accelerated depreciation, the tax law computes depreciation deductions as if capital depreciates more rapidly than it does. For example, capital with a 0.08 depreciation rate may be depreciated for tax purposes at a 0.12 rate. One unit of investment results in a depreciation deduction t years later of $0.12 \exp(-0.12t)$, rather than the true depreciation of $0.08 \exp(-0.08t)$. The deductions are higher than true depreciation for capital that is less than 10.137 years old and lower for capital that is older. This deferral of tax liability results in capital having a value less than unity. The tax law provides accelerated depreciation for nearly all types of tangible capital.

Front-Loaded Personal Savings Incentives

Another form of deferred income taxation is the provision of front-loaded incentives for personal saving. The amount saved is deducted and the proceeds are fully taxed when withdrawn from a designated account. These incentives apply to pensions, conventional individual retirement accounts (IRAs), 401(k)s, 403(b)s, medical savings accounts, education IRAs, and Keogh accounts for self-employed taxpayers. In some cases, a 10 percent penalty may also apply to withdrawals. The taxation of the proceeds reduces the value of the assets to $(1 - \tau_y)$ or, if the penalty is applicable, to $(0.9 - \tau_y)$. Repeal of the individual income tax forgives the tax and penalty.²¹

The incentives provided to Roth IRAs do not have the same effects. The household receives no deduction for the original saving, but the return on the account is exempt. Although these incentives are often referred to as back-loaded, their timing is actually neutral. There is no deferral because the same zero tax rate applies at all times. Income tax repeal does not increase the net value of Roth IRAs.

Another instance of deferred taxation is the delay in taxing capital gains until the gains are realized. Repeal of the income tax forgives the tax on unrealized capital gains.²²

Taxation of Corporate Dividends and Retained Earnings

Another potential source of deferred taxation has broad applicability. Shareholders in many corporations must pay individual income tax on dividends and on the capital gains that

result from corporate retained earnings (in addition to the corporate income tax imposed at the firm level).²³ The tax on dividends is generally higher than the effective tax on retained earnings. Under one theory of corporate financial policy, this differential taxation is a deferral of tax liability and reduces the value of existing capital.

Consider a corporation that uses equity to finance all its investment. Let *ISSUE* denote the funds raised by issuing and selling new shares, *DIV* denote the dividends paid to existing shareholders (gross of dividend tax), and *RETAIN* denote the earnings retained on behalf of existing shareholders. The business cash flow distributed to stockholders consists of dividend payments to existing stockholders minus equity issuance proceeds received from new stockholders. By definition, business cash flow equals gross capital income minus gross investment, so $DIV - ISSUE = Y_K - I$. Retained earnings equal the net increase in the capital stock existing stockholders own, consisting of the increase in the firm's capital stock (gross investment minus depreciation) minus the portion sold to new stockholders, so $RETAIN = (I - \delta K) - ISSUE$. Rewriting these equations yields

$$(16) \quad \begin{aligned} DIV_t + RETAIN_t &= Y_{K,t} - \delta K_t; \\ RETAIN_t + ISSUE_t &= I_t - \delta K_t. \end{aligned}$$

For given values of real variables (capital income, investment, and depreciation), Equation 16 places two restrictions on the three financial variables (dividends, equity issuance, and retained earnings). The corporation has one degree of freedom in choosing its financial policy.

If a common tax rate τ applies to both dividends and retained earnings, the liability under any financial policy satisfying Equation 16 is

$$(17) \quad T_t = \tau(DIV_t + RETAIN_t) = \tau(Y_{K,t} - \delta K_t).$$

Regardless of the corporation's financial policy, this is simply a tax on net capital income with no tax deferral.

However, since the federal income tax system offers a preferential tax rate on long-term capital gains, the dividend tax rate, τ_d , exceeds the effective tax rate on retained earnings, τ_r . Because this system treats different financial flows differently, its effects depend on the corporation's financial policy.

Economists have considered two major theories of corporate financial policy. The earliest theory, generally called the "old" or "traditional" view, assumes that firms pay dividends

equal to a fixed fraction x of their net capital income, which implies

$$(18) \quad \begin{aligned} DIV_t &= x(Y_{K,t} - \delta K_t); \\ RETAIN_t &= (1 - x)(Y_{K,t} - \delta K_t); \\ ISSUE_t &= I_t - (1 - x)Y_{K,t} - x\delta K_t. \end{aligned}$$

Since increases in I result in one-for-one increases in *ISSUE* with no changes in *DIV* or *RETAIN*, new share issuance is the marginal source of finance for new investment.

Under this theory, the tax imposed on stockholders is

$$(19) \quad \begin{aligned} T_t &= \tau_d DIV_t + \tau_r RETAIN_t \\ &= [x\tau_d + (1 - x)\tau_r](Y_{K,t} - \delta K_t). \end{aligned}$$

Under the old view, the system imposes a tax on net capital income, with the effective rate equal to a weighted average of the rates on dividends and retained earnings. The lower rate on retained earnings merely reduces the overall tax rate with no deferral. Since investment is financed from new share issuance, with no change in dividends or retained earnings, no tax saving or payment occurs at the time of investment. The subsequent output from the investment generates a stable mixture of dividends and retained earnings at each date, so its tax treatment is the same at each date.

However, King (1974) and later writers challenge the old view's assumption that the corporation simultaneously issues new equity and pays dividends. Even in the no-tax economy, raising funds from new stockholders and paying them to current stockholders generates unnecessary transaction costs. More important, this behavior raises shareholders' taxes. Lowering both dividends and share issuance by one dollar, which increases retained earnings by one dollar, reduces taxes by $(\tau_d - \tau_r)$. Also, the small amount of equity issuance by mature corporations casts doubt on the old view's assertion that such issuance is the marginal source of investment finance.

King and those who followed him advocate an alternative theory of corporate financial behavior, known as the "new view."²⁴ Under this theory, a mature corporation, defined as one with positive cash flow, pays dividends equal to its business cash flow and issues no new equity:

$$(20) \quad \begin{aligned} DIV_t &= Y_{K,t} - I_t; \\ RETAIN_t &= I_t - \delta K_t; \\ ISSUE_t &= 0. \end{aligned}$$

Since increases in I result in one-for-one increases in *RETAIN* and decreases in *DIV*, with no change in *ISSUE*, retained earnings (foregone dividends) are the marginal source of finance for new investment.

Under this theory, the tax imposed on equity holders equals

$$(21) \quad T_t = \tau_d DIV_t + \tau_r RETAIN_t \\ = \tau_r (Y_{K,t} - \delta K_t) + (\tau_d - \tau_r)(Y_{K,t} - I_t).$$

The tax combines a net-capital-income tax with effective rate τ_r and a cash-flow tax with effective rate equal to $(\tau_d - \tau_r)$, the “extra” tax on dividends. Under the new view, the extra dividend tax is a deferred tax. Since new investment is financed by retained earnings (a reduction in dividends), a tax savings of $(\tau_d - \tau_r)$ is received at the time of investment. The subsequent output is distributed as dividends, in accordance with Equation 20, on which taxes are imposed. This tax timing—an initial tax savings offset by subsequent tax payments—is similar to that of the consumption tax and front-loaded investment incentives.

Under the new view, only the tax on retained earnings (capital gains) is a net-income tax that distorts investment. The extra tax on dividends is a business-cash-flow tax that leaves investment undistorted but reduces the value of capital to $1 - \tau_d + \tau_r$. The combined effect of income tax repeal and introduction of a consumption tax at rate τ_c is to change the capital stock’s value by $(\tau_d - \tau_r - \tau_c)$. The real value of existing capital may even increase, depending on the tax rates.

Although the new view is a theoretically appealing description of the behavior of mature corporations with positive business cash flow, its validity remains controversial. Zodrow (1991) reports that some empirical evidence favors the old view, while Auerbach and Hassett (2000) report evidence favoring the new view. Zodrow discusses the difficulty of conclusively testing the two theories, particularly in light of additional modifications (not considered here) that can be made to each, including models of the interaction of equity and debt finance.

EXTENSION 3: ADJUSTMENT COSTS

Incorporating more realistic assumptions about production generally (but not always) mitigates the decline in value implied by the simplified analysis.²⁵

The simplified analysis assumes the supply of capital is infinitely elastic because unlimited amounts of each type of capital can be produced and installed at constant cost (in terms of consumption). It is more realistic to assume that capital’s marginal production cost rises when economy-wide production increases. Also, some evidence suggests adjustment costs exist at the

firm level, causing the marginal installation costs of capital at each firm to rise when the firm installs more capital. Since both forces have similar implications when investment increases throughout the economy, I discuss them together and refer to them as adjustment costs.²⁶

As discussed previously, tax reform is likely to cause the aggregate capital stock to expand, so that the equilibrium pretax rate of return is reduced. With adjustment costs, this expansion is associated with a rise in the cost of capital goods, which mitigates the decline in value for existing capital. Adjustment costs also restrain the expansion of the capital stock.

With adjustment costs, the pretax rate of return equals $(F_K + \dot{q})/q - \delta$ rather than $F_K - \delta$, where q is pretax replacement cost and the dot denotes rate of change. Dividing by q is necessary because q units of consumption must be sacrificed to obtain one unit of capital. Adding the change in q is necessary to reflect the capital gain (or loss) earned by holding capital. The first-order conditions for investment under income and consumption taxation are (respectively)

$$(22) \quad \frac{F_{K,t} + \dot{q}_t}{q_t} = \delta + \frac{r}{1 - \tau_{y,t}},$$

and

$$(23) \quad \frac{F_{K,t} + \dot{q}}{q_t} = \delta + r,$$

rather than Equations 6 and 12. If the after-tax required return r remains constant, the pretax return still declines after tax reform, but a decline in F_K is now only part of the likely response (and is smaller because the capital stock does not expand as much). Another part is a rise in q (and still another is a negative value of \dot{q} since the increase in q following tax reform is likely to decay over time). Ignoring the income tax deferral considered above, each unit of capital is still valued at q under the income tax and $(1 - \tau_c)q$ under the consumption tax. However, this no longer implies a proportional decline of τ_c , because q is higher under the consumption tax.

Note that the increase in investment and the resulting rise in q are due to the repeal of the income tax rather than the introduction of the consumption tax. If a consumption tax is introduced as a supplement to the income tax (or as a replacement for a wage tax), the value of existing capital is still likely to decline by a proportion equal to the consumption tax rate, as in the simplified analysis. Similarly, if the consumption tax rate is subsequently raised to meet

increased revenue needs, the real value of existing capital is still likely to decline by a proportion equal to the rate increase.

In the simplified analysis, the decline in value is always τ_c , regardless of the response of r to tax reform; if r rises, it simply dampens the decline in F_K . With adjustment costs, however, an increase in r dampens the rise in q as well as the decline in F_K . If after-tax rates of return rise, the decline in value of existing capital is greater than it would otherwise be.

The extreme form of adjustment costs occurs when adjustment is impossible and the quantity of capital is fixed; additional units cannot be produced at any cost and the existing units cannot be converted back into consumption. If all types of capital are in fixed supply and changes in labor supply are unimportant, the marginal product of capital is unchanged by tax reform. Consider the standard example, in which $\delta = 0.08$ and $r = 0.04$ both before and after tax reform. With no adjustment costs, the marginal product declines from 0.13 to 0.12 and the value falls from 1 to 0.75. But if capital is in fixed supply and the marginal product remains unchanged at 0.13, the value of each unit of capital is

$$\int_{t=0}^{\infty} \exp(-.04t)[(.75)(.13)]\exp(-.08t)dt \\ = \frac{.75(.13)}{.12} = .81$$

and the decline in value is 19 percent rather than 25 percent. If some adjustment costs are present, but capital is not in fixed supply, an intermediate outcome occurs. Also, if tax reform raises the required after-tax return, the decline in value is greater than 19 percent, even under the fixed-supply assumption.

Adjustment costs have opposite implications for lightly taxed types of capital. Consider a system in which some types of capital face effective tax rates of 30 percent and others face effective rates of zero. If the after-tax rate of return is initially 0.04, pretax rates of return are 0.057 for the former and 0.04 for the latter. If tax reform causes the after-tax rate of return to rise to .045, the stock of the heavily taxed capital expands until its pretax rate of return falls from 0.057 to 0.045, while the stock of the untaxed capital contracts until its pretax rate of return rises from 0.04 to 0.045. The untaxed capital does not benefit from tax reform, and it is crowded out by the rise in after-tax interest rates.

Therefore, untaxed (or lightly taxed) types of capital are likely to contract rather than expand after tax reform. All of the above analy-

sis is then reversed. Adjustment costs reduce the replacement cost of these types of capital, reinforcing any decline in the value of existing capital. As noted above, consumer and government capital is not taxed, while many types of intangible capital face effective tax rates of zero because they are expensed. This analysis is likely to apply to these types of capital.²⁷

POTENTIAL MAGNITUDES OF EFFECTS

This section combines the various extensions discussed above and incorporates them into the simplified analysis. The aggregate decline in value is smaller than the simplified analysis suggests, but its distribution is less uniform.

Table 3 summarizes the possible impacts for five categories of capital. (Even so, the analysis is somewhat aggregated; the actual impact may vary significantly across different types of capital within each category.) The consumption tax rate is assumed to be 25 percent. Column A lists the percentage declines that apply when there is no income tax deferral and no adjustment costs. Column B lists the modification attributable to front-loaded investment incentives. Column C lists the modification attributable to adjustment costs; due to uncertainty about the magnitude, only the sign of the effect is reported. Column D combines columns A through C. Column E states the appropriate modification if the new view is valid, and column F combines that modification with column D.

The first row refers to consumer and government capital. Column A shows zero because this capital is exempt from the cash flow tax. The entry in column B is also zero because this capital does not receive any front-loaded investment incentives. Its preferential treatment under the current income tax consists of facing a zero tax rate at every stage of its life.

Column C reports a negative effect because consumer capital and government capital are exempt from income tax and are likely to contract after tax reform, as discussed above. Congressional Budget Office (1997, 45–46) and Gravelle (1996b) survey the literature on possible reductions in value of the largest category of consumer capital, owner-occupied homes. Allowing for some increase in after-tax interest rates, Gravelle estimates that homes would decline in value by about 22 percent under the extreme assumption that they are in fixed supply. With more realistic assumptions about the magnitude of adjustment costs, however, she concludes that the decline may be as low as 9 percent.

Table 3

Summary of Transition Effects on Real Value of Capital

Percentage change in value from replacement of income tax with 25 percent consumption tax

	(A) Simplified analysis*	(B) Front-loaded investment incentives	(C) Adjustment costs	(D) Net effect (if old view is valid)	(E) Additional effect (if new view is valid)	(F) Net effect (if new view is valid)
Consumer and government capital	0	0	< 0	< 0	0	< 0
Tangible capital except equity-financed mature corporation	-25	8	> 0	> -17	0	> -17
Tangible capital, equity-financed mature corporation	-25	8	> 0	> -17	25	> 8
Intangible capital except equity-financed mature corporation	-25	35	< 0	< 10	0	< 10
Intangible capital, equity-financed mature corporation	-25	35	< 0	< 10	25	< 35

* Modified to reflect special treatment of consumer and government capital.

The entry in column E is zero because the new view is inapplicable to noncorporate capital, including consumer and government capital. The net impact shown in columns D and F is a value decline whose magnitude depends on adjustment costs.

The next two rows refer to tangible capital, such as plant and equipment. The first of these rows refers to investment for which the new view is inapplicable. This includes debt-financed corporate investment, equity-financed investment by immature corporations with negative cash flow, and investment by noncorporate firms (proprietorships, partnerships, and limited liability companies) and S corporations that are taxed in the same manner as noncorporate firms. The other row refers to investment for which the new view (if valid) is applicable, which is equity-financed investment by corporations (other than S corporations) with positive cash flow.

Under the simplified analysis, the value of tangible capital declines by 25 percent, as shown in column A. However, this type of capital has deferred tax liabilities due to accelerated depreciation and other front-loaded investment incentives. Following Auerbach (1996, 51), I assume these incentives reduce the value of this capital by an average of 8 percent and enter this number in column B.

I report a positive effect in column C, since this type of capital should expand after tax reform and adjustment costs should increase its value. The magnitude is highly uncertain. Auerbach (1996, 62) estimates an increase of about 10 percent under one assumption about adjustment costs but notes that a smaller or

larger increase is possible.

The combined effect shown in column D is a decline in value of less than 17 percent. An increase is possible if adjustment costs are quite large.

For equity-financed investment by mature corporations, the net impact is more favorable, if the new view is valid. This is the category Koenig and Huffman (1998) consider. Following their assumption that dividends are taxed at 25 percent and capital gains at zero, I enter 25 percent in column E. The net impact is an increase in value of more than 8 percent. If the old view is valid, this adjustment does not apply.

The last two rows refer to intangible capital, again distinguishing between capital for which the new view (if valid) is applicable and that for which it is inapplicable. The initial impact is 25 percent. Because this capital is expensed, it is currently devalued by a proportion equal to the income tax rate. I enter 35 percent, the top corporate income tax rate, in column B. The adjustment-costs effect is negative since, as explained above, tax reform is likely to reduce investment in this capital. The net impact is an increase in value of less than 10 percent. The value may decline if adjustment costs are sufficiently large. For equity-financed investment by mature corporations, the net impact is an increase in value of less than 35 percent, if the new view is valid.

These estimates do not include front-loaded saving incentives. The removal of the income tax (and penalty) on withdrawals from employer pension plans and tax-deferred accounts constitutes an increase in value that should be added to the numbers in Table 3.

CONCLUSION

Replacing income taxation with consumption taxation would have wide-ranging effects on the value of the capital stock. A simple result can be obtained by assuming that the income and consumption taxes have stylized forms and that capital goods can be produced at constant cost (with no adjustment costs). In this simplified analysis, the real value of existing capital would decline by a proportion equal to the consumption tax rate. This decline would occur because existing capital would be treated less favorably than new investment. The harm to owners of existing capital would be mitigated because income tax repeal would increase after-tax rates of return.

However, under a more realistic specification of the consumption tax, consumer and government capital would receive preferential treatment that would allow them to escape this value decline. Also, under more realistic assumptions about income tax design and the production process, income tax repeal would offset part of the negative impact from the introduction of the consumption tax. Income tax repeal would enhance the value of business capital by forgiving deferred tax liabilities. Repeal would also increase investment in many types of business capital, which, in the presence of adjustment costs, would drive up the value of existing capital. However, repeal would reduce investment in consumer and government capital and some lightly taxed forms of business capital, which would drive down their real value.

The net result is that the decline in the real value of existing capital is smaller and less uniform than the simplified analysis suggests. Some types of capital might even rise in value. The reduced overall impact on the real value of capital weakens the argument for broad transition relief. However, the uneven nature of the effects might support an argument for targeted relief for types of capital that are more adversely affected. Uncertainty about the magnitude of adjustment costs and the appropriate theory of corporate financial behavior complicates decisions on transition policies.

The analysis in this article offers an incomplete description of the transition. The distribution of the wealth decline depends on how tax reform affects the real value of outstanding debt. What are the relative effects on stockholders and bondholders? When owner-occupied homes decline in value, is the loss borne fully by the owners, or do mortgage lenders bear part of the loss? In Part 2, I address these issues.

NOTES

I am grateful to Mark Wynne, Mine Yücel, Gregory Huffman, and V. Brian Viard for extremely helpful comments and to Monica Reeves for careful editing.

- ¹ Many authors discuss this result, including Bradford (2000, 319–25), Lyon (1990), Sandmo (1979), Johansson (1969), and Samuelson (1964).
- ² See Koenig and Huffman (1998, 31), Gentry and Hubbard (1997, 8), Gravelle (1996a, 1427), Joint Committee on Taxation (1995, 57), and Auerbach and Kotlikoff (1987, 133).
- ³ I express the tax rate in a tax-inclusive manner rather than the tax-exclusive manner in which retail sales tax rates are usually expressed. For example, the sales tax rate is usually said to be 33.33 percent if a \$33.33 tax is imposed on a consumption good with a pretax price of \$100 and an after-tax price of \$133.33. I refer to this levy as a 25 percent tax (τ_c equals 25 percent) because the tax is 25 percent of the after-tax price. The tax-inclusive approach is consistent with the manner in which income tax rates are stated. Koenig (1999, 685), Gale (1999, 443–44), Gillis, Mieszkowski, and Zodrow (1996, 730, note 17), and Joint Committee on Taxation (1995, 54, note 83) discuss the relationship between tax-exclusive and tax-inclusive rates.
- ⁴ A time-varying consumption tax rate is distortionary because it penalizes investment in years when the tax rate is temporarily low. Time-varying rates generally pose greater difficulties for consumption taxes than for income taxes. See Bradford (2000, 311–31) and Auerbach and Kotlikoff (1987, 62, 83–87).
- ⁵ Estimates of the revenue-neutral consumption tax rate include 21.8 percent (Koenig 1999, 697); 27.7 percent (Gale 1999, 455, replacing excise as well as income taxes and allowing for tax avoidance and evasion and base erosion); 25.2 percent to 25.7 percent (Ventura 1999, 1445, imposing revenue neutrality only in steady state); and 21.4 percent (Feenberg, Mitrusi, and Poterba 1997, 75). The Treasury Department has also estimated a revenue-neutral rate of about 25 percent. Gilles, Mieszkowski, and Zodrow (1996, 763) make a similar estimate.
- ⁶ Bradford (2000, 71–72, 91–92), Gentry and Hubbard (1997, 6), Congressional Budget Office (1997, 29), and Joint Committee on Taxation (1995, 58, note 94) discuss the taxation of pure profits. Also, in an economy with uncertainty, the returns from various risky investments may be higher or lower than the return on a safe investment. Under the income and consumption taxes, the government shares in these surpluses and shortfalls in the proportions τ_y and τ_c , respectively. The market value of the surpluses and shortfalls is zero, as Bradford (2000, 93; 1996, 129) and Gentry and Hubbard (1997, 7–9) explain. Also, see Joint Committee on Taxation (1995, 94–99).
- ⁷ Abel et al. (1989) demonstrate that business cash flow has been consistently positive in the United States. If it

were consistently negative, more resources would be devoted to producing capital than were produced by it. Such an economy would be considered dynamically inefficient because it could increase both current and future consumption by reducing its capital stock.

⁸ Bradford (2000, 68), Koenig and Huffman (1998, 26), Gentry and Hubbard (1997, 5), Congressional Budget Office (1997, 66), Auerbach (1996, 30–31), and Joint Committee on Taxation (1995, 55) note this equivalence.

⁹ See Bradford (2000, 80, 99), Diamond and Zodrow (1999, 25), Lyon and Merrill (1999, 308), Hall (1997, 147), Congressional Budget Office (1997, 66), Auerbach (1996, 47) and Gravelle (1996a, 1443). These authors differ in the extent to which they acknowledge the qualifications to this conclusion that I address in the text when I modify the simplified analysis. Lewis and Seidman (2000, 100), Gentry and Hubbard (1997, 10–11), Feenberg, Mitrusi, and Poterba (1997, 85), Gillis, Meiszkowski, and Zodrow (1996, 747), Joint Committee on Taxation (1995, 84), and Auerbach and Kotlikoff (1987, 62, 79) also note in more general terms that the adoption of a consumption tax reduces the real value of existing wealth.

¹⁰ Lewis and Seidman (2000), Diamond and Zodrow (1999, 26), Congressional Budget Office (1997, 67), Gentry and Hubbard (1997, 11), Feenberg, Mitrusi, and Poterba (1997, 85), Gillis, Mieszkowski, and Zodrow (1996, 748), Auerbach (1996, 60), Bradford (1996, 139–40), and Joint Committee on Taxation (1995, 87) note the effects of higher after-tax returns. In the text, I consider households that experience a wealth decline equal to the 25 percent reduction in the value of the capital stock (aggregate wealth). Recall that this article does not address how the wealth decline is divided between debt and equity holders or household lenders and borrowers. I will explain in Part 2 that wealth changes may vary greatly across households with different portfolios.

¹¹ A related approach maintains the cash-flow tax but gives each unit of existing capital offsetting rebates with a present value of τ_c . This may be done through an immediate rebate of τ_c or, as Bradford (2000, 327–28) discusses, a permanent stream of rebates equal to $\tau_c(\delta + r) \exp(-\delta t)$ in year t . The rebate approach differs from the wage-tax option only in taxing any future pure profits and maintaining the appearance of a tax on capital.

¹² Bradford (2000, 110; 1996, 143) discusses the relative treatment of long-lived and short-lived capital under this transition policy.

¹³ The federal government also holds capital. It is economically irrelevant, however, whether the federal government taxes itself on this capital. Capital held by nonprofit organizations would also receive preferential treatment under the major consumption tax proposals, and the analysis in the text generally applies to this capital.

¹⁴ If homeowners perform their own services, their imputed wages are also exempt from income tax and proposed consumption taxes. This exemption distorts the allocation of labor but has no implications for the valuation of capital.

¹⁵ This statement assumes that state and local governments make their investment decisions using the same profit-maximization criteria as private firms. In reality, their decisions may be affected by a variety of political factors.

¹⁶ Some argue that the difficulty of measuring these imputed service flows is a disadvantage of the consumption tax. The opposite is true, since the exemption of these flows causes capital misallocation under the income tax but not under the consumption tax. Capital income must be measured to be taxed at a positive rate but need not be if it is to be taxed at a zero effective rate, which is the objective of the consumption tax. See Bradford (2000, 10–12, 94–95).

¹⁷ Bradford (2000, 107; 1996, 140), Lewis and Seidman (2000, 100), Diamond and Zodrow (1999, 25), Hall (1997, 149), Congressional Budget Office (1997, 66–67), and Sullivan (1996, 342) note that consumer capital escapes the decline in value that affects other capital. In the absence of special rules, the preferential treatment applies to capital consumers and governments own on the reform date, regardless of subsequent transactions. For example, housing that is owner-occupied on that date still benefits, even if it is converted to rental use the next day; although subsequent rental payments are taxed, an immediate deduction equal to the home's value is granted because the conversion is treated as new investment. Conversely, housing used for rental on the reform date does not benefit, even if it is converted to owner use the next day; although the owner's subsequent imputed rental income is exempt, an immediate tax is imposed on the home's value because the conversion is treated as disinvestment and consumption.

¹⁸ This equivalence follows because

$$.4 \int_{t=5.776}^{\infty} \exp(-.12t) dt = .2 \int_{t=0}^{\infty} \exp(-.12t) dt.$$

Note that $\exp[-(5.776)(.12)]$ equals 0.5.

¹⁹ If firms can convert a unit of older capital back into one unit of consumption without any tax liability, the value of this capital cannot fall below unity. Indeed, no older capital remains in existence since all firms make such conversions. To prevent this outcome, the tax system must require the firm to pay a tax of 0.083 units to recapture the benefits of the earlier tax-free period. Under the federal income tax, most front-loaded investment incentives are accompanied by recapture taxes. Since the tax law often allows firms that purchase existing capital from other firms to claim the same front-loaded benefits as if they had produced new capital, it also imposes recapture taxes on selling firms to prevent tax-motivated sales. Auerbach and

Kotlikoff (1983, 129–36) describe U.S. recapture taxes then in place.

²⁰ Under the tax law, each owner of a sole proprietorship, partnership, limited liability company, or small (S) corporation pays individual income tax on his or her share of the firm's income. The front-loaded investment incentives discussed in the text are used in computing each owner's tax liability. Each corporation (other than an S corporation) pays a firm-level corporate income tax on its taxable income, and (as discussed in the text below) each of its shareholders also pays individual income tax on his or her dividends and capital gains. The front-loaded investment incentives are used to compute the corporate income tax but not the shareholders' individual income taxes. Auerbach and Kotlikoff (1987, 131–35; 1983) discuss the effects of front-loaded investment incentives on the value of capital. Lyon and Merrill (1999, 307), Diamond and Zodrow (1999, 26), Gillis, Mieszkowski, and Zodrow (1996, 748), Bradford (1996, 137), Auerbach (1996, 36), and Joint Committee on Taxation (1995, 84–85) discuss the resulting implications for the transitional effects of tax reform.

²¹ Nondeductible IRAs and tax-deferred annuities also receive front-loaded incentives. Lewis and Seidman (2000, 100), Gillis, Mieszkowski, and Zodrow (1996, 747), and Auerbach (1996, 38, 69) discuss the transitional effects of front-loaded savings incentives.

²² Lewis and Seidman (2000, 100), Congressional Budget Office (1997, 67), and Gillis, Mieszkowski, and Zodrow (1996, 747) discuss the transitional implications of accrued capital gains.

²³ The analysis in this section does not apply to investment by S corporations, noncorporate firms, or consumers and governments.

²⁴ Sinn (1991a; 1991b) thoroughly discusses the new view. Congressional Budget Office (1997, 67), Gentry and Hubbard (1997, 39), Gillis, Mieszkowski, and Zodrow (1996, 748), and Auerbach (1996, 37, 69) note its implications for the transitional effects of tax reform. Koenig and Huffman (1998) assume the validity of the new view in their analysis.

²⁵ If new investments are imperfect substitutes for old capital because they incorporate different technologies, the decline in value of existing capital is also mitigated. In the standard example, when tax reform reduces the marginal product of new capital from 0.13 to 0.12, I assume the marginal product of existing capital falls by the same amount, which (along with the increase in its tax payments) causes its value to decline. However, if the two vintages of capital are not perfect substitutes, the expansion of new investment may not drive down the return on existing capital to the same extent.

²⁶ Bradford (2000, 104–5; 1996, 138), Huffman and Koenig (1998, 27–29), Lyon and Merrill (1999, 307–09), Diamond and Zodrow (1999, 26), Gentry and Hubbard

(1997, 41), Congressional Budget Office (1997, 67), and Auerbach (1996, 48, 61–63) discuss the implications of adjustment costs for the transitional effects of tax reform.

²⁷ Bradford (2000, 105, 107; 1996, 138, 140), Hall (1997, 149–50), Gentry and Hubbard (1997, 12, 43), and Joint Committee on Taxation (1995, 85) discuss the effects of tax reform on lightly taxed capital.

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Gasoline and Crude Oil Prices: Why the Asymmetry?

Stephen P. A. Brown and Mine K. Yücel

The available evidence suggests that asymmetry is unlikely to be the result of monopoly power exercised by large, integrated oil companies.

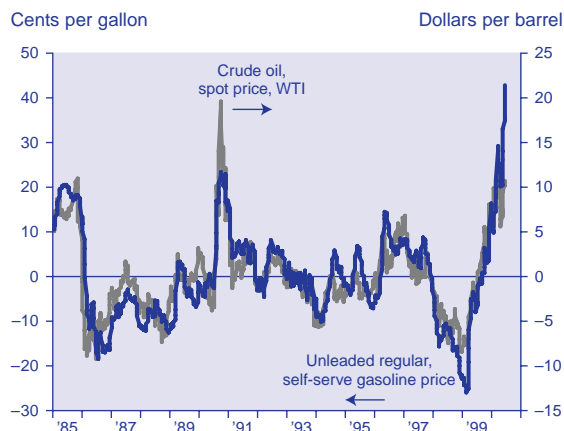
The United States consumes 8.5 million barrels of gasoline daily—nearly half its daily consumption of all petroleum products. The average automobile tank is filled weekly, and gasoline prices are posted at every street corner where there is a gasoline station. Consequently, most U.S. consumers are very aware of movements in gasoline prices and closely observe the asymmetry when crude oil and gasoline prices fluctuate. Many consumers complain that gasoline prices rise more quickly when crude oil prices are rising than they fall when crude oil prices are falling, exhibiting an asymmetric relationship.¹ To the naked eye, movements in spot crude oil and retail gasoline prices may lend some credence to consumers' complaints (*Figure 1*).

Furthermore, in some instances when gasoline prices have risen sharply and swiftly following a rise in crude oil prices—such as occurred in 1999 and 2000 and during the Gulf War in 1990—consumers and politicians have called for policies to put a stop to what is seen as unfair pricing practices for petroleum products.² Such reactions seem to stem from a popular suspicion that large, integrated companies have monopolized the oil industry. The public seems to take the asymmetric relationship between gasoline and crude oil prices as evidence that the petroleum industry is monopolistic.

Most of the previous research on the subject confirms at least part of what consumers suspect: it provides econometric evidence of an asymmetric relationship between gasoline and crude oil prices. This article extends inquiry into the issue by considering competing explanations for the asymmetry. The available evidence

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Figure 1
Detrended Crude Oil and Retail Gasoline Prices



SOURCES: Department of Energy; Haver Analytics.

suggests that asymmetry is unlikely to be the result of monopoly power exercised by large, integrated oil companies. An examination of the possible explanations for the asymmetry also suggests that government intervention to prevent the asymmetry between gasoline and crude oil prices is likely to reduce economic efficiency.

THE EVIDENCE FOR ASYMMETRY

Most of the previous research provides econometric support for public claims that gasoline prices rise more quickly when crude oil prices are rising than they fall when crude prices are falling. Bacon (1991) finds asymmetry for the UK gasoline market. Karrenbock (1991); French (1991); Borenstein, Cameron, and Gilbert (1997); Balke, Brown, and Yücel (1998); and a GAO report (1993) all find some evidence for an asymmetric response in U.S. gasoline markets.³ In contrast with the other studies, Norman and Shin (1991) find a symmetric response in U.S. gasoline markets.

Of these studies, one of the most visible and comprehensive is that of Borenstein, Cameron, and Gilbert (1997), hereafter identified as BCG. They use weekly and biweekly data from 1986 to 1992 in a series of bivariate error-correction models to test for asymmetry in price movements between gasoline's various stages of production and distribution—from crude oil through the refinery to the retail pump. They find strong and pervasive evidence of asymmetry in all segments of the market.

Shin (1992) argues, however, that the periodicity of the data, the sample period of estimation, and the model specification may affect the results obtained in various studies. To examine the issues that Shin raises, Balke, Brown, and Yücel (1998), hereafter identified as BBY, extend the work of BCG by using several different model specifications and various subsamples of weekly data from 1987 through early 1996. BBY confirm BCG's supposition that most of the price volatility originates upstream (in or closer to markets for crude oil) rather than downstream (in or closer to final consumer markets). They also find that asymmetry is sensitive to model specification but not to sample period. With their most preferred specification, however, BBY find evidence that asymmetry is pervasive across the stages of gasoline production and distribution.

For example, BBY find retail gasoline prices initially rise sharply after the crude oil price rises and then increase more gradually, as

shown in Panel 1 of Figure 2. In contrast, retail gasoline prices respond only gradually to a falling crude oil price (Panel 2). The net effect is an asymmetric response in gasoline prices (Panel 3). Retail gasoline prices respond more quickly when crude oil prices are rising than when they are falling.

EXPLANATIONS OF ASYMMETRY

With a number of studies showing that gasoline prices respond more quickly when crude oil prices rise than when they fall, economists have offered numerous explanations for the phenomenon.⁴ Explanations include market power, search costs, consumer response to changing prices, inventory management, accounting practices, refinery adjustment costs, and the behavior of markups over the business cycle. For the gasoline markets, however, no one has posited a formal econometric test that would allow the testing of the various explanations—including market power—for price asymmetry against the available data. In the absence of such tests, judgment and economic theory must be used to sort through the explanations and determine whether the asymmetric response of gasoline prices to movements in crude oil prices is the result of market power or more benign forces.

Market Power

Market power is probably the greatest concern to those who observe that gasoline prices respond more quickly when crude oil prices rise than when they fall. For the banking industry, Neumark and Sharpe (1992) show that market concentration is an explanatory variable for the asymmetry found in interest rate movements. In a comprehensive study of U.S. industry, however, Peltzman (2000) finds no evidence that market power is related to price asymmetry. In addition, neither we nor Peltzman could find a theoretical model that relates market power to an asymmetric response of downstream prices to changes in upstream prices.⁵ Were such a model to exist, it might involve consumer search costs or firms concerned with maintaining a tacit collusion or both.

Consider an industry with a few dominant firms that are engaged in an unspoken collusion to maintain higher profit margins. Reputation can be important to maintaining such a tacit agreement (Tirole 1990). If the firms value the agreement and have imperfect knowledge of the upstream prices their competitors are paying, each firm would face an asymmetric loss

function where it would be more reluctant to lower its selling price than to raise it. When upstream prices rise, each firm is quick to raise its selling price because it wants to signal its competitors that it is adhering to the tacit agreement by not cutting its margin. When the upstream price falls, each firm is slow to lower its selling price because doing so runs the risk of sending a signal to its competitors that it is cutting its margin and no longer adhering to the tacit agreement. In the gasoline markets, such an explanation could be applied to each upstream price and its adjacent downstream price.

Despite popular wisdom and an explanation linking concentration to the asymmetry between movements in crude oil and gasoline prices, there does not appear to be much evidence of monopolization in any segment of the gasoline market. The United States consumed 123 billion gallons of gasoline in 1996. The market share claimed by the four largest gasoline refiner/marketers (37.7 percent), as well as a relatively low Herfindahl–Hirschman Index of 650, suggests that U.S. gasoline production is competitive when viewed at the national level.⁶

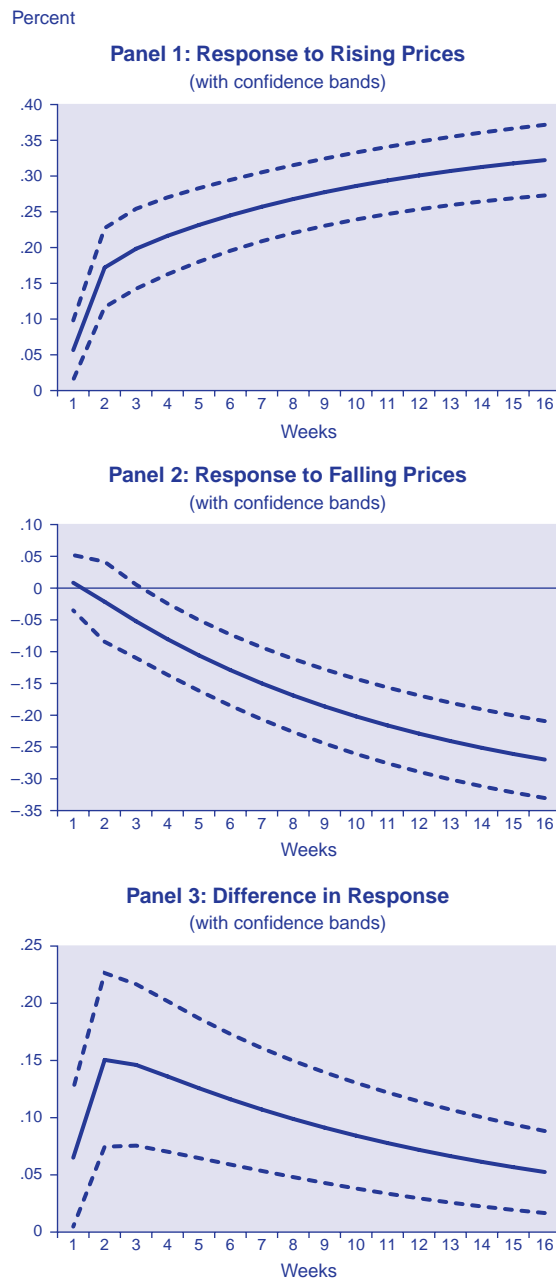
Because refined products are harder and more expensive to ship than crude oil, however, gasoline markets tend to be regionalized. In addition, regional variation in the environmental regulation of gasoline formulation may be increasing the regionalization of gasoline markets. Furthermore, changes in technology and environmental regulation have caused some smaller refiners to go out of business and increased the market share of the remaining refiners—most notably in California, where the clean air rules are more stringent than the national average and the number of refiners has decreased (from 31 in 1990 to 23 in 1996).

If gasoline markets were strictly regional, the number of refiners serving a region would be limited by the size of the regional market and economies of scale. In those regions with a few refiners, market power would be a possibility. Nonetheless, gasoline shipments between regions seem sufficient to establish workable competition in most areas, and in most regions of the country one can find a number of competing brands of gasoline.

The case for market power also seems difficult to make for the retail sector. In rural areas and small towns, regional monopolies could exist, and gasoline stations have often been cited as examples of monopolistic competition. But, the sheer number of retail gasoline stations makes complete monopolization unlikely. The United States had 190,246 retail

gasoline outlets in 1996. Of these, 114,452 were branded outlets (that is, they sold brand-name gasoline) belonging to 21 companies with at least 1,000 outlets each. Citgo, a subsidiary of the Venezuelan PDVSA, had the most retail outlets, with 14,529 in 48 states; Texaco came in second with 13,785 outlets in 25 states. The top six companies had 55 percent of the branded market and 33 percent of the total retail market, none of which provides strong evidence of

Figure 2
Asymmetric Response of Retail Gasoline Prices to Movements in Crude Oil Prices



SOURCE: Balke, Brown, and Yücel (1998).

Components of the Retail Gasoline Price

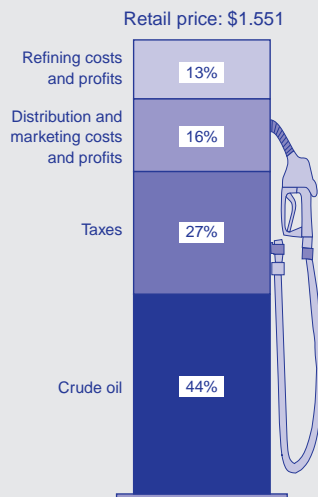
The cost to produce and deliver gasoline to consumers includes the cost of crude oil to refiners, refinery processing costs, marketing and distribution costs, and retail station costs and taxes. In July 2000 crude oil costs made up 44 percent of the total cost of gasoline. Refining costs and profits were 13 percent, and distribution, marketing, and retail costs were 16 percent.

Federal and state taxes (not including county and local taxes) were 27 percent of the total price, on average. Both federal and state taxes have been increasing in the past two decades. After staying constant at 4 cents per gallon until 1983, federal taxes rose gradually to 18.4 cents per gallon by 1994, where they have remained. State taxes have increased steadily from the 1920s to the current rate of 19.96 cents.

SOURCE: Energy Information Administration, Office of Oil and Gas, online publication "A Primer on Gasoline Prices."

What Do We Pay For in a Gallon of Regular Grade Gas?

(July 2000)



car consumes 504 gallons of gasoline per year. For a person filling up the tank every week, that comes to 9.7 gallons per week. The price differential between gasoline stations is usually not more than a couple of cents. If the difference were 10 cents (which is much higher than average), it would amount to 97 cents per week, about the price of a cup of coffee, which is likely to be less than the value of the time used in an aggressive search for lower-priced gasoline.⁸

More Benign Explanations

Beyond market power and search costs, economists have offered a number of explanations for the asymmetric response of gasoline prices to movements in crude oil prices. Alternative explanations include markups that vary over the business cycle, consumer response to changing prices, inventory management, accounting practices, and refinery adjustment costs. Other than the variation in markups over the business cycle, none of the explanations can be ruled out on either theoretical or empirical grounds.

If markups vary over the business cycle, the difference between the crude oil and retail gasoline price could increase as overall prices rise. Reagan (1982) and Reagan and Weitzman (1982) offer a theoretical explanation for such a relationship based upon the variation in demand over the business cycle. Haltiwanger and Harrington (1991) further suggest that the fluctuations in margins may result from variations in the degree of collusive behavior. However, BBY find that the shocks to crude oil and gasoline prices originate with supply rather than demand, which renders the explanation inapplicable.

The consumer response to changing gasoline prices may contribute to the asymmetry between movements in crude oil and gasoline prices at the retail level. If consumers accelerate their gasoline purchases to beat further increases when its price is rising, they will increase inventories held in automobiles and quicken the pace at which the price rises. If drivers fear running out of gasoline and do not slow their purchases when its price is falling by as much as they accelerated their purchases when prices rose, the price of gasoline will fall more slowly than it rose.

Similarly, firms in the oil industry may view the short-run costs of unexpected changes in their inventories as asymmetric (see BCG). If operation costs rise sharply when inventories are reduced below normal operating levels, a reduction of upstream supply could lead a firm to raise its output prices aggressively to prevent a

market concentration or market power. Nonetheless, Borenstein and Shepard (1993) find some evidence of coordinated pricing in a study using data from 1986–91 for 59 U.S. cities.

Limited Market Power and Search Costs

In the retail gasoline market, consumer search costs could lead to temporary market power for gasoline stations and an asymmetric response to changes in the wholesale price of gasoline. (See BCG, Norman and Shin 1991, Borenstein 1991, Deltas 1997, and Peltzman 2000.) Each gasoline station has a locational monopoly that is limited by consumer search. After consumers have searched, the profit margins at each gasoline station are pushed down to a roughly competitive level. When wholesale prices rise, the owner of each station acts to maintain profit margins and quickly passes the increase on to customers.⁷ When wholesale prices fall, however, each station temporarily boosts its profit margins by slowly passing the decrease on to customers. Only after the customers engage in a costly and time-consuming search to find the lowest prices are the stations forced to lower prices to a competitive level.

A factor slowing the search process is that the costs of an intensive search are likely to be much higher for most consumers than the corresponding gains from finding a cheaper price for gasoline. The money saved is a very small part of the consumer's budget, so that consumers will not search unless the price differential is very high. How large is this differential for the average consumer? The average passenger

loss of inventories. If an increase in inventories above normal operating levels has a relatively small effect on costs, the firm could be less aggressive in reducing its selling prices when it experiences an increase in upstream supply. Hence, inventories would buffer downstream price movements less when prices are rising than when they are falling.

If oil supply shocks cause asymmetric movements in inventories—with higher inventories when oil supply is plentiful and lower inventories when oil supply is reduced—the asymmetry of price movements could be enhanced by FIFO (first in, first out) accounting. If inventories are lower when upstream supply is reduced, the firm will sell the products incorporating the higher upstream price sooner. If inventories are higher when upstream supply is increased, the firm will sell the products incorporating the lower upstream price later. These actions help foster asymmetric pricing.

Refiners also face adjustment costs to changing their output or their product mix and, consequently, adjust their output slowly when possible. When crude oil supplies are reduced, refiners as a group have little choice but to reduce output quickly, which would lead to fairly quick increases in gasoline prices. When crude oil supplies are increased, however, refiners don't necessarily have to increase output quickly. They can increase output slowly and delay the decreases in gasoline prices.

THE POLICY RESPONSE

If we adhere to the traditional view that economic policy should be directed only at market failures or imperfections, policy probably should not be directed at eliminating the asymmetry between crude oil and retail gasoline prices. The evidence of monopolization in refining and wholesale markets for gasoline is weak at best. Peltzman (2000) finds that asymmetry itself is not indicative of a monopolized market. Any market power that might exist at the retail level appears to be related to the costs of product differentiation—most likely in the form of locational differences.

Furthermore, Peltzman finds that an asymmetric relationship between an upstream and a downstream price is as likely in competitive markets as in markets thought to be monopolized. If competitive market forces and asymmetry coexist, steps to suppress or eliminate the asymmetry are likely to prove costly because government interference in natural market processes typically reduces economic efficiency.⁹

If the monopolization of gasoline markets is a concern, policies will be more effectively directed at monopolization than at market phenomena that can be the result of either competitive or monopolized markets.

Refining and Wholesale Markets

Because there is little evidence of monopolization in the refinery and wholesale markets for gasoline, the observed asymmetry between wholesale gasoline and crude prices is most likely the result of competitive market forces. Calculations based on the BBY estimates also suggest the degree of asymmetry of response in wholesale gasoline prices to changes in crude oil prices is quite small and of short duration. Given a 1 percent increase and a 1 percent decrease in the crude oil price, the difference in response of wholesale gasoline to these changes is only 0.35 percent and persists only for two weeks. The asymmetry of response in wholesale gasoline prices starts around the third week and becomes insignificant around the fifth week. If competitive market forces account for the asymmetry between wholesale gasoline and crude oil prices, any policies to eliminate it are quite likely to involve higher costs than living with the asymmetry.

Even if it is the result of market power, the asymmetry is so fleeting that the likely costs of the unintended consequences of a policy to prevent price asymmetries probably would outweigh the benefits. If policymakers are concerned about the monopolization of refinery or wholesale markets for gasoline, the most prudent policy is to watch for mergers that increase market concentration without providing gains in the economies of scale, rather than to take direct steps to suppress asymmetry.

Retail Markets

Compared with the upstream markets, price asymmetries in the retail market are longer in duration and smaller in magnitude. Locational differentiation and consumer search costs could contribute to market power, and Borenstein and Shepard (1993) find evidence of coordinated pricing in the retail gasoline market. But, asymmetric pricing can arise whether or not there is market power. Consequently, the benefits of policies to eliminate asymmetry in the retail gasoline market are likely to be small, while the costs could be high.

Calculations made with the BBY estimates suggest that a 1 percent increase and a 1 percent decrease in the price of oil lead to a peak differential of only 0.2 percent in the response

of the retail gasoline price. To illustrate, suppose the current prices for oil and gasoline are \$30 per barrel and \$1.50 per gallon, respectively. The peak difference in the response of the retail gasoline price to a \$6 increase and decrease in the per barrel price of crude oil would be only 6 cents per gallon.¹⁰ For the average driver, this differential would amount to about 60 cents in the peak week. Because the differential is so small and search costs are high, it is not surprising that the price asymmetry persists longer than 16 weeks.

Since there is no evidence or theory suggesting that asymmetry necessarily arises from market power in the retail market, policies aimed at eradicating asymmetry are likely to reduce efficiency. Even a simple policy of requiring retail margins to remain constant over time could have unintended consequences for inventories and lead to shortages when prices are rising. More complicated policies would be more difficult to administer. Again, the best policy seems to be to watch for mergers that increase market concentration, rather than to take direct steps to suppress the asymmetry.

CONCLUSIONS

A number of econometric studies confirm casual observations that gasoline prices respond asymmetrically to crude oil price movements by rising more quickly when crude oil prices are rising than falling when crude oil prices are falling. Although popular opinion seems to attribute the asymmetry to market power, Peltzman (2000) shows that price asymmetries arise independently of market structure. In addition, no formal theory relating market power to asymmetry has been tested (to our knowledge), nor is there much evidence of concentration in U.S. markets for gasoline. Consumer search costs and locational advantages may provide market power to some retailers, but such market power might be viewed as the costs of product differentiation under monopolistic competition.

With the evidence pointing away from market power as an explanation, asymmetry is likely to be the consequence of other market factors. As such, policies to suppress asymmetric price movements are likely to lead to undesirable outcomes. If one is concerned about market power in the production, distribution, and marketing of gasoline, the best policy seems to be watching for mergers that increase market concentration without increasing economies of scale, rather than taking direct steps to suppress asymmetry.

NOTES

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- ¹ Previous research does not find this type of asymmetry. Increased environmental regulation of refinery operations and increased taxation of gasoline appear to have been offset by productivity gains. See Borenstein, Cameron, and Gilbert (1997) and Balke, Brown, and Yücel (1998).
- ² For examples, see Ferguson (2000) and Ivanovich (2000).
- ³ Peltzman (2000) finds that the fuel component of the consumer price index responds asymmetrically to the fuel component of the producer price index.
- ⁴ Pricing asymmetries have been observed in many industries, including banking (Neumark and Sharpe 1992) and agriculture (Mohanty et al. 1995). Peltzman (2000) finds pricing asymmetry exists in about two-thirds of U.S. industry.
- ⁵ Variations of the kinked-demand model of oligopoly do not suggest an asymmetrical movement in the output price of an industry in the response to common shocks to the input prices of the firms in that industry. The model explains why prices are less likely to change in either direction. See Scherer (1980) and Neumark and Sharpe (1992).
- ⁶ The Herfindahl–Hirschman Index (HHI) is a summary measure of market concentration.

$$HHI = \sum_{i=1}^n S_i^2,$$

where S_i is the market share of the i th firm. A monopolistic industry with one firm would have an *HHI* of 10,000 (where market shares are measured in percentage terms).

- ⁷ Given that retail margins are very small (see Deltas 1997 and BCG), a large increase in input prices could quickly turn margins negative. Hence, retailers hasten to pass on input price increases.
- ⁸ The low individual costs associated with limited market power should not be taken as an argument that asymmetry has little aggregate cost. We are simply pointing out that the individual benefit–cost calculations made by rational individuals are likely to result in a relatively slow search. When multiplied by the tens of millions of people who drive on a daily basis, the aggregate costs of asymmetry are significant, but these costs are presumably lower than the aggregate search costs that would be necessary to eliminate asymmetry.
- ⁹ Such policies might include government manipulation of inventories or a requirement that oil companies, distributors, and retailers use LIFO (last in, first out)

pricing for gasoline with constant markups over time. To the extent that either policy interfered with free market outcomes, implementation would reduce economic efficiency. A policy of varying taxes inversely with oil prices would be ineffective in eliminating asymmetry because it would not produce additional gasoline when prices are rising.

¹⁰ Six dollars per barrel is equal to the variance of oil prices in the past 10 years.

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Financial Statements and Reality: Do Troubled Banks Tell All?

Jeffery W. Gunther and Robert R. Moore

T*his analysis provides direct evidence of exams' significant role in uncovering financial problems and ensuring bank accounting statements reflect them.*

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Efforts requiring banks to divulge information on their financial condition have a long history. In the early 1800s, some states required banks to file reports of condition with the governor or legislature, arguing the state was a shareholder in the banks and therefore entitled to the information (Robertson 1995). However, the reports contained only broad breakdowns of assets and liabilities and no information bank directors did not wish to disclose. In 1869, Congress empowered the comptroller of the currency to “call” for a full statement of condition from national banks several times a year. Regulators have since made many changes to the resulting call report, but its purpose remains the same—to provide timely information regarding the condition of banks.

The modern call report, or Report of Condition and Income, is filed quarterly by all banks and contains hundreds of accounting items that regulators and private analysts use to characterize the financial condition of both individual banks and the industry. Call reports now include detailed measures of assets, liabilities, revenues, expenses, and off-balance-sheet activity. The level of detail is somewhat greater for large banks than for small ones, but even small banks file an extensive report.

This article analyzes call report revisions to assess the extent to which regulatory exams promote accurate data. If the loan-loss accounting in call reports is widely used to measure loan quality, the findings support the view that exams are important in the public dissemination of accurate information on banks' financial condition.

DISCLOSURE OF LOAN LOSSES

An old saw in banking is that making loans is easy, but getting paid back is hard. While banks have developed a substantial tool kit for identifying creditworthy borrowers, all loans entail some risk and inevitably, some will not be repaid. A loan that appears sound at origination may deteriorate in quality and eventually become a loan for which repayment is highly unlikely. Because loans are a primary banking product, a true picture of a bank's overall financial condition often depends on the accuracy with which loan portfolio problems have been identified and measured. As a result, the accuracy of the line items pertaining to loan quality and performance has the potential for determining a call report's usefulness in tracking financial developments.

The banking industry uses a specialized system to account for loan quality problems, at

the heart of which is the allowance for loan and lease losses (ALLL). Through provision for loan and lease losses, banks add funds to ALLL. These provisions are an expense item and reduce a bank's net income.¹ The ALLL balance is subtracted from total loans, so that loans on the balance sheet are reported net of ALLL. When loans are charged off, total loans are reduced by the amount of the losses, but the losses are charged against ALLL, leaving net loans unaffected.² If a bank recovers some of the losses on loans previously charged off, the recoveries are added back to ALLL.

When a bank charges off a loan, the resulting loss does not affect reported profitability, since the charge-off is against ALLL. Credit quality problems affect reported profitability when a bank incurs the provision expense, since the expense directly reduces net income. As a result, timely disclosure of information on credit quality and its impact on overall operating results depends on the degree to which provisions are made in anticipation of, or concurrent with, actual impairment in the loan portfolio. If adequate provisions are made only after the impairment occurs, profitability prior to the provisions is overstated.

Regulatory guidance directs banks to make provisions if ALLL is insufficient to absorb estimated credit losses. However, the definition of estimated credit losses highlights the difficulty in pinpointing an appropriate level for provisions: "Estimated credit losses are anticipated losses that are reasonably expected to occur but whose amounts or obligors cannot be specifically identified" (Federal Reserve Board of Governors 1999). Because assessing the adequacy of ALLL and the need for provisions is based on an estimate of losses, in many cases it may only be possible to determine a range of suitable levels for provision expense, rather than the single most appropriate level. In addition, exam findings can lead banks to charge off some existing loans, thereby reducing ALLL and potentially requiring additional provisions.

EXAMS AND TRANSPARENCY

Various incentives may induce banks to set provisions outside the range commensurate with credit quality. In response, policymakers have sought to blunt or counteract these incentives.

Banks can reduce the variability of reported income by making higher provisions than necessary when credit quality and net income are high. In this case, provisions would not have to increase as much if credit quality

were to deteriorate. This form of income smoothing might lead outside observers and investors to regard banks as more stable and less risky than they are.³ An undesirable aspect of such income smoothing is that it could make a bank's financial condition less transparent to the users of financial statements.⁴

Potential tax benefits are another incentive for manipulating loan-loss provisions. Before the 1986 Tax Reform Act, provisions were treated as a deductible expense, and setting higher provisions often lowered taxable income. However, for banks with assets over \$500 million, the act linked the amount of a bank's deduction to its actual charge-off experience (Walter 1991).

Another factor that might prompt banks to set an inappropriate level of ALLL and provision expense involves regulatory or market-based penalties for a deterioration in financial condition. Risk-based capital requirements allow banks to count ALLL only in Tier 2 capital and only up to 1.25 percent of risk-weighted assets (Kwan and O'Toole 1997). By not making the necessary provisions, banks with asset-quality problems can raise reported net income and retained earnings, thereby boosting Tier 1 capital and potentially avoiding the numerous restrictions regulators typically place on troubled banks.

Given the current institutional framework, which assigns regulators a large role in the monitoring and disciplining of banks, this latter incentive provides a particularly strong reason for regulatory exams. The *Commercial Bank Examination Manual* states that "the examiner's responsibility to determine the adequacy of a bank's ALLL is one of the most important functions of any examination" (Federal Reserve Board of Governors 1999). In verifying the adequacy of ALLL, examiners consider information obtained during the current and prior exams, loan quality trends and peer group data, processes for internal credit review, past-due and restructured loans, and economic conditions. If after considering these factors an examiner finds that a bank's ALLL is too low, the institution normally is required to increase its provision expense and raise ALLL to the desired level.⁵

Several studies support the view that troubled banks often have insufficient ALLL and that exams are important in helping correct the problem. The General Accounting Office (1990, 1991) finds troubled or failing banks often have insufficient ALLL. Similarly, Berger, King, and O'Brien (1991) discuss the potential for insufficient ALLL, particularly when a bank has not been examined recently. Gilbert (1993) provides

Table 1
**Provision Expense as a Percentage of Average Assets,
 Year-End 1996–98**

Percentile	No revision	Downward revisions		Upward revisions	
	Reported	Reported	Revised	Reported	Revised
25	.03	.09	.00	.11	.30
50 (median)	.12	.26	.16	.25	.52
75	.24	.42	.29	.49	1.00
Average	.18	.37	.19	.42	.87
Percentage of banks	98.83	.17		1.00	

NOTES: The categories are based on revisions to the level of provisions. The data show the distribution of the ratio of provision expense to average assets.

SOURCE: Original and revised files of the Report of Condition and Income, Federal Financial Institutions Examination Council.

evidence of atypical movements in call report data for the quarters in which banks are downgraded by examiners.

Setting provisions requires detailed knowledge about a bank's loan portfolio. Regulators and, especially, bank managers are more likely than outsiders to have such detailed knowledge. If an exam aligns provision expense and ALLL with credit quality, it may facilitate the public communication of important bank-specific information and thereby enhance banking system transparency.

Consistent with this view, Docking, Hirschey, and Jones (1997) find a bank's announcement of loan-loss provisions adversely affects that bank's stock price and sometimes the stock price of other banks as well. Berger and Davies (1998) provide evidence that quarterly financial statements are a conduit for transmitting exam findings to financial markets. And Flannery and Houston (1999) find exams affect the relationship between a bank holding company's market and book value, possibly reflecting the improved accuracy of financial statements following an exam or a certification effect whereby exams serve as a stamp of approval on published financial statements.

Other researchers have reached a different conclusion, however, arguing essentially that outsiders can see through a bank's loan-loss accounting and discern the true quality of its loans, even if provisions and ALLL are lower than necessary. Wall and Koch (2000) cite several studies that indicate investors often do not react to announcements of loan-loss provisions, presumably having already effectively estimated the extent of the deterioration in bank loan portfolios. If, without substantial cost, outsiders can accurately estimate losses in a bank's loan portfolio on the basis of other information, the

benefits of exams in assessing loan quality and the sufficiency of ALLL may be limited mostly to the supervisory process itself, as opposed to the promotion of financial transparency in general.

These earlier studies address important issues. Do banks sometimes set provisions below what is needed to cover their loan losses? If so, how often does this occur and by what magnitude do banks underreport? Are exams effective in promoting adequate levels of ALLL? And finally, do provisions and ALLL convey useful information to outsiders about banks' financial condition? The following analysis addresses some of these issues further by providing evidence based on the incidence and size of revisions to call report data.

Sample

The analysis examines call report revisions to gain insight into exams' role in promoting accurate financial information. Given the importance of information on loan quality in assessing banks' overall financial condition, the analysis is limited to provision expense revisions. To focus on safety and soundness concerns, most of the analysis is directed at upward revisions. If examiners determine the provision expense a bank reports is inadequate, they may require the bank to make additional provisions and refile one or more recent call reports to reflect the change.⁶ It is important to note, however, that not all exam findings on provisions necessarily require call report revisions. If additional provisions are necessary, the expense may simply be reflected on a bank's subsequent call report. Nevertheless, the revisions provide a unique window through which to view the results of exam activity.

The data this study uses are obtained from files at the Federal Reserve Bank of Dallas and are limited to commercial banks, year-end 1996–98. The originally reported data are from files transmitted from the Federal Reserve Board, seventy to eighty days following the report dates. The revised data are for the same report dates but were transmitted from the Board in May 2000. Any differences between the original data and the data obtained in May reflect revisions made sometime after the data were published as "final," which typically occurs about sixty-five days after the report date.⁷

Several additional restrictions frame the analysis. First, the sample is limited to banks that received a satisfactory rating on the last exam prior to the report date.⁸ Focusing on these banks facilitates an assessment of whether new or emerging problems are freely divulged by banks

or reported only at the behest of examiners. In addition, banks less than four years old are excluded, since young banks typically exhibit unique financial characteristics and are not directly comparable to more mature banks. The resulting sample contains 24,519 year-end call reports for the period from 1996 through 1998.

Results

The analysis reveals an interesting relationship between revisions to call report data and exam results.

Frequency and Magnitude of Revisions. While banks in general seldom revise their financial reports, when they do, the revision is often substantial. As Table 1 shows, reported provision expense was unrevised nearly 99 percent of the time.⁹ Downward revisions were made to only 0.17 percent of the reports. However, banks revised their provisions upward in 1 percent of the cases examined, and these revisions tended to be large. The median ratio of provision expense to average assets originally reported by the banks that revised upward is 0.25 percent, compared with a median ratio of 0.52 percent based on the revised reports. The same comparison holds for the average of the revised provision expense ratio, which is more than twice as high as originally reported. These revisions are sufficient to lower reported profitability appreciably. For the banks that revised their provisions upward, the return on assets originally reported is 1.02 percent, on average, compared with 0.71 percent for the revised reports.

The number of upward revisions in our sample is fairly small. However, these were good times for the banking industry. Because financial problems were few, the need for increases in provisions could be expected to have been low. The analysis below controls for this factor by examining sound and troubled banks separately.

Financial Problems, Exams, and Revisions. To investigate whether revisions to provision expense are driven by examiners' findings, the sample is divided into five groups. The first group contains banks for which an exam began in the first quarter of the year immediately following the fourth quarter report date. The second group is banks for which the first exam in the subsequent year occurred in the second quarter, and so on for the third and fourth groups. The fifth group contains banks that were not examined in the year following the call report date.

The banks are also divided into ten asset-quality categories. These categories are based

Table 2
Percentage of Banks with Upward Revisions to Provision Expense, Year-End 1996–98

Asset-quality category	Quarter of first exam in subsequent year				
	First	Second	Third	Fourth	None
1	.76	.00	.23	.00	.00
2	1.32	.46	.95	.28	.70
3	.57	.43	.89	.00	.29
4	.40	.23	.23	.00	.28
5	1.26	.21	.92	.00	.14
6	1.37	.41	.00	.00	.56
7	.99	.69	.46	.59	.54
8	1.76	1.83	1.09	.59	.71
9	3.26	3.02	.93	1.56	.84
10	9.60	3.37	1.84	1.12	1.46

NOTES: The percentages are based on the number of upward revisions to the level of provisions. The asset-quality categories are based on the ratio to assets of loans past-due thirty days or more and still accruing and nonaccrual loans, where the first group is banks with the lowest problem-asset ratios and the tenth group those with the highest ratios. The ratios are calculated using revised data. Each asset-quality group contains 10 percent of the sample.

SOURCE: Original and revised files of the Report of Condition and Income, Federal Financial Institutions Examination Council.

on the ratio to assets of loans past-due thirty days or more and still accruing and nonaccrual loans. The first group is banks with the lowest problem-asset ratios and the tenth group those with the highest ratios. The ratios are calculated using revised data.¹⁰ Each group contains 10 percent of the sample.

This exercise indicates that banks with severe asset-quality problems are more likely than other banks to revise their loan-loss provision upward. In addition, banks that are examined—particularly in the first quarter of the year after the call report date—also are more likely to raise their provision. As Table 2 shows, almost 10 percent of the banks in the worst asset-quality group that were examined in the first quarter revised their loan-loss provision upward. In contrast, only 1.46 percent of the banks in the worst asset-quality group that were not examined in the year following the call report date revised their provision upward. Moreover, only 0.76 percent of the banks in the best asset-quality group that were examined in the first quarter revised their provision upward. None of the unexamined banks in the best asset-quality group raised their provision expense.

Further evidence that exams are a significant impetus for call report revisions is obtained by dividing the banks into two categories based on whether they were downgraded by examiners to problem status. Of the banks examined and downgraded in the first quarter, 36 percent revised their loan-loss provision upward. In contrast, of the banks examined in the first quarter that were not downgraded,

only 1.4 percent raised their provision expense. For banks examined in the fourth quarter, about 2 percent of those that were downgraded restated their provision at a higher level, while under 1 percent of those that remained in nonproblem status revised it upward. These figures indicate banks that are downgraded by examiners, particularly early in the year, often revise the preceding year's fourth quarter call report to reflect a greater degree of financial difficulty than originally reported.¹¹

Summary of Findings. These data provide a look at the frequency and magnitude of call report revisions and their relationship to exams. Upward revisions of provisions are large enough to reduce profitability appreciably. For banks in general, the revisions are infrequent. However, banks with new or emerging problems often significantly underreport provision expense. There is a strong relationship between examiner downgrades of banks and upward revisions to the provision expense reported for the previous year, especially when the downgrades occur early in the current year.

CONCLUSION

This analysis provides direct evidence of exams' significant role in uncovering financial problems and ensuring bank accounting statements reflect them. The auditing role of exams directly manifests itself in the difference between original and revised call reports. For the report dates used in the analysis, more than one-third of the banks that fell into problem status had to revise their most recent call report to reflect a greater degree of financial difficulty than originally reported. To the extent outsiders use provisions and ALLL in assessing loan quality, these results support the view that exams are important in the public dissemination of accurate information on banks' financial condition.

The findings also point to the need for further research. Because call reports are filed quarterly, whereas banks are typically examined about once every twelve to eighteen months, call report data potentially provide a more up-to-date picture of a bank's condition than on-site exams alone. For this reason, regulators use call report data extensively in a variety of efforts to monitor banks' condition. One such effort involves the construction and implementation of statistical early-warning models to identify emerging financial problems. These statistical systems typically rely heavily on call report data for input variables. (Cole, Cornyn, and Gunther 1995 provide an example of this use of call

report data.) However, if call report information does not accurately reflect financial conditions when published, the report's usefulness in tracking financial developments between on-site exams could be reduced. Additionally, if inaccuracies in the call report data are ultimately corrected, the revisions might overstate the report's usefulness in tracking financial developments in real time, as Cole and Gunther (1998) point out. These considerations suggest the need to analyze early-warning models based on originally published data to assess whether these models' ability to identify financial problems is appreciably lower than that of models based on revised data.

NOTES

- ¹ Banks can use a reverse provision to remove funds from ALLL.
- ² For simplicity, the text refers exclusively to loan performance. Losses on leases are treated similarly.
- ³ Greenawalt and Sinkey (1988) find evidence of income smoothing and further discuss banks' motivation for the practice. See also Wall and Koch (2000).
- ⁴ An interagency statement on March 10, 1999, directs banks to maintain "prudent, conservative, but not excessive, loan-loss allowances that fall within an acceptable range of estimated losses" (Securities and Exchange Commission et al. 1999). The statement also discusses plans for interagency cooperation in issuing guidance on appropriate methodologies, documentation, and disclosure.
- ⁵ In addition to examiner review, a bank's loan-loss accounting may be reviewed by independent auditors. While all commercial banks are subject to exams, not all are subject to external audits. The Federal Reserve requires bank holding companies with consolidated assets of \$500 million or more to have an annual external audit. New banks are also required to have external audits. The Securities and Exchange Commission requires audits for publicly traded companies, including bank holding companies. Finally, the Federal Deposit Insurance Corporation Improvement Act of 1991 requires annual external audits for any bank insured by the Federal Deposit Insurance Corp. with assets greater than \$500 million (Federal Reserve Board of Governors 1994).
- ⁶ The analysis assumes the judgment of examiners is correct—that is, an upward revision to provision expense is taken to mean the initial level of ALLL was, in fact, too low.
- ⁷ As regulators process call report data, substantial effort is devoted to validating the reported information. The primary goal is to ensure the data are accurate before they are published as "final." While the data are typically published about sixty-five days after the

report date, revisions can be made for up to five years.

- ⁸ Satisfactory status corresponds to a safety and soundness rating of 1 or 2. Safety and soundness ratings of 3, 4, and 5 are considered unsatisfactory.
- ⁹ In first quarter 1998, banks began reporting provision for credit losses and no longer reported provision for loan and lease losses. The new provision covers loan and lease losses but also includes provisions for losses on certain types of off-balance-sheet activity. For simplicity, we refer to provision expense in all years as provision for loan and lease losses. Banks continue to report ALLL and now also report an allowance for credit losses, which includes the allowance for losses on off-balance-sheet activity. Comparing the two quantities makes it possible to estimate the size of the provision for losses on off-balance-sheet activity. The provision for losses on this activity is very small overall in comparison with the provision for loan and lease losses, and for the vast majority of banks the provision for off-balance-sheet losses is zero.
- ¹⁰ Similar but not identical results are obtained when the originally reported data are used to calculate the ratios.
- ¹¹ Upward revisions to provision expense tend to occur mostly at small and midsize banks. The incidence is fairly equal for banks with assets under \$100 million, from \$100 million to \$500 million, and above \$500 million but below \$1 billion. Banks with assets of \$1 billion or more have a substantially lower incidence of upward revisions. However, in our sample few downgrades occur in the largest size category. The relative lack of financial problems among the large banks may help explain their low incidence of upward revisions to provision expense.

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