

TRANSITION STRATEGIES IN ENACTING FUNDAMENTAL TAX REFORM

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This paper discusses transition strategies that might be used in moving from an income tax to consumption based business taxes in the form of an R-base cash-flow tax, an R+F-base tax, or an ACE (allowance for corporate equity) tax. While these three taxes have attractive neutrality properties, moving from the status quo to a new system often involves a difficult trade-off between short-run losses and long-run gains. We consider two alternative ways of spreading the gains and costs of reform more evenly across generations. Deficit financing of the large revenue loss that occurs immediately after reform allows the smoothing of wage tax rates over time and the elimination or reduction of short-run income losses. Alternatively, a system of delayed deductions requires firms to carry forward with interest some of the large deductions that are newly available after the enactment of a major tax reform. In shifting tax revenue from the future to the present, such policies are politically appealing, as they trade somewhat reduced future income gains for improved economic performance immediately after reform.

Keywords: cash-flow taxes, ACE tax, investment, unemployment, transition policies

JEL Codes: H21, H25, H32, J64

I. INTRODUCTION

Company taxation often slows down economic growth and impairs efficient capital allocation. A large literature focuses on the design of neutral taxes that avoid distortions both in the level and allocation of capital (for reviews, see Auerbach (2002), Hassett and Hubbard (2002), and Sinn (1987)). The Meade Report (Institute for Fiscal Studies, 1978) developed consumption-based tax systems with cash-flow taxation of profits. A business cash-flow tax is part of the flat-tax proposal of Hall and Rabushka

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(1995) and was recently included in one of the reform plans proposed by the U.S. President's Advisory Panel on Federal Tax Reform (2005).¹ Mitschke (2004) opted for a cash-flow tax on real and financial cash flows (The Meade Committee's R+F-base) as part of a tax reform proposal for Germany.² The main alternative concept is a corporate tax system that maintains deductions for depreciation and interest expense but adds an allowance for corporate equity (ACE) (Boadway and Bruce, 1984; Institute for Fiscal Studies, 1991). Bond and Devereux (1995) argue that the ACE and cash-flow taxes are, in fact, equivalent. The Mirrlees Review (Institute for Fiscal Studies, 2011) recommends an ACE tax as part of its overall tax design.

A substantial literature discusses the benefits and costs of moving towards a consumption based tax system, using either the cash-flow tax or ACE tax approach (Auerbach, 2008; Bradford, 2005; Gordon et al., 2004).³ Some of this work uses computer simulation models to assess the efficiency and distributional consequences of such reforms (Auerbach, Kotlikoff, and Skinner, 1983; Auerbach and Kotlikoff, 1987; Auerbach, 1996; Altig et al., 2001; Keuschnigg, 1991; Keuschnigg and Dietz, 2007; Radulescu and Stimmelmayer, 2007; Diamond and Zodrow, 2007, 2008; and Zodrow, 2002). Bradford (1996), Kaplow (2008), Sarkar and Zodrow (1993), and Zodrow (2002) discuss reform-induced transition problems. Kaplow focuses on the role of capital levies and the treatment of windfall gains and losses upon the enactment of reform. In essence, this literature points to a conflict between the long-run gains and short-run losses of a growth-oriented tax reform. These transition problems illustrate Feldstein's (1976) argument that an attractive "de novo" tax design might not be as attractive if the need for compensating potential losers is considered. Zodrow (1981, 1986) discusses ways to reduce reform-induced intergenerational windfall gains and losses using techniques such as postponing, phasing-in, and partially enacting reforms.

A large fraction of the long-run welfare gains from implementing a consumption tax reform results not from efficiency gains but from unintended redistributions from current generations toward future generations. Gravelle (1991) finds welfare gains that approach zero when reform includes compensation of losers. Altig et al. (2001) find that variants of consumption based tax reform in the United States cause significant redistributions across income groups and generations. For example, introducing a flat tax with a business cash-flow tax benefits future generations by imposing a windfall loss on existing capital at the expense of current old generations. Implementing a flat

¹ In fact, the Growth and Investment Tax proposal of the President's Panel includes a cash-flow tax with an add-on personal capital income tax. The analysis of this proposal by Diamond and Zodrow (2007) is similar to our analysis of cash-flow tax reform since personal capital income taxes are proportional and remain unchanged in our scenarios.

² The R+F-base tax is sometimes referred to as S-base tax (Sinn, 1987), and equals a tax on dividends net of the inflow of funds from new share issues. Auerbach (2008) reviews this approach in more detail.

³ In some countries, the existing tax structure may not raise much revenue from taxing capital income (Gordon and Slemrod, 1988; Gordon et al., 2004; Becker and Fuest, 2005). Moving to a consumption-based system would be much easier if it results in small tax revenue losses.

tax with transition relief, modeled by cutting the effective cash-flow tax rate in half, protects the owners of preexisting capital but also reduces the long-run increase in national income from 4.5 to 1.9 percent.

This paper investigates the transition problems of fundamental tax reform, using a detailed computational growth model of an open economy with overlapping generations, calibrated for Germany. The model is novel in that it includes an endogenous capital structure choice, differential tax treatment of debt and equity which allows the comparison of different variants of neutral corporate tax systems, and a system of delayed expensing to explicitly model flexible transition relief. Another novel feature of the model is the existence of equilibrium unemployment, which highlights a new channel for analyzing the incidence of the reform of the corporate tax in a large welfare state as reform-induced capital accumulation not only raises labor productivity and wages, but also reduces unemployment. The fiscal gains from lower unemployment augment reform-induced increases in economic growth. Using our simulation model, we compare the consequences of moving to three alternative forms of consumption-based corporate taxation: the R-base and R+F-base cash-flow taxes, and the ACE tax. We focus on the fact that the timing of tax revenue flows differs considerably among these options even if the present value of revenue is identical. A key contribution of the paper is analyzing the effects of financing revenue losses during the transition, either by issuing government debt or by delaying the deductions associated with expensing of business purchases, so that gains and losses caused by reform are spread more evenly across generations. The proposed system of delayed deductions works like a systematic carry-forward of tax losses with interest and, in fact, can be operated in a way that makes cash-flow taxes fully equivalent to an ACE system.⁴

The paper proceeds as follows. Section II derives stylized analytical results and discusses the nature of the transition problems in moving toward fundamental tax reform. Section III reports simulation results. We first focus on moving towards an R+F-base cash-flow tax, as was recently recommended for Germany by Mitschke (2004) and analyzed by Becker and Fuest (2005), and then consider the alternatives of an R-base and ACE tax. We report two main sets of results: (1) depending on the specific scenario, the long-run gains from enacting consumption-based reform can be substantial, with GDP between 5.6 and 7 percent higher, wages up by around 3.5 percent, and unemployment down by 1 to 1.4 percentage points; and (2) an appropriately designed transition policy will assure short-run gains, coupled with smaller long-run gains. Section IV summarizes the main insights.

⁴ Our analysis differs from Altig et al. (2001) in that they model a closed economy with an endogenous interest rate, and do not explicitly distinguish between debt and equity; they thus cannot examine the differences between the ACE, R+F-base, and R-base tax systems. They also model transition relief in a reduced form only. Altig et al. report sizeable windfall losses when they introduce a cash-flow tax. In contrast, when we introduce an R+F-base cash-flow tax, we obtain sizeable windfall gains that result from reductions in the debt-equity ratio. Although the long-run results in the two studies are broadly comparable, the transition strategies considered are quite different in the two analyses.

II. CORPORATE TAX REFORM

A. Long-Run Impact

We design a computable general equilibrium model to analyze the short- and long-run effects of fundamental tax reform. The model includes several taxes at the firm and investor levels, allows for different definitions of the tax base, and can simulate the transition to alternative tax systems such as variants of a cash-flow tax or an ACE system. We present here only those details necessary to derive the main long-run implications of tax reform and to illustrate the transition problems confronted when moving from the status quo to full implementation. An Appendix derives the optimal investment paths and capital structure choices of firms and describes the details of capital income taxation at the personal level.⁵

Value maximization leads firms to invest and issue new debt and equity and thereby accumulate stocks of debt B and total assets K according to⁶

$$\begin{aligned} (a) \quad K_{t+1} &= I + (1 - \delta)K, \\ (1) \quad (b) \quad K_{t+1}^T &= (1 - \varepsilon')I + (1 - \delta^T)K^T, \\ (c) \quad B_{t+1} &= B^N + (1 - \delta)B \end{aligned}$$

where I is gross investment and δ is the depreciation rate. Debt is repaid at the same rate as capital depreciates, so that B^N is new debt issues and δB is debt repayment, giving net new debt of $B^N - \delta B$. The tax or book value of the capital stock K^T is depreciated at rate δ^T . A portion $\varepsilon'I$ of investment is immediately expensed, and the remaining part is added to the depreciable capital stock. The generosity of tax depreciation allowances is reflected in ε' and δ^T .

Net investment adds to the capital stock and determines earnings $\tilde{Y} = F(K, L^D) - J(I, K) - W^D$ where F is a standard production function and L^D and W^D are employment and the wage bill. Installation costs J of new equipment are measured in terms of foregone output. They are convex, increasing in investment and declining in the capital stock, and are normalized to zero when the investment-to-capital ratio is at a steady state equilibrium. Total assets K are split into debt B and equity $K - B$. Subtracting the cost of external debt and corporate tax yields profits $\pi = \tilde{Y} - i^B B - mK - T^K$. The cost of external debt not only includes interest i^B paid to investors, but also “agency costs” or debt management costs $m(b)$ per unit of capital, where $b = B/K$ is the debt-asset ratio. Following much of the tax literature, we model $m(b)$ in reduced form only and assume it is convex in the debt-asset ratio b , reflecting the idea that some debt may be useful to discipline management, but too much debt increases the likelihood of incurring a

⁵ See Keuschnigg and Keuschnigg (2010), available at www.alexandria.unisg.ch/publications/61463. A Technical Appendix with complete model documentation is available upon request.

⁶ We list the time index only if it refers to a period different from the current period t .

costly bankruptcy. These offsetting forces are assumed to result in an optimal capital structure b^* such that agency costs are minimized, i.e., $m' \geq 0 \Leftrightarrow b \geq b^*$. For simplicity, $m(b^*)$ is normalized to zero. Tax liability is determined by

$$\begin{aligned} T^K &= t^K [\tilde{Y} - \delta^T K^T - \varepsilon^0 D^T - \delta^D K^D], \\ (2) \quad K_{t+1}^D &= (1 + i^E) K^D + (1 - \varepsilon^0) D^T - \delta^D K^D, \\ D^T &= \varepsilon^I I + \varepsilon^E i^E (K - B) + \varepsilon^B (i^B B + mK) - \varepsilon^N (B^N - \delta B) \end{aligned}$$

Given the corporate income tax rate t^K , tax liability depends on the definition of the tax base, which consists of earnings less tax depreciation $\delta^T K^T$ and other deductions. From the firm's deduction claims for new investment D^T , a portion ε^0 can be immediately expensed while the remaining portion is delayed and adds to the stock of unused deductions, K^D . The firm can use up previously accumulated deduction claims at rate δ^D so that actual deductions in a given period are $\varepsilon^0 D^T + \delta^D K^D$. Unused deductions are carried forward with interest equal to the firm's discount rate i^E , which is the opportunity cost of equity.⁷ Most real world consumption-based tax systems are characterized by $\varepsilon^0 = 1$ and $K^D = 0$, although there are often elements of tax carry forward or carry backward over limited periods. With new deduction claims immediately expensed, the tax liability is relatively low in the present (e.g., relative to an income-based tax) and higher in the future. When ε^0 is set to zero, or at least is less than one, new claims are not immediately deducted but carried forward with interest, thereby augmenting the stock of unused deductions and reducing the future tax base by $\delta^D K^D$. Delayed expensing is a form of implicit public debt, as the government collects more tax currently but repays it with lower tax receipts in the future when firms use their delayed deductions accumulated with interest.⁸

The firm's new deduction claims D^T are determined by several ε -parameters. Under most income tax systems, the tax code allows a deduction for the cost of debt ($\varepsilon^B = 1$), including interest expense and debt management costs. If $\varepsilon^N = 1$, as under an R+F cash flow tax, firms must include the proceeds from new debt issues B^N in their taxable earnings and can subtract repayment δB of existing debt. Finally, some tax systems, such as the ACE tax, set $\varepsilon^E = 1$ and thereby include an allowance for the cost of equity. Most existing income tax systems are characterized by $\varepsilon^B = 1$ (full deduction of interest on debt), $\varepsilon^N = 0$ (no inclusion of new net debt), $\varepsilon^E = 0$ (no deduction for the opportunity cost of equity), $\varepsilon^I = 0$ (no immediate write-off), and $\delta^T \geq \delta$ (accelerated or economic tax depreciation).

⁷ Conceptually, interest on unused deductions must be equal to the firm's discount rate so that delaying deductions does not change firm value and decision rules. In practice, it might not be possible to exactly identify the right interest rate so that delaying deductions might be only approximately neutral. This problem is similar to finding the appropriate interest rate for the opportunity cost of equity under the ACE tax.

⁸ By analogy, social security programs create "implicit debt" when the government promises pension rights that cannot be covered by projected future revenues under current contribution rates.

Value maximization yields the decision rules for firms, including the optimal time path of investment, as detailed in the Appendix. The optimal debt-asset ratio $b = B/K$, for example, is implicitly determined by the condition

$$(3) \quad \left[1 - (\varepsilon^N + \varepsilon^E)t^K\right]i^E = (1 - \varepsilon^B t^K)[i^B + m'(b)];$$

in the initial income tax equilibrium, this reduces to $i^E = (1 - t^K)(i^B + m')$. The international capital market dictates the rates of return on equity and debt, i^E and i^B , which depend on the world interest rate i^* and personal taxes on interest, dividends, and capital gains. Firms increase leverage and accept increasingly high agency costs m' until the costs of equity and debt are equalized. A higher tax rate thus encourages more leverage since the cost of debt is tax deductible while the opportunity cost of equity is not.

In a long-run stationary equilibrium, the pretax return on capital, which is equal to the user cost of capital $u^K = F_K - \delta$, is

$$(4) \quad \begin{aligned} u^K &= (1-b) \frac{1 - \varepsilon^E t^K}{1 - t^K} i^E + b \frac{(1 - \varepsilon^B t^K)i^B + \varepsilon^N t^K i^E}{1 - t^K} + P^I, \\ P^I &\equiv [\delta t^K - (i^E + \delta)Z + (1 - \varepsilon^B t^K)m]/(1 - t^K), \\ Z &\equiv \varepsilon^I t^K + (1 - \varepsilon^I)t^K \delta^T / (i^E + \delta^T). \end{aligned}$$

The impact of the tax system on the user cost of capital consists of three parts. The first two terms capture the cost of equity and debt financing and are weighted in proportion to the equity and debt ratios, $1 - b$ and b , respectively. The third term captures the tax cost or subsidy independent of the source of finance, where Z is the effective tax subsidy to the purchase cost of new capital and includes expensing and the present value of normal tax depreciation deductions. In the initial equilibrium, the user cost of capital is $u^K = (1 - b)i^E/(1 - t^K) + bi^B + P^I$ and $P^I = m(b) - (\delta^T - \delta)i^E t^K / [(i^E + \delta^T)(1 - t^K)]$. To the extent that investment is equity financed, the corporate tax raises the user cost of capital and discourages investment since the cost of equity is not tax deductible. Finally, accelerated tax depreciation $\delta^T > \delta$ (in the absence of inflation) reduces the cost of capital, and implies $P^I < 0$. On the other hand, if the tax system distorts financing choices ($b > b^*$), it leads to higher debt management costs $m > 0$. In the absence of taxes, agency costs are zero since the financing choice is not distorted, leading to $P^I = 0$. Without personal taxes, $i^E = i^B = i^* = u^K$, giving the well-known investment rule for an open economy $F_K = i^* + \delta$.

An R-base cash-flow tax allows expensing of investment but denies deductions for new net debt and for interest on debt and the opportunity cost of equity ($\varepsilon^I = 1$ and $\varepsilon^B = \varepsilon^E = \varepsilon^N = 0$). The tax base is equal to a firm's real cash flow and limits new deductions to $D^T = I$. It is neutral towards capital structure choice, $i^E = i^B + m'$. The R-base tax reduces the price of equipment by $Z = t^K$ implying an investment subsidy $P^I = (m - i^E t^K)/(1 - t^K)$. The user cost of capital becomes $u^K = (1 - b)i^E + [(i^B - i^E t^K)b + m]/(1 - t^K)$. If personal taxes are non-discriminatory, $i^E = i^B = i$, yielding $m = m' = 0$, then

$u^K = i^*$ as without tax. If personal taxes discriminate between debt and equity, some non-neutrality remains.

When moving to an R+F-base cash-flow tax, the government defines the tax base to include both real and financial cash flows, which implies $\varepsilon^I = 1$, $\varepsilon^B = \varepsilon^N = 1$, and $\varepsilon^E = 0$. The tax base thus includes financial cash flows equal to new net debt minus interest costs. No deduction for the cost of equity is allowed. New deduction claims thus amount to $D^T = I - (B^N - \delta B) + (i^B + m/b)B$. The optimal use of debt (3) implies $i^E = i^B + m'$. The R+F-base cash-flow tax thus implies debt neutrality at the firm level. If, in addition, interest, dividends and capital gains are all taxed at identical (effective annual accrual) rates $t^D = t^G = t^B$, the tax system would be completely neutral since $i^E = i^B$ and $m'(b^*) = 0$, as in a world without taxes. Immediate expensing reduces the effective price of equipment by $Z = t^K$ and leaves an investment subsidy of $P^I = m - t^K i^E / (1 - t^K)$ to both equity and debt financed investment. The cost of capital thus becomes $u^K = (1 - b)i^E + bi^B + m$, i.e., the R+F-base tax is neutral with respect to investment decisions. If personal level taxes are also uniform, investment incentives are again summarized by $F_K = i^* + \delta$.

Finally, an ACE tax does not allow investment expensing or deductions for new debt but grants deductions for all costs of finance, i.e., both interest on debt and the opportunity cost of equity. Tax and economic depreciation are equal. The tax base is thus defined by $\varepsilon^E = \varepsilon^B = 1$, $\varepsilon^I = \varepsilon^N = 0$ and $\delta^T = \delta$. New deduction claims are $D^T = i^E(K - B) + (i^B + m/b)B$ and tax depreciation is allowed at rate δ . Evaluating (3) demonstrates the financial neutrality of the ACE tax. When tax and economic depreciation are equal, the purchase cost is reduced by $Z = t^K \delta (i^E + \delta)$, which leaves an effective investment subsidy of $P^I = m$ which equals zero if personal level taxes are neutral. The ACE tax implies a user cost of capital $u^K = (1 - b)i^E + bi^B + m$ and is thus also neutral with respect to investment decisions and, with neutral personal taxation, $u^K = i^*$ as in the absence of taxes.

B. Transition Problems

Neutrality with respect to investment and financing decisions are the main advantages of cash-flow and ACE taxes. However, moving from the status quo to such a new tax system raises challenging transitional problems, including an initial shortfall in corporate tax revenue. To illustrate the main difficulty, Table 1, using (2), compares the tax bases under the status quo (the initial income tax equilibrium) and in the first period after the enactment of the three fundamental tax reforms analyzed.

At the date of enactment of any of the three reforms, stocks and earnings $\tilde{Y}$ are pre-determined. Unused deduction claims K^D are zero, and firms are assumed to continue to receive depreciation allowances on the tax basis of the capital stock existing at the time of enactment $\delta^T K^T$.⁹ These allowances approach zero over time as the existing

⁹ Note that this assumption differs from the approach recommended by Hall and Rabushka (1985) under which all such deductions would be denied. Altig et al. (2001) treat the continuation of depreciation deductions as a special transition rule. We return to this point below.

Table 1
Shocks to the Corporate Tax Base

Status quo (income tax)	$\tilde{Y} - \delta^T K^T - (i^B + m/B)B$
ACE Tax	$\tilde{Y} - \delta K^T - (i^B + m/B)B - i^E(K - B)$
R+F-base tax	$\tilde{Y} - \delta^T K^T - (i^B + m/B)B + (B^N - \delta B) - I$
R-base tax	$\tilde{Y} - \delta^T K^T - I$

capital stock is written off following $K_{t+1}^T = (1 - \delta^T)K_t^T$. The transitional problems are largest in the first period. When moving to an R+F-base cash-flow tax, the tax base can shrink dramatically for two reasons. First, immediate investment expensing erodes the tax base by an additional amount I , which can be substantial as the optimal level of investment, especially in the first period if adjustment costs are not too high, can be very large. Second, since the R+F-base tax eliminates the tax preference for debt under the status quo, firms repay part of their debt and issue equity instead. Hence, net new debt issues are likely to be negative, $B^N - \delta B < 0$, which further erodes the tax base. By comparison, the R-base cash-flow tax eliminates interest deductions on external debt and introduces investment expensing. Given the much higher investment levels in response to the reform, we similarly expect a substantial loss in tax revenue in the first period, although less than with an R+F-base tax, since interest on existing loans continues to be deductible. Finally, moving to an ACE tax loses revenue by introducing new deductions for the opportunity cost of equity. In all cases, fundamental tax reform involves a difficult trade-off between short-run revenue losses and long-run gains.

The shrinking corporate tax base in the short run has two unfavorable consequences. First, the lower corporate tax is capitalized in firm values and might lead to large windfall gains to the owners of old capital, which would have unfavorable distributional consequences. Second, the loss in corporate tax revenue must be replaced with revenue, which we assume comes from other distorting taxes. In particular, raising wage or consumption taxes erodes real wages, which will have detrimental effects in the labor market. These will be especially large in the early transition period when the capital stock has not yet sufficiently increased to raise labor productivity. The resulting declines in labor supply could have rather negative macroeconomic consequences, at least until reform-induced increases in the capital stock occur. The challenge is to explore non-distortionary ways of increasing tax revenue in the years immediately following enactment while avoiding large windfall gains.

The following analysis explores three such strategies. First, one might consider a one-time reduction in the tax basis of the existing depreciable capital stock K^T , which would result in lower depreciation deductions during the transition period. Second, rather than raising other taxes, the government might increase public debt to offset the shortfall in

corporate tax revenue. In the future, the interest on the larger public debt would be paid from increased tax revenues attributable to reform-induced growth. One could use this mechanism to fully smooth wage tax rates over the entire transition. Finally, instead of issuing debt on the capital market, the government could introduce delayed expensing (i.e., spread the deduction for expensing over several years, with the present value of the deductions equal to the value of immediate expensing), and thereby implicitly issue debt to the business sector.

C. Simulation Model

To simulate the effects of fundamental tax reform, we use a dynamic computable general equilibrium model of an open economy with an internationally fixed interest rate. The household sector is characterized by an overlapping generations model with a period length of one year. Agents are aggregated into five active and three retired age groups. Households supply work effort, search for jobs, and save to smooth consumption in the face of uneven life-cycle income patterns. Accumulated wealth is invested in internationally traded bonds and public debt as well as the equity and debt of the business sector. Assuming complete home bias, equity is fully held by domestic investors. Government spending is on public goods and income transfers to households. Tax revenues are obtained from indirect taxes, labor and capital income taxes, and social security contributions. In addition, there is a pay-as-you-go pension and an unemployment insurance system. A novel aspect of the model is that it accounts for involuntary unemployment that reflects job search by households and job creation by firms.¹⁰ Aggregate labor supply can thus change on both the intensive and extensive margins, i.e., by varying hours of work (or work effort) and changes in work force participation. Both wage and consumption taxes reduce the real wage and, in turn, hours worked on the job. Incentives for job search and unemployment depend on the gap in disposable income between work and leisure. Hence, job search is discouraged not only by wage and social security taxes but also by the generosity of unemployment benefits and social assistance.

The model is calibrated to the German economy. The Appendix reports in more detail how model parameters are chosen to replicate empirical evidence on key behavioral margins, and also discusses the relevant econometric literature. Reflecting long-run averages for Germany, the net real interest rate and the growth rate are set to 4 and 1.5 percent, respectively. In the last decade, the unemployment rate was as high as 10.5

¹⁰ We implement a static, one-shot search and matching model of the labor market with wage bargaining. Depending on the extent of bargaining power, the wage is lower than the marginal product but higher than the worker's opportunity cost, which consists of unemployment benefits and other non-work income. Higher wages imply lower job rents for firms, and the job creation and labor demand. Higher wages also increase the job rents of workers and stimulate job search and labor supply. Equilibrium labor market tightness determines the matching of workers and unfilled vacancies to productive jobs so that some workers remain unemployed and some vacancies remain unfilled. See the Technical Appendix for details.

percent. Labor market distortions are measured by effective tax rates, which summarize the total tax burden from wage taxes, (employee) social security contributions with partial benefit offset in an earnings linked system, and indirect taxes. The effective tax rate on hours worked amounts to 35 percent for the youngest age group (20–30 years old) and rises to 40 percent for the 40–50 years old with higher earnings. The effective tax rate on job search is substantially larger at 69 percent. This tax rate summarizes the total burden that accrues when switching from unemployment into a job, and consists of wage and contribution taxes plus forgone unemployment benefits. The replacement rate of unemployment benefits in Germany is roughly 50 percent.¹¹

Investment and savings incentives are also measured using effective tax rates (Sorensen, 2004). The Appendix derives the required pre-tax return on investment (the user cost of capital). Using the debt-asset ratio as a weight, the average cost of finance is $i^K = (1 - b)i^E + bi^B + m$. We define the effective tax rates on investment and savings as $\tau^I = (u^K - i^K)/u^K$ and $\tau^S = (i^K - r)/i^K$, respectively. Hence, the total tax wedge is $r = (1 - \tau^S)(1 - \tau^I)u^K$. In Germany, capital income taxation is proportional and implies $t^B = t^D > t^G$ where the effective tax rate on capital gains is lower due to tax deferral until realization and exemption of gains at death. Hence, the marginal tax rate on average returns to equity (dividends and capital gains) satisfies $t^E < t^B$, leading to $i^E < i^B = i^*$. Personal level taxes favor retained earnings relative to new share issues and, slightly, equity over debt. About 60 percent of investment is externally financed (Organisation for Economic Co-operation and Development, 2004). Prior to reform, we calculate τ^I to be 13.3 percent and τ^S to be 23.7 percent. Our reform scenarios eliminate investment and financing distortions at the firm level, reducing to zero the effective tax rate on investment and reducing the total wedge by 13 percentage points. Under current law, deductibility of interest on debt with no deductions for the cost of equity leads to a substantial tax bias towards debt and contributes to larger debt-asset ratios.

One would expect that moving to a neutral tax system would result in a large stimulus to investment and a substantial reduction in the debt-asset ratio. The magnitude of these effects depends on how the labor market responds to wage increases, and the adjustments of wage tax rates depends on behavioral elasticities. The elasticity of capital demand with respect to the user cost is assumed to be -1 , which requires an elasticity of substitution in production of 1.2, moderately higher than used by Altig et al. (2001). The sensitivity analysis halves these values. Reflecting a mix of buildings and capital equipment, the economic depreciation rate is 7.6 percent. The half-life of capital accumulation is eight years. An increase in the corporate tax rate of 10 percentage points raises the debt-asset ratio by 3.6 points. The real wage elasticity of hours worked is -0.2 . Raising the unemployment insurance replacement rate by 10 percent increases the unemployment rate by 1.4 points. The intertemporal elasticity of substitution in consumption is set at 0.35, somewhat higher than the relatively low value of 0.25 used by Altig et al. (2001). This elasticity is less important in an open economy model with a fixed interest rate.

¹¹ Agents are entitled to some social assistance after the benefits of unemployment insurance expire. In the model, benefits are thus a weighted average of unemployment benefits and social assistance.

III. QUANTITATIVE RESULTS

A. Long-Run Gains and Short-Run Losses

Table 2 reports the long-run simulation results of moving to an R+F-base cash-flow tax from the current income tax in Germany. This reform scenario involves the following changes: (1) immediate expensing replaces normal tax depreciation of new investment; and (2) firms must add new debt to the tax base but may subtract repayment of

	Symbol	ISS	CONS	WAGE	DEBT1	DEBT2
Absolute Changes:						
Additional						
wage/consumption tax	t^j	0	-0.034	-0.045	0.027	-0.005
Public debt/GDP ratio	d^G	0.676	0.628	0.622	1.202	0.941
User cost of capital	u^K	0.06	0.052	0.052	0.052	0.052
Debt-to-capital ratio	b	0.6	0.525	0.525	0.525	0.525
Effective tax rate, investment	τ^I	0.133	0	0	0	0
Effective tax rate, savings	τ^S	0.237	0.225	0.225	0.225	0.225
Effective tax rate labor	τ_1^L	0.35	0.334	0.322	0.372	0.349
Unemployment rate	u	0.105	0.09	0.084	0.097	0.091
Percentage Changes:						
Corporate tax revenue	T^K		-12.802	-10.578	-15.501	-13.226
Gross wage	w		3.55	3.212	3.676	3.456
Effective hours worked	l		1.365	1.741	0.023	0.811
Effective labor demand	L^D		3.033	4.08	0.862	2.343
Capital stock	K		16.663	17.848	14.205	15.881
GDP	Y		7.644	8.737	5.376	6.923
Private consumption	C		6.467	7.4	0.223	3.442
Private financial wealth	A		2.07	2.318	1.885	2.067
Firm value, $t = 1$	V_1		13.201	10.29	12.439	0

Notes: ISS reflects the initial steady state. Under the CONS scenario, a consumption tax (e.g., VAT) is used to achieve budget balance each period. Under the WAGE scenario, the wage tax is used to achieve budget balance each period. Under the DEBT1 scenario, government debt is used to smooth wage tax rates. Under the DEBT2 scenario, government debt is used to smooth wage tax rates and the tax depreciable capital stock is reduced by -81.2 percent at the time of enactment of reform.

both interest and principal on existing debt. The cost of equity remains non-deductible. Given that we assume that the corporate tax rate cannot be changed, the narrowing of the tax base loses tax revenue that must be raised from other sources.¹² We consider four scenarios, all of which are characterized by constant per capita public consumption. In the first two scenarios (columns CONS and WAGE in Table 2), we adjust consumption and wage tax rates in each period to maintain constant revenues, keeping fiscal debt constant per capita. Revenue from consumption taxes might come from raising the value added tax rate (VAT), raising the rates of specific excise taxes, or from eliminating VAT loopholes such as exemptions, reduced rates, and zero rating of certain goods. Hence, the effective consumption tax rate is not identical to the statutory VAT rate. The last two scenarios (columns DEBT1 and DEBT2) use explicit public debt to smooth tax rates and cushion the short-run costs of tax reform. Section III.C below discusses a fifth scenario — delayed deductions for expensing and the associated implicit debt to firms (scenario DEBT3).

1. Consumption Tax Financing

The main long-run effects of reform are due to reducing the effective tax rate on investment from 13 percent to zero, and from eliminating the tax incentive to use external debt. Eliminating the tax preference for debt reduces the debt-asset ratio from 60 to 52 percent. The reduction in the user cost of capital expands the capital stock by 17 percent in the long run. Given a cost share and thus an output elasticity of capital equal to 0.35, capital accumulation alone leads to a 5.8 percent increase in GDP ($\approx 0.35 \times 0.167$). The higher capital intensity, in turn, boosts labor productivity and wages by 3.5 percent. Higher wage earnings stimulate labor supply at both the intensive and extensive margins. Increased earnings relative to unemployment benefits increases job search and reduces unemployment by 1.5 percentage points.¹³ In addition, the higher net real wage leads to a 1.4 percent gain in effective hours worked. The increased work effort per capita together with lower unemployment expands effective employment by 3 percent in the long run, which in turn reinforces the output gains from capital accumulation. In total, GDP is 7.6 percent larger in the long run, relative to the growth path in the absence of reform. Higher wage earnings augment private consumption and wealth by 6.5 percent and 2.1 percent, respectively.

¹² Although beyond the scope of the model, a higher corporate tax rate also induces profit shifting by multinationals and makes a revenue neutral increase in the corporate tax rate unattractive. Given a constant corporate tax rate, the narrowing of the tax base reduces the average tax rate and should make Germany more attractive to internationally mobile firms (Keuschnigg, 2008).

¹³ Unfortunately, our model does not distinguish between high- and low-skilled labor. Unemployment tends to be concentrated among low-skilled workers. If technology exhibits capital-skill complementarity, then capital and low-skilled labor are substitutes, so that low-skilled workers might face lower wages and higher unemployment when tax reform increases capital intensity. As a referee pointed out, our results on wages and unemployment might be sensitive to these factors to some extent, an issue we leave to future research.

Moving to an R+F-base cash-flow tax substantially narrows the tax base but reduces taxable corporate profits by only 12.8 percent in the long run. A much larger revenue loss is prevented by reform-induced capital accumulation, which increases corporate earnings. The expansionary effects of reform further increase other tax bases, so that higher revenue from other taxes more than compensates for the reduction in revenue from the corporate tax. Fiscal balance in each period thus allows a cut in the consumption tax rate of 3.4 percentage points in the long run, which further raises the real wage and reinforces the positive labor market impact of the reform. Hence, moving to an R+F-base tax promises a “double dividend,” since the tax reform not only improves investment incentives and removes tax distortions in capital structure choice, but also yields additional fiscal revenue that can be used to reduce labor market distortions. However, one must emphasize that the additional revenue is available only in the long run, when the transition costs and the associated burdens on present generations are sunk costs. As will be shown below, a large fraction of these long-run gains effectively result from intergenerational redistribution towards future generations, and are thus the mirror image of rather unfavorable short-run effects.

2. Wage Tax Financing

Consumption taxes discriminate less than wage taxes against job search and labor market participation, since replacement income, as well as active earnings, are subject to the consumption tax when spent. In contrast, a lower wage tax in the long run not only stimulates intensive but also extensive labor supply by augmenting the income gap between work and leisure, thereby improving incentives for job search. The long-run impact of moving to an R+F-base tax is thus more favorable than in the CONS scenario. Given that wage tax rates can be reduced by 4.5 percentage points, the larger increase in effective hours worked is reinforced by a substantial reduction of the unemployment rate to 8.4 percent (compared to 9 percent in the consumption tax scenario). This adds an extra percentage point to the long-run increase in total employment and GDP, which now rise by 4 percent and 8.7 percent, respectively.

3. Transition Problems

The need for transition relief arises because the wage tax scenario in column WAGE of Table 2 assumes budget balance in each period and thus requires a large increase in short-run wage tax rates. The lower long-run wage tax rates reported are possible only because this “shock therapy” with instantaneous budget balance imposes all of the transition costs of reform on generations alive in the early transition phase. Moving to an R+F-base system loses a large amount of corporate tax revenue. The introduction of instantaneous investment expensing narrows the tax base in the long run, and even more so in the short run. The short-run loss in corporate tax revenue is drastically magnified since investment is highest in the years immediately following reform. Finally, and perhaps most importantly, when moving to an R+F-base system, firms must add

new debt to the tax base while repayment can be deducted. Like any other neutral tax system, the R+F-base tax leads firms to reduce their debt-asset ratio, from around 60 to 52 percent. Firms achieve this by repaying a substantial part of preexisting debt to bring down the debt-asset ratio. The debt repayment in the first period also reduces the corporate tax base, and is financed by issuing large amounts of new shares.

In this rather extreme scenario, all of these elements combine to yield a negative tax base, so that the government must pay large subsidies to the business sector instead of collecting tax revenue.¹⁴ When these large revenue losses must be financed out of wage tax revenue, budget balance in each period requires drastic increases in the wage tax rate in the years immediately following enactment: 36 percentage points in the first period and 15 points in the second period. This worst-case scenario clearly has very unfavorable short-run labor market consequences. Reflecting the size of the tax shock, the unemployment rate jumps by 8 percentage points to more than 18 percent in the first period, and to 13 percent in the second period. Given the decline in effective employment, GDP contracts by 12 percent and 4 percent, respectively.¹⁵ In subsequent periods, corporate tax losses disappear rapidly and tax revenues grow fast in this period of recovery and high transitional growth, as firms issue new debt again and add the debt to the tax base under the R+F-base system; in addition, depreciation deductions for capital existing at the time of reform decline. After roughly 25 years, wage tax rates fall below their initial values, and asymptotically approach the long-run equilibrium value in Table 2 where the wage tax rate is lower by 4.5 percentage points. In the early years of the transition, the labor market recovers due to increasingly lower tax rates and wage growth induced by capital accumulation. After 12 years, the unemployment rate falls below its initial level. Driven by investment, GDP recovers even sooner and exceeds the initial level after only seven periods.

These adjustments illustrate the stark trade-off between short-run costs and long-run benefits that would result from instantaneous implementation of fundamental tax reform. The income gains from a growth-oriented tax reform are delayed, since the productivity gains from capital deepening occur only after a prolonged period of accumulation. Only those generations living in the more distant future will be able to fully benefit from higher capital stocks and wages while present generations are confronted with large increases in other distorting taxes, which can result in large income losses. Transition relief must thus be a prime policy concern.

B. Tax Smoothing with Government Debt

The first two scenarios impose high wage and consumption tax rates in the years immediately after the enactment of reform and lower rates in the future, thereby imposing a large transition burden on current workers. The scenario in column DEBT1 in Table 2 assumes the government instead uses deficit finance to avoid large initial

¹⁴ Allowing loss carry forward, thereby reducing the need to raise wage taxes and dampening the short-run contraction, could avoid these subsidies. This and other transition strategies are discussed below.

¹⁵ Our model does not capture labor hoarding and other business strategies to absorb large transitory shocks. Such a mechanism might reduce the short-run contraction.

increases in wage tax rates. In this way, future generations benefit from a higher capital stock and higher wages but also share in the transition cost by paying higher taxes to service the increase in government debt. Relative to the first two scenarios, accumulating government debt thus redistributes from future to present generations.¹⁶ The debt policy is assumed to be chosen to achieve perfect tax smoothing, i.e., the wage tax rate is adjusted once and remains constant in all periods after reform. Using deficit finance to reduce high initial wage taxes leads to permanently higher debt levels and requires higher tax rates in the future to pay interest. Simulations show that public debt would almost double from 68.1 percent of GDP to 120 percent, and the wage tax schedule would shift up permanently by 2.7 percentage points. Compared to the WAGE scenario, wage taxes are more than 7 percentage points lower.

Higher future wage taxes, relative to the WAGE scenario, have more unfavorable labor market consequences in the long run. The unemployment rate is 9.7 percent instead of 8.4 percent. Rather than rising by 1.7 percent, hours worked remain unchanged. Employment growth is reduced by more than 3 percentage points, which implies the capital stock is 3.6 percentage points smaller. The long run gains in output are similarly smaller, as GDP increases by only 5.4 percent, rather than the 8.7 percent increase in the WAGE scenario. On the other hand, deficit financing avoids the large initial increase in wage tax rates and thus has less negative effects in the short run. The unemployment rate in the first period rises only slightly to 10.9 percent (instead of 18.6 percent), total employment declines by only 1 percent (instead of 17.7 percent), and GDP shrinks by 0.7 percent (instead of by 11.8 percent). Spreading the transition costs more equally over present and future generations is thus successful in avoiding large short-run income losses from introducing a cash-flow tax but also substantially reduces the long-run growth effects of the reform.

The DEBT1 scenario yields large windfall gains to the owners of old capital, due to an instantaneous increase in firm value equal to 12.4 percent (Table 2). A key reason for this increase is that firms repay a substantial amount of debt to reduce their debt-asset ratios in response to the elimination of the tax-favored status of debt. Since debt repayment is tax deductible with an R+F-base tax, firm value rises due to the resulting substantial tax savings, which in turn require higher wage taxes.¹⁷ The reform thus redistributes substantially from present and future workers towards the owners of old capital. A novel feature of the simulation model is that it includes a calculation of the depreciable capital stock K^T . All of the first three scenarios assumed that these past claims are fully written off at rate δ^T in the years following reform. The present value of these future tax deductions increases firm value, and are independent of future investment levels and have no consequences for investment incentives.¹⁸

¹⁶ Given the absence of an altruistic bequest motive, government debt is not neutral in our model.

¹⁷ In Altig et al. (2001), the introduction of an R-base business cash-flow tax results in windfall losses. Since the authors do not distinguish between debt and equity, they cannot capture how the adjustment of capital structure affects firm value and, indeed, cannot model an R+F-base or an ACE tax.

¹⁸ This essentially explains the difference between average and marginal q (Hayashi, 1982), as is documented in the Technical Appendix.

The presence of windfall gains suggests overly generous treatment of old capital, which redistributes wealth towards the owners of the current capital stock without yielding any benefits in terms of future investment incentives and economic growth. To avoid such redistribution, scenario DEBT2 reduces the tax depreciable capital stock K^T by 81 percent, which reduces tax allowances, increases corporate tax payments in the early phase of the transition, and reduces firm value at the date of enactment of reform. Effectively, the measure imposes a one time wealth tax on current capital owners; it is set to exactly eliminate any windfall gains or losses in the aggregate so that the instantaneous change in firm value upon enactment of reform is zero (Table 2).¹⁹ By raising corporate tax revenue in the years immediately following the enactment of reform, this measure reduces the amount of wage tax financing required; it also reduces the amount of public debt needed for tax smoothing, as the DEBT2 scenario results in a long-run debt-GDP ratio of 94 percent, much lower than the 120 percent under the DEBT1 scenario. Intertemporal fiscal balance is achieved with a constant wage tax rate that is half a percentage point lower than without reform. This corresponds to a reduction of more than three percentage points compared to the DEBT1 scenario. Lower wage taxes naturally improve labor market performance. Figure 1 illustrates that negative short-run effects on unemployment and GDP are completely avoided since wage tax rates are instantaneously and permanently reduced by half a percentage point. After-tax wage earnings grow in all periods, and all generations enjoy higher consumption in all periods.

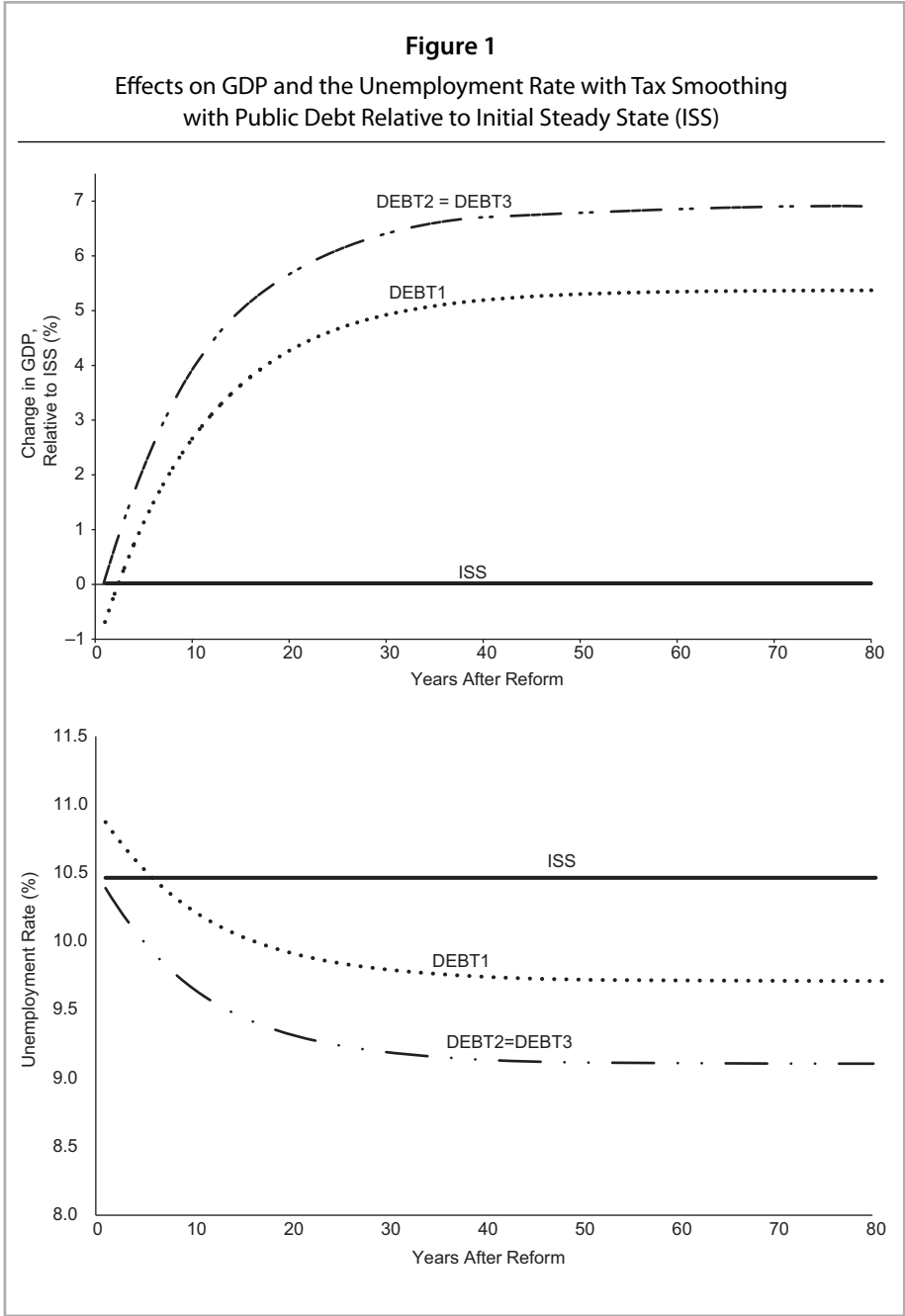
By avoiding reform-induced windfall gains, this transition strategy increases the growth effects of moving to an R+F-base system. Unemployment falls significantly from 10.5 to 9 percent, employment expands by 2.3 percent, and GDP rises by almost 7 percent. Figure 1 shows that the DEBT2 reform scenario results in improved economic performance over the entire transition period. We conclude that a transition strategy for favorable economic outcomes in both the present and the future should (1) implement the reform immediately to reduce distortions of investment and financing decisions at the earliest possible date; and (2) be designed to avoid windfall gains for present equity owners.

However, the need to finance the initial revenue losses attributable to fundamental tax reform with increased government deficits might not be politically acceptable when public debt is already at very high levels. Accordingly, we turn next to an alternative transition strategy.

C. Transition Relief with Delayed Deductions – Present Value Expensing

An alternative strategy for smoothing tax revenue over the transition is to reduce the short-run decline in corporate taxes by delaying tax deductions, while letting firms accumulate unused deductions with interest — an approach that has been described

¹⁹ Keuschnigg (1994) defines intergenerational neutrality of tax changes as the absence of income effects across generations, which includes the absence of reform-induced windfall gains or losses for the oldest generation alive at the time of reform.



as “present value expensing.” Rather than deducting D^T from the tax base, firms add these claims to a stock of unused deductions K^D to be used in future periods. Given that the postponed deductions earn a rate of interest i^E equal to the firm’s discount rate, the timing of deductions does not affect the present value of tax savings and firm value.²⁰ Conversely, firms can only deduct a share δ^D of the historically accumulated stock K^D instead of new claims D^T . In the long run, actual deductions are related to the stream of new claims by $\delta^D K^D = D^T \delta^D / (\delta^D - i^E)$ so that $\delta^D K^D \rightarrow D^T$ in a steady state. A larger deduction rate δ^D implies smaller actual deductions in the long run, that is, $\delta^D K^D > D^T$ as δ^D rises. When introducing a system of delayed deductions, firms initially have zero unused claims K^D , because all such deductions were used in the past. The stock of unused deductions builds up slowly over time and eventually approaches the long-run level. Hence, in choosing a small rate δ^D , the government limits deductions and increases corporate tax revenues today, at the cost of larger deductions (including interest) and lower corporate tax revenues in the future. However, by using delayed deductions to smooth corporate tax revenue over time, the government avoids increasing its deficit in order to smooth wage tax rates.

Since the choice of the rate δ^D determines the implicit fiscal debt, the system of delayed deductions can be constructed to yield long-run effects that are equivalent to those with explicit debt. Scenario DEBT3 in Table 3 sets the deduction rate δ^D equal to one-third, which yields long-run changes that are exactly identical to scenario DEBT2. It also imposes the same reduction in the tax depreciable capital stock. The only differences are in the official debt-to-GDP ratio and in corporate tax revenue. Since the government keeps the per capita level of public debt constant, the debt-to-GDP ratio falls from 67 percent in the initial steady state to 63 percent since GDP grows by almost 7 percent. Long-run corporate tax revenue now falls by 48 percent as compared to the 13 percent decline under scenario DEBT2, which reflects the effects of the implicit fiscal debt.

Figure 2 illustrates the time paths of corporate tax revenues and deductions under alternative approaches to smoothing the transition to an R+F-base cash-flow tax. Scenario DEBT2 allows corporate tax revenue to decline in the early phase of the transition and smoothes wage tax rates by issuing public debt. For the reasons discussed above, the instantaneous decline in corporate tax revenues is dramatic, leading to a subsidy to the business sector in the first period. Due to the repayment of corporate debt in the first period, deductions are about six times higher than in the initial steady state. After this one time correction, deductions are much smaller and corporate tax revenue declines only moderately (by 13 percent in the long run).

²⁰ The system would only be approximately neutral if the carryforward interest rate were not equal to the firm’s discount rate. Note that the same issue arises with the ACE tax. If the government chooses an interest rate lower than the discount rate in calculating the equity allowance, the ACE tax would reduce firm value and discourage equity-financed investment.

Table 3
Long-Run Effects of Alternative Tax Systems

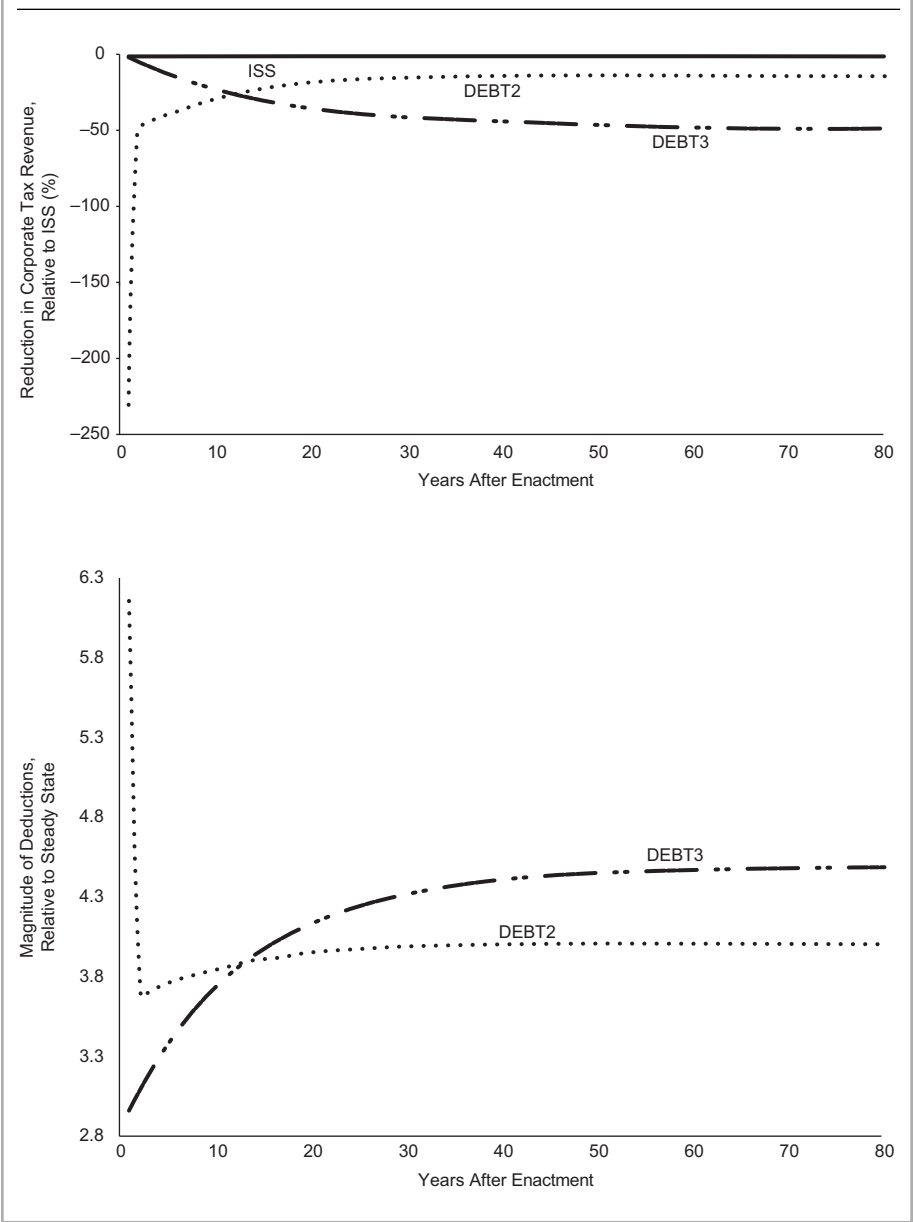
	Symbol	ISS	DEBT3	ACE	R+F-BASE	R-BASE
Absolute Changes:						
Deduction rate	δ^D	0	0.332	0.5	0.224	0.117
New deduction claims ¹	D^T	0.082	0.328	0.152	0.325	0.267
Actual deductions ¹	$\delta^D K^D$	0.082	0.368	0.164	0.387	0.386
Unused deductions, $t = 1^1$	K_1^D	0	0.002	0.489	-0.023	1.557
Additional wage tax	t^L	0	-0.005	0.018	0.018	0.019
Effective tax rate, investment	τ^I	0.133	0	0	0	0.003
Unemployment rate	u	0.105	0.091	0.095	0.095	0.096
Percentage Changes:						
Corporate tax revenue	T^K		-48.138	-69.204	-69.204	-69.204
Gross wage	w		3.456	3.609	3.609	3.544
Effective labor demand	L^D		2.343	1.307	1.307	1.205
Capital stock	K		15.881	14.709	14.709	14.298
GDP	Y		6.923	5.841	5.841	5.637
Private consumption	C		3.442	1.176	1.176	0.989
Firm value, $t = 1$	V_1		0	0	-0.001	0.282

Notes: ISS reflects the initial steady state. In all of the reform scenarios, the tax depreciable capital stock is instantaneously reduced by -81.2 percent and the wage tax rate is adjusted for government budget balance in each period. Under the DEBT3 scenario, deductions are delayed which results in a smooth decline in corporate tax revenue. Under the ACE scenario, an ACE is introduced with delayed expensing. Under the R+F-BASE scenario, an ACE equivalent R+F-base cash-flow tax is introduced with delayed expensing. Under the R-BASE scenario, an ACE equivalent R-base cash-flow tax is introduced with delayed expensing.

¹All deductions are measured as a percentage of initial GDP.

Scenario DEBT3 of Table 3 introduces a system of delayed deductions and also smoothes the decline in corporate tax revenues following a path $T_t^K = T_\infty^K + (T_1^K - T_\infty^K)\mu^{t-1}$ where μ is chosen so that half of the long-run decline in tax occurs within 12 years. Revenue T_1^K in the first period is endogenously computed to avoid any windfall gains to the owners of old capital. Given that this scenario also includes the one-time reduction of 81.2 percent in the tax depreciable capital stock described above, the tax revenue required in the first period is roughly identical to the initial steady state

Figure 2
Effects on Corporate Tax Revenues with Delayed Deductions



value.²¹ As noted previously, since there are no unused deductions prior to the reform, the stock K^D is zero at the outset and grows slowly as new deduction claims are added over time. At each date, firms can claim actual deductions equal to the share δ^D of the stock K^D . Since current deductions are reduced and future deductions are increased, corporate tax revenue is shifted from the future to the present. In the long run, corporate tax revenue declines by 48 percent rather than the 13 percent in scenario DEBT2. By imposing the smooth decline in corporate tax revenue illustrated in Figure 2, this scenario also achieves fiscal balance without any noticeable adjustments in wage tax rates, not only in the long run, but also along the entire transition path. For this reason, the two alternative approaches to implementing an R+F-base cash-flow tax yield almost identical effects on GDP, unemployment and other real variables, as shown in Figure 1.²²

D. Sensitivity Analysis

Simulation results are sensitive to key behavioral parameters that are often imprecisely estimated. The dynamics of capital formation is crucial for the design of transition strategies. Table 4 shows how the results change when the model is calibrated with alternative values for the elasticity of capital demand and adjustment costs. The first column repeats scenario DEBT3 (Table 3). In this base case, adjustment cost parameters imply a half-life of capital accumulation of eight years. To offset windfall gains, the transition policy endows firms with a negligible stock of deductions K_1^D at the time of enactment of reform, leading to delayed deductions of less than 1 percent of initial deductions. To avoid a large, instantaneous loss in corporate tax revenue, the policy allows expensing of only 48 percent of new deductions in the first period, with the remainder added to the stock of unused deductions. To achieve a smooth decline in corporate tax revenue, starting with -1 percent in the first period and approaching -48 percent in the long run, the share ε^0 is gradually reduced to zero until the system of delayed deductions is fully implemented. This policy thus prevents a short-run increase in the wage tax rate and a decline in employment and output (Figures 1 and 2).

If we slow down the transition by raising adjustment costs and lengthening the half-life of capital accumulation to 10 years (column SLOW of Table 4), the value of a unit of installed capital must increase more, leading to larger windfall gains. The policy must thus extract 7.4 percent more corporate tax revenue from firms in the early adjustment period to offset these windfall gains. To achieve this, total deductions (instantaneous and delayed, $\varepsilon_1^0 D_1^T + \delta^D K_1^D$) are endogenously reduced relative to the base case. Although firms may claim a slightly larger share of new deductions (ε_1^0 increases), they have a

²¹ If we had chosen a faster adjustment speed μ , corporate tax revenue would decline more rapidly which would lead, all else equal, to an increase in firm values. To offset this, tax revenue would have required a larger value T_1^K in the first period in order to avoid windfall gains.

²² Short-run economic performance would be slightly better with a faster adjustment speed, leading to larger corporate tax revenue and lower wage tax rates in the short run; see footnote 21.

Table 4
Sensitivity Analysis

	Symbol	ISS	DEBT3	SLOW	FAST	ELAST
Absolute changes, long run:						
Additional wage tax	t^L	0	-0.005	-0.005	-0.005	-0.003
Unemployment rate	u	0.105	0.091	0.091	0.091	0.092
Percentage changes, long run:						
GDP	Y		6.923	6.923	6.923	4.359
Employment	L^D		2.343	2.343	2.343	2.168
Capital stock	K		15.881	15.881	15.881	8.643
Private consumption	C		3.442	3.442	3.442	3.106
Percentage changes, short run, $t = 1$:						
Employment	L_1^D		0.055	0.304	-0.172	-0.184
Firm value	V_1		0	0	0	0
Corporate tax revenue	T_1^K		-0.946	7.433	-8.612	-10.078
Share immediate deductions	ϵ_1^0	1	0.478	0.512	0.446	0.441
Delayed deductions ¹	$\delta^D K_1^D$	0	0.007	-0.287	0.276	0.375

Notes: Under scenario DEBT3, the half-life of capital accumulation is eight years. Under scenarios SLOW, the half-life of capital accumulation is 10 years. Under scenario FAST, the half-life of capital accumulation is six years. Under scenario ELAST, the investment demand elasticity is reduced from 0.95 to 0.54. ¹Numbers are expressed as a percentage of initial deductions D_0^T . In all cases, the consumption rate δ^D of unused deductions is 0.332, and the tax depreciable capital stock is reduced by -81.2 percent at the date of enactment of reform.

negative initial stock of unused deductions that reduces deductions relative to expensing by -28.7 percent of initial deductions. Hence, tax payments first rise and then gradually decline until they are 48 percent lower in the long run. Since high adjustment costs increase windfall gains, more tax revenue must be extracted in the short run to offset these gains. Consequently, the government is able to achieve fiscal balance by slightly cutting wage tax rates, which leads to marginally better labor market performance at the time of enactment of reform. Since adjustment costs affect only the transitional equilibrium, the long-run effects remain unchanged. By comparison, when transition is fast (column FAST of Table 4), windfall gains tend to be smaller relative to the base case, so that government must extract 8.6 percent less corporate tax revenue in the short run to compensate the owners of old capital. The need to rely more on wage taxes slightly erodes labor market performance and output in the short run.

The ELAST scenario shown in Table 4 considers the consequences of imposing a lower elasticity of investment demand with respect to the user cost of capital by reducing the elasticity of substitution in the CES production function from 1.2 to 0.6. Given such a relatively large parameter change, capital accumulation and the long run output gain are substantially diminished, with the increase in GDP falling from 6.9 to 4.4 percent. Windfall gains to old capital are also smaller. To offset these gains, corporate tax revenue must decline by 10 percent. Since this revenue loss is offset with slightly higher wage tax rates, this has a slightly negative short-run effect on the labor market.

E. An Equivalent Tax Reform

The neutrality with respect to investment decisions and financial structure achieved with R+F-base cash-flow tax can also be attained with the ACE and R-base cash-flow taxes. The main differences are in the timing of tax liabilities. While raising the same present value of tax revenues, the ACE tax shifts revenue losses to the future since the cost of capital is deducted later, relative to expensing under cash-flow taxes. Given the same tax rate, an ACE system thus raises less revenue in the long run.²³ This section illustrates how corporate tax regimes can be made equivalent by using a system of delayed deductions even if two separate policy constraints are imposed: the statutory corporate tax rate must be identical under all three tax regimes and explicit public debt is not available to shift tax burdens intertemporally.

Table 3 illustrates the equivalence of these tax concepts. Full equivalence requires that corporate tax revenue must be the same, not only in present value but in all periods. This guarantees fiscal balance with the same wage tax rates during the entire transition period and thus avoids differential effects on the labor market. Given the timing of tax liabilities, revenue from an ACE system must be shifted from the present to the future to assure that the entire time path of corporate tax revenue becomes identical, while the reverse is required with cash-flow taxes. This requirement can be met by injecting the appropriate amount of implicit fiscal debt in using delayed deductions. With cash-flow taxes, new deduction claims are large in the early phase of the transition due to immediate investment expensing and thus should be consumed at a relatively low rate δ^D which delays them to a large extent. The associated high level of implicit debt is “repaid” in the future (a small δ^D means large deductions $\delta^D K^D$ in the future) when tax revenue is high due to increased capital accumulation. With an ACE tax, in contrast, current deductions are relatively small since there is no investment expensing. To reduce revenue in the early years after reform, deductions must be claimed at a relatively large rate δ^D , resulting in small levels of implicit debt and shifting of revenue from the present to the future.

²³ Ignoring any other details, the tax base is $f(K) - iK$ with an ACE tax and $f(K) - gK$ with a cash-flow tax where $I = gK$ is stationary investment. Since interest exceeds the growth rate g in a dynamically efficient economy ($i > g$), the long-run stationary tax base is lower with an ACE tax.

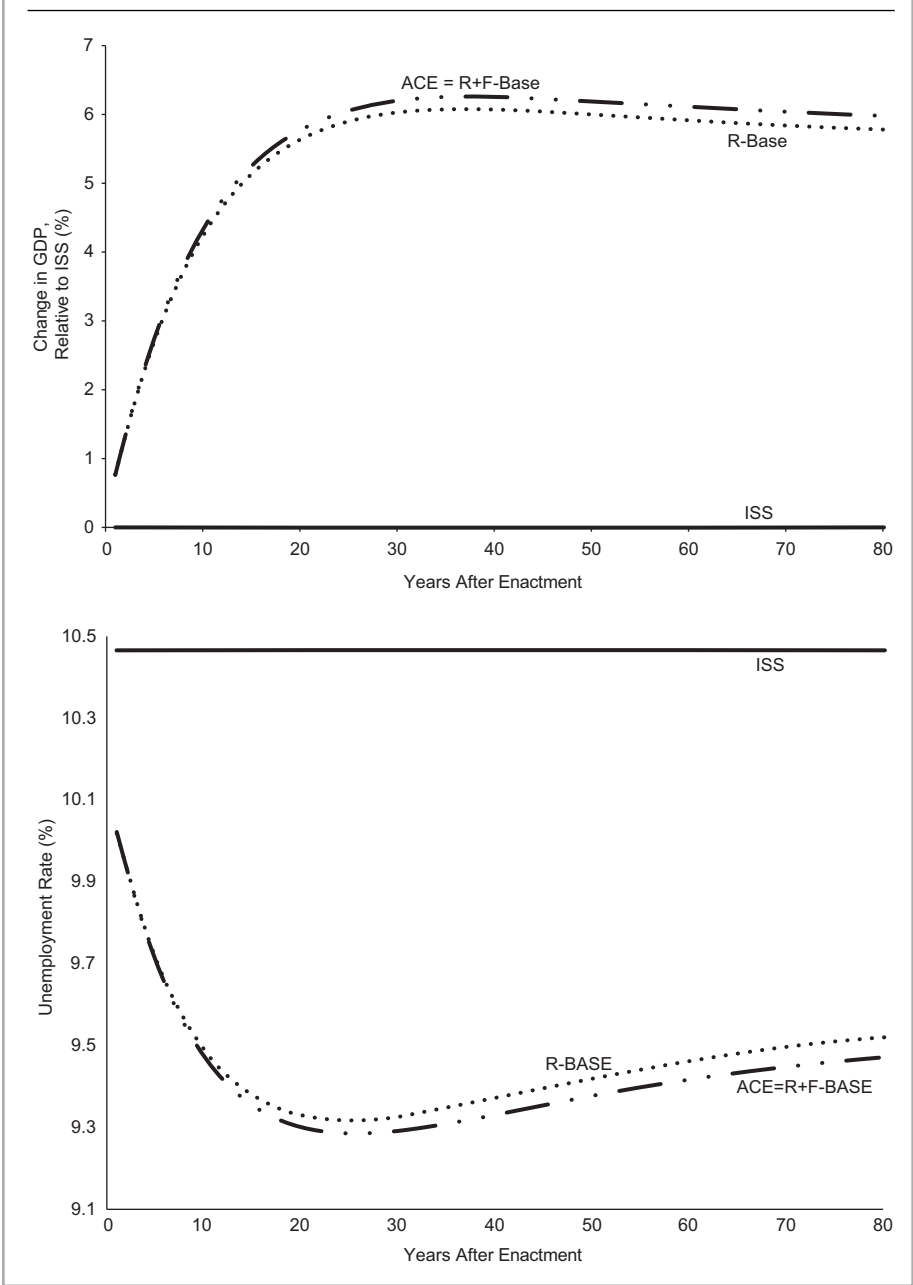
Following this approach, we show in Table 3 the required rates of delay δ^D and the associated levels of implicit debt such that all three alternatives yield exactly the same amount of corporate tax revenue and — for total fiscal balance — require the same adjustment in the wage tax rate t^L . As argued above, the ACE tax requires a very high deduction rate, equal to 0.5 compared to 0.22 and 0.12 for cash-flow taxes. For this reason, actual deductions in the long run are only slightly higher than new deduction claims with an ACE tax, while they are substantially larger with cash-flow taxes. Table 3 shows that the decline in corporate tax revenue, which is same in all three regimes by construction, amounts to almost 70 percent and is much higher than under the R+F-base tax scenario shown in column DEBT3. The reason is that, given an unchanged statutory tax rate, the long-run tax base under an ACE system is too small to raise the same revenue as under the R+F-base tax. A further increase in the deduction rate, leading to less delay and implicit debt, does not increase future tax revenue since actual deductions are already almost as small as new deduction claims (16 and 15 percent of initial GDP, respectively).

Adopting an ACE tax without changing the statutory rate forces policy makers to accept lower corporate tax revenue in the long run, which dictates a higher wage tax rate to assure fiscal balance. The resulting negative labor market effects slightly reduce economic performance under an ACE tax. Column ACE is the new benchmark for demonstrating equivalence between the tax systems. In Table 3, the economic effects of an ACE and the R+F-base cash-flow tax are identical. GDP grows by 5.8 percent and unemployment falls by one percentage point. The R-base system, however, is fully neutral only with uniform effective personal taxes on equity and debt. Due to the taxation of capital gains only upon realization, equity remains tax favored even if statutory personal income tax rates on interest, dividends and capital gains are equal. Personal taxes thus lead to a small bias with respect to capital structure and investment. The equivalence between the R-base cash-flow tax and its alternatives is thus only approximate.²⁴

To make corporate tax systems equivalent without using explicit public debt, they must yield equal revenue not only in present value but also during the entire transition. To avoid non-monotonic paths of wage tax rates, we impose a smooth decline in corporate tax revenue with a half-life of 12 years as before, leading to a revenue loss of 70 percent in the long run (Table 3). Since extracting more tax reduces firm values, we scale up tax revenue T_1^K in the first period — and thus the entire path of tax revenue during the transition — by an amount that exactly eliminates windfall gains to old capital. Prior to reform, corporate tax revenue is 3.4 percent of GDP. To prevent windfall gains, this share increases in the first period to 4.6 percent and then slowly declines to 1 percent of initial GDP. This same stream of corporate tax revenue is attained in all three regimes by adjusting the system of delayed deductions. Given the somewhat higher level of corporate tax revenue in the first period, fiscal balance requires an immediate reduction of wage taxes. In plotting the time paths of GDP and unemployment, Figure 3 illustrates

²⁴ If the effective capital gains tax rate were exactly identical to the statutory rates on other forms of capital income, there would be complete neutrality and the equivalence in Table 3 would be exact.

Figure 3
Economic Performance With Equivalent Tax Systems



how the appropriate transitional policies lead to identical economic performance, thereby establishing the equivalence of the alternative tax systems.²⁵ By avoiding windfall gains, these transition strategies promise higher GDP and lower unemployment from the time of enactment, irrespective of whether an ACE, R-base, or R+F-base tax is introduced.

In reality, access to policy instruments that shift tax revenue across time are surely limited, making it difficult to achieve the desired time path of corporate revenue with delayed deductions alone. The method used here is motivated by the existence of income tax rules that allow carry-forward or carry-backward of tax losses when firms do not have enough profits to make full use of deductions. A system of delayed deductions could be largely successful in avoiding large shocks to corporate tax revenues after the implementation of fundamental tax reform. If delayed deductions were not fully successful in smoothing out declines in corporate tax revenue, the government could achieve this goal by raising some transitory debt on the capital market.

IV. CONCLUSIONS

We have analyzed the short-run and long-run effects of fundamental tax reform, defined as moving from an income tax to an R+F-base cash-flow tax, an R-base tax, and an ACE tax. All of these reforms stimulate capital formation, increase wages, and improve labor market performance, leading to significantly lower unemployment. Given current tax distortions, the long-run income gains could be in the range of 5 to 8 percentage points of GDP. However, these gains mainly accrue in the long run and thus benefit future generations. If the corporate tax rate cannot be raised, the loss in corporate tax revenue after the enactment of reform leads to large windfall gains for the owners of old capital. If the government must balance the budget each year, the tax burden must be shifted to labor, which has very negative short-run effects on employment and output.

This paper demonstrates how imposing a one-time reduction in the tax basis of the existing depreciable capital stock can reduce these short-run costs of fundamental tax reform. This measure reduces the loss in corporate tax revenue, and can also be designed to eliminate windfall gains to avoid unfavorable distributional effects. One possibility for spreading the gains and costs of tax reform more evenly across generations is to issue government debt rather than increasing wage tax rates. An alternative strategy is to incur "implicit" public debt by introducing a system of delayed deductions, under which firms would not be allowed to deduct new claims immediately but would be required to carry them forward with interest, leading to higher deductions in the future. This policy shifts corporate tax revenue from the future to the present, while avoiding increases in other distorting taxes in the short run. Our simulations suggest that it is possible to design transition strategies so that fundamental tax reform plans result in improved economic performance both in the short run and the long run.

²⁵ As argued above, the R-base and R+F-base tax systems are not entirely equivalent when the taxation of capital gains leads to a slight preference for equity and thus creates some distortions under the R-base cash-flow tax system.

ACKNOWLEDGMENTS

Financial support from Humanistische Stiftung in Frankfurt and very helpful comments by Georg Jehner, Joachim Mitschke, Clemens Fuest, and Martin Kolmar are gratefully acknowledged. We are indebted to two anonymous referees and the editor, George Zodrow, for many constructive suggestions.

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