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Abstract

This paper discusses alternative transition strategies of moving towards an S-base cash-flow business tax. While the tax has attractive neutrality properties, moving from the current situation towards the new system often involves a stark trade-off between short-run losses and long-run gains. We evaluate several alternative transition strategies. The preferred strategy consists of instantaneous implementation, an 80% devaluation of historical tax depreciation claims, and transitory deficit financing for intertemporal tax smoothing. This policy prevents windfall gains or losses on old capital, avoids a negative impact on labor market performance and thereby prevents short-run income losses. Simulations with a calibrated model for Germany indicate that this transition policy induces strong investment driven growth and yields a 7% gain in GDP per capita and a reduction in the unemployment rate by 1.5 percentage points in the long-run.

JEL-Classification

H21, H25, H32, J64.

Keywords

Cash-flow tax, investment, unemployment, transition policy.

1 Introduction

In most countries, the system of company taxation has historically evolved in a way that slows down growth and interferes with an efficient allocation of capital. Business taxation distorts on multiple behavioral margins (see Auerbach, 2002, for a review). The tax system typically discourages investment and capital accumulation (Hasset and Hubbard, 2002), favors debt over equity financing (Miller, 1977, and Graham, 2003), favors profit retentions and reduces payouts (Poterba, 2004, and Chetty and Saez, 2005), discourages foreign direct investment and leads to profit shifting in high tax countries (see OECD, 2007, for a review), can distort the choice of legal form (MacKie-Mason and Gordon, 1997), and often discourages new firm creation (see Cullen and Gordon, 2002). Presumably the most important distortions with the largest detrimental effect on economic performance are the impact on investment and capital structure choice. The distorting effects of taxes on these margins are summarized by the measurement of marginal and average effective tax rates (King and Fullerton, 1984, and Sorensen, 2004).

A large literature focusses on the design of a more neutral tax system that could yield important efficiency gains by eliminating distortions both in the level and allocation of capital. Sinn (1987) discusses a range of alternative tax systems, analyzes their neutrality properties and derives the effects on investment based growth. The Meade Report (1978) developed various designs of consumption-based tax systems with cash-flow taxation of profits. A cash-flow tax is part of the *flat-tax* proposal of Hall and Rabushka (1995) and was recently recommended by the US President's Advisory Panel on Federal Tax Reform (2006). Mitschke (2004) opted for a variant (S-base) of a cash-flow tax as part of a comprehensive tax reform proposal for Germany. The present paper studies the transitional and long-run consequences of introducing an S-base cash-flow tax. The main advantages of the tax are its neutrality properties with respect to investment and financial choices which could lead to substantial income gains when it replaces the distorting aspects of the current system. The main alternative concept is the ACE system with an *allowance for corporate equity* which goes back to Boadway and Bruce (1984) and was introduced in the tax reform debate by the Institute for Fiscal Studies (1991). Bond and Devereux (1995) argue that ACE and cash-flow taxes are, in fact, equivalent. In the UK, the background studies for the Mirrlees Report (2009) seem to favor an ACE system.

A considerable literature discusses the potential benefits and costs of moving towards a

consumption based tax system of which a cash-flow corporate tax is part of it (see Auerbach, 2008, for a primer, as well as Bradford, 2005, Gordon et al. 2004, and references therein). Part of this work uses simulation models to assess efficiency and distributional consequences of moving from the income to variants of a consumption tax (Auerbach, Kotlikoff and Skinner, 1983; Auerbach and Kotlikoff, 1987; Auerbach, 1996; Altig et al., 2001; Keuschnigg, 1991; Keuschnigg and Dietz, 2007; Radulescu and Stimmelmayr, 2007, Sarkar and Zodrow, 1993; and Zodrow, 2002). Bradford (1996) and Kaplow (2008) discuss fundamental conceptual problems related to the transition issues. Kaplow particularly focusses on the role of capital levies and the treatment of windfall gains and losses at the date of reform. In essence, this literature points to an important conflict between the long-run gains and short-run losses of a growth oriented tax reform and shows that transition relief to protect present generations often reduces the long-run growth effects quite substantially.

The present paper specifically discusses the consequences of moving to an S-base cash-flow tax in Germany. Such a system was recently suggested by Mitschke (2004). Using balance sheet and income tax data, Becker and Fuest (2005) found that the revenue losses might actually be quite moderate and conclude that the current tax system collects little revenue from actually taxing the normal return to capital. Their analysis follows the methodology of Gordon and Slemrod (1988) who argued that the US might have actually gained revenue by moving to a consumption tax while their update in Gordon, Kalambokidis, Rohaly and Slemrod (2004) for the years 1995 and 2004 yields considerable losses in tax revenue. These empirical studies, however, do not take into account any behavioral response of tax reform. Fuest et al. (2006) use a microsimulation model and found rather moderate long-run effects of implementing the entire income tax proposal due to Mitschke (2004) which includes also a general income tax reform apart from moving to an S-base cash-flow tax. Their model is less useful in computing growth effects from induced capital accumulation and dynamic gains of tax reform since it doesn't take account of transitional issues. The analysis of alternative transition strategies and their trade-offs between short- and long-run growth is the main contribution of this paper.

This paper studies the short- and long-run consequences of moving to an S-base cash-flow tax in Germany and uses a detailed computational growth model of an open economy with overlapping generations. A particularly novel feature is the existence of equilibrium unemployment

which introduces a new transmission channel of gains and costs of capital income tax reform. The incidence of the corporate income tax is, thus, not only on the wealth of present generations and wage earnings of present and future workers, but is also felt in terms of significant effects on involuntary unemployment (see Keuschnigg, 2009, for analytical results). The paper thus yields new insights on capital income tax reform in an advanced welfare state with high unemployment which seems particularly important for Germany. Apart from intertemporal savings and investment behavior as drivers of growth and wealth creation, the model also endogenizes capital structure choice. This will reveal the quantitative implications of eliminating the tax distortion in favor of debt financing. It will also identify an important transitional problem of moving to an S-base system that is neglected in many if not most of the quantitative studies. The tax reform leads firms to reduce the debt asset ratio. Since capital accumulation and, thus, total assets can change only slowly, firms achieve a lower debt asset ratio in the short-run by repaying a large amount of debt and issuing new equity instead. In an S-base system, new debt is added to taxable profit but repayment of debt reduces the tax base, leading to losses of corporate tax revenue in the short-run. These losses significantly add to the transition costs. This and other transition problems are an illustration of Feldstein's (1976) argument that an attractive 'de novo' design of a tax system might not be as attractive anymore if the difficulties of moving from initial conditions to the new system and the need for compensating potential losers is appropriately taken account of.

A careful discussion of problems related to transition is important for several reasons. Apart from important legal aspects related to the implementation, the political acceptance of fundamental tax reform is certainly bigger if the reform yields positive effects in the short-run as well. Further, a large part of the long-run gains might merely reflect redistribution towards future generations rather than pure efficiency gains. Our discussion of transition strategies emphasizes three crucial elements: (i) Speed of reform, i.e. gradual versus instantaneous implementation of the system; (ii) Treatment of windfall gains or losses on old capital at the date of reform which fundamentally affects the distribution between owners of old capital and present and future workers; (iii) The use of debt policy to smooth tax rates and to distribute transition costs more evenly between present and future generations. After evaluating a number of alternatives, our most favored transition policy is characterized by the following elements: (i) Instantaneous im-

plementation of the S-base system without delay; (ii) Devaluation of historical tax depreciation allowances by about 80% and writing off the remaining 20% of the stock in the early transition phase. This measure implies that current owners of the capital stock experience neither windfall gains nor losses and are exactly compensated;[1] (iii) Using public debt to perfectly smooth wage tax rates over time where the level of these tax rates is chosen to satisfy the government's intertemporal budget constraint.

When keeping capital income tax rates constant, we find that the once and for all change in the wage tax is almost zero, i.e. the reform can be implemented with no significant change in the wage tax burden. Using deficit finance in the short-run to smooth tax rates over time accumulates public debt of 94% of GDP in the long-run, up from today's level of 67%. The transition policy thus prevents an increase in labor taxes (or other distorting taxes) and thereby avoids a negative impact on short-run labor market performance. There is no instantaneous decline in GDP, no increase in unemployment and no windfall loss on household sector financial wealth. Yet the strong investment incentives of the S-base cash-flow tax are immediately effective to start capital accumulation. Once the associated productivity gains materialize, wages rise, unemployment declines and GDP strongly grows not only because of capital accumulation, but also because of higher employment. When the economy approaches the new stationary equilibrium, the unemployment rate is down by 1.5 percentage points, wages are 3.4% higher, employment expands by 2.3% and GDP grows by 7% in the long-run, compared to what it would be with balanced growth in the absence of tax reform. With the S-base system, corporate tax revenue is 13% lower but the loss in tax revenue and the larger interest cost of servicing the higher level of public debt are fully compensated by the growth induced revenue gains from other taxes, and from the savings in social spending due to lower unemployment.

In the following, Section 2 first derives some stylized analytical results and then discusses the more elaborate structure and the calibration of the simulation model. Section 3 reports simulation results. Section 4 summarizes the main insights.

[1] In isolating efficiency gains of tax reform from redistribution in an overlapping generations model with old and young agents, Keuschnigg (1994, p. 351-2) defines intergenerational neutrality of tax changes by the absence of income effects across generations. Part of this definition is the absence of windfall gains or losses imposed on the first old generation. This result intuitively rationalizes the design of our preferred transition strategy.

2 Transition to a Cash-Flow Tax

2.1 Long-Run Impact

We design a quantitative model to analyze the short- and long-run effects of moving to a cash-flow tax in Germany. The model includes several taxes at the firm and investor level, allows for different definitions of the tax base and can, thus, simulate the transition to widely discussed alternative tax systems such as variants of a cash-flow tax, a CBIT business tax or an ACE system (allowance for corporate equity). This paper focusses on moving towards an S-base cash-flow tax, as was recently suggested for Germany by Mitschke (2004) and analyzed by Becker and Fuest (2005). We present here only those parts of the model which are necessary to derive the main long-run implications of the reform and illustrate the difficulties confronted when moving from the status quo to full implementation of the reform. The Appendix derives optimal investment and capital structure choice of firms and shortly introduces the details of capital income taxation at the personal level.[2]

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

$$\begin{aligned} (a) \quad K_{t+1} &= I_t + (1-\delta) K_t, \\ (b) \quad \tilde{K}_{t+1} &= \left(1-\epsilon^I\right) I_t + \left(1-\tilde{\delta}\right) \tilde{K}_t, \\ (c) \quad B_{t+1} &= B_t^N + B_t, \end{aligned} \tag{1}$$

where B^N is new debt issues, I gross investment and δ the economic depreciation rate. Importantly, firms also accumulate a tax depreciable capital stock $\tilde{K}$ which is written off at a rate $\tilde{\delta}$. While a part $\epsilon^I I$ of investment is immediately expensed, the remaining part is added to the tax depreciable capital stock and written off over the remaining life-time of the asset. The generosity of tax depreciation is reflected in ϵ^I and $\tilde{\delta}$.

Net investment adds to capacity and determines earnings $\tilde{Y} = F\left(K, L^D\right) - J\left(I, K\right) - W^D$ where F is a standard production function and L^D and W^D are employment and the wage bill.[3]

[2] The reader is referred to Keuschnigg and Keuschnigg (2009) for a complete model documentation, including frictional unemployment resulting from job search of households and job creation by firms.

[3] The separate Appendix (Keuschnigg and Keuschnigg, 2009) explains hiring subject to recruitement costs in a search labor market.

Further, installing I units of new equipment creates installation costs J, measured in terms of foregone output. These costs are convex increasing in investment and declining in the capital stock, and are normalized to zero when the investment to capital ratio is stationary. Subtracting the cost of external debt, consisting of interest i^B plus debt management costs m per unit of capital, as well as economic depreciation and corporate tax yields firm profits

$$\begin{aligned} \pi &= \tilde{Y} - i^B B - mK - \delta K - T^K, \\ T^K &= t^K \left[\tilde{Y} - \tilde{\delta}\tilde{K} - \epsilon^I I - \epsilon^B \left(i^B B + mK \right) + \epsilon^N B^N - \epsilon^E i^E \left(K - B \right) \right]. \end{aligned} \tag{2}$$

The cost of external debt not only includes interest paid to investors, but also 'agency costs' or debt management costs $m(b)$. Following much of the tax literature, we model them in reduced form only. They are assumed convex in the firms's debt asset ratio $b = B/K$. While some debt might be useful to discipline management, too much debt can create bankruptcy costs. These offsetting forces are assumed to result in an optimal capital structure $\bar{b}$ such that agency costs are minimized, i.e. $m' \gtrless 0 \Leftrightarrow b \gtrless \bar{b}$. For simplicity, $m\left(\bar{b}\right)$ is normalized to zero.

Apart from the corporate tax rate t^K, the tax liability depends on the definition of the tax base which is controlled by several ϵ-parameters. The tax base consists of earnings and is reduced by normal and instantaneous tax depreciation, $\tilde{\delta}\tilde{K}$ and $\epsilon^I I$. Total assets K are split into debt B and equity $K - B$. In most real world tax systems, the tax code further allows a deduction of the cost of debt ($\epsilon^B = 1$), consisting of interest spending and debt management costs. If $\epsilon^N = 1$, firms must add the proceeds from new debt issues to their taxable earnings and, conversely, can subtract repayment of debt. Finally, some tax systems set $\epsilon^E = 1$ and thereby include an allowance for the cost of equity (ACE). In standard systems, and reflecting the status quo in Germany, $\epsilon^B = 1$ (full deduction of interest on debt), $\epsilon^N = 0$ (no addition of new debt), $\epsilon^E = 0$ (no deduction of the interest cost of equity), $\epsilon^I = 0$ (no immediate write-off, or at least small), and $\tilde{\delta} \geqslant \delta$ (faster tax depreciation). An **S-Base Cash-flow** tax is characterized by $\epsilon^I = \epsilon^B = \epsilon^N = 1$ and $\epsilon^E = 0$. Apart from immediate depreciation, new debt must be added to the tax base while interest costs are deducted. No allowance for the cost of equity is possible.

Value maximization yields optimal decision rules of firms as in (A.4-A.5) of the Appendix. The optimal debt asset ratio $b = B/K$, for example, is implicitly determined by the condition

$$\left[1 - \left(\epsilon^N + \epsilon^E\right) t^K\right] \cdot i^E = \left(1 - \epsilon^B t^K\right) \cdot \left[i^B + m'(b)\right]. \tag{3}$$

In the status quo, characterized by $\epsilon^N = \epsilon^E = 0$ and $\epsilon^B = 1$, the rule reduces to $i^E = \left(1 - t^K\right)\left(i^B + m'\right)$. The market dictates rates of return on equity and debt equal to i^E and i^B which depend on interest i^* and personal taxes on interest, dividends and capital gains. Firms raise their leverage and accept increasingly high agency costs m' at the margin until the cost of equity is equalized to the net cost of debt. A higher tax rate thus encourages higher leverage since the cost of debt is tax deductible while the opportunity cost of equity is not. When moving to an **S-Base cash-flow tax**, the government defines the tax base by setting $\epsilon^I = 1$, $\epsilon^B = \epsilon^N = 1$ and $\epsilon^E = 0$. The optimal use of debt is now governed by $i^E = i^B + m'$. In equally treating the costs of debt and equity, an S-Base cash-flow tax implies debt neutrality at the firm level. If, in addition, interest, dividends and capital gains were all taxed in a non-discriminatory way, with identical personal level tax rates $t^D = t^G = t^B$, the tax system would be completely neutral since $i^E = i^B$ and $m'\left(\bar{b}\right) = 0$, just as in a world without taxes.

In a long-run, stationary equilibrium, the pretax return on capital equal to the user cost of capital $u^K \equiv F_K - \delta$, is given in (A.7) of the Appendix and can be written as

$$\begin{aligned} u^K &= (1-b)\cdot \tfrac{1-\epsilon^E t^K}{1-t^K} i^E + b \cdot \tfrac{\left(1-\epsilon^B t^K\right) i^B + \epsilon^N t^K i^E}{1-t^K} + P^I, \\ P^I &\equiv \left[\delta t^K - \left(i^E + \delta\right) Z + \left(1 - \epsilon^B t^K\right) m\right] / \left(1 - t^K\right), \\ Z &\equiv \epsilon^I t^K + \left(1 - \epsilon^I\right) \tfrac{z}{1+i^E}, \quad \tfrac{z}{1+i^E} = \tfrac{\tilde{\delta} t^K}{i^E + \tilde{\delta}}. \end{aligned} \tag{4}$$

The present value of normal tax depreciation is z while Z is the effective tax subsidy to the purchase cost of new capital, including instantaneous depreciation. The impact of the tax system on the cost of capital is in three parts. The first two terms capture the impact on the cost of equity and debt financing which feed through to the user cost in proportion to the equity and debt ratios, $1 - b$ and b, respectively. The third term captures a tax cost or subsidy independent of the source of finance. In the status quo, accelerated tax depreciation can be summarized by $\epsilon^I = 0$ and $\tilde{\delta} > \delta$, and the tax base is defined by $\epsilon^N = \epsilon^E = 0$ and $\epsilon^B = 1$. The user cost of capital thus emerges as $u^K = (1-b)\cdot i^E / \left(1 - t^K\right) + b \cdot i^B + P^I$ where $P^I = m(b) - \left(\tilde{\delta} - \delta\right) \frac{i^E}{i^E + \tilde{\delta}} \frac{t^K}{1-t^K}$. To the extent that investment is equity financed, the corporate tax raises the user cost and discourages investment since the cost of equity is not tax deductible. Firms have to earn a higher pre-tax return $i^E / \left(1 - t^K\right)$ to pay investors the required return i^E after firm level taxes. The tax, however, does not discourage debt financed investment since the cost of debt is deducted from the tax base. Finally, accelerated tax depreciation $\tilde{\delta} > \delta$ results

in a present value of tax savings that effectively subsidize the cost of capital, leading to $P^I < 0$. On the other hand, if the tax system distorts financing choices ($b \neq \bar{b}$), it leads to higher debt management costs and, thereby, inflates the user cost by $m > 0$.[4] In the absence of tax, agency costs are zero since 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 $F_K = i^* + \delta$ in an open economy.

When moving to an **S-base cash-flow tax**, the investment subsidy is $Z = t^K$ due to immediate expensing which leaves a subsidy $P^I = m - t^K i^E / \left(1 - t^K\right)$ to *both* equity and debt financed investment. The cost of capital thus emerges as $u^K = (1-b) \cdot i^E + b \cdot i^B + m$, i.e. the corporate tax is neutral with respect to investment. If, in addition, personal level taxes are non-discriminating, investment incentives are again summarized by $F_K = i^* + \delta$.

2.2 Transition Strategies

To illustrate the main difficulty, one should first note that allowing immediate investment expensing also implies that firms are denied any claims on normal tax depreciation. When the government honors past promises, the tax base is still reduced by depreciation allowances $\tilde{\delta}\tilde{K}$ at the date of reform since past claims are historically predetermined. These allowances disappear over time since the existing tax depreciable capital stock is written off according to $\tilde{K}_{t+1} = \left(1 - \tilde{\delta}\right) \tilde{K}_t$. Comparing the tax bases under the status quo and after implementation of the S-base cash-flow tax yields

$$\begin{aligned} \textbf{Status Quo} \quad &: \quad T^K = t^K \cdot \left[\tilde{Y} - \left(i^B B + mK\right) - \tilde{\delta}\tilde{K}\right], \\ \textbf{S-base} \quad &: \quad T^K = t^K \cdot \left[\tilde{Y} - \left(i^B B + mK\right) - \tilde{\delta}\tilde{K} - I + B^N\right], \end{aligned}$$

At the date of tax reform, the allowances $\tilde{\delta}\tilde{K}$ are still present in the full amount and disappear only after an extended transitional period. All stocks and, largely also $\tilde{Y}$, are fixed in the short-run. The transitional problems are largest in the first period of implementation when stocks are predetermined. The tax base can shrink dramatically for two reasons. First, immediate investment expensing erodes the tax base by an additional amount $I - B^N$ which can be substantial. Especially, in the first periods investment will be particularly high to start the growth process.

[4] Defining the average costs of finance as $i^K = (1-b)\, i^E + b i^B + m$ yields an effective firm level tax rate $\tau^I = \left(u^K - i^K\right) / u^K$ as reported in Figure 1 and Table 1 below.

Given that the S-Base tax removes the debt preference under the status quo, firms might also want to repay part of their debt and issue equity instead, making $B^N < 0$, which further erodes the tax base under the S-Base system in the early adjustment phase. Second, some tax reform proposals (such as Mitschke, 2004, for Germany) argue that old equity capital $K - B$ must be compensated for the following reason: since immediate expensing reduces the acquisition price of new capital from 1 to $1 - t^K$, arbitrage dictates that the value of old capital would fall as well but it never had the advantage of immediate expensing. If the government wanted to grant a compensation to avoid 'expropriation' of old capital because it did not benefit from immediate expensing, one way to do so would be to raise $\tilde{K}$ instantaneously by adding part of old equity $K - B$. Such compensation of the owners of old capital – even if stretched over time – would inflate the allowances $\tilde{\delta}\tilde{K}$ and additionally shrink the tax base during the early transition, leading to even larger short-run losses in tax revenue.

We implement a series of transition scenarios that highlight the trade-off between short-run losses and long-run gains of moving towards an S-base cash-flow tax. These scenarios point to three key factors in determining this trade-off: (i) the treatment of *old capital* to avoid windfall gains or losses; (ii) the *speed* of implementing the reform, i.e. instantaneous versus gradual introduction; (iii) the use of public debt for intertemporal budget balance with *tax smoothing*. Without tax smoothing, annual budget balance would require very high tax rates in the short-run when introduction of the S-base tax yields particularly high revenue losses. Once growth sets in, tax bases expand and tax rates can be reduced. Instead of accepting very high wage tax rates in the short-run with damaging labor market effects, the scenario allows for transitory deficits and accumulates debt in a way that reduces wage tax rates in the short-run and raises them in the future to service higher debt until rates are equalized over the entire time horizon.

Gradual implementation of the S-base system is modeled as follows. The value of a given ϵ-parameter defining the tax base is equal to ϵ_1 in the status quo and ϵ_T in the S-base system. For example, instantaneous investment expensing would be $\epsilon_1^I = 0$ before and $\epsilon_T^I = 1$ after full implementation of the reform. Gradual implementation sets a time path $\epsilon_t = \epsilon_T + (\epsilon_1 - \epsilon_T) \cdot \mu^{t-1}$, where $\mu < 1$ is the transition speed. The same reform speed μ is applied to all other ϵ-parameters discussed above. Slowing down the transition limits short-run revenue losses but also postpones to some extent the favorable incentive and growth effects of the reform.

2.3 Simulation Model

For quantitative evaluation, we use a dynamic general equilibrium model which is calibrated to replicate the data of the German economy. In essence, it is a neoclassical growth model of an open economy with an internationally given interest rate which features intertemporally optimizing investment and savings, endogenous labor supply along intensive and extensive margins, and a detailed modeling of the tax system. A novel aspect of the model is that it takes account of involuntary unemployment reflecting job search of households and job creation of firms. This should be particularly important for an analysis of tax reform in Germany where the unemployment rate has fluctuated around 10 percent in recent periods.[5] The household sector is based on an overlapping generations model with a period length of one year where agents are analytically aggregated into a limited number of age groups. We distinguish 5 active worker groups and 3 retired age groups. The overlapping generations structure allows us to address intergenerational distribution effects of several alternative transition strategies of tax reform. A complete mathematical documentation is found in Keuschnigg and Keuschnigg (2009).

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 government debt as well as equity and debt of the business sector. Assuming a strong home bias in asset ownership, equity is fully held by domestic investors. Firms hire workers on a frictional labor market, invest in new equipment and endogenously choose the capital structure. Fiscal spending is on public consumption and transfers to households. Tax revenue consists of several types of capital income taxes on the investor and firm level, labor income taxes and indirect taxes. Public debt may be used to shift the tax burden between present and future generations. In addition, there is a pay as you go pension system, balancing contributions and pensions, and an unemployment insurance system collecting contributions of employed workers and paying benefits to the unemployed. Labor supply can thus change on the intensive and extensive margins, i.e. by varying hours of work (or work effort) of the employed and job search of currently unemployed workers.

[5] Substantial empirical research points to important effects of business tax reform on the unemployment rate. Keuschnigg (2009) analytically discusses the transmission channels and the implications of policy reform.

Table 1: Model Parameters

Investment and Financing:		
g	Growth rate of labor productivity	0.015
i	Real interest rate, gross	0.052
r	Real interest rate, net	0.040
δ	Depreciation rate of capital	0.076
b	Share of external debt financing	0.600
α	Share of capital income	0.350
τ^I	Effective tax rate, investment	0.133
τ^S	Effective tax rate, savings	0.237
τ	Effective tax rate, total capital	0.338
Consumption and Labor Supply:		
σ^C	Intertemporal elasticity of substitution	0.350
τ^L	Effective tax rate, young, hours worked	0.350
τ^{JS}	Effective tax rate, young, job search	0.688
Frictional Labor Market:		
ξ	Bargaining power employees	0.750
η	Matching elasticity w.r.t. job search	0.500
$\bar{u}$	Average unemployment rate	0.105

Table 1 reports the most important parameters. Some of them are standard and are, thus, not discussed in much detail (see Altig et al., 2001, for a comparison). The interest rate and the growth rate of labor productivity and of GDP reflect long-run averages for Germany. About 60% of investment is externally financed (see OECD Economic Outlook, December 2004). The elasticity of substitution between capital and labor is chosen to replicate empirical estimates of the elasticity of investment with respect to the user cost of capital (see Table 2 below). The effective tax rates on hours worked of actively employed and on job search of unemployed workers summarize the total tax burden from wage income taxes, (employee) social security contributions and indirect taxes. The effective tax rate on hours worked amounts to 35% for the youngest age group (20-30 years-old) and rises to 40% for the 40-50 years-old with higher earnings. The effective tax rate on job search is substantially larger and amounts to 69%. Like a

participation tax rate, this rate summarizes the total fiscal burden that accrues when switching from unemployment into employment. Essentially, it corresponds to the wage and contribution tax burden *plus* the forgone unemployment benefit as a share of earnings. The replacement rate of unemployment benefits alone amounts to roughly 50%. Such high participation tax rates are usual in Europe, see Immervoll et al. (2007). The bargaining power of employees in wage negotiation and the matching elasticity determine the wage and unemployment rates in labor market equilibrium. When the bargaining power is larger than the matching elasticity as in Table 1, the unemployment rate is inefficiently high (see Hosios, 1990). A reduction in the unemployment rate would yield significant welfare gains.

Table 2 summarizes behavioral elasticities in long-run equilibrium. Given the consensus of econometric estimates, as discussed in Immervoll et al. (2007) and Blundell and MaCurdy (1999), the elasticity of intensive labor supply (effective hours worked) with respect to the net real wage is set to $\epsilon_L = 0.2$. Accordingly, a 1% larger net real wage results in a reduction of the effective hours worked by 0.2%. The fiscal effects on the unemployment rate reflect econometric evidence for OECD countries. Scarpetta (1996) estimated that an increase of by 10% in the replacement rate for unemployment benefits results in an increase of 1.3 percentage points in the unemployment rate. This value is consistent with the estimates of 1.7 in Layard et al. (1991), 1.1 in Nickel (1997) and similar in Blanchard and Wolfers (2000), see Holmlund (1998) for a summary of the empirical literature. We parametrize our model such that an increase in the replacement rate by 10% raises the unemployment rate by 1.4 percentage points, i.e. $\epsilon_U = 1.4$.

The parametrization of firms' debt behavior is based on Gordon and Lee (2001). The study estimates an elasticity $\epsilon_B = 0.36$, implying that an increase in the profit tax by 10 percentage points would raise the debt ratio by 3.6 percentage points. Graham, Lemmon and Schallheim (1998) study the reaction of external debt to changes in tax rates and get a similar elasticity of 0.426. The growth effects of a tax reform depend crucially on how sensitive investment and capital accumulation are to a tax induced cut in the user cost of capital. Hassett and Hubbard (2002) review the econometric literature and put the elasticity of capital demand with respect to the user cost of capital in the range between -0.5 and -1. According to De Mooij and Ederveen (2003), the response of direct investment of multinational firms is even stronger. Hence, we set the elasticity of capital demand at $\epsilon_K = -1$ and calibrate the elasticity of substitution between

capital and labor to replicate this elasticity.

Capital accumulation is a slow process and affects output, wages and tax revenue only after some delay. In an open economy, and according to the q-theory of investment (see Hayashi, 1982), the length of the transition phase is controlled by adjustment costs to investment. It is optimal for firms to spread investment over several periods and avoid excessive fluctuations. We calibrate adjustment cost parameters to replicate estimates of the transition speed as measured by the half-life of capital stock adjustment. According to estimates by Cummins, Hassett and Hubbard (1996), and the overview of the empirical literature in Hassett and Hubbard (2002), about half of the long-run adjustment in the capital stock is achieved within 7 to 8 years.

Table 2: Behavioral Elasticities in Equilibrium

Elasticity hours worked	ϵ_L	0.205
Elasticity unemployment rate	ϵ_U	1.417
Elasticity debt ratio	ϵ_B	0.365
Elasticity investment	ϵ_K	-0.951
Half-life of capital stock adjustment	$T_{0.5}$	8.000

Legend: ϵ_L %-increase in hours worked wrt. 1% higher real wage. ϵ_U %-points unemployment rate wrt. 10% higher replacement rate of un employment insurance. ϵ_B %-points debt ratio wrt. 1%-point higher corporate tax rate. ϵ_K %-decrease in capital stock wrt. 1% higher user cost. $T_{0.5}$ half-life of capital adjustment in years.

Figure 1 documents effective marginal tax rates on investment and savings that result from firm and personal level taxes including special provisions in the tax base. The left side illustrates the current situation where the first group of bars corresponds to the numbers in Table 1. The Figure also computes these rates separately for different modes of finance. A fully debt financed investment is subject to a slightly negative rate and, hence, is effectively subsidized at the firm level. Since the cost of debt is tax deductible, there is no disincentive from the profit tax rate, see also the discussion of (4). However, also a fully debt financed investment benefits from accelerated tax depreciation and other investment incentives, leading to a small subsidy.

Interest earnings, dividends and capital gains are taxed at a uniform rate at the investor level but capital gains are taxable only upon realization and benefit from tax deferral. Hence,

the personal level effective tax is slightly lower in case of equity finance, as compared to a debt financed investment. Equity financing reflects a mix between retained earnings and new share issues where the latter represents a relatively small share. Since the returns on self-financed investment mainly accrue in terms of capital gains, the personal tax burden on such an investment is considerably lower compared to the case of new equity, reflecting the tax advantage from deferral until realization. Considering the total effective tax rates reveals a ranking of alternative ways of investment financing, where debt is cheapest and new equity the most expensive mode of finance, with retained earnings in between.[6]

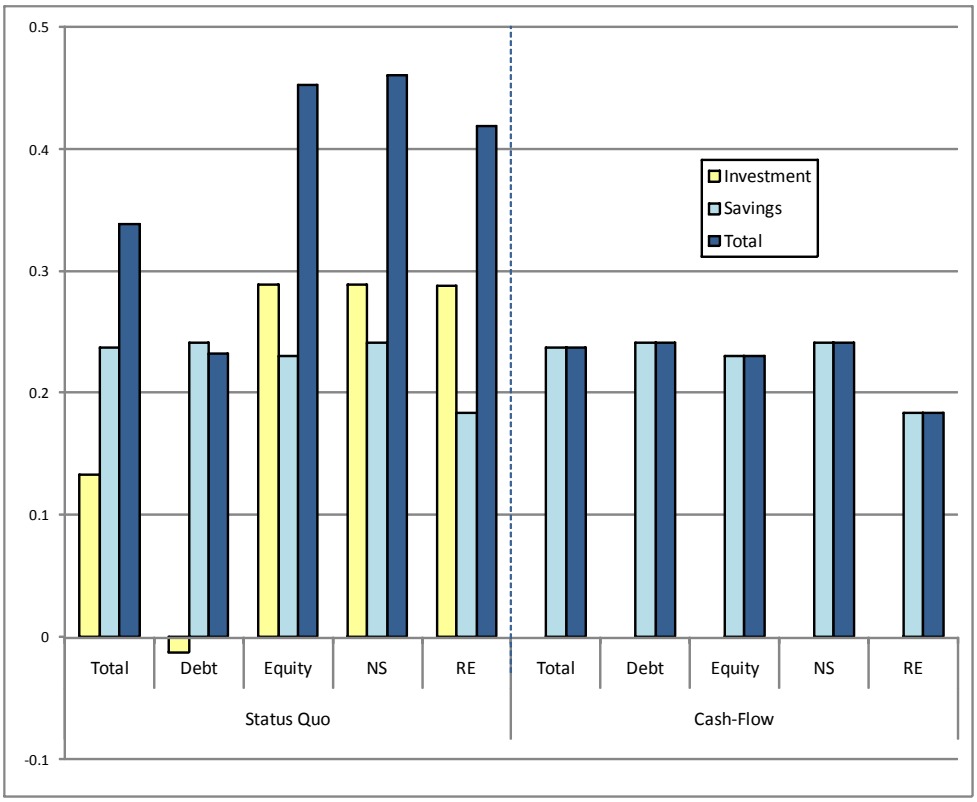

Figure 1: Effective Marginal Tax Rates

The right hand side of the Figure shows effective tax rates after a complete implementation of the S-base cash-flow tax. As was shown in the preceding subsection, the reform completely eliminates the investment and financing distortions at the firm level, reducing to zero the effective tax rate on investment and leading to a reduction of the total wedge by 13 percentage points in the case of mixed financing. The remaining part of the effective tax rate stems from personal

[6] The labels RE and NS stand for retained earnings and new shares.

capital income taxation. Note, however, that this is a savings and not an investment distortion. The residence principle of interest taxation implies that personal taxation of government and internationally traded bonds yields a net return $r = \left(1 - t^B\right) i^*$, see the Appendix. Investors insist on the same net return on equity which accrues in terms of dividends and capital gains, taxable at (effective) rates t^D and t^G. The composition of equity returns is determined by the firms' pay-out ratio θ, giving an effective tax rate $t^E = \theta t^D + (1 - \theta) t^G$ on equity returns. Hence, the cost of equity before personal taxes is $i^E = r / \left(1 - t^E\right) < i^*$. Current capital income taxation in Germany implies $t^B = t^D > t^G$ where the effective tax rate on capital gains is lower due to tax deferral until realization. Hence, $t^E < t^B$, leading to $i^E < i^*$. As a result, the market rate of return on investment in Germany could be even slightly lower than the world rate of interest. Moving towards an S-base cash-flow tax thus eliminates the investment wedge but is not entirely neutral with respect to financing choices. Personal level taxes slightly favor equity over debt and, in particular, retained earnings relative to new share issues. Figure 1 illustrates. However, the distortion in capital structure choice is much less dramatic than before the reform where the effective tax rate is 45% with equity financing but only 23% with debt financing. The S-Base tax adds new debt to the tax base so that, after the reform, the marginal tax burden on new investment is roughly equal across financing modes, debt or equity.

3 Quantitative Results

3.1 Long-Run Results

Table 3 reports long-run simulation results of moving to an S-base cash-flow tax in Germany. Compared to current tax rules, the scenario involves the following changes: (i) immediate expensing replaces normal tax depreciation of new investment; (ii) firms must add new debt to the tax base but may subtract repayment of existing debt from taxable profits. As is current practice, interest on debt remains deductible while the cost of equity is not. It was shown in Section 2 that the S-base tax is neutral with respect to firms' investment and capital structure choices. Given that the corporate tax rate cannot be changed,[7] the narrowing of the tax base

[7] Although beyond the model, a higher tax rate might induce profit shifting by multinationals and thereby make a revenue neutral increase in the corporate tax rate rather unattractive and expensive. Germany is already

looses revenue which must be raised from other sources. Specifically, we assume per capita public consumption to remain constant in all scenarios, as well as government debt (except in the last scenario). To highlight the consequences of alternative ways of financing tax reform, we run four different scenarios corresponding to the columns in Table 3 which use lump-sum, consumption and wage taxes (columns 'LS', 'Cons' and 'Wage', respectively) to finance tax reform.

Table 3: Long-Run Effects of an S-Base Cash-Flow Tax

Absolute Changes:	ISS		LS	Cons	Wage	Trans1
Add. wage/cons. tax	0.000	t^j	0.000	-0.034	-0.045	0.036
User cost of capital	0.060	u^K	0.052	0.052	0.052	0.052
Debt to capital ratio	0.600	b	0.525	0.525	0.525	0.525
Eff.tax rate, investment	0.133	τ^I	0.000	0.000	0.000	0.000
Eff.tax rate, savings	0.237	τ^S	0.225	0.225	0.225	0.225
Eff.tax rate labor	0.350	τ_1^L	0.353	0.334	0.322	0.377
Unemployment rate	0.105	$\bar{u}$	0.092	0.090	0.084	0.099
Percentage Changes:						
Corporate-tax revenue		T^K	-13.581	-12.802	-10.578	-16.115
Gross wage		$\bar{w}$	3.490	3.550	3.212	3.737
Effective hours worked		$\bar{l}$	0.688	1.365	1.741	-0.188
Effective labor demand		L^D	2.111	3.033	4.080	0.464
Capital stock		K	15.619	16.663	17.848	13.754
GDP		Y	6.681	7.644	8.737	4.959
Private consumption		C	5.299	6.467	7.400	-0.620
Private financial wealth		A	1.700	2.070	2.318	1.841

Legend: (LS): Financing with lump-sum tax; (Cons): Financing with consumption/VAT tax; (Wage): Financing with wage tax; (Trans1): Financing with wage tax and government debt policy.

A discussion of alternative transition strategies is postponed to the next subsection. Transition relief is not relevant for long-run results, except when the government uses debt to smooth tax rates over time as in the last column of Table 3. Of course, redistribution from future to present generations by accumulating debt in the early transition phase does change the long-run

perceived as a high tax country for businesses.

equilibrium. The wage tax scenario with an instantaneous introduction of the S-base system requires high wage tax rates early on and low ones in the future to balance the budget, therefore imposing a large transition burden on current workers. The scenario 'Trans1' in the last column relies on deficit financing to prevent large increases in tax rates in the early phase. In this way, future generations will not only benefit in terms of a higher capital stock and higher wages but they also share in the transition cost by paying higher taxes to service the accumulated debt. The debt policy is endogenously chosen to achieve perfect tax smoothing, i.e. the wage tax rate is adjusted once and for all and stays constant in all periods after the reform.

***Lump-Sum Tax Financing*:** This hypothetical scenario, referring to column LS, is of little relevance to real world tax policy and is only meant to illustrate the incentive effects of the reform without mixing with the influence of other taxes. Section 2 has shown the S-base tax to be neutral with respect to investment and capital structure decisions. The main long-run effects thus stem from reducing the effective tax rate on investment from 13% to zero, and from undoing the tax incentive to use external debt, see Figure 1 for illustration. Eliminating the tax preference for debt reduces the debt asset ratio from 60 to 52%. This should make firms financially more robust. The reduction in the user cost triggers an investment boom and expands the capital stock by 15% in the long-run. Given a cost share and, thus, an output elasticity of capital equal to .35, as reported in Table 1, capital accumulation alone leads to a 5.5% increase in GDP ($\approx .35 \times .156$). The higher capital intensity, in turn, boosts labor productivity and wages by 3.5%. With lump-sum tax finance, wage and consumption tax rates remain constant so that net of tax real wages must rise by the same amount. Higher wage earnings stimulate intensive and extensive labor supply. The increased earnings relative to unemployment benefits boost job search and reduce unemployment by 1.3 percentage points. More hours worked together with lower unemployment expand effective employment by 2.1% in the long-run. More employment reinforces the output gains from capital accumulation. In total, GDP is 6.7% larger in the long-run compared to the growth path in the absence of reform.

Moving to an S-base cash-flow tax substantially narrows the tax base but reduces taxable corporate profits only by 13.6% in the long-run. A much larger decline in corporate tax revenues is prevented by induced capital accumulation which boosts corporate earnings. The expansionary effects of the reform further swell the tax bases and the revenue yield of other taxes. In the

long-run, higher revenue (from other taxes) more than compensates the reduction in profit taxes. Fiscal balance thus allows higher transfers to private households which add to higher wage earnings and augment private consumption and wealth by 5.3% and 1.7%, respectively. It will become evident below that a large part 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.

***Consumption Tax Financing*:** Using lump-sum instruments is usually not an option for real world tax policy. We thus contrast the effects of the reform when tax rates on consumption (commodity taxes such as VAT) or wage income are adjusted to balance the budget (columns 'Cons' and 'Wage' in Table 3). As we have just argued, the strong expansionary impact expands tax bases to an extent that more than compensates for the direct revenue losses of narrowing the tax base by moving to an S-base system. As a result, the consumption tax rate can be cut by 3.4 percentage points in the long-run. However, since lower commodity taxes strengthen real income of both employed and unemployed workers in the same way, the real income gap between work and non-participation is not much affected, leaving incentives for job search largely unaffected. The unemployment rate falls by a negligible amount only. While extensive labor supply is not responsive, the higher net real wage almost doubles the increase in effective hours worked, compared to the first scenario, and leads to a 1.4% gain in effective hours worked in the long-run. Effective employment rises by 3% instead of 2% with lump-sum financing, and GDP growth is similarly magnified, leading to a total gain of 7.6%. Hence, moving to an S-base tax yields a 'double dividend' in the long-run since the tax reform not only improves investment incentives and removes tax distortions in capital structure choice, but also yields additional fiscal revenue which can be used to reduce labor market distortions. Again, one must emphasize that the additional revenue is available only in the long-run, when the transition costs and the associated burden on present generations are already sunk.

***Wage Tax Financing*:** Consumption taxes discriminate less towards job search and labor market participation since not only active earnings but also replacement income are subject to this tax when income is spent. In contrast, a *lower* wage tax not only stimulates intensive but also extensive labor supply by augmenting the income gap between work and non-work and, thereby, strengthening job search incentives. The long-run impact of moving to an S-base

tax thus looks even more favorable than in the preceding scenario. Given that wage tax rates can be reduced by 4.5 percentage points, the more significant rise in effective hours worked is reinforced by a substantial reduction of the unemployment rate to 8.4% (compared to 9% 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% and 8.7%, respectively.

The simulation results also point to a new channel of the labor market and fiscal impact of corporate tax reform in the presence of a large welfare state (see Keuschnigg, 2009, for the analytical argument). Given that the tax reform boosts investment incentives and raises wages, it strengthens job search (or labor market participation, more broadly). The resulting decline in unemployment yields very favorable fiscal gains which are proportional to participation tax rates, defined as the sum of replacement rates plus tax and social security contributions. Each person switching from unemployment into employment represents one more worker paying wage taxes and social security contributions, and is one person less who claims unemployment benefits, social assistance and other welfare benefits. Based on a stylized theoretical model, Keuschnigg (2009) shows that with current participation tax rates varying around 50-80% in Europe (see Immervoll et al., 2007, and the effective tax rate on job search in Table 1), a reduction in the profit tax rate may actually improve fiscal balance due to savings in social spending and higher wage tax and contribution revenues. The long-run results in Table 3 clearly point to the importance of this channel. As before, the large size of the long-run gains are to a considerable extent due to intergenerational redistribution at the cost of present generations.

Wage Tax Smoothing: The last column 'Trans1' in Table 3 is the first scenario with transition relief and is illustrated in Figure 2. The need for transition relief arises because the wage tax scenario in column 'Wage' is based on periodic budget balance and requires a large increase in short-run wage tax rates. Moving to an S-Base system looses a large amount of corporate tax revenue, not only because of the instantaneous introduction of investment expensing but also because the scenario assumes that 50% of old equity capital $K - B$ is added to the tax depreciable capital stock which is meant to avoid a one time devaluation of old capital when new capital is favored by an instantaneous deduction from tax. This measure generates large additional tax depreciation in the early adjustment period and magnifies the loss in tax revenue. Moving to immediate expensing erodes the tax base particularly strongly

since investment is highest in the early phase to start capital accumulation. Finally, and maybe most importantly, when moving to an S-base system, firms must add new debt to the tax base while repayment can be deducted.

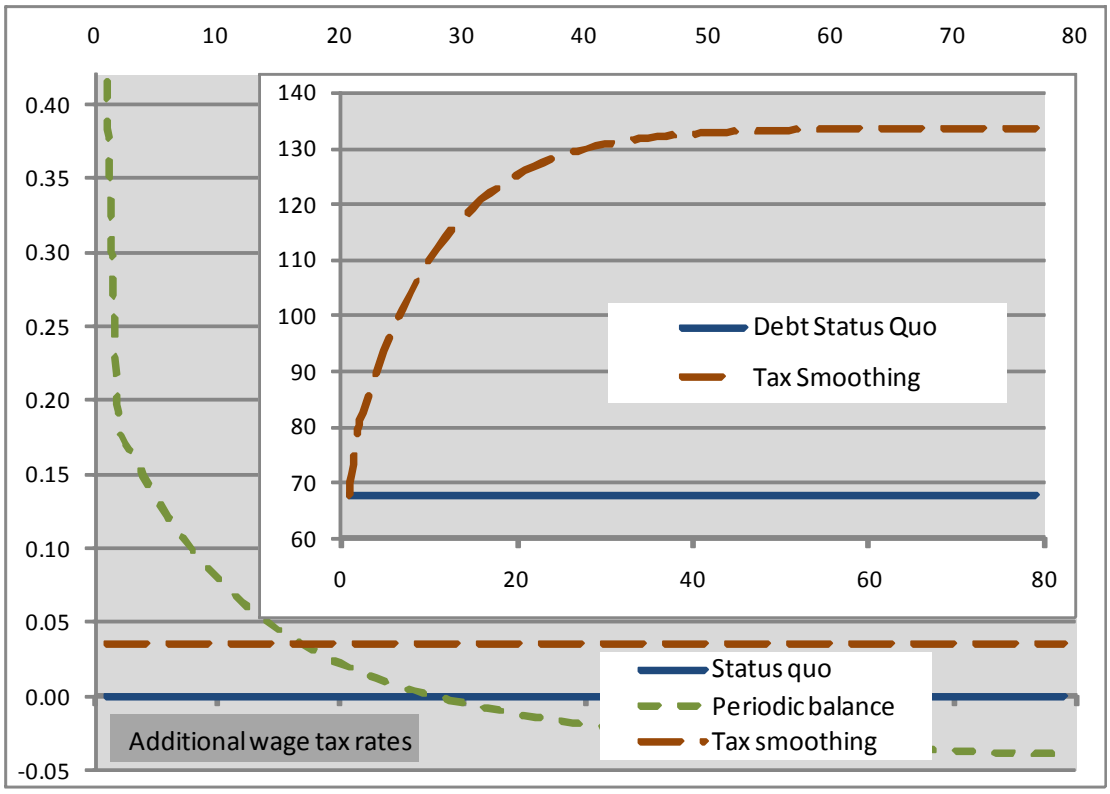

Fig. 2: Tax Smoothing

The financial neutrality of the S-base tax leads firms to reduce their debt asset ratio from around 60 to 52%. Firms achieve this by repaying a substantial part of preexisting debt to bring down the debt asset ratio. This debt repayment in the first period is financed by issuing large amounts of new shares. Only later on, firms will issue new debt again to accommodate capital accumulation. The debt repayment in the first period also subtracts from the tax base. In this extreme scenario, all elements together lead to a negative tax base so that the government must pay large subsidies to the business sector instead of collecting tax revenues. When these large revenue losses must be periodically financed out of wage tax revenue, budget balance requires a drastic increase in wage tax rates. Figure 2 shows that the government would have to add about 42 percentage points to the current wage tax schedule. Clearly, this worst case scenario must have very unfavorable short-run consequences. In subsequent periods, when firms issue again new debt and must add this to the tax base under an S-base system, and given that old

tax depreciation claims are increasingly written off, corporate tax losses rapidly disappear and tax revenues grow fast in this period of high transitional growth. After less than three decades, wage tax rates fall below the tax rates applied prior to reform and asymptotically approach the long-run equilibrium value in Table 3 where these rates would be lower by 4.5 percentage points.

However, lower long-run wage tax rates are possible only because this shock therapy with instantaneous budget balance imposes the full transition cost of moving to an S-base system on present generations living in the early transition period. One strategy for distributing gains and costs of tax reform more evenly across present and future generations is to resort to deficit financing in the early transition period. Using deficit finance to reduce overly high wage taxes early on necessarily requires higher tax rates in the future to service the accumulated public debt. Figure 2 illustrates this tax smoothing scenario where deficits are incurred and debt is accumulated to an extent that is consistent with a once and for all change in the wage tax rates. Simulations show that public debt would almost double from 68 to 133, or in terms of GDP ratios from 68.2 to 127%, and the wage tax schedule would shift up once and for all by 3.6 percentage points. Compared to column 'Wage' in Table 3 referring to periodic budget balance, the difference is more than 8 percentage points of the wage tax rate.

The higher wage tax in the long-run has unfavorable labor market consequences. The unemployment rate is 9.9 instead of 8.4%, and hours worked shrink by 0.2% instead of an increase by 1.7%. Employment growth is almost wiped out and, for this reason, cuts off about four percentage points of the increase in the capital stock. Compared to the uncompensated case with strong redistribution from present to future generations, tax smoothing requires future generations to pay for the transition cost in terms of higher debt. The GDP gain is only 5% and much more modest than the 8.7% increase in the uncompensated scenario. The positive side of this scenario is that deficit financing avoids the large increase in wage tax rates and gives a much brighter picture in the short-run. Compared to the uncompensated scenario in column 'Wage', the unemployment rate in the first period rises only slightly to 11% (instead of 20.5%), total employment declines only by 1.4% (instead of 21%), and GDP shrinks by less than 1% as a result of weaker labor market performance (instead of an instantaneous GDP contraction of 14.2% with uncompensated 'shock therapy'). The important insight is that spreading the tax burden over present and future generations is 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. In the next subsection we investigate a number of alternative transition strategies that aim at a more favorable trade-off between long-run gains and short-run costs.

3.2 Transition Strategies

***Transition Problems*:** The preceding subsection has illustrated a stark trade-off between short-run costs and long-run benefits of dynamic tax reform. The income gains of a growth oriented tax reform are delayed since the productivity gains from capital deepening arrive 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 tend to harm labor market performance and can result in a significant loss in present income. The previous subsection has identified three important sources of revenue losses at the date of reform when moving to an S-base cash-flow tax: introduction of immediate investment expensing, repayment of existing debt to move towards a lower debt capital ratio, and 'compensation' of old capital to prevent windfall losses. In contrast to new capital, previously invested old capital has not benefited from immediate expensing but its market value might decline in the absence of compensation when new capital gets cheaper. While transitory deficit finance can avoid a large part of the present income losses and forces future generations to share in the short-run costs, such a strategy also diminishes the long-run gains of the reform. Taking the previous scenario 'Trans1' as a benchmark, we now compare this with alternative transition scenarios. This will clarify the role of reform speed and of the treatment of old capital in shaping the intertemporal trade-off.

Understanding the forces determining revaluation of old capital and, thus, the sources of windfall gains and losses, is critical for the design of a transition policy. To uncover the key arguments in the simplest way, assume that the acquisition cost of a new capital good is 1 prior to reform and is subsidized by the factor $1-t^K$ after moving to a cash-flow tax. Suppose that the present value of future earnings and, thus, the market value of an installed capital good, is $\eta\left(i^E\right)$ where the discount factor i^E depends only on personal level taxes and is independent of the profit tax rate. When the capital stock is costlessly adjusted and firms can instantaneously realize the desired long-run capital intensity, the investment criterion is $\eta\left(i^E\right) = 1 - t^K$, indicating that

firms invest until the present value of future returns and, thus, the market value of an installed capital good, is equal to the current acquisition cost of new equipment. Hence, with frictionless investment, introducing a cash-flow tax reduces the acquisition cost from 1 to $1-t^K$ and, thereby, also imposes a one time windfall loss on old capital goods.

However, when installing a substantially higher capital stock creates additional adjustment costs J_I, the investment condition becomes $\eta\left(i^E\right) = 1 - t^K + J_I$.[8] While these adjustment costs are small at normal investment levels ($J_I = 0$ in a stationary state), they can become substantial at above normal investment levels required to build up a larger capital stock. Investment and, thus, adjustment costs are highest immediately after implementing the reform because firms are still far off the desired long-run levels of capital. Hence, the present value of future returns equal to the market value of a capital good must not only pay for the lower acquisition cost $1 - t^K$ but also for substantial adjustment costs J_I. While $\eta = 1$ prior to reform, valuation will be $\eta = 1 - t^K + J_I$ immediately after implementation of the reform. Hence, the market value of new and old capital can *increase or decrease*, leading to *windfall gains or losses* on old capital. Which outcome prevails, depends on the degree of frictions in the adjustment process and the stickiness of capital accumulation.

It is not clear at all whether old capital should be compensated or, in contrast, should be subject to a one time tax to prevent windfall gains. The question can only be decided empirically and must take account of possible adjustment costs as in the present simulation model. Three factors are important in determining the revaluation of old capital and the magnitude of induced windfall gains or losses. One determinant is the dynamics of the accumulation process as reflected in the half-life of investment, see Table 2. Another factor is the speed of tax reform, whether reform is implemented instantaneously like a shock therapy, or is implemented only gradually over time. A third factor is tax treatment of old capital. For example, old capital might be compensated for potential windfall losses by allowing a proportion of equity to be added to the tax depreciable capital stock and to be written off in subsequent years. A novel feature of the simulation model is that it also includes lump-sum components of firm value unrelated to new investment and the capital stock. Such elements are historic tax depreciation claims as

[8] This is a stylized version of A.4 in the Appendix and reflects the q-theory of investment underlying a large part of the empirical investment literature, see Blanchard and Fischer (1989) or Romer (1996), for example.

included in the tax depreciable capital stock $\tilde{K}$, see section 2.1. The present value of future tax deductions boosts firm value independent of investment levels.[9] One way of compensating old capital is to add a fraction of the book value $K - B$ of old equity capital to the tax depreciable capital stock, thereby allowing value increasing tax deductions unrelated to new investment and without consequences for investment incentives. Alternatively, should market forces lead to windfall gains, the historic tax depreciable capital stock can be reduced once and for all, thereby reducing lump-sum tax allowances during the transition in order to eliminate windfall gains.

We now discuss four alternative transition scenarios that highlight the role of reform speed and the tax treatment of old capital. In all cases, the fiscal budget is balanced by scaling the wage tax schedule and public debt is used for perfect tax smoothing: (1) The benchmark scenario is the 'shock therapy' of the scenario 'Trans1' in the first column of Table 4, which corresponds to the last column of Table 3 and is characterized by instantaneous introduction of the new S-base system, full allowances for historic tax depreciation claims and tax relief for 50% of existing equity capital. (2) Scenario 'Trans2' features a gradual introduction of the new system, gives no tax relief on old capital, but continues tax allowances for historic tax depreciation claims. Section 2.2 discussed how gradual introduction weighs together the old and new definitions of the tax base with a variable factor. The transition speed for tax reform is set at $\mu = .85$, meaning that it takes between 4 to 5 years to implement half and roughly 9 years to complete about three quarters of the changes in tax parameters etc. (3) The scenario 'Trans3' opts for instantaneous reform but denies any tax relief on old capital. The historic tax depreciable capital stock $\tilde{K}$ is fully written off, i.e. depreciation allowances are largest in the first period and then decline at rate $\tilde{\delta}$ in the early transition phase. (4) Scenario 'Trans4' combines 'shock therapy' with a one time *tax* on old capital in terms of a one time devaluation of the tax depreciable capital stock (reducing $\tilde{K}$ yields smaller tax allowances in subsequent periods) so that the equilibrium change in the value of the capital stock is just zero at the date of reform. The devaluation is endogenously computed so that there are neither windfall gains nor losses on old capital. Table 4 reports the long-run consequences of these scenarios which depend on the degree of debt accumulated during transition for perfect tax smoothing. The first line lists the long-run debt to GDP ratios while the last line reports the windfall gains or losses which are

[9] This essentially explains the difference between average and marginal q as in Hayashi (1982), as is documented in the separate Appendix Keuschnigg and Keuschnigg (2009) for the present model.

measured by the percentage changes of firm value at the date of tax reform.

Table 4: Long-run Effects of Alternative Transition Strategies

Absolute Changes:	ISS		Trans1	Trans2	Trans3	Trans4
Public debt/GDP ratio	0.676	d^G	1.270	1.168	1.202	0.941
Additional wage tax	0.000	t^L	0.036	0.023	0.027	-0.005
Eff. tax rate labor	0.350	τ_1^L	0.377	0.369	0.372	0.349
Unemployment rate	0.105	$\bar{u}$	0.099	0.096	0.097	0.091
Percentage Changes:						
Corporate tax revenue		T^K	-16.115	-15.198	-15.500	-13.225
Gross wage		$\bar{w}$	3.737	3.646	3.676	3.456
Effective labor demand		L^D	0.464	1.058	0.863	2.343
Capital stock		K	13.754	14.427	14.206	15.882
GDP		Y	4.959	5.581	5.376	6.923
Private consumption		C	-0.620	0.642	0.224	3.444
Firm value, $t = 1$		V_1	15.613	-0.800	12.442	-0.001

Legend: (Trans1): instantaneous implementation, 50% equity relief; (Trans2): slow implementation, 0% equity relief; (Trans3): instantaneous implementation, 0% equity relief; (Trans4): instantaneous implementation, 0% equity relief, and -81.224 % reduction of tax depreciable capital stock. All scenarios use public debt to smooth wage tax rates for all periods.

Transition Scenario 'Trans1': The benchmark scenario of instantaneous reform was discussed at the end of section 3.1. It corresponds to the last column of Table 3 which is repeated in the first column of Table 4. The last line immediately reveals that giving tax relief to 50% of equity capital is much too generous and leads to windfall gains at the date of reform equal to a 15.6% increase in firm values.

Transition Scenario 'Trans2': Compared to the benchmark, this scenario gradually introduces the S-base system, with half of the reform completed within 4 to 5 years and 3 quarters within 9 years. No tax relief on old equity capital is ceded but tax allowances on historic depreciation claims are continued until the stock is fully depreciated. Compared to 'shock therapy', a gradual reform slows down the transition, limits short-run revenue losses and, thus, accumulates less debt to smooth tax rates. For this reason, the debt to GDP ratio in

Table 4, column 'Trans2', is only 116% of GDP, compared to 127% in the first scenario. The wage tax rate must rise, once and forever, by 2.3 percentage points instead of 3.6 points. The more moderate tax burden slightly improves labor market performance in the long-run which translates into a GDP gain of 5.6% instead of 4.9%. Gradual reform with tax smoothing leads to somewhat larger income gains in the long-run.

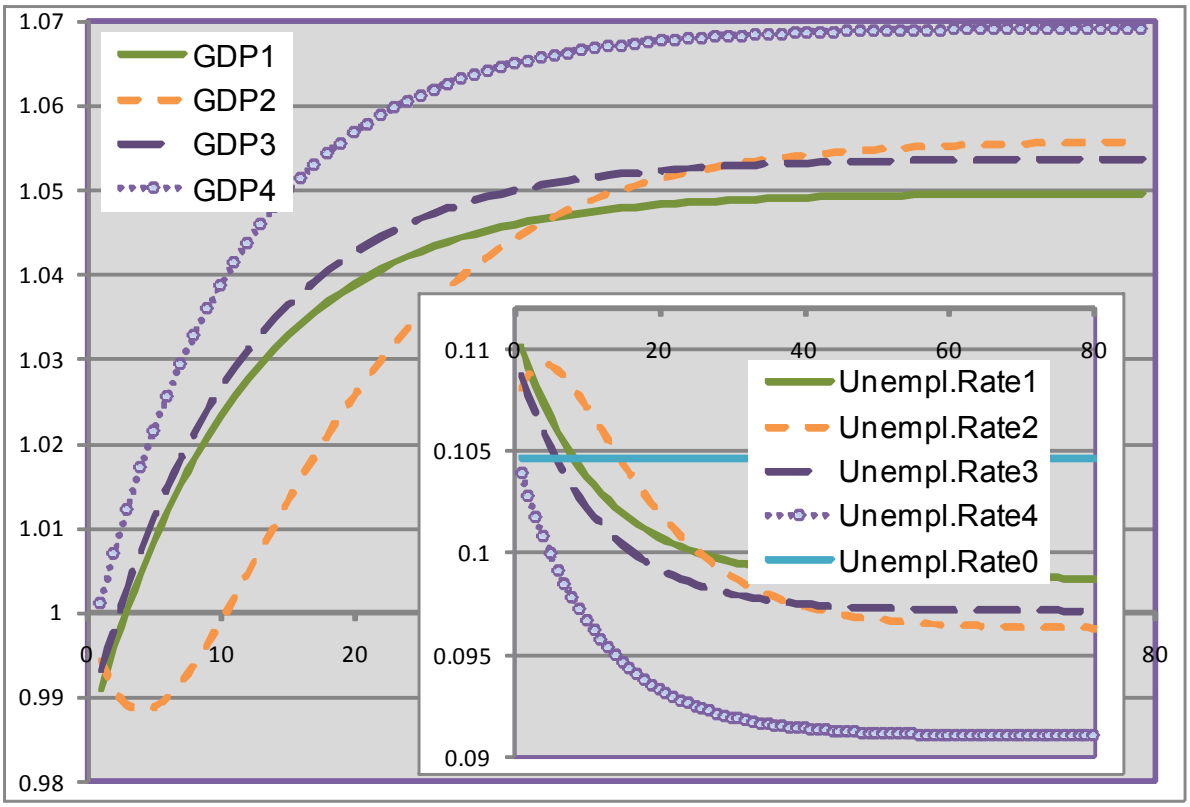

Fig. 3: Alternative Transition Strategies

However, gradual implementation also means that investment incentives are weaker in the early adjustment period when tax reform is not yet fully implemented. Compared to instantaneous reform, capital accumulation, output expansion and growth in labor productivity are all postponed. Although the decline in GDP and rise in unemployment are smaller in the first two years after reform, the subsequent output growth is much delayed and remains significantly smaller. Only after about 35 years, GDP gets larger than in scenario 1 with instantaneous reform. As Figure 3 illustrates, the unemployment rate falls below the rate in scenario 1 after about 25 periods. Somewhat surprisingly, a gradual reform does not reduce transition costs. Quite to the contrary, because the scenario boosts investment incentives only at a slow rate,

the growth effects of the reform are delayed, leading to a prolonged transition period with lower income and higher unemployment than with shock therapy. For the same reason, the scenario entirely wipes out the large windfall gains which resulted in scenario 1, see Table 3.

Transition Scenario 'Trans3': Given the large windfall gains in the benchmark case (column 'Trans1'), this scenario provides no tax relief for equity at all, but continues depreciation allowances on historically accumulated claims until the tax depreciable stock $\tilde{K}$ is fully written off. Table 4 and Figure 3 show a moderate improvement relative to the benchmark strategy, yielding somewhat higher GDP and lower unemployment over the entire transition and in the long-run. Avoiding tax relief for old equity does not harm growth but contains the revenue loss in the short-run. Less public debt is accumulated for tax smoothing during the transition, leading to a debt GDP ratio of 120 instead of 127% in the long-run. Hence, the labor tax burden is lower and economic performance is slightly better as compared to the benchmark case. In providing strong growth incentives right from the beginning, this scenario still leads to a substantial increase in the market value of installed capital and, thus, to substantial windfall gains. At the date of reform, the value of old capital rises by 12%.

Transition Scenario 'Trans4': Windfall gains indicate a too generous treatment of old capital which only redistributes wealth towards the owners of the current capital stock without yielding any benefits in terms of growth. To avoid such redistribution, scenario 4 devalues the historic tax depreciable capital stock $\tilde{K}$ by more than 80% which reduces tax allowances, inflates corporate tax payments in the early transition phase, and reduces firm value at the date of reform. Essentially, the measure imposes a one time wealth tax on current capital owners and is computed to exactly eliminate any windfall gains or losses. In strengthening corporate tax revenue during the early transition phase, this measure much reduces the amount of public debt needed for tax smoothing. The last column in Table 4 therefore reports a long-run debt GDP ratio of 94% which is much lower than the 127% in the baseline scenario. The once and for all wage tax adjustment is roughly zero and avoids a negative impact of tax reform on labor market performance. Since both employment and the capital stock are unaffected in the first period, the scenario prevents any negative short-run impact. In parallel to capital accumulation, wages, employment and output increase right from the beginning, and the unemployment rate immediately falls as Figure 3 illustrates.

In avoiding windfall gains, this transition strategy boosts the growth potential of moving to an S-base system. The long-run effects are much better than in any of the other scenarios. Unemployment falls quite significantly from 10.5 to 9%, employment expands by 2.3%, and GDP rises by almost 7%. Figure 3 shows better economic performance over the entire transition period. We conclude that a transition strategy for a favorable economic outcome now and in the future should (i) implement the reform instantaneously to reduce investment and financing distortions at the earliest possible date, and (ii) avoid windfall gains for present equity owners. The latter requirement might often be administratively difficult and is achieved here by a one time reduction of the historically accumulated, tax depreciable capital stock. In reducing tax allowances and inflating corporate tax liability in the early transition period, this measure reduces firm value at the date of reform and acts like a one time wealth tax which exactly offsets the market induced appreciation of old capital.

3.3 Sensitivity Analysis

Simulation results are sensitive to variations of key parameters. Econometric estimates of behavioral parameters are often imprecise and sometimes vary over a considerable range. For the present purposes, the elasticity of capital demand and labor supply elasticities with respect to hours worked and job search are important. We don't explore these sensitivities here since they are well known in the literature. The focus of this study is on the design of transition strategies which importantly hinge on the revaluation of the preexisting capital stock at the date of reform. By the q-theory of investment, windfall gains or losses depend on the dynamics of capital formation. As discussed in Table 2, the half-life of investment is estimated at 8 years. It takes 8 years to complete half of the adjustment from any initial condition to the long-run value. After another 8 years, the remaining gap is halved, etc. As argued before, the value of capital would fall to the long-run value in the first period if adjustment costs were absent and capital could be instantaneously adjusted. If capital is costly to adjust and accumulation is slow, the value of a unit of capital might well increase at the date of reform before it approaches the lower long-run value. Hence, compared to a normal adjustment speed, windfall gains in the first period tend to be larger with slow adjustment, and smaller with fast adjustment.

Table 5 summarizes the results. The first column labelled 'Normal' repeats the results from

the last column of Table 4 relating to an immediate introduction of reform and a 81% devaluation of the preexisting stock of tax depreciation claims. If we slow down the transition process by raising adjustment costs and lengthening the half-life to 10 years (column 'Slow'), the initial value of a unit of installed capital must rise more, leading to larger windfall gains. To offset these wealth effects, the tax depreciable capital stock must be cut even more, by 86 instead of 81%, to prevent windfall gains. All other results remain almost unchanged. Hence, the real effects of the proposed transition policy in the short- and the long-run are not sensitive at all to a variation of adjustment costs, as long as the required one time wealth tax fully offsets the market induced capital appreciation. As the above arguments suggest, the one time wealth tax in terms of a 77% cut in the tax depreciable capital stock is significantly smaller when accumulation is fast and the half-life of investment is reduced to about 6 years.

Table 5: Sensitivity Analysis

Absolute Changes:	ISS		Normal	Slow	Fast
Public debt/GDP ratio	0.676	d^G	0.940	0.940	0.941
Additional wage tax	0.000	t^L	-0.005	-0.005	-0.005
Unemployment rate	0.105	$\bar{u}$	0.091	0.091	0.091
Percentage Changes:					
GDP		Y	6.926	6.927	6.921
Private Consumption		C	3.450	3.452	3.438
Employment, $t = 1$		L_1^D	0.188	0.199	0.194
Tax capital stock, $t = 1$		$\tilde{K}_1$	-81.258	-85.803	-76.965
Firm value, $t = 1$		V_1	-0.025	-0.001	-0.001

Legend: (Normal) Half-life of capital accumulation is about 8 years; (Slow) Half-life 10 years; (Fast) Half-life 6 years.

4 Conclusions

In this paper, we have analyzed the short- and long-run consequences of moving to a cash-flow income tax. A cash-flow tax was advocated by the Meade Report (1978), was part of the Hall and Rabushka (1995) flat tax proposal and was supported by the U.S. President's Advisory Panel on Federal Tax Reform (2006). Transforming the current corporate tax into an S-base cash-flow

tax is also part of Mitschke's (2004) tax reform proposal for Germany. This tax is attractive since it is neutral towards investment and capital structure choices of firms. In removing the effective marginal tax rate (EMTR) on investment at the firm level, corresponding to a reduction of about 13 percentage points of the EMTR, the reform stimulates capital formation, boosts wages, improves labor market performance leading to significantly lower unemployment, and promises important long-run income gains of around 5 to 8 percentage points, depending on the specific implementation scenario. By removing the tax incentive to use external debt, it should also substantially reduce the debt ratio of the business sector and make firms financially more robust. However, as with most growth oriented tax reform proposals, the gains mainly accrue in the long-run and benefit future generations while the transition cost is concentrated in the short-run and could lead to substantial income losses of present generations. This study emphasizes that the intergenerational distribution and the level of the income gains depend importantly on how the resulting losses in corporate tax revenue are financed, and what type of transition strategy is adopted to smooth the revenue losses over time. Since the output gains from capital accumulation accrue only slowly, the main challenge is to avoid a large burden on present generations which are, after all, the ones to decide on implementing such a reform.

This paper has studied short-run consequences and alternative transition strategies of implementing an S-base cash-flow tax. Since the capital stock is predetermined, short-run GDP is driven by labor market performance. The labor market impact can be significantly negative if the losses of corporate tax revenue must be financed with higher wage or consumption taxes. There are three sources of potentially large short-run revenue losses that are, in fact, connected with the neutrality properties of the reform. First, by initiating an investment boom to start capital accumulation, the reform leads to large tax allowances in the first periods from immediate investment expensing. Second, because the reform removes tax incentives to use debt, firms tend to repay external debt and replace it with new equity. Since new debt is added, but debt repayment is subtracted from the tax base of an S-base system, this financial restructuring leads to large short-run losses in corporate tax revenue again. Third, if the government, intending to avoid a one time capital levy from introducing a cash-flow tax, gives temporary tax allowances to old equity capital, this would further erode tax revenue. Adding up these sources of revenue losses, the government might either have to raise substantially short-run wage taxes (or VAT)

which is bad for current labor market performance and GDP, or it might resort to temporary debt financing which shifts the tax burden into the future and reduces the long-run gains. This illustrates an important trade-off between short-run costs and long-run gains when moving to a neutral cash-flow tax which applies more generally to most growth oriented tax reforms. An alternative would be a gradual introduction of the reform. While this limits short-run revenue losses, it also postpones investment incentives and growth effects of the reform, leading to a rather prolonged period of lower income, wages and higher unemployment, compared to instantaneous reform. Gradual implementation is not an attractive transition strategy.

A key issue of any transition policy is how to treat windfall gains or losses on present owners of the capital stock upon introduction of a new tax system. It is frequently argued that moving to a cash-flow tax reduces the value of existing capital and puts a one time capital levy on owners. However, we have argued to the contrary that an instantaneous implementation of the reform is most likely to lead to windfall gains. The market value of installed capital is likely to rise when capital accumulation is sticky as postulated by the q-theory of investment and related empirical literature. In equilibrium, the present value of future returns of a new capital good is equal to the current acquisition cost *plus* the additional adjustment costs associated with above normal investment levels. In the simulation model, which is parameterized in line with empirical estimates to generate a half-life equal to roughly 8 years, the existence of adjustment costs leads to significant windfall gains. These gains represent a lump-sum redistribution towards current owners without improving investment incentives. Our preferred transition strategy eliminates windfall gains on old equity by a one time devaluation of the tax depreciable capital stock of 80%, leaving only 20% of undepreciated historical investments for further depreciation. Hence, tax allowances in the early transition phase are significantly reduced which erodes the value of capital to an extent that allows neither windfall gains nor losses. For the same reason, corporate tax revenue is higher and the need for raising other taxes is reduced. We find that the S-base system can be introduced in a way that avoids short-run costs and yields substantial long-run income gains of about 7% of GDP. This transition strategy features (i) instantaneous implementation of the reform, (ii) an 80% devaluation of historic tax depreciation claims, and (iii) use of public debt to perfectly smooth wage tax rates over time. It turns out that intertemporally balancing the budget this way requires no change in the wage tax rate.

Appendix

The Appendix derives investment and financing choices from intertemporal optimization.

Capital Income Taxation: The costs of debt and equity at the firm level depend on the structure of personal capital income taxes. Given tax rates t^B on interest, t^D on dividends and t^G on capital gains, no-arbitrage dictates identical net rates of return on perfectly substitutable assets. With the residence principle of interest taxation, gross interest rates are equal across countries, $i = i^*$, leaving a net interest $r = \left(1 - t^B\right) i^*$ on internationally tradeable bonds. In a small country, the world interest i^* is fixed. If interest on business debt is taxed at the same rate, no-arbitrage requires a gross rate $i^B = i^*$ which is the cost of debt to firms. Holding equity shares yields dividends and capital gains (D and ∇) subject to effective tax rates t^D and t^G. Capital gains of old share owners amount to $\nabla = V_{t+1} - V - V^N$ in total where V is the firm value and V^N is the value of new share issues (net of share repurchases).[10] Again, firm valuation must satisfy the no-arbitrage condition

$$r \cdot V = \left(1 - t^D\right) D + \left(1 - t^G\right) \nabla, \quad \nabla \equiv V_{t+1} - V^N - V. \tag{A.1}$$

Gross income on firm ownership is $D + \nabla$. To be flexible with respect to the new and old views of dividend taxation (see Sorensen, 1995, for a review), we distinguish between average and marginal pay-out ratios. Dividend policy yields an average pay-out ratio $\bar{\theta}$, implied by $D = \bar{\theta}\,(D + \nabla)$. The empirical literature since Lintner (1956) emphasizes that dividends fluctuate less than total returns. We thus assume that dividends consist of a stable component $\bar{D}$ and a variable part $\theta\,(D + \nabla)$ which fluctuates with total income, i.e. $D = \theta \cdot (D + \nabla) + \bar{D}$. Adding capital gains $\nabla = (1 - \theta)\,(D + \nabla) - \bar{D}$ yields total income again. Characterizing dividend policy by the parameters θ and $\bar{D}$ and substituting into (A.1) results in

$$r \cdot V = \left(1 - t^E\right)(D + \nabla) - \left(t^D - t^G\right)\bar{D}, \quad t^E = \theta t^D + (1 - \theta)\, t^G, \tag{A.2}$$

where t^E is the marginal effective tax rate on equity returns, consisting of an average of dividends and capital gains. Dividing by $1 - t^E$ and replacing ∇ gives

$$\left(1 + i^E\right) V = D - \bar{\chi} - V^N + V_{t+1}, \quad i^E = \frac{r}{1 - t^E}, \quad \bar{\chi} = \frac{t^D - t^G}{1 - t^E} \cdot \bar{D}. \tag{A.3}$$

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

The cost of equity is i^E and rises with the effective tax rate t^E on equity income at the investor level. In virtually all tax systems, dividends are taxed more heavily than capital gains, $t^D > t^G$. Reducing the stable dividend and raising the marginal pay-out ratio $\theta \to \bar{\theta}$ thus makes the effective tax rate on equity depend more on the dividend tax. In line with the 'old view', the dividend tax inflates the cost of equity and reduces investment. According to the 'new view', marginal investment is financed by retained earnings at the expense of dividends and yields mainly capital gains. Reducing the marginal pay-out ratio θ makes the effective tax rate t^E depend less on the dividend tax and relatively more on the capital gains tax rate. In the extreme case, the dividend tax is neutral. The cost of equity and investment incentives thus depend on the effective capital gains tax rate. In setting θ and $\bar{D}$, we are thus able to flexibly implement either view on the effect of dividend taxation.

Optimization: Given a return on equity i^E as requested by owners, firms maximize the present value of dividends net of new share issues ($\chi = D - \bar{\chi} - V^N$ in A.3). A firm's financial policy is constrained by the identity $D+(I-\delta K) = \pi + B^N + V^N$, i.e. dividends and net investment must be financed out of profits, new debt and new share issues. Using the financial identity to replace D yields net dividends $\chi = \pi + B^N - (I - \delta K) - \bar{\chi}$. Defining the end of period value function by $V^e \equiv \left(1+i^E\right) V$ results in a dynamic program $V^e\left(K, \tilde{K}, B\right) = \max_{I,B^N} \chi + V^e_{t+1} / \left(1+i^E_{t+1}\right)$ subject to (1). Noting the definitions of $\tilde{Y} = F\left(K, L^D\right) - J\left(I, K\right) - W^D$ and π in (2) and defining shadow prices $\eta = dV^e/dK$, $z = dV^e/d\tilde{K}$ and $\lambda = -dV^e/dB$ yields optimality conditions for investment and new debt[11]

$$\begin{aligned} I: \quad \eta_{t+1} / \left(1+i^E_{t+1}\right) &= \left(1-t^K\right) J_I + \left[1 - \epsilon^I t^K - \left(1-\epsilon^I\right) z_{t+1} / \left(1+i^E_{t+1}\right)\right], \\ B^N: \quad \lambda_{t+1} / \left(1+i^E_{t+1}\right) &= 1 - \epsilon^N t^K, \end{aligned} \tag{A.4}$$

and envelope conditions for three stock variables,

$$\begin{aligned} K: \quad \eta_t &= \left(1-t^K\right)\left(F_K - J_K\right) + \epsilon^E t^K i^E \\ &\quad - \left(1-\epsilon^B t^K\right)\left(m - bm'\right) + \left(1-\delta\right)\eta_{t+1} / \left(1+i^E_{t+1}\right), \\ \tilde{K}: \quad z_t &= t^K \tilde{\delta} + \left(1-\tilde{\delta}\right) z_{t+1} / \left(1+i^E_{t+1}\right), \\ B: \quad \lambda_t &= \left(1-\epsilon^B t^K\right)\left(i^B + m'\right) + \epsilon^E t^K i^E + \lambda_{t+1} / \left(1+i^E_{t+1}\right). \end{aligned} \tag{A.5}$$

Interpretations are standard and discussed in Section 2.1 of the main text. Combining (A.4-A.5) to eliminate λ yields the optimal capital structure as given in (3).

[11] See the separate Appendix on hiring decisions in a matching labor market.

To characterize investment incentives, we derive the *user cost of capital* in a stationary equilibrium. Denote the effective tax subsidy to the purchase cost of new capital in (A.4) by

$$Z \equiv \epsilon^I t^K + \left(1-\epsilon^I\right)\cdot z/\left(1+i^E\right), \quad z/\left(1+i^E\right) = \tilde{\delta}t^K/\left(i^E+\tilde{\delta}\right), \tag{A.6}$$

where z is the present value of tax depreciation from (A.5). When normalizing adjustment costs to investment to be zero in a stationary state, $J_I = J_K = 0$, the shadow price of capital in (A.4) becomes $\eta = (1-Z)\left(1+i^E\right)$. Using this in (A.5) and eliminating m' by the condition for optimal capital structure in (3) yields the user cost of capital

$$\begin{aligned} u^K &\equiv F_K - \delta = \frac{\delta t^K - \left(i^E+\delta\right)Z + \left(1-\epsilon^B t^K\right)m}{1-t^K} \\ &: \quad + \frac{\left(1-\epsilon^E t^K\right)i^E}{1-t^K}\cdot(1-b) + \frac{\left(1-\epsilon^B t^K\right)i^B + \epsilon^N t^K i^E}{1-t^K}\cdot b. \end{aligned} \tag{A.7}$$

A slight rearrangement results in (4).

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