# On the Double Taxation of Corporate Profits[*]

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### Abstract

We study the aggregate and distributional effects of reforms that replace corporate profits taxes with shareholder taxes in a model that features both household and firm heterogeneity. The reform yields distributional gains with a large majority of households benefitting. If the reform maintains the equality between dividend and capital gains taxes, it also leads to efficiency gains and an implied optimal corporate tax rate of zero. In contrast, if only dividend taxes are raised the reform can yield losses in the aggregate and the trade-off between aggregate and distributional gains is optimally resolved at a positive rate for the corporate tax, implying double taxation.

JEL classification: *E6*

Keywords: *Optimal corporate taxes; Double taxation; Heterogeneity; Misallocation.*

# 1  Introduction

Reductions in the corporate income tax rate are often proposed based on the understanding that this tax constitutes an inefficient instrument for raising revenue relative to labor income taxes. However, there remains substantial opposition to such proposals which argues that they would lead to a reduction in government revenues that will either have to be compensated through higher personal income taxes or lead to a shrinkage of government programs that benefit the less wealthy. The academic literature provides support for both the efficiency gains from lower corporate taxes and the potential distributional costs.[1]

In this paper, we propose a corporate profits tax reform that can deliver some of the efficiency gains expected from a corporate tax cut and, at the same time, can avoid the negative distributional effects and gain popular support. The idea is to compensate for the lost revenue from reducing corporate taxes by increasing taxes that fall on the same group of people, namely shareholders. To be more specific, we consider dividend and capital gains taxes and investigate whether increasing one, or both, of them to compensate for a reduction in the corporate tax can lead to efficiency, distributional and overall welfare improvements.

From an efficiency perspective, the question can be thought of as a comparison between the relative importance of the distortions caused by the corporate tax versus the distortions caused by shareholder taxes. We argue that the answer can be misleadingly simple in the context of a standard growth model. In that context, corporate income taxes reduce investment incentives by lowering the after tax returns to investment, capital gains taxes also distort investment by raising the cost of capital, but a (constant) dividend tax is non-distortionary because it does not directly affect the returns to investment. A dividend tax that is higher than the capital gains tax does affect stock prices (through a Tobin's Q channel), but this has no other effects on real allocations.[2] This would suggest that concentrating all taxes on dividends would be the optimal choice. However, this conclusion would be unwarranted when markets are incomplete because, in that case, a wedge between dividend and capital gains taxes does have real effects. When households face uninsurable idiosyncratic risk, the wealth effect arising from a change in stock prices is transmitted in general equilibrium to savings and investment and the neutrality of dividend taxes is no longer true. In addition, when firms seek external financing to grow, a difference between the dividend tax rate and the capital gains tax rate acts as a financing friction and leads to distortions in the allocation of capital across firms.[3] Our first objective is to quantify these distortions and compare the direct distortions of the corporate tax to the indirect distortions, through the tax wedge, of a dividend tax.

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[1] Compare, for example, the literature based on the classic Chamley-Judd results with more recent work in incomplete markets setups such as Domeij and Heathcote (2004) and Conesa, Kitao and Kruger (2009).

[2] See McGrattan and Prescott (2005), Santoro and Wei (2011) and Atesagaoglu (2012) amongst many others

[3] These two points are made in Anagnostopoulos et al (2012) and Gourio and Miao (2010) respectively.

The preceding discussion suggests that the indirect distortions due to the tax wedge can be avoided simply by increasing the capital gains tax in tandem with the dividend tax and avoiding introducing the wedge. However, this would now introduce the direct distortion of the capital gains tax on the cost of capital and it is an open question whether this distortion compares favorably to the one caused by corporate taxes. We argue that in a simple growth model these distortions are identical and the corporate tax is equivalent to an equal tax on dividends and capital gains. We subsequently provide conditions under which this result can be extended to an economy with incomplete markets and external financing. Although this result constitutes a theoretical contribution in itself, it relies on unrealistic assumptions such as no inflation and a definition of taxable corporate income which is at odds with the actual tax code. These assumptions are relaxed in our quantitative analysis so that the equivalence is no longer true. Clarifying and quantifying the trade-offs in this case is the second objective of our paper.

We analyze each of those two types of reforms in turn, focusing not only on efficiency but also on distributional and welfare consequences. By considering a series of tax cuts of different size, all the way up to a complete elimination of the corporate tax, we are able to determine the optimal level of the corporate tax in each case. This sheds light on the question of double taxation, namely the fact that corporate profits are currently taxed at the firm level and then once more at the shareholder level. By incorporating the relevant trade-offs, our model is well suited to address the question of whether double taxation can be justified as an optimal policy. This is the third objective of this paper.

In order to incorporate all of the aforementioned trade-offs, as well as to investigate the distributional consequences of such reforms, we construct an infinite horizon model that features a continuum of households that are subject to uninsurable idiosyncratic labor income risk and a continuum of firms that are subject to idiosyncratic productivity shocks. To our knowledge, our model is the first one that combines a substantial amount of heterogeneity on both the household and the firm side and this constitutes an important methodological contribution. In the model, firms use a decreasing returns to scale technology that combines labor and capital to produce output. They own capital directly and decide on investment, payout and financing policy. The latter consists in choosing between using internal funds or issuing new equity. All of the firms' stocks are bundled together in one asset which can be interpreted as a mutual fund. This simplifying assumption, which we borrow from Favilukis, Ludvigson and van Nieuwerburgh (2013), is crucial in making the model tractable.[4] Households can trade in shares of this single asset and earn asset income, in the form of dividends and capital gains from their share holdings, as well as labor income. The government faces a fixed amount of spending which it can finance through flat taxes on firms' corporate profits and on households' labor and asset

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[4] Favilukis et al (2013) focus on the housing market, specifically the variability of the price-rent ratio. In their model, there are only two firm-sectors, a consumption good producing sector and a housing sector. Households buy stocks in a mutual fund that combines these two productive sectors.

income.

Starting at the benchmark calibrated economy we consider permanent changes in the corporate tax rate and concurrent increases in shareholder taxes that maintain long run government revenue fixed. In the first experiment, only dividend taxes are increased and this introduces a tax wedge between dividend and capital gains taxes. In the second experiment, we increase both dividend and capital gains taxes maintaining the equality between the two. In both experiments, wages increase and capital returns decrease in the long run. This ensures that households at the bottom of the wealth distribution that rely mainly on labor income benefit from the reforms. Thus both types of reform have positive distributional consequences, in the sense that high marginal utility households benefit, and are supported by a large majority of households. This stands in contrast to corporate tax cuts financed through labor taxes which tend to imply negative redistribution and limited support. However, the two reforms are markedly different regarding their effects on efficiency.

When only dividend taxes are increased, the resulting misallocation of capital due to the wedge between dividend and capital gains taxes dominates the distortions caused by the corporate tax. Although aggregate capital and output increase significantly, the misallocation of capital combined with large transitional costs due to the short run increase in savings and drop in consumption lead to welfare losses from an aggregate perspective. Using a utilitarian social welfare function, these aggregate losses are traded-off against the distributional gains. Quantitatively, social welfare improves because the distributional component dominates. Interestingly, social welfare is maximized at a positive corporate tax rate, implying that double taxation can be an optimal response to the efficiency versus distribution trade-off in this case.

In contrast, increasing both dividend and capital gains taxes together, yields both efficiency and distributional benefits These become larger, the larger the decrease in corporate taxes which means that the optimal choice would be to eliminate corporate taxes in this case. The efficiency benefits arise due to an improvement in capital allocation. In the long run, aggregate capital is lower but more efficiently distributed and output and consumption are higher. Because the increase in long run consumption does not rely on increased savings in the short run, the transitional costs are muted and the result is a gain in welfare from an aggregate perspective. Although the elimination of corporate taxes yields the highest social welfare gains as measured by our utilitarian welfare function, it requires a considerable increase in the shareholder tax rate. A more realistic reform, which equalizes the tax rates for all types of personal income as well as for corporate income, requires a common tax rate of approximately 28% and results in welfare gains for more than 84% of households. This scenario, which conforms to suggestions by some economists as well as to the corporate tax rate proposed by President Obama,[5] would lead to overall welfare gains and command wide political support.

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[5] See, for example, Luigi Zingales' piece titled *A Better Way to Tax Corporations* at http://www.nydailynews.com/opinion/better-tax-corporations-article-1.1093804. and *The President's Framework for Business Tax Reform (2012)*.

Our results suggest that the reform which maintains equality of dividend and capital gains taxes might be preferable in the sense that it delivers efficiency gains on top of the distributional gains. That reform is also more robust to relaxing the assumption that tax changes are unexpected. We show this by also computing transitions and welfare under the assumption that the reform is anticipated one or two years in advance. In that case, the reform that increases dividends only can have very different implications regarding the short run responses of macroeconomic aggregates. This is because firms engage in tax arbitrage in an attempt to take advantage of the temporarily low dividend tax. This tax arbitrage has the effect of increasing distributional costs due the resulting fluctuations of wages during the transition, which mostly affect low-wealth individuals.

Given the computational complexity involved,[6] the model necessarily abstracts from several other potentially important mechanisms through which corporate taxes can affect macroeconomic outcomes. Recent studies have identified some of those mechanisms, such as the importance of the choice of the legal form of organization (Chen, Qi and Schlagenhauf (2014)), the presence of lumpy investment (Miao and Wang (2014)) or the role of capital mobility in an open economy setting (Fehr, Jokisch, Kambhampati, Kotlikoff (2013)). None of these studies consider shareholder taxation as part of the suggested reform and this is where our paper's contribution lies relative to them.

Motivated by the Jobs and Growth Tax Relief Reconciliation Act of 2003, Gourio and Miao (2010) and Anagnostopoulos et al. (2012) investigate the effects of reducing shareholder taxes. Relative to the former, our model incorporates household heterogeneity and incomplete markets which are crucial in order to capture the effects of shareholder taxes on precautionary savings as well as to evaluate the distributional effects of tax reforms. Relative to the latter, our model incorporates firm heterogeneity and external financing which are crucial in order to evaluate the distortionary effects of an increase in dividend taxes. Including both mechanisms is important since they can have opposite implications regarding the effects of shareholder taxes. Neither of these studies investigates the trade-off between corporate and shareholder taxes.

Conesa and Dominguez (2013) is the most related paper since it investigates corporate taxes in conjunction with dividend (but not capital gains) taxes. They go a step further than the previously mentioned studies as well as ours, in that they compute optimal Ramsey taxes rather than once-and-for-all tax rate changes. They show that the optimal scheme in the long run features zero corporate taxes and positive dividend and labor income taxes that are equalized to each other. Relative to our work, they abstract from firm and household heterogeneity and incomplete markets which means their model does not capture the distortions arising from the difference between dividend and capital gains taxes. Their conclusion is similar to ours in that they propose switching from corporate taxes toward shareholder taxes. Our work qualifies this result by

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[6] The double - sided heterogeneity is further complicated by the presence of occasionally binding constraints for both firms and households as well as the need to go further than steady states and compute transition paths in order to evaluate the welfare consequences of reforms.

arguing that the use of dividend taxes should be combined with capital gains taxes.

Section 2 provides the model, Section 3 discusses the main qualitative insights, Section 4 presents the calibration of the benchmark economy and Section 5 presents the quantitative results. Section 6 concludes.

# 2 The Model

We consider an infinite horizon economy with endogenous production, where time is discrete and indexed by $t$ Idiosyncratic firm productivity shocks generate firm heterogeneity and, at the same time, idiosyncratic labor efficiency shocks generate household heterogeneity. Both types of shocks wash out in the aggregate so that there is no aggregate uncertainty in this model. To keep the model tractable, we assume households trade only a single asset, which is interpreted as a mutual fund composed of all the firms in the economy as in Favilukis et al (2013). The sole role of the mutual fund is to intermediate between firms and households. A government maintains a balanced budget every period by taxing firm profits as well as household labor, dividend and capital gains income.

## 2.1 Households

There is a continuum (measure 1) of households indexed by $i$ with identical utility functions given by

$$E_0 \sum_{t=0}^{\infty} \beta^t u\left(c_{it}\right), \tag{1}$$

where $\beta \in (0,1)$ is the subjective discount factor, $c_{it}$ denotes consumption and $E_0$ denotes the expectation conditional on information at date $t = 0$. The period utility function $u\left(\cdot\right) : \mathbb{R}_+ \rightarrow \mathbb{R}$ is assumed to be strictly increasing, strictly concave and continuously differentiable, with $\lim_{c_i \to 0} u'(c_i) = \infty$ and $\lim_{c_i \to \infty} u'(c_i) = 0$. We assume a constant level of inflation $\pi$ and express everything in real terms.

In the absence of leisure in the utility, households supply a fixed amount of labor (normalized to one) and receive labor income that is exogenous from their point of view. The economy-wide real wage rate is denoted by $w_t$ but each household is subject to an idiosyncratic shock $\epsilon_{it}$ to their productivity, so that labor income of household $i$ is $w_t \epsilon_{it}$. The productivity shock is i.i.d. across households and follows a Markov process with transition matrix $\Omega_\epsilon(\epsilon'|\epsilon)$ and $N_\epsilon$ possible values.

Markets are incomplete. Households can only partially insure against uncertainty by trading shares $\theta_{it}$ of a mutual fund, which comprises all the firms in the economy. Holding shares provides income to the household in the form of dividends as well as capital gains resulting from changes in the market value of these shares. Since there is no aggregate uncertainty, dividends and share prices are certain and the traded asset is risk free.

Households face proportional taxes on labor income, dividend income and capital gains income at rates of $\tau_{lt}$, $\tau_d$ and $\tau_g$ respectively. They can use their after-tax income from all sources to purchase consumption goods or to buy shares $\theta_{it}$ of the mutual fund at a competitive market price $P_t$. After-tax income includes labor income and the income from holding shares $\theta_{it-1}$. These shares entitle the household to a share $\theta_{it-1}$ of the total after-tax dividend payout $(1 - \tau_d) D_t$. In addition, the shareholder can sell his shares at a price $P_t^0$, which represents the time $t$ value of equity outstanding in period $t - 1$. The increase in the value of this existing equity $\left(P_t^0 - \frac{P_{t-1}}{1+\pi}\right)\theta_{it-1}$ represents accrued capital gains, which are taxed at the rate $\tau_g$.[7] Since we allow firms to raise new equity $S_t$, the market value of equity at time $t$ (after new equity is issued) is $P_t = P_t^0 + S_t$. The households' budget constraint can be expressed as:

$$c_{it} + P_t\theta_{it} = (1 - \tau_{lt})w_t\epsilon_{it} + \left((1-\tau_d)D_t + P_t^0\right)\theta_{it-1} - \tau_g\left(P_t^0 - \frac{P_{t-1}}{1+\pi}\right)\theta_{it-1} \tag{2}$$

Short-selling of the mutual fund shares is not allowed

$$\theta_{it} \geq 0 \tag{3}$$

In each period $t$, households choose how much to consume and how many shares to buy given prices, dividends and tax rates $\{P_t, P_t^0, w_t, D_t, \tau_{lt}, \tau_d, \tau_g\}_{t=0}^{\infty}$. The optimal consumption/savings choice is described by a standard Euler equation which holds with equality for unconstrained households

$$1 + r_{t+1} \equiv \frac{P_{t+1}^0 + (1 - \tau_d)D_{t+1} - \tau_g\left(P_{t+1}^0 - \frac{P_t}{1+\pi}\right)}{P_t} = \frac{u'(c_{it})}{\beta E_t u'(c_{it+1})} \tag{4}$$

where we have defined the (net) real after tax return to be $r_{t+1}$. Note that, given the absence of aggregate uncertainty, that return is deterministic. Equation (4) simply states that, at an optimum, the after tax return on the asset must equal the intertemporal marginal rate of substitution of unconstrained households.

## 2.2 Firms

The production sector follows Gourio and Miao (2010) with some modifications. Firms use capital $k$ and labor $l$ to produce consumption goods $y$ using a Cobb-Douglas production function with decreasing returns to scale

$$y = zf(k,l) = zk^{\alpha_k}l^{\alpha_l} \tag{5}$$

where $0 < \alpha_k, \alpha_l < 1$ and $\alpha_k + \alpha_l < 1$. Production is subject to an idiosyncratic productivity shock $z$ which is i.i.d. across firms and follows a Markov process

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[7] We make the simplifying assumption that capital gains taxes are paid on an accrual basis and that capital losses are subsidized at the same rate. This is the standard approach in the literature with the notable exceptions of Gavin, Kydland and Pakko (2007) and Dammon, Spatt and Zhang (2001).

with transition matrix $\Omega_z(z'|z)$ and $N_z$ possible values. We now consider the problem of a particular firm $j$.

Each period $t$, given the available capital and the current productivity realization, firm $j$ chooses labor demand optimally. The choice of labor demand is a static problem and it defines the operating profit of the firm as follows:

$$\pi\left(k_{jt}, z_{jt}; w_t\right) \equiv \max_{l_{jt}} \left\{z_{jt}f(k_{jt}, l_{jt}) - w_t l_{jt}\right\} \tag{6}$$

where $w_t$ is the economy-wide wage rate. The firm's labor demand is determined by the following optimality condition:

$$w_t = \alpha_l z_{jt} k_{jt}^{\alpha_k} l_{jt}^{\alpha_l - 1}$$

Given the determination of operating profits, we can now turn to the dynamic aspect of the firm's decision making problem, which includes the investment, financing and payout decisions. The firm has two sources of funds, internal and external, which it can allocate to investment $x_{jt}$, dividends $d_{jt}$ and capital adjustment costs $\Phi\left(x_{jt}, k_{jt}\right)$. External funds are obtained by issuing new equity. The value of new equity issued in period $t$ is denoted by $s_{jt}$. Internal funds consist of operating profits $\pi\left(k_{jt}, z_{jt}; w_t\right)$ net of taxes $\tau_c T_{jt}$, where $T_{jt}$ denotes taxable income and $\tau_c$ is a flat corporate income tax rate $\tau_c$. Thus, the firm's financing constraint is given by

$$d_{jt} + x_{jt} + \Phi\left(x_{jt}, k_{jt}\right) = \pi\left(k_{jt}, z_{jt}; w_t\right) - \tau_c T_{jt} + s_{jt} \tag{7}$$

where

$$T_{jt} = \pi\left(k_{jt}, z_{jt}; w_t\right) - \delta k_{jt} - \phi \Phi\left(x_{jt}, k_{jt}\right) \tag{8}$$

Deductions from taxable income include a depreciation allowance $\delta k_{jt}$ as well as a fraction $\phi$ of adjustment costs. The fraction $\phi$ captures both deductions of capital adjustment costs which are immediately deductible (such as worker retraining) as well as the present value of depreciation allowances for installation costs which are not immediately deductible.[8]

Investment $x_{jt}$ adds to the firm's capital stock according to:

$$k_{j,t+1}\left(1 + \pi\right) = x_{jt} + \left(1 - \delta\right) k_{jt} \tag{9}$$

where $\delta \in [0,1]$ is the capital depreciation rate. Finally, we assume dividend payments cannot be negative

$$d_{jt} \geq 0 \tag{10}$$

and no repurchases are allowed[9]

$$s_{jt} \geq 0 \tag{11}$$

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[8] Apppendix A provides an explicit model of these two different components of $\phi$ following Auerbach (1989).

[9] This assumption is innocuous for the calibrated versions of our model where $\tau_d = \tau_g$. For the cases where dividend taxes are raised above capital gains taxes, we refer the reader to Gourio and Miao (2010) for a discussion of the relevance of the assumption as well as the potential effects from relaxing it.

We assume that firm $j$ maximizes the expected present discounted sum of cash flows

$$E_0 \sum_{t=0}^{\infty} \left( \prod_{n=1}^{t} \frac{1+\pi}{1+\frac{\tilde{r}_n}{1-\tau_g}} \right) \left[ \frac{1-\tau_d}{1-\tau_g} d_{jt} - s_{jt} \right] \qquad (12)$$

where $\tilde{r}_t \equiv (1+r_t)(1+\pi) - 1$ is the nominal after tax net return and the discount rate represents the shareholders' discount rate for mutual fund cash flows implied by (4).[10]

Let $q_t$, $\lambda_t^d$, $\lambda_t^s$ be the multipliers on the constraints (9), (10) and (11) respectively.[11] The first order conditions of the firm's problem are:

$$\frac{1-\tau_d}{1-\tau_g} + \lambda_t^d + \lambda_t^s = 1 \qquad (13)$$

$$q_t = \left( \frac{1-\tau_d}{1-\tau_g} + \lambda_t^d \right) \left[ 1 + \Phi_x(x_t, k_t)(1 - \tau_c \phi) \right] \qquad (14)$$

$$q_t = \frac{1}{1+\frac{\tilde{r}}{1-\tau_g}} E_t \left( q_{t+1}(1-\delta) + \left( \frac{1-\tau_d}{1-\tau_g} + \lambda_{t+1}^d \right) R_{k,t+1} \right) \qquad (15)$$

$$R_{k,t+1} \equiv (1 - \tau_c) \frac{\partial \pi(k_{t+1}, z_{t+1}; w)}{\partial k_{t+1}} + \tau_c \delta - \Phi_k(x_{t+1}, k_{t+1})(1 - \tau_c \phi) \qquad (16)$$

When $\tau_d = \tau_g$, internal and external funds are equivalent sources of financing for the firm. In the absence of adjustment costs, marginal $q$ would equal one for all firms and each firm would jump immediately to its long run optimal capital level. The presence of adjustment costs means firms will not in general be at their optimal level and the distribution of capital across firms could, in principle, be improved through tax changes. When $\tau_d > \tau_g$ there is an additional friction that prevents the distribution of capital from being efficient. In that case, equity issuance is costly and firms exhaust their internal funds first before seeking external finance. Due to the tax wedge, firms will issue less equity than optimal and might even not issue equity at all and only grow internally. Firms with low current earnings but high productivity are the ones most in need of external finance and, hence, affected by this friction. As a result, the larger the tax wedge, the less efficient will be the distribution of capital.

Tax changes can affect the severity of both of these frictions and will, in general, cause a change in the distribution of capital across firms. In turn, this will have implications for total factor productivity, which can be measured in the model using:

$$TFP_t \equiv \frac{Y_t}{K_t^{\alpha_k} L_t^{\alpha_l}} \qquad (17)$$

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[10] A discussion of alternative assumptions about the discount factor can be found in Favilukis et al (2013).

[11] We suppress the firm index $j$ and focus on the stationary distribution in the following discussion.

where $Y_t$, $K_t$ and $L_t$ denote aggregate output, capital and labor input respectively. Under this definition, if capital were to increase proportionally across all firms, then $TFP$ would remain unaffected. Thus, changes in $TFP$ capture the effects of changes in the distribution of capital on aggregate production.

## 2.3 Government

In each period $t$, the government consumes an exogenous, constant amount $G$ and taxes corporate profits, dividends, capital gains and labor income at rates $\tau_c$, $\tau_d$, $\tau_g$ and $\tau_{lt}$ respectively. We assume that the government maintains a balanced budget every period. The government budget constraint is given by

$$G = \tau_d D_t + \tau_{lt} w_t L_t + \tau_g (P_t^0 - \frac{P_{t-1}}{1 + \pi}) + \tau_c \int T_{jt} dj \tag{18}$$

## 2.4 Market Clearing

At every period $t$, the stock market, the labor market and the goods markets clear[12]

$$\int \theta_{it} di = 1$$

$$\int l_{jt} dj = \int \epsilon_{it} di$$

$$\int c_{it} di + \int x_{jt} dj + G + \int \Phi(x_{jt}, k_{jt}) dj = \int y_{jt} dj$$

# 3 Theoretical Analysis

This section discusses the main qualitative insights of the paper regarding the question of replacing corporate income taxes with shareholder taxes. Since we use the term 'shareholder taxes' to refer to two different tax instruments, i.e. dividend and capital gains taxes, there are several possibilities for the exact type of reform one could consider. We focus on two of them: using equal dividend and capital gains taxes to replace corporate income taxes; and using only dividend taxes to replace corporate income taxes, while keeping capital gains taxes fixed.[13]

We first discuss the case of a standard growth model in which the question has straightforward answers. In this benchmark, replacing corporate taxes with equal dividend and capital gains taxes has no effects. On the other hand, replacing the corporate tax with a constant dividend tax is clearly a welfare improving policy since a highly distortionary tax is replaced by a non-distortionary one.

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[12] A formal definition of the recursive competitive equilibrium as well as the computational algorithm used are available in an online appendix.

[13] The third obvious case would be to raise capital gains taxes only, keeping dividend taxes fixed. However, since we start at a benchmark where $\tau_d = \tau_g$, this would imply $\tau_g > \tau_d$ which would generate arbitrage possibilities. Hence, we do not consider this option.

The subsequent two subsections aim to clarify the reasons for why these sharp results rely on simplifying assumptions of the standard growth model and are not true in the full model. The implication is that the question of replacing corporate income taxes with shareholder taxes does not have an obvious answer and this is precisely the question addressed in this paper.

## 3.1 Tax Effects in the Standard Growth Model

Suppose there is a representative household and a representative firm operating a constant returns to scale technology. Abstract from uncertainty, inflation, adjustment costs and equity issuance, in which case the model collapses to a standard growth model.[14] In the absence of taxes, the representative firm's financing constraint is:

$$D_t + K_{t+1} - K_t = K_t^\alpha L_t^{1-\alpha} - w_t L_t - \delta K_t \tag{19}$$

The left side of the equation corresponds to dividends plus retained earnings, while the right hand side displays accounting profits, which constitute the corporate tax base. Normalizing the total number of outstanding stocks to one, let $P_t$ denote both the market value of the firm or, equivalently, the price per stock. In this framework, the market value of the firm is equal to the aggregate capital stock, $P_t = K_{t+1}$. In turn, this equality between stock prices and aggregate capital implies that retained earnings $K_{t+1} - K_t$ are equal to capital gains $P_t - P_{t-1}$.

Now consider introducing taxes. Several results can be easily deduced.[15] First, imposing a corporate tax on the corporate tax base (the right hand side of the financing constraint) is equivalent to imposing a tax at the firm level on the sum of dividends and retained earnings (i.e. an equal tax on the two terms of the left hand side of the financing constraint). This follows directly from equation (19). Second, assuming as usual that the firm maximizes shareholder value, it can be shown that a corporate tax is also equivalent to an equal tax on dividends and capital gains at the household level. In the presence of shareholder taxes, the relationship between stock prices and aggregate capital is given by $P_t = \frac{1-\tau_d}{1-\tau_g} K_{t+1}$. As long as $\tau_d = \tau_g$, it is still the case that retained earnings are equal to capital gains and the equivalence between corporate and shareholder taxes holds. Third, since dividends are the residual of operating profits after investment has been subtracted, a constant tax on dividends does not tax investment directly. In fact, McGrattan and Prescott (2005) have shown that a constant dividend tax does not affect any of the long run equilibrium aggregate variables except the market value of the firm $P_t$, which is affected by the change in $\frac{1-\tau_d}{1-\tau_g}$.

Given these results, we can conclude on the effects of the two alternative reforms mentioned above in the context of a simple growth model: replacing

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[14] The assumption of a dynamic firm that owns the capital stock, as opposed to a static firm renting capital from the household period-by-period, is innocuous. See Carceles-Poveda and Coen-Pirani (2010) for the equivalence of the two settings.

[15] Formal proofs are omitted, but available upon request.

corporate taxes with equal dividends and capital gains taxes will have no effects, whereas replacing corporate taxes with a tax on dividends only will be an optimal policy, since the dividend tax is not distortionary.

## 3.2 Using Equal Dividend and Capital Gains Taxes in the Full Model

The simple equivalence between corporate and equal dividend and capital gains taxes that obtains in the simple growth model fails in our full model due to several features such as household heterogeneity, firm heterogeneity, uninsurable idiosyncratic risk for both firms and households, equity issuance, decreasing returns to scale technologies, adjustment costs and inflation. We explain this by providing a proposition which proves a similar equivalence result in a modified version of our model and by highlighting the modifications needed to obtain the equivalence. The crucial modifications include the absence of inflation and a re-definition of accounting profits for corporate tax purposes. Since these modifications do not necessarily reflect the reality of the US economy, they will serve as guide for the intuition as to why the equivalence is broken in our more realistic full model.

Suppose that taxable income in (8) is adjusted to be:

$$\tilde{T}_{jt} = T_{jt} + (q_{jt}k_{j,t+1}(1+\pi) - q_{jt-1}k_{jt}) - (k_{j,t+1}(1+\pi) - k_{jt}) \qquad (20)$$

where $q_{jt}$ denotes the shadow value of capital for firm $j$. This definition introduces an additional component to taxable corporate income, which amounts to the difference between retained earnings and the value of those retained earnings when capital is valued at marginal $q$. We can now prove the following proposition.

**Proposition 1** *Suppose $T_{jt}$ is replaced by $\tilde{T}_{jt}$ and, in addition, $\phi = 1$ and $\pi = 0$ Starting at a stationary distribution of this model with $\tau_c$ and $\tau_s (= \tau_d = \tau_g)$ being the corporate and shareholder tax rates respectively, a reform that changes these tax rates to $\tau_c^*$ and $\tau_s^*$ such that*

$$(1 - \tau_s^*)(1 - \tau_c^*) = (1 - \tau_s)(1 - \tau_c)$$

*has no effect on any individual or aggregate variables except the dividend payout $d_{jt} - s_{jt}$ which is adjusted according to*

$$(d_{jt} - s_{jt})^* = (d_{jt} - s_{jt}) + (\tau_c - \tau_c^*)\tilde{T}_{jt}$$

*with the corresponding aggregate $D_t - S_t$ adjusted accordingly.*

We provide the proof in Appendix B. The proof follows the main idea from the standard growth model in recognizing that the corporate tax base is closely related to the sum of dividends and retained earnings and that retained earnings are closely related to capital gains. The assumed modifications with respect

to our full model ($\tilde{T}_{jt}$, $\phi = 1$, $\pi = 0$) ensure these close relations are made precise by addressing two issues. First, to obtain equivalence of corporate and shareholder taxes in the presence of adjustment costs, these costs need to be completely deductible from corporate taxes in order to have the same tax base as with shareholder taxes. This is because a tax on dividends and retained earnings necessarily falls on a base from which the adjustment costs are already deducted. This explains the requirement that $\phi = 1$. The second issue arises in establishing the relation between retained earnings and capital gains and this is where the other two modifications are needed. Loosely speaking, the new term in $\tilde{T}_{jt}$ essentially corrects taxable income by the difference between capital gains and retained earnings and the requirement that $\pi = 0$ ensures there are no capital gains tax revenues in the long run. We explain those two requirements more precisely below.

In the presence of adjustment costs, the simple (inflation-adjusted) relation between the market value of the firm and the capital stock, $p_{jt} = (1 + \pi) k_{jt+1}$, is no longer true. As a result, a tax on retained earnings $k_{j,t+1} (1 + \pi) - k_{jt}$ and a tax on capital gains $p_{jt} - \frac{p_{jt-1}}{1+\pi}$ is not exactly the same thing. This is because the valuation of capital in the market is no longer exactly one. Suppose for the sake of argument that marginal $q$ equals average $Q$, in which case $(q_{jt} k_{j,t+1} (1 + \pi) - q_{jt-1} k_{jt})$ captures capital gains. The additional term in $\tilde{T}_{jt}$, by adding the difference between capital gains and retained earnings to the corporate tax base, ensures that the corporate tax falls on dividends and capital gains instead of dividends and retained earnings as usual. This adjustment ensures the equivalence of shareholder and corporate taxes at the margin. However, there is an additional complication arising from the fact that marginal $q$ and average $Q$ are not equalized in our setting because of decreasing returns to scale technologies. As a result, the overall revenues raised from a tax on $\int q_{jt} k_{j,t+1} (1 + \pi) \, dj - \int q_{jt-1} k_{jt} dj$ will not in general be equal to those raised from a tax on $P_t - \frac{P_{t-1}}{1+\pi}$. By focusing on the long run stationary distribution and assuming that $\pi = 0$, the proposition ensures that capital gain revenues are equal to zero and this discrepancy in revenues is not an issue.

The tax code adjustments that recover the equivalence between corporate and shareholder taxes in the presence of adjustment costs are inspired by Abel (1983). To see the connection more closely, one can rearrange taxable income $\tilde{T}_{jt}$ as follows

$$\tilde{T}_{jt} = \pi \left(k_{jt}, z_{jt}; w_t\right) - \Phi \left(x_{jt}, k_{jt}\right) - \left(q_{jt-1} - (1 - \delta) q_{jt}\right) k_{jt} - (1 - q_{jt}) x_{jt} \quad (21)$$

As discussed in Abel (1983), this essentially replaces the deduction of physical depreciation $\delta k_{jt}$ with a deduction of true economic depreciation, which is given by $\left(q_{jt-1} - (1 - \delta) q_{jt}\right) k_{jt}$, and also deducts the difference between investment spending and the market value of this spending after installation. Abel uses this to show that corporate taxes are neutral in the presence of debt interest deductibility. Our proposition differs in three aspects: Conceptually, we are interested in establishing an equivalence between shareholder taxes and corporate taxes whereas Abel provides conditions under which the corporate tax is

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non-distortionary. Second, our result is proved in a general equilibrium framework with household and firm heterogeneity whereas Abel focuses on a partial equilibrium model of one firm. Third, Abel's result relies on homogeneity assumptions on production whereas we prove our result in an environment with decreasing returns. The equivalence between shareholder and corporate taxes would hold more generally under constant returns in our adjusted model, but with decreasing returns to scale we can only show this is true at the stationary distribution with $\pi = 0$. Although our main objective is to use this result to build some intuition on why the reform *does* have effects in an economy without these tax code adjustments, we believe this Proposition is of independent theoretical interest.

To summarize, the proposition above shows that, when replacing corporate taxes with equal shareholder taxes, as long as the combined tax rate on the return to capital $\tau = 1 - (1 - \tau_s)(1 - \tau_c)$ is kept fixed, there will be no changes in either the decisions of firms and households at the margin or the overall tax revenues of the government (i.e. the tax bills footed explicitly or implicitly by shareholders). However, this relies on assumptions such as no inflation, full deductibility of adjustment costs and a correction of taxable income which do not necessarily correspond to the actual US economy. Since we relax these assumptions in our full model, the implication is that switching from corporate taxes to an equal dividend and capital gains tax will make a difference and we investigate this quantitatively with our calibrated model.

### 3.3   Using Only Dividend Taxes in the Full Model

Using only dividend taxes changes the tax wedge $\frac{1-\tau_d}{1-\tau_g}$ and hence the market value of the fund. In the standard growth model, this change has no other effects on equilibrium quantities. The existing literature has identified two assumptions that are crucial for this: a representative household facing complete markets and a representative firm with no financing frictions. Regarding the first, in our model markets are incomplete and households save for precautionary reasons. Anagnostopoulos et al (2012) have shown that in this environment there can be a large wealth effect which tends to increase savings and capital when this wedge goes down through an increase in dividend taxes. Regarding the second, Gourio and Miao (2010) have shown that if $\tau_d > \tau_g$, this can create significant misallocation of capital in an environment with heterogeneous firms. The idea is that such a tax wedge makes equity financing costly and hurts disproportionately those firms that have high growth prospects and need equity financing the most. Consequently, introducing a dividend tax will have important effects on both aggregate savings and the allocation of capital across firms. In sum, with incomplete markets, both household and firm heterogeneity break the neutrality of constant dividend taxes.

Given the above results, it is no longer obvious that a dividend tax alone is preferable to a corporate tax. On the one hand, a corporate tax creates distortions to capital accumulation by directly affecting after tax returns to investment. On the other hand, while the dividend tax does not directly affect

the after tax return to capital, it can indirectly do so through wealth effects in general equilibrium and it can also affect the allocation of capital across firms. The calibration exercise that follows incorporates these different effects and aims to quantitatively determine which of these distortions are more severe. It is worthwhile noting that, by incorporating these trade-offs between the distortions of corporate taxes and the distortions caused by dividend taxes, our model has the potential to deliver double taxation as an optimal policy. We view this as an important novel feature of our work.

## 4 Calibration

The time period is assumed to be one year and the parameters used are reported in Table 1. Preferences are of the CRRA class, $u(c) = \frac{c^{1-\mu}-1}{1-\mu}$, with a coefficient of relative risk aversion $\mu = 1$. Inflation is set to $\pi = 2\%$ and the discount factor is set to $\beta = 0.94$ which makes the after-tax real return $r$ equal to $3\%$. The implied aggregate capital to output ratio is 1.54, which is roughly in line with the average capital output ratio in the US corporate sector.

The benchmark economy features substantial heterogeneity on the household side arising from the idiosyncratic labor productivity process. This process is taken from Davila, Hong, Krusell and Ríos-Rull (2012) and is constructed so that it delivers reasonable values for the Gini coefficients of labor earnings and of wealth using a parsimonious Markov chain model with only three states.[16] Table 2 shows that it yields a stationary distribution with $50\%$ of households at the low productivity, $44\%$ with medium productivity and only $6\%$ with high productivity. The implied Gini coefficient of labor earnings is equal to 0.60, which is very close to the value of 0.636 reported in Diaz-Gimenez, Glover and Rios-Rull (2011) based on the 2007 Survey of Consumer Finances. They also report a Gini coefficient of wealth equal to 0.82. In the model, the wealth distribution is endogenous and has a Gini coefficient equal to 0.88, with $44\%$ of households owning no stocks.

The calibration of the production sector follows closely the one in Gourio and Miao (2010). The depreciation rate $\delta$ is set to 0.075 to match the aggregate investment-capital ratio of 0.095 in the National Income and Product Accounts (NIPA). The adjustment cost function is assumed to be $\Phi(x,k) = \frac{\psi}{2}\left(\frac{x}{k} - (\delta + \pi)\right)^2 k$ and the parameter $\psi = 1.605$ is chosen to match a cross-sectional volatility of the investment rate of 0.156. Gourio and Miao (2010) estimate the degree of decreasing returns to scale using COMPUSTAT Industrial Annual Data. The production function parameters $\alpha_k$ and $\alpha_l$ are obtained by choosing $\alpha_l = 0.650$ to match the average labor income share in US data and $\alpha_k = 0.311$ to capture the estimated degree of decreasing returns to scale. The process for firm level productivity shocks is estimated by fitting an AR(1)

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[16]For details on this see also Diaz, Pijoan-Mas, Ríos-Rull (2003) and Castaneda, Diaz-Gimenez and Ríos-Rull (2003).

process to the residuals $z_t$ of their estimated regression

$$\ln z_t = \rho \ln z_{t-1} + \varepsilon_t, \ \varepsilon_t \sim N\left(0, \sigma^2\right)$$

The estimated values for $\rho$ and $\sigma$ are 0.767 and 0.211 respectively. This process is approximated using a 10-state Markov chain, shown in Table 3, obtained by applying the method of Tauchen and Hussey (1991).

Regarding government variables, we set the labor income tax rate to $\tau_l = 0.28$ following Mendoza et al (1994).[17] For shareholder taxes, we use $\tau_d = \tau_g = 0.20$ which is the top statutory rate in effect since the American Taxpayer Relief Act of 2012.[18] We follow Gourio and Miao (2010) in setting the corporate tax rate $\tau_c = 0.34$ which is roughly consistent with the statutory rate at the top bracket (0.35). Given those tax rates, government budget balance implies a value of $G = 0.164$ which means that government spending is roughly 28% of output $Y$ in the stationary distribution.

To choose a value for the fraction $\phi$ of adjustment costs that can be deducted from corporate taxes it is important to realize that adjustment costs could include both installation costs as well as other disruptions to production. Whereas installation costs are not immediately deductible from corporate taxes, other disruptions such as retraining of employees could be immediately deductible. However, even installation costs generate some deductions in the form of future depreciation allowances. We choose $\phi$ so as to incorporate both of these sources of deductions. Let the fraction of installation costs that is ultimately deducted be $\Gamma$ in present value terms and let $\xi$ denote the fraction of overall costs that correspond to installation costs. Then the overall fraction deducted is $\phi = 1 - \xi + \Gamma\xi$. Appendix B provides a model of depreciation allowances in the tradition of Auerbach (1989) and shows that the long run value of $\Gamma$ can be computed as

$$\Gamma = \frac{\delta}{\frac{\tilde{r}}{1-\tau_g} + \delta}$$

For all our computations, we set $\Gamma$ to its long run value.[19] In our benchmark calibration we assume that $\xi = 1$. This follows Auerbach (1989), who argues that treating adjustment costs as part of capital expenditures for tax purposes is consistent with US tax law which requires adding all indirect costs, such as installation costs, to basis. In turn, this implies that $\phi = \Gamma = 0.54$. In addition, we also discuss cases with $\phi = 0.77$ and $\phi = 1$ corresponding to $\xi = \frac{1}{2}$ and $\xi = 0$ respectively.[20]

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[17] Using the same methodology, but more recent data, Domeij and Healthcote (2004) report a similar value.

[18] These values are consistent with the 2013 federal average marginal income taxes on qualified dividends and long term capital gains reported by Feenberg and Coutts (1993).

[19] We only use the long run value of $\Gamma$ because allowing for time-variation would introduce an additional state variable signficantly complicating our numerical solution. Note also that we fix $\Gamma$ to its pre-reform value and do not take into account the changes induced by changes in $\tau_g$ and $r$ in our experiments, since this has a quantitatively small impact on our results.

[20] In principle, $\phi$ could also be higher not because $\xi$ is lower but rather because $\Gamma$ is higher due to, for example, accelerated depreciation. This is an alternative way to think of higher $\phi$ values which, from the point of view of firms in our model, is equivalent.

Since we assume that $\tau_d = \tau_g$ in the benchmark economy, firms can be in one of the following two financing regimes: the dividend distribution (DD) regime or the equity issuance (EI) regime. Firms in the DD regime have sufficient internal funds to cover their desired level of investment, they do not need to issue equity and they pay the residual cash flow as dividends. These are typically firms with low marginal product, either due to low $z_t$ or due to high capital. In contrast, firms with high marginal product will typically need to issue equity to grow and will be in the EI regime. A third financing regime discussed in Gourio and Miao (2010), liquidity constraint firms (LC), is not present in the benchmark economy. However, these firms will exist post-reform whenever the reform introduces a tax wedge $\tau_d > \tau_g$. In that case, equity issuance is costly and some firms with intermediate levels of marginal product will not find it optimal to pay the cost and will instead grow internally without paying dividends.

Table 4 provides some of the characteristics of the distribution of firms across the EI and DD regimes in the benchmark. The table displays the share of capital, the earnings to capital and the average Tobin's Q for each of the regimes, together with their data counterpart.[21] Consistent with the data, EI firms in the model are relatively small, have higher earnings to capital ratios and higher Tobin's Q. Most of the capital in the economy is held by firms in the DD regime and the share of capital held across the different regimes is consistent with the data.

# 5    Quantitative Results

We consider two alternative types of reforms in both of which the corporate profits tax rate $\tau_c$ is permanently reduced and the government budget remains balanced. The two types of reforms differ in the tax instruments used in order to maintain the same level of long run revenue. In the first type of reform, both dividend and capital gains taxes are adjusted, whereas in the second only dividend taxes are adjusted. In both cases, we use labor taxes to balance the budget during the transition.

For each type of reform, we discuss first a specific reform that reduces the corporate tax rate to zero. We discuss both the long run effects and the transitional, distributional and welfare effects of this case. Since transitional effects can be important for welfare, we also consider alternative assumptions regarding the extent to which a reform is anticipated in advance of its implementation. At the end, we also determine numerically the optimal level of the new $\tau_c$ for each type of reform by considering a range of values for the new level of $\tau_c$.

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[21]We use COMPUSTAT annual data between 1988 and 2006 and we follow the standard criteria described in Gourio and Miao (2010) to clean the data and construct the variables. Whenever firms distribute dividends and issue equity at the same time, something that is not possible in our model, we classify these firms as equity issuance firms.

## 5.1 Using Equal Dividend and Capital Gains Taxes

### 5.1.1 Long Run Effects

The first column of Table 5 displays the long run effects of a reform that cuts corporate profits taxes to zero and replaces them with dividend and capital gains taxes, maintaining $\tau_d = \tau_g$. In the long run, the reform leads to a decrease in aggregate capital but TFP increases and this leads to an increase in aggregate output and consumption. These changes are a result of a combination of several counteracting mechanisms which can be understood with reference to the proposition of Section 3.2. It is helpful to distinguish between mechanisms that affect all firms in a similar fashion and mechanisms that have potentially opposite effects on different firms. The latter are used to explain changes in TFP, which arise from changes in the distribution of firms, whereas the former are used to explain changes in aggregate capital.

Consider first the intuition for changes in aggregate capital. In the modified economy of the proposition, the combined marginal tax rate on the return to capital, $\tau = 1 - (1 - \tau_g)(1 - \tau_c)$, is maintained fixed after the reform. This ensures that the optimal choices of firms and households at the margin remain the same. The proposition shows that this choice for shareholder tax rates also maintains the overall tax revenues of the government the same in that economy. In contrast, in our benchmark economy, maintaining the same combined marginal tax rate would not ensure the same overall tax revenues and, as a result, the combined tax rate has to increase. This combined tax rate is 47.2% before the reform but rises to 48.2% after the reform.

There are two reasons why maintaining the same $\tau$ after the reform will not generate the same tax revenues in our economy: first, we now have positive inflation as opposed to $\pi = 0$; second, part of the adjustment costs are not deductible from corporate taxes as opposed to $\phi = 1$. These two departures from the case of neutrality have opposite implications regarding the impact of the reform on overall tax revenue. The presence of inflation implies that switching to shareholder taxes will increase the tax base. To understand why, notice that the presence of inflation implies positive retained earnings and capital gains in the long run. Whereas the corporate tax implicitly raises revenues from retained earnings, the capital gains tax directly raises revenues from capital gains. Because of decreasing returns to scale, average $Q$ is larger than one and this implies that long run capital gains are larger than retained earnings. In contrast, less than full deductibility of adjustment costs from corporate taxes means that switching from corporate taxes to shareholder taxes reduces the tax base. This is because all adjustment costs are implicitly deducted from shareholder taxes since dividends and capital gains realize after payment of adjustment costs. These two effects act in opposite directions and, in our computational experiment, the mechanism through adjustment costs that reduces revenues is stronger. As a result, shareholder taxes rise so much that the combined tax rate $\tau$ is now higher than before. In turn, a higher marginal tax rate on the return to capital pushes investment and capital of all firms downwards. In addition to

the effect through tax revenues, there is another effect that tends to reduce the incentives of firms to invest even if $\tau$ were to remain fixed. This relates to the implicit benefit of increasing capital that comes from lowering future adjustment costs (see the last term of equation (16)). This benefit is only partly taxed by the corporate tax, but fully taxed under shareholder taxes, so the overall effect of switching to shareholder taxes is to increase the marginal tax rate on this benefit.

Before moving on to the intuition regarding TFP changes, we briefly discuss the dependence of these results on the value of $\phi$. It is clear from the preceding discussion that the value of $\phi$ can be crucial for determining which effects dominate since the level of deductibility is crucial for the mechanisms that reduce capital but it is not so for the inflation mechanism that would increase capital. In the extreme case that $\phi = 1$, the deductibility effects discussed above would disappear and the inflation effect would dominate. In that case, we would expect the combined tax rate $\tau$ to go down as a result of the reform and the aggregate capital to increase. This is exactly borne out in the second and third columns of Table 5, which present the results for two alternative values of $\phi$, namely $\phi = 0.77$ and $\phi = 1$. The combined tax rate indeed falls in those cases (to 46.8% and 44.9% respectively) and the aggregate capital rises, more so the higher is the value of $\phi$.

Consider now the intuition for changes in the distribution of capital across firms and, hence, TFP. The proposition of Section 3.2 ensures that the reform is distributionally neutral by adjusting the taxable corporate income according to the term $\chi_{jt} \equiv (q_{jt}k_{j,t+1}(1+\pi) - q_{jt-1}k_{jt}) - (k_{j,t+1}(1+\pi) - k_{jt})$. With this adjustment, the corporate tax is equivalent to shareholder taxes indicating that shareholder taxes implicitly tax the adjusted income. Thus, in the absence of this adjustment, a switch to shareholder taxes imposes relatively higher burden to firms with high $\chi_{jt}$ and a lower burden to those with low $\chi_{jt}$. Note that marginal $q$ is decreasing for firms with high marginal productivity that are investing and growing and decreasing for firms that are downsizing. This valuation effect means productive firms have relatively low values of $\chi_{jt}$ and can therefore benefit from a switch to shareholder taxes. On the other hand, the reduction in the corporate tax rate essentially increases adjustment costs. In particular, no deduction of adjustment costs takes place when the corporate tax is zero so overall costs paid are higher. This increases the dispersion in marginal $q$ and therefore the misallocation of capital due to adjustment costs. This second effect becomes stronger as the deductibility $\phi$ of adjustment costs increases. For reasonable levels of deductibility ($\phi = 0.54, 0.77$) the first effect dominates and TFP increases. For the extreme case with $\phi = 1$, where adjustment costs are fully deductible (i.e. none of those costs are treated as installation costs), the second effect dominates and TFP decreases. These reallocation effects can be seen in Table 6, which reports the average capital conditional on the value of $z$ before and after the reform that eliminates corporate taxes. For $\phi = 0.54$, the effect of the reform is to reduce average capital for low-$z$ firms and increase it for high-$z$ firms whereas the opposite is true for $\phi = 1$.

Importantly, the dependence of aggregate capital and TFP effects on the

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value of $\phi$ does not carry over to long run aggregate output and consumption. Both of these increase regardless of the value of $\phi$ as is evident in Table 5.

### 5.1.2 Transition, Distribution and Welfare

We use a standard utilitarian social welfare function to measure welfare and determine optimality. To better understand the welfare results, we use the method of Domeij and Heathcote (2004) to provide a decomposition of overall welfare into an aggregate and a distributional component. The aggregate component captures the effects of changes in aggregate consumption, both in the long run and along the transition, by assuming these are proportionally distributed across individuals. The distributional component is computed as the residual and thus captures any departures from a proportional allocation of consumption effects. We also discuss how welfare effects differ by individual.

The bottom panel of Table 5 reports the welfare effects of the reform. The overall welfare gain is 0.36% in consumption equivalent terms. The decomposition into aggregate and distributional components indicates that there are both efficiency and distributional gains from the reform. The aggregate component is positive because aggregate consumption increases in the long run and, importantly, decreases only briefly in the short run. This can be seen in Figure 1, which displays the transition paths for the main macroeconomic aggregates. Aggregate consumption falls initially by approximately 2% but recovers within two years and is higher than before the reform thereafter. This implies that the transitional cost is small relative to the long run benefits and leads to a positive aggregate component of welfare of 0.13%. One of the reasons for these small transitional costs is that the increase in long run output and consumption arises due to gains in TFP rather than an increase in savings and capital. Instead, savings and capital fall, but the reform still generates an increase in output due to the TFP increase.

The reform also delivers distributional gains of 0.23% because high marginal utility households benefit and only a small fraction of low marginal utility households lose from the reform. This is illustrated in Figure 2, which plots the welfare gains and losses for each household $(\theta, \epsilon)$ separately. Gains are decreasing in wealth and households with few or no stocks are the main beneficiaries, while only households with substantial wealth or very high labor productivity experience losses. The underlying reason has to do with the effects of the reforms on the after tax wage and after tax return. The after tax wage rises because of the increase in TFP, whereas the after tax return falls. As a result, households which earn primarily labor income tend to benefit whereas households that earn primarily capital income (i.e. high wealth, low marginal utility households) lose.

Note that these distributional implications stand in sharp contrast to the findings in the literature regarding corporate tax cuts (e.g. Domeij and Heathcote (2004)) where such reforms are typically found to have negative distributional effects. The fundamental reason for this difference is the use of a capital tax (shareholder taxes in this case) to replace the corporate tax as opposed to using a labor tax. In existing literature, corporate tax revenues are made up

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using labor taxes and this implies that after tax wages drop as a result of the reform despite the positive general equilibrium effect on before tax wages.[22]

Two assumptions could be potentially important for the welfare results and we consider each in turn as a robustness check. First, it was shown that the choice of $\phi$ can be crucial for the long run effects of the reform on aggregate capital and TFP. However, this importance of the value of $\phi$ for long run aggregates does not carry over to welfare. Specifically, the bottom panel of Table 5 also reports welfare effects for the cases $\phi = 0.77$ and $\phi = 1$ and shows that the main message of this quantitative exercise, namely that eliminating corporate taxes in favor of shareholder taxes is welfare improving, remains true regardless of the value of $\phi$. It is also still the case that the welfare improvement comes from both efficiency and distributional gains.

Second, welfare effects can, in principle, depend on the extent to which the reform is anticipated by the private sector and our welfare results could be skewed because of the somewhat unrealistic assumption that the reform is unanticipated. For this reason, we have also computed transitions and welfare under the assumption of anticipation, with the period of anticipation being one or two years. The welfare effects for these experiments are reported on Table 7. Recall that welfare effects can be thought of in terms of the long run value of aggregate consumption, the transition path of aggregate consumption and the distributional effects. Whereas the long run value of aggregate consumption is independent of the period of anticipation, the transitional path of aggregate consumption and the distributional effects do depend to some extent on our assumption of unexpected tax changes. The transitional paths for consumption are displayed in Figure 1, displaying the results with zero, one and two years of anticipation. For all cases, consumption experiences a similar fall initially and then overshoots before converging to the new long run steady state. However, with anticipation, consumption overshoots earlier, staying above the no antipation level in the short run, and it converges faster, staying below the no anticipation level afterwards. These two counteracting effects leave the aggregate component of welfare reported on Table 7 almost unaffected by the anticipation length. On the other hand, the positive distributional gains from the reform are somewhat stronger the longer the period of anticipation and this translates to a larger increase in overall welfare. This is because the labor tax adjustment over the transition is smoother and implies a smaller, and more short-lived, temporary drop in after tax wages.

The overall conclusion is that this reform can deliver both efficiency and distributional gains and these positive aspects are robust to different anticipation periods.

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[22]Our model differs from Domeij and Heathcote (2004) mainly in its production sector, where we have heterogeneous firms operating decreasing returns to scale technologies whereas they have a representative firm with constant returns to scale. In experiments not reported here, we have confirmed that the same arguments that work in the Domeij and Heathcote (2004) setting go through in our setting too when labor taxes are used to replace corporate taxes.

### 5.1.3 Optimal corporate tax

Although the elimination of corporate taxes in favor of shareholder taxes delivers welfare gains, $\tau_c = 0$ might not be the optimal choice. We investigate this by repeating the benchmark experiment for a range of different values of $\tau_c$ and determining numerically the choice of $\tau_c$ that maximizes welfare. Figure 3 shows the overall welfare gains, as well as the decomposition to aggregate and distributional components, for several values of $\tau_c$ from 0 up to the pre-reform value of 0.34. All cases considered yield positive overall welfare gains and these gains are increasing the larger the reduction in $\tau_c$. This is true for both the aggregate and the distributional component. Overall welfare gains are highest at $\tau_c = 0$ meaning that the complete elimination of corporate taxes discussed earlier is indeed the optimal choice.

Using the welfare effects by individual and the corresponding measure of individuals at each point $(\theta, \epsilon)$ in the stationary distribution, we can obtain the total measure of households that experience gains and the total measure experiencing losses. Table 8 reports this measure of political support and shows that such a reform would have high support. The levels reported are high for all cases, ranging from 82.8% to 84.6%, and tend to be slightly higher for reforms that do not decrease $\tau_c$ all the way to zero.

Although the complete elimination of corporate taxes is the case associated with the highest social welfare gains, it calls for a large increase in shareholder taxes (from 20% to 48.2%) and this can make it harder to implement in practice. Given this, we also consider a milder reform that could potentially be easier to implement. The idea is to equalize the tax rate on corporate income and on shareholder income. In our model, the tax rate required for this is 27.4% which is also very similar to the labor income tax rate of 28%. That is, all types of personal income as well as corporate income are taxed at essentially the same rate.[23] This is a reform often suggested by political commentators on the grounds of 'fairness' and it is also in the spirit of calls for simplification of the tax code. Compared to the complete elimination of corporate taxes, this reform yields a smaller TFP increase of 0.3% and a smaller overall welfare gain of 0.16%, of which two-thirds are due to distributional gains and one-third due to aggregate efficiency gains. However, the gains are even more widely spread, with 84.4% of households in the economy experiencing welfare gains.

In sum, the model suggests that eliminating corporate taxes would yield the highest benefits and should command wide support but even milder, more practically feasible reforms of this type can still yield economic benefits and potentially have even wider support.

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[23] *Exactly* equalizing all tax rates ($\tau_g = \tau_d = \tau_c = \tau_l$) requires a tax rate of 27.8% and gives almost identical results to this experiment.

## 5.2 Using Dividend Taxes Only

### 5.2.1 Long Run Effects

Consider now a reform which uses only dividend taxes to replace corporate profits tax revenue, but leaves the capital gains tax rate untouched. This reform stands in sharp contrast to the one of the previous section, where the direct effect of the decrease in corporate taxes on after tax returns to investment was to a large extent counteracted by an increase in capital gains taxes. Here, with the capital gains taxes remaining unchanged as the corporate tax falls, there is now a large direct effect on the after tax return on investment which provides a strong incentive for increasing capital across all firms. In addition, because of incomplete markets, there is an indirect, general equilibrium effect that pushes (before tax) returns downwards and capital upwards. This is the wealth effect explained in Anagnostopoulos et al (2012). The idea is that higher dividend taxes reduce the market value of the mutual fund for a given capital stock through their effect on $\frac{1-\tau_d}{1-\tau_g}$. To ensure equilibrium in capital markets, stock returns have to fall so as to provide the signal to households to hold less wealth and the signal to firms to increase their capital stock, and hence the value of the fund, to the point where supply and demand for wealth is equalized. Both of those effects contribute to the substantial increase of 43.6% in the aggregate capital stock reported in the last column of Table 5.

Table 5 also indicates a positive effect on long run output from the reform, but the quantitative response of output is muted compared to the large increase in capital. The reason is that TFP now falls as a result of the reform. This counteracting effect arises from the misallocation of capital implied by the introduction of a wedge between $\tau_d$ and $\tau_g$, as explained in Gourio and Miao (2010). The idea is that when $\tau_d > \tau_g$, a unit of equity raised by the firm reduces the (after-tax) capital gains of existing shareholders by $1 - \tau_g$. When that unit is paid to shareholders in the form of dividends it only yields $1 - \tau_d < 1 - \tau_g$. In this sense, equity financing is now more costly than internal funds. Growing firms, which need to issue equity in order to grow, are hurt by the creation of the wedge and their investment suffers as a result. In turn, this implies that these firms take longer to reach their optimal capital level and spend more time at an inefficiently low level of capital. The end result is a reallocation of capital from relatively productive firms to relatively unproductive firms. Table 6 illustrates this point by showing that changes in capital stock are not proportional across firms. Even though capital increases across all firms, average capital for low-$z$ firms increases by more than average capital for high-$z$ firms. As a result, the overall increase in output does not fully reflect the increase in aggregate capital, i.e. TFP has decreased by 1.2%.[24]

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[24]In contrast to the experiment of the previous subsection, the value of $\phi$ does not significantly affect the conclusions of the benchmark model, qualitatively or quantitatively, and we therefore do not include the results for other values of $\phi$. The reason is that the direct effect of $\tau_c$ and the misallocation and wealth effects of $\tau_d$ are much stronger mechanisms and they dominate the responses.

### 5.2.2 Transition, Distribution and Welfare

Consider now the welfare implications of the reform. In the long run, aggregate consumption rises as a result of the reform and this has a positive effect on welfare. However, even from a pure efficiency perspective, this is not enough to conclude that the aggregate component of welfare is positive because there are potentially large transitional costs. Indeed, aggregate consumption does fall during the transition while households substantially increase their savings. This short run reduction in aggregate consumption is illustrated in Figure 4. Compared to the case of equal dividend and capital gains taxes, the short run drop in consumption lasts much longer, with consumption remaining below the pre reform steady state after 10 years, and the magnitude of the drop is much larger at approximately 17% at the trough. These transitional costs dominate from an efficiency perspective and this results in a negative aggregate component of welfare of close to 1%. On the other hand, this reform maintains the positive distributional aspects that were also found in the previous section. This is because after tax wages increase and after tax returns decrease. Figure 5 illustrates the fact that the reform benefits low wealth, low income (productivity) households and only hurts wealthy or high productivity households with low marginal utility.

Quantitatively, the unexpected elimination of corporate taxes yields an overall positive welfare effect of 0.30% in consumption equivalent terms because the distributional component dominates the aggregate component (see Table 5). However, contrary to the previous reform, in this case anticipation effects can reverse the welfare conclusions. To understand this point, it is instructive to look at the transitional paths for aggregate capital, output and consumption shown in Figure 4. In the case of anticipated dividend tax changes, the standard argument that constant dividend taxes do not directly affect returns to investment does not apply any longer because the dividend tax path expected by the private sector is no longer constant. Instead, current dividend taxes are lower than expected future dividend taxes and that directly reduces the investment return in the short run. As a result, firms engage in tax arbitrage.[25] They reduce current investment and increase current dividends, to take advantage of relatively lower dividend taxes that are in place temporarily. Thus, in contrast to the unanticipated case where capital and output increase monotonically to the new steady state, with anticipation capital and output fall initially until the reform is implemented and then rise slowly from a lower level to the new steady state. In terms of aggregate consumption, with anticipation it rises initially but then falls more abruptly at implementation. From an aggregate welfare perspective, the initial rise in consumption is counteracted by the subsequent larger drop and overall more fluctuation leaving the aggregate component almost unchanged. However, the benefits of tax arbitrage accrue mostly to shareholders. In contrast, low wealth individuals with limited ability to smooth consumption

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[25]This point is also made in Gourio and Miao (2011) in the context of unanticipated, temporary dividend tax changes, which induce an anticipation of tax changes in the future when the temporary reform expires.

are hurt by the additional fluctuation in after tax wages. Thus, the distributional component of welfare becomes worse in the case of anticipation. As a result of these changes, the positive overall welfare gains equivalent to 0.30% of consumption that were found in the unanticipated case, now become losses with anticipation and can be as large as 0.12% (0.36%) of consumption for the case of 1 (2) years of anticipation.

### 5.2.3 Optimal corporate tax

We consider again a range of levels for the new value of $\tau_c$ in order to determine the optimal choice for this type of reform, focusing on unanticipated changes. The welfare effects are displayed in Figure 6. It is interesting to note that the overall welfare effect is non-monotonic in $\tau_c$. Specifically, welfare gains from the reform rise as $\tau_c$ is reduced from 34% to 14% but then fall again when $\tau_c$ is reduced further down to 0. Thus, our quantitative experiment suggests an optimal tax rate for $\tau_c$ close to 14% and a corresponding tax rate on dividends of 42.6%. That is, it suggests that taxing both corporate profits and dividends at the same time is an optimal response to the trade-off between efficiency and distribution. From a pure efficiency perspective, i.e. focusing on the aggregate component, the replacement of corporate taxes with shareholder taxes yields negative effects. This indicates that the financing distortions introduced by the dividend tax outweigh the usual distortions associated with corporate taxes. The overall welfare gain in consumption equivalent terms is 0.52% at the optimum with $\tau_c = 0.14$. In terms of political support, this reform also delivers high support as shown on Table 8, with approximately 80% of households gaining from the tax change.

## 6  Conclusion

We find that replacing corporate income taxes with shareholder taxes is a policy that can command wide support in the sense that a large majority of households would benefit. When the shareholder tax used is only the dividend tax rate, this policy can have negative consequences on efficiency because the resulting misallocation of capital creates more distortions than the removal of the corporate tax solves. Moreover, this reform can have additional negative consequences to the extent that it is anticipated. In contrast, when both dividend and capital gains taxes are used, the policy can generate efficiency gains in addition to the distributional ones and the gains are robust to alternative assumptions regarding anticipation.

These results are demonstrated in an environment that incorporates important features of the actual US economy, such as wealth heterogeneity across households, lack of perfect insurance markets, productivity heterogeneity across firms and an endogenous financing choice for firms. All of these components are important in evaluating the effects of different types of capital income taxes. However, our model abstracts from the fact that a significant fraction of house-

hold savings are not subject to dividend or capital gains taxes because they are held in retirement accounts. It also necessarily abstracts from other potentially important channels through which a corporate profits tax cut can affect macroeconomic performance. These include the choice of legal form of organization, the extensive margin effects when investment is lumpy, the effects on employment as well as the possibility of international capital flows. It is noteworthy that studies which include these other channels seem to reach a similar conclusion to ours, namely that a reduction in corporate profits taxes can be beneficial to the economy. This paper contributes to the discussion by suggesting an alternative way of financing this tax cut that can increase popular support for such a reform.

An additional argument in favor of reducing corporate taxes and replacing them with shareholder taxation is advanced by Luigi Zingales and relates to the issue of tax avoidance.[26] Zingales argues that it is no longer the case that corporations are easier to locate and audit than individuals. In addition, lobbying power is much more concentrated in large corporations than it is amongst a few wealthy individuals. As a result, corporate taxes have ended up being a very ineffective way of raising revenue due to endless loopholes in the tax code. Although our model does not incorporate tax avoidance strategies, this argument would strengthen our main conclusion which is that the tax code should be focused on taxing shareholders directly rather than indirectly through corporations. As a first step, reducing the corporate income tax rate to around 28%, as recently suggested by the current administration, and removing the preferential tax treatment of shareholder income relative to other personal income, seem to be measures that a large majority could agree with and benefit from.

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[26] See "A Better Way to Tax Corporations" at http://www.nydailynews.com/opinion/better-tax-corporations-article-1.1093804.

## APPENDIX A - Modelling Depreciation Allowances

In this section, we show how the present value of depreciation allowances can be captured through the parameter $\phi$. To model depreciation allowances, we closely follow Auerbach (1989). Throughout the section, we let $\pi_{jt} \equiv \pi(k_{jt}, z_{jt}; w_t)$.

Let $1-\xi$ be the fraction of adjustment costs that are immediately deductible from corporate taxes and $\xi$ be the fraction that corresponds to installation costs. The constraints of the firm can be written as:

$$
\begin{aligned}
d_{jt} + x_{jt} + \Phi(x_{jt}, k_{jt}) &= \pi_{jt} - \tau_c\left[\pi_{jt} - (1-\xi)\Phi(x_{jt}, k_{jt}) - G_{jt}\right] + s_{jt} \\
k_{jt+1}(1+\pi) &= (1-\delta)k_{jt} + x_{jt} \\
G_{jt} &= \sum_{u=-\infty}^{t-1} \frac{\delta}{1+\pi}\left(\frac{1-\delta}{1+\pi}\right)^{t-1-u}\left[x_{ju} + \xi\Phi(x_{ju}, k_{ju})\right] \\
n_{jt} &\geq 0 \\
d_{jt} &\geq 0
\end{aligned}
$$

where $G_{jt}$ represents the depreciation allowances at time $t$ arising from all past capital expenditures including installation costs. Using the capital accumulation equation to express $k_{jt}$ in terms of all past investment as

$$
k_{jt} = \sum_{u=-\infty}^{t-1} \frac{1}{(1+\pi)}\left(\frac{1-\delta}{1+\pi}\right)^{t-1-u} x_{ju}
$$

$G_{jt}$ can equivalently be written as:

$$
G_{jt} = \delta k_{jt} + \sum_{u=-\infty}^{t-1} \frac{\delta}{1+\pi}\left(\frac{1-\delta}{1+\pi}\right)^{t-1-u} \xi\Phi(x_{ju}, k_{ju})
$$

This makes explicit the fact that total allowances are composed of the standard depreciation term $\delta k_{jt}$ plus a second component corresponding to the "depreciation" of installation costs. When $\xi = 0$, this additional component disappears and we are back to the standard case. To simplify this second component, let the discount factor of the firm between periods $t$ and $s$ be denoted by $M_{t,s} = \left(\prod_{n=1}^{s-t} \frac{1+\pi}{1+\frac{\tilde{r}_{t+n}}{1-\tau_g}}\right)$. If we write the Lagrangian of the firm's problem and assume that the multiplier on the financing constraint is equal to $M_{0t}\gamma_{jt}$, the term involving $G_{jt}$ can be written as:

$$
\begin{aligned}
\sum_{t=0}^{\infty} M_{0,t}\gamma_{jt}\tau_c G_{jt} &= \tau_c \sum_{t=0}^{\infty} M_{0t}\gamma_{jt}\left[\delta k_{jt} + \frac{\delta}{1+\pi}\sum_{u=-\infty}^{t-1}\left(\frac{1-\delta}{1+\pi}\right)^{t-1-u}\xi\Phi(x_{ju}, k_{ju})\right] \\
&= \tau_c \sum_{t=0}^{\infty} M_{0,t}\gamma_{jt}\left[\delta k_{jt} + \Gamma_{jt}\xi\Phi(x_{jt}, k_{jt})\right]
\end{aligned}
$$

where

$$\Gamma_{jt} = \frac{\delta}{1+\pi} \sum_{s=1}^{\infty} M_{t,t+s} \frac{\gamma_{js+t}}{\gamma_{jt}} \left(\frac{1-\delta}{1+\pi}\right)^{s-1}$$

and we have used the fact that $M_{0,s+t} = M_{0t} M_{t,t+s}$. This has collected together all the future depreciation allowances arising from the time $t$ installation costs and expressed them in present value terms. The total fraction of the current installation costs $\xi \Phi(x_{jt}, k_{jt})$ that is ultimately deducted is, in present value terms, represented by $\Gamma_{jt}$.

Using this expression, the financing constraint of the firm can be written as:

$$d_{jt} + x_{jt} + \Phi(x_{jt}, k_{jt}) = \pi_{jt} - \tau_c \left[\pi_{jt} - \delta k_{jt} - (1 - \xi + \Gamma_{jt}\xi) \Phi(x_{jt}, k_{jt})\right] + s_{jt}$$

which essentially implies that the firm is deducting a fraction $(1 - \xi + \Gamma_{jt}\xi)$ of capital adjustment costs every period.

Because of the presence of time varying endogenous variables in the infinite sum of $\Gamma_{jt}$, a full numerical implementation of this problem would require an additional state variable, essentially capturing the "stock" of installation costs paid.[27] Given the additional computational complexity this would introduce, we instead choose to follow Auerbach's approach, which is to simply compute the value of $\Gamma$ at the long run equilibrium. We focus on the case $\tau_d = \tau_g$ where $\gamma_{js+t} = \gamma_{jt}$. Replacing the long run value of the firm's discount factor, the value of $\Gamma$ is equal to:

$$\Gamma = \frac{\delta}{\frac{\tilde{r}}{1-\tau_g} + \delta}$$

where $\tilde{r} = (1+r)(1+\pi) - 1$ and $\phi = (1 - \xi + \xi\Gamma)$.

---

[27] A recursive formulation can be provided upon request.

## APPENDIX B - Proof of Proposition

The goal is to show that all long run equilibrium conditions are satisfied for the new taxes $\tau_c^*$, $\tau_s^*$ and dividend payout $(d_{jt} - s_{jt})^*$ but for otherwise identical allocations and prices to the ones before the reform. We focus only on the conditions that involve the taxes and dividend payout, since the rest are trivially satisfied. Throughout the section, we let $\pi_{jt} \equiv \pi(k_{jt}, z_{jt}; w_t)$.

Firms' conditions have to be adjusted according to the new tax code assumptions. Using the newly defined taxable corporate income in (20), the firms' financing constraint reads

$$d_{jt} - s_{jt} = \pi_{jt} - \Phi(x_{jt}, k_{jt}) - x_{jt} - \tau_c \tilde{T}_{jt}$$

After the reform this financing constraint is satisfied by construction of the dividend payout specified in the Proposition. Recall that with equal capital gains and dividend taxes, $\lambda_t^d = \lambda_t^s = 0$ and note that we use $\tau_s$ to denote both dividend and capital gains tax rates since they are equal. The first order condition for investment is now

$$q_{jt} = 1 + (1 - \tau_c \phi) \Phi_x(x_{jt}, k_{jt}) - \tau_c \phi (1 - q_{jt})$$

After some rearrangement, this gives

$$q_{jt} = 1 + \Phi_x(x_{jt}, k_{jt})$$

which is still satisfied after the reform for the same allocations since no tax term is involved. The capital first order condition is now:

$$
\begin{aligned}
q_{jt} =\ & \frac{1}{1 + \frac{\tilde{r}}{1-\tau_s}} E_t \left[ (1 - \delta) q_{j,t+1} + (1 - \tau_c) \frac{\partial \pi_{jt+1}}{\partial k_{jt+1}} \right] \\
& + \frac{1}{1 + \frac{\tilde{r}}{1-\tau_s}} E_t \left[ \tau_c \left( q_{jt} - (1 - \delta) q_{jt+1} \right) - (1 - \tau_c \phi) \Phi_k(x_{jt+1}, k_{jt+1}) \right]
\end{aligned}
$$

After some manipulation this can be simplified to

$$\tilde{r} = \frac{1}{q_{j,t}} E_t (1 - \tau_s) \left[ (1 - \tau_c) \left( (1 - \delta) q_{j,t+1} - q_{j,t} + \frac{\partial \pi_{jt+1}}{\partial k_{jt+1}} \right) - (1 - \tau_c \phi) \Phi_k(x_{jt+1}, k_{jt+1}) \right]$$

It is easy to see that if $\phi = 1$, the previous condition is also still satisfied for the same allocation when the overall tax wedge $(1 - \tau_c)(1 - \tau_s)$ is kept fixed.

The household budget constraint and the first order condition for stocks are the same as in Section 2. At steady state, these are

$$c_{it} + P\theta_{it} - \frac{P}{1+\pi}\theta_{it-1} = (1-\tau_l)w\epsilon_{it} + \left( (1 - \tau_s)(D - S) + (1 - \tau_s)\left( P - \frac{P}{1+\pi} \right) \right)\theta_{it-1}$$

and

$$\tilde{r} \equiv \frac{(1 - \tau_s)(D - S) + (1 - \tau_s)\left( P - \frac{P}{1+\pi} \right)}{\frac{P}{1+\pi}}$$

Note that we have added the term $-\frac{P}{1+\pi}\theta_{it-1}$ to both sides of the budget constraint and rearranged the Euler equation to have the nominal net return on the left which remains fixed. From the households' perspective taxes may affect the overall payoff $(1-\tau_s)(D-S)+(1-\tau_s)\left(P-\frac{P}{1+\pi}\right)$ on the right hand side of both of those conditions. Using the financing constraint of a firm together with the taxable income in equation (20) and aggregating over all firms $j$, these terms can be written as:

$$
\begin{aligned}
&(1-\tau_s)(D-S)+(1-\tau_s)(P-\frac{P}{1+\pi})\\
=\ &(1-\tau_s)\left[\Pi-\int\Phi(x_{jt},k_{jt})\,dj-X-\tau_c\int\tilde{T}_{jt}dj\right]+(1-\tau_s)(P-\frac{P}{1+\pi})\\
=\ &(1-\tau_s)\left[\Pi-\int\Phi(x_{jt},k_{jt})\,dj-X\right]\\
&-(1-\tau_s)\tau_c\left[\Pi-\int\Phi(x_{jt},k_{jt})\,dj-X+\int\left(q_{jt}k_{j,t+1}(1+\pi)-q_{jt-1}k_{jt}\right)\right]\\
&+(1-\tau_s)(P-\frac{P}{1+\pi})\\
=\ &(1-\tau_s)(1-\tau_c)\left(\Pi-\int\Phi(x_{jt},k_{jt})\,dj-X+\left[\int\left(q_{jt}k_{j,t+1}(1+\pi)-q_{jt-1}k_{jt}\right)\right]\right)+\\
&..+(1-\tau_s)\left[(P-\frac{P}{1+\pi})-\left[\int\left(q_{jt}k_{j,t+1}(1+\pi)-q_{jt-1}k_{jt}\right)\right]\right]
\end{aligned}
$$

where $\Psi=\int\Phi(x_{jt},k_{jt})\,dj$ and we have used $\phi=1$ again. Under constant returns to scale, we would have $P_t=\int q_{jt}k_{j,t+1}(1+\pi)$ and the last two terms would cancel out. In the absence of constant returns to scale, inflation creates a wedge between the capital gains of the households and the ones within the firm and these two terms do not cancel out. However, in a stationary distribution with $\pi=0$, capital gains are zero anyway and the last two terms disappear. As a result, every household's budget constraint (2) and Euler equation (4) are still satisfied after the reform. It follows that government revenues are the same after the reform and thus the government's budget is also satisfied. This completes the proof.

# References

[1] Abel, A. B., 1983. "Tax Neutrality in the Presence of Adjustment Costs." The Quarterly Journal of Economics, 98 (4), pp. 705 - 712.

[2] Atesagaoglu, O. E., 2012. "Taxes, Regulations and the Corporate Debt Market." International Economic Review, 53 (3), pp. 979 - 1004.

[3] Anagnostopoulos, A., Carceles-Poveda, E., Lin, D., 2012. "Dividend and Capital Gains Taxation under Incomplete Markets." Journal of Monetary Economics, 59 (7), pp. 898 - 919.

[4] Auerbach, A. J., 1989. "Tax Reform and Adjustment Costs: The Impact on Investment and Market Value." International Economic Review, 30 (4), pp. 939 - 962.

[5] Castañeda, A., Diaz-Gimenez, J., Ríos-Rull, J. V., 2003. "Accounting for earnings and wealth inequality." Journal of Political Economy, 111(4), pp. 818 - 857.

[6] Cárceles-Poveda, E., Coen-Pirani, D., 2010. "Owning Capital or Being Shareholders: An Equivalence Result under Incomplete Markets". Review of Economic Dynamics 13, pp. 537-558.

[7] Chen, D., Qi, S., Schlagenhauf, D. E., 2014. "Corporate Income Tax, Legal Form of Organization, and Employment." Working paper.

[8] Conesa, J. C., Dominguez, B., 2013. "Intangible Capital and Ramsey Capital Taxation." Journal of Monetary Economics, 60, pp. 983 - 995.

[9] Conesa, J.C., Kitao, S., Krueger, D., 2009. "Taxing Capital? Not a Bad Idea After All!". American Economic Review, 99 (1), pp. 25 - 48.

[10] Dammon, R. M., Spatt, C. S., Zhang, H. H., 2001. "Optimal Consumption and Investment with Capital Gains Taxes." The Review of Financial Studies, 14 (3), pp. 583 - 616.

[11] Davila, J., Hong, J. H., Krusell P., Ríos-Rull, J. V., 2012. "Constrained Efficiency in the Neoclassical Growth Model with Uninsurable Idiosyncratic Shocks." Econometrica, 80 (6), pp. 2431 - 2467.

[12] Diaz, A., Pijoan-Mas, J., Ríos-Rull, J. V., 2003. "Habit Formation: Implications for the Wealth Distribution." Journal of Monetary Economics, 50 (6), pp. 1257 - 1291.

[13] Diaz-Gimenez, J., Glover, A., Rios-Rull, J. V., 2011. "Facts on the Distributions of Earnings, Income, and Wealth in the United States: 2007 Update." Federal Reserve Bank of Minneapolis Quarterly Review, 34 (1), pp. 2 - 31.

[14] Domeij, D., Heathcote, J., 2004. "On the Distributional Effects of Reducing Capital Taxes." International Economic Review, 45 (2), pp. 523-554.

[15] Favilukis, J., Ludvigson, S. C., van Nieuwerburgh, S., 2013. "The Macroeconomic Effects of Housing Wealth, Housing Finance, and Limited Risk-Sharing in General Equilibrium." Unpublished manuscript.

[16] Feenberg, D., Coutts, E. 1993. "An Introduction to the Taxsim Model." Journal of Policy Analysis and Management, 12 (1), pp. 189 - 194.

[17] Fehr, H., Jokisch, S., Kambhampati, A., Kotlikoff, L. J., 2013. "Simulating the Elimination of the U.S. Corporate Income Tax." NBER working Paper No. 19757.

[18] Gavin, W. T., Kydland, F. E., Pakko, M. R., 2007. "Monetary Policy, Taxes, and the Business Cycle." Journal of Monetary Economics, 54 (6), pp. 587 - 1611.

[19] Gourio, F., Miao, J., 2010. "Firm Heterogeneity and the Long Run Effects of Dividend Tax Reform." American Economic Journal: Macroeconomics, 2 (1), pp. 131 - 168.

[20] Gourio, F., Miao, J., 2011. "Transitional Dynamics of Dividend and Capital Gains Tax Cuts." Review of Economic Dynamics, 14 (2), pp. 368-383.

[21] McGrattan, E. R., Prescott, E. C. 2005. "Taxes, Regulations and the Value of U.S. Corporations." Federal Reserve Bank of Minneapolis, Research Department Staff Report 309.

[22] Mendoza, E., Razin, A., Tesar, L., 1994. "Effective Tax Rates in Macroeconomics. Cross Country Estimates of Tax Rates on Factor Income and Consumption". Journal of Monetary Economics, 34 (3), pp. 297-323.

[23] Miao, J., Wang, P., 2014. "Lumpy Investment and Corporate Tax Policy." Journal of Money, Credit and Banking, 46 (6), pp. 1171 - 1203.

[24] Santoro, M., Wei, C., 2011. "Taxation, Investment and Asset Pricing." Review of Economic Dynamics, 14 (3), pp. 443-454.

[25] Tauchen, G., Hussey, R., 1991. "Quadrature-Based Methods for Obtaining Approximate Solutions to Nonlinear Asset Pricing Models." Econometrica, 59 (2), pp. 371 - 396.

## Table 1. Parameter Values - Baseline Calibration

|  | Parameter | Value |
|---|---|---|
| Discount Factor | $\beta$ | 0.940 |
| Share of Capital in Production | $\alpha_k$ | 0.311 |
| Share of Labor in Production | $\alpha_l$ | 0.650 |
| Depreciation Rate | $\delta$ | 0.075 |
| Inflation Rate | $\pi$ | 0.020 |
| Adjustment Cost Parameter | $\psi$ | 1.605 |
| CRRA Parameter | $\mu$ | 1.00 |
| Fraction of Adjustment Cost Deducted | $\phi$ | 0.54 |
| Labor Productivity Shocks | $\epsilon_{it}$ | See Table 2 |
| Firm Level Productivity Shocks | $z_{it}$ | See Table 3 |
| Tax Rate on Corporate Income | $\tau_c$ | 0.34 |
| Tax Rate on Dividends | $\tau_d$ | 0.20 |
| Tax Rate on Capital Gains | $\tau_g$ | 0.20 |
| Tax Rate on Labor Income | $\tau_l$ | 0.28 |

## Table 2. Labor Productivity Process [*]

$$\epsilon = \begin{bmatrix} 1.00 & 5.29 & 46.55 \end{bmatrix}$$

$$\Omega_\epsilon^* = \begin{bmatrix} 0.498 & 0.443 & 0.059 \end{bmatrix}$$

$$\Omega_\epsilon(\epsilon'/\epsilon) = \begin{bmatrix} 0.992 & 0.008 & 0.000 \\ 0.009 & 0.980 & 0.011 \\ 0.000 & 0.083 & 0.917 \end{bmatrix}$$

[*] Notation: $\epsilon$ denotes the values of the labor productivity shock, $\Omega_\epsilon^*$ is the stationary distribution of the labor productivity shock process, and $\Omega_\epsilon(\epsilon'/\epsilon)$ is the Markov transition matrix.

Table 3. Firm Level Productivity Process [*]

$$z = \begin{bmatrix} 0.36 & 0.47 & 0.59 & 0.73 & 0.90 & 1.11 & 1.36 & 1.69 & 2.13 & 2.79 \end{bmatrix}$$

$$\Omega_z^* = \begin{bmatrix} 0.00 & 0.02 & 0.08 & 0.16 & 0.24 & 0.24 & 0.16 & 0.08 & 0.02 & 0.00 \end{bmatrix}$$

$$\Omega_z(z'/z) = \begin{bmatrix}
0.308 & 0.463 & 0.195 & 0.031 & 0.003 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
0.062 & 0.327 & 0.404 & 0.175 & 0.030 & 0.002 & 0.000 & 0.000 & 0.000 & 0.000 \\
0.007 & 0.114 & 0.354 & 0.360 & 0.141 & 0.022 & 0.002 & 0.000 & 0.000 & 0.000 \\
0.001 & 0.022 & 0.166 & 0.374 & 0.316 & 0.106 & 0.014 & 0.001 & 0.000 & 0.000 \\
0.000 & 0.003 & 0.045 & 0.218 & 0.385 & 0.269 & 0.073 & 0.007 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.007 & 0.073 & 0.269 & 0.385 & 0.218 & 0.045 & 0.003 & 0.000 \\
0.000 & 0.000 & 0.001 & 0.014 & 0.106 & 0.316 & 0.374 & 0.166 & 0.022 & 0.001 \\
0.000 & 0.000 & 0.000 & 0.002 & 0.022 & 0.141 & 0.360 & 0.354 & 0.114 & 0.007 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.002 & 0.030 & 0.175 & 0.404 & 0.327 & 0.062 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.003 & 0.031 & 0.195 & 0.463 & 0.308
\end{bmatrix}$$

[*] Notation: z denotes the values of the firm level productivity shock, $\Omega_z^*$ is the stationary distribution of the firm level productivity shock process, and $\Omega_z(z'/z)$ is the Markov transition matrix.


Table 4. Distribution of Firms Across Finance Regimes (Data vs. Model)
Benchmark Economy - (Pre-Reform Steady State)

|  | Equity Issuance Regime | Liquidity Constrained Regime | Dividend Distribution Regime |
|---|---|---|---|
| Share of Capital |  |  |  |
| Data [1] | 0.21 | 0.06 | 0.73 |
| Model | 0.17 | 0.00 | 0.83 |
|  |  |  |  |
| Earnings/Capital Ratio |  |  |  |
| Data [1] | 0.56 | 0.29 | 0.33 |
| Model | 0.38 | n/a | 0.19 |
|  |  |  |  |
| Tobin's Q |  |  |  |
| Data [1] | 3.63 | 1.81 | 2.50 |
| Model | 2.34 | n/a | 1.34 |

[1] The data reported are authors' calculations using COMPUSTAT Industrial Annual data for the years 1988-2006. Firms that simultaneously issue equity and distribute dividends are classified under the "Equity issuance Regime". Their share of capital is 17%.

## Table 5. Eliminating Corporate Income Taxes

| REFORM | $\tau_g = \tau_d$ [1] | | | $\tau_d$ [2] |
|---|---|---|---|---|
| | φ=0.54 (Benchmark) | φ=0.77 | φ=1.00 | φ=0.54 (Benchmark) |
| **Tax Rates** | | | | |
| $\tau_c$ | 0.0 | 0.0 | 0.0 | 0.0 |
| $\tau_d$ | 48.2 | 46.8 | 44.9 | 54.3 |
| $\tau_g$ | 48.2 | 46.8 | 44.9 | 20.0 |
| **Long Run Aggregates (% change)** | | | | |
| Y | 0.9 | 0.6 | 0.4 | 10.6 |
| K | -0.6 | 1.0 | 3.3 | 43.6 |
| C | 0.1 | 0.2 | 0.5 | 6.7 |
| TFP | 1.1 | 0.3 | -0.6 | -1.2 |
| w | 0.9 | 0.6 | 0.4 | 10.6 |
| r | -2.9 | -1.5 | 0.4 | -15.5 |
| **Welfare (%) [3]** | | | | |
| Overall | 0.36 | 0.18 | 0.09 | 0.30 |
| Aggregate | 0.13 | 0.03 | 0.07 | -0.91 |
| Distributional | 0.23 | 0.15 | 0.02 | 1.23 |

[1]  In this reform, dividend and capital gains taxes change together, equalized to each other

[2]  In this reform, capital gains taxes are kept constant at their benchmark levels ($\tau_g$=0.20).

[3]  Social welfare gain/loss in consumption equivalent terms. It incorporates the effects of transition.

Table 6. Effects of Eliminating $\tau_c$ on Capital Distribution Across Productivity Levels

| Productivity (z) | z1 | z2 | z3 | z4 | z5 | z6 | z7 | z8 | z9 | z10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Change (%) in $E(k\,|\,z)$ [1] | | | | | | | | | | |
| Reform - ($\tau_c$ vs. $\tau_d=\tau_g$) | | | | | | | | | | |
| Case - ($\phi=0.54$) (Benchmark) | -16.8 | -14.0 | -11.2 | -8.3 | -5.2 | -1.8 | 2.0 | 6.1 | 10.6 | 15.0 |
| Case - ($\phi=0.77$) | -5.4 | -4.2 | -3.1 | -1.9 | -0.7 | 0.7 | 2.1 | 3.5 | 5.1 | 6.7 |
| Case - ($\phi=1.00$) | 8.7 | 7.7 | 6.8 | 5.8 | 4.7 | 3.6 | 2.4 | 1.2 | -0.2 | -1.5 |
| Reform - ($\tau_c$ vs. $\tau_d$) | | | | | | | | | | |
| Case - ($\phi=0.54$) | 70.9 | 63.0 | 56.8 | 51.6 | 47.2 | 43.5 | 40.5 | 38.0 | 36.3 | 35.3 |

[1]  Mean capital conditional on productivity z

**Table 7. Welfare Effects with Anticipation - Elimination of Corporate Income Taxes**

**Benchmark Economy (ϕ=0.54)**

| Case $\tau_g = \tau_d$ : Financing with Dividend and Capital Gains Taxes | | | |
|---|---|---|---|
| Years of Anticipation | 0 | 1 | 2 |
| Welfare (%) [1] | | | |
| Overall | 0.36 | 0.48 | 0.49 |
| Aggregate | 0.13 | 0.11 | 0.10 |
| Distributional | 0.23 | 0.37 | 0.38 |

| Case $\tau_d$ : Financing with Dividend Taxes | | | |
|---|---|---|---|
| Years of Anticipation | 0 | 1 | 2 |
| Welfare (%) [1] | | | |
| Overall | 0.30 | -0.12 | -0.36 |
| Aggregate | -0.91 | -0.93 | -0.92 |
| Distributional | 1.23 | 0.81 | 0.57 |

[1]  Social welfare gain/loss in consumption equivalent terms. It incorporates the effects of transition.

## Table 8. Political Support

### A. Reform ($\tau_c$ vs. $\tau_d=\tau_g$)

| $\tau_c$ | 0 | 0.04 | 0.09 | 0.14 | 0.19 | 0.24 | *0.274* | 0.29 | **0.34** |
|---|---|---|---|---|---|---|---|---|---|
| $\tau_d=\tau_g$ | 0.482 | 0.459 | 0.427 | 0.391 | 0.351 | 0.307 | *0.274* | 0.257 | **0.200** |
| Fraction in Favor (%) | 82.8 | 82.8 | 82.9 | 83.2 | 83.4 | 84.0 | *84.4* | 84.6 | - |

### B. Reform ($\tau_c$ vs. $\tau_d$)

| $\tau_c$ | 0 | 0.04 | 0.09 | 0.14 | 0.19 | 0.24 | 0.29 | **0.34** |
|---|---|---|---|---|---|---|---|---|
| $\tau_d$ | 0.543 | 0.512 | 0.471 | 0.426 | 0.378 | 0.325 | 0.264 | **0.200** |
| Fraction in Favor (%) | 79.2 | 79.5 | 79.7 | 79.9 | 80.1 | 80.3 | 80.7 | - |

# Figure 1: Transition Paths when Corporate Income Taxes are Eliminated

Reform ( $\tau_c$ vs. $\tau_d = \tau_g$ )

( $\phi = 0.54$ )
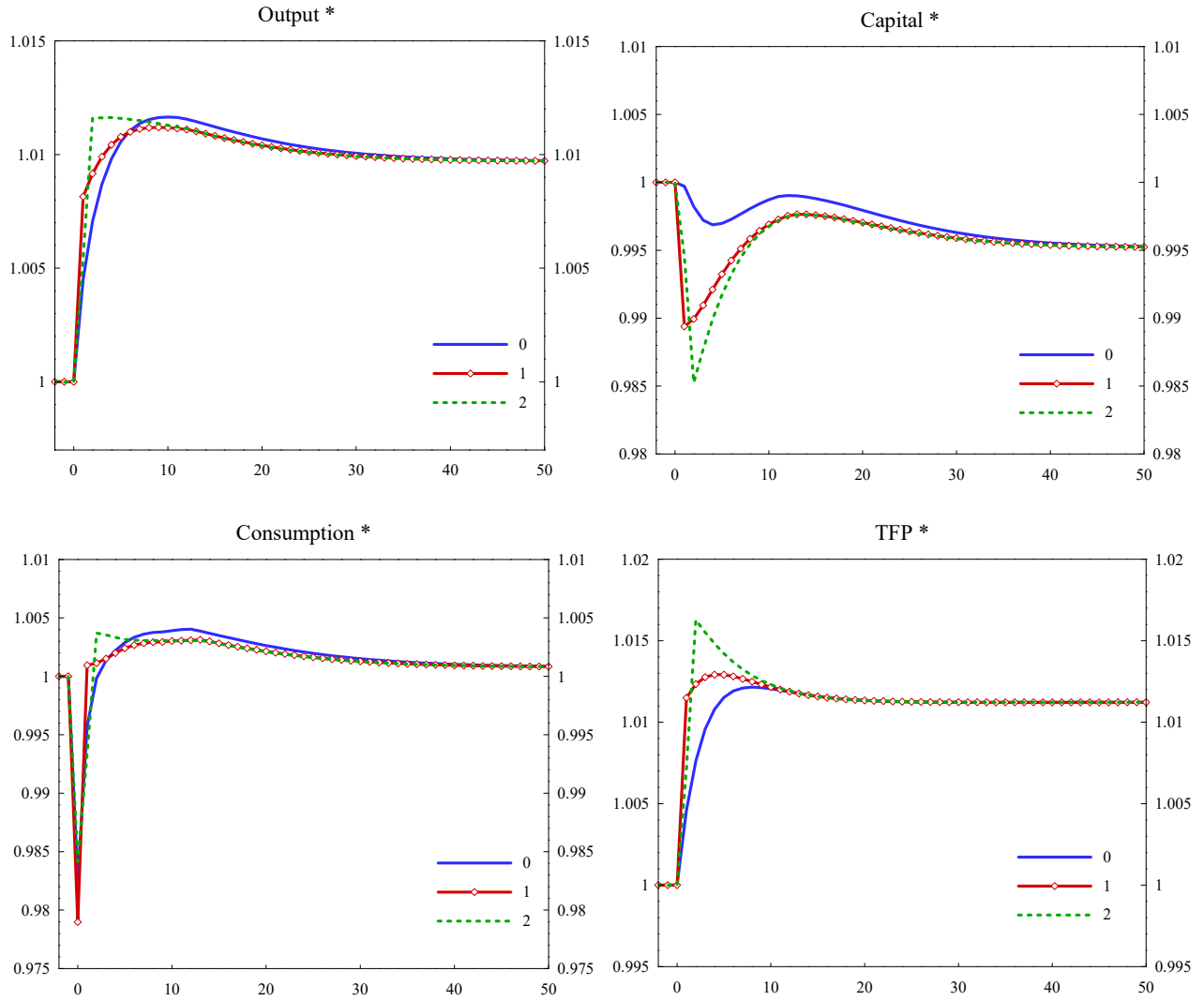


* value relative to the pre-reform level

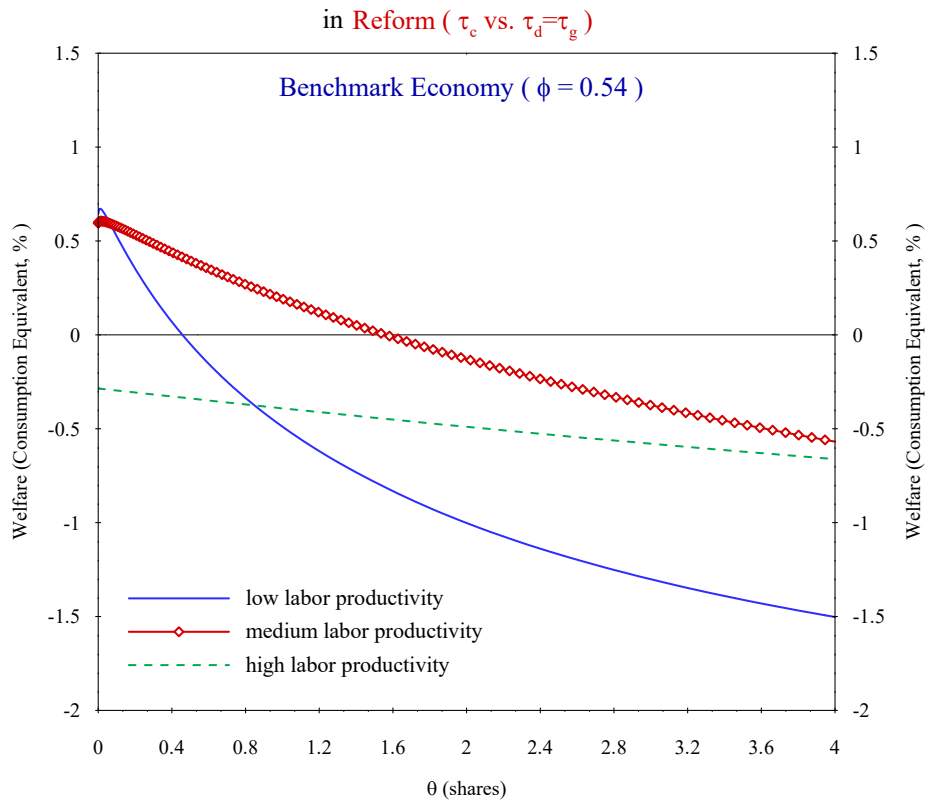Figure 2: Individual Welfare Gains from Eliminating Corporate Taxes
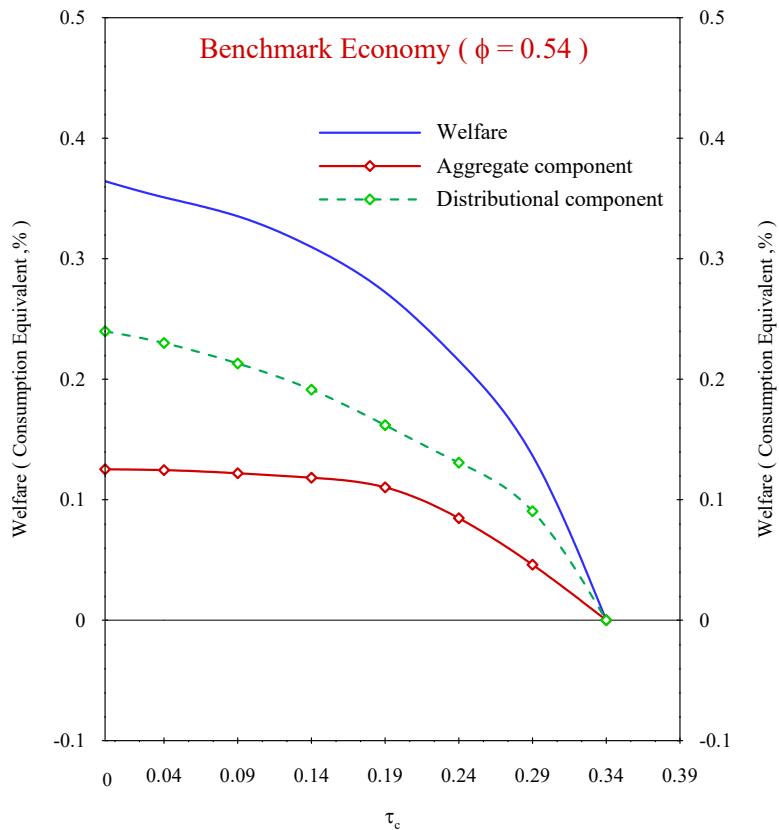in Reform ( $\tau_c$ vs. $\tau_d = \tau_g$ )



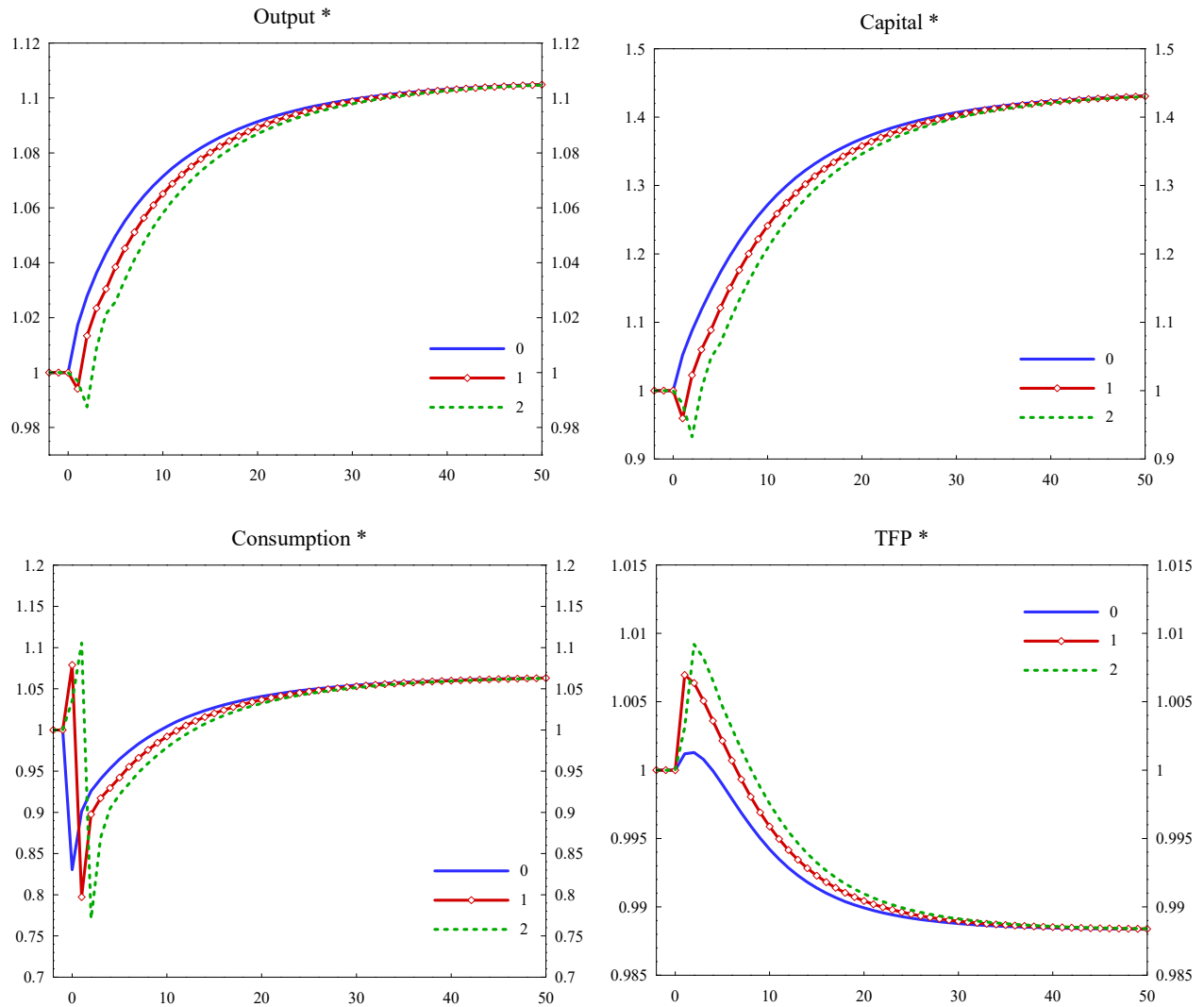Figure 3. Welfare Effects of Reform ( $\tau_c$ vs. $\tau_d = \tau_g$ )

# Figure 4: Transition Paths when Corporate Income Taxes are Eliminated

Reform ( $\tau_c$ vs. $\tau_d$ )

( $\phi = 0.54$ )



* value relative to the pre-reform level

Figure 5:  Individual Welfare Gains from Eliminating Corporate Taxes in Reform ( $\tau_c$ vs. $\tau_d$ )
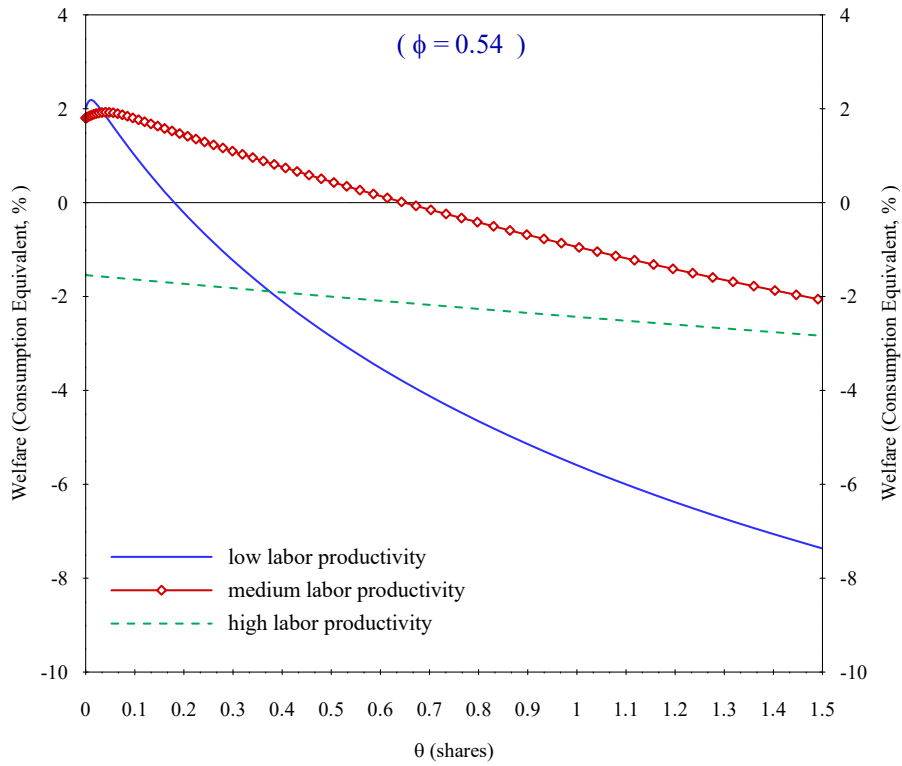


Figure 6. Welfare Effects of Reform ( $\tau_c$ vs. $\tau_d$ )