Quantitative Economics 13 (2022), 315–354 1759-7331/20220315

Financing corporate tax cuts with shareholder taxes

Alexis Anagnostopoulos
Department of Economics, Stony Brook University

Orhan Erem Atesagaoglu
Faculty of Business, Istanbul Bilgi University

Eva Cárceles-Poveda
Department of Economics, Stony Brook University

We study the aggregate and distributional consequences of replacing corporate profit taxes with shareholder taxes, namely taxes on dividends and capital gains, in a setting with incomplete markets and heterogeneity at both the household and the firm level. The reform yields distributional gains with a large majority of households benefiting. Moreover, if dividend and capital gains are taxed at the same rate, the reform is also efficiency-enhancing and the implied optimal corporate income tax rate is zero. In contrast, an asymmetric tax treatment of dividend and capital gains induces a trade-off between efficiency and distributional concerns that is optimally resolved at a positive optimal corporate tax rate, implying double taxation.

Keywords. Optimal corporate taxes, double taxation, heterogeneity, misallocation.

JEL classification. E6.

1. Introduction

Corporate income tax cuts remain one of the most polarizing topics in fiscal policy. This issue returned to the forefront of political debate recently with the Tax Cuts and Jobs Act of 2017, which included a sizable reduction in corporate profit rates. Often, proponents of the tax cuts emphasize the inefficiency of raising revenues using corporate taxes relative to other income taxes, while opponents argue that the revenue loss induced by the reforms would have to be compensated with personal income tax hikes or cutbacks in benefits programs, targeted at the least wealthy, if the reforms are to be revenue-neutral.

Alexis Anagnostopoulos: alexis.anagnostopoulos@stonybrook.edu
Orhan Erem Atesagaoglu: erem.atesagaoglu@bilgi.edu.tr
Eva Cárceles-Poveda: ecarcelespov@gmail.com
This paper was previously circulated under the title "On the Double Taxation of Corporate Profits." We wish to thank Arpad Abraham, Juan Carlos Conesa, Allan Drazen, Ayse Imrohoroglu, Ayse Kabukcuoglu, Andrea Lanteri, Han Ozsoylev, Joseph Zeira as well as seminar participants at the EUI, Koc, Southampton, St. Andrews, Sabanci, Bilgi and Bogazici Universities and conference participants at the Midwest Macro, SED, CRETE, and North American Summer meetings for helpful comments and suggestions. We also thank two anonymous referees for suggestions that have improved the paper substantially.

 https://doi.org/10.3982/QE1167

The academic literature provides ample support to both the positive efficiency gains from lower corporate taxes and the potential negative distributional effects.[1]

In this paper, we study whether a corporate profit tax reform can deliver some of the efficiency gains from a corporate tax cut while, at the same time, avoiding the negative distributional consequences and gaining popular support. We address these questions in an infinite horizon framework with incomplete markets that features idiosyncratic uncertainty at both the household and the firm level. In such a setting, we show that corporate profit tax cuts can gain widespread political support whenever revenue-neutrality is induced via higher taxes that fall on the same group of people, namely, the 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. In addition, by considering a series of tax cuts of different size, we are able to determine the optimal mix of corporate and shareholder taxes. This also sheds light on the question of whether double taxation of dividends is justified from an optimal perspective. To our knowledge, our model is the first one to investigate these issues in a setting with a substantial amount of both household and firm heterogeneity.

From a pure efficiency perspective, our analysis 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. First, we argue that the answer can be misleadingly simple in the context of a standard growth model with no heterogeneity. 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 does not distort the investment decision because it does not directly affect the returns to investment (although it affects stock prices).[2] This would suggest that concentrating all taxes on dividends only would be the optimal choice. However, this conclusion is unwarranted when markets are incomplete. When households face uninsurable idiosyncratic risk, the wealth effect arising from the stock price changes is transmitted in general equilibrium to savings and investment, implying that 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] One of the main objectives of this paper is to quantify and compare the direct distortions of the corporate profit tax with the indirect distortions of shareholder taxes in the presence of a tax wedge between the dividend and capital gains tax rates.

---

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

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

[3]These two points are made in Anagnostopoulos, Carceles-Poveda, and Lin (2012), in the context of a model with only household heterogeneity, and by Gourio and Miao (2010), in the context of a model with only firm heterogeneity. The two papers study the effects of a reduction in shareholder taxes, but they do not study changes in the corporate tax rate.

The preceding discussion suggests that the distortions due to the tax wedge could potentially be avoided simply by increasing the capital gains tax in tandem with the dividend tax, which avoids introducing the wedge. However, this would introduce a 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 direct 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. Moreover, we provide conditions under which this result can be extended to an economy with incomplete markets and external financing, a result that constitutes a theoretical contribution in itself. However, the equivalence between corporate and shareholder taxes relies on a definition of taxable corporate income, which is at odds with the actual tax code. In our quantitative analysis, which uses a more standard definition of taxable income, the equivalence is no longer true. Clarifying and quantifying the direct distortions of corporate and shareholder taxes is another important objective of the present paper.

In addition to efficiency considerations, we are interested in the distributional effects of the reforms so our model incorporates household heterogeneity. As a result, our model features both 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. Firms use 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. Households can trade in shares of a mutual fund comprising all firms and earn asset income, in the form of dividends and capital gains from their share holdings, as well as labor income. The government maintains a fixed amount of exogenous spending, which it can finance through flat taxes on firms' profits and on households' labor and asset 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, we increase both dividend and capital gains taxes maintaining the equality between the two. In the second experiment, only dividend taxes are increased and this introduces a tax wedge between dividend and capital gains taxes.[4] 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. Interestingly, this stands in contrast to corporate tax cuts financed through labor taxes, which tend to imply negative redistribution and limited support. At the same time, the two reforms are markedly different regarding their effects on efficiency.

When only dividend taxes are increased, we show that the resulting misallocation of capital due to the wedge in shareholder taxes dominates the distortions caused by the

[4]When dividend taxes are increased above capital gains taxes, firms have an incentive to use repurchases instead of dividends to avoid the dividend tax and this is not allowed in our model. As a result, the policy change considered here implicitly includes the introduction of a rule against repurchases.

corporate tax. Although aggregate capital and output increase significantly due to the corporate tax reduction, 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 positive distributional effects. For large reductions in the corporate tax rate, social welfare decreases because the aggregate component dominates, while smaller reductions have a quantitatively small, positive effect on social welfare. The implication is that 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, leading to higher output. In contrast to the standard effects of capital tax cuts, which induce additional savings to increase long run output, the transition here features a reduction in savings and an increase in consumption, which generates positive efficiency effects.

Overall, our results suggest that a 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. Although eliminating corporate taxes while maintaining the equality of shareholder taxes yields the highest social welfare gains, it would represent a dramatic change that might be politically difficult to implement in practice. A less dramatic corporate tax reduction would be to consider a reform which equalizes the tax rates for all types of personal income as well as for corporate income. We include results from such an experiment, where the common tax rate required is approximately 28%, and we find that such a reform would lead to overall welfare gains and command wide political support in the sense of welfare gains for 84% of households.

The reform which maintains equality of dividend and capital gains taxes 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 1 or 2 years in advance. In that case, a reform that increases only dividend taxes can have very different implications regarding the short run responses of macroeconomic aggregates 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 introducing additional fluctuation in wages during the transition and this mostly affects low-wealth individuals. As a result, the distributional benefits of the reform are reduced.

Given the computational complexity involved,[5] 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

[5]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.

mechanisms, such as the importance of the choice of the legal form of organization (Chen, Qi, and Schlagenhauf (2018)), the presence of lumpy investment (Miao and Wang (2014)) or the role of capital mobility in an open economy setting (Fehr, Jokisch, Kambhampati, and 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, Carceles-Poveda, and Lin (2012) investigate the effects of reducing shareholder taxes, but are silent about changes in the corporate profits tax. 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 welfare 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. Integrating both mechanisms within the same framework is important since they can have opposite implications regarding the effects of shareholder taxes.

Conesa and Dominguez (2013) is most closely related to our work, since it investigates corporate taxes in conjunction with dividend taxes. 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. While they go one step further by computing optimal Ramsey taxes rather than once and for all tax rate changes, they abstract from capital gains taxes and heterogeneity, implying that their model does not capture the distortions arising from the tax wedge in shareholder taxes when markets are incomplete. Incorporating those elements, we show that switching from corporate taxes to dividend taxes is only a welfare improving policy if capital gains taxes are also increased.

Section 2 provides the model, Section 3 discusses the main qualitative insights, Section 4 presents the calibration of the benchmark economy, Section 5 presents the quantitative results, and Section 6 discusses the sensitivity of our results to modeling and calibration choices. Section 7 concludes.

2. The model

We consider an infinite horizon economy, 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, Ludvigson, and van Nieuwerburgh (2017). 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

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

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 $u(\cdot) : \mathbb{R}_+ \to \mathbb{R}$ is assumed to be strictly increasing, strictly concave and continuously differentiable, with $\lim_{c_i \to 0} u'(c_i) = \infty$ and $\lim_{c_i \to \infty} u'(c_i) = 0$.

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 ϵ_{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_ϵ possible values.

Markets are incomplete. Households can only partially insure against uncertainty by trading shares θ_{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 τ_{lt}, τ_d, and τ_g, respectively. They can use their after tax income from all sources to purchase consumption goods or to buy shares θ_{it} of the mutual fund at a competitive market price P_t. After tax income includes labor income and the income from holding shares θ_{it-1}. These shares entitle the household to a share θ_{it-1} of the total after tax dividend payout $(1 - \tau_d) D_t$. In addition, the shareholder can sell their 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 $(P_t^0 - P_{t-1})\theta_{it-1}$ represents accrued capital gains, which are taxed at the rate τ_g.[6] 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

$$c_{it} + P_t \theta_{it} = (1 - \tau_{lt}) w_t \epsilon_{it} + \big((1 - \tau_d) D_t + P_t^0\big)\theta_{it-1} - \tau_g \big(P_t^0 - P_{t-1}\big)\theta_{it-1}. \tag{1}$$

Short selling of the mutual fund shares is not allowed:

$$\theta_{it} \geq 0.$$

[6] 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, 2004).

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,

$$1 + r_{t+1} \equiv 1 + \frac{(1-\tau_d)D_{t+1} + (1-\tau_g)\big(P_{t+1}^0 - P_t\big)}{P_t} = \frac{u'(c_{it})}{\beta E_t u'(c_{it+1})}, \tag{2}$$

where we have defined the net after tax return to be r_{t+1}. Note that, given the absence of aggregate uncertainty, that return is deterministic. Equation (2) simply states that, at an optimum, the after tax return on the asset must equal the intertemporal marginal rate of substitution of unconstrained households. It can be used to express the market value of the mutual fund as a present discounted sum of tax adjusted payouts

$$P_t = \sum_{j=1}^{\infty}\left(\prod_{k=1}^{j}\frac{1}{1+\dfrac{r_{t+k}}{1-\tau_g}}\right)\left[\frac{(1-\tau_d)}{(1-\tau_g)}D_{t+j} - S_{t+j}\right]. \tag{3}$$

Note that shareholders discount future payouts using the before tax return $\frac{r}{1-\tau_g}$ and that equity issuance reduces the payout for current shareholders. When $\tau_d = \tau_g$, the payout is simply $D_{t+j} - S_{t+j}$ but when $\tau_d > \tau_g$, then dividends are valued less than capital gains.

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

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

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 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:

$$\pi(k_{jt}, z_{jt}; w_t) \equiv \max_{l_{jt}}\big\{z_{jt} f(k_{jt}, l_{jt}) - w_t l_{jt}\big\},$$

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. External funds are obtained by issuing new equity.[7] The value of new equity issued in period t is denoted by s_{jt}. Internal funds consist of operating profits $\pi(k_{jt}, z_{jt}; w_t)$ net of taxes $\tau_c T_{jt}$, where T_{jt} denotes taxable income and τ_c is a flat corporate income tax rate τ_c. Funds can be allocated to dividends d_{jt} or capital expenditures, the latter consisting of new additions to the capital stock x_{jt} and capital adjustment costs $\Phi(x_{jt}, k_{jt})$. Thus, the firm's financing constraint is given by

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

where

$$T_{jt} = \pi(k_{jt}, z_{jt}; w_t) - \delta k_{jt} - \phi\Phi(x_{jt}, k_{jt}). \tag{4}$$

Deductions from taxable income include a depreciation allowance δk_{jt} as well as a fraction ϕ of adjustment costs. The firm's capital stock evolves according to

$$k_{j,t+1} = x_{jt} + (1 - \delta)k_{jt}, \tag{5}$$

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

$$d_{jt} \geq 0 \tag{6}$$

and no repurchases are allowed[8]

$$s_{jt} \geq 0. \tag{7}$$

We assume that firm j maximizes the following objective:

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

based on the mutual fund value in (3). Specifically, the discount factor used by all firms is the risk-free rate. Although individual firms are not directly traded here, the discount factor used is consistent with firms being traded as long as households hold diversified portfolios, that is, as long as no individual firm j is a large enough proportion of a household's portfolio to affect its marginal rate of substitution.[9]

[7]In Section 6, we extend the model to also allow for debt financing.

[8]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. For additional discussion, see also Section 7.

[9]The mutual fund assumption is borrowed from Favilukis, Ludvigson, and van Nieuwerburgh (2017) who 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. In their model, a household's MRS can covary with sector specific (aggregate) shocks making the choice of firm objective nontrivial. We refer the reader to their paper for a discussion of alternative assumptions regarding the discount factor in that context.

Let q_t, λ_t^d, λ_t^s be the multipliers on the constraints (5), (6), and (7), respectively.[10] The first-order conditions of the firm's problem are:

$$\begin{aligned}
&\frac{1-\tau_d}{1-\tau_g} + \lambda_t^d + \lambda_t^s = 1, \\
&\qquad q_t = \left(\frac{1-\tau_d}{1-\tau_g} + \lambda_t^d\right)\left[1 + \Phi_x(x_t, k_t)(1-\tau_c\phi)\right], \\
&\qquad q_t = \frac{1}{1+\dfrac{r}{1-\tau_g}} E_t\left(q_{t+1}(1-\delta) + \left(\frac{1-\tau_d}{1-\tau_g} + \lambda_{t+1}^d\right) R_{k,t+1}\right), \\
&R_{k,t+1} \equiv (1-\tau_c)\frac{\partial \pi(k_{t+1}, z_{t+1}; w)}{\partial k_{t+1}} + \tau_c\delta - \Phi_k(x_{t+1}, k_{t+1})(1-\tau_c\phi).
\end{aligned} \tag{8}$$

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

$$TFP_t \equiv \frac{Y_t}{K_t^{\alpha_k} L_t^{\alpha_l}},$$

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 τ_c, τ_d, τ_g, and τ_{lt}, respectively. We assume that the government maintains a balanced budget ev-

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

ery period. The government budget constraint is given by

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

2.4 *Market clearing*

At every period t, the stock market, the labor market, and the goods markets clear[11]

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

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

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

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, that is, 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.[12]

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 has considerable merit since a highly distortionary tax is replaced by a nondistortionary one.

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, adjustment costs, and eq-

[11] A formal definition of the recursive competitive equilibrium as well as the computational algorithm used are available in sections S1 and S2 of the Online Supplementary Material (Anagnostopoulos, Atesagaoglu, and Cárceles-Poveda (2022)).

[12] 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.

uity issuance, in which case the model collapses to a standard growth model.[13] In the absence of taxes, the representative firm's financing constraint is

$$D_t + K_{t+1} - K_t = K_t^{\alpha} L_t^{1-\alpha} - w_t L_t - \delta K_t. \tag{9}$$

The left-hand 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 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.[14] 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 (9). Second, assuming that a dynamic firm owns the capital stock and 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 directlyand it does not distort the investment decision. 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 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,

[13]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 Cárceles-Poveda and Coen-Pirani (2010) for the equivalence of the two settings.

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

and adjustment costs. 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 modification is a redefinition of accounting profits for corporate tax purposes. Since this modification does not necessarily reflect the reality of the US economy, it will serve as a guide for the intuition as to why the equivalence is broken in our more realistic full model.

Suppose that taxable income in (4) is adjusted to be

$$\tilde{T}_{jt} = T_{jt} + (q_{jt}k_{j,t+1} - q_{jt-1}k_{jt}) - (k_{j,t+1} - k_{jt}), \tag{10}$$

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, $\phi = 1$. Starting at a stationary distribution of this model with τ_c and τ_s $(= \tau_d = \tau_g)$ being the corporate and shareholder tax rates, respectively, a reform that changes these tax rates to τ_c^* and τ_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 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 A. The proposition shows that corporate profit taxes are equivalent to shareholder taxes that are kept equal as long as the combined tax rate on the return to capital $\tau \equiv \tau_c + \tau_s(1 - \tau_c)$ is kept fixed. The proof follows the main idea from the standard growth model discussed above in recognizing that the corporate tax base is equivalent to the sum of dividends and retained earnings, while retained earnings are closely related to capital gains. The assumed modifications with respect to our full model ($\tilde{T}_{jt}$, $\phi = 1$) ensure these that these relations hold in the long run by addressing two issues.

First, a tax on dividends and retained earnings falls on a base from which the adjustment costs have already been deducted. Therefore, to obtain equivalence of corporate and shareholder taxes in the presence of adjustment costs, these costs need to be completely deductible from corporate taxes, which ensures the same tax base as with shareholder taxes. This explains the requirement that $\phi = 1$.

Second, the simple relation between the market value of the firm and the capital stock, $p_{jt} = k_{jt+1}$, is no longer true in the presence of adjustment costs. Instead, $p_{jt} = Q_{jt}k_{jt+1}$ where Q_{jt} denotes average (Tobin's) Q. As a result, a tax on retained earnings $k_{j,t+1} - k_{jt}$ and a tax on the change in market value $p_{jt} - p_{jt-1}$is not exactly the same thing. Under constant returns to scale, marginal q would equal average Q, in which case $(q_{jt}k_{j,t+1} - q_{jt-1}k_{jt})$ would capture the change in market value. The additional term in $\tilde{T}_{jt}$, by adding the difference between market value changes and retained earnings to the corporate tax base, would ensure that the corporate tax falls on dividends and capital gains, and thus that both corporate and shareholder taxes fall on the same base. In other words, this adjustment would ensure the equivalence of shareholder and corporate taxes at the margin. However, with decreasing returns to scale, marginal q and average Q are not equalized and the overall revenues raised from a tax on $\int q_{jt}k_{j,t+1}dj - \int q_{jt-1}k_{jt}dj$ will not in general be equal to those raised from a tax on capital gains. By focusing on the long run stationary distribution, however, the proposition ensures that market value changes are equal to zero and this discrepancy in revenues is not an issue.

The tax code adjustments in the proposition above 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:

$$\tilde{T}_{jt} = \pi(k_{jt}, z_{jt}; w_t) - \phi\Phi(x_{jt}, k_{jt}) - \big(q_{jt-1} - (1-\delta)q_{jt}\big)k_{jt} - (1 - q_{jt})x_{jt}. \qquad (11)$$

As discussed in Abel (1983), this essentially replaces the deduction of physical depreciation δk_{jt} with a deduction of true economic depreciation, which is given by $(q_{jt-1} - (1-\delta)q_{jt})k_{jt}$, and also deducts the difference between new additions to the capital stock x_{jt} and the market value of these additions 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 nondistortionary. 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.

To summarize, the proposition shows that, when replacing corporate taxes with equal shareholder taxes, as long as the combined tax rate on the return to capital τ 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. However, this relies on full deductibility of adjustment costs and a correction of taxable income, neither of which necessarily corresponds to the actual US tax code. The main usefulness of the theoretical result is in helping to build some intuition on why the reform *does* have effects in an economy without these tax code adjustments. 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 affects the tax wedge $\frac{1-\tau_d}{1-\tau_g}$, and hence the market value of the fund P_t. 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 knife edge result, neither of which are present in our full model: a representative household facing complete markets and a representative firm that is mature in the sense that it generates enough cash flow to finance investment and pay dividends, and hence, does not need to issue equity.

Regarding the first, markets are incomplete in our model and households save for precautionary reasons. Anagnostopoulos, Carceles-Poveda, and Lin (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 as a result of an increase in dividend taxes. The idea is that higher dividend taxes decrease the wedge and thus the value of equity and the overall wealth, leading to an increase in precautionary savings. 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, even a constant 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 and 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 tradeoffs 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 1 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 $\mu = 1$. The discount factor is set to $\beta = 0.934$, which makes the mutual fund return r equal to 4%. The implied aggregate capital to output ratio is 2.03, 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. Table 2 reports the process used. This process is taken from Davila, Hong, Krusell, and Ríos-Rull (2012) and is constructed so that it delivers reasonable inequality levels with a parsimonious Markov

Table 1. Parameter values—baseline calibration.[a]

	Parameter	Value
Discount Factor	β	0.934
Share of Capital in Production	α_{k}	0.311
Share of Labor in Production	α_{l}	0.650
Depreciation Rate	δ	0.054
Adjustment Cost Parameter	ψ	1.210
CRRA Parameter	μ	1.00
Fraction of Adjustment Cost Deducted	φ	0.52
Labor Productivity Shocks	ϵ_{it}	See Table 2
Firm Level Productivity Shocks	z_{it}	See Table 4
Tax Rate on Corporate Income	τ_{c}	0.34
Tax Rate on Dividends	τ_{d}	0.20
Tax Rate on Capital Gains	τ_{g}	0.20
Tax Rate on Labor Income	τ_{l}	0.28

[a]See "Section 4: Calibration" for details on data resurces used in the becnhmark calibration.

chain model of only three states.[15] The highest productivity is almost 50 times the lowest productivity and the transition matrix is such that the stationary distribution of labor earnings has 50% of households at the low productivity, 44% with medium productivity and only 6% with high productivity. Together, these imply a Gini coefficient of labor earnings of 0.6 just as in US data. Importantly, the transition matrix is constructed so that it induces (endogenously) a highly skewed wealth distribution. The idea is that there is a substantial risk of dropping from the top of the earnings distribution to the bottom and this induces top earners to accumulate large precautionary savings. In our benchmark economy, the Gini coefficient of wealth is 0.87, which is only slightly larger than the value of 0.816 reported in Diaz-Gimenez, Glover, and Rios-Rull (2011). Quintiles of the wealth distribution are reported in Table 3, together with their counterpart in the data.[16] As the table shows, more than 90% of wealth is held by the top quintile both in the data and in the model.

Table 2. Household labor productivity process.[a]

$$\epsilon = [\,1.00\ \ 5.29\ \ 46.55\,]$$

$$\Omega_{\epsilon}^{*} = [\,0.498\ \ 0.443\ \ 0.059\,]$$

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

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

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

[16]The data is taken from Abraham and Carceles-Poveda (2010) who use data for net financial assets from the 2004 Survey of Consumer Finances (SCF). Net financial assets exclude residential property, vehicles, and direct business ownership from the assets as well as mortgages and vehicle loans from the liabilities.

TABLE 3. The distribution of financial wealth in the model and the data.[a]

Economy	Quintiles				
	Q1	Q2	Q3	Q4	Q5
Model	0.00	0.00	0.00	2.72	97.28
Data	−1.55	0.09	1.61	8.66	91.20

[a]Data for net financial assets from Abraham and Carceles-Poveda (2010) based on the 2004 Survey of Consumer Finances (SCF). Net financial assets exclude residential property, vehicles and direct business ownership from the assets as well as mortgages and vehicle loans from the liabilities.

The depreciation rate δ is set to 0.054 following Atesagaoglu (2012) who computes this using National Income and Product Accounts and Fixed Asset Tables data for the post WWII period. For the production function and firm productivity shocks, we use the calibration from Gourio and Miao (2010). They estimate the degree of decreasing returns to scale using Compustat Industrial Annual Data. The production function parameters α_k and α_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) process to the residuals z_t of their estimated regression:

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

The estimated values for ρ and σ are 0.767 and 0.211, respectively. This process is approximated using a 10 state Markov chain, shown in Table 4, obtained by applying the method of Tauchen and Hussey (1991). Finally, the adjustment cost function is assumed to be $\Phi(x, k) = \frac{\psi}{2}(\frac{x}{k} - \delta)^2 k$ and the parameter $\psi = 1.210$ is chosen to match the cross sectional volatility of investment rates of 0.156 in Compustat data from 1988 to 2002, as reported in Gourio and Miao (2010).[17]

Regarding government variables, we set the labor income tax rate to $\tau_l = 0.28$ following Mendoza, Razin, and Tesar (1994).[18] 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 for a vast majority of households.[19] 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 $G = 0.186$, which means that government revenues are 28% of output Y in the stationary distribution.

This data counterpart is closer to the model's available liquid asset than the more traditional net worth definition. A similar picture emerges when net worth is used instead.

[17]Cooper and Haltiwanger (2006) find this volatility to be 0.337 in the Longitudinal Research Database (LRD). We use the value from Compustat since that data set focuses on publicly traded corporations, which are the relevant entities for our corporate tax experiments. We consider sensitivity of our results with respect to this choice in Section 6.

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

[19]The values of 20% are consistent with the 2013 federal average marginal income taxes on qualified dividends and long term capital gains reported by Feenberg and Coutts (1993).

Table 4. Firm level productivity process.[a]

$z = [0.36 \quad 0.47 \quad 0.59 \quad 0.73 \quad 0.90 \quad 1.11 \quad 1.36 \quad 1.69 \quad 2.13 \quad 2.79]$

$\Omega_z^* = [0.00 \quad 0.02 \quad 0.08 \quad 0.16 \quad 0.24 \quad 0.24 \quad 0.16 \quad 0.08 \quad 0.02 \quad 0.00]$

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

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

Auerbach (1989) argues that, even though capital costs such as installation costs are treated as capital expenditures in US tax law and are therefore not immediately deductible, they nevertheless generate deductions in the future through depreciation allowances. He shows how one can incorporate the present value of these deductions as immediate deductions and we follow that approach in Appendix B to obtain a reasonable value for the fraction $\phi$of adjustment costs that can be immediately deducted from corporate taxes. Using a steady state approximation, we obtain a present value of depreciation allowances using the expression $\frac{\delta}{\frac{r}{1-\tau_g}+\delta}$. In the benchmark version of our model, we set $\phi = 0.52$, which is the value implied by this expression in the prereform stationary distribution.[20] Note that, if some part of the adjustment costs cannot be attributed to investment,[21] then these costs would be immediately deductible and the value of ϕ would be higher than what we have assumed. Given this, and the fact that $\phi = 0.52$ is only an approximation that is specific to our calibration, we also present results for the alternative extreme case with $\phi = 1$ in Table 7.

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

[20]We only use a steady-state approximation because allowing for time variation in the fraction of deductions would introduce an additional state variable significantly complicating our numerical solution. Note also that we do not take into account the changes induced by endogenous changes in τ_g and r in our experiments, since this has a quantitatively small impact on our results.

[21]For example, this would be the case if such costs represent lower productivity due to worker retraining to handle new equipment.

Table 5. 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[a]	0.21	0.06	0.73
Model	0.19	0.00	0.81
Earnings/Capital Ratio			
Data[a]	0.56	0.29	0.33
Model	0.35	n/a	0.13
Tobin's Q			
Data[a]	3.63	1.81	2.50
Model	1.96	n/a	1.20

[a]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%.

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 5 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.[22] 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.

Finally, Table 6 shows features of the investment rate distribution in our benchmark economy and compares to the data reported in Cooper and Haltiwanger (2006).

Table 6. Moments of the investment rate distribution.

	Data[a]	Model
Inactive ($\lvert \frac{x}{k} \rvert < 0.01$)	0.081	0.061
Positive Spike ($\frac{x}{k} > 0.2$)	0.186	0.161
Negative Spike ($\frac{x}{k} < -0.2$)	0.018	0.003
Positive Investment ($\frac{x}{k} > 0.01$)	0.815	0.577
Negative Investment ($\frac{x}{k} < -0.01$)	0.104	0.360

[a]Data Source: Cooper and Haltiwanger (2006).

[22]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.

As is well known, the data shows evidence of lumpy investment. Specifically, a significant fraction (19%) of firms experience positive spikes in investment rates, a significant fraction (8%) are inactive and there is an asymmetry in that more firms undertake positive investment than negative investment. Although our model does not include non convex costs, the combination of the estimated idiosyncratic shock process together with the calibrated convex adjustment costs can take us a long way toward matching these features of the investment rate distribution. This confirms the finding in Khan and Thomas (2008) that carefully chosen idiosyncratic productivity shocks can generate enough lumpiness without the need for nonconvex costs to be introduced in the model. The main remaining discrepancy between our model and the data is that we underpredict the asymmetry between positive and negative investments, likely due to not including growth in our model.

5. Quantitative results

We consider two alternative types of reforms in both of which the corporate profits tax rate τ_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 consider a range of values for the new level of τ_c to determine numerically the optimal level of corporate taxes.

5.1 *Using equal dividend and capital gains taxes*

5.1.1 *Long run effects* The first column of Table 7 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. 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, which in turn can be used to explain changes in aggregate capital, 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.

Consider first the intuition for the decrease in aggregate capital. In the modified economy of the proposition in Section 3.2, the combined marginal tax rate $\tau \equiv \tau_c + \tau_g(1 - \tau_c)$ on the return to capital is maintained fixed after the reform. This ensures that the optimal choices of firms and households at the margin remain the same and, at the same time, the overall tax revenues for the government also remain the same. In contrast, in our benchmark economy, maintaining the same combined marginal tax rate would not ensure the same tax revenues for the government. This is because part of the adjustment costs are not deductible from corporate taxes ($\phi < 1$ as opposed to $\phi = 1$), but all adjustment costs are implicitly deducted from shareholder taxes, since dividends and capital gains are defined after payment of adjustment costs. As a result, switching from corporate taxes to shareholder taxes reduces the tax base and shareholder taxes have to rise to a point in which the combined tax rate τ is higher than before (it increases from 47.2% before the reform to 50.6% after the reform). 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 τwere to remain fixed. As reflected in the last term of equation (8), one of the benefits of increasing capital is that it lowers future adjustment costs. This benefit is taxed only partly by the corporate tax, but it is fully taxed under shareholder taxes. In other words, switching to shareholder taxes increases the marginal tax rate on this benefit and it also lowers the incentives to invest.

Before moving on to the intuition regarding TFP changes, we briefly discuss the dependence of these results on the value of ϕ. It is clear from the preceding discussion that a lower value of ϕ will lead to stronger effects on aggregate capital. In other words, the lower the value of ϕ, the larger the increase in the combined tax rate after the reform, and the larger the decrease in the aggregate capital stock. This is what we see in Table 7,

Table 7. Eliminating corporate income taxes.

Reform	$\tau_g = \tau_d$[a]			τ_d[b]
	$\varphi = 0.52$ (Benchmark)	$\varphi = 0.00$	$\varphi = 1.00$	$\varphi = 0.52$ (Benchmark)
		Tax Rates		
τ_c	0.0	0.0	0.0	0.0
τ_d	50.6	52.4	47.2	43.7
τ_g	50.6	52.4	47.2	20.0
		Long Run Aggregates (% change)		
Y	0.1	1.1	−0.5	9.7
K	−4.4	−6.4	−0.4	40.6
C	−0.9	−0.6	−0.3	8.5
TFP	1.5	3.2	−0.4	−1.4
w	0.1	1.1	−0.5	9.7
r	−2.0	−3.5	0.5	−2.2
		Welfare (%)[c]		
Overall	0.39	1.08	0.01	−0.21
Aggregate	0.13	0.65	0.02	−0.84
Distributional	0.25	0.42	−0.01	0.64

[a] In this reform, dividend and capital gains taxes change together, equalized to each other.
[b] In this reform, capital gains taxes are kept constant at their benchmark levels ($\tau_g = 0.20$).
[c] Social welfare gain/loss in consumption equivalent terms. It incorporates the effects of transition.

TABLE 8. Effects of eliminating τ_c on capital distribution across productivity levels.

Productivity (z)	z1	z2	z3	z4	z5	z6	z7	z8	z9	z10
Change (%) in $E(k\|z)$[a]										
Reform—(τ_c vs. $\tau_d = \tau_g$)										
Case—($\varphi = 0.52$) (Benchmark)	−23.7	−20.5	−17.2	−13.7	−10.0	−5.9	−1.4	3.6	9.0	14.5
Case—($\varphi = 0.00$)	−41.7	−36.4	−30.8	−24.7	−17.8	−9.8	−0.7	9.7	21.7	34.0
Case—($\varphi = 1.00$)	2.4	1.9	1.4	0.9	0.3	−0.2	−0.9	1.5	−2.2	−2.9
Reform—(τ_c vs. τ_d)										
Case—($\varphi = 0.52$)	66.0	60.2	55.2	50.4	45.8	41.3	36.9	32.9	29.7	27.6

[a] $E(k|z)$ represents the mean capital conditional on productivity z.

with the $\phi = 0$ case exhibiting the largest decrease in aggregate capital and the $\phi = 1$ case the smallest one.

Consider now the intuition for changes in the distribution of capital across firms, and hence, TFP. There are two opposing forces. First, the proposition of Section 3.2 ensures that the reform is distributionally neutral by adding the term $\chi_{jt} \equiv (q_{jt}k_{j,t+1} - q_{jt-1}k_{jt}) - (k_{j,t+1} - k_{jt})$ to taxable corporate income T_{jt}. Since shareholder taxes implicitly tax the adjusted income $\tilde{T}_{jt} = T_{jt} + \chi_{jt}$, this makes the tax base of corporate and shareholder taxes equivalent. Firms with relatively high productivity have relatively low values of χ_{jt} due to the fact that their investment rates are currently higher than the long run and their marginal q is falling, while the opposite is true for firms with relatively low marginal productivity. Thus, in the absence of this adjustment, a switch to shareholder taxes imposes relatively higher burden to unproductive firms with high χ_{jt} and a lower burden to those that are more productive and have a low χ_{jt}, leading to positive capital reallocation. Second, a reduction in the corporate tax rate essentially increases the effects of adjustment costs by virtue of shifting some of the burden of these costs away from the government and back to the firm. 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 ϕ of adjustment costs increases. As is evident in Table 7, the first effect dominates and TFP increases for the benchmark level of deductibility. For the case with $\phi = 1$, where adjustment costs are fully deductible, the second effect dominates and TFP decreases. These reallocation effects can also be seen in Table 8, which reports the average capital conditional on the value of z before and after the reform that eliminates corporate taxes. For $\phi = 0.52$ and $\phi = 0$, 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 $\phi = 1$.

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, 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 7 reports the welfare effects of the reform. The overall welfare gain is 0.39% in consumption equivalent terms. The decomposition into aggregate and distributional components indicates that there are both efficiency and distributional gains from the reform. The fundamental reason why the reform yields efficiency benefits is that it delivers higher production both in the short run and in the long run despite lower aggregate investment. This is due to the positive TFP effects, as is evident in the transition paths of macroeconomic aggregates displayed in Figure 1. Aggregate consumption exhibits a temporary but long lived (15 years) increase and a long run de-

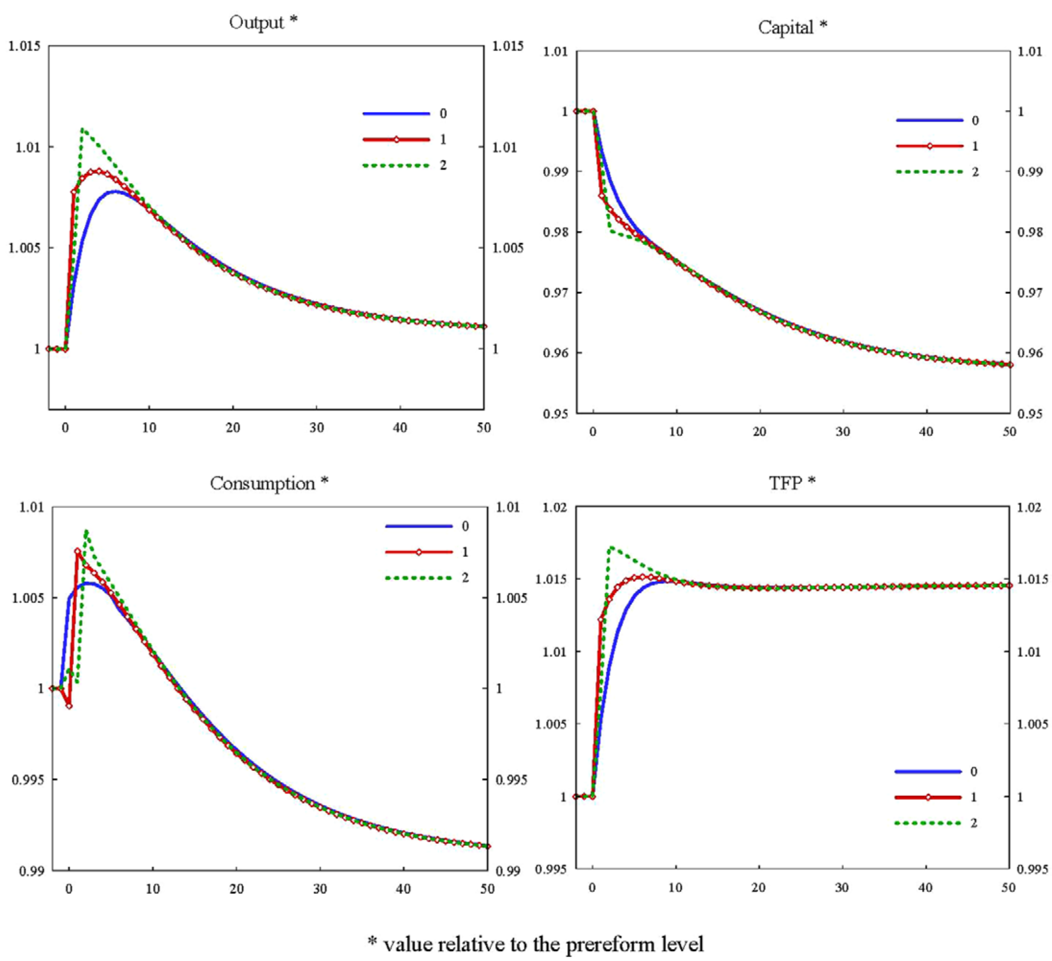

FIGURE 1. Transition paths when corporate income taxes are eliminated in reform (τ_c vs. $\tau_d = \tau_g$). $\phi = 0.52$. Note: The values for all variables are relative to their prereform levels. In all cases, the reform is announced at $t = 0$ but the actual tax change occurs at $t = 0$, 1, or 2 depending on the period of anticipation being 0, 1, or 2 years.

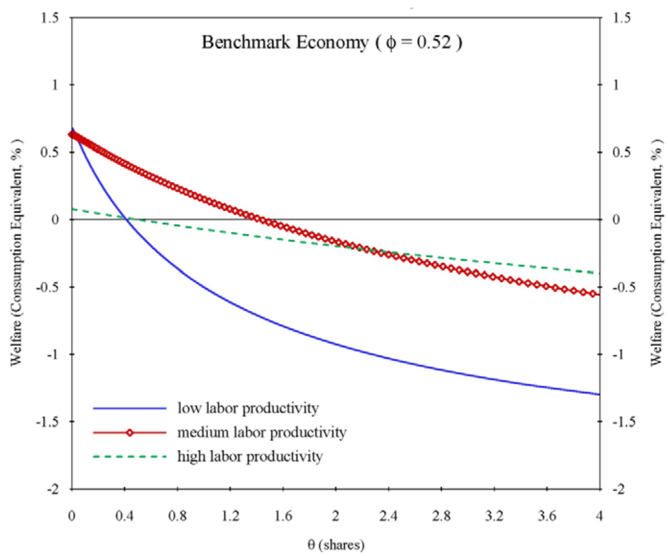

FIGURE 2. Individual welfare gains from eliminating corporate taxes in reform (τ_c vs. $\tau_d = \tau_g$).

crease.[23] Quantitatively, the transitional benefit dominates the long run cost and leads to a positive aggregate component of welfare of 0.13%.

The reform also delivers distributional gains of 0.25% because high marginal utility households benefit and only a small fraction of low marginal utility households lose from the reform. This is illustrated inFigure 2, which plots the welfare gains and losses for each household (θ, ϵ) separately. Gains are decreasing in wealth and households with few or no stocks are the main beneficiaries, while only households with substantial wealth 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 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.

The bottom panel of Table 7 also reports welfare effects for the cases $\phi = 0$ and $\phi = 1$. Welfare gains are decreasing in the degree of deductibility of adjustment costs. In the ex-

[23]The long run decrease is an artifact of the simplifying assumption that adjustment costs are lost resources. This could be avoided by rebating costs back to the households at the cost of increasing computational time and introducing unintended distributional effects. Since the model yields a positive aggregate component of welfare despite this limitation, we have opted for not rebating the costs. We expect welfare gains to be larger if this is addressed.

Table 9. Welfare effects with anticipation—elimination of corporate income taxes benchmark economy ($\varphi = 0.52$).

Years of Anticipation	0	1	2
	Case $\tau_g = \tau_d$: Financing with Dividend and Capital Gains Taxes		
Welfare (%)[a]			
Overall	0.39	0.40	0.41
Aggregate	0.13	0.13	0.12
Distributional	0.25	0.27	0.29
	Case τ_d: Financing with Dividend Taxes		
Welfare (%)[a]			
Overall	−0.21	−1.03	−1.13
Aggregate	−0.84	−1.20	−1.18
Distributional	0.64	0.18	0.05

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

treme case of full deductibility welfare gains are small, which is not surprising given the small effects on long run aggregates in this case. However, the main message of this exercise, namely that eliminating corporate taxes in favor of shareholder taxes is welfare improving, remains true regardless of the value of ϕ. To the extent that adjustment costs reflect installation costs not fully deductible from the tax base, these gains can be significant.

An important robustness check is to investigate whether the welfare effects are sensitive to the assumption that tax reforms are unanticipated. For this reason, we have also computed transitions and welfare under the assumption of anticipation, with the period of anticipation being 1 or two years. The welfare effects for these experiments are reported in Table 9. Anticipation does not make a significant quantitative difference for this type of reform. If anything, welfare gains rise with the length of anticipation period due to slightly better distributional effects. 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.

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 τ_c and determining numerically the choice of τ_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 τ_c from 0 up to the prereform value of 0.34. All cases considered yield positive overall welfare gains and these gains are increasing the larger the reduction in τ_c. This is true for both the aggregate and the distributional compo-

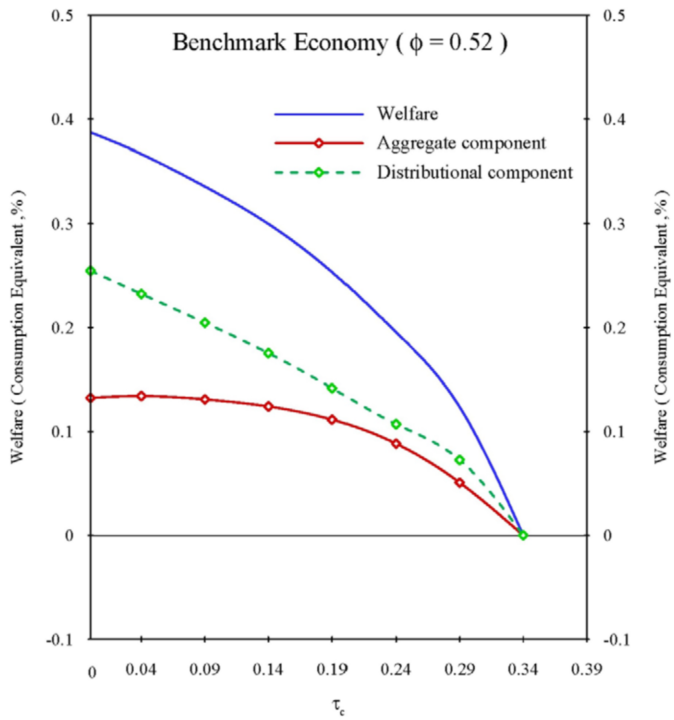

FIGURE 3. Welfare effects of reform (τ_c vs. $\tau_d = \tau_g$).

nent. Overall welfare gains are highest at $\tau_c = 0$ meaning that the complete elimination of corporate taxes discussed earlier is indeed the optimal choice.[24]

Using the welfare effects by individual and the corresponding measure of individuals at each point (θ, ϵ) in the stationary distribution, we can obtain the total measure of households that experience gains and the total measure experiencing losses. Table 10 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 81.2% to 84.8%, and tend to be slightly higher for reforms that do not decrease τ_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 50.6%) and this can make it harder to implement in practice. Given this, we also consider a milder reform in which we equalize the tax rates on all types of personal income as well as corporate income, $\tau_c = \tau_d = \tau_g = \tau_l$. In our model, the tax rate required for this is 27.8%, which is also very similar to our benchmark labor income tax rate of 28%. This is a reform often suggested in the past 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 0.48% and a smaller overall welfare gain of 0.18%, of which two-thirds are due to distributional gains and one-third due to aggregate efficiency gains. However, the gains are

[24]This is conditional on a corporate tax that is restricted to be positive. A subsidy might deliver even higher benefits but we do not explore this in this paper.

TABLE 10. Political support.

	A. Reform (τ_c vs. $\tau_d = \tau_g$)								
τ_c	0	0.04	0.09	0.14	0.19	0.24	***0.278***	0.29	**0.34**
$\tau_d = \tau_g$	0.506	0.482	0.448	0.410	0.367	0.319	***0.278***	0.264	**0.200**
Fraction in Favor (%)	0.812	0.814	0.817	0.825	0.831	0.837	***0.840***	0.848	–
	B. Reform (τ_c vs. τ_d)								
τ_c	0	0.04	0.09	0.14	0.19	0.24	0.29	**0.34**	
τ_d	0.437	0.417	0.390	0.360	0.326	0.288	0.245	**0.200**	
Fraction in Favor (%)	0.755	0.755	0.756	0.757	0.758	0.759	0.765	–	

even more widely spread, with 84% 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.

5.2 *Using dividend taxes only*

5.2.1 *Long run effects* Consider now a reform, which uses only dividend taxes to replace the corporate profits tax, but leaves the capital gains tax rate untouched. Note that such a reform would create incentives for firms to avoid dividend taxes by using repurchases as a means of payout. In our model, this is not alloweddue to the no repurchase constraint in equation (7), which only becomes operative when dividend taxes differ from capital gains taxes. So, the experiment of changing dividend taxes onlycan be thought of as a policy change that combines an increase in τ^d together with an introduction of a rule against repurchases.

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, the combined marginal tax rate on the return to capital $\tau \equiv \tau_c + \tau_g(1 - \tau_c)$ falls significantly providing 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, Carceles-Poveda, and Lin (2012), who study the effect of reducing shareholder taxes in a model with household heterogeneity. 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 40.6% in the aggregate capital stock reported in the last column of Table 7.

Table 7 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, which is not present when we increase both shareholder taxes, arises from the misallocation of capital implied by the introduction of a wedge between τ_d and τ_g. This is explained in Gourio and Miao (2010), who study the effect of reducing shareholder taxes in a model with firm heterogeneity. 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 $1 - \tau_g$ but 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. In the stationary distribution, this is reflected as a reallocation of capital from relatively productive firms to relatively unproductive firms. Table 8 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, that is, TFP has decreased by 1.4%.[25]

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. Consumption remains below the prereform steady state after 10 years, and the magnitude of the drop is large at approximately 15% at the trough. These transitional costs dominate from an efficiency perspective and this results in a negative aggregate component of welfare of about 0.84%. 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 negative welfare effect of 0.21% in consumption equivalent terms because the aggregate component dominates the distributional component (see Table 7). As in the previous reform, anticipation effects do not reverse the qualitative welfare conclusions, but in this case overall welfare loss increases substantially with the periods of anticipation. To

[25]In contrast to the experiment of the previous subsection, the value of ϕ does not signficantly affect the conclusions of the benchmark model, qualitatively or quantitatively, and we therefore do not include the results for other values of ϕ. The reason is that the direct effect of τ_c and the misallocation and wealth effects of τ_d are much stronger mechanisms and they dominate the responses.

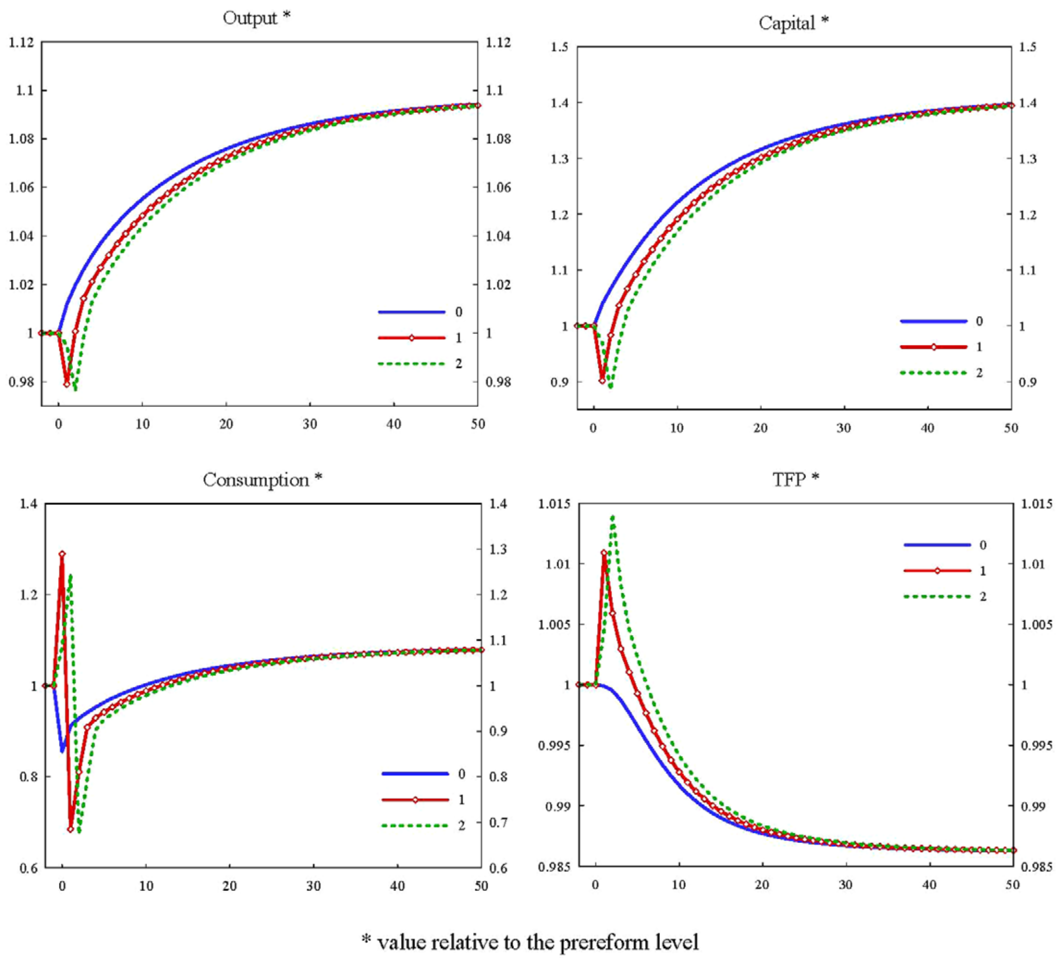

Figure 4. Transition paths when corporate income taxes are eliminated in reform (τ_c vs. τ_d). $\phi = 0.52$. Note: The values for all variables are relative to their prereform levels. In all cases, the reform is announced at $t = 0$ but the actual tax change occurs at $t = 0$; 1 or 2 depending on the period of anticipation being 0, 1, or 2 years.

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. They reduce current investment and increase current dividends, to take advantage of relatively lower dividend taxes that are in place temporarily.[26] Thus, in con-

[26]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.

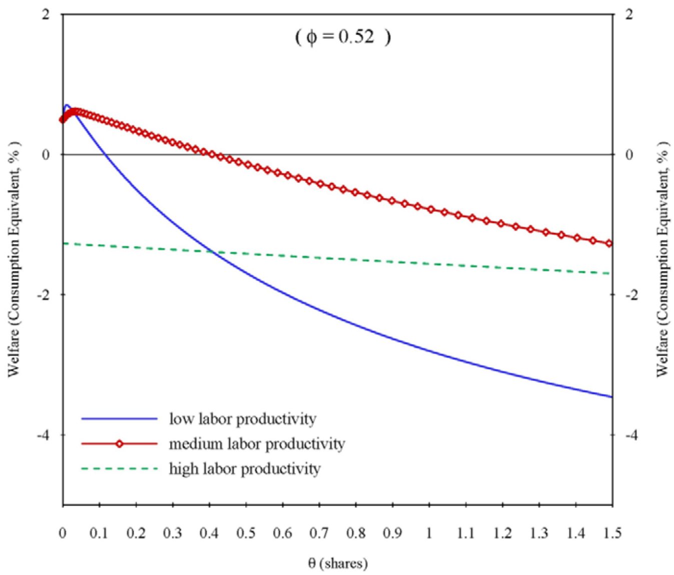

FIGURE 5. Individual welfare gains from eliminating corporate taxes in reform (τ_c vs. τ_d).

trast 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 and this increases the welfare costs with anticipation. Moreover, the benefits of tax arbitrage accrue mostly to shareholders. In contrast, low wealth individuals with limited ability to smooth consumption are hurt by the additional fluctuation in after tax wages. Thus, the distributional component of welfare also becomes worse in the case of anticipation. As a result of these changes, the overall welfare costs equivalent to 0.21% of consumption that were found in the unanticipated case, now become even higher with anticipation and can be as large as 1.03% (1.13%) 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 τ_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 τ_c. Specifically, welfare gains from the reform rise as τ_c is reduced from 34% to 29% but then fall and eventually become negative when τ_c is reduced further down to 0. Thus, our quantitative experiment suggests an optimal tax rate for τ_c close to 29% and a corresponding tax rate on dividends of 24.5%. That is, it suggests that taxing both corporate profits and dividends at the same time is an optimal response to the tradeoff between efficiency and distribution. From a pure efficiency perspective, that is, focusing on the aggregate component, the replacement

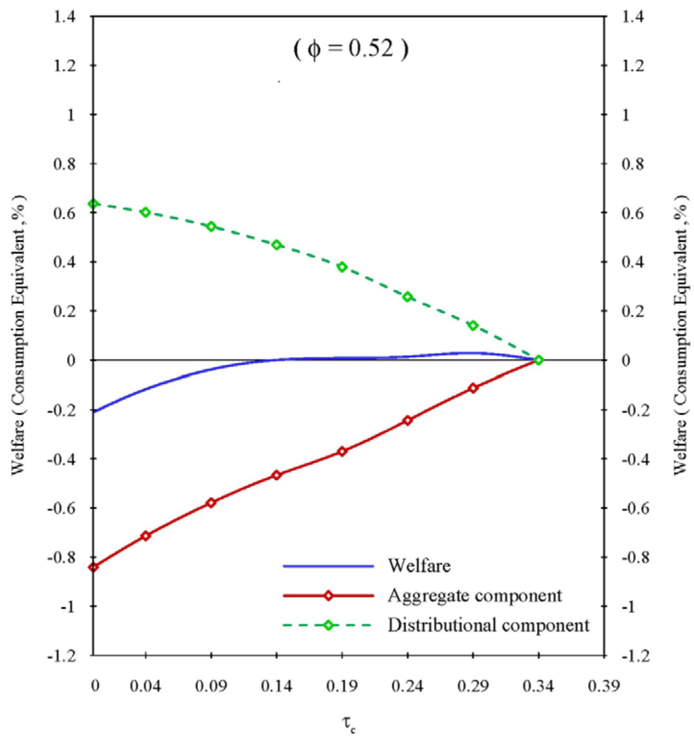

FIGURE 6. Welfare effects of reform (τ_c vs. τ_d).

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. However, this is outweighed by the positive redistributional effects and the overall welfare gain in consumption equivalent terms is 0.03% at the optimum with $\tau_c = 0.29$. In terms of political support, this reform also delivers high support as shown on Table 10, with approximately 76.5% of households gaining from the tax change.

6. Robustness

In the previous section, we discussed the sensitivity of our results to different values of ϕ as well as to different anticipation periods. We have also considered alternative calibrations of adjustment costs as well as a model with debt financing. We briefly summarize our findings below.[27]

6.1 *Adjustment costs*

As discussed in the calibration section, part of the literature on heterogeneous firms chooses to target the cross sectional volatility of investment rates in LRD data reported

[27]More details can be found in Section S3 of the Online Supplementary Material.

Table 11. Reforms with lower capital adjustment cost.

Reform	A: τ_c vs. $\tau_g = \tau_d$	B: τ_c vs. τ_d
Tax Rates		
τ_c	0.00	0.00
τ_d	0.52	0.47
τ_g	0.52	0.20
Long Run Aggregates (% change)		
Y	0.14	3.34
K	−5.19	37.10
C	−0.94	3.28
TFP	1.82	−6.33
w	0.15	3.34
r	−2.42	−0.12

in Cooper and Haltiwanger (2006) as opposed to the one in Compustat which we use in our benchmark. The volatility difference is substantial, the LRD suggests 0.337 whereas Compustat suggests 0.156. We chose to use the latter number because the LRD has plant level data for manufacturing firms, whereas Compustat has firm level data for publicly traded corporations, which is more relevant for the tax experiments we consider. However, given the substantial difference, we conduct a sensitivity experiment where we recalibrate the adjustment cost parameter ψ to match the higher investment rate volatility. Table 11 reports the results and illustrates that this does not affect our results qualitatively but it does have a quantitative effect. The main difference is that the long run effects of the two reforms on TFP are now more pronounced. TFP increases by more in the $\tau_d = \tau_g$ case and it falls by more in the $\tau_d > \tau_g$ experiment. In this sense, our benchmark results can be viewed as a lower bound.

We have also experimented with introducing fixed adjustment costs similar to Khan and Thomas (2008) to our model. A small fixed cost can help increase the fraction of inactive firms (less than 1% investment rate) from 6% to 8% in our benchmark economy. However, the size of the cost needed is small and as a result, neither the other moments of the investment rate distribution in our benchmark nor the effects of the tax changes are substantially affected.[28]

6.2 *Debt financing*

In our tax change experiments, financing a decrease in τ_c through increasing τ_d only is found to be welfare reducing. To a large extent, this is because equity financing becomes costly and this generates capital misallocation. In practice, firms can switch to debt financing, and thus potentially mitigate the distortionary effects of the tax wedge, but our benchmark model abstracts from debt financing. In this section, we introduce debt financing and show that the presence of the debt financing option does not change our results significantly. The main reason is that these tax changes also reduce incentives for

[28]Numerical results are not included in the interest of space considerations.

debt financing, and thus there is little scope for substituting away from equity financing into debt financing in response to the tax changes. In contrast, we find some substitution from equity to debt in the case $\tau_d = \tau_g$ because, in that case, the tax advantage of debt is actually increased.

In the extended model, firm j's financing constraint is

$$\begin{aligned} d_{jt} + x_{jt} + \Phi(x_{jt}, k_{jt}) + \tilde{r}_t b_{jt} + \xi \tilde{r}_t \frac{b_{jt}^2}{k_{jt}} \\ = \pi(k_{jt}, z_{jt}; w_t) - \tau_c T_{jt} + s_{jt} + b_{jt+1} - b_{jt}, \\ T_{jt} = \pi(k_{jt}, z_{jt}; w_t) - \delta k_{jt} - \phi \Phi(x_{jt}, k_{jt}) - \tilde{r}_t b_{jt} \left(1 + \xi \frac{b_{jt}}{k_{jt}}\right), \end{aligned}$$

where b_{jt} denotes debt outstanding at t, $\tilde{r}_t$ is the before tax interest on debt and $\xi \tilde{r}_t \frac{b_{jt}^2}{k_{jt}}$ represent costs of debt holding. Firms tradeoff the tax benefit of debt arising from its deductibility from corporate taxes against a marginal cost of debt that is increasing in the debt to capital ratio $\frac{b_{jt}}{k_{jt}}$. Debt is held by households who obtain an after tax interest $(1 - \tau_i)\tilde{r}_t$ where τ_i is the tax on interest income. In equilibrium, the after tax interest on debt is equalized to the after tax return on stocks r_t and households are indifferent between the two assets.

The firm's optimal choice of debt is described by the Euler equation

$$\gamma_{jt} = E_t \frac{\left(1 + (1 - \tau_c)\tilde{r}_{t+1}\left(1 + 2\xi \frac{b_{jt+1}}{k_{jt+1}}\right)\right)\gamma_{jt+1}}{1 + \frac{1 - \tau_i}{1 - \tau_g}\tilde{r}_{t+1}},$$

where $\gamma_{jt} = \frac{1-\tau_d}{1-\tau_g} + \lambda_{jt}^d$ is the multiplier on firm j's financing constraint. In the benchmark economy, where $\tau_d = \tau_g$ and $\gamma_{jt} = 1$, this gives a firm's debt to capital ratio as

$$\frac{b_{jt+1}}{k_{jt+1}} = \frac{\frac{1 - \tau_i}{(1 - \tau_g)(1 - \tau_c)} - 1}{2\xi}$$

reflecting the tradeoff between the tax advantage and the marginal cost of being in debt that is increasing in $\frac{b_{jt+1}}{k_{jt+1}}$. The tax advantage obtains whenever the combined marginal tax rate of corporate income $\tau \equiv \tau_c + \tau_g(1 - \tau_c)$ is larger than the tax rate on debt interest income τ_i. When equity issuance becomes costly due to the reform making $\tau_d > \tau_g$, firms which need external financing ($\gamma_{jt} > E_t \gamma_{jt+1}$) will choose higher debt to capital ratios than firms which do not.

The long run results of the two reforms where τ_c is reduced to zero while revenue is made up with $\tau_d = \tau_g$ or with τ_d only keeping τ_g fixed are shown in Table 12.[29]

[29] For the quantitative results, the debt cost parameter ξ is calibrated to match a ratio of debt to assets of 0.12 based on Hennessy and Whited's (2007) reported number from Compustat data and $\tau_i = \tau_l = 0.28$.

TABLE 12. Reforms in the presence of debt financing.[a]

Reform	A: τ_c vs. $\tau_g = \tau_d$	B: τ_c vs. τ_d
Tax Rates		
τ_c	0.00	0.00
τ_d	0.52	0.42
τ_g	0.52	0.20
Long Run Aggregates (% change)		
Y	−0.3	9.2
K	−5.4	36.3
C	−1.7	8.4
TFP	1.5	−0.8
w	−0.3	9.2
r	−2.8	−0.8
Financial Aggregates (% change)		
S	−55.8	−98.9
Debt Issuance	56.7	−23.7
B	33.7	−83.8

[a]Debt issuance is calculated as the aggregate of $b_{j,t+1} - b_{j,t}$ over all firms j with $b_{j,t+1} - b_{j,t} > 0$.

In the first case ($\tau_d = \tau_g$), the combined marginal tax rate on corporate income increases relative to the benchmark (from $\tau = 0.472$ to $\tau = 0.52$), and thus the tax incentive for holding debt is stronger. The debt to capital ratio increases from 0.15 to 0.21 and some of the equity issuance is replaced by increased debt issuance. In terms of the macroeconomic aggregates, the results are similar to the case of no debt.

The second case ($\tau_d > \tau_g$) is the one that is more interesting. In order to finance a move to a zero corporate tax, the dividend tax rate has to be significantly increased. In turn, this creates a large tax wedge ($\tau_d \gg \tau_g$), which makes equity very costly and induces almost all growing firms to grow internally instead of using equity financing. This was the case in our benchmark experiments without debt and, as reflected in Table 12, this is still the case in the presence of debt. Despite that, we do not find that debt financing is used to replace equity financing. Instead, total debt held falls by more than 80% and even aggregate new debt issuance (for firms that issue positive amounts) decreases by 24%. The reason is that the combined marginal tax rate on corporate income is significantly reduced (from $\tau = 0.472$ to $\tau = 0.20$) and this has made the tax advantage of debt disappear. The majority of firms hold zero debt because tax considerations make holding any debt suboptimal. Only very few severely cash strapped ($\gamma_{jt} \gg E_t \gamma_{jt+1}$) firms are willing to issue new debt. As a result, it is still the case that external financing becomes much less prevalent and the effects of this reform on the macroeconomic aggregates are similar to the case of no debt.

7. Conclusion

We find that reforms which replace corporate income taxes with shareholder taxes can enjoy widespread popular support. Whether such reforms are efficiency enhancing hinges critically on the mix of dividend and capital gains taxes and the degree to which the new policy is anticipated. In particular, if dividends and capital gains are taxed at the same rate, we predict efficiency gains that are robust to different degrees of anticipation. However, 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 ones solved by the removal of the corporate tax. Moreover, this reform can have additional negative consequences to the extent that it is anticipated.

These results are derived in a rich environment, consistent with key features of the US economy, such as wealth inequality at the household level, imperfect risk sharing, productivity differences across firms, and endogenous financing decisions for the corporate sector. All of these components are important in evaluating the effects of different types of capital income taxes. While incorporating those components that are crucial for the policy question at hand, we have abstracted from several other potentially important margins.

First, the literature has identified additional channels through which a corporate profits tax cut can affect macroeconomic performance, which we did not incorporate in our model. These include the choice of legal form of organization, 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.

Second, our dynamic general equilibrium model does not incorporate some of the intricacies of the actual tax code that could play a role in policy decisions. For example, a significant fraction of household savings are not subject to dividend or capital gains taxes because they are held in retirement accounts and that is not captured in the model. More importantly, we have not modelled capital gains taxes on a realization basis so our model cannot capture potentially relevant aspects of the taxation of capital gains such as the timing of realizations and lockin effects, the deferral of realization until death to take advantage of tax forgiveness at death as well as the issues arising from using a nominal basis for capital gains in the actual tax code. We share this limitation with the vast majority of the existing literature. This is especially the case for work on general equilibrium macroeconomic models like ours, not only because of the complications introduced by the timing of the realization decision but also due to the need to keep track of past purchase prices for each component of an agent's portfolio. This is an important modeling question to be addressed in future research.

Third, consistently with most of the literature, we do not provide a model of the choice between dividends and share buybacks as a means to distribute profits. In our model, when dividend and capital gains taxes are equalized the choice is irrelevant. However, whenever dividend taxes are higher than capital gains taxes, firms would prefer to use buybacks and our model simply assumes this option away. This tax arbitrage is another reason why equalization of dividend and capital gains taxes is often proposed in practice and that margin is missing in our model. On the other hand, firms' ability to use buybacks might reduce the importance of the financing frictions introduced by dividend taxes. A careful model of the tradeoffs in using dividends versus buybacks as a means to distribute profits is beyond the scope of the present study.

With these caveats in mind, our main conclusion is that a tax code that focuses more on taxing shareholders directly rather than indirectly through corporations would be a step in the right direction, in the sense that a large majority of households could agree with and benefit from it.

Appendix A: Proof of Proposition 1

The goal is to show that all long run equilibrium conditions are satisfied for the new taxes τ_c^*, τ_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 (11), 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 τ_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

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

After some manipulation, this can be simplified to

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

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

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

and

$$r \equiv \frac{(1-\tau_s)(D-S)}{P}.$$

From the households' perspective, taxes may affect the overall payoff $(1-\tau_s)(D-S)$ on the right-hand side of both of those conditions. Using the financing constraint of a firm together with the taxable income in equation (10) and aggregating over all firms j, this term can be written as

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

where $\Pi = \int \pi_{jt} dj$, $\Psi = \int \Phi(x_{jt}, k_{jt}) dj$ and we have used $\phi = 1$ again. In a stationary distribution, the last term disappears. As a result, every household's budget constraint (1) and Euler equation (2) 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.

Appendix B: Modeling depreciation allowances

In this section, we show how the present value of depreciation allowances can be captured through the parameter ϕ. 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 G_{jt} represent the depreciation allowances at time t arising from all past capital expenditures including installation costs The constraints of the firm can be written as

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

Using the capital accumulation equation to express k_{jt} in terms of all past investment as

$$k_{jt} = \sum_{u=-\infty}^{t-1} (1-\delta)^{t-1-u} x_{ju}$$

G_{jt} can equivalently be written as

$$G_{jt} = \delta k_{jt} + \sum_{u=-\infty}^{t-1} \delta(1-\delta)^{t-1-u} \Phi(x_{ju}, k_{ju}).$$

This makes explicit the fact that total allowances are composed of the standard depreciation term δk_{jt} plus a second component corresponding to the "depreciation" of installation costs. To simplify this second component, let the discount factor of the firm between periods t and s be denoted by $M_{t,s} = (\prod_{n=1}^{s-t} \frac{1}{1+\frac{r_{t+n}}{1-\tau_g}})$. 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

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

where

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

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 $\Phi(x_{jt}, k_{jt})$ that is ultimately deducted is, in present value terms, represented by Γ_{jt}.

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

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

which essentially implies that the firm is deducting a fraction Γ_{jt} of capital adjustment costs every period.

Because of the presence of time varying endogenous variables in the infinite sum of Γ_{jt}, a full numerical implementation of this problem would require an additional state variable, essentially capturing the "stock" of installation costs paid.[30] Given the additional computational complexity this would introduce, we instead choose to follow Auerbach's approach, which is to simply compute the value of Γ 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

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

firm's discount factor, the value of Γ is equal to

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

References

Abel, A. B. (1983), "Tax neutrality in the presence of adjustment costs." *The Quarterly Journal of Economics*, 98 (4), 705–712. [327]

Abraham, A. and E. Carceles-Poveda (2010), "Endogenous trading constraints with incomplete asset markets." *Journal of Economic Theory*, 145, 974–1004. [329, 330]

Anagnostopoulos, A., O. E. Atesagaoglu, E. Cárceles-Poveda (2022), "Supplement to 'Financing corporate tax cuts with shareholder taxes'." *Quantitative Economics Supplemental Material*, 13, https://doi.org/10.3982/QE1167. [324]

Anagnostopoulos, A., E. Carceles-Poveda, and D. Lin (2012), "Dividend and capital gains taxation under incomplete markets." *Journal of Monetary Economics*, 59 (7), 898–919. [316, 319, 328, 340]

Atesagaoglu, O. E. (2012), "Taxes, regulations and the corporate debt market." *International Economic Review*, 53 (3), 979–1004. [316, 330]

Auerbach, A. J. (1989), "Tax reform and adjustment costs: The impact on investment and market value." *International Economic Review*, 30 (4), 939–962. [331, 350]

Cárceles-Poveda, E. and D. Coen-Pirani (2010), "Owning capital or being shareholders: An equivalence result under incomplete markets." *Review of Economic Dynamics*, 13, 537–558. [325]

Castañeda, A., J. Diaz-Gimenez, and J. V. Ríos-Rull (2003), "Accounting for earnings and wealth inequality." *Journal of Political Economy*, 111 (4), 818–857. [329]

Chen, D., S. Qi, and D. E. Schlagenhauf (2018), "Corporate income tax, legal form of organization, and employment." *American Economic Journal: Macroeconomics*, 10 (4), 270–304. [319]

Conesa, J. C. and B. Dominguez (2013), "Intangible capital and Ramsey capital taxation." *Journal of Monetary Economics*, 60, 983–995. [319]

Conesa, J. C., S. Kitao, and D. Krueger (2009), "Taxing capital? Not a bad idea after all!" *American Economic Review*, 99 (1), 25–48. [316]

Cooper, R. and J. Haltiwanger (2006), "On the nature of adjustment costs." *The Review of Economic Studies*, 73 (3), 611–633. [330, 332, 345]

Dammon, R. M., C. S. Spatt, and H. H. Zhang (2001), "Optimal consumption and investment with capital gains taxes." *The Review of Financial Studies*, 14 (3), 583–616. [320]

Dammon, R. M., C. S. Spatt, and H. H. Zhang (2004), "Optimal asset location and allocation with taxable and tax-deferred investing." *Journal of Finance*, 59 (3), 999–1037. [320]

Davila, J., J. H. Hong, P. Krusell, and J. V. Ríos-Rull (2012), "Constrained efficiency in the neoclassical growth model with uninsurable idiosyncratic shocks." *Econometrica*, 80 (6), 2431–2467. [328]

Diaz, A., J. Pijoan-Mas, and J. V. Ríos-Rull (2003), "Habit formation: Implications for the wealth distribution." *Journal of Monetary Economics*, 50 (6), 1257–1291. [329]

Diaz-Gimenez, J., A. Glover, and J. V. Rios-Rull (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), 2–31. [329]

Domeij, D. and J. Heathcote (2004), "On the distributional effects of reducing capital taxes." *International Economic Review*, 45 (2), 523–554. [316, 330, 335, 337]

Favilukis, J., S. C. Ludvigson, and S. van Nieuwerburgh (2017), "The macroeconomic effects of housing wealth, housing finance, and limited risk-sharing in general equilibrium." *Journal of Political Economy*, 125 (1), 140–223. [319, 322]

Feenberg, D. and E. Coutts (1993), "An introduction to the taxsim model." *Journal of Policy Analysis and Management*, 12 (1), 189–194. [330]

Fehr, H., S. Jokisch, A. Kambhampati, and L. J. Kotlikoff (2013), "Simulating the elimination of the U.S. corporate income tax." NBER working Paper No. 19757. [319]

Gavin, W. T., F. E. Kydland, and M. R. Pakko (2007), "Monetary policy, taxes, and the business cycle." *Journal of Monetary Economics*, 54 (6), 587–1611. [320]

Gourio, F. and J. Miao (2010), "Firm heterogeneity and the long run effects of dividend tax reform." *American Economic Journal: Macroeconomics*, 2 (1), 131–168. [316, 319, 321, 322, 328, 330, 331, 332, 341]

Gourio, F. and J. Miao (2011), "Transitional dynamics of dividend and capital gains tax cuts." *Review of Economic Dynamics*, 14 (2), 368–383. [342]

Hennessy, C. A. and T. M. Whited (2007), "How costly is external financing? Evidence from a structural estimation." *The Journal of Finance*, 62 (4), 1705–1745. [346]

Khan, A. and J. Thomas (2008), "Idiosyncratic shocks and the role of nonconvexities in plant and aggregate investment dynamics." *Econometrica*, 76 (2), 395–436. [333, 345]

McGrattan, E. R. and E. C. Prescott (2005), "Taxes, regulations, and the value of US and UK corporations." *Review of Economic Studies*, 72, 767–796. [316, 325]

Mendoza, E., A. Razin, and L. Tesar (1994), "Effective tax rates in macroeconomics. Cross country estimates of tax rates on factor income and consumption." *Journal of Monetary Economics*, 34 (3), 297–323. [330]

Miao, J. and P. Wang (2014), "Lumpy investment and corporate tax policy." *Journal of Money, Credit and Banking*, 46 (6), 1171–1203. [319]

Santoro, M. and C. Wei (2011), "Taxation, investment and asset pricing." *Review of Economic Dynamics*, 14 (3), 443–454. [316]

Tauchen, G. and R. Hussey (1991), "Quadrature-based methods for obtaining approximate solutions to nonlinear asset pricing models." *Econometrica*, 59 (2), 371–396. [330]

Co-editor Christopher Taber handled this manuscript.

Manuscript received 5 July, 2018; final version accepted 5 July, 2021; available online 2 September, 2021.