On the Double Taxation of Corporate Profits[*]

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Abstract

U.S. corporate profits are currently taxed at the firm level and then once more at the shareholder level, a situation often referred to as the "double taxation" of profits. This paper studies the aggregate and distributional effects of switching from taxing corporate profits at the firm level to taxing them at the household level, in the form of dividend and capital gains taxes. It is argued that a careful analysis of the relevant trade-offs necessitates the construction of a macroeconomic model that incorporates substantial heterogeneity across households and across firms. Such a model is constructed and used to search for the optimal combination of personal and corporate income taxes by evaluating a range of alternative reforms. Using shareholder taxes to replace corporate taxes provides a better alternative to using labor income taxes, because it generates welfare benefits for a majority of households. Focusing on shareholder taxes, the option of increasing dividend taxes only is evaluated against the alternative of increasing both dividend and capital gains taxes. The former reform has the unintended consequence of creating misallocation of capital across firms by increasing the cost of external equity financing, whereas the latter does not, which makes it a better alternative. Eliminating corporate profits taxes in the latter case increases both long run output and welfare and is found to be the optimal reform. Accordingly, we find that the double taxation of corporate profits is not optimal.

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1 Introduction

Amidst the unprecedented level of polarization and gridlock in Washington, there appears to be a remarkable congruence of thinking between the two sides of the aisle regarding a reduction in corporate income tax rates. President Obama and his advisors have explicitly stated that "*America's system of business taxation is in need of reform*" because, amongst other things, the "*statutory corporate tax rate will soon be the highest among advanced economies*" and this "*does little to encourage job creation and investment in the United States*". Partly because of these reasons "*...the President is committed to reform that will....increase incentives to invest and hire in the United States by lowering rates,...*".[1] Similar sentiments are expressed in the Tax Reform Act of 2014, which was proposed by the House Committee on Ways and Means chaired by the Republican Dave Camp, as well as by several Republican members of Congress.[2] As if even a modicum of agreement between the two parties were not surprising enough, numerous articles in the popular media have made similar arguments, often going a step further and calling for a complete elimination of corporate profits taxation.[3]

Despite this apparent agreement, there is still substantial opposition to reducing corporate income taxes based on the popular belief that this will benefit wealthy capitalists at the expense of hard working Americans. The underlying idea is that such a policy would lead to a reduction in government revenues that will either have to be compensated through higher personal income taxes or lead to a shrinkage of government programs that benefit the less wealthy. Interestingly, there is some academic support for this belief. In an environment featuring heterogeneous households and incomplete markets, Domeij and Healthcote (2004) showed that when capital taxes are replaced by labor taxes, the result is a redistribution from the wealth-poor to the wealth-rich. Given the amount of skewness in the U.S. wealth distribution, this naturally implies that there should be limited popular support for such a tax change.

Our first objective is to propose a corporate profits tax reform that can deliver some of the positive, growth enhancing effects expected from a corporate tax cut and, at the same time, can avoid these negative distributional effects and could potentially gain popular support. The idea is to compensate for the lost revenue from reducing corporate taxes by increasing taxes that fall on the same group of people. Shareholder taxes, that is taxes on dividends and capital gains, represent a natural candidate especially given the recent history of changes in the tax law. Income from capital gains has a long history of being

[1] All preceding quotes are from the introduction to *The President's Framework for Business Tax Reform* published in February 2012.

[2] The President's plan proposed a flat 28 percent rate while the Tax Reform Act of 2014 proposed a flat 25 percent rate beginning in 2019. There are, of course, several potentially irreconcilable differences in the two plans regarding other elements proposed, which we ignore here.

[3] See, for example, Larry Kotlikoff's op-ed titled "Abolish the Corporate Income Tax" at http://www.nytimes.com/2014/01/06/opinion/abolish-the-corporate-income-tax.html?_r=0.

taxed at a separate rate, lower than other personal income. The 2003 Jobs and Growth Tax Relief Reconciliation Act (JGTRRA) reduced the capital gains tax rate further and granted the same type of preferential treatment to dividend income. Even though the initial law was only temporary, the 2012 American Taxpayer Relief Act (ATRA) made this preferential treatment of shareholder income permanent.[4] In this paper we show that a corporate income tax cut financed through an increase in shareholder taxes, as opposed to labor income taxes, would result in welfare improvement for a substantial majority of US households.

Our second objective is to identify potential efficiency gains from such a reform, by investigating its quantitative effects on aggregate investment and production. Corporate profits are currently taxed at the firm level and then once more at the shareholder level, a situation often referred to as the "double taxation of profits". This situation has arisen largely due to the historical evolution of US tax law and it is not at all obvious that it represents an optimal tax scheme. It is well known that, at least in theory, corporate income taxes reduce investment incentives by lowering the after tax returns to investment. There is less agreement regarding the effects of shareholder (especially dividend) taxes on investment and the macroeconomy. McGrattan and Prescott (2005), Santoro and Wei (2011) and Atesagaoglu (2012) amongst many others have argued that dividend taxes do not have such distortionary effects on investment and might therefore offer a more efficient way of raising revenue. They show that, in a standard growth model, constant dividend taxes have no effect on allocations and prices other than decreasing stock market values. In addition, Anagnostopoulos et al (2012) point out that, when markets are incomplete, this drop in stock prices reduces existing precautionary wealth and can induce additional savings and, hence, investment. However, in the presence of firm heterogeneity and external financing, Gourio and Miao (2010) show that raising the dividend tax rate above the capital gains tax rate makes equity financing costly and can therefore act as a financing friction, thus inducing capital misallocation. While this misallocation can be avoided by raising both dividend and capital gains taxes to the same level, higher capital gains taxes distort investment by increasing the cost of capital. In sum, the effect of shareholder taxes on the macroeconomy depends on the relative strength of opposing mechanisms and our paper is the first one that assesses their relative importance. More importantly, we go a step further by focusing on the distortions caused by corporate taxes in addition to shareholder taxes which allows us to search for the optimal mix of corporate profits, dividend and capital gains taxes. To put the question simply, is it optimal to tax only at the corporation level, only at the shareholder level or is there scope for doing both at the same time, i.e. maintain the so-called "double taxation"?

To answer these questions, we build a model that features a substantial amount of heterogeneity on both the household and the firm side in order to

[4] The JGTRRA lowered the top statutory rate for both capital gains and dividends to 15%. The ATRA raised this rate to 20% which is still much lower than the top rate on other personal income.

capture all of the aforementioned trade-offs. We construct an infinite horizon model that features a continuum of households that are subject to uninsurable idiosyncratic labor income risk and a continuum of firms that are subject to idiosyncratic productivity shocks. Firms use a decreasing returns to scale technology that combines labor and capital to produce output. Whereas labor is hired from households, capital is directly owned by firms who decide on investment, subject to capital adjustment costs. In addition to the investment decision, each firm decides on its payout policy as well as its financing policy. The latter consists in choosing between using internal funds or issuing new equity. All of the firms' stocks are bundled together in one asset which can be interpreted as a mutual fund. This simplifying assumption, which we borrow from Favilukis, Ludvigson and van Nieuwerburgh (2013), is crucial in making the model tractable.[5] Households can trade in shares of this single (risk free) asset and earn asset income, in the form of dividends and capital gains from their share holdings, as well as labor income. The government faces a fixed amount of spending which it can finance through flat taxes on firms' corporate profits and on households' labor and asset income.

We search for the optimal tax scheme by considering a range of alternative tax reforms. Starting at the benchmark calibrated economy with the status quo personal income and corporate profit taxes, we assume that the latter are unexpectedly and permanently changed to several different levels, both above and below the status quo, while maintaining government spending fixed at its pre-reform level. We maintain government budget balance in three alternative ways: by adjusting labor income taxes; by adjusting dividend taxes only, keeping the capital gains tax rate fixed; and by adjusting dividends and capital gains taxes simultaneously so as to maintain the equality between the two. For this last case, we include in our experiments a scenario often proposed in which all personal income, i.e. labor and shareholder income, is taxed at the same rate.[6] For all the reforms, we compute both the new long run steady states implied by the new tax schemes as well as the transitional dynamics that precede them. This allows us to compute welfare effects of the reforms both at the individual and at the societal level and to determine what is the mix of capital taxes that maximizes social welfare.

Our main findings are as follows. When labor taxes are used to finance a corporate income tax cut, aggregate investment and output increase as expected. However, the majority of households actually suffer a welfare loss as a result and the (utilitarian) social welfare function indicates a decrease in social welfare. The reason is that the increase in labor taxes dominates the general equilibrium effect of an increase in the marginal product of labor. That is, after tax wages fall and after tax asset returns rise, generating negative redistribu-

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

[6] See, for example, Luigi Zingales' piece titled "A Better Way to Tax Corporations" at http://www.nydailynews.com/opinion/better-tax-corporations-article-1.1093804.

tion from the poor to the rich. This is consistent with the result in Domeij and Heathcote (2004), extended to an environment with heterogeneous firms. Firm heterogeneity adds an extra benefit from lowering corporate taxes, namely a more efficient distribution of capital across firms, but this extra benefit is not enough to overturn the Domeij and Heathcote result.

When we use instead shareholder taxes to make up for lost revenue, as in our second and third experiments, the negative redistribution is avoided and a majority of households experience a welfare gain from the reform. However, the two reforms are markedly different regarding their effects on efficiency. When only dividend taxes are increased, the resulting misallocation of capital due to the wedge between dividend and capital gains taxes implies significant loss in the efficiency of capital distribution across firms. As a result, when aggregate and distributional components of welfare are taken into account together, the reduction in corporate taxes yields zero or small social welfare gains. In contrast, increasing both dividend and capital gains taxes together, avoids introducing this financing friction and, at the same time, generates distributional gains. For this reform, we find the best case scenario to be a complete elimination of corporate income taxes. In this scenario, aggregate capital actually drops somewhat, but the allocation of capital across firms is significantly improved and this leads to an overall increase in production of approximately 2%. The associated welfare gains are more than 1% of consumption and are shared by more than 85% of the households.

Although the elimination of corporate taxes yields the highest social welfare gains as measured by our utilitarian welfare function, it requires raising shareholder taxes to above 50% and still leaves 15% of households (at the top of the wealth distribution) suffering welfare losses. A more realistic reform, which equalizes the tax rates for all types of personal income as well as for corporate income while maintaining the same level of tax revenues, requires a common tax rate of 28% and results in welfare gains for more than 95% of households. This scenario, which conforms to some of the suggestions by economists and the popular media as well as to the corporate tax rate proposed by the President, appears to offer something close to a Pareto improvement.

An additional, theoretical contribution of our paper is that we provide conditions under which corporate and shareholder taxes would be equivalent. The conditions involve changes to the current corporate tax code as in Abel (1983). This theoretical result clarifies the intuition for why corporate and shareholder taxes are not equivalent under the current tax code.

To our knowledge, our model is the first one that combines a substantial amount of heterogeneity on both the household and the firm side and this constitutes an important theoretical contribution. Given the computational complexity involved,[7] the model necessarily abstracts from several other potentially important mechanisms through which corporate taxes can affect macroeconomic outcomes. Recent studies have identified some of those mechanisms. Chen, Qi

[7] 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.

and Schlagenhauf (2014) focus on the employment effects of a corporate tax cut and argue that the choice of the legal form of organization (e.g. C-corp versus S-corp or partnership) is important in evaluating such effects. Miao and Wang (2014) point instead to the importance of lumpy investment, arguing that there are both intensive and extensive margins to be considered when evaluating the effects of a corporate tax cut on investment. Fehr, Jokisch, Kambhampati, Kotlikoff (2013) also study corporate tax cuts but they focus on the welfare effects and they do so in an open economy setting in order to highlight the role of international capital mobility. 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.

Conesa and Dominguez (2013), on the other hand, include dividend (but not capital gains) taxes amongst the tax instruments that a government has at its disposal, in addition to corporate taxes and labor income taxes. They go a step further than the previously mentioned studies as well as ours, in that they compute optimal Ramsey taxes rather than once-and-for-all tax rate changes. They show that the optimal scheme in the long run features zero corporate taxes and positive dividend and labor income taxes that are equalized to each other. Relative to our work, they abstract from firm and household heterogeneity which implies their model does not capture the distortions arising from the difference between dividend and capital gains taxes nor the effects of dividend taxation on precautionary savings. Dividend taxes in their model introduce instead a distortion in the intra-period allocation of time between working to produce consumption goods and working to produce capital goods. Although the margins incorporated in their work are different from ours, their conclusion is similar to ours in that they propose zero corporate taxes and positive dividend income taxes.

Our model is closest to Gourio and Miao (2010) and Anagnostopoulos et al. (2012). Relative to former, our model incorporates household heterogeneity and incomplete markets which are crucial in order to capture the effects of shareholder taxes on precautionary savings as well as to evaluate the distributional effects of tax reforms. Relative to the latter, our model incorporates firm heterogeneity and external financing which are crucial in order to evaluate the distortionary effects of an increase in dividend taxes. These two papers identify different mechanisms through which dividend taxes affect investment with opposite effects. By incorporating both mechanisms, we are able to evaluate which one is quantitatively more important. In addition, both of these papers focus on the effects of a specific tax reform (the JGTRRA) which changed shareholder taxes keeping corporate profits taxes fixed. Our paper differs in two ways: First, we consider changes in corporate profits taxes in conjunction with shareholder taxes. Second, we seek to determine an optimal tax scheme rather than focusing on a specific reform.

The rest of the paper is organized as follows. Section 2 presents the model, section 3 defines the stationary recursive competitive equilibrium, section 4 discusses the calibration and results and section 5 summarizes and concludes.

2 The Model

We consider an infinite horizon economy with endogenous production, where time is discrete and indexed by $t = 0, 1, 2, ...$ 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. Households trade only a single asset, which is interpreted as a mutual fund composed of all the firms in the economy.[8] The sole role of the mutual fund is to intermediate between firms and households. A government maintains a balanced budget every period by taxing firm profits as well as household labor, dividend and capital gains income.

2.1 Households

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

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

where $\beta \in (0,1)$ is the subjective discount factor, c_{it} denotes consumption and E_0 denotes the expectation conditional on information at date $t = 0$. The period utility function $u(\cdot) : \mathbb{R}_+ \to \mathbb{R}$ 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, from their point of view, exogenous. The economy-wide 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

[8] This assumption is made for tractability and it is used by Favilukis, Ludvigson and van Nieuwerburgh (2013) in a model with two sectors that produce housing and consumption goods. Alternatively, one can view this model as one in which households can buy shares in each individual firm, with the restriction that they have to hold the same share of all firms.

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 his shares at a price P_t^0, which represents the time t value of equity outstanding in period $t-1$. The increase in the value of this existing equity $\left(P_t^0 - P_{t-1}\right)\theta_{it-1}$ represents accrued capital gains, which are taxed at the rate τ_g.[9] Since we allow firms to raise new equity S_t, the market value of equity at time t (after new equity is issued) is $P_t = P_t^0 + S_t$.[10] The households' budget constraint can thus be expressed as:

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

Short-selling of the mutual fund shares is not allowed, i.e. households cannot borrow

$$\theta_{it} \geq 0 \quad (3)$$

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

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

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 (4) simply states that, at an optimum, the after tax return on the asset must equal the intertemporal marginal rate of substitution of unconstrained households.

2.2 Firms

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

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

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

[9] 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).

[10] This follows the notation in Gourio and Miao (2010). The budget constraint can be written equivalently in the notation of Anagnostopoulos et al (2012) by defining the number of stocks e_{it} and the dividend "per stock" and price "per stock" d_t^e and p_t^e respectively. The equivalence can be seen by replacing $\theta_{it} = \frac{e_{it}}{e_t}$, $D_t = d_t^e e_{t-1}$, $P_t = p_t^e e_t$ and $P_t^0 = p_t^e e_{t-1}$. Note that this formulation would imply that the total number of stocks $e_t = \int e_{it}di$ changes over time due to equity issuance, while with our current notation $\int \theta_{it}di = 1$ is fixed over time.

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

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

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

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

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

Given the determination of operating profits, we can now turn to the dynamic aspect of the firm's decision making problem, which includes the investment, financing and payout decisions. The firm has two sources of funds, internal and external, which it can allocate to investment x_{jt}, dividends d_{jt} and capital adjustment costs given by $\psi \frac{x_{jt}^2}{2k_{jt}}$. External funds are obtained by issuing new equity. The value of new equity issued in period t is denoted by s_{jt}. Internal funds consist of after-tax operating profits, which are taxed at a flat corporate income tax rate τ_c, with depreciation spending excluded from taxation. Thus, the firm's financing constraint is given by

$$d_{jt} + x_{jt} + \frac{\psi x_{jt}^2}{2k_{jt}} = \left(1 - \tau_c\right)\pi\left(k_{jt}, z_{jt}; w_t\right) + \tau_c \delta k_{jt} + s_{jt} \tag{7}$$

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

$$k_{j,t+1} = x_{jt} + \left(1 - \delta\right) k_{jt} \tag{8}$$

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

$$d_{jt} \geq 0 \tag{9}$$

and no repurchases are allowed[11]

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

We assume that firm j maximizes the following objective as in Gourio and Miao (2010)

$$E_t \sum_{t=0}^{\infty} \left(\prod_{n=1}^{t} \frac{1}{1 + \frac{r_n}{1-\tau_g}}\right) \left[\frac{1-\tau_d}{1-\tau_g} d_{jt} - s_{jt}\right] \tag{11}$$

[11]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.

This represents the expected present discounted value of cash flows, where the discounting is in terms of the risk free rate. Recall that households buy shares of a mutual fund that is composed of all firms, but do not invest directly in each individual firm. In this sense, the firms are only indirectly owned by the shareholders through the mutual fund and it is not entirely clear who should decide on the firm's objective. Moreover, even if firms were traded and owned directly, the combination of shareholder heterogeneity, market incompleteness and decreasing returns to scale technologies would imply lack of unanimity regarding the objective of the firm.[12]. In the absence of a commonly agreed upon objective, we have to take a stand and we assume that the firm maximizes the present discounted value of cash flows in (11) subject to (7) - (10).

We now describe briefly optimal firm behavior, focusing on the stationary distribution where w and r are constant.[13] Let λ_t^d and λ_t^s be the multipliers on the constraints (9) and (10) respectively and let q_t denote the shadow value of capital, i.e. the multiplier on the capital accumulation equation (8). The first order conditions of the firm's problem are

$$\frac{1-\tau_d}{1-\tau_g} + \lambda_t^d + \lambda_t^s = 1 \tag{12}$$

$$q_t = \left(\frac{1-\tau_d}{1-\tau_g} + \lambda_t^d\right)\left(1 + \frac{\psi x_t}{k_t}\right) \tag{13}$$

$$q_t = \frac{1}{1+\frac{r}{1-\tau_g}} E_t\left(q_{t+1}(1-\delta) + \left(\frac{1-\tau_d}{1-\tau_g} + \lambda_{t+1}^d\right) R_{k,t+1}\right) \tag{14}$$

$$R_{k,t+1} \equiv (1-\tau_c)\frac{\partial \pi(k_{t+1}, z_{t+1;} w)}{\partial k_{t+1}} + \tau_c \delta + \frac{\psi}{2}\left(\frac{x_{t+1}}{k_{t+1}}\right)^2 \tag{15}$$

Equation (12) governs the optimal financing decision. Raising a unit of equity reduces firm value by one, but can be paid as dividend increasing the firm value by $\frac{1-\tau_d}{1-\tau_g}$ and, in addition, it relaxes constraints (9) and (10). These marginal costs and benefits are equalized at the optimum. When $\tau_d = \tau_g$, the financing condition implies that $\lambda_t^d = \lambda_t^s = 0$. Raising equity to pay dividends leaves the total (after-tax) payout unchanged and a version of the Modigliani-Miller theorem holds. That is, only $d - s$ can be determined but not dividends and equity issuance separately. In other words, it is equivalent for the firm to finance investment using either internal or external funds. In the absence of adjustment costs ($\psi = 0$), the optimal choice of investment given in (13) would imply that marginal q equals to one for all firms. In turn, the capital Euler equation given in (14) - (15) would dictate that each firm jumps immediately to

[12] See Carceles-Poveda and Coen-Pirani (2009) for a discussion of shareholder unanimity under incomplete markets and constant returns to scale technology. A discussion of alternative assumptions about the discount factor can also be found in Favilukis et al (2013).

[13] We suppress j in what follows. It should be understood that all firm-level variables are indexed by j.

its long run optimal capital level determined by its current (and, hence, expected future) productivity level z.

In contrast, when $\tau_d \neq \tau_g$ financial policy does matter for investment decisions. For the relevant case in which $\tau_d > \tau_g$, equity issuance is costly relative to internal funds and this introduces a financing friction that can move capital decisions away from the long run optimum even in the absence of adjustment costs. To be specific, a firm can be in one of the following three financing regimes: the dividend distribution (DD) regime, the equity issuance (EI) regime or the liquidity constrained (LC) regime. Firms in the DD regime have sufficient internal funds to cover their desired level of investment, they do not need to issue costly equity and they pay the residual cash flow as dividends. These are typically firms whose productivity z_t is low relative to their current capital k_t. Firms with insufficient cash flow to finance investment have to decide whether, and to what extent, they will tap equity markets to obtain additional funds for investment. Firms with relatively low k_t and high z_t, will have high expected returns and this will justify issuing equity to invest, albeit less so than in the absence of the financing friction. These are the EI firms. However, some firms would optimally like to invest more than their available cash flow, but they are close enough to their long run optimal capital so that the returns to investment will not exceed the cost of issuing equity. These firms will use all their internal funds for investment, pay no dividends but issue no equity either. These are the LC firms.

The preceding discussion abstracts from adjustment costs. It is well known that these costs prevent the allocation of capital across firms from being fully efficient. Thus, the model incorporates two reasons for which the allocation of capital can be inefficient: capital adjustment costs and a financing friction whenever $\tau_d > \tau_g$. Changes in the tax code, to the extent that they imply a change in the distribution of capital across firms, can have important effects on total factor productivity.

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 every period. The government budget constraint is given by

$$G = \tau_d D_t + \tau_{lt} w_t L_t + \tau_g (P_t^0 - P_{t-1}) + \tau_c (\Pi_t - \delta K_t) \tag{16}$$

where D_t, K_t, L_t and Π_t denote aggregate dividends, capital, labor and profits.

3 Stationary Recursive Competitive Equilibrium

In this section, we provide the recursive formulation of the household and firm problems and define a stationary recursive competitive equilibrium.[14] Given the absence of aggregate uncertainty, in the long run all aggregates are constant and household and firm problems can be expressed in terms of individual state variables only.

The household's state vector is fully characterized by the pair (θ, ϵ) and its problem can be written recursively as follows:

$$\begin{aligned} v_h(\theta,\epsilon) &= \max_{\{\theta',c\}} u(c) + \beta \sum_{\epsilon'} \Omega_\epsilon(\epsilon',\epsilon)\, v_h(\theta',\epsilon') \text{ s.t.} \\ c + P\theta' &= (1-\tau_l)w\epsilon + \left((1-\tau_d)D + P^0\right)\theta - \tau_g\left(P^0 - P\right)\theta \\ \theta' &\geq 0 \end{aligned} \tag{17}$$

The solution to the household's problem consists of a value function v_h as well as policy rules for shares and consumption which we denote by:

$$c = c(\theta,\epsilon),\ \theta' = g_h(\theta,\epsilon) \tag{18}$$

Similarly, the state vector for a given firm is given by the pair (k, z), its static labor demand decision is described by a decision rule $l = l(k, z)$ obtained from

$$\pi(k,z) = \max_l \{zf(k,l) - wl\} \tag{19}$$

and its dynamic problem is as follows:

$$\begin{aligned} v_f(k,z) &= \max_{\{x,k',s,d\}} \frac{1-\tau_d}{1-\tau_g} d - s + \frac{1}{1+\frac{r}{1-\tau_g}} \sum_{z'|z} \Omega_z(z'|z)\, v_f(k',z') \\ d + x + \frac{\psi(x)^2}{2k} &= (1-\tau_c)\pi(k,z) + \tau_c\delta k + s, \\ k' &= x + (1-\delta)k,\ d \geq 0,\ s \geq 0 \end{aligned} \tag{20}$$

The solution to the firm's problem consists of a value function v_f as well as policy rules for investment, capital, equity issuance and dividends:

$$x = x(k,z),\ k' = g(k,z),\ s = s(k,z),\ d = d(k,z) \tag{21}$$

Let μ_h be the cross sectional distribution of households over the state (θ, ϵ) and μ_f the cross sectional distribution of firms over the state (k, z). These distributions follow the laws of motion

$$\mu_h' = \Gamma_h(\mu_h) \tag{22}$$

$$\mu_f' = \Gamma_f(\mu_f) \tag{23}$$

[14] The corresponding definitions for the non-stationary transitions are omitted in the interest of brevity.

These stationary distributions can be used to calculate aggregate consumption demand C, aggregate effective labor supply L^s and aggregate demand for share holdings Θ from the household side

$$\begin{aligned} C &= \int c(\theta,\epsilon)\, d\mu_h(\theta,\epsilon) \\ L^s &= \int \epsilon d\mu_h(\theta,\epsilon) \\ \Theta &= \int g_h(\theta,\epsilon)\, d\mu_h(\theta,\epsilon) \end{aligned} \tag{24}$$

as well as aggregate labor demand L, investment X, capital stock K', output Y, operating profits Π, dividends D and equity issuance S from the firm side

$$\begin{aligned} L &= \int l(k,z)\, d\mu_f(k,z)\,,\ X = \int x(k,z)\, d\mu_f(k,z) \\ K' &= \int g(k,z)\, d\mu_f(k,z)\,,\ Y = \int zf(k,l(k,z))\, d\mu_f(k,z) \\ \Pi &= \int \pi(k,z)\, d\mu_f(k,z)\,,\ D = \int d(k,z)\, d\mu_f(k,z) \\ S &= \int s(k,z)\, d\mu_f(k,z) \end{aligned} \tag{25}$$

Definition: Given the transition matrices Ω_ϵ and Ω_z, a *stationary recursive competitive equilibrium* relative to a government policy $(\tau_l, \tau_d, \tau_g, \tau_c, G)$, consists of stationary distributions μ_h and μ_f, laws of motion Γ_h and Γ_f, prices w and P, decision rules for firms and households, $l(k,z)$, $x(k,z)$, $g(k,z)$, $s(k,z)$, $d(k,z)$, $c(\theta,\epsilon)$, $g_h(\theta,\epsilon)$, as well as associated value functions $v_h(\theta,\epsilon)$ and $v_f(k,z)$ such that:

- *Optimal Household Choice:* Given prices and aggregates, the individual policy functions $c(\theta,\epsilon)$ and $g_h(\theta,\epsilon)$ and the value function v_h solve the problem of the household in (17)
- *Optimal Firm Choice:* Given the wage rate, $l(k,z)$ solves the static problem in (19) and $x(k,z)$, $g(k,z)$, $s(k,z)$, $d(k,z), v_f(k,z)$ solve the dynamic problem in (20)
- The aggregates satisfy equations (24), (25) and $P^0 = P - S$.
- *Government Budget Balance:* Government spending equals government revenue
$$G = \tau_l wL + \tau_d D + \tau_g \left(P^0 - P\right) + \tau_c (\Pi - \delta K)$$
- *Market Clearing:* Prices are such that all markets clear
$$\begin{aligned} \Theta &= 1 \\ L &= L^s \\ C + X + G + \Psi &= Y \end{aligned}$$

where $\Psi \equiv \int \frac{\psi x(k,z)^2}{2k} d\mu_f\left(k,z\right)$ represents aggregate adjustment costs.

- *Consistency:* Γ_h and Γ_f are consistent with the households' and firms' optimal decisions respectively.

4 Results

We use a calibrated version of our model to study several alternative corporate profit tax reforms. We start with a discussion of the calibration approach and the resulting main features of the benchmark economy. Subsequently, we analyze the long run as well as the transitional effects of the different reforms.

4.1 Benchmark Economy Calibration

The time period is assumed to be one year and the parameters used are reported in Table 1. Preferences are of the CRRA class, $u\left(c\right) = \frac{c^{1-\mu}-1}{1-\mu}$, with a coefficient of relative risk aversion $\mu = 1$. The discount factor is set to $\beta = 0.942$ which makes the after-tax return r on the mutual fund equal to 3%. The implied aggregate capital to output ratio is 1.61, which is roughly in line with the average capital output ratio in the US corporate sector.

The benchmark economy features substantial heterogeneity on the household side arising from the idiosyncratic labor productivity process. This process is taken from Davila, Hong, Krusell and Ríos-Rull (2012) and the productivity values $\boldsymbol{\epsilon}$, transition matrix $\boldsymbol{\Omega}_\epsilon\left(\epsilon'|\epsilon\right)$ and associated stationary distribution $\boldsymbol{\Omega}^*_\epsilon$ are given in Table 2. The process is constructed so that it delivers reasonable values for the Gini coefficients of labor earnings and of wealth using a parsimonious Markov chain model with only three states.[15] This is achieved by choosing productivity values that assign productive individuals 46 times the productivity of unproductive individuals and a transition matrix implying a non-trivial probability of transition from high productivity to medium and, eventually, low productivity. The process yields a stationary distribution with 50% of households at the low productivity, 44% with medium productivity and only 6% with high productivity. The implied Gini coefficient of labor earnings is equal to 0.60, which is very close to the value of 0.636 reported in Diaz-Gimenez, Glover and Rios-Rull (2011) based on the 2007 Survey of Consumer Finances. They also report a Gini coefficient of wealth equal to 0.82. In the model, the wealth distribution is endogenous and has a Gini coefficient equal to 0.84, with 44% of households owning no stocks.

The calibration of the production sector follows closely the one in Gourio and Miao (2010). The depreciation rate δ is set to 0.095 to match the aggregate investment-capital ratio of 0.095 in the National Income and Product Accounts (NIPA). The adjustment cost parameter $\psi = 1.31$ is chosen to match a cross-sectional volatility of the investment rate of 0.156. Gourio and Miao (2010)

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

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

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

The estimated values for ρ and σ are 0.767 and 0.211 respectively. This process is approximated using a 10-state Markov chain obtained by applying the method of Tauchen and Hussey (1991). Table 3 presents the resulting productivity values $\mathbf{z}$, transition matrix $\mathbf{\Omega}_z\left(z'|z\right)$ and associated stationary distribution $\mathbf{\Omega}_z^*$.

Regarding government variables, we set the labor income tax rate to $\tau_l = 0.28$ following Mendoza et al (1994).[16] 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.[17] 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 $G = 0.157$ which means that government spending is 26% of output Y in the stationary distribution.

Since we assume $\tau_d = \tau_g$ in our benchmark economy, there are no firms in the LC regime. Table 4 provides some of the characteristics of the distribution of firms across the EI and DD regimes. 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.[18] 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. Figure 1 plots the distribution of capital generated by the model. The distribution is skewed to the right with a small number of firms having very large capital holdings.

4.2 Tax Reforms

We consider several alternative revenue-neutral tax reforms, all of which involve an unexpected, permanent change in the corporate profits tax rate τ_c. For each reform, the level of government spending G is maintained fixed at the pre-reform level so some of the other taxes need to be adjusted to maintain budget balance

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

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

[18] 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.

in the long run. We distinguish three types of reforms depending on which taxes are adjusted in order to achieve this long run budget balance. In the first one we adjust labor income taxes τ_l only (reform A), in the second we adjust dividend taxes τ_d only (reform B) and in the third we adjust both dividend and capital gains taxes while maintaining the equality $\tau_d = \tau_g$ between the two (reform C). In all three cases, we use labor taxes to balance the budget during the transition. For each type of reform, we consider several possibilities for the new level of τ_c, which will allow us to numerically determine the optimal level of the new τ_c. Optimality is determined on the basis of a utilitarian social welfare function, but we also decompose the overall welfare effects into aggregate and distributional components using the method of Domeij and Heathcote (2004) and look at welfare effects for each household separately.[19]

4.2.1 Reform A: Corporate vs Labor Income Taxes

In our first experiment, we assume that changes in the corporate tax rate are financed through a corresponding change in labor income taxes and maintain shareholder taxes fixed. This experiment will serve as a useful benchmark to compare to the existing literature on capital tax changes which typically makes that assumption.[20] Table 5A presents the long run effects on macroeconomic aggregates of changing τ_c from its benchmark value of 0.34 to several different values both above and below the benchmark. Qualitatively, the effects of a decrease in τ_c are consistent with the findings in Domeij and Heathcote (2004). A reduction in corporate taxes tends to increase the after-tax return to investment across all firms and would, other things equal, induce them to invest more. In the long run, this indeed leads to higher aggregate capital and hence output and consumption. However, this increase in production is not enough to make up for the loss in tax revenues and, as a result, labor income taxes need to increase to balance the government's budget. This increase has important consequences regarding the distributional effects of a corporate tax cut. Even though the increase in capital implies an increase in wages before taxes, after tax wages go down because the increase in labor income taxes dominates this general equilibrium effect. At the same time, both the stock price P and the payout $D - S$ increase, but the latter increases by more so the long run, after-tax stock return $r = (1 - \tau_d) \frac{D-S}{P}$ increases. These changes in the wage and the stock return imply a redistribution from wealth-poor households, whose main income is from wages, to wealth-rich households who earn significant income through stocks.

Relative to Domeij and Heathcote (2004), the presence of firm heterogeneity introduces an additional channel through which lower corporate profits taxes increase aggregate output and consumption. We illustrate this by computing

[19] In order to evaluate welfare it is necessary to solve for transition paths. This significantly increases the computational complexity, especially in this model with two sided heterogeneity and occasionally binding constraints on both sides.

[20] See, for example, Domeij and Heathcote (2004).

total factor productivity, defined as

$$TFP \equiv \frac{Y}{K^{\alpha_k} L^{\alpha_l}} \tag{26}$$

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. There are potentially two fundamental frictions in our model that prevent the distribution of capital from being fully efficient: adjustment costs and, when there is a tax wedge, the financing friction. Since both the pre-reform and post-reform tax scheme has $\tau_d = \tau_g$, the financing friction effect is absent in this case and any inefficiency in the distribution of capital arises due to adjustment costs.

TFP increases with a decrease in τ_c indicating an increase in the efficiency with which the available capital is used. Table 6A presents information regarding the effects of this reform on the distribution of capital, focusing on the case where corporate taxes are completely eliminated (τ_c is set to 0). In particular, it compares average capital conditional on a productivity level z (denoted $E(k|z)$ in Table 6A) in the stationary distribution before and after the reform. Firms with relatively low z hold less capital and those with relatively high z hold more capital after the reform which translates to an increase in the TFP measure. This is because the long run optimal levels for low z firms have decreased and those for high z firms have increased. In turn, this is the result of two counteracting forces on the optimal capital of firms: the increase in the equilibrium values of w and r tends to decrease it and the lower corporate tax rate tends to increase it. The latter effect is asymmetric across firms due to the presence of adjustment costs. For high z firms the tax effect dominates the general equilibrium effect whereas for low z firms the opposite happens, which explains the pattern of $E(k|z)$ in Table 6A. Notice that the dispersion of capital for a given z ($\frac{std(k|z)}{E(k|z)}$ in Table 6A) increases as a result of the reform. With decreasing returns to scale this would tend to reduce TFP, but this effect is dominated by the reallocation of capital across z's toward more productive firms. Overall, we conclude that the reform reduces the inefficiency arising from adjustment costs and leads to an increase in TFP.

Figure 2A presents the transition paths for the reform that eliminates τ_c altogether. The transition paths are entirely standard. The capital stock increases to its new steady state only gradually and so does output. Dividends and equity issuance increase both on impact and subsequently as capital increases. The overall payout $D - S$ is higher than before the reform throughout the transition and, as a result, stock prices jump on impact and continue increasing over time as $D - S$ increases. The crucial thing to note is that aggregate consumption falls initially as savings and investment increase and remains below the pre-reform level for several years.

The bottom row of Table 5A reports welfare effects based on a utilitarian social welfare function in terms of the equivalent variation in consumption. Based on this measure, reductions in the corporate profits tax are associated with welfare losses. Instead, a slight increase in the corporate profits tax rate delivers a small welfare gain of less than 0.1% of consumption. This pattern is evident in figure 3 which plots these welfare gains as a function of the corporate profits tax. The peak of the welfare curve is to the right of the status quo. To understand this result it is helpful to decompose the welfare effects into aggregate and distributional components, as is done in figure 3. The aggregate component isolates the effect of the changes in aggregate consumption along the transition path and the distributional component can be understood in terms of the corresponding changes in after-tax factor prices discussed earlier. From an aggregate perspective, i.e. focusing only on the evolution of aggregate consumption, a reduction in corporate profits taxes is found to be welfare improving. This improvement arises due to higher long run, and despite lower short run, aggregate consumption. However, the short run effect significantly mitigates the aggregate benefits of the reform and these are dominated by large negative distributional effects. With a reduction in corporate profits taxes benefiting stockholders over labor income earners, the utilitarian social welfare function indicates a decrease in social welfare. This is both because households that rely primarily on labor income rather than asset income have typically higher marginal utility and because there are many more of them in the economy. Altogether, it is evident in figure 3 that the desirability of maintaining large levels of τ_c results mainly from the distributional component.

Figure 4 provides additional information on the distribution of welfare gains and losses by plotting these gains/losses for each household (θ, ϵ) separately.[21] Consistent with the existing literature, it shows that welfare gains from reducing τ_c are increasing in stock holdings and only those with significant stock holdings actually benefit. The group that benefits the most are stockholders with low productivity who see their after tax asset income increase and are relatively unaffected by the reductions in after tax wages. The figure does not provide information regarding the measure of households at any given (θ, ϵ) in the stationary distribution. This information is taken into account in Table 7A, which complements this figure by assigning a measure to each point in the figure and aggregating to find the total measure of households that experience gains and the total measure experiencing losses. The finding is that reductions in corporate profits taxes would have little political support, ranging from 20.7% to 22.8% depending on the specific reform. On the contrary, a significant majority would benefit from an *increase* in corporate profits taxes.

These findings motivate, in part, our main experiments below. The negative distributional effects and the lack of popular support are a direct result of the use of labor income taxes to compensate for the tax revenues lost. The pure general equilibrium effects work in the opposite direction and could generate positive redistribution and wide support, as long as the taxes used to compensate for revenues fall on capital income earning households. More importantly, the next two sections go to the heart of the questions addressed in this paper which relate to the effects of taxing profits at the household versus the firm level and the

[21] The figure focuses on only one of the reforms, namely the one where τ_c is eliminated. The other cases are qualitatively similar.

extent to which this double taxation of profits can be theoretically justified.

4.2.2 Reform B: Corporate vs Dividend Taxes

Consider now a reform which uses dividend taxes instead of labor taxes to replace corporate profits tax revenue, but leaves the capital gains tax rate untouched. Table 5B reports the effect of this reform on the steady state values of several aggregate variables of interest. Similarly to the previous section, these tax changes lead to an increase in capital, output and consumption in the long run. Quantitatively, the increase in output and consumption is of a similar order of magnitude as in the previous section, but the increase in capital is much more pronounced. For example, in the case where τ_c is completely eliminated, the aggregate capital stock increases by 33.4% compared to 16.4% under reform A. This additional increase in the capital stock arises due to the effect of an increase in dividend taxes on precautionary savings. As explained in Anagnostopoulos et al (2012), higher dividend taxes reduce the market value of the mutual fund for a given capital stock. 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. Although this explains the drop in stock returns and the additional increase in capital compared to the previous section, it begs the question of why this additional increase in capital is not translated to additional output. The explanation lies in the effects of the reform on TFP which we turn to in what follows.

Increasing dividend taxes while maintaining capital gains taxes fixed introduces a wedge between the two taxes. This wedge acts as a financing friction and produces a significant misallocation effect. This effect, which was first pointed out in Gourio and Miao (2010), can be explained as follows. With $\tau_d > \tau_g$, a unit of equity raised by the firm reduces the (after-tax) capital gains of existing shareholders by $1 - \tau_g$. When that unit is paid to shareholders in the form of dividends it only yields $1 - \tau_d < 1 - \tau_g$. In this sense, equity financing is now more costly than internal funds. Growing firms, which need to issue equity in order to grow, are hurt by the creation of the wedge and their investment suffers as a result. In turn, this implies that these firms take longer to reach their optimal capital level and spend more time at an inefficiently low level of capital. Although dividend distributing firms are not directly affected by this tax wedge, since they do not issue equity, they are ultimately affected through general equilibrium changes in factor prices. Specifically, the reduction in capital demand by growing firms, pushes wages downwards and lower wages push optimal capital levels upwards for all firms. The end result of these general equilibrium price movements is a smaller drop in the average capital of growing firms and an increase in the average capital of dividend distributing firms.[22] In a nutshell, the creation of the tax wedge reallocates capital from relatively

[22] The preceding discussion focuses on the effects of an increase in τ_d and abstracts from the effects of the concurrent decrease in τ_c. As a result, some of the effects discussed here are not evident in Table 5B because the τ_c effects dominate.

productive firms to relatively unproductive firms and moves the distribution of capital further away from the efficient one. This reduction in efficiency can be illustrated in several ways.

One way to measure misallocation is to look at the share of capital held by firms under different financing regimes, displayed in Table 8. The idea is that as financing frictions increase, one would observe less capital held by EI firms. In addition, financing frictions can induce firms that would otherwise issue equity to stop issuing equity altogether because the return to investment is not high enough to justify equity issuance. That is, financing frictions create a group of firms in the LC regime. In the benchmark economy, where there is no financing friction, there are no LC firms. Firms can be categorized into the DD or EI regimes depending on whether their overall payout $d_j - s_j$ is positive or negative respectively. The bottom row of Table 8 shows that approximately 80% of capital is held by DD firms and 20% by EI firms in the benchmark economy. When dividend taxes are increased slightly (τ_c goes from 0.34 to 0.29, τ_d goes from 0.20 to 0.268) , the resulting stationary distribution features a substantial number of firms in the LC regime. To be precise, 18% of the economy's capital is now held by these LC firms which are severely constrained in their investment by the financing friction induced by the tax wedge. As the dividend tax is increased further, the fraction of LC firms keeps increasing. Notice however, that this misallocation effect is very strong up to $\tau_c = 0.19$, but further increases in τ_d create progressively smaller additional distortions. The reason is that the financing friction at $\tau_c = 0.19$, $\tau_d = 0.385$ is so large that there are almost no equity issuing firms left (92% of the overall equity issuance has disappeared) and further increases in τ_d have relatively minor effects.

The composition of capital across financing regimes provides an interesting but imperfect illustration of the misallocation effect, since the average productivity conditional on the regime can also change after the reforms. The most direct measure of the efficiency of allocation of capital is provided by TFP as defined in (26). Table 6B illustrates the fact that changes in capital stock are not proportional across firms. Instead, the change in capital as a function of z is U-shaped. Average capital increases by more for low-z and high-z firms and by less for firms in the middle range of z's. This is the result of two opposing effects on the distribution of capital. Recall from the previous section that the reduction in corporate profits taxes leads to an increase in this TFP measure because it reduces the inefficiency arising from adjustment costs. The concurrent increase in τ_d considered in this section has the opposite effect on efficiency because it introduces a financing friction. Overall, this counteracting effect dominates and leads to an overall decrease in TFP of approximately 0.6%. Notice in Table 5B that, although TFP falls in all of the cases considered, the effect is non-monotonic in the size of the τ_c decrease. The reason is that, whereas the positive effect of τ_c on efficiency increases roughly linearly as τ_c is reduced, the negative effect of τ_d is stronger initially and progressively levels off. This non-monotonicity also plays a role in the welfare effects discussed at the end of this section.

Transition paths for the main macroeconomic and financial aggregates are shown in Figure 2B.[23] Similarly to reform A, capital and output grow gradually to the new steady state and consumption drops initially and only rises above steady state after several years. It is important to notice that the magnitude of the immediate consumption drop is now much larger, with consumption falling almost by 15% compared to 5% in reform A. The reason for this much larger temporary fall in consumption can be traced back to the additional precautionary savings induced by the dividend tax increase. Crucially, these higher savings and investment do not lead to a commensurate increase in long run consumption because of the inefficiency associated with the tax wedge. There are also large changes in the financial variables. In this extreme experiment where corporate taxes are eliminated, the dividend tax rate rises to 0.542 while the capital gains tax is fixed at 0.2 and this translates to large costs of equity financing. As a result, equity issuance drops to almost zero and stays there throughout the transition. Dividend distributions drop initially as dividend distributing firms use their internal funds to increase capital, but eventually rise above the pre-reform level because capital is now higher. Finally, stock prices fall on impact and then gradually increase as capital increases. Stock prices, however, remain below pre-reform levels even in the long run because dividend taxes are now much higher.

Consider now the distributional and welfare effects. Distributional effects are governed by after tax prices. With higher capital, the marginal product of labor and hence wages are higher. Since we have maintained labor taxes fixed, this directly implies an improvement for workers that hold few or no stocks. In contrast, because after tax stock returns have fallen, this implies a relative deterioration for households relying primarily on asset income. As a result, the negative redistribution identified in the previous section is now reversed. This is reflected in the welfare effects reported in figure 5. The figure shows that a reduction in corporate profits taxes financed through an increase in dividend taxes yields positive, albeit small, welfare gains. Interestingly, the decomposition of the gains into aggregate and distributional reveals that this reform has very different consequences from the one where labor taxes are used to raise revenues. Specifically, it is now the distributional component that is positive and the aggregate component that is negative. The distributional component is positive for the reason just explained and ultimately arises because labor income taxes are not used to finance the corporate income tax cut. The aggregate effect is negative despite higher aggregate consumption in the long run, because the consumption fall during the transition is now larger. For small decreases in τ_c (small increases in τ_d) the misallocation effect is strong, the aggregate component of welfare falls sharply and the overall welfare effects are almost zero. For larger decreases in τ_c, misallocation has reached its maximum level, the aggregate component falls at a slower rate and the distributional component dominates yielding positive welfare gains. The welfare gains are highest at $\tau_c = 0.09$, but are moderate in magnitude at 0.2% of consumption. It is interesting to note that this reform would optimally maintain the "double taxation"

[23] We focus on the $\tau_c = 0$ reform once again.

of profits, albeit significantly shifting the burden away from firms and toward shareholders.

Finally, figure 6 shows that a reform that completely eliminates corporate profits taxes and replaces them with dividend taxes would benefit households with low wage income (productivity) and with few or no assets. On the contrary, high labor income earners and households with significant asset holdings stand to lose from such a reform. Importantly, Table 7B indicates that the former group forms a clear majority in the population, with the percentage of households benefiting from this reform amounting to almost 78%.

4.2.3 Reform C: Corporate vs Dividend and Capital Gains Taxes

Although replacing corporate profits taxes with dividend taxes leads to overall welfare gains, these gains are quantitatively moderate. The main culprit for reducing the gains is the introduction of the tax wedge and the resulting inefficiency due to the financing friction. This misallocation effect can be avoided by increasing the capital gains tax together with the dividend tax in order to avoid creating a tax wedge. The downside of this alternative is that an increase in capital gains taxes increases the cost of capital and can potentially undo the increased incentives for investment arising from the corporate tax cut. This section considers such a reform in order to quantitatively assess the importance of these trade-offs.

Table 5C displays the long run effects of a reform that cuts corporate profits taxes and replaces them with dividend and capital gains taxes, maintaining $\tau_d = \tau_g$. The last row also reports consumption equivalents associated with each reform. The reforms yield welfare gains larger than the previous ones and suggest that a complete elimination of corporate profits taxes would be the optimal reform, being associated with welfare gains equivalent to more than 1% of consumption. Figure 7, which plots the welfare gains together with the decomposition into aggregate and distributional components, indicates that the increased welfare gains arise because there is no trade-off between aggregate and distributional components. Instead, both components are positive and increasing in the size of the τ_c tax cut. The crucial difference compared to the reform that only increases τ_d is that here output and consumption increase due to an increase in the efficiency of the distribution of capital rather than due to an increase in aggregate capital. In fact, aggregate capital falls in the long run as a result of the reform but TFP increases enough so that long run output rises. In turn, this implies that higher long run consumption is not a result of higher investment and lower consumption in the short run. As is evident in Figure 2C which displays the transition paths, aggregate consumption falls only in the initial period and only by approximately 1% (compare this to 15% in reform B). This is the reason why the aggregate component of welfare is now also positive, since the transitional cost is almost non-existent.

In order to understand the effects of this reform on aggregate capital and on the efficiency of the distribution of capital, it is helpful to establish a benchmark model under which such a reform would have no consequences. The following proposition proves that this would indeed be the case if our benchmark model were adjusted so that taxable corporate income is

$$T_{jt} = \pi\left(k_{jt}, z_{jt}; w_t\right) - \psi \frac{x_{jt}^2}{2k_{jt}} - \left(q_{jt-1} - (1-\delta)\, q_{jt}\right) k_{jt} - \left(1 - q_{jt}\right) x_{jt} \qquad (27)$$

where q_{jt} refers to the shadow value of capital for firm j. Compared with our benchmark model, where taxable income in equation (7) is the more standard $\pi\left(k_{jt}, z_{jt}; w_t\right) - \delta k_{jt}$, this involves three adjustments to the tax code: First, adjustment costs are deducted from taxable income. Second, true economic depreciation given by $\left(q_{jt-1} - (1-\delta)\, q_{jt}\right) k_{jt}$ is deducted from corporate taxes instead of just δk_{jt}. Third, the tax code allows for a deduction of the difference between investment spending and the market value of this spending after installation.

Proposition 1 *Suppose the model of Section 2 is adjusted so that taxable corporate income is given by (27). Starting at a stationary distribution of this model with τ_c and $\tau_s (= \tau_d = \tau_g)$ being the corporate and shareholder tax rates respectively, a reform that changes these tax rates to τ_c^* and τ_s^* such that*

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

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

$$\left(d_{jt} - s_{jt}\right)^* = \left(d_{jt} - s_{jt}\right) + \left(\tau_c - \tau_c^*\right) T_{jt}$$

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

We provide a sketch of the proof in Appendix A. The idea is that if the overall tax wedge on the investment margin $\left(1 - \tau_s\right)\left(1 - \tau_c\right)$ is kept fixed, households' savings decisions are not affected because the after tax payout to households remains the same and government revenues are also not affected. These, in turn, rely on the three adjustments to the tax code which were first used by Abel (1983). In particular, Abel also uses the notion of true economic depreciation defined as the change in the value of installed capital, where the valuation is according to the shadow price q_{jt}. Our proposition borrows the idea from Abel (1983) but 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 non-distortionary. Second, our result is proved in a general equilibrium framework with household and firm heterogeneity whereas Abel focused 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. Thus, whereas the equivalence between shareholder and corporate taxes would hold generally under constant returns in this adjusted model, with decreasing returns we can only show this is true at the stationary distribution, i.e. in the long run. Although our main objective is to use this result to build some intuition on why the reform *does* have effects in an economy without these tax code adjustments, we believe this Proposition is of independent theoretical interest.

Returning to our main result, the current setup does not satisfy the conditions required for neutrality. In particular, it differs from the economy where neutrality would hold in two important aspects: First, adjustment costs are non-deductible from corporate taxation but are implicitly deducted from shareholder taxes and this implies a change in the tax base as a result of the reform.[24] The implication of this first departure is that τ_d and τ_g need to be raised more than proportionally to the decrease in τ_c which, in turn, implies that the returns to investment fall and would induce all firms to invest less. This explains why aggregate capital falls in our setup. In addition, the implicit benefit of increasing capital that comes from lowering future adjustment costs (see the last term of equation (15)) is now taxed more, and this also reduces the incentives of firms to invest. The second departure from the neutrality case established in the Proposition above has to do with the treatment of depreciation in the tax code. To the extent that the tax code allows for expensing capital depreciation at δk_t rather than true economic depreciation, shifting from taxing firms to taxing shareholders can have reallocation effects by benefiting relatively productive firms over less productive ones. This is where the efficiency gains from this reform arise. Relatively productive firms have typically high and decreasing q_t and, hence, relatively high true economic depreciation. When the tax code allows for expensing depreciation at δk_t ignoring the effects of q_t, this benefits relatively unproductive firms over productive ones. The reform that reduces τ_c and increases shareholder taxes reverses this and benefits relatively productive firms. As a result, more capital is allocated to more productive firms and efficiency increases. This reallocation can be seen in Table 6C. The effect of the reform is to reduce average capital for low-z firms and increase it for high-z firms.

Quantitatively, for the case of complete elimination of corporate taxes, the model predicts a 4% decrease in capital but a 3% increase in TFP and an almost 2% increase in GDP. Both dividends and equity issuance increase in the long run, but shareholder taxes have to be increased substantially to 0.547 to maintain a balanced budget and this implies that the after tax payout and, hence, the stock price both decrease. In terms of factor prices, after tax wages increase and stock returns fall which implies a relative improvement for workers over stockholders. Both of these price movements are smaller than in the case where only dividend taxes are adjusted and this is reflected in the distributional component of welfare in figure 7 which is still positive but smaller than in the previous section (0.35% vs. 1.3%)

Figure 8, which presents welfare gains by individual, reflects that, as in the previous section, gains are decreasing in wealth. Households with little or no stock holdings benefit. Interestingly, this is now true even for those households with very high labor productivity. This also implies increased popular support

[24] As is pointed out in Auerbach (1989), treating adjustment costs as part of capital expenditures for tax purposes is consistent with US tax law which requires adding all indirect costs, such as installation costs, to basis.

for this reform. In particular, the fraction of the population that stands to gain from the complete elimination of corporate profits taxes now rises to almost 86%, as can be seen in Table 7C.

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 and this can make it harder to implement in practice. We also consider a reform that could potentially be easier to implement. The idea is to equalize all tax rates in the economy so that all types of personal income as well as corporate income are taxed at the same rate. This is a reform often suggested by political commentators on the grounds of 'fairness' and it is also in the spirit of calls for simplification of the tax code. We have computed the tax rate that would ensure enough revenues to finance the same level of government spending G in the long run. Interestingly, this turns out to be equal to 0.28, our originally assumed labor income tax rate. This reform yields a smaller TFP increase and a smaller welfare gain than the complete elimination of corporate taxes. However, the gains are even more widely spread with more than 95% of households in the economy experiencing welfare gains. Thus, the model suggests that shifting the burden of taxation from corporations to shareholders can yield economic benefits and should command almost unanimous support.

5 Conclusion

We find that the effects of reducing corporate profits taxes depend crucially on what taxes are used to make up for the foregone government revenue. When labor taxes are used, the tax change can result in aggregate gains but would command limited political support. When only dividend taxes are used, there is much wider political support but the gains are limited because of the financing frictions implied by the tax wedge between dividend and capital gains tax rates. When both dividend and capital gains taxes are used preserving their equality, the tax change has even wider political support and the gains are larger because there are no extra financing frictions introduced.

These results are demonstrated in an environment that incorporates important features of the actual US economy, such as wealth heterogeneity across households, lack of perfect insurance markets, productivity heterogeneity across firms and an endogenous financing choice for firms. All of these components are important in evaluating the effects of different types of capital income taxes. The model necessarily abstracts from other potentially important channels through which a corporate profits tax cut can affect macroeconomic performance. As discussed in the introduction, these other channels could include the choice of legal form of organization, the extensive margin effects when investment is lumpy, the effects on employment as well as the possibility of international capital flows. It is noteworthy that studies which include these other channels seem to reach a similar conclusion to ours, namely that a reduction in corporate profits taxes can be beneficial to the economy. This paper contributes to the discussion by suggesting an alternative way of financing this tax cut that can increase popular support for such a reform.

An additional argument in favor of reducing corporate taxes and replacing them with shareholder taxation is advanced by Luigi Zingales and relates to the issue of tax avoidance.[25] Zingales argues that it is no longer the case that corporations are easier to locate and audit than individuals. In addition, lobbying power is much more concentrated in large corporations than it is amongst a few wealthy individuals. As a result, corporate taxes have ended up being a very ineffective way of raising revenue due to endless loopholes in the tax code. Although our model does not incorporate tax avoidance strategies, this argument would strengthen our main conclusion which is that the burden of capital income taxation should be shifted away from corporations and towards shareholders. As a first step, reducing the corporate income tax rate to 28%, as recently suggested by the President, and removing the preferential tax treatment of shareholder income relative to other personal income, seem to be measures that almost everyone could agree with and benefit from.

[25] Reference provided in footnote 6.

APPENDIX A - Proof of Proposition

We provide a sketch of the proof for the Proposition in Section 4.2.3. The goal is to show that all 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. Firms' conditions have to be adjusted according to the new tax code assumptions. Using the newly defined taxable corporate income in (27), the firms' financing constraint reads

$$d_{jt} - s_{jt} = \pi\left(k_{jt}, z_{jt}; w_t\right) - \frac{\psi x_{jt}^2}{2k_{jt}} - x_{jt} - \tau_c T_{jt}$$

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, $\lambda_t^d = \lambda_t^s = 0$. The first order condition for investment is now

$$q_{jt} = 1 + (1 - \tau_c)\,\psi \frac{x_{jt}}{k_{jt}} - \tau_c\left(1 - q_{jt}\right)$$

After some rearrangement, this gives

$$q_{jt} = 1 + \frac{\psi x_{jt}}{k_{jt}}$$

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

$$q_{jt} = \frac{1}{1 + \frac{r_{t+1}}{1-\tau_s}} E_t\left[(1-\delta)\,q_{j,t+1} + (1-\tau_c)\left(\frac{\partial \pi\left(k_{jt+1}, z_{jt+1}; w_{t+1}\right)}{\partial k_{jt+1}} + \psi\frac{x_{jt+1}^2}{2k_{jt+1}^2}\right) + \tau_c\left(q_{jt} - (1-\delta)\,q_{jt+1}\right)\right]$$

After some manipulation this can be simplified to

$$r_{t+1} = \frac{1}{q_{jt}}\left(1-\tau_c\right)\left(1-\tau_s\right) E_t\left[\frac{\partial \pi\left(k_{jt+1}, z_{jt+1}; w_{t+1}\right)}{\partial k_{jt+1}} + \psi\frac{x_{jt+1}^2}{2k_{jt+1}^2} - \left(q_{jt} - (1-\delta)\,q_{jt+1}\right)\right]$$

This is also still satisfied for the same allocation since 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 with the notation τ_s for the common tax rate replacing τ_d and τ_g. At steady state, these are

$$\begin{aligned} c_{it} + P\theta_{it} &= (1-\tau_{lt})w\epsilon_{it} + \left((1-\tau_s)(D-S) + P\right)\theta_{it-1} \\ 1 + r &= \frac{P + (1-\tau_d)(D-S)}{P} \end{aligned}$$

From the households' perspective all that matters is the after-tax dividend payout $(1-\tau_d)(D-S)$. Using the financing constraint of a firm together with the taxable income in equation (27) and aggregating over all firms j, the after-tax payout can be written as

$$
\begin{aligned}
(1-\tau_s)(D-S) &= (1-\tau_s)\left[\Pi-\Psi-X-\tau_c\int T_{jt}dj\right] \\
&= (1-\tau_s)\left[\Pi-\Psi-X-\tau_c\left[\Pi-\Psi-X-\int\left(q_{jt-1}-(1-\delta)\,q_{jt}\right)k_{jt}+\int q_{jt}x_{jt}\right]\right] \\
&= (1-\tau_s)(1-\tau_c)(\Pi-\Psi-X)+(1-\tau_s)\,\tau_c\left[\int q_{jt-1}k_{jt}-\int q_{jt}k_{jt+1}\right]
\end{aligned}
$$

This also remains unaffected by the reform since the last term is zero at the stationary distribution and the first term remains unchanged. To put it differently, every household's budget constraint (2) and Euler equation (4) are still satisfied after the reform. Finally, it follows from Walras' Law that the government's budget is also satisfied, i.e. the tax changes stipulated in the Proposition maintain the government's budget balanced. This completes the proof.

APPENDIX B - Computational Algorithm

Computing the Stationary Competitive Equilibrium

For given prices, the problems of individual firms and households are solved using value function iteration algorithms. Policy rules are then used to obtain stationary distributions and aggregate variables and these, in turn, are used to check market clearing and update prices. Let the individual firm state vector be denoted by $s_f = (k, z)$ and the individual household state vector be denoted by $s_h = (\theta, \epsilon)$.

Step 1. Guess a wage and a return $\left(w^0, r^0\right)$.

Step 2. (Firm Problem)

Step 2.1. Solve the firm's problem given $\left(w^0, r^0\right)$ using value function iterations and obtain the value function $v_f(s_f)$ and the optimal decision rules for the firm, namely labor demand $l = l(s_f)$, investment $x = x(s_f)$, capital $k' = g(s_f)$, equity issuance $s = s(s_f)$ and dividends $d = d(s_f)$.

Step 2.2. Use the firm decision rules from step 2.1 to solve for the stationary distribution of firms $\mu_f = \mu_f(k, z)$.

Step 2.3. Obtain the firm aggregates L, X, K', Y, Π, S and D using equations (25), P using the steady state version of (4) and $P^0 = P - S$.

Step 2.4. Check that the wage rate w^0 clears the labor market, namely that $L = L^s$, where $L^s = \int \epsilon d\mu_h(\theta, \epsilon)$ is the exogenous (effective) labor supply from the households. If labor markets do not clear, update the wage rate.

Step 2.5: Repeat steps 2.1 - 2.4 the labor market clears. This will deliver a new wage w^{new}.

Step 3 (Household Problem)

Step 3.1 Solve the household's problem given $\left(r^0, w^{new}, P, P^0, D\right)$ using value function iterations and obtain the value function $v_h(s_h)$ and the optimal decision rules for the households, namely asset holdings $\theta' = g_h(s_h)$ and consumption choices $c = c(s_h)$.

Step 3.2. Use the household decision rules from step 3.1 to solve for the stationary distribution of households μ_h.

Step 3.3. Obtain the aggregate asset demand Θ and consumption C using equations (24).

Step 3.4. Check whether the guessed return r^0 clears the asset market, namely that $\Theta = 1$. If asset markets do not clear, update the interest rate.

Step 3.5: Repeat steps 3.1 - 3.4 until the asset market clears. This will deliver a new interest rate r^{new}.

Step 4. Update the price vector using a standard bisection method between the guessed $\left(w^0, r^0\right)$ and implied (w^{new}, r^{new}) prices and repeat steps 2 and 3 until convergence.

In the pre-reform steady state all taxes are exogenously given and the solution process simply delivers the endogenous value of G. In the post-reform steady state, G is fixed and one (or two, depending on the experiment) of the tax rates needs to be solved for endogenously. The algorithm in that case involves an outer loop where the endogenous tax rates are guessed and then updated until they imply government budget balance.

Computing the Transitional Dynamics

Let $(\tau_c^i, \tau_d^i, \tau_g^i, \tau_l^i)$ be the tax rates associated with the initial steady state and $(\tau_c^*, \tau_d^*, \tau_g^*, \tau_l^*)$ denote the tax rates associated with the new steady state. Similar notation is used for the policies, value functions and prices in the two steady states which are already computed using the stationary equilibrium algorithm. For example r^i is the return in the initial steady state and r^* the one in the final steady state. Assume that the economy converges to the new steady state in T periods.

Step 1. Guess a path for the prices $\{w_t^0, r_{t+1}^0\}_{t=1}^T$.

Step 2. (Firm Problem)

Step 2.1. Use the path of prices $\{w_t^0, r_{t+1}^0\}_{t=1}^T$ together with the fact that $v_{fT}(s_f) = v_f^*(s_f)$ to solve the firm's problem by finite backward induction and obtain the time-dependent policy functions for labor demand $l_t(s_f)$, investment $x_t(s_f)$, capital $g_t(s_f)$, equity issuance $s_t(s_f)$ and dividends $d_t(s_f)$, as well as the time-dependent value functions $v_{ft}(s_f)$, for each period $t = 1, 2, ..., T$.

Step 2.2. Use the time-dependent policy functions and the stationary distribution of firms for the initial steady state μ_f^i to compute the implied cross-sectional distribution of firms μ_{ft} for any period $t = 1, 2, ..., T$.

Step 2.3. Obtain the firm aggregates as well as P_t, P_t^0 in each period $t = 1, 2, ..., T$ using equations (25), (4) and $P_t^0 = P_t - S_t$.

Step 3. (Government Budget)

Given government spending G, fixed tax rates $\left(\tau_c^*, \tau_d^*, \tau_g^*\right)$, the exogenous labor supply level L^s and the paths for wages and firm aggregates, use the government budget in period t to obtain the labor tax rate τ_{lt} that ensures budget balance for each $t = 1, 2, ..., T$.

Step 4. (Household Problem)

Step 4.1 Use the path of prices $\{w_t^0, r_{t+1}^0\}_{t=1}^T$ and the computed paths for the financial aggregates $\{P_t, P_t^0, D_t\}_{t=1}^T$ and labor taxes $\{\tau_{lt}\}_{t=1}^T$, together with the fact that $v_{hT}(s_h) = v_h^*(s_h)$, to solve the household's problem by finite backward induction and obtain the time-dependent policy functions for asset holdings $g_{ht}(s_h)$ and consumption choices $c_t(s_h)$, as well as the time-dependent value functions $v_{ht}(s_h)$, for each period $t = 1, 2, ..., T$.

Step 4.2. Use the time-dependent policy functions and the stationary distribution of households for the initial steady state μ_h^i to compute the implied cross-sectional distribution of households μ_{ht} for any period $t = 1, 2, ..., T$.

Step 4.3 Obtain the path for aggregate asset demand $\{\Theta_t\}_{t=1}^T$ using the expression in (24) for each period $t = 1, 2, ..., T$.

Step 5. For each period $t = 1, 2, ..., T$, check whether the guessed prices $\left(w_t^0, r_{t+1}^0\right)$ clear the asset market and the labor market and, if not, update accordingly. Although the direction in which prices should be adjusted is clear, the strength of adjustment cannot be analytically derived from the model due to the presence of heterogeneity on both sides and this complicates the solution. We find that the following updating rules work well

$$\begin{aligned} w_t^{new} &= \left(\varphi + (1-\varphi)(L_t/L^s)^{1-\alpha_l}\right) w_t^0 \\ r_{t+1}^{new} &= \left(\varphi + (1-\varphi)(\Theta_t)^{\alpha_k - 1}\right) r_{t+1}^0 \end{aligned}$$

where $\varphi = 0.90$.

Step 6. Update the path for prices by setting $\{w_t^0, r_{t+1}^0\}_{t=1}^T = \{w_t^{new}, r_{t+1}^{new}\}_{t=1}^T$ and repeat steps 2 - 5 until convergence (i.e. until both markets clear).

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Table 1. Parameter Values - Baseline Calibration

	Parameter	Value
Discount Factor	β	0.942
Share of Capital in Production	α_k	0.311
Share of Labor in Production	α_l	0.650
Depreciation Rate	δ	0.095
Adjustment Cost Parameter	ψ	1.31
CRRA Parameter	μ	1.00
Labor Productivity Shocks	ϵ_{it}	See Table 2
Firm Level Productivity Shocks	z_{it}	See Table 3
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

Table 2. Labor Productivity Process *

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

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

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

Earnings Gini : 0.60

Wealth Gini : 0.84

* 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.

Table 3. Firm Level Productivity Process *

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

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

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

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

Table 4. Distribution of Firms Across Finance Regimes (Data vs. Model)

(Pre-Reform Steady State)

	Equity Issuance Regime	Liquidity Constrained Regime	Dividend Distribution Regime
Share of Capital			
Data [1]	0.21	0.06	0.73
Model	0.21	0.00	0.79
Earnings/Capital Ratio			
Data [1]	0.56	0.29	0.33
Model	0.40	n/a	0.18
Tobin's q			
Data [1]	3.63	1.81	2.50
Model	2.47	n/a	1.45

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

Table 5A. Long Run Effects of Reform A (τ_c vs. τ_l) [1,2]

τ_c	0	0.04	0.14	0.24	0.29	**0.34**	0.39	0.44	0.49
τ_l	0.347	0.339	0.319	0.299	0.290	**0.280**	0.270	0.261	0.251
Aggregates (% change)									
Y	7.2	6.5	4.6	2.4	1.3	-	-1.3	-2.8	-4.3
K	16.4	14.7	10.3	5.5	2.9	-	-3.0	-6.2	-9.7
C	4.1	3.8	2.9	1.6	0.9	-	-1.0	-2.1	-3.5
TFP	2.3	2.1	1.4	0.7	0.4	-	-0.4	-0.8	-1.3
P	23.8	21.2	14.5	7.5	3.9	-	-3.9	-95.5	-95.8
D	46.5	41.1	27.7	14.0	7.0	-	-7.1	-14.3	-21.6
S	48.2	42.7	28.7	14.4	7.3	-	-7.3	-14.6	-22.0
w	7.2	6.5	4.6	2.4	1.3	-	-1.3	-2.8	-4.3
w(1-τ_l)	-2.7	-2.2	-1.1	-0.3	-0.1	-	0.0	-0.2	-0.5
r	18.0	16.2	11.3	6.0	3.0	-	-3.3	-6.8	-10.5
Welfare (%) [3]	-2.00	-1.61	-0.81	-0.25	-0.06	-	0.05	-0.03	-0.23

[1] In this reform, dividend and capital gains taxes are kept constant at their benchmark levels (τ_d=τ_g=0.20).

[2] The table rows display (i) the values for the tax rates on corporate income τ_c and labor income τ_l , and (ii) the percentage change in output Y, capital stock K, consumption C, total factor productivity TFP, stock price P, dividends D, equity issued S, wage rate w, after tax wage rate (1-τ_l)w and stock return r.

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

Table 5B. Long Run Effects of Reform B (τ_c vs. τ_d) [1,2]

τ_c	0	0.04	0.09	0.14	0.19	0.24	0.29	**0.34**
τ_d	0.542	0.512	0.473	0.431	0.385	0.331	0.268	**0.200**
Aggregates (% change)								
Y	8.8	7.8	6.5	5.1	3.7	2.3	1.0	-
K	33.4	30.0	25.5	20.9	16.0	10.7	5.2	-
C	4.7	4.2	3.6	2.9	2.1	1.3	0.6	-
TFP	-0.6	-0.7	-0.8	-0.9	-1.0	-0.9	-0.6	-
P	-7.8	-6.5	-5.0	-3.8	-2.5	-1.5	-0.5	-
D	7.6	5.0	1.6	-1.7	-4.8	-6.8	-5.9	-
S	-98.4	-98.1	-97.4	-95.8	-91.8	-81.6	-55.3	-
w	8.8	7.8	6.5	5.1	3.7	2.3	1.0	-
$w(1-\tau_l)$	8.8	7.8	6.5	5.1	3.7	2.3	1.0	-
r	-14.0	-12.1	-9.6	-7.3	-5.2	-3.1	-1.3	-
Welfare (%) [3]	0.10	0.18	0.21	0.18	0.10	0.02	0.00	-

[1] In this reform, labor and capital gains taxes are kept constant at their benchmark levels (τ_l=0.28 and τ_g=0.20).

[2] The table rows display (i) the values for the tax rates on corporate income τ_c and dividend income τ_d , and (ii) the percentage change in output Y, capital stock K, consumption C, total factor productivity TFP, stock price P, dividends distributed D, equity issued S, wage rate w, after tax wage rate $(1-\tau_l)$w and stock return r.

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

Table 5C. Long Run Effects of Reform C (τ_c vs. τ_d=τ_g) [1,2]

τ_c	0	0.04	0.09	0.14	0.19	0.24	0.29	**0.34**
τ_d=τ_g	0.547	0.518	0.478	0.434	0.385	0.330	0.269	**0.200**
Aggregates (% change)								
Y	1.8	1.6	1.5	1.3	1.1	0.8	0.4	-
K	-4.2	-3.6	-2.7	-1.9	-1.2	-0.7	-0.3	-
C	0.4	0.5	0.6	0.6	0.6	0.5	0.3	-
TFP	3.1	2.8	2.4	1.9	1.5	1.0	0.5	-
P	-3.5	-3.0	-2.2	-1.5	-0.9	-0.4	-0.2	-
D	49.6	43.7	36.3	29.0	21.7	14.5	7.2	-
S	6.1	6.4	6.5	6.2	5.5	4.2	2.4	-
w	1.8	1.6	1.5	1.3	1.1	0.8	0.4	-
w(1-τ_l)	1.8	1.6	1.5	1.3	1.1	0.8	0.4	-
r	-4.5	-3.8	-3.0	-2.3	-1.7	-1.1	-0.5	-
Welfare (%) [3]	1.09	1.05	0.98	0.87	0.73	0.54	0.30	-

[1] In this reform, labor income tax is kept constant at its benchmark level (τ_l=0.28).

[2] The table rows display (i) the values for the tax rates on corporate income τ_c , dividend income τ_d and capital gains τ_g , and (ii) the percent change in output Y, capital stock K, consumption C, total factor productivity TFP, stock price P, dividends distributed D, equity issued S, wage rate w, after tax wage rate (1-τ_l)w and stock return r.

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

Table 6. Long Run distribution of Capital Across Productivity Levels z

(A) Reform A - (τ_c vs. τ_l)

Productivity (z)	z1	z2	z3	z4	z5	z6	z7	z8	z9	z10
E(k|z) [1]										
$\tau_c = 0.34$	0.274	0.345	0.432	0.547	0.702	0.921	1.246	1.753	2.593	4.017
$\tau_c = 0.00$	0.232	0.309	0.410	0.549	0.748	1.046	1.513	2.283	3.632	6.030
Change (%)	-15.4	-10.4	-5.1	0.5	6.7	13.6	21.4	30.3	40.1	50.1
Std(k|z) / E(k|z) [2]										
$\tau_c = 0.34$	1.239	1.294	1.343	1.392	1.440	1.486	1.525	1.546	1.530	1.433
$\tau_c = 0.00$	1.557	1.637	1.707	1.773	1.834	1.887	1.922	1.924	1.866	1.702
Change (%)	25.6	26.5	27.1	27.4	27.4	27.0	26.0	24.4	22.0	18.8

(B) Reform B - (τ_c vs. τ_d)

Productivity (z)	z1	z2	z3	z4	z5	z6	z7	z8	z9	z10
E(k|z) [1]										
$\tau_c = 0.34$	0.274	0.345	0.432	0.547	0.702	0.921	1.246	1.753	2.593	4.017
$\tau_c = 0.00$	0.408	0.491	0.598	0.739	0.934	1.217	1.646	2.336	3.526	5.634
Change (%)	48.7	42.6	38.2	35.1	33.1	32.1	32.1	33.2	36.0	40.2
Std(k|z) / E(k|z) [2]										
$\tau_c = 0.34$	1.239	1.294	1.343	1.392	1.440	1.486	1.525	1.546	1.530	1.433
$\tau_c = 0.00$	1.133	1.287	1.436	1.586	1.737	1.884	2.018	2.118	2.145	2.032
Change (%)	-8.6	-0.5	6.9	14.0	20.6	26.8	32.4	37.0	40.2	41.8

(C) Reform C - (τ_c vs. $\tau_d = \tau_g$)

Productivity (z)	z1	z2	z3	z4	z5	z6	z7	z8	z9	z10
E(k|z) [1]										
$\tau_c = 0.34$	0.274	0.345	0.432	0.547	0.702	0.921	1.246	1.753	2.593	4.017
$\tau_c = 0.00$	0.166	0.227	0.309	0.424	0.593	0.851	1.264	1.962	3.210	5.468
Change (%)	-39.5	-34.2	-28.6	-22.4	-15.5	-7.6	1.5	11.9	23.8	36.1
Std(k|z) / E(k|z) [2]										
$\tau_c = 0.34$	1.239	1.294	1.343	1.392	1.440	1.486	1.525	1.546	1.530	1.433
$\tau_c = 0.00$	1.818	1.905	1.977	2.043	2.102	2.148	2.171	2.152	2.064	1.862
Change (%)	46.7	47.2	47.2	46.8	46.0	44.6	42.4	39.2	34.9	29.9

[1] Mean capital conditional on productivity z

[2] Standard deviation of capital divided by the mean conditional on productivity level z

Table 7A. Political Support for Reform A (τ_c vs. τ_l) [1]

τ_c	0	0.04	0.14	0.24	0.29	**0.34**	0.39	0.44	0.49
τ_l	0.347	0.339	0.319	0.299	0.290	**0.280**	0.270	0.261	0.251
Fraction in Favor (%)	20.7	20.9	21.4	21.9	22.8	-	77.2	76.7	76.0

[1] In this reform, dividend and capital gains taxes are kept constant at their benchmark levels (τ_d=0.20 and τ_g=0.20).

Table 7B. Political Support for Reform B (τ_c vs. τ_d) [2]

τ_c	0	0.04	0.09	0.14	0.19	0.24	0.29	**0.34**
τ_d	0.542	0.512	0.473	0.431	0.385	0.331	0.268	**0.200**
Fraction in Favor (%)	77.8	77.8	77.8	77.7	77.4	76.9	76.7	-

[2] In this reform, labor income and capital gains taxes are kept constant at their benchmark levels (τ_l=0.28 and τ_g=0.20).

Table 7C. Political Support for Reform C (τ_c vs. τ_d=τ_g) [3]

τ_c	0	0.04	0.09	0.14	0.19	0.24	0.29	**0.34**
τ_d=τ_g	0.547	0.518	0.478	0.434	0.385	0.330	0.269	**0.200**
Fraction in Favor (%)	85.9	86.8	88.1	89.7	91.6	93.7	95.7	-

[3] In this reform, the labor income tax is kept constant at its benchmark level (τ_l=0.28).

Table 8. Long Run Distribution of Capital Across Finance Regimes in Reform B (τ_c vs. τ_d) [1]

τ_c	Equity Issuance Regime	Liquidity Constrained Regime	Dividend Distribution Regime	τ_d
0.00	0.003	0.384	0.613	0.542
0.04	0.004	0.375	0.621	0.512
0.09	0.006	0.361	0.633	0.473
0.14	0.009	0.348	0.643	0.431
0.19	0.017	0.323	0.660	0.385
0.24	0.037	0.279	0.684	0.331
0.29	0.089	0.183	0.727	0.268
0.34	0.206	0.000	0.794	0.200

[1] Each row represents a different long run distribution arising due to different corporate taxes (first column, labelled τ_c) and dividend taxes (last column, labelled τ_d). For each of these cases, the middle three columns show the fraction of the aggregate capital stock held by firms in the Equity Issuance, Liquidity Constrained and Dividend Distribution regimes respectively.

Figure 1. Firm Size Distribution (pdf)

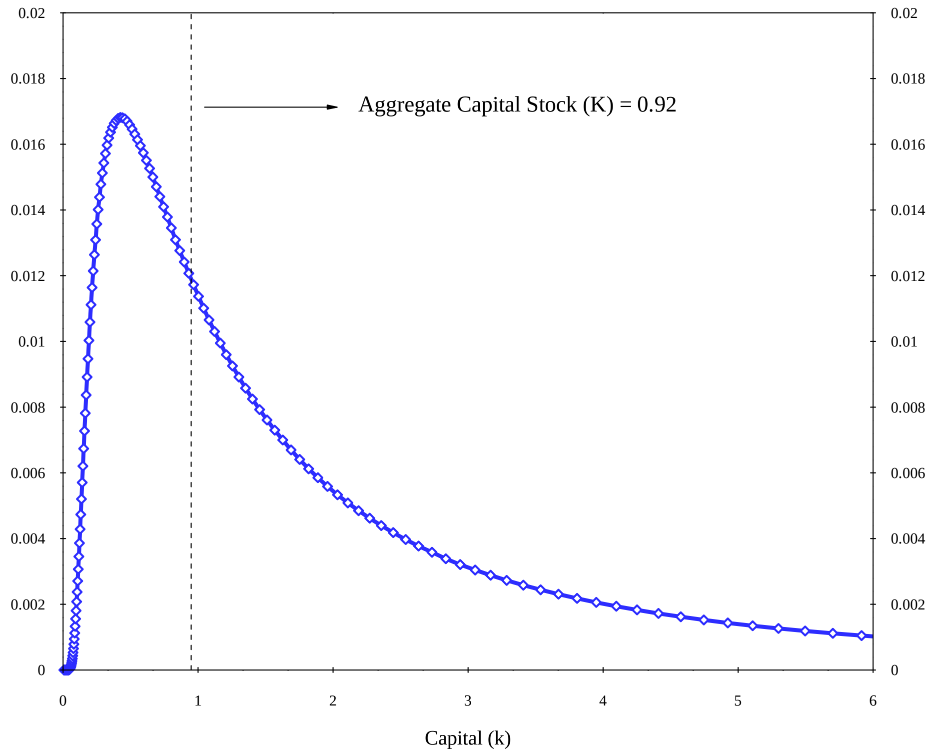
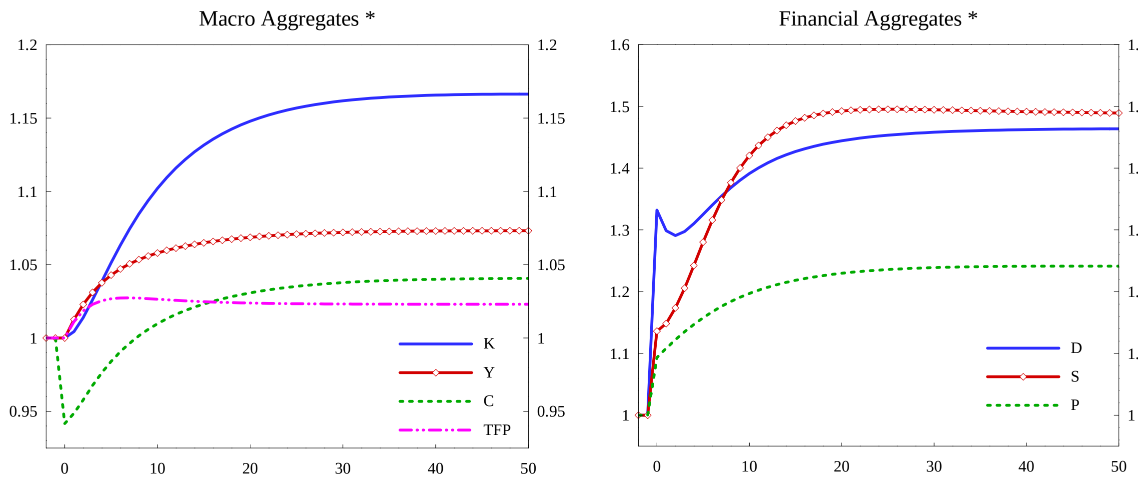
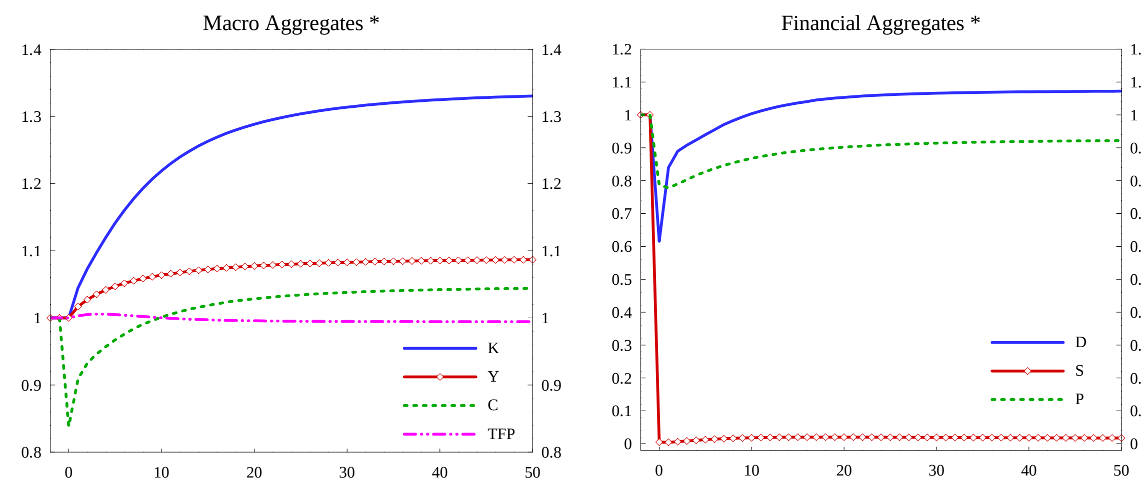


Figure 2: Transition Paths when Corporate Income Taxes are Eliminated

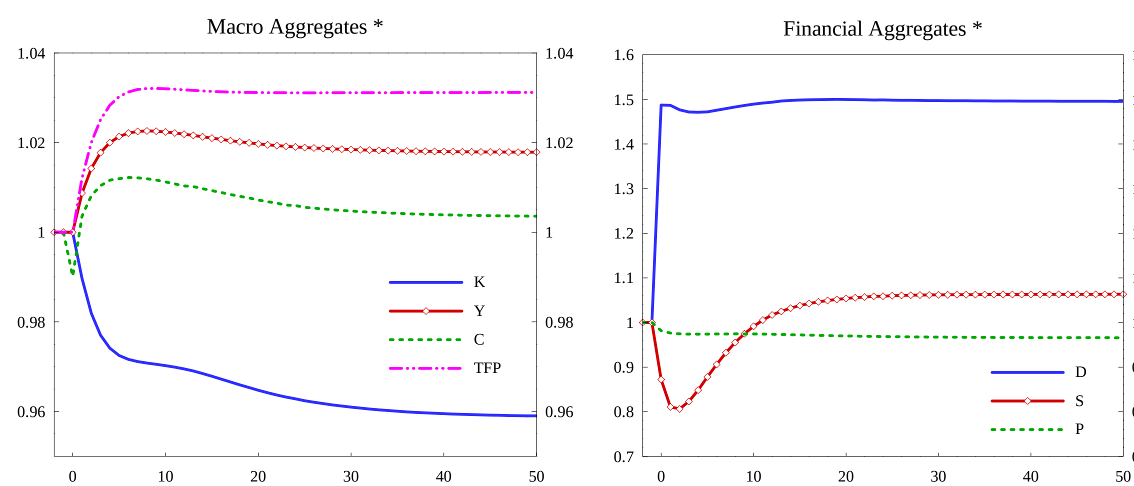
(A) Transition Paths - Reform A (τ_c vs. τ_l)



(B) Transition Paths - Reform B (τ_c vs. τ_d)



(C) Transition Paths - Reform C (τ_c vs. $\tau_d = \tau_g$)



* value relative to the pre-reform level

Figure 3. Welfare Effects of Reception A (τ_c vs. τ_l)

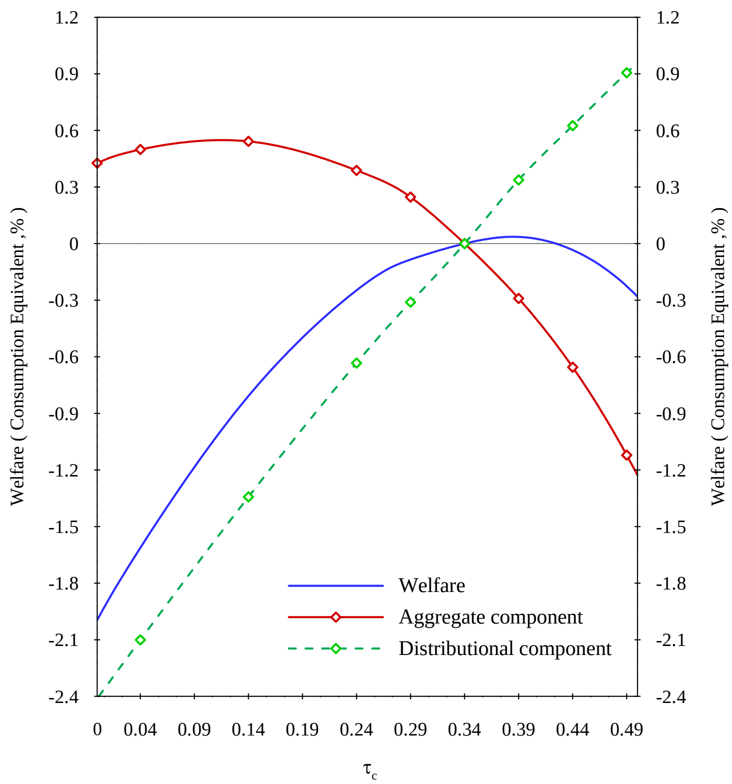


Figure 4: Individual Welfare Gains from Eliminating Corporate Taxes in Reform A (τ_c vs. τ_l)

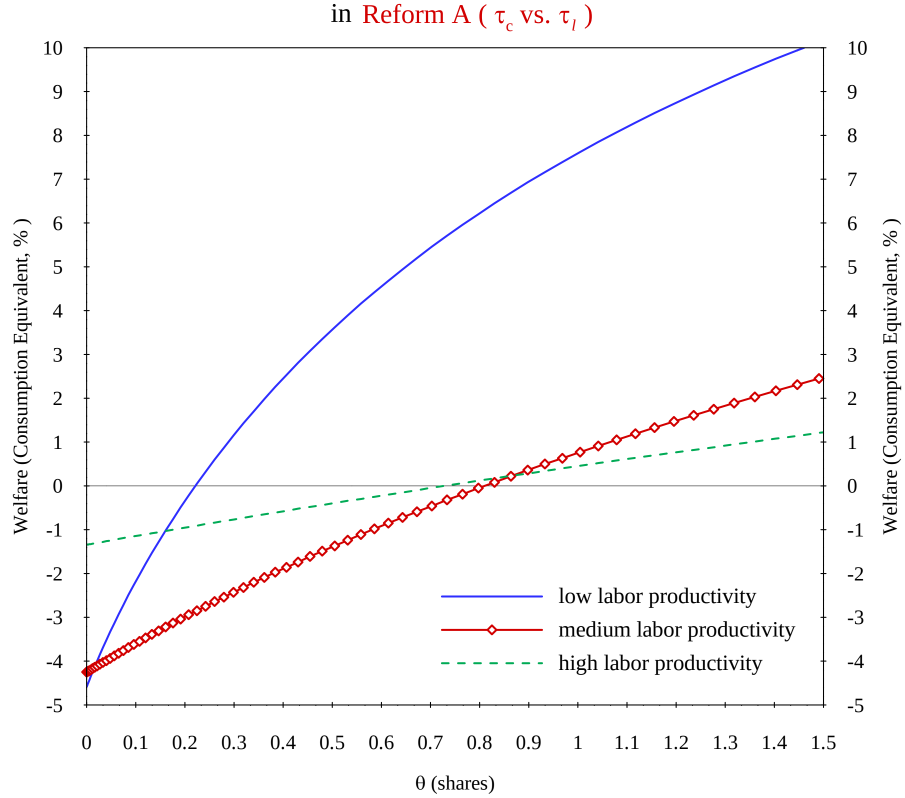


Figure 5. Welfare Effects of Reform B (τ_c vs. τ_d)

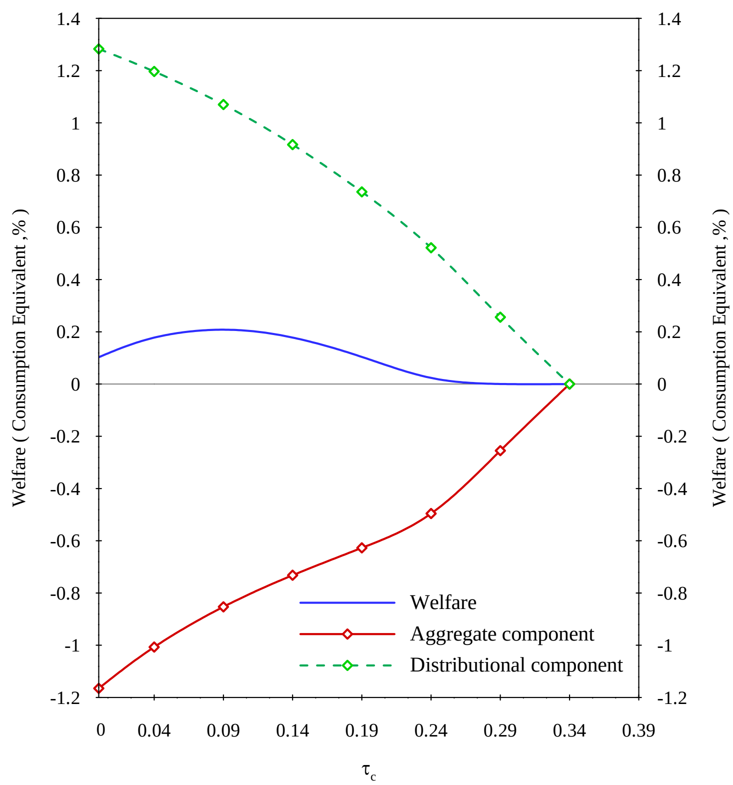


Figure 6: Individual Welfare Gains from Eliminating Corporate Taxes
in Reform B (τ_c vs. τ_d)

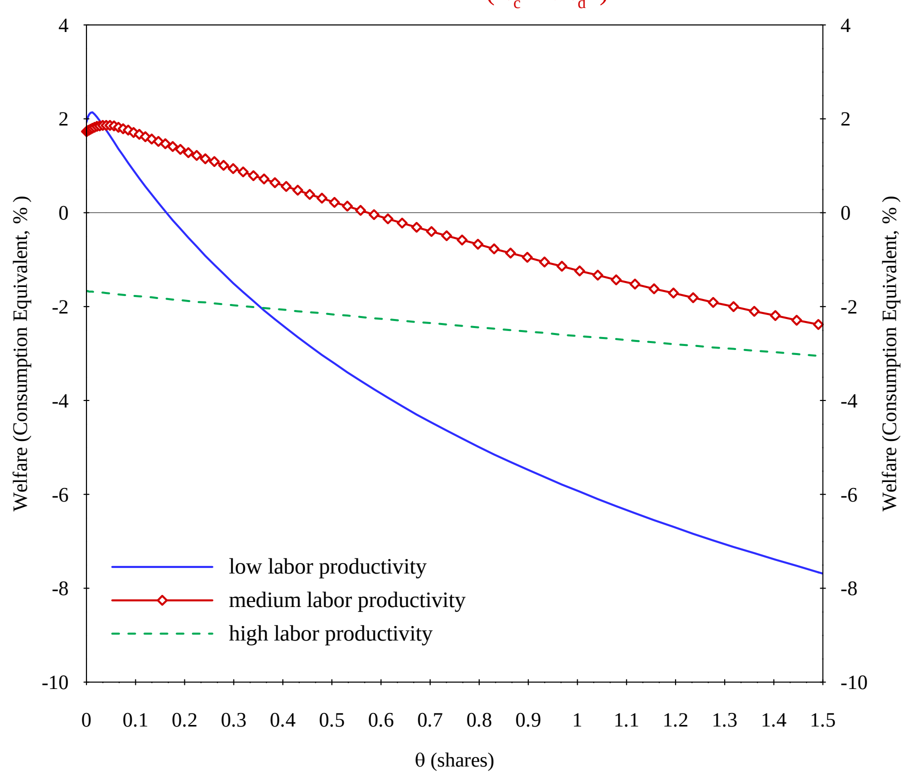


Figure 7. Welfare Effects of Reform C (τ_c vs. τ_d=τ_g)

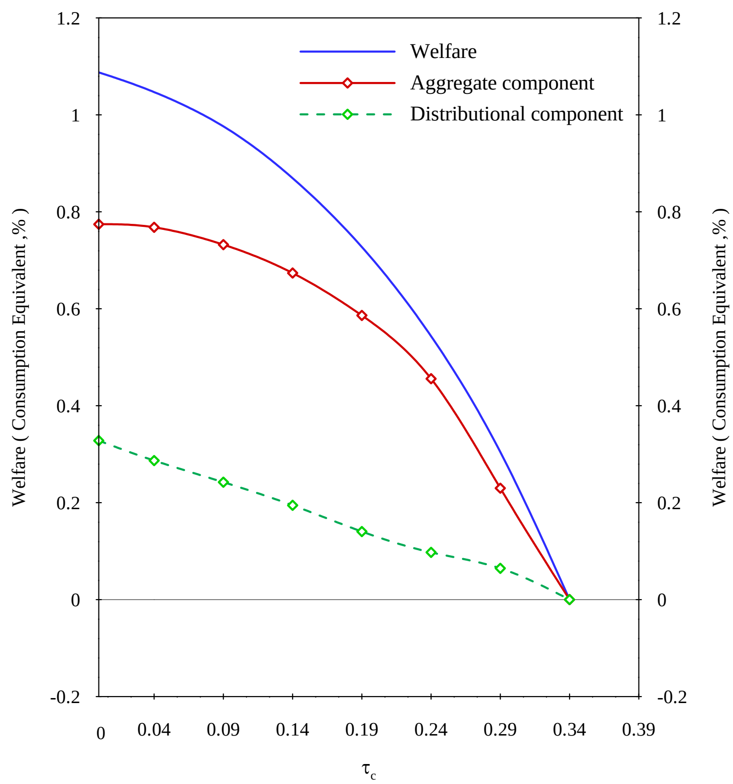


Figure 8: Individual Welfare Gains from Eliminating Corporate Taxes in Reform C (τ_c vs. τ_d=τ_g)