Dividend and Capital Gains Taxation under Incomplete Markets

Alexis Anagnostopoulos[a], Eva Cárceles-Poveda[b], Danmo Lin[c] *

[a] Stony Brook University; [b] Stony Brook University; [c] University of Maryland

Received Date; Received in Revised Form Date; Accepted Date

Abstract

Motivated by the Jobs and Growth Tax Relief Reconciliation Act (JGTRRA) of 2003, we study the effects of capital income tax cuts in an economy with heterogeneous households and a representative, mature firm. Dividend tax cuts, contrary to capital gains tax cuts, lead to a decrease in investment and capital. This is because they increase the market value of existing capital and households require a higher return to hold this additional wealth. In line with empirical evidence, the model predicts substantial increases in dividends and stock prices. Overall, the tax cuts lead to a welfare reduction equivalent to a consumption drop of 0.5% .

Keywords: Incomplete Markets, Tax Reform, Dividend Taxes, Capital Gains Taxes

JEL classification: E23, E44, D52

*We wish to thank Erem Atesagaoglu, Andy Atkeson, Marjorie Flavin, Vincenzo Quadrini and Neil Wallace as well as seminar participants at Florida State, Maryland, Penn State, Stony Brook, USC Marshall and UC San Diego and conference participants at the MMM, CEA, CEF and EEA for helpful comments and suggestions.

1. Introduction

In 2003, the Bush Administration introduced the Jobs and Growth Tax Relief Reconciliation Act (JGTRRA) which, amongst other reforms, lowered dividend and capital gains taxes. This act had a sunset provision that stipulated its expiry by the end of 2010, but it was recently extended for two more years by the current administration. Whether it should be made permanent or not remains an important subject of political debate. This paper contributes to the current debate by analyzing the quantitative effects of these capital income tax changes in a dynamic stochastic general equilibrium model calibrated to US data.

Reforms like the JGTRRA which aim to reduce capital income taxation traditionally draw both enthusiastic support by some as well as vehement opposition by others. This reform has been no different. Those who argue in favor of lower capital income taxes focus on the effects of such taxes on investment incentives and, consequently, on job creation whereas those opposed to lowering capital income taxes point to the potential negative effects of such a reform on the government's budget and on levels of inequality. Crucially, the non-academic debate often makes no distinction between the different types of capital income taxes and treats all of them as though they have similar effects. On the contrary, the academic community has long recognized the difference between taxing returns to investment (e.g. corporate profits, capital gains) and taxing distributions in the form of dividends. This paper's main contribution lies in re-examining the differential effects of dividend and capital gains taxes in an incomplete markets environment. The aim is to contribute to our understanding of these taxes theoretically and to provide a quantitative analysis of the size of the costs and benefits associated with the JGTRRA.

To that end, we build a general equilibrium model in which households face uninsurable idiosyncratic labor income risk. In addition to risky labor income, households receive capital income from owning shares in a representative mature firm. Both labor and capital income are taxed by the government. An important assumption is that the government taxes div-

idends and capital gains at potentially different rates. The firm in our model undertakes investment with a view to maximizing shareholder value. We calibrate our model to US data and compute both long run steady states and transitions.

Our results regarding steady states are as follows. A reduction in dividend tax rates has the surprising effect of reducing aggregate investment and the capital stock. To understand the reason, first note that the dividend tax cut does not directly affect the cost of capital. Its only effect is to raise the market valuation of the existing capital stock and hence aggregate wealth. If markets were complete, there would be no other effects and we would obtain the well-known neutrality of dividend taxation.[1] However, changes in wealth do matter for household decisions because markets are incomplete. Specifically, households demand a higher return in order to hold the additional wealth. In equilibrium, the firm responds by reducing the capital stock and this increases the marginal product of capital and, thus, the rate of return. Contrary to the dividend tax, a capital gains tax cut directly affects the cost of capital and therefore acts as a standard capital income tax, effectively reducing the after tax rate of return and increasing the capital stock and investment. At the same time, a fall in the capital gains tax reduces the market valuation of the existing capital stock and, for the reasons explained above, this effect also leads to an increase in the capital stock. When dividend and capital gains taxes are reduced simultaneously to the levels of the JGTRRA reform, the dividend tax cut effects dominate, largely due to the higher reduction in the dividend tax that was stipulated by the reform. As a result, the JGTRRA reform reduces investment and the capital stock in the long run. At the same time dividends, stock prices and returns increase substantially, which is consistent with the experience of the US economy following the reform.[2]

[1] The assumption of a representative, mature firm is crucial for this statement to be true. We discuss the implications of this assumption in the following section.

[2] Evidence that a decrease in dividend taxes raises dividend payments can be found in Chetty and Saez (2005) and Poterba (2004). Blouin, Raedy and Shackelford (2004) also find an increase in payout but provide some qualifications for the result. The effect of dividend taxes on investment is difficult to establish, as discussed by Chetty and Saez (2005).

To evaluate the welfare consequences of the reform, it is important to complement these long run results with the short run effects of the tax reform. Following an unexpected, permanent tax change, aggregate consumption initially increases as the economy starts dissaving, but eventually falls below the pre-reform level as production is reduced due to lower investment. Based on a utilitarian welfare criterion, we find an average welfare reduction of approximately 0.5% (in consumption equivalent terms). This arises from significant long run welfare costs mitigated by short run welfare gains due to the temporary increase in aggregate consumption.

Using the methodology proposed by Domeij and Heathcote (2004), we also provide a decomposition of welfare effects into "aggregate" and "distributional" components. The aggregate component refers to the welfare effect arising from a change in aggregate consumption for a given distribution of consumption across households. The distributional component captures the effect of changes in the distribution of consumption. The decomposition reveals a positive aggregate effect arising from the immediate consumption hike, but a larger negative distributional effect. The latter is due to the fact that the reform benefits households in the upper tail of the wealth distribution and hurts those in the lower tail. To be precise, individuals at the low end of labor productivity and those holding zero or very few stocks stand to lose from the reform, whereas those holding a lot of stocks stand to gain. The marginal utility of the former is higher (and there are more of them) so the utilitarian welfare function is negatively affected. Overall, only 20% of the population experiences a welfare improvement, which indicates limited political support.

The rest of the paper is organized as follows. Section 2 points out related articles, discusses some interesting implications of our result and addresses potential caveats. Section 3 presents the model. Section 4 discusses the theoretical effects of the tax cuts and provides intuition for the results. In Section 5, we calibrate the model to US data and provide a quantitative evaluation of the welfare implications of the Bush tax reforms both in the long

run and along the transition. Section 7 summarizes and concludes.

2. Related Literature and Discussion

From a theoretical perspective, this paper can be seen as bridging the gap between two strands of literature. The first strand includes articles that analyze tax reform and optimal taxation in the presence of household heterogeneity and uninsurable risk. This is done in an infinite horizon framework by Aiyagari (1995), Domeij and Heathcote (2004) and Ábrahám and Cárceles-Poveda (2010) among others, and in a setting with overlapping generations by Imrohoroglu (1998), Conesa and Krueger (2006) and Conesa, Kitao and Krueger (2009). Our paper is most closely related to the former, in the sense that we use an infinite horizon setting. A purely cosmetic difference lies in our choice of modelling firms as the owners of the capital stock, which we view as the most natural setup in which to think of dividend and capital gains taxes.[3] The crucial difference is that we explicitly model dividend and capital gains taxes as opposed to assuming a general income tax on the return to capital.

The second strand of the literature is the one focusing on the effects of dividend taxes on capital accumulation and the stock market in a framework with no heterogeneity. McGrattan and Prescott (2005), Gourio and Miao (2008), Atesagaoglu (2012), Santoro and Wei (2011) and Conesa and Dominguez (2010) show that, in such a setting, a constant flat tax rate on dividends only affects stock prices, leaving investment and dividends unaffected. We add household heterogeneity and find that dividend taxes affect all equilibrium quantities.

Our paper also contributes to the long standing debate in the public finance literature about the effects of dividend taxes on the cost of capital and investment. The debate is centered around two views, the 'traditional' view and the 'new' view. According to the new view, a reduction in dividend taxes has no effects other than increasing the stock price, just

[3] An equivalent formulation assuming static firms that rent capital from consumers is available upon request. See also Cárceles-Poveda and Coen Pirani (2010) for a general equivalence result between the two settings with incomplete markets but no taxes.

like in the articles mentioned above. In contrast, the traditional view is that a dividend tax cut should raise dividend payments and increase investment. The work of Poterba and Summers (1983), Auerbach and Hassett (2003) and, more recently, of Gourio and Miao (2011) has shed light on the implicit assumptions underlying each view, highlighting the importance of the marginal sources and uses of funds. In the absence of household heterogeneity, if the sources and uses of funds are the same, then capital formation is unaffected by dividend taxes and the firm conforms to the 'new' view. However, if the sources and uses of funds are asymmetric, then dividend taxes reduce capital formation through an increase in the cost of capital. In our model, firms do not use equity issuance to finance investment. Instead, the marginal source of financing is retained earnings (i.e. a reduction in dividends) and the resulting profits are distributed as dividends in the future. Thus, in the above taxonomy, our firm conforms to the new view, since the sources and uses of funds are symmetric.

An important implication of our model is that the intimate connection between sources and uses of funds and the two views is broken when we introduce household heterogeneity. Even though our assumption of a single, mature firm means that the sources and uses of funds are the same, the dividend tax has real effects on investment and dividends. This should raise concerns about empirical tests of the new versus the traditional view based on theoretical implications of representative agent models. Empirical evidence of an increase in dividend payments in response to a decrease in dividend taxes is often seen as evidence in favor of the traditional view and, specifically, of the idea that the marginal source of funds is equity issuance. This observation seems to contradict the empirical fact that the majority of investment is carried out by mature firms who use internal funds to finance their investment.[4] Our model provides a reconciliation of these two pieces of evidence, since it

[4]Using Compustat data, Gourio and Miao (2010) find that firms which distribute dividends and use retained earnings to finance investment undertake more than 90% of investment and hold more than 90% of the capital stock. In earlier work using the Survey of Current Business and Federal Reserve Bulletins, Sinn (1991) concludes that "*...most corporate equity capital is generated by internal investment rather than new share issues*".

predicts that dividends can respond strongly and positively to a decrease in dividend taxes even when investment is financed exclusively using internal funds.[5]

The article most closely related to ours is by Gourio and Miao (2010). The authors investigate the effects of the JGTRRA in a general equilibrium model with firm heterogeneity instead of household heterogeneity.[6] In contrast to our results, they find that the reform could lead to an increase in investment through several channels. First, the decrease in capital gains taxes reduces the cost of capital for all firms, making it easier to invest. This mechanism is also present in our model, albeit dominated by the wealth effect of the dividend tax cut. Second, their model features firms that can be in one of three finance regimes: liquidity constrained, equity issuing or dividend paying. Equity issuing firms are the ones that are most productive and hence carry out the majority of investment (contrary to the data). Since the JGTRRA reform has the effect of moving firms from the liquidity constrained stage to the equity issuing stage, it increases aggregate investment through reallocation. Additionally, because the sources and uses of funds are asymmetric for equity issuing firms, the dividend tax cut directly reduces the cost of capital for those firms and this also raises investment. Their result and ours, when taken together, point to the presence of opposing theoretical mechanisms through which the JGTRRA tax cuts should affect investment, which might explain the muted actual response of investment documented in Desai and Goolsbee (2004).

Both the preceding discussion of the literature and our model assume that the tax reform is unexpected and perceived as permanent. These two assumptions are not innocuous. If individuals face a non-constant dividend tax rate profile, as would be the case if the reform was temporary or expected, then the dividend tax will affect investment even in the absence of heterogeneity.[7] There are good reasons to believe that the reform was unexpected. It was not part of Bush's 2001 election platform, it was first suggested in January 2003 and

[5] A similar result is obtained by Chetty and Saez (2010) in an agency model of the firm.

[6] Korinek and Stiglitz (2009) do this in a partial equilibrium framework.

[7] A non-constant dividend tax profile is introduced by Korinek and Stiglitz (2009), McGrattan (2010), Gourio and Miao (2011) and, indirectly, Santoro and Wei (2010).

seemed to lose momentum several times in the following months until it was signed into law in May 2003. Thus, the window of opportunity for anticipation effects to matter was short. This is confirmed in Chetty and Saez (2005), who provide empirical evidence supporting the idea that the tax cuts were unexpected. Whether the reform was perceived as temporary or permanent is more controversial. While the JGTRRA included a sunset provision, it was clear at the time that this was not introduced because the tax reform was intended to be temporary, but rather as a means of circumventing the Byrd rule and avoiding having the act blocked in the Senate. Auerbach and Hassett's (2005) work also seems to support the idea that markets perceived this tax change as fairly permanent. To the extent that markets perceived the reform as temporary, both Korinek and Stiglitz (2009) and Gourio and Miao (2011) have shown that the dividend tax cut would tend to increase dividend payments and decrease investment. Thus, our results would only be reinforced in that case.

3. The Model

We consider an infinite horizon economy with endogenous production and uninsurable labor income risk. The economy is populated by a continuum (measure 1) of infinitely lived households that are indexed by i, a representative firm that maximizes its market value and a government that maintains a balanced budget. Time is discrete and indexed by $t = 0, 1, 2, ...$

3.1. Households

Households have identical additively separable preferences over sequences of consumption $c_i \equiv \{c_{it}\}_{t=0}^{\infty}$ of the form:

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

where $\beta \in (0, 1)$ is the subjective discount factor and E_0 denotes the expectation conditional on information at date $t = 0$. The period utility function $u\left(\cdot\right) : \mathbb{R}_+ \to \mathbb{R}$ is assumed to be

strictly increasing, strictly concave and continuously differentiable, with $\lim_{c\to 0} u'(c) = \infty$ and $\lim_{c\to\infty} u'(c) = 0$.

Each period, households can only trade in stocks of the firm to insure against uncertainty. We denote by s_{it-1} the number of stocks held at the beginning of period t. Stocks can be traded between households at a competitive price p_t and the ownership of stocks entitles the shareholder to a dividend per share of d_t. We assume that there is no aggregate uncertainty, implying that dividends, the stock price and hence the return on the stock are certain.

In addition to asset income, household i earns labor income. We assume that all households supply a fixed amount of labor (normalized to one) but their productivity, ϵ_{it}, varies stochastically. This productivity is i.i.d. across households and follows a Markov process with transition matrix $\Pi(\epsilon'|\epsilon)$. Individual labor income is thus equal to $w_t\epsilon_{it}$, where w_t is the aggregate wage rate.

The government levies proportional taxes on labor income, dividend income and capital gains income at rates of τ_{lt}, τ_d and τ_g respectively.[8] Households can use their after-tax income from all sources to purchase consumption goods or to purchase additional stocks. The households' budget constraint can be expressed as:

$$c_{it} + p_t s_{it} = (1-\tau_{lt})w_t\epsilon_{it} + \left((1-\tau_d)d_t + p_t\right) s_{it-1} - \tau_g \left(p_t - p_{t-1}\right) s_{it-1}. \tag{2}$$

Note that we have simplified by assuming capital gains taxes are paid on an accrual basis and that capital losses are subsidized at the same rate.[9] At each date, household i also faces a no short-selling constraint on stocks:

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

The presence of this constraint will allow us to have a well-defined firm objective on which all the shareholders agree, despite the market incompleteness. Individuals choose how

[8] After a permanent change in capital income taxes, labor taxes will vary over time to balance the government budget until a new steady state is reached. We therefore index them by t throughout the paper.

[9] For a way to model capital gains taxes on a realization basis see Gavin, Kydland and Pakko (2007).

much to consume and how many stocks to buy in each period given prices, dividends and tax rates $\{p_t, w_t, d_t, \tau_d, \tau_{lt}, \tau_g\}_{t=0}^{\infty}$.

Before proceeding with the description of the firm, we derive the relationship between stock prices and future dividends, which we call the price dividend mapping. We will use this mapping in the following subsection to define the value of the firm and to derive the relationship between physical capital and the stock price.

The optimal choice of stocks by an unconstrained household i with $s_{it} > 0$ requires the following optimality condition to hold:

$$p_t u_{c,it} = \beta E_t u_{c,it+1} \left[(1 - \tau_d) d_{t+1} + p_{t+1} - \tau_g (p_{t+1} - p_t) \right] \tag{4}$$

where $u_{c,it}$ denotes the marginal utility of the agent. As usual, the expected intertemporal marginal rates of substitution for all unconstrained households are equalized and they are equal to the reciprocal of the gross return from the stock between t and $t+1$

$$1 + r_{t+1} \equiv \frac{\left[(1 - \tau_d) d_{t+1} + p_{t+1} - \tau_g (p_{t+1} - p_t) \right]}{p_t} = \frac{u_{c,it}}{\beta E_t u_{c,it+1}} \tag{5}$$

Using this relationship, the absence of aggregate uncertainty and assuming that there are no-bubbles, the stock price can then be written as a function of dividends as follows[10]

$$p_t = \sum_{j=1}^{\infty} \left(\prod_{i=0}^{j-1} \frac{1}{1 + \frac{r_{t+1+i}}{1-\tau_g}} \right) \frac{1 - \tau_d}{1 - \tau_g} d_{t+j} \tag{6}$$

3.2. The Firm

The representative firm owns the capital stock K_t, hires labor and combines these two inputs to produce consumption goods using a constant returns to scale technology:

$$Y_t = AF(K_t, L_t)$$

[10] Detailed derivations of the expressions in this section, as well as a precise equilibrium definition and the computational method used are available in a supplementary online appendix.

where K and L are the aggregate capital and effective labor, while A is the total factor productivity, which is assumed to be constant. The total number of stocks outstanding is normalized to one and we assume that the firm has no access to additional sources of external finance, namely, it cannot issue new equity or debt. Thus the total wage bill and investment as well as the distributions of dividends to shareholders have to be financed solely using internal funds.[11] The firm's financing constraint is therefore:

$$d_t + K_{t+1} - (1-\delta) K_t + w_t L_t = AF(K_t, L_t) \tag{7}$$

where $\delta \in [0,1]$ is the capital depreciation rate.

The firm's objective is to maximize its market value for the shareholders. In general, when markets are incomplete, maximizing the value of the firm is not an objective to which all shareholders would agree. However, Cárceles-Poveda and Coen-Pirani (2009) show that, even under incomplete markets, shareholder unanimity can be obtained if the technology exhibits constant returns to scale and short-selling is not allowed. We maintain these two assumptions throughout the paper. Using the price-dividend mapping (6), the value of the firm at t can be written as:

$$V_t = \frac{1-\tau_d}{1-\tau_g} d_t + p_t = \sum_{j=0}^{\infty} \left(\prod_{i=0}^{j-1} \frac{1}{1+\frac{r_{t+1+i}}{1-\tau_g}} \right) \frac{1-\tau_d}{1-\tau_g} d_{t+j}$$

Maximizing this objective subject to (7) leads to the aggregate labor demand equation:

$$w_t = AF_L(K_t, L_t) \tag{8}$$

Optimal investment dynamics are described by the capital Euler equation:

$$1 = \frac{1}{1+\frac{r_{t+1}}{1-\tau_g}} \left(1 - \delta + AF_K(K_{t+1}, L_{t+1})\right) \tag{9}$$

[11] We do not allow firms to use repurchases as a means of distributing profits. See Gordon and Dietz (2006) for a discussion of alternative ways to ensure firms pay dividends.

This last expression together with (6) implies the following relation between aggregate capital and the stock price:

$$p_t = \frac{1-\tau_d}{1-\tau_g} K_{t+1} \tag{10}$$

Differences between dividend and capital gains tax rates create a wedge between the physical capital stock and its market valuation. Crucially for the results that will follow, changes in the ratio $\frac{1-\tau_d}{1-\tau_g}$ will cause movements in the total wealth held by households, even keeping the capital stock constant.

3.3. Government

In each period t, the government consumes an exogenous, constant amount G and taxes labor, dividend and capital gains income at rates τ_{lt}, τ_d and τ_g respectively. We assume that the government maintains a balanced budget. The government budget constraint is given by

$$G = \tau_d d_t + \tau_{lt} w_t L_t + \tau_g (p_t - p_{t-1}) \tag{11}$$

4. Qualitative Analysis

A key result of this paper is that, in the presence of uninsured idiosyncratic risk, a reduction in dividend taxes reduces the capital stock. This section explains why this has to be the case theoretically, while the following section evaluates the quantitative importance of this effect in the context of the 2003 tax reform both in the long run and throughout the transition. Our discussion in this section focuses on steady states.

To understand the effects of taxes on distributions on the capital stock, the three key equations are the stock Euler equation (5), the capital Euler equation (9) and the price-capital relationship (10). This is directly analogous to a standard Aiyagari economy. In fact,

using a simple change of variable will make this analogy clear and help with the intuition. Let a_{it+1} denote the (value of) assets acquired by individual i at time t

$$a_{it+1} \equiv p_t s_{it} \tag{12}$$

Using the definition of the after tax return r_t given in (5), the budget constraint (2) can be written as:

$$c_{it} + a_{it+1} = (1 - \tau_l) w_t \epsilon_{it} + (1 + r_t)\, a_{it}. \tag{13}$$

This makes it clear that what matters for household consumption and savings decisions is the after tax return r_t as opposed to p_t and d_t separately. Equation (5) represents an individual's demand for assets. Aggregating across i we obtain the aggregate demand for assets Ea_{t+1} as a function of the after tax return r. When markets are incomplete, this aggregate demand for assets is increasing in r and tends to infinity as the return approaches the time preference rate $\frac{1}{\beta} - 1$ because of the precautionary savings motive. We call this curve equity demand and denote it by A_h.[12]

Equations (9) and (10) will be used to provide the equity supply curve. The first one describes the firm's desired capital stock K as a function of r. The second one describes the relationship between assets inside the firm (the capital stock) and assets outside the firm (the market value of stocks). This last relationship states that one unit of capital inside the firm is valued at $q \equiv \frac{1-\tau_d}{1-\tau_g}$ by investors. The aggregate supply of assets is equal to the market value of all stocks, $p = qK$. This is given as a function of r by combining (9) and (10). We call this curve equity supply and denote it by A_f.

In equilibrium, aggregate asset demand has to equal the stock value, $Ea_{t+1} = qK$. If there are no taxes on capital gains and dividends, or if these two taxes are the same, then $q = 1$. This implies that the value of capital inside the firm is equal to the value of the firm's equity. In that case, our model is equivalent to a standard incomplete markets economy

[12] This is what Aiyagari calls the capital supply curve. There is no guarantee that this curve is smooth in general, but this turns out to be the case in our numerical experiments.

like the one in Aiyagari (1994). The equilibrium can then be represented as in the left panel of Figure 1. If $q = 1$, then $p = K$ and the equity supply curve A_f coincides with the familiar downward sloping marginal product of capital schedule, as in a standard Aiyagari economy. The equilibrium return r^* and the equilibrium value of assets held p^* are found at the intersection of the equity supply curve A_f and the equity demand curve A_h, while the equilibrium level of the capital stock can be read off the K curve once r^* is known.

Now suppose there is a difference in dividend and capital gains tax rates and suppose, for the sake of exposition, that $\tau_d > \tau_g$ so that $q < 1$. This has been the case historically for the US and will be assumed for the pre-reform steady state in our quantitative experiments. A unit of capital in the firm is now worth less than one unit to the shareholders. As a result, the value of stocks p and the physical capital K held by the firm will not be the same. The right panel of Figure 1 shows how to obtain the equilibrium return in the stock market and the implied capital stock in such an economy. Similarly to the previous case, the equity demand curve A_h is simply a depiction of the demand for wealth Ea_{t+1} given by the aggregated stock Euler equation (5). To obtain the equity supply curve A_f, the first step is the same as before, namely, we plot the capital stock K given in (9). But when we translate this into the supply of assets by multiplying it by q, the equity supply curve A_f is now below the K curve because $q < 1$. The equilibrium in the stock market is (r^*, p^*) and the implied capital stock is $K^* = \frac{1-\tau_g}{1-\tau_d} p^*$.

Consider now a decrease in τ_d, keeping τ_g fixed. This has no effect on the K and A_h schedules but it does increase q and therefore shifts the A_f schedule to the right. The new A_f curve is the dashed line shown in the left panel of Figure 2.[13] A decrease in dividend taxes raises the rate of return and, interestingly, has opposite effects on the stock price and the aggregate capital stock, raising the former and reducing the latter. The intuition is straightforward. At the prevailing rate r^*, households want to hold the same wealth as

[13] The graphical depiction assumes that q increases but remains below 1. In the experiment of the next section, q increases to exactly 1, which leads qualitatively to the same effects.

before and firms want to invest the same capital stock as before. But this capital stock is now valued more so that the supply of wealth is now higher. In order to induce households to hold more wealth, the return on stocks has to increase and this increase serves as the signal to the firm to start reducing the capital stock.

This result suggests that using a cut in dividend taxes as a way to promote investment can actually have negative effects on the capital stock and achieve the exact opposite effect. A crucial aspect required to yield this result is that the desired wealth held by households is not perfectly elastic, as it would be in a complete markets infinite horizon economy. The equilibrium with complete markets is depicted in the right panel of Figure 2. After a decrease in the dividend tax, the stock price increases proportionally to the change in the tax. Wealth held by individuals is now higher than before, but agents are content to hold this higher amount of wealth as long as the return remains equal to the time preference rate. The end result is an increase in stock prices but no change in capital (or any other variable). This is the essence of Proposition 2 in McGrattan and Prescott (2005) and Proposition 1 in Santoro and Wei (2011) and the sense in which dividend taxes are not distortionary under the new view.

An alternative extreme would be to postulate that the desired wealth schedule A_h is perfectly inelastic. Indeed, this would be a formalization of the intuition given by Poterba and Summers (1983), who argue that " *If the desired wealth-to-income ratio is fixed, then an increase in the dividend tax, which reduces each capital good's market value, will actually* increase *equilibrium capital intensity*". This intuition is not borne out of their model, which conforms to the standard infinite horizon complete markets model and therefore predicts no effects of dividend taxes on the capital stock. Our Bewley economy delivers this intuitive result, by allowing both the desired level of wealth and the long run rate of return to be endogenously determined.

The preceding discussion essentially analyzes the effects of an increase in q. This can

arise through any combination of changes in τ_d and τ_g that increases $\frac{1-\tau_d}{1-\tau_g}$. However, there are two important differences between the two tax changes. First, a reduction in τ_g reduces q and leads to the exact opposite effects to those discussed above. In particular, a decrease in τ_g, will raise the capital stock but reduce the stock price, ceteris paribus. Second, when τ_d falls but τ_g is kept fixed, the dividend tax change does not directly affect the cost of capital in the sense that it does not distort the capital Euler equation. This means that τ_d affects the equilibrium only through its effect on q. By contrast, a change in τ_g directly distorts the capital Euler equation and therefore has additional effects that are more closely related to the standard effects of capital taxes. In particular, a decrease in the capital gains tax rate reduces the cost of capital $\frac{r}{1-\tau_g}$ and this has the direct effect of shifting the K curve outwards. The implied wealth provided by the firm is therefore also shifted outward, keeping q fixed. So, the capital stock increases for two reasons after a decrease in τ_g, but the stock price could go either way depending on which effect is stronger.

To summarize, in our economy, a reduction in dividend taxes reduces the capital stock and increases the stock price whereas a reduction in capital gains taxes increases the capital stock and has ambiguous effects on the stock price. In the tax reform experiment of the next section, both taxes fall, but τ_d falls by more than τ_g leading to a rise in q. This effect will thus be present but there are additional effects arising from the change in τ_g. The overall effect of a reform that reduces both is, thus, theoretically ambiguous and can only be determined by quantifying these mechanisms. This is the objective of the following section.

5. Quantitative Results

This section uses a calibrated version of our model to study the effects of the 2003 capital tax reforms. First, we discuss the calibration and solution method for the benchmark economy. Subsequently, we study the effects of a reduction in taxes both in the long run and during the transition.

5.1. Calibration

The time period is assumed to be one year. Preferences are of the CRRA class, $u(c) = \frac{\left[c^{1-\mu}-1\right]}{1-\mu}$, with a risk aversion of $\mu = 2$. The production function is Cobb-Douglas, $F(K,L) = AK^{\alpha}L^{1-\alpha}$ with $\alpha = 0.32$ and the technology parameter A is normalized so that output is equal to one in the steady state of the deterministic version of our economy. We choose a discount factor $\beta = 0.92$ to match an average capital to output ratio of 2.8. The depreciation rate is set to $\delta = 0.103$**.** Although this depreciation rate implies a very high investment to output ratio, it is chosen to match the average dividend to GDP ratio of 2.8% observed in NIPA data up to 2002.[14]

The idiosyncratic labor productivity process is taken from Davila, Hong, Krusell and Ríos-Rull (2007). They construct the process so as to generate inequality measures for earnings and (endogenously) wealth that are close to US data using a very parsimonious model.[15] As shown in Table 1, this is achieved with a three-state Markov chain with transition matrix $\Pi(\epsilon'|\epsilon)$ which exhibits very strong persistence and with productivity values ϵ that assign productive individuals 46 times the productivity of unproductive individuals. The resulting stationary distribution is denoted by Π^* and is also displayed in Table 1.

We take our tax rates from Feenberg and Coutts (1993).[16] These are Federal plus State marginal tax rates for wages, qualified dividends and long term capital gains respectively. For our benchmark economy we use $\tau_l = 0.28$, $\tau_d = 0.31$ and $\tau_g = 0.24$, which are the values reported for 2002.[17] These imply $G = 0.27$ which means government spending is 20% of GDP. Feenberg and Coutts report marginal tax rates of 18.42 and 19.64 for dividends and

[14] In a previous version of the paper we calibrated the capital depreciation rate to match the investment to GDP ratio which resulted in a much higher dividend to GDP ratio. This, in turn, led to much larger effects of changes in dividend taxation. In this sense, our current calibration biases the quantitative significance of our results downwards.

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

[16] The data we use can be downloaded from http://www.nber.org/taxsim.

[17] Using an average of the tax rates for years 1997 to 2002 gives essentially the same numbers.

capital gains respectively for 2003. Since the intention of the reform was to equalize the two tax rates, and since the case of equal tax rates is the standard theoretical benchmark with $p = K$, it seems natural to choose equal rates after the reform. Thus we assume dividend and capital gains tax rates are reduced to $\tau_d = \tau_g = 0.19$. The labor tax rate adjusts along the transition to maintain government budget balance.[18]

5.2. Tax Reform Experiments

5.2.1. Long Run

We begin with an analysis of the long run implications of revenue neutral tax reforms that reduce dividend and capital gains taxes at the expense of higher labor income taxes. To isolate the effects of each of these tax changes, we start by analyzing a reduction in dividend taxes and capital gains taxes separately. First, we consider the effects of a reduction in the dividend tax rate while maintaining the capital gains tax at $\tau_g = 0.24$ (reform 1).[19] Next, we consider a reform that reduces capital gains taxes while keeping dividend taxes at the original level of $\tau_d = 0.31$ (reform 2). Finally, we consider the full tax reform in which both the dividend and the capital gains taxes are reduced to 19% (reform 3). In all the reforms we consider, the government is required to maintain a balanced budget for the same level of government spending as in the benchmark economy. This implies that labor taxes have to be adjusted upwards unless the reform is self-financing (see reform 2).

Table 2 reports steady state results for the three experiments. The first column displays results for the benchmark economy and the other three columns display the resulting long run steady state values after each of the reforms. The different rows correspond to the tax rates (τ_d, τ_g, τ_l), the stock return r, the level of output Y, the aggregate capital K, the

[18] Alternative ways to balance the budget, as well as extensions including corporate taxes and progressive labor taxes, are investigated in the online supplementary appendix.

[19] The aim of this experiment is to provide a decomposition of the effects of lowering different taxes. However, it should be pointed out that these tax rates could generate tax arbitrage if raising new equity were allowed. In this case, firms would be able to raise \$1 of new equity at a cost of $1 - \tau_g$ and then use these funds to pay dividends, with a gain of $(1 - \tau_d) - (1 - \tau_g) > 0$ to the shareholders.

stock price p, the aggregate wage rate and dividends before taxes (w, d) and after taxes $((1-\tau_l)\,w, (1-\tau_d)\,d)$ as well as three measures of the long run welfare effects of the reform. We compute the welfare change λ, in consumption equivalent (ce) terms, based on a utilitarian social welfare function. We also decompose the total welfare change into an aggregate component $\hat{\lambda}$ and a distributional component $\tilde{\lambda}$.[20]

Reform 1 reduces τ_d from 0.31 to 0.19. Despite the large reduction in the tax rate, the effect on the government budget is quite small because we have calibrated our economy so that dividend income is a small percentage of GDP. As a result, the government can balance its budget using a very small increase in the labor tax rate, from 0.28 to 0.29. As described in the previous section, the decrease in τ_d raises the market value of capital and thus the value of the assets held by individuals. This leads to an increase in the rate of return and a decrease in the capital stock. In addition, there is a secondary channel through which the capital stock is reduced. The reform leads to a change in the composition of income, with labor income, which is risky, becoming a smaller fraction of the total. This is both because of taxation shifting from capital to labor and because of the endogenous response of before-tax wages and dividends. Both mechanisms increase capital income and reduce labor income, thus reducing the amount of risk faced by households and, consequently, reducing precautionary savings. Overall, the capital stock falls by more than 9% while, at the same time, the stock price rises by 6%.

Comparing welfare measures across steady states we find that total welfare is reduced by 3%. This can be decomposed into an aggregate and a distributional component following Domeij and Heathcote (2004). Whereas they find a positive aggregate effect and a negative distributional effect of a reduction in capital income taxes, our finding is that both components are negative. The negative aggregate welfare effect is a direct result of the reduction in the capital stock which, in the long run, reduces output and aggregate consumption. The

[20] The decomposition follows Domeij and Heathcote (2004) and is provided in the supplementary online appendix.

distributional effect is negative for reasons similar to those found in the previous literature on capital taxation. As labor income is reduced relative to capital income, individuals at the low end of the wealth distribution suffer welfare losses whereas those at the high end enjoy welfare gains. Given a utilitarian welfare function, and a strictly decreasing marginal utility, the loss of the wealth-poor section of the population is reflected more strongly in the aggregate welfare measure. In sum, the reduction in the dividend tax increases the stock price, decreases the aggregate capital stock and reduces total welfare due to negative aggregate and distributional effects.

In many respects, the capital gains tax rate reduction works in the opposite direction. Focusing on the results from reform 2, we find an increase in the capital stock and a decrease in the rate of return. The stock price falls, because the effect from the decrease in q dominates the counteracting effect of the decrease in the cost of capital, which pushes the capital demand schedule (and thus the price) upwards. As the capital stock increases, that also implies an increase in the marginal product of labor which increases labor income. Notice that the labor tax rate is effectively unchanged which reflects the fact that the government collects no revenues from taxing capital gains at steady state. Thus, the reduction in the capital gains tax rate does not cause a deterioration in the government's budget. In fact, because wages increase as a result of the reform, the tax base increases and the labor tax rate that balances the budget is slightly lower (not seen up to the second digit reported). This reform is therefore self-financing at steady state. Overall, the welfare effects of the capital gains tax decrease are positive but smaller than in the case of dividend taxes. This largely reflects the fact that the capital gains tax rate falls by less than the fall in the dividend tax in the first reform. In sum, the decrease in the capital gains tax decreases the stock price, increases the aggregate capital stock and raises total welfare due to positive aggregate and distributional effects.

Once the two separate changes have been understood, the full reform (reform 3) follows

easily. The effects of the reform are qualitatively the same as the dividend tax cut, but quantitatively less strong because the capital gains tax rate reduction partly mitigates these effects. Quantitatively, we find a 5% reduction in the long run capital stock, a 4% increase in stock prices and a negative long run welfare effect equivalent to a 2% permanent reduction in consumption, arising both from reduced aggregate consumption and from reverse redistribution.

It is perhaps too early to assess whether these long run effects can be seen in the data. Initial evidence, however, seems to be consistent with the theoretical prediction on stock returns**.** Consider, for example, the average after tax return, which is equal to $r = \frac{d(1-\tau_d)}{p} = \frac{d(1-\tau_g)}{K}$ in the present model. Using the average dividend to capital ratios $\frac{d}{K}$ before and after 2003 from NIPA data, and letting τ_g fall from 0.24 to 0.19 as in the theoretical experiment, we obtain an increase in the stock return from 0.72 to 1.23. Comparing to Table 2, the first value coincides with the level of returns in our benchmark calibration by construction. Remarkably, the second value also coincides with the predicted after tax return following reform 3. The fact that the dividend-to-capital ratio has increased following the JGTRRA is also confirmed by Gourio and Miao (2010) and by DeBacker (2009) using Compustat data. A more thorough examination of the data, as in e.g. Chetty and Saez (2005) and Poterba (2004), also seems to suggest there was a significant increase in dividends following the reform.

Looking at steady states allows us to clarify the intuition for our results and understand the qualitative mechanisms taking place in our model. However, for obtaining a quantitative assessment of the welfare effects of the tax reform it is imperative that we consider the transition. It is well known that results about the long run are often mitigated, and sometimes even reversed, when short run effects are taken into account. In our case, it is clear that this could be so. After all, the predicted reduction in the long run capital stock will reduce aggregate consumption in the long run but increase aggregate consumption in the short run.

We investigate this further in the next section.

5.2.2. Transition

We focus on the transitional paths for the full reform (reform 3) only. We assume that the economy begins at a steady state with dividend taxes that are equal to 31% and capital gains taxes that are equal to 24%. These taxes are unexpectedly and permanently reduced to 19% and 19% respectively and the economy is simulated until convergence to the new steady state. Labor taxes are adjusted in every period of the transition to keep the government's budget balanced.

The transition paths are as expected. Aggregate capital decreases monotonically to the new steady state. Stock prices increase by almost 10% on impact, as q has suddenly risen but the capital stock has not had time to adjust. As the economy reduces its capital stock, stock prices gradually fall towards a new steady state, which is higher than the old one. The aggregate wage rate follows a decreasing path, similar to the one of the aggregate capital stock. The same is true for the after tax wage, but the decrease in the latter is larger due to the higher labor income tax rate.[21] Per share dividends rise sharply on impact as investment is reduced and after tax dividends rise even more because the tax rate has fallen. The subsequent downward adjustment in the capital stock brings dividends down, although they remain significantly above the pre-reform level even in the long run.

The sharp initial increase in after-tax dividends resulting from lower investment is also reflected in the path for aggregate consumption displayed in the upper panel of Figure 3. The initial increase is approximately 3%, but aggregate consumption starts falling as the capital stock decreases. Eventually, aggregate consumption falls below the original steady state and, in the long run, settles at a level approximately 0.5% below the pre-reform level. This

[21] Since the reform is unexpected, it creates large capital gains in the initial period. In turn, these create a one time upward jump in stock returns. In addition, these imply a much lower labor tax income needed to balance the budget in the first period and higher after tax labor income. These three variables are plotted here from period two onwards for expositional purposes.

lower level of aggregate consumption in the long run is what leads to a negative aggregate component of welfare in the long run (see Table 2).

The overall welfare effects along the transition are depicted in the lower panel of Figure 3. The decrease in welfare when the transition effects are taken into account is just above 0.5% of consumption. This is much less than the long run decrease of 1.9% because of the temporary increase in aggregate consumption. In fact, the time path of welfare gains follows closely the time path of aggregate consumption. Performing a decomposition of the welfare gains reveals positive aggregate welfare gains of approximately 1.8% when the transition is taken into account. This is because the decrease in long run consumption is dominated by the temporary increase in consumption in the short run. The distributional component on the other hand is negative and larger, -2.3%.

This negative redistribution effect has been pointed out in existing studies of capital income tax reforms[22]. The dividend tax cut makes this effect more pronounced than in previous studies because the bottom of the wealth distribution, which relies mostly on labor income, now faces a negative general equilibrium effect on wages due to the fall in aggregate capital. The finding that the aggregate component is positive is also consistent with existing studies. However, the reasons are different. In those studies, the aggregate component is positive following a capital income tax cut, because the long run increase in aggregate consumption dominates the temporary decrease. In contrast, following our dividend tax cut experiment, aggregate consumption temporarily increases and this dominates the long run decrease.

Decomposing the welfare gains across individuals provides further insights into the effects of the reform. Such a decomposition is provided in Figure 4, which shows individual welfare gains for different combinations of productivity (labor income) and asset levels. An examination of this figure will reveal two things: who gains and who loses from the reform

[22] See e.g. Aiyagari (1995), Domeij and Heathcote (2004) and Ábrahám and Cárceles-Poveda (2010).

and whether the reform could have public support or not. A couple of important observations emerge from the figure. First, welfare gains are increasing in the amount of asset wealth held by an individual. Indeed, most individuals holding stocks gain from this reform and only some individuals holding no stocks (and some holding very few stocks) lose. This is not surprising, since the reform reduces the taxation of asset wealth and increases the stock return**.** Second, given a large amount of asset wealth, welfare gains are higher for low productivity individuals. This is because among agents with the same asset level, agents with lower productivity rely less on labor income compared to asset income. Therefore, the increase in labor income taxes and the decrease in wages hurts them the least. However, given little or no wealth, welfare gains are lower (or rather, welfare losses are larger) for low productivity individuals. This is because those agents enjoy very low levels of consumption anyway and their marginal utility is very high. In addition, given the persistence of the labor productivity process, they are unlikely to benefit from low asset taxation in the future either.

In terms of support for the reform, individuals at the low end of the wealth distribution and with low labor productivity would not support the reform. It turns out that the bulk of the distribution is actually concentrated in this region. When we aggregate over the population across asset levels and productivity levels using the stationary distribution of the pre-reform steady state, we find that the overall political support for the reform is 20 percent. In sum, this reform would not get wide political support, mostly because of strong redistribution effects from the poor to the rich.

6. Conclusion

This paper studies the effects of a reduction in dividend and capital gains taxes. Our finding that reductions in these taxes lead to reverse redistribution, and hence are detrimental from the point of view of a utilitarian social welfare function, is in line with previous research

on capital tax reforms. The new insight, obtained by disaggregating capital taxes into dividend and capital gains taxes, is that a dividend tax cut can have the exact opposite effect from the one intended, i.e. it can reduce investment instead of increasing it. We explain that this result arises because the increase in stock prices feeds back to household choices through a wealth effect. We also provide a quantitative assessment of the 2003 JGTRRA reform and find it to be welfare reducing, even after positive short run effects are taken into account.

Given that our result on the effect of dividend taxes on investment is surprising, a natural question to ask is whether this mechanism is borne out by the aftermath of the 2003 reform. Desai and Goolsbee (2004) touch on this issue and find the investment recovery from 2003 onwards to be weaker than in previous recoveries. As Kevin Hassett suggests in his discussion of that paper, it is not clear that comparing to previous recoveries is the right metric to be used. Looking at the raw data, there does seem to be an increase in capital expenditures following the 2003 reform. However, it is important to realize that the reform did not only change dividend taxes. Various other provisions, such as the increase in depreciation allowances, the decrease in estate taxes and the decrease in the level and the progressivity of labor taxes, could have spurred investment *despite* the dividend tax decrease.

An attempt at empirically evaluating the effect of dividend taxes on investment would have to separate these effects as well as somehow take into account the business cycle. Unfortunately, estimating the effects of dividend taxes on investment is not a straightforward exercise. To quote Chetty and Saez (2005) " ... the time series of investment is extremely volatile and of much larger magnitude than dividend payments."[23] Crucially, even if the ceteris paribus effect of the dividend tax cut on investment could be conclusively determined empirically, that effect would only be the result of a combination of different mechanisms.

[23] Similar statements about the difficulty of assessing these effects can be found in Hassett's discussion of Desai and Goolsbee's article. Poterba's (2004) take on existing evidence on this issue is that it is "controversial".

The decrease in dividend taxes exerts a downward pressure on investment because of the mechanism explained in this paper. Additional downward pressure would arise to the extent that the reform is perceived as temporary, as argued in Gourio and Miao (2011) and in Korinek and Stiglitz (2009). On the other hand, the tax cut exerts an upward pressure in the presence of firm heterogeneity as explained in Gourio and Miao (2010) or in the presence of agency issues as in Chetty and Saez (2010).

Finally, we focus more closely on the effects of dividend taxes compared to capital gains taxes. Such focus is partly because the change in dividend taxes was of a much larger magnitude but also because we view our treatment of capital gains taxes as less satisfactory. In our model capital gains are taxed on an accrual basis which simplifies the computational burden significantly but is arguably unrealistic. In practice, capital gains are only taxed upon realization and this allows individuals to time the realization of capital gains in their favor. It is often suggested, see for example Poterba (2004) or Sinn (1991), that this could be crudely modelled as an accrual tax at a lower rate. To the extent this is true, our main result of a fall in the capital stock and in welfare should survive such an extension since this would reduce the effects of capital gains taxes. One could also explicitly model realization-based capital gains taxes along the lines of Gavin, Kydland and Pakko (2007), but at a higher computational cost.

References

Ábrahám, Á., Cárceles-Poveda, E., 2010. Endogenous Trading Constraints with Incomplete Asset Markets. Journal of Economic Theory 145, 974-1004.

Aiyagari, S.R., 1995. Optimal Capital Income Taxation with Incomplete Markets, Borrowing Constraints and Constant Discounting. Journal of Political Economy 103(6), 1158-75.

Aiyagari, S.R., 1994. Uninsured Idiosyncratic Risk and Aggregate Saving. Quarterly Journal of Economics 109(3), 659-684.

Atesagaoglu, O.E., 2012. Taxes, Regulations and the Corporate Debt Market. International Economic Review, forthcoming.

Auerbach, A.J., Hassett, K.A., 2003. On the Marginal Source of Investment Funds. Journal of Public Economics 87(1), 205-232.

Auerbach, A.J., Hassett, K.A., 2005. The 2003 Dividend Tax Cuts and the Value of the Firm: An Event Study. NBER Working Paper 11449.

Blouin, J.L., Raedy, J.S., Shackelford, D.A., 2004. Did Dividends Increase Immediately after the 2003 Reduction in Tax Rates?. NBER Working Paper 10301.

Castañeda, A., Díaz-Giménez, J., Ríos-Rull, J.V., 2003. Accounting for earnings and wealth inequality. Journal of Political Economy 111(4), 818-857.

Cárceles-Poveda, E., Coen Pirani, D., 2009. Shareholders Unanimity with Incomplete Markets. International Economic Review 50(2), 577-706.

Cárceles-Poveda, E., Coen Pirani, D., 2010. Owning Capital or Being Shareholders: An Equivalence Result with Incomplete Markets. Review of Economic Dynamics 13(3), 537-558.

Chetty, R., Saez, E., 2010. Dividend and Corporate Taxation in an Agency Model of the Firm. American Economic Journal: Economic Policy 2(3), 1-31.

Chetty, R., Saez, E., 2005. Dividend Taxes and Corporate Behavior: Evidence from the 2003 Dividend Tax Cut. Quarterly Journal of Economics 120(3), 791-833.

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

Conesa, J.C., Krueger, D., 2006. On the Optimal Progressivity of the Income Tax Code. Journal of Monetary Economics, 53(7), 1425–50.

Conesa, J.C., Dominguez, B., 2010. Intangible Investment and Ramsey Capital Taxation. Unpublished Manuscript.

Davila, J., Hong, J.H., Krusell, P., Ríos-Rull, J.V., 2007. Constrained Efficiency in the Neoclassical Growth Model with Uninsurable Idiosyncratic Shocks. Unpublished Manuscript.

Desai, M.A., Goolsbee, A., 2004. Investment, Overhang, and Tax Policy. Brookings Papers on Economic Activity 2, 285-355.

DeBacker, J.. 2009. Capital Taxes with Real and Financial Frictions. Working paper, Department of Economics, Terry College of Business, Brooks Hall, University of Georgia.

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

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

Feenberg, D., Coutts, E., 1993. An Introduction to the Taxsim Model. Journal of Policy Analysis and Management, 12(1).

Gavin, W., Kydland, F., Pakko, M.R., 2007. Monetary Policy, Taxes, and the Business Cycle. Journal of Monetary Economics, 1587-1611.

Gordon, R., Dietz, M., 2006. Dividends and Taxes. NBER Working Paper 12292.

Gourio, F., Miao, J., 2008. Dynamic Effects of Permanent and Temporary Dividend Tax Policies on Corporate Investment and Financial Policies. Unpublished Manuscript.

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

Gourio, F., Miao, J., 2011. Transitional Dynamics of Dividend and Capital Gains Tax Cuts. Review of Economic Dynamics, 14, 368-383.

Imrohoroglu, S. 1998. A Quantitative Analysis of Capital Income Taxation. International Economic Review, 39(2), 307–28.

Korinek, A., Stiglitz, J., 2009. Dividend Taxation and Intertemporal Tax Arbitrage. Journal of Public Economics, 93, 142-159.

McGrattan, E.R., 2010. Capital Taxation during the US Great Depression. Working Paper 670, Federal Reserve Bank of Minneapolis.

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

Poterba, J.M., Summers, L.H., 1983. Dividend Taxes, Corporate Investment, and 'Q'. Journal of Public Economics 22, 135-167.

Poterba, J.M. 2004. Taxation and Corporate Payout Policy. American Economic Review 94(2), 171-175.

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

Santoro, M., Wei, C., 2010. A Note on the Impact of Progressive Dividend Taxation on Investment Decisions. Macroeconomic Dynamics, forthcoming.

Sinn, H.-W.. 1991. Taxation and the Cost of Capital: the Old View, the New View and Another View. NBER Working Paper 3501.

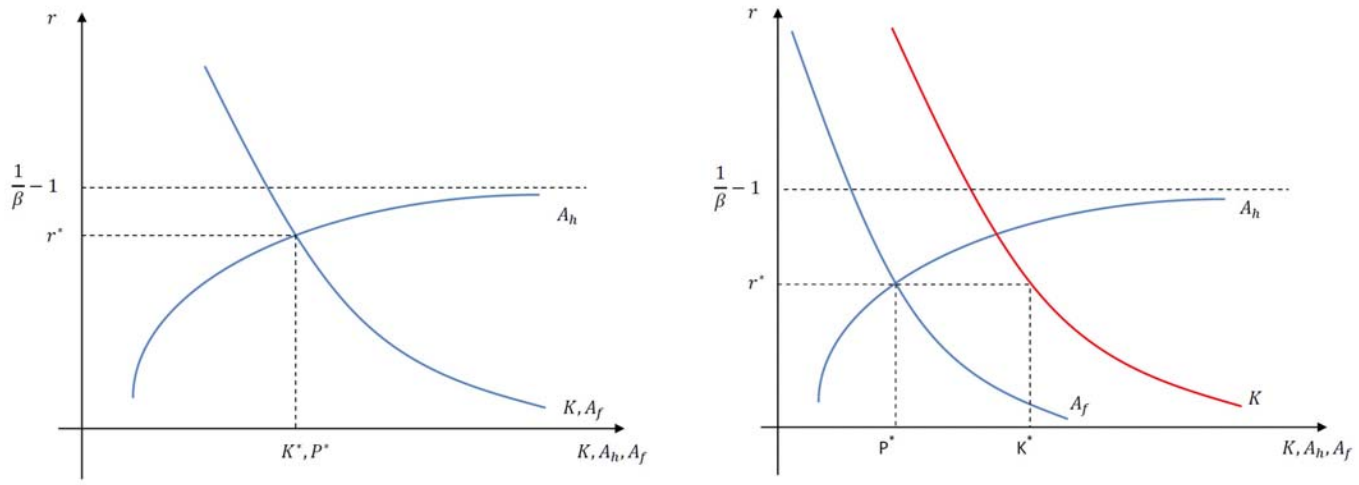

Fig 1. Left Panel: Equilibrium in an Aiyagari (1994) model where $q = \frac{1-\tau_d}{1-\tau_g} = 1$. Right Panel: Equilibrium in our model where $q = \frac{1-\tau_d}{1-\tau_g} < 1$. A_h: Equity Demand; A_f: Equity Supply; K : Capital Stock; r : Stock Return.

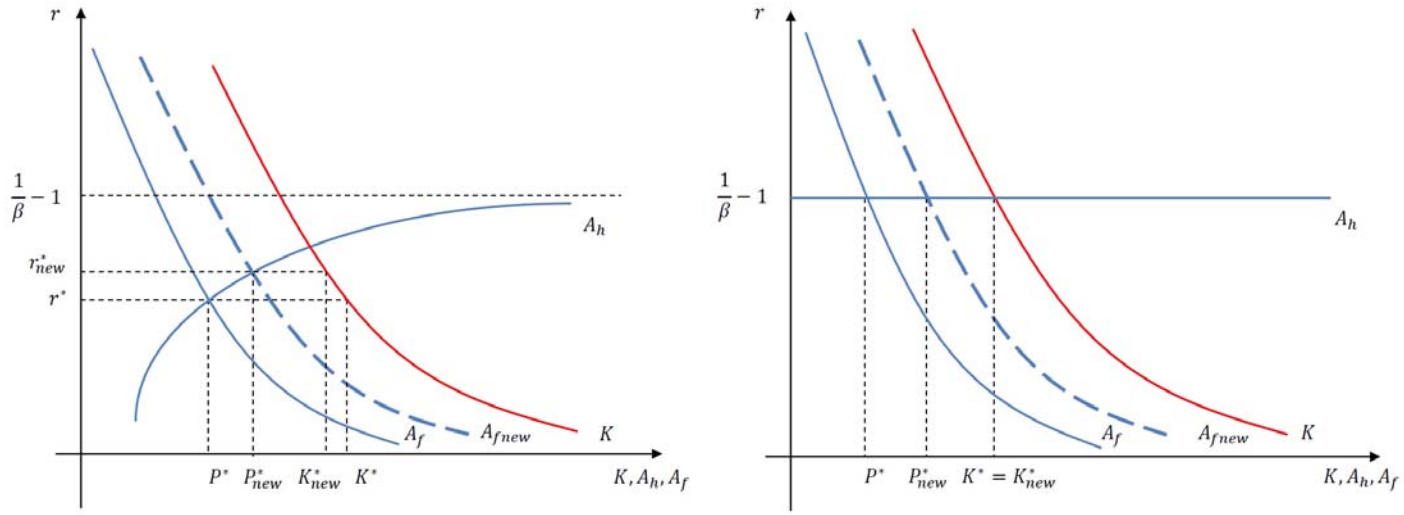

Fig. 2. Left Panel: The effect of an increase in $q = \frac{1-\tau_d}{1-\tau_g} < 1$ in our model. Right Panel: The effect of an increase in $q = \frac{1-\tau_d}{1-\tau_g} < 1$ in a representative agent model. A_h: Equity Demand; A_f: Equity Supply; K : Capital Stock; r : Stock Return.

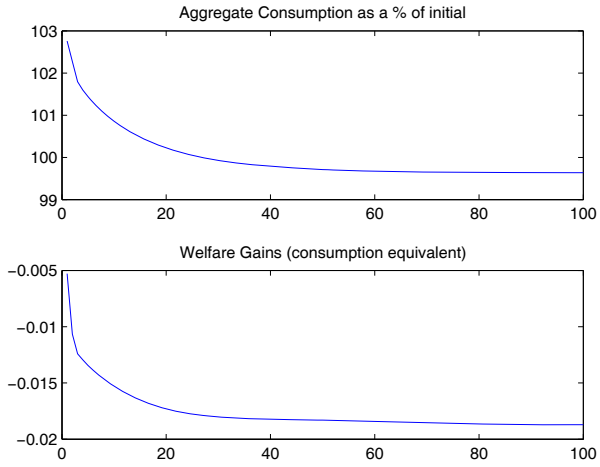

Fig. 3: Aggregate Consumption and Welfare Gains Over the Transition in the Full Reform

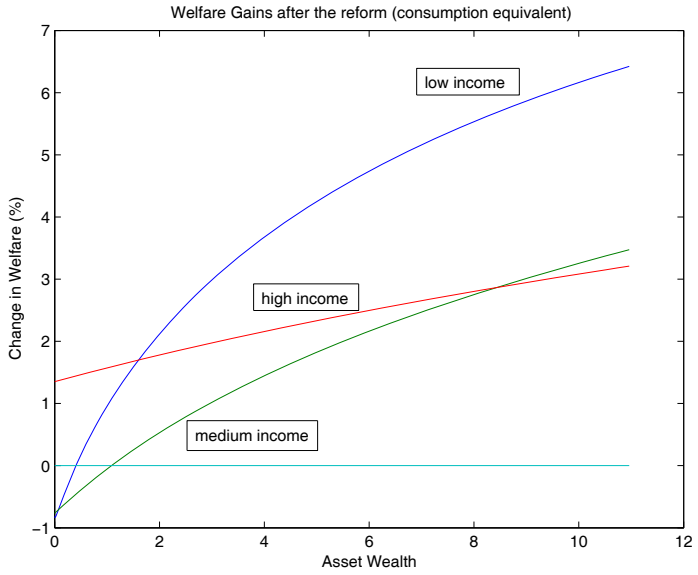

Fig. 4: Individual Welfare Gains Across Wealth Levels and Income Levels in the Full Reform

Table 1: Earnings Process[24]

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

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

$$\Pi\left(\epsilon'|\epsilon\right) = \begin{bmatrix} 0.992 & 0.008 & 0.000 \\ 0.009 & 0.980 & 0.011 \\ 0.000 & 0.083 & 0.917 \end{bmatrix}$$

[24] ϵ denotes the values of the productivity shock, Π^* is the stationary distribution of the shock process and $\Pi\left(\epsilon'|\epsilon\right)$ is the Markov transition matrix.

Table 2: Long run effects of tax reforms[25]

	Benchmark	Reform 1	Reform 2	Reform 3
(τ_d, τ_g, τ_l)	$(0.31, 0.24, 0.28)$	$(0.19, 0.24, 0.29)$	$(0.31, 0.19, 0.28)$	$(0.19, 0.19, 0.29)$
r	0.7	1.3	0.55	1.2
Y	1.36	1.32 (−3%)	1.38 (+1.5%)	1.33 (−1.8%)
K	3.82	3.46 (−9.4%)	3.99 (+4.2%)	3.62 (−5%)
p	3.47	3.69 (+6%)	3.40 (−2.3%)	3.62 (+4%)
w	0.166	0.160 (−3.6%)	0.168 (+1.2%)	0.163 (−1.8%)
$(1-\tau_l)w$	0.119	0.114 (−4.4%)	0.121 (+1.7%)	0.116 (−2.4%)
d	0.038	0.062 (+39%)	0.027 (−31%)	0.052 (+36%)
$(1-\tau_d)d$	0.026	0.050 (+48%)	0.019 (−27%)	0.042 (+62%)
ce total λ	0	−3.0%	0.9%	−1.9%
ce aggregate $\hat{\lambda}$	0	−0.8%	0.2%	−0.5%
ce distribution $\tilde{\lambda}$	0	−2.3%	0.7%	−1.4%

[25] The table rows display the values for the tax rates on dividends, capital gains and labor income, τ_d, τ_g, τ_l, the stock return r, the output Y, the capital stock K, the stock price p, the wage rate w and after tax wage rate $(1-\tau_l)w$, the dividends d and after tax dividends $(1-\tau_d)\,d$ and the consumption equivalent welfare measure λ, as well as its aggregate and distributional components $\hat{\lambda}$ and $\tilde{\lambda}$. The columns of the table display the values of the different variables in the benchmark economy and after the different tax reforms. Numbers in parentheses give the % change relative to the benchmark.