Firm Heterogeneity and the Long-Run Effects of Dividend Tax Reform

F. Gourio and J. Miao

Presented by
Román Fossati

Universidad Carlos III

November 2009
Introduction

Question

- What are the LR effects of dividend taxation on aggregate capital accumulation and productivity?

Motivation and Related Literature

In 2003 the USA Congress cut the dividend and capital gains tax rates and it could be made permanent from now on.

Economists disagree on the economic effects of dividend taxation on investment. Two views are prevalent:

- **Traditional view**: the marginal source of funds is new equity $\Rightarrow$ a dividend tax cut reduces the user cost of capital $\Rightarrow$ raises investment (Poterba and Summers 1983 and 1985 using UK data).

- **New View**: firms use internal funds to finance investment $\Rightarrow$ dividend taxation does not influence the user cost of capital and investment. (Desai and Goolsbee 2004 using US data).
Introduction

- Auerbach and Hassett (2002) show that in US firms behave according to both views, an indication of substantial heterogeneity in the data.

The insight

- Firm heterogeneity plays a key role: depending on its productivity and its capital stock, a firm reacts according to these different views.

The idea to answer this question:

- They build a DGE model in which there is a continuum of firms subject to idiosyncratic productivity shocks.

The results

- They find that a D tax cut raises aggregate productivity by reducing the frictions in the reallocation of capital across firms
- When both D and K gains tax rates are cut from 25 and 20 %, respectively, to 15% permanently, the aggregate LR K stock increases by about 4%.
Introduction

They take into account three finance regimes:

- **Equity issuance regime**: the marginal source of finance is new equity (which reflects the traditional view)
- **Liquidity constrained regime**: firm's investment is limited to the amount of retained earnings
- **Dividend distribution regime**: the marginal source of finance is retained earnings (reflects the new view)

Because of firm heterogeneity, at any point in time different firms may be in different finance regimes ⇒ respond to the dividend tax cut in different ways
Taking data from the COMPUTSTAT database we can see the averages across years from 1988 to 2002 (before the tax cut):

<table>
<thead>
<tr>
<th></th>
<th>Equity issuance regime</th>
<th>Liquidity constrained regime</th>
<th>Dividend distribution regime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of firms</td>
<td>0.230</td>
<td>0.297</td>
<td>0.474</td>
</tr>
<tr>
<td>Share of capital</td>
<td>0.028</td>
<td>0.059</td>
<td>0.913</td>
</tr>
<tr>
<td>Share of investment</td>
<td>0.039</td>
<td>0.057</td>
<td>0.904</td>
</tr>
<tr>
<td>Earnings-capital ratio</td>
<td>0.567</td>
<td>0.275</td>
<td>0.355</td>
</tr>
<tr>
<td>Investment-capital ratio</td>
<td>0.290</td>
<td>0.193</td>
<td>0.194</td>
</tr>
<tr>
<td>Tobin’s q</td>
<td>3.768</td>
<td>1.784</td>
<td>2.837</td>
</tr>
</tbody>
</table>

- Firms issuing equity are
  - more productive (earnings-to-capital ratio), small (capital) and have high Tobin’s q
  - these “growth firms” (highest I/K) have good investment opportunities, and require external finance to make investments.

- The two other groups have similar investments, but the firms paying dividends have higher Tobin’s q and higher productivity.
Introduction

After the 2003 dividend tax cut:

- Agg. dividends increased significantly (ratio of D/GDP increased from 3.8% to 5.3% -avg. 1988-2002 vs 2003-2006-).
- Equity issuance, aggregate investment, and aggregate earnings also rose significantly.

<table>
<thead>
<tr>
<th></th>
<th>Equity issuance regime</th>
<th>Liquidity constrained regime</th>
<th>Dividend distribution regime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of firms</td>
<td>0.283</td>
<td>0.173</td>
<td>0.544</td>
</tr>
<tr>
<td>Share of capital</td>
<td>0.034</td>
<td>0.070</td>
<td>0.896</td>
</tr>
<tr>
<td>Share of investment</td>
<td>0.044</td>
<td>0.057</td>
<td>0.900</td>
</tr>
<tr>
<td>Earnings-capital ratio</td>
<td>0.784</td>
<td>0.336</td>
<td>0.455</td>
</tr>
<tr>
<td>Investment-capital ratio</td>
<td>0.231</td>
<td>0.148</td>
<td>0.182</td>
</tr>
<tr>
<td>Tobin’s q</td>
<td>3.396</td>
<td>1.913</td>
<td>2.876</td>
</tr>
</tbody>
</table>

- the share of firms in the LCR fell and the shares of firms in the EIR and DDR rose.
- they present a model that produces this effect where the change in the firm distribution across finance regimes is an important mechanism.
Model

Economic Environment

- $t = 0, 1, \ldots, \infty$ infinite horizon, discrete time
- there is a continuum of firms facing idiosyncratic shocks and adjustment costs which:
  - accumulates $K$, and
  - make financing decisions
- a representative household
- a government finance lump-sum transfers with taxes on
  - corporate income, $\tau_c$
  - dividends, $\tau_d$
  - labor and interest income, $\tau_i$
  - capital gains, $\tau_g$
The required return to equity (RRE) is

\[ R_t = \frac{1}{P_t} E_t \left[ (1 - \tau_d) d_{t+1} + (1 - \tau_g) (P_{t+1} - s_{t+1}) \right] \]  

(1)

where \( P_{t+1} \) = ex-dividend value of equity, and \( s_{t+1} \) = value of issued new shares.

The steady state RRE in equilibrium satisfies:

\[ R_t = (1 - \tau_i) r \]  

(2)

Define the cum-dividend equity value as

\[ V_t = P_t - s_t + \frac{(1 - \tau_d)}{(1 - \tau_g)} d_{t+1} \]  

(3)

from eqs. (1) to (3) we have:

\[ V_t = \frac{(1 - \tau_d)}{(1 - \tau_g)} d_t - s_t + \frac{E_t[V_{t+1}]}{1 + r(1 - \tau_i)/(1 - \tau_g)} \]  

(4)

they use this equation to formulate the firm’s DPP.
The firm chooses investment and financial policies to maximize equity value:

\[ V(k, z; w) = \max_{k', x, s, d} \left( \frac{1 - \tau_d}{1 - \tau_g} d - s \right) \]

\[ + \frac{1}{1 + r(1 - \tau_i)/(1 - \tau_g)} \int V(k'_{t+1}, z'; w) Q(z, dz') \]

subject to:

\[ x + \frac{\psi x^2}{2k} + d = (1 - \tau_c) \pi(k, z; w) + \tau_c \delta k + s \]

\[ k' = (1 - \delta) k + x \]

\[ d \geq 0 \]

\[ s \geq 0 \]

The solutions are the policy functions:

\[ x = x(k, z, w), k' = g(k, z, w), s = s(k, z, w), d = d(k, z, w). \]

There is a cross sectional distribution of firms over the states \( \mu(z, k). \)
Households

Representative household static optimization problem:

\[
\max \sum_{t \geq 1} \beta^t u(C_t, L_t)
\]

s.t.

\[
C = (1 - \tau_d) \int d(k, z; w) \mu(dk, dz) - (1 - \tau_g) \int s(k, z; w) \mu(dk, dz)
\]
\[
+ (1 - \tau_i) w L + T
\]

Government

It collects corporate income taxes, dividend taxes, personal income taxes, and capital gains taxes, and transfers these tax revenues to the HH

\[
T = \tau_c \int [\pi(k, z; w) - \delta k] \mu(dk, dz) + \tau_d \int d(k, z; w) \mu(dk, dz)
\]
\[
- \tau_g \int s(k, z; w) \mu(dk, dz) + \tau_i w L
\]
A stationary equilibrium consists of a constant wage rate $w$; a stationary distribution of firms $\mu^*$; aggregate quantities, $C(z, k, w), I(z, k, w), \Psi(z, k, w), Y(z, k, w), L^d(z, k, w), L^s(z, k, w)$; and decision rules, $k' = g(k; z; w); x = x(k; z; w); s = s(k; z; w); d = d(k; z; w)$; such that

i) the decision rules solve the firm’s problem

ii) $C(\cdot)$ and $L^s(\cdot)$ solve the HH problem

iii) $\mu^*$ is the stationary distribution of firms,

iv) $T$ satisfies the government budget constraint, and

v) markets clear:

$$L^d(\mu^*, w) = L^s(\mu^*, w)$$
$$C(\mu^*, w) + I(\mu^*, w) + \Psi(\mu^*, w) = Y(\mu^*, w)$$

Fossati Román (UNIVERSIDAD CARLOS III) Firm Heterogeneity and the Long-Run Effects November 2009 11 / 25
Rewrite the DPP as a sequence problem

\[
\max_{x_t, k_{t+1}, s_t} \quad E \left[ \sum_{t=0}^{\infty} \frac{1}{1 + r(1 - \tau_i)/(1 - \tau_g)} \frac{1 - \tau_d}{1 - \tau_g} d_t - s_t \right] \tag{6}
\]

s.t.:

\[
x_t + \frac{\psi x_t^2}{2k_t} + d_t &= (1 - \tau_c) \pi(k_t, z_t; w) + \tau_c \delta k_t + s_t \tag{7}
\]

\[
k_{t+1} = (1 - \delta) k_t + x_t \tag{8}
\]

\[
d_t \geq 0 \tag{9}
\]

\[
s_t \geq 0 \tag{10}
\]

Let \( q_t, \lambda^d_t \) and \( \lambda^s_t \) be the Lagrange multipliers associated with the last 3 constraints.

\( q_t = \) shadow price of capital (marginal q)
Analysis of A Single Firm’s Decision Problem

FOCs

\[ s_t : \frac{1 - \tau_d}{1 - \tau_g} + \lambda^d_t + \lambda^s_t = 1 \]

\[ x_t : q_t = \left( \frac{1 - \tau_d}{1 - \tau_g} + \lambda^d_t \right) \left( 1 + \frac{\psi x_t}{k_t} \right) \]

\[ k_{t+1} : q_t = \frac{1}{1 + r(1 - \tau_i)/(1 - \tau_g)} E_t \{ q_{t+1}(1 - \delta) + \left( \frac{1 - \tau_d}{1 - \tau_g} d_t + \lambda^d_{t+1} \right) \left[ (1 - \tau_c) \pi(k_t, z_t; w) + \tau_c \delta k_t + \frac{\psi}{2} \left( \frac{x_{t+1}}{k_{t+1}} \right)^2 \right] \} \]
In particular, the FOC w.r.t. $s_t$ determines the financial policy of the firm:

$$s_t : \frac{1 - \tau_d}{1 - \tau_g} + \lambda^d + \lambda^s = 1$$

(11)

Interpretation: LHS = Benefits:

- Raising 1 unit of new E to pay dividends relaxes the dividend constraint, the share repurchase constraint, and the shareholder receives $\frac{1 - \tau_d}{1 - \tau_g}$ units of after-tax dividends.

RHS = marginal cost to the shareholder:

- 1 unit increase in new share lowers E value by 1 unit
Analysis of A Single Firm’s Decision Problem

\[ s_t : \frac{1 - \tau_d}{1 - \tau_g} + \lambda^d_t + \lambda^s_t = 1 \]

If \( \tau_d = \tau_g \) there is no tax differential between dividends and retained earnings. Eq. (12) implies that \( \lambda^d_t = \lambda^s_t = 0 \) \( \Rightarrow \) firm’s financial policy is irrelevant (MM irrelevance theorem): it does not matter for firm value

- to retain earnings for use as internal finance, or
- to distribute D and issue E in the external equity market

More formally, in the \( d_t - s_t \) can be determined, but \( d_t \) and \( s_t \) are indeterminate
If $\tau_d \neq \tau_g \Rightarrow$ firm’s financial policy matters. Before the 2003 $\tau_d > \tau_g \Rightarrow$ we cannot have $\lambda_t^d = \lambda_t^s = 0 \Rightarrow$ it is not optimal for the firm to simult. issue new E and distribute D (the financial dec. change E value)
If $\tau_d \neq \tau_g \Rightarrow$ firm’s financial policy matters.
Before the 2003 $\tau_d > \tau_g \Rightarrow$ we cannot have $\lambda^d_t = \lambda^s_t = 0 \Rightarrow$ it is not optimal for the firm to simult. issue new E and distribute D (the financial dec. change E value)

This implies that one of the constraints $d_t \geq 0$ or $s_t \geq 0$ must be binding $\Rightarrow$ 3 cases to consider:

- $d_t > 0$, $s_t = 0$: Distribution Regime: the firm has enough retained earnings to finance I and to distribute D
If $\tau_d \neq \tau_g \Rightarrow$ firm’s financial policy matters.

Before the 2003 $\tau_d > \tau_g \Rightarrow$ we cannot have $\lambda_t^d = \lambda_t^s = 0 \Rightarrow$ it is not optimal for the firm to simult. issue new E and distribute D (the financial dec. change E value)

This implies that one of the constraints $d_t \geq 0$ or $s_t \geq 0$ must be binding $\Rightarrow$ 3 cases to consider:

- $d_t > 0, s_t = 0$: **Distribution Regime**: the firm has enough retained earnings to finance I and to distribute D
- $d_t = 0, s_t > 0$: **Equity Issuance Regime**: the firm does not have enough internal funds to distribute D. The marginal source of I finance is the external equity market
Analysis of A Single Firm’s Decision Problem

If \( \tau_d \neq \tau_g \) \( \Rightarrow \) firm’s financial policy matters.
Before the 2003 \( \tau_d > \tau_g \) \( \Rightarrow \) we cannot have \( \lambda_t^d = \lambda_t^s = 0 \) \( \Rightarrow \) it is not optimal for the firm to simult. issue new E and distribute D (the financial dec. change E value)

This implies that one of the constraints \( d_t \geq 0 \) or \( s_t \geq 0 \) must be binding \( \Rightarrow \) 3 cases to consider:

- \( d_t > 0, s_t = 0 \): **Distribution Regime**: the firm has enough retained earnings to finance I and to distribute D
- \( d_t = 0, s_t > 0 \): **Equity Issuance Regime**: the firm does not have enough internal funds to distribute D. The marginal source of I finance is the external equity market
- \( d_t = 0, s_t = 0 \): **Liquidity Constrained Regime**: the firm exhausts all internal funds to finance investment and neither distribute D nor issue E (because the marginal return to investment does not justify the reduction in E value -due to share dilution-).

In this last regime, a **windfall addition to current earnings, will raise I**.
A firm will change regime according to shocks and K accumulation.

In the cross section with firm heterogeneity, different firms may lie in different finance regimes.

Quantitative Results

- The model has no closed-form solution for the stationary equilibrium → they numerically compute the approximate equilibrium.
- They calibrate the model to match some moments from the COMPUSTAT database.
Quantitative Results: General Equilibrium

Quantitatively the model matches well the facts presented before.

<table>
<thead>
<tr>
<th></th>
<th>Equity issuance regime</th>
<th>Liquidity constrained regime</th>
<th>Dividend distribution regime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of firms</td>
<td>0.201</td>
<td>0.342</td>
<td>0.457</td>
</tr>
<tr>
<td>Share of capital</td>
<td>0.108</td>
<td>0.229</td>
<td>0.663</td>
</tr>
<tr>
<td>Share of investment</td>
<td>0.402</td>
<td>0.436</td>
<td>0.161</td>
</tr>
<tr>
<td>Earnings-capital ratio</td>
<td>0.431</td>
<td>0.264</td>
<td>0.170</td>
</tr>
<tr>
<td>Investment-capital ratio</td>
<td>0.354</td>
<td>0.181</td>
<td>0.023</td>
</tr>
<tr>
<td>Average Tobin’s q</td>
<td>2.633</td>
<td>1.941</td>
<td>1.348</td>
</tr>
</tbody>
</table>

**First policy experiment:** taxes rates cut from $\tau_d = .25$, $\tau_g = .20$ to $\tau_d = .22$, $\tau_g = .20$:

- Fewer firms are constrained: some firms in the LCR move to the EIR and some other to the DDR
- The firms in the EIR account for most of the increase in $I$

These behavior is consistent with the traditional view of dividend taxation and with the empirical results (what really happened)
Percentage changes from the initial steady state

<table>
<thead>
<tr>
<th></th>
<th>$\tau_d = 0.22$</th>
<th>$\tau_d = 0.20$</th>
<th>$\tau_d = 0.15$</th>
<th>$\tau_d = 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau_g$</td>
<td>0.20</td>
<td>0.20</td>
<td>0.15</td>
<td>0</td>
</tr>
<tr>
<td>Capital</td>
<td>0.27</td>
<td>0.52</td>
<td>4.26</td>
<td>13.95</td>
</tr>
<tr>
<td>Output</td>
<td>0.58</td>
<td>1.00</td>
<td>2.15</td>
<td>5.04</td>
</tr>
<tr>
<td>Consumption</td>
<td>0.38</td>
<td>0.63</td>
<td>1.30</td>
<td>2.91</td>
</tr>
<tr>
<td>Dividends</td>
<td>6.23</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Equity Issuance</td>
<td>40.05</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Wage</td>
<td>0.48</td>
<td>0.82</td>
<td>1.72</td>
<td>3.95</td>
</tr>
<tr>
<td>Firm value</td>
<td>3.40</td>
<td>5.78</td>
<td>10.52</td>
<td>24.09</td>
</tr>
<tr>
<td>Welfare</td>
<td>0.31</td>
<td>0.52</td>
<td>1.04</td>
<td>2.27</td>
</tr>
</tbody>
</table>

- the long-run aggregate $K$, output, consumption, and $w$ increase
- the wage increases:
  - more firms are in the EIR and these firms are profitable and invest more $\Rightarrow \uparrow L^d$
  - $\downarrow L^s$ because the HH receives higher payouts (are wealthier) (GE feedback)
Second policy experiment: taxes rates cut from $\tau_d = .25, \tau_g = .20$ to $\tau_d = .15, \tau_g = .15$:

<table>
<thead>
<tr>
<th></th>
<th>$\tau_d = 0.22$</th>
<th>$\tau_d = 0.20$</th>
<th>$\tau_d = 0.15$</th>
<th>$\tau_d = 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\tau_g = 0.20$</td>
<td>$\tau_g = 0.20$</td>
<td>$\tau_g = 0.15$</td>
<td>$\tau_g = 0$</td>
</tr>
<tr>
<td>Capital</td>
<td>0.27</td>
<td>0.52</td>
<td>4.26</td>
<td>13.95</td>
</tr>
<tr>
<td>Output</td>
<td>0.58</td>
<td>1.00</td>
<td>2.15</td>
<td>5.04</td>
</tr>
<tr>
<td>Consumption</td>
<td>0.38</td>
<td>0.63</td>
<td>1.30</td>
<td>2.91</td>
</tr>
<tr>
<td>Dividends</td>
<td>6.23</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Equity Issuance</td>
<td>40.05</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Wage</td>
<td>0.48</td>
<td>0.82</td>
<td>1.72</td>
<td>3.95</td>
</tr>
<tr>
<td>Firm value</td>
<td>3.40</td>
<td>5.78</td>
<td>10.52</td>
<td>24.09</td>
</tr>
<tr>
<td>Welfare</td>
<td>0.31</td>
<td>0.52</td>
<td>1.04</td>
<td>2.27</td>
</tr>
</tbody>
</table>

- firms do not face the tax differential cost of external E finance $\Rightarrow$ MM dividend policy irrelevance theorem holds $\Rightarrow D$ and new $E$ values are indeterminate
- the increases in agg. $K$, $Y$, $C$ and $w$ are higher: in particular, agg. $K \uparrow = 4.26\%$
## Quantitative Results: General Equilibrium

**Productivity:** we consider the changes of \( \tau_d \) from 0.25 to 0.22 and 0.20

<table>
<thead>
<tr>
<th></th>
<th>( \tau_d = 0.25 )</th>
<th>( \tau_d = 0.22 )</th>
<th>( \tau_d = 0.20 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage change in TFP</td>
<td>0.00</td>
<td>0.479</td>
<td>0.721</td>
</tr>
<tr>
<td>Percentage change in ( Y/L )</td>
<td>0.00</td>
<td>0.430</td>
<td>0.818</td>
</tr>
</tbody>
</table>

- TFP and Labor productivity increases after the tax reduction:
  - some liquidity constrained firms move to the EIR and they attract more K and Labor \( \Rightarrow \) the allocation of K and L is more efficient
Final Remarks

This article presents DGEM to analyze the LR effects of the dividend tax reform on agg. K accumulation. Two features are central to the analysis: Firm heterogeneity in productivity and GE.

- Firm heterogeneity implies that firms may lie in different finance regimes over time and respond to dividend taxation in different ways:
  - In particular, some firms behave according to the traditional view of dividend taxation and others behave according to the new view.
- GE provides better estimates.

The results indicate that:

- When both D and K gains tax rates are cut from 25 and 20 %, respectively, to the same 15 % permanently, the agg. LR capital stock increases by about 4 %.

Fossati Román (Universidad Carlos III) Firm Heterogeneity and the Long-Run Effects November 2009 25 / 25