Taxing Firms Facing Financial Frictions

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Corporate income is often taxed at different sources

- Equity at the firm level
  - Corporate income tax ($\tau_c$)

- Equity at the individual level
  - Dividends ($\tau_d$) and capital gains taxes ($\tau_g$)

- Debt at the individual level
  - Household income tax due to interest payments ($\tau_i$)
Motivation and question

- Some countries like the U.S, Chile and more recently Colombia, tax dividends on top of corporate profits

- Under financial frictions, linear taxes on dividends and corporate profits are not equivalent

**Research question:**
What is the effect of replacing the corporate income tax by a tax on shareholders, in a revenue neutral way?
What we do

- We use a model of heterogeneous firm dynamics
  - idiosyncratic productivity,
  - borrowing constraints,
  - costly equity issuance, and
  - endogenous entry and exit
- We calibrate the model to U.S. data
  - Compustat industrial files from 2003 to 2015,
- We find that in *steady state*,
  - total factor productivity increases by 1.7%.
  - output increases by 6.8%
Mechanism

- Firms are hit by idiosyncratic productivity shocks
- Conditional on productivity, there is an optimal size
- Due to financial frictions, adjustment of capital stock is not immediate
- Instead, profits are (often) re-invested
- The corporate income tax reduces such profits
- This delays capital accumulation
- Taxing at the shareholder level does not reduce net worth
General Equilibrium Feedback

- Faster capital accumulation increases labor demand
- Higher wage forces least productive firms to exit
- Households increase their labor supply
1] **Theory**
   - Traditional View [Poterba and Summers, 1984]
   - New View [Auerbach, 1979], [Bradford, 1981], [King, 1974]
   - Marginal source of investment is exogenous

2] **Empirics**
   - Dividend tax cuts have no effect of investment [Yagan, 2015]
   - Bonus depreciation allowances have a strong effect on investment [Zwick et al., 2014]
   - Difference in difference approach

3] **Closest papers** [Gourio and Miao, 2010], [Gourio and Miao, 2011].
   - Bush tax cuts increased steady state stock of capital by 4%.
   - Equity and retained earnings differ only because of tax reasons.
Model Overview

- Discrete time, infinite horizon
- Representative household owns the firms and supplies labor.
  \[ \log \left( C - \kappa L^{1+1/\gamma} \right) \]
- Heterogenous firms invest to reach an optimal size.
  \[ zk^{\alpha_k} f^{\alpha_l} = f \quad z' \sim \log \mathcal{N}(\rho z, \sigma^2) \]
- Firms face collateral constraints and equity issuance costs.
  \[ b' \leq \theta (1 - \delta) k' \quad \lambda_0 + \lambda_1 e \]
Endogenous entry and exit.

- Government uses linear tax rates to finance exogenous expenditure $G$.

- Operating profits: $\pi(k, z) = \max_l zk^\alpha l^\alpha - f - wl$

- Corporate taxes paid: $\tau_c(\pi(k, z) - \delta k - rb)$

- Define net worth as

$$\omega = \pi(k, z) - \tau_c(\pi(k, z) - \delta k - rb) + (1 - \delta)k - (1 + r)b$$
Firms Objective

- No arbitrage,

\[(1 - \tau_i) r = (1 - \tau_g) \frac{E'_0 - E}{E} + (1 - \tau_d) \frac{D}{E}\]

- When new shares are issued,

\[E'(s) = E'_0(s) + N(s) + \Lambda(N(s))\]

- Firms maximize the market (cum-dividend) value

\[P(s) = \frac{1 - \tau_d}{1 - \tau_g} \underbrace{D(s) - N(s) - \Lambda(N(s))}_{1 - \tilde{\tau}_d} + \left(1 + \frac{1 - \tau_i}{1 - \tau_g} r\right)^{-1} \underbrace{P'(s)}_{\tilde{\beta}}\]
Let $\phi = 1\{d < 0\}$

$$P(\omega, z) = \max_{k', b'} (1 - \phi)(1 - \tilde{\tau}_d)d + \phi (d - \Lambda(-d))$$

$$+ \tilde{\beta} \mathbb{E}_{z'} \left[ \max \{\Omega(k', b'), P(\omega', z')\} \mid z \right]$$

Subject to

$$\theta(1 - \delta)k' \geq b' \quad \text{(Collateral Constraint)}$$

$$\omega' = (1 - \tau_c)(\pi(z', k') - \delta k' - rb') + k' - b'$$

$$d = \omega - k' + b'$$

$$\Omega(k', b') = (1 - \tilde{\tau}_d)[(1 - (1 - \tau_c)\delta)k' - (1 + (1 - \tau_c)r)b']$$

is the value of exit
Free entry

\[ \mathbb{E} P(0, z) = c_e, \text{ if } M > 0 \]
\[ \mathbb{E} P(0, z) < c_e, \text{ if } M = 0 \]

Entrants draw the productivity shock from the ergodic distribution of \( z \)
Firm Policies

Small firms issue equity, bigger firms use debt. Only big firms distribute dividends.
Corporate Income Tax
Lower corporate income taxes increase investment

Change in Corporate Income Tax
Partial equilibrium effect

\[ \tau_c = 0.35 \]
\[ \tau_c = 0.30 \]

Net worth
Mass of firms

\( k' \)

FOC
The equity - retained earnings margin is not distorted.
Key parameters are calibrated via SMM.

We use data from the Compustat industrial files, from 2003 to 2015.

\( \theta, \lambda_0, \lambda_1 \) drive the severity of financial frictions.

\( \delta \) drives investment in steady state.

\( \rho_z, \sigma_z, f \) drive turnover.

A second set of parameters is fixed. We use estimates typically found in the literature.
Targeted parameters are estimated via Simulated Method of Moments. In front of each parameter is the moment that is most informative to identify the corresponding parameter.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target / Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta$</td>
<td>0.223</td>
<td>Average leverage</td>
</tr>
<tr>
<td>$\lambda_0$</td>
<td>0.026</td>
<td>Frequency of equity issuances</td>
</tr>
<tr>
<td>$\lambda_1$</td>
<td>0.071</td>
<td>Average equity issuances</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.077</td>
<td>Average investment rate</td>
</tr>
<tr>
<td>$\rho_z$</td>
<td>0.75</td>
<td>Autocorrelation of profits to assets</td>
</tr>
<tr>
<td>$\sigma_z$</td>
<td>0.099</td>
<td>Std. deviation of profits to assets</td>
</tr>
<tr>
<td>$H$</td>
<td>3.4</td>
<td>Aggregate hours</td>
</tr>
<tr>
<td>$f$</td>
<td>1.445</td>
<td>Average dividends to profits</td>
</tr>
<tr>
<td>$c_e$</td>
<td>0.042</td>
<td>Turnover</td>
</tr>
</tbody>
</table>
## Parameterization

### Fixed Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target / Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\gamma$</td>
<td>0.5</td>
<td>[Chetty et al., 2011]</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.972</td>
<td>4% interest rate</td>
</tr>
<tr>
<td>$\alpha_I$</td>
<td>0.64</td>
<td>Prescott (1986)</td>
</tr>
<tr>
<td>$\alpha_K$</td>
<td>0.23</td>
<td>Midpoint of [0.83,0.91] DRS in Lee (2005)</td>
</tr>
</tbody>
</table>

### Tax Rates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target / Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau_C$</td>
<td>0.35</td>
<td>Top statutory rate</td>
</tr>
<tr>
<td>$\tau_D$</td>
<td>0.15</td>
<td>Top statutory rate</td>
</tr>
<tr>
<td>$\tau_G$</td>
<td>0.15</td>
<td>Top statutory rate</td>
</tr>
<tr>
<td>$\tau_I, \tau_J$</td>
<td>0.28</td>
<td>Mendoza, Razin, Tesar (1994)</td>
</tr>
</tbody>
</table>
## Targeted Moments

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average investment rate</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Standard deviation of profits</td>
<td>0.11</td>
<td>0.09</td>
</tr>
<tr>
<td>Average leverage</td>
<td>0.17</td>
<td>0.21</td>
</tr>
<tr>
<td>Average equity issuances</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>Frequency of equity issuances</td>
<td>0.19</td>
<td>0.22</td>
</tr>
<tr>
<td>Autocovariance of profits</td>
<td>0.39</td>
<td>0.61</td>
</tr>
<tr>
<td>Turnover (Lee, Mukoyama)</td>
<td>0.06</td>
<td>0.05</td>
</tr>
<tr>
<td>Time at work</td>
<td>0.33</td>
<td>0.33</td>
</tr>
<tr>
<td>Average dividends to profits</td>
<td>0.48</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Data moments are computed using Compustat annual industrial files 2003-2015. Autocorrelation and standard deviation of profits are computed using both firm and time fixed effects.
Thought experiment

In the baseline model, government expenditures 12.9% of GDP.¹

We fix the value of $G$, and find $\tau$ such that,

$$G = \tau_i rB + \tau D + \hat{\tau}_c (\Pi - \delta K - rB - f) + \tau (E' - E) + \tau_I (wL)$$

for $\hat{\tau}_c \in [0.35, 0.0]$.

¹Compared to 9.05% average between and 2003-2015
## Results

<table>
<thead>
<tr>
<th>$\tau_c$</th>
<th>35%</th>
<th>0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>100</td>
<td>106.8</td>
</tr>
<tr>
<td>Capital</td>
<td>100</td>
<td>115.2</td>
</tr>
<tr>
<td>Labor</td>
<td>100</td>
<td>102.6</td>
</tr>
<tr>
<td>Consumption</td>
<td>100</td>
<td>106.4</td>
</tr>
<tr>
<td>TFP</td>
<td>100</td>
<td>101.7</td>
</tr>
<tr>
<td>Wage</td>
<td>100</td>
<td>105.3</td>
</tr>
<tr>
<td>SS utility</td>
<td>100</td>
<td>102.6</td>
</tr>
<tr>
<td>Turnover</td>
<td>5%</td>
<td>9%</td>
</tr>
</tbody>
</table>
Channels

1. Faster capital accumulation
2. Higher wage and exit by low productivity firms
3. Labor supply
Faster capital accumulation

Capital Accumulation Before and After Reform

Benchmark
Reform

Time since entry
Capital

0 2 4 6 8 10 12 14
0 20 40 60 80 100 120

0 2 4 6 8 10 12 14
0 20 40 60 80 100 120

Faster capital accumulation
Reallocation

Distribution of Productivity

\[ \tau_c = 0.35 \]

\[ \tau_c = 0.0 \]
What would be the effect of the reform if firms and households faced the pre-reform wage, but the post-reform tax and interest rates?

What would be the effect of the reform if labor supply was inelastic?
## Decomposition

<table>
<thead>
<tr>
<th></th>
<th>Pre-reform</th>
<th>Accumulation</th>
<th>Reallocation</th>
<th>Post-reform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>100</td>
<td>100.4</td>
<td>104</td>
<td>106.7</td>
</tr>
<tr>
<td>Capital</td>
<td>100</td>
<td>112.2</td>
<td>111.3</td>
<td>115.2</td>
</tr>
<tr>
<td>Labor</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>102.6</td>
</tr>
</tbody>
</table>
We studied the effects of replacing the corporate income taxation, by a tax on shareholders, in a model with borrowing constraints, costly equity issuances and endogenous entry and exit.

When capital gains can be taxed on accrual (or equity issuances are tax deductible), eliminating the corporate income in a revenue neutral way increases steady state GDP by 6.8%, TFP by 1.7%.

More generally, models of heterogenous firms facing financial frictions are promising to rationalize empirical tax elasticities.


Transitional dynamics of dividend and capital gains tax cuts.  

- **King, M. A. (1974).**  
  Taxation and the cost of capital.  

- **Poterba, J. M. and Summers, L. H. (1984).**  
  The economic effects of dividend taxation.

- **Yagan, D. (2015).**  

- **Zwick, E., Mahon, J., et al. (2014).**  
  Do financial frictions amplify fiscal policy? evidence from business investment stimulus.  
  *Harvard University.*
Set $\tau_i = \tau_g = \tau_d$.

<table>
<thead>
<tr>
<th>$\tau_c$</th>
<th>35%</th>
<th>0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>100</td>
<td>107.1</td>
</tr>
<tr>
<td>Capital</td>
<td>100</td>
<td>116.2</td>
</tr>
<tr>
<td>Labor</td>
<td>100</td>
<td>102.7</td>
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</tr>
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<td>Turnover</td>
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<td>9%</td>
</tr>
</tbody>
</table>
Dividend, Capital Gains Taxes and Interests

Firm policies are unchanged

Change in Dividend Tax and Capital Gains Partial equilibrium effect

\[ \tau_d = \tau_g = \tau_i = 0.15 \]

\[ \tau_d = \tau_g = \tau_i = 0.10 \]
Timing

\[ (k, b) \quad z \quad \omega \quad k', b' \quad t + 1 \]

entry (M)

exit
Household
First Order Conditions

- No arbitrage,
\[
(1 - \tau_i) r = (1 - \tau_g) \frac{E'_0 - E}{E} + (1 - \tau_d) \frac{D}{E}
\]

- Labor supply
\[
-u_l(C, L) = (1 - \tau_l) wu_c(C, L)
\]

- Euler equation
\[
u_c(C, L) = (1 + (1 - \tau_i)r) \beta E V'(A') \]

The inter-temporal wedge only depends on the personal income tax.
Stationary Equilibrium

Allocation rules C, B’, L for the household,
Allocation rules k’, b’, l’ for each firm,
A mass of entrants E and a measure G, such that,

- C, B’, L solve the household problem, given r, w
- k’, b’, l’, and exit decision solve the firm problem, given r, w
- M is consistent with free entry
- $B' = \int q'(\omega, z)dG(\omega, z)$
- $L = \int l'(\omega, z)dG(\omega, z)$
- $G'(\otimes, Z) = G(\otimes, Z)$
Investment Decision

\[
P_{\omega}(\omega, z) \tilde{\beta}^{-1} = (1 - \tilde{\tau}_d)(1 - (1 - \tau_c)\delta) Pr(z' < z^*(k', b')) \\
+ \int_{z^*(k', b')}^{Z} P_{\omega}(\omega', z') \left( (1 - \tau_c)(\alpha z' k'^{\alpha-1} - \delta) + 1 \right) \pi(z'|z) \, dz'
\]

where

\[
P_{\omega}(\omega', z') = 1 - \tilde{\tau}_d \quad \text{if} \quad \phi(w', z') = 0 \\
= 1 + \lambda_1 \quad \text{if} \quad \phi(w', z') = 1
\]
Investment Decision

\[ P_\omega(\omega, z) \beta^{-1} = (1 - \tilde{\tau}_d)(1 - (1 - \tau_c)\delta)Pr(z' < z^*(k', b')) + \int_{z^*(k', b')}^{\bar{z}} P_\omega(\omega', z') \left( (1 - \tau_c)(\alpha z' k'^{\alpha - 1} - \delta) + 1 \right)\pi(z'|z)dz' \]

where

\[ P_\omega(\omega', z') = 1 - \tilde{\tau}_d \quad \text{if} \quad \phi(w', z') = 0 \]
\[ = 1 + \lambda_1 \quad \text{if} \quad \phi(w', z') = 1 \]

- If firm is issuing equity, investment is decreased by dividend taxes. If it is distributing dividends, investment is increased.
Investment Decision

\[ P_{\omega}(\omega, z) \tilde{\beta}^{-1} = (1 - \tilde{\tau}_d)(1 - (1 - \tau_c)\delta)Pr(z' < z^*(k', b')) \]

\[ + \int_{z^*(k', b')}^{\bar{z}} P_{\omega}(\omega', z') \left( (1 - \tau_c)(\alpha z' k'^{\alpha - 1} - \delta) + 1 \right) \pi(z'|z)dz' \]

where

\[ P_{\omega}(\omega', z') = 1 - \tilde{\tau}_d \quad \text{if } \phi(w', z') = 0 \]

\[ = 1 + \lambda_1 \quad \text{if } \phi(w', z') = 1 \]

- Corporate taxes decrease the marginal product of capital in every state of the world.
There is a unique $z^*(k', q')$ such that

$$(1 - \tilde{\tau}_d)[(1 - (1 - \tau_c)\delta)k' - (1 + (1 - \tau_c)r)b'] = P(\omega'(z^*, k', b'), z^*)$$

and firms exit if and only if $z' < z^*(k', b')$

- $z^*$ increases in $\tau_c$.
- $z^*$ decreases in $\tilde{\tau}_d$. 

back