Optimal Corporate Taxation Under Financial Frictions

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Introduction

- Most governments tax corporations ("firms")
- Suppose a government wants to tax firms
  - What kind of taxes should be collected?
  - Which companies should be taxed?
- Frictionless models: taxing firms is just taxing factors
- Financial frictions: funds inside the firm can be worth more than funds outside

Our Approach

- Normative theory of optimal corporate taxes
  - Revenue-raising objective
  - Partial equilibrium
  - Nothing to say about choice of corporate form
- What are the optimal allocations?
- What tax policies implement these allocations?
  - Does "tax_rate×(profits - deductions)" make sense?
  - Why deduct interest payments but not dividends?
- Large positive literature on corporate taxation
  - but surprisingly few normative results

Key Ideas

- It is optimal to tax only financially unconstrained firms
  - ...but it is hard to tell which firms are constrained!
  - Big literature: Fazzari et al. [1988], Kaplan and Zingales [1997]
  - Firms, however, know whether they are constrained
- Government should use a mechanism to elicit which firms are constrained, then tax the unconstrained firms
  - The mechanism must be incentive compatible: firms that reveal to be unconstrained know they will be taxed

Corporate Payout Tax

- Result: the optimal mechanism is a **Corporate Payout Tax**
  - A tax paid in proportion to firms' dividends+share buybacks
  - Implementation: all retained earnings and interest payments deductible
- Key idea: constrained firms don't like to make payouts
  - They have good investment opportunities
  - Unconstrained firms still want to make payouts at some point
    - Firms' goal is to maximize NPV of dividends
- Quantitative Result: revenue-neutral switch from profit to payout taxation increases firm value by 7%

Literature

- Vast positive literature on personal and corporate taxation
  - Surveys: Auerbach and Hines Jr [2002] and Graham [2013]
  - Firms as a veil: incidence on factors (Harberger [1962])
  - Dividend taxation: Poterba and Summers [1984]
  - Adding taxes to financial friction models: Li et al. [2016]
- Normative literature on personal and capital taxation
  - Static models: Mirrlees [1971].
  - Survey of Dynamic Models: Golosov et al. [2016]
  - Judd [1985], Chamley [1986], Chari and Kehoe [1999], Straub and Werning [2020]
- Underdeveloped normative literature on corporate taxation:
  - Optimality of interest deduction: He et al. [2015]
- Models and Empirics of Financial Frictions:
  - Kehoe and Levine [1993], Rampini and Viswanathan [2010]
  - Fazzari et al. [1988], Kaplan and Zingales [1997]

Paper Outline

1. Stylized Model
   - Two-period model with ad-hoc financial friction
   - Illustrates key ideas behind why payout tax is optimal
2. Dynamic infinite horizon model
   - Micro-founded financial friction
   - No government commitment
   - Entry with debt/equity tradeoff
   - Payout tax remains optimal
3. Quantitative model
   - Calibrated model with entry and exit
   - Assess revenue-neutral policy change

- Extensions (alternative frictions, equity issuance post-entry) in paper

Stylized Model

- Two dates, zero and one, no discounting
- Measure $\mu(\theta)$ of firms with productivity $\theta \in (0, 1]$
  - All firms have date one profits $\theta_0 f(k_0)$
  - Investing k_1 at date zero will generate date one profits $\theta f(k_1)$
  - Cannot raise financing (extreme form of financial friction)
  - Usual assumptions: $f(0) = 0$, f increasing, cont. differentiable, concave
- Government: must raise taxes with NPV $G > 0$
  - can tax at date zero but doesn't know θ
  - can tax at date one, observes profits and capital (infers productivity)
  - must respect no-external-financing constraint, cannot subsidize

Government's Problem

- Mechanism: $k_1(\hat{\theta}), \tau_0(\hat{\theta}), \tau_1(\theta, \hat{\theta})$, all non-negative
  - functions of report $\hat{\theta}$, date one taxes can condition on truth θ
- Firm value:

$$V\left(\theta, \hat{\theta}\right) = \underbrace{\theta_0 f\left(k_0\right) - k_1\left(\hat{\theta}\right) - \tau_0\left(\hat{\theta}\right)}_{\text{date zero payout}} + \underbrace{\theta f\left(k_1\left(\hat{\theta}\right)\right) - \tau_1\left(\theta, \hat{\theta}\right)}_{\text{date one payout}}$$

- Gov Problem: $\max_{k_1(\hat{\theta}), \tau_0(\hat{\theta}), \tau_1(\theta, \hat{\theta})} \int_0^1 V\left(\theta, \theta\right) d\mu\left(\theta\right)$
  - subject to IC, $\theta \in \arg\max_{\hat{\theta} \in (0,1]} V\left(\theta, \hat{\theta}\right)$,
  - revenue-raising, $G \leq \int_0^1 \left(\tau_0\left(\theta\right) + \tau_1\left(\theta, \theta\right)\right) d\mu\left(\theta\right)$,
  - and no-financing: $\theta_0 f\left(k_0\right) \geq k_1\left(\hat{\theta}\right) + \tau_0\left(\hat{\theta}\right)$, $\theta f\left(k_1\left(\hat{\theta}\right)\right) \geq \tau_1\left(\theta, \hat{\theta}\right)$

Discussion

- Can punish liars with τ_1, but constrained by limited liability
  - not obvious if IC binds
- No exogenous redistribution motive (unlike Mirrlees)
- Goal instead is constrained production efficiency:
  - define first-best capital $k^*(\theta) = \min\{k \geq 0 : \theta f'(k) = 1\}$
  - define constrained efficient (second-best) capital $k^{ce}(\theta) = \min\{\theta_0 f(k_0), k^*(\theta)\}$
- Claim: if a mechanism is feasible and IC, and $k_1(\theta) = k^{ce}(\theta)$, and raises exactly G, it is optimal
  - no concern for redistribution apart from production efficiency
  - does such a mechanism exist?

Payout Taxes

- Payout tax mechanism:

$$k_1\left(\hat{\theta}\right) \in \arg \max_{k_1 \in [0, \theta_0 f(k_0)]} \frac{1}{1+\tau_d}(\theta_0 f(k_0) - k_1) + \frac{1}{1+\tau_d}\hat{\theta} f(k_1),$$

$$\tau_0\left(\hat{\theta}\right) = \frac{\tau_d}{1+\tau_d}\left(\theta_0 f\left(k_0\right) - k_1\left(\hat{\theta}\right)\right),$$

$$\tau_1\left(\theta, \hat{\theta}\right) = \frac{\tau_d}{1+\tau_d}\theta f\left(k_1\left(\hat{\theta}\right)\right).$$

  - taxes proportional (τ_d) to payouts received by owners (tax rate $\frac{\tau_d}{1+\tau_d}$)
  - capital chosen to maximize value of firm accounting for taxes (IC)
  - is feasible (all payouts non-negative)

The Optimality of Payout Taxes

- Constrained efficiency:
  - if $k^*(\hat{\theta}) \leq \theta_0 f(k_0)$, FOC $\frac{1}{1+\tau_d}(\hat{\theta} f'(k_1(\hat{\theta})) - 1) = 0$
  - if $k^*(\hat{\theta}) > \theta_0 f(k_0)$, $k_1(\hat{\theta}) = \theta_0 f(k_0)$
  - Auerbach [1979] with financial friction + private information
- Revenue raising:

$$G_d(\tau_d) = \frac{\tau_d}{1+\tau_d} \int_0^1 \left[\theta_0 f(k_0) - k^{ce}(\theta) + \theta f(k^{ce}(\theta))\right] d\mu(\theta).$$

  - either $G_d(\tau_d) = G$ for some $\tau_d \in [0, \infty)$, or problem is infeasible
- Conclusion: payout tax is optimal
  - other optimal mechanisms also exist
  - don't need to punish liars ($\hat{\theta} \neq \theta$)

Profit Taxes

- Full depreciation; profits
  $\pi_0 = \theta_0 f(k_0) - k_0, \quad \text{and} \quad \pi_1 = \theta f(k_1) - k_1.$
- Profit tax mechanism, $\tau_p \in (0,1)$:

$$\begin{aligned} k_1\left(\hat{\theta}\right) &\in \arg \max_{k_1 \in [0,(1-\tau_p)\theta_0 f(k_0)+\tau_p k_0]} (1-\tau_p)\left(\theta_0 f(k_0) - k_0\right) \\ &\quad + (1-\tau_p)\left(\hat{\theta} f(k_1) - k_1\right), \\ \tau_0\left(\hat{\theta}\right) &= \tau_p\left(\theta_0 f(k_0) - k_0\right), \\ \tau_1\left(\theta, \hat{\theta}\right) &= \tau_p \max\left\{\theta f\left(k_1\left(\hat{\theta}\right)\right) - k_1\left(\hat{\theta}\right), 0\right\}. \end{aligned}$$

  - mechanism feasible (by construction)
  - mechanism IC (k_1 chosen to max post-tax value)

The Sub-Optimality of Profit Taxes

- Profit taxes do not achieve constrained efficiency:
  - if $k_1^*(\hat{\theta}) > (1-\tau_p)\theta_0 f(k_0) + \tau_p k_0$
  - past profits do not indicate a lack of financial constraints
  - in contrast, willingness to payout does indicate lack of constraints
- This is different from the usual problem
  - FOC: $(1-\tau_p)\left(\hat{\theta} f'\left(k_1(\hat{\theta})\right) - 1\right) = 0$
  - due to full depreciation; partial depreciation would lead to distortion
  - "full expensing" fixes this distortion but not frictions problem

The General Model

- General model: more robust theory results, build towards quantification
- Compared to stylized model:
  1. micro-founded financing constraint [Rampini and Viswanathan, 2010].
  2. infinite-horizon model with entry and exit.
  3. no government commitment.
  4. more general production function, neoclassical depreciation, discounting.
  5. investment and payouts chosen separately (two IC constraints)

Agents

- Three agents
  1. Firms, controlled by "shareholders"
  2. Outside investors
  3. Government
- Risk-neutral firms and outside investors
- Gross real interest rate/discount rate $R > 1$
  - Invariant to policy (partial equilibrium)
- Government
  - Must raise taxes from firms
  - Maximizes firms' welfare
  - Can borrow/save

Within-Date Timing

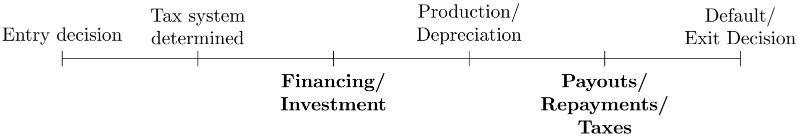


Figure: Within-date timeline

Financing and Investment

- The firm begins the period with wealth w_t
- The firm can raise debt $R^{-1}b_t \geq 0$
  - No government subsidies
  - No equity issuance, except at entry
- The firm invests the resources in capital

$$0 \leq k_t \leq R^{-1}b_t + w_t$$

  - No removal of funds from firm at this stage
  - Free disposal, but this will never be optimal

Production and Types

- Firms' production function: $f(k_t, \theta_t)$
  - Neoclassical assumptions (DRS)
  - Capital depreciates at a rate δ
- Firms date t productivity (type) $\theta_t \in [0,1]$ is publicly observed
- Firms date $t+1$ productivity $\theta_{t+1} \in [0,1]$ is
  - Known to the firm at date t, known to the government at $t+1$
  - Measure $\Pi(\cdot|\theta_t)$ on θ_{t+1} given θ_t
  - $\theta_t = 0$ is "exiting"
- Efficient level of capital $k^*(\theta)$
  - smallest level of capital with

$$f_k(k^*(\theta), \theta) + 1 - \delta = R$$

  - "cash-like" option, $f_k(k, \theta) + 1 - \delta \geq R$
  - $f_{k\theta}(k, \theta) > 0$ for $k < k^*(\theta)$

Dividends, Taxes, and Repayment

- Firms declare a dividend (payout), $d_t \in \left[0, w^D(k_t, \theta_t)\right]$
- Firms face repayment $b_t \geq 0$ and taxes $\tau_t \geq 0$
- If the firm pays its dividend, taxes, and creditors, wealth remaining is

$$w_{t+1} = f\left(k_t, \theta_t\right) + \left(1 - \delta\right) k_t - d_t - b_t - \tau_t$$

- We define wealth following default (pre-dividend) as

$$w^D\left(k_t, \theta_t\right) = f\left(k_t, \theta_t\right) + \left(1 - \varphi\right)\left(1 - \delta\right) k_t$$

- Shareholders can keep profits and $1 - \varphi$ share of un-depreciated capital, as in Rampini and Viswanathan [2010]

Default

- Default assumption
  - Limited enforcement
  - No exclusion (firm can "restructure")
- No history dependence (government can't punish default)
- Government/creditors can allow or block dividends
  - prevents "looting" immediately before default
- Generates constraint of RV 2010:

$$w_{t+1} \geq w^D(k_t, \theta_t) - d_t \Leftrightarrow \tau_t + b_t \leq \varphi(1-\delta)k_t$$

Exit

- Type $\theta = 0$ is "exiting"
  - Exiting firms have no productive opportunities
  - $k^*(0) = 0$, $\theta_t = 0 \Rightarrow \theta_{t+1} = 0$.
  - leave economy once zero wealth is reached
- Firms forced to exit with probability $\Pi(0|\theta_t)$
- Can choose to exit if not forced
  - won't happen in eq.
- Government knows current type (if firm is exiting)
  - only firm knows if it will be exiting next period

What is Missing

- No uncertainty, except about firm's type
  - For simplicity, not necessary
- "Cash-like" investment instead of cash (doesn't change results)
- No factors aside from capital
  - Other factors don't change things, but need DRS
  - Or (maybe) imperfect substitutes across firms' goods
- Extension: costly equity issuance
- Extension: functional form of w^D, debt-to-earnings restrictions

Critical Assumptions

- RV 2010 financial constraint
  - Otherwise, asymmetric info. matters for private creditors
- Government cannot commit or subsidize
  - Otherwise, can circumvent financial frictions
- Government can borrow and save
  - Uses borrowing and saving to ensure constant payout tax
- Firms can't pay out wealth except via dividend/share repurchases
  - Result related to "trapped equity" view
  - No way to dodge taxes
- Firms maximize NPV of dividends
  - If firms max manager pay, taxing manager pay may be optimal

Intuition

- A constant dividend tax rate $\tau_t = \tau_d \times d_t$ doesn't distort Euler equation
  - Euler: make payouts today vs. invest and pay tomorrow
  - well-known in public economics (Auerbach [1979])
  - from a model without financial frictions
- How do financial frictions matter?

$$\frac{1}{1+\tau_d} V_{t+1}(w_{t+1}, \theta_{t+1}) \geq \frac{1}{1+\tau_d} V_{t+1}(w^D(k_t, \theta_t) - d_t, \theta_{t+1})$$

$$w_{t+1} - w^D(k_t, \theta_t) + d_t = \varphi(1-\delta)k_t - \tau_t - b_t$$

  - Looks like payout tax will matter
  - But... firms that are constrained won't make payouts!
  - So constraint tightens only for firms for whom it doesn't bind!

Firm Population and Government Debt

- Population of firms μ_t and government debt B_t are state variables
- measure of entering firms $de_t\left(w',\theta';\mu_t,B_t\right)$
- wealth and taxes under optimal policies: $w^*_{t+1}\left(\theta';w,\theta\right)$, $\tau^*_t\left(\theta';w,\theta\right)$

$$d\mu_{t+1}\left(w',\theta'\right)=de_t\left(w',\theta';\mu_t,B_t\right)\\+\int_{0^+}^{\infty}\int_0^1\delta_{\text{Dirac}}\left(w^*_{t+1}\left(\theta';w,\theta\right)-w'\right)d\Pi\left(\theta'|\theta\right)d\mu_t\left(w,\theta\right)$$

$$B_{t+1}=R\left(B_t+G_t\right)-\int_{0^+}^{\infty}\int_0^1\int_0^1\tau^*_t\left(\theta';w,\theta\right)d\Pi\left(\theta'|\theta\right)d\mu_t\left(w,\theta\right)$$

Government Policy

- Choose spending G_t, and mechanism $m_t(w, \theta)$ for each observable (w, θ)
- Gov spending choice: for some $\bar{\chi} > 1$, target $\bar{G}$, utility

$$u(G_t) = \begin{cases} \left(G_t - \overline{G}\right), & \text{if } G_t \geq \overline{G} \\ -\overline{\chi}\left(\overline{G} - G_t\right), & \text{if } G_t < \overline{G}, \end{cases}$$

  - spending above target valued same as transfers to firm owners
  - spending below target valued more
- Mechanism: chosen from set $\mathcal{M}(w, \theta, V_{t+1})$
  - some constraints (e.g. IC, no-default) depend on continuation value function
  - determines $w^*_{t+1}(\theta'; w, \theta), \tau^*_t(\theta'; w, \theta)$, $d^*_t(\theta'; w, \theta)$

Mechanisms

- Observable type (w, θ)
- Report when investing θ', report when paying out θ''
- Non-negative functions
  $w_{t+1}(\theta', \theta''; w, \theta), \tau_t(\theta', \theta''; w, \theta), d_t(\theta', \theta''; w, \theta),$
  $b_t(\theta'; w, \theta), k_t(\theta'; w, \theta)$,
  - $w^*_{t+1}(\theta'; w, \theta) = w_{t+1}(\theta', \theta'; w, \theta)$ under truthful reporting
- Feasible: div. limit, initial budget, production function
- No-default: no-default post-div, no-default with blocked div., no ignoring mech.
- IC: report truth at both financing/investment and dividend/taxes stages
- $\mathcal{M}(w, \theta, V_{t+1})$: set of feasible, no-default, IC mechanisms

Government's Problem

- In Markov sub-game perfect equilibrium, gov. solves

$$
\begin{aligned}
J_t\left(\mu_t, B_t\right) = & \max_{B_{t+1}, G_t, \{m_t(w,\theta) \in \mathcal{M}(w,\theta,V_{t+1})\}_{w \in \mathbb{R}_+, \theta \in [0,1]}} u\left(G_t\right) \\
& + R^{-1} \int_{0^+}^{\infty} \int_0^1 \int_0^1 d_t^*\left(\theta'; w, \theta\right) d\Pi\left(\theta' | \theta\right) d\mu_t\left(w, \theta\right) \\
& + R^{-1} J_{t+1}\left(\mu_{t+1}, B_{t+1}\right),
\end{aligned}
$$

- Transversality $\lim_{s\to\infty} E_t[R^{-s} J_{t+s}(B_{t+s}, \mu_{t+s})] = 0$
- No-Ponzi $\lim_{s\to\infty} E_t[R^{-s} B_{t+s}] \leq 0$
- Stationarity: $J_t(B, \mu) = J_{t+1}(B, \mu)$, $V_t(w, \theta; B, \mu) = V_{t+1}(w, \theta; B, \mu)$
- Firm value with constant payout tax: $\overline{V}\left(w, \theta; \tau_d\right) = \frac{1}{1+\tau_d} \overline{V}\left(w, \theta; 0\right)$

Entry

- Measure $e(\hat{w}, \theta')$ of potential entrants, fixed cost F
- If choosing to enter, can choose entry wealth:

$$w_E\left(\hat{w}, \theta'; \mu_t, B_t\right) \in \arg\max_{w' \in [0, \hat{w}]} \mathbb{E}\left[V_{t+1}\left(w', \theta'; \mu_{t+1}, B_{t+1}\right) \middle| \mu_t, B_t\right] - w'$$

- Will enter if

$$\mathbb{E}\left[V_{t+1}\left(w_E\left(\hat{w}, \theta'; \mu_t, B_t\right), \theta'; \mu_{t+1}, B_{t+1}\right) \middle| \mu_t, B_t\right] - w_E\left(\hat{w}, \theta'; \mu_t, B_t\right) \geq F$$

- Entering mass at $t+1$:

$$\begin{aligned} de_t\left(w', \theta'; \mu_t, B_t\right) = \int_{0^+}^{\infty} \int_0^1 & \mathbf{1}\{\mathbb{E}\left[V_{t+1}\left(w_E\left(\hat{w}, \theta'; \mu_t, B_t\right), \theta; \mu_{t+1}, B_{t+1}\right) \middle| \mu_t, B_t\right] \\ & - w_E\left(\hat{w}, \theta'; \mu_t, B_t\right) \geq F\} \\ & \times \delta_{\text{Dirac}}\left(w_E\left(\hat{w}, \theta'; \mu_t, B_t\right) - w'\right) de\left(\hat{w}, \theta'\right), \end{aligned}$$

Dynamic Model Results

Net intertemporal budget violation with constant payout tax:

$$N(\mu, B, \tau_d) = \frac{\tau_d}{1+\tau_d} \int_0^\infty \int_0^1 \overline{V}(w, \theta; 0)\, \mu(w, \theta)\, d\theta dw$$
$$+ \frac{\tau_d}{1+\tau_d} \frac{1}{R-1} \int_0^\infty \int_0^1 \overline{V}(w, \theta; 0)\, \overline{e}(w, \theta; \tau_d)\, d\theta dw$$
$$- B - \frac{\overline{G}}{1-R^{-1}}.$$

Proposition

If there exists a $\overline{\tau}_d \geq 0$ such that $N(\mu_0, B_0, \overline{\tau}_d) \geq 0$, and $N(\mu_0, B_0, \tau)$ is continuous on $\tau \in [0, \overline{\tau}_d]$, then there exists an equilibrium characterized by a tax rate $\tau_d \in [0, \overline{\tau}_d]$ in which, on the equilibrium path, the government implements a constant payout tax rate equal to τ_d, and chooses a level of spending equal to its target, $G_t = \overline{G}$, $\forall t > 0$. If $B_0 + \frac{\overline{G}}{1-R^{-1}} > 0$, then $\tau_d > 0$, $G_0 = \overline{G}$, and $N(\mu_0, B_0, \tau_d) = 0$.

Discussion

- target spending, no extra taxes: NPV spending + initial debt = NPV taxes
- NPV production - NPV taxes = NPV dividends
- Therefore, goal is to achieve constrained production efficiency
  - payout tax feasible, IC, achieves constrained efficient: optimal for existing firms
- Entry adds a new wrinkle:
  - payout tax "least bad" way of collecting fixed NPV
  - limited commitment prevents taxing old firms but not new firms
  - taxes distort entry (extensive and intensive margins)
- Manage future gov. debt level to ensure constant payout tax

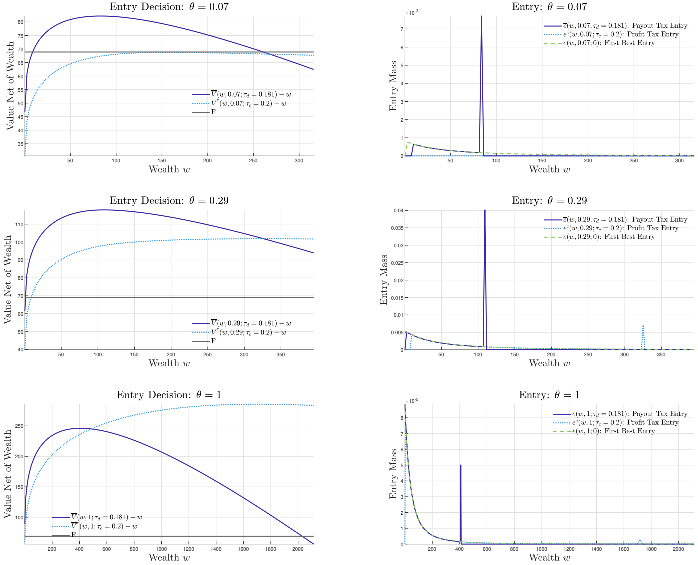
Quantitative Exercise

- Theory results assume no government commitment
  - government accounts for future but not past entry decisions
- Taxes distort entry on two margins:
  - Extensive: pay fixed cost F to enter
  - Intensive: choose how much wealth w to enter with
- Switch from profit taxation to payout taxation:
  - Optimal for current firms by theory results
  - Reduces extensive margin entry distortion
  - Increases intensive margin entry distortion
  - calibration: intensive margin effect smaller than extensive effect

Quantitative Calibration

- Individual firm dynamics parameters: Li et al. [2016]
  - estimated from Compustat data, use profit tax rate of 20%
- Entry and Exit rates: Lee and Mukoyama [2015]
- Elasticity of entry with respect to corporate tax rates: Djankov et al. [2010]
- Start firm pop. in steady state with profit tax, switch to payout tax
- Results:
  - payout tax of $\tau_d = 18.1\%$ sufficient for revenue neutrality
  - entry increases by 31% (entrants likely to be constrained)
  - total value of present+future firms increases by 7%
  - large amounts of borrowing along transition path

Payout Taxes vs Profit Taxes: Entry



Conclusion

- Can view corporate taxes through optimal taxation lens
- Financial frictions generate different marginal value of wealth
- Key principle: tax unconstrained firms
- Payouts reveal which firms have low marginal value of wealth
- So corporate payout taxes are optimal
- Calibration: revenue-neutral reform increases firm value by 7%
- Implementation: all interest and retained earnings deductible

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