Optimal Corporate Taxation Under Financial Frictions

Eduardo Dávila (Yale and NBER)
Benjamin Hébert (Stanford and NBER)

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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 “\text{tax}\_\text{rate} \times (\text{profits} - \text{deductions})” make sense?
  - Why deduct interest payments but not dividends?
- Large positive literature on corporate taxation
  - but surprisingly few normative results
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 $\theta$
  - 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 $\theta$

- Firm value:

$$V\left(\theta, \hat{\theta}\right) = \theta_0 f(k_0) - k_1(\hat{\theta}) - \tau_0(\hat{\theta}) + \theta f(k_1(\hat{\theta})) - \tau_1(\theta, \hat{\theta})$$

  - date zero payout
  - date one payout

- Gov Problem: $\max_{k_1(\hat{\theta}), \tau_0(\hat{\theta}), \tau_1(\theta, \hat{\theta})} \int_0^1 V(\theta, \hat{\theta}) \, d\mu(\theta)$

  - subject to IC, $\theta \in \arg\max_{\hat{\theta} \in (0,1]} V(\theta, \hat{\theta})$,

  - revenue-raising, $G \leq \int_0^1 \left(\tau_0(\theta) + \tau_1(\theta, \theta)\right) \, d\mu(\theta)$,

  - and no-financing: $\theta_0 f(k_0) \geq k_1(\hat{\theta}) + \tau_0(\hat{\theta}), \theta f(k_1(\hat{\theta})) \geq \tau_1(\theta, \hat{\theta})$
Can punish liars with $\tau_1$, 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:

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

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

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

- taxes proportional \( (\tau_d) \) 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, \( \tau_p \in (0, 1) \):

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

  \[ \tau_0 \left( \hat{\theta} \right) = \tau_p \left( \theta_0 f(k_0) - k_0 \right), \]

  \[ \tau_1 \left( \theta, \hat{\theta} \right) = \tau_p \max \left\{ \theta f(k_1 \left( \hat{\theta} \right)) - k_1 \left( \hat{\theta} \right), 0 \right\}. \]

- 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 \( \delta \)

- 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 \( \theta_{t+1} \) given \( \theta_t \)
  - \( \theta_t = 0 \) 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
  \[
  w_{t+1} = f(k_t, \theta_t) + (1 - \delta) k_t - d_t - b_t - \tau_t
  \]
- We define wealth following default (pre-dividend) as
  \[
  w^D(k_t, \theta_t) = f(k_t, \theta_t) + (1 - \varphi)(1 - \delta) k_t
  \]
- 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:

\[
 w_{t+1} \geq w^D(k_t, \theta_t) - d_t \iff \tau_t + b_t \leq \varphi(1 - \delta)k_t
\]
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 $\mu_t$ and government debt $B_t$ are state variables
- measure of entering firms $de_t (w', \theta'; \mu_t, B_t)$
- wealth and taxes under optimal policies: $w_{t+1}^* (\theta'; w, \theta), \tau_t^* (\theta'; w, \theta)$

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

$$B_{t+1} = R (B_t + G_t) - \int_0^\infty \int_0^1 \int_0^1 \tau_t^* (\theta'; w, \theta) d\Pi (\theta'|\theta) d\mu_t (w, \theta)$$
Government Policy

- Choose spending $G_t$, and mechanism $m_t(w, \theta)$ for each observable $(w, \theta)$
- Gov spending choice: for some $\bar{\chi} > 1$, target $\bar{G}$, utility
  \[
  u(G_t) = \begin{cases} 
  (G_t - \bar{G}) , & \text{if } G_t \geq \bar{G} \\
  -\bar{\chi} (\bar{G} - G_t) , & \text{if } G_t < \bar{G},
  \end{cases}
  \]
  - 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 \((w, \theta)\)
- Report when investing \(\theta'\), report when paying out \(\theta''\)
- Non-negative functions
  \[ w_{t+1} (\theta', \theta''; w, \theta), \tau_t (\theta', \theta''; w, \theta), d_t (\theta', \theta''; w, \theta), b_t (\theta'; w, \theta), k_t (\theta'; w, \theta), \]
  \[ w^*_{t+1} (\theta'; w, \theta) = w_{t+1} (\theta', \theta'; w, \theta) \text{ under truthful reporting} \]
- 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

\[
J_t(\mu_t, B_t) = \max_{B_{t+1}, G_t, \{m_t(w, \theta) \in M(w, \theta, V_{t+1})\}_{w \in \mathbb{R}_+, \theta \in [0, 1]}} u(G_t)
\]

\[
+ R^{-1} \int_0^\infty \int_0^1 \int_0^1 d^*_t (\theta'; w, \theta) \ d\Pi(\theta'|\theta) \ d\mu_t(w, \theta)
\]

\[
+ R^{-1} J_{t+1}(\mu_{t+1}, B_{t+1}),
\]

- 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: \( \overline{V}(w, \theta; \tau_d) = \frac{1}{1+\tau_d} \overline{V}(w, \theta; 0) \)
Entry

- Measure $e(\hat{w}, \theta')$ of potential entrants, fixed cost $F$
- If choosing to enter, can choose entry wealth:
  
  $$w_E(\hat{w}, \theta'; \mu_t, B_t) \in \arg \max_{w' \in [0, \hat{w}]} \mathbb{E} \left[ V_{t+1} (w', \theta'; \mu_{t+1}, B_{t+1}) \mid \mu_t, B_t \right] - w'$$

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

- Entering mass at $t + 1$:
  
  $$d e_t (w', \theta'; \mu_t, B_t) = \int_0^\infty \int_0^1 \mathbf{1} \left\{ \mathbb{E} \left[ V_{t+1} (w_E(\hat{w}, \theta'; \mu_t, B_t), \theta; \mu_{t+1}, B_{t+1}) \mid \mu_t, B_t \right] - w_E(\hat{w}, \theta'; \mu_t, B_t) \geq F \right\}$$
  
  $$\times \delta_{\text{Dirac}} (w_E(\hat{w}, \theta'; \mu_t, B_t) - w') \, d e (\hat{w}, \theta') ,$$
Dynamic Model Results

Net intertemporal budget violation with constant payout tax:

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

Proposition

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

Entry Decision: $\theta = 0.07$

Entry Decision: $\theta = 0.29$

Entry Decision: $\theta = 1$

Entry: $\theta = 0.07$

Entry: $\theta = 0.29$

Entry: $\theta = 1$
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


