Taxes and Corporate Dynamics: The Product-Market Effect

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(preliminary and incomplete)

Motivation

- Contribute to our understanding of capital budgeting with costly external finance
- Examine the effect of perfect product-market competition on corporate dynamics
- Clarify flaws of traditional capital budgeting methods.

Our Starting Point 1

- Costly "round trip" to internal capital.
  → distinction between internal capital & external finance

Our Proposition:

- One dollar of internal capital is more valuable in states of the world where competitors have little cash.
  - Competitors have little cash
    → investment in industry capacity low
    → marginal return to physical capital high
    → marginal value of low-cost capital (internal capital) high.

Our Starting Point 2

Therefore: value in being an "industry contrarian": correlated with industry return.

- Effective cost of capital includes covariance (project, other projects in the industry) even if risk neutral environment.

- CAPM-like result for industry portfolio of projects

Related Literature 1

- Capital budgeting: Corporate investment guided by rates of return available to investors (Brennan, 2003).
  No financial frictions → product market unimportant (Leahy, 1992).

- Investment/CF correlation (Gomes, 2001)

- Debt dynamics (Hennessy and Whited, 2005).

Here 1. Focus on internal versus external cash.
2. Effect of product-market competition.

Related Literature 2

- Corporate finance/product-market competition: Focus on strategic interactions: Brander and Lewis (1986), Bolton and Scharfstein (1990), Tirole (2006, Ch. 7).

Instead, we focus on perfect product-market competition and its effect on corporate decisions in presence of costly external finance.

Model (1): The Product-Market

- Single perfectly competitive product market.
  Inverse demand $p = P(X)$, X aggregate output
- Firm i invests x_{i0} in riskless asset, x_{ij} in the j^{th} risky, real asset.
- 1 dollar invested provides 1 unit of output for one period.
- Cost of producing x_{ij} is $\check{c}_j x_{ij}$. Costs $\check{c}_j$ are functions of a random variable ω with cdf f distributed on a compact set. Stochastic constant returns to scale.
- Stationary distribution of project returns.
- Physical capital is rented or can sell in a perfect market.

Model (2): The Financial Market

- Each firm is endowed in period 1 with internal capital b_{i1}. Denote $b_1=\{b_{11},\ldots,b_{N1}\}$. Firms enter each period with internal capital in the industry, b, inherited from the previous period.
- In each period, firms issue new equity e_i at no cost and pay shareholders dividend d_i that is subject to linear tax rate t_d.
- The adjusted amount $b_i + e_i - d_i$ invested in $x_i=\{x_{i0},x_{i1},\ldots x_{in}\}$
- The product market opens, each firm supplies a quantity x_i, and the equilibrium price is determined as $p=P(\sum_{ij} x_{ij})$.
- Costs are realized. Riskless asset earns r_f, investment x_j earns operating cash flow $[p(X^t)x_{ij} - c_j x_{ij}]$. Corporate tax rate t_c
- Personal tax rate $t_p < t_c$

Model (3): The equilibrium

- $q(b)$; the market to book ratio.
- $\{x_{ij}(), e_i(), d_i()\}$
- $v(b, \omega)$, the next period's market to book ratio given this period's amount of internal cash and given the realization of ω (infinite horizon)
- $b'(b, \omega)$, next period's internal cash.
  Rational expectations require that $v(b, \omega) = q(b'(b, \omega))$.

Recursive competitive equilibrium (Stokey & Lucas 1989).
Partial equilibrium social welfare:

$$W'(b) = Max_{d,\, e,\, xj}\ S(X) + (1-t_d)d(b) - e(b) + [1 + r_f(1-t_p)]^{-1} E[W(b'(b, \omega))]$$

Model (4): The Firm's Program

- Firm *i* max value to risk-neutral shareholders:

$$Max_{di,\ ei,\ xij}\ (1-t_d)d_i(b) - e_i(b) + E[v(b'(b, \omega))\ b_i'(b, \omega)]$$

subject to:

- $\sum_j x_{ij}(b) = b_i - d_i(b) + e_i(b)$
- $d_i(b),\ e_i(b),\ x_{i\ j}(b) \geq 0$
- $b'(b, \omega) = [p(X(b))\ X(b) - \sum_j c_j(\omega) x_j(b)\ ](1-t_c) + x_0(1+r_f(1-t_c))]$

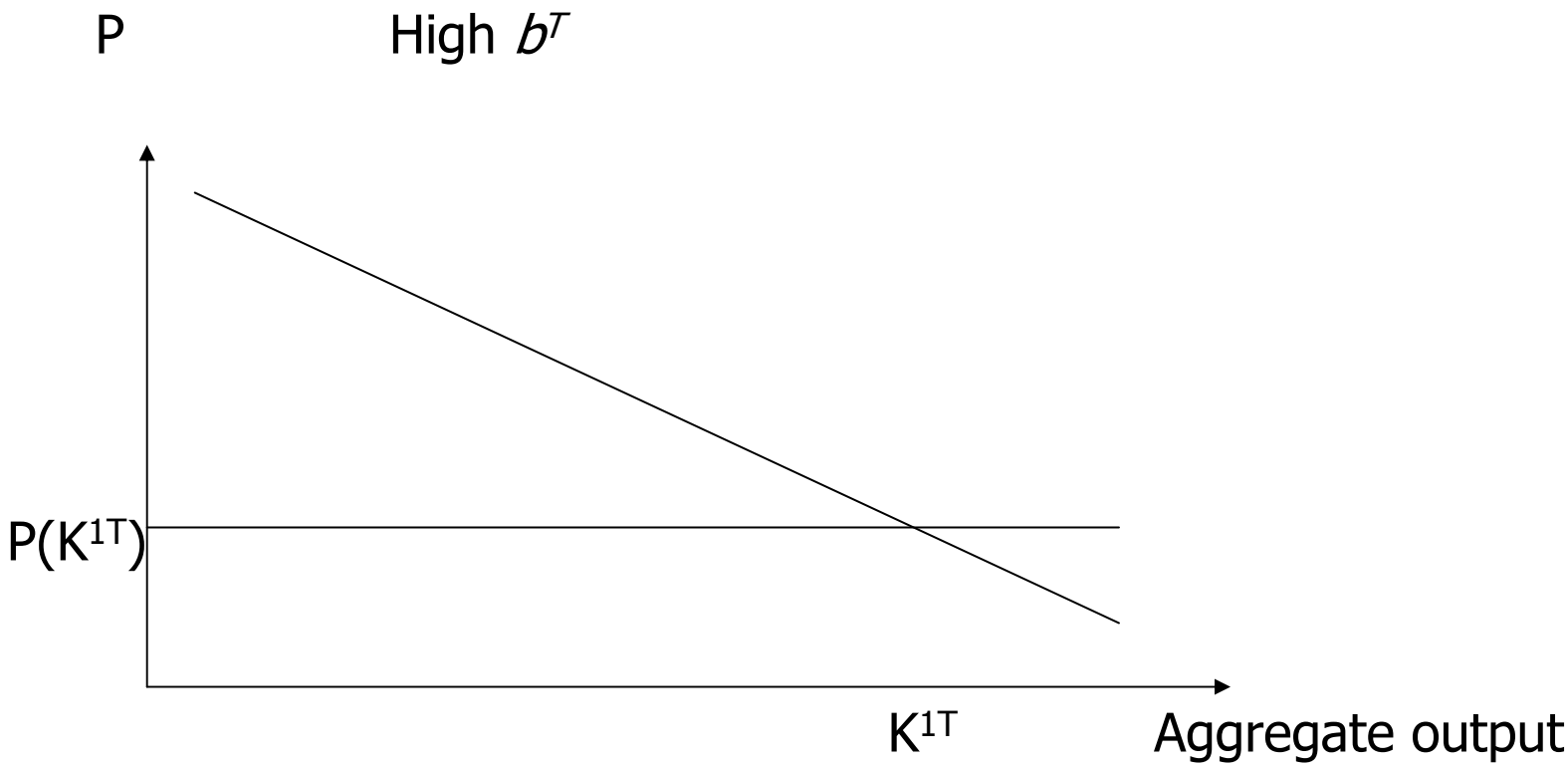
Social Planner's Problem

- Social planner's pb has a unique bounded continuous solution.
- Pb with 1 state variable, the aggregate internal equity.
- "Everything aggregates": Aggregate *e, d, x* depend only on *b*
- *W* is increasing in *b* and ω.
- The SP's solution can be implemented as a competitive equilibrium.
- The competitive stock market price of internal equity in each period is the marginal social value of equity. Same with the product price.

The One-Period problem 1

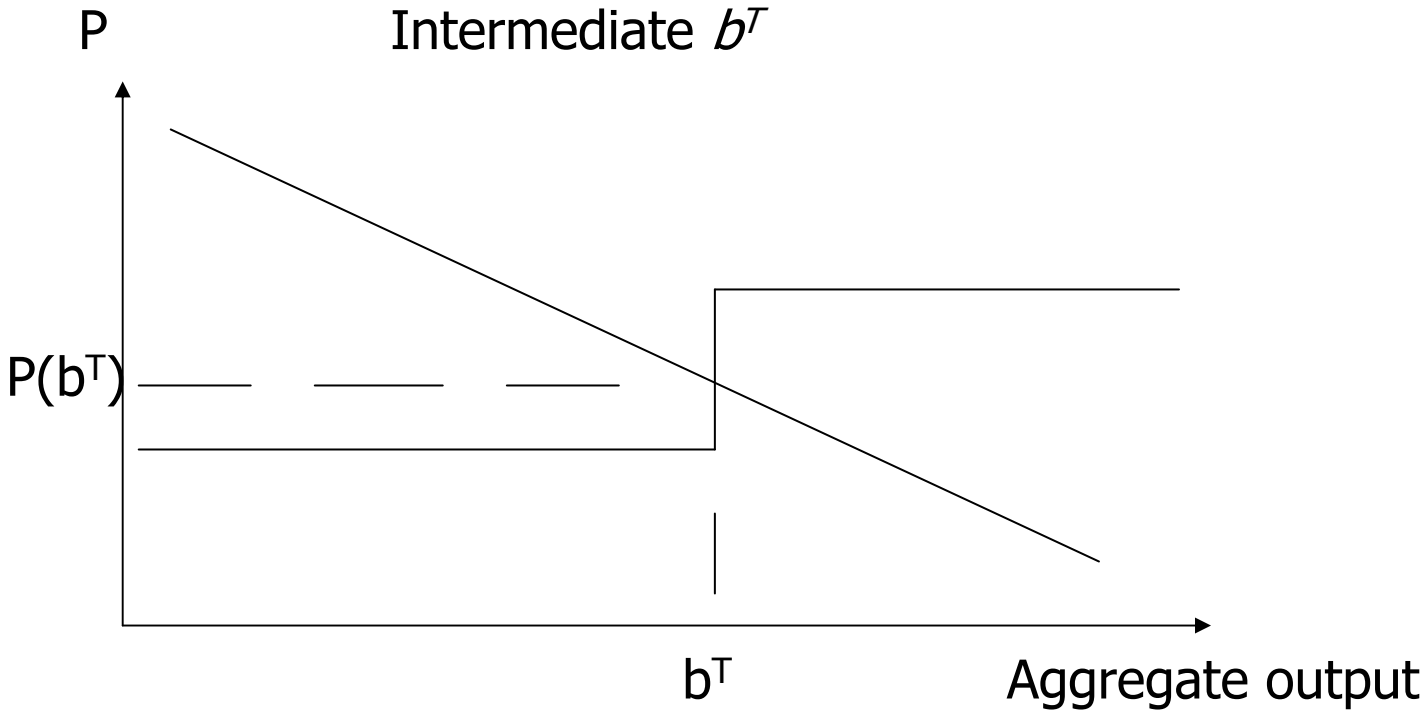
- Firms invest in the risky project with the lowest expected cost only.
- As $t_p < t_{c,,}$ firms do not invest in the riskless asset.
- If b^T is very large, then NPV of every dollar invested is zero.
- If b^T is lower, profit made on dollars of internal capital invested.

The One-Period problem.



All output financed with internal capital. Zero profit.

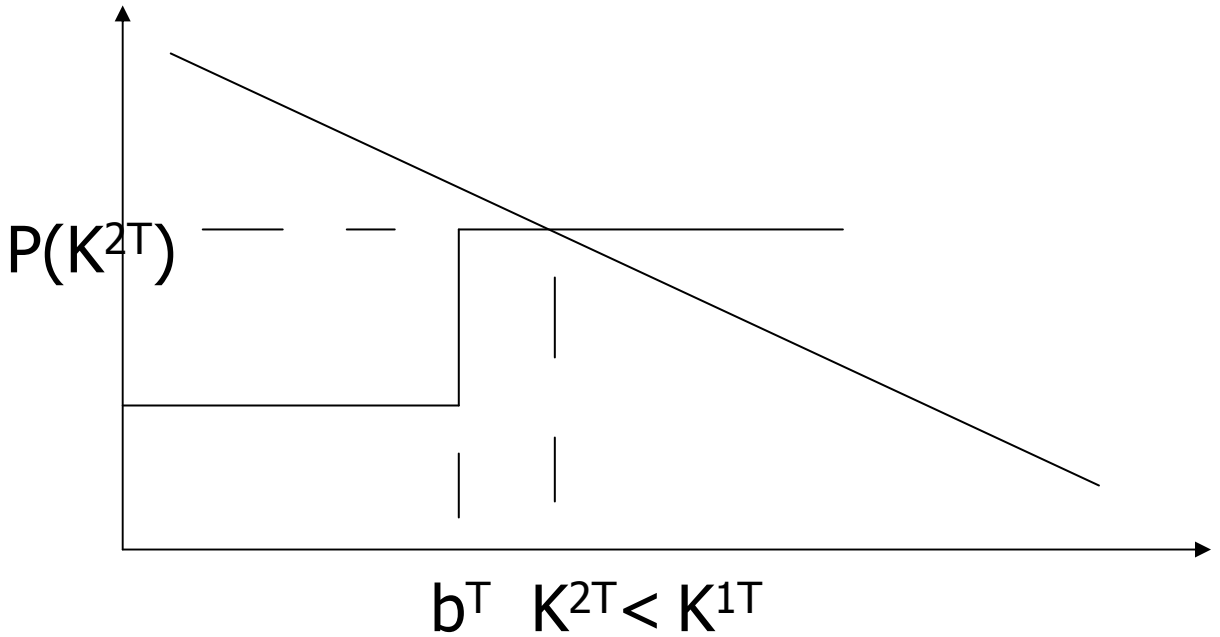
The One-Period problem.



Higher price. Profit.

The One-Period problem.

P Low b^T



Profit t_d on units of output financed with internal capital.

The Two-Period Problem

- Supply from one firm is perfect substitute to supply from another.
- Aggregate internal equity is a sufficient statistic for product market prices, Tobin's *q*...
- Tobin's *q* decreases with internal capital in the industry.

The Two-Period problem 2

- The value of $1 of internal capital invested in the project is higher when competitors' cost of capital is high. Value of being a contrarian.
- Firms take into account the correlation between projects and the Tobin's *q*.
- With normal distributions, that collapses to:

$$E(r_j) = r_f + \lambda \, cov(c_j, \sum_{ij} c_j(\omega) x_{ij}(b))$$

- Firms like projects with low expected costs and with negative correlation with product market.

The Two-Period Problem 3

Notes:

- Everything here is derived in a risk-neutral environment.
- The product market partially completes an otherwise incomplete financial market.

The Infinite Horizon Problem 1

- Firm value $q(b)b$, with $q()$ decreasing in b
- Equity issues for low levels of internal capital
- As internal capital increases, no investment in the riskless asset, then x_O increases
- Dividends for high levels of internal capital

The Infinite Horizon Problem 2

- Inventory model of internal capital

Capital Budgeting Implications 1

- The value of projects incorporates that each dollar of return is an option of either paying a dividend or reinvesting.

- Unlike APV or WACC that are inconsistent with simple opportunity cost principles :

1. They value project returns as cash, not as internal capital with a market price.

2. They treat the investment of $1 of internal equity as $1 independently of amount of internal equity available and of future projects.

Capital Budgeting Implications 2

1. Unlike APV/WACC, trapped equity effect of dividend taxation may increase investment

2. Rational pecking order theory (with riskless debt as in Hennessy Whited) where cost of debt is higher when capital is scarce in the industry.

Risk Management Implications

- Firms gain from insurance to transfer wealth from next-period states of low q (high b) to states of high q (low b).
- In equilibrium, the optimal amount of insurance at the firm level is irrelevant (like in an M&M world)
- The total demand for insurance against a risk (summing across all firms in the product market) is determined in equilibrium.

Empirical Predictions

- Investment/cash flow correlation is now well-documented.

  Here, we predict that investment by one firm decreases with internal capital in competitors.

- Capital budgeting rules affected by technological environment and product-market competition.

- Market value of cash, and, eg, corporate governance. Think harder about adequate thresholds, etc.

- Rationale for FF factors?

- Hedging industry shocks rather than firm shocks

Conclusion

- Product-market matters in a simple risk-neutral environment with corporate and personal taxes.
- The interactions between capital budgeting and the product market may well deserve greater scrutiny.
- Capital budgeting has a "home-made" risk-management feature.