Harvard University
Department of Economics

Professor Adriano Rampini
Economics 1760

Topics in Finance
Spring 2013

Week 12: Risk Management

- Financial constraints provide rationale for corporate risk management
  - If firms' net worth matters, then firms are as if risk averse
  - Collateral constraints link financing and risk management
  - More constrained firms hedge less and often completely abstain
- Readings: Rampini/Viswanathan (2010), Collateral, risk management, and the distribution of debt capacity
- See also: Tirole (2006), Section 5.4

Corporate Risk Management

- Why should firms hedge?
  - Firms are risk neutral, why hedge?
  - Financial constraints make firms risk averse
    - Firms' value function concave in net worth
- **Financing vs. risk management trade-off**
  - Limited enforcement: Need to collateralize promises to financier and counterparties
  - Collateral constraints link financing and risk management
  - More constrained firms hedge less as financing needs dominate hedging concerns
- Relatedly for **households:** Financing vs. insurance trade-off
  - "The poor can't afford insurance"

Risk Management à la Rampini/Viswanathan (2010, 2013)

- Environment (as in Class 9 (pages 76-81) but here with uncertainty)
  - Time 0, 1, & 2; uncertainty: state $j \in \mathcal{J}$ at time 1 – probability p_j; e.g., $\mathcal{J} = \{H, L\}$
  - Two types of agents, owner/borrower and investor/lender
- Preferences
  - Borrower is risk neutral, impatient β, and subject to limited liability
  - Lender is risk neutral and discounts at $R^{-1} \in (\beta, 1)$
- Endowments
  - Borrower has limited funds $w > 0$ at time 0; lender has deep pockets
- Technology
  - Capital k invested at time 0 yields stochastic payoff ("cash flow") in state j at time 1
    $$A_j f(k)$$
    where A_j is realized "total factor productivity" (TFP)
  - Capital k' invested at time 1 yields deterministic payoff $Af(k')$ at time 2
  - Strict concavity $f_k(k) > 0$; $f_{kk}(k) < 0$; also: $\lim_{k\to 0} f_k(k) = +\infty$; $\lim_{k\to\infty} f_k(k) = 0$
  - Capital is durable and depreciates at rate δ; capital $k(1-\delta)$ remains next period
- **Collateral constraints:** Need to collateralize all promises to pay with tangible assets
  - Can pledge up to fraction $\theta < 1$ of value of depreciated capital

Firms are Effectively Risk Averse about Net Worth

- **Firm's problem at time 1** (given net worth w_j in state j) (working backwards)
  $$\max_{\{d_1,d_2,k',b'\}} d_1 + \beta d_2$$
  subject to budget constraints and collateral constraint
  $$\begin{aligned} w_j + b' &\geq d_1 + k' \\ Af(k') + k'(1-\delta) &\geq d_2 + Rb' \\ \theta k'(1-\delta) &\geq Rb' \end{aligned}$$
  and limited liability $d_1,\, d_2 \geq 0$
- First-order conditions (multipliers μ, μ', and λ)
  $$\begin{aligned} 1 \leq \mu, &\qquad \beta = \mu' \\ \mu = \mu'[Af_k(k') + (1-\delta)] + \lambda\theta(1-\delta), &\qquad \mu = \mu' R + \lambda R \end{aligned}$$
- Optimal investment/capital k' solves
  $$\mu = \beta \frac{Af_k(k') + (1-\theta)(1-\delta)}{\wp}$$
  - Dividend paying firm: If $\mu = 1$, then $k' = \bar{k}$ which requires at least net worth $\bar{w} = \wp\bar{k}$
  - Constrained firm: If $w < \bar{w}$, $k' = w/\wp$ and $\mu = \beta[Af_k(w/\wp) + (1-\theta)(1-\delta)]/\wp$
  - **Marginal value of net worth is μ**
  - **Value function $v(w)$ is concave** (for $w < \bar{w}$): $d\mu/dw = \beta A f_{kk}(w/\wp)/\wp^2 < 0$

Corporate Risk Management Problem

- **Firm's problem at time 0** (given net worth w and given time 1 value function v)
  - Collateral constraint for state contingent borrowing b_j

$$\theta k(1-\delta) \geq Rb_j$$

    - Equivalently, borrow as much as possible and hedge $h_j \equiv \theta k(1-\delta) - Rb_j \geq 0$
  - **Firm's risk management problem**

$$\max_{\{d_0, w_j, k, h_j\}} d_0 + \beta \sum_{j \in \mathcal{J}} p_j v(w_j)$$

    subject to budget constraints and **short sale constraints**, for all $j \in \mathcal{J}$,

$$\begin{aligned} w_j &\geq d_0 + \wp k + \underbrace{R^{-1} \sum_{j \in \mathcal{J}} p_j h_j}_{\text{cost of hedging portfolio}} \\ A_j f(k) + (1-\theta)k(1-\delta) + h_j &\geq w_j \\ h_j &\geq 0 \end{aligned}$$

    and limited liability $d_0 \geq 0$

- First-order conditions (multipliers μ_o, $p_j \mu_j$, and $p_j \lambda_j$)

$$\begin{aligned} 1 &\leq \mu_0, & \beta v_w(w_j) &= \mu_j \\ \wp \mu_0 = \sum_{j \in \mathcal{J}} p_j \mu_j [A_j f_k(k) + (1-\theta)(1-\delta)], & & \mu_0 &= \mu_j R + \lambda_j R \end{aligned}$$

Financing vs. Risk Management Trade-off

- **Investment Euler equation** (rewriting first order condition for investment)

$$\begin{aligned} 1 &= \sum_{j \in \mathcal{J}} p_j \frac{\mu_j}{\mu_0} \frac{A_j f_k(k) + (1-\theta)(1-\delta)}{\wp} \\ &\geq p_j \frac{\mu_j}{\mu_0} \frac{A_j f_k(k) + (1-\theta)(1-\delta)}{\wp} \end{aligned}$$

  - As net worth $w \to 0$, capital $k \to 0$ and marginal product $f_k(k) \to \infty$
  - Therefore, marginal value of net worth in state j (relative to at time 0) $\mu_j/\mu_0 \to 0$
  - Using first order condition for hedging

$$\lambda_j/\mu_0 = R^{-1} - \mu_j/\mu_0 > 0$$

    so **severely constrained firms do not hedge at all**

- Financing risk management trade-off
  - Hedging uses up net worth which is better used to purchase additional capital
- If firms hedge, they hedge states with low net worth due to low cash flows

Why Was This Not Previously Recognized?

- **Reasons for incomplete hedging – as in Tirole (2006)**
  - 5 reasons provided (beyond "transactions costs")
    - (i) market power; (ii) serial correlation of profits; (iii) aggregate risk; (iv) asymmetric information; (v) incentives
  - Fact that hedging uses up net worth is not listed
    - That said, Holmström/Tirole (2000) come close
- **No financing risk management trade-off in previous models**
  - Models consider risk management using frictionless markets
    - Without imposing same frictions on financing and hedging, no trade-off
  - Models have no financing in first period where firms hedge
    - Without investment which requires financing, no trade-off
- **Intuitive, but dubious, conclusion: More constrained firms hedge more**
  - Froot/Scharfstein/Stein (1993)
- In practice, more constrained (and smaller) firms hedge less!

Conclusions

- **Corporate risk management**
  - Rationale
    - Financial constraints make firms as if risk averse
  - Trade-off between financing and risk management
    - Promises to financiers and hedging counterparties need to be collateralized
    - Severely constrained firms hedge less or not at all
      - ... both in theory and in practice
    - Such firms may be more susceptible to downturns

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Week 12: Risk Management (Cont'd)

- Why is household risk management so limited?
  - Laboratory: Rainfall insurance in rural Indian households
  - Methodology: Randomized Controlled Trials (RCT) in field and survey
  - Factors: Price, liquidity constraints(!), trust, literacy, salience ...
  - New frontier in microfinance: Microinsurance (next new frontier: microleasing)
- Readings: Cole/Giné/Tobacman/Topalova/Townsend/Vickery (2013), Barriers to household risk management: Evidence from India

Rainfall Insurance in Village India à la Cole et al. (2013)

- **Insurance in village India** (Andhra Pradesh and Gujarat)
  - Rainfall important (indeed primary) source of exogenous income risk
  - "Index insurance" products pay off when there is too little/too much rain
- **Methodology**
  - Randomized Controlled Trials (RCT) in field – **treatments**
    - **Price:** Discounts
    - **Trust:** Endorsements from microfinance institution, peer, or teacher
    - **Liquidity constraints:** Cash compensation after household visit
    - **Literacy:** Financial education
    - **Salience:** Household visit
    - Framing: Individual vs. group; religion – no effect except religion
- Noteworthy summary statistic (Table 2)
  - Discount rate 0.75 per month over 3 month Monsoon season 0.43(!)
- Non-experimental evidence
  - Regressions of insurance uptake on household characteristics (incl. skills)

Barriers to Rainfall Insurance in Village India

- **Price sensitivity** (Table 6) – Survey: "It is not good value"
  - Price discounts have significant effect (10% price reduction increases demand by 11%)
- **Liquidity constraints** (Table 5) – Survey: **"Insufficient funds to buy insurance"**
  - Cash reward significant effect on uptake ($\approx$ 40% increase) (especially for poor)
  - Insurance demand higher for wealthy households (Tables 5/8)
  - Or reciprocity?
- Literacy: Financial education has negligible effect (typical finding in literature) (Table 5)
- Salience: Household visit has significant effect (12-17% increase) (Table 5)
- Trust (Tables 5/6) – Survey: "It does not pay out when I suffer a loss"
  - Survey households & households that know microfinance institution more likely to buy
  - Prior experience with insurance and "quantitative skills" increase uptake (Table 8)
- Risk aversion has *negative* effect (Table 8)
- Ignored: Basis risk
- Claim (in conclusions)
  - **Bundling insurance and credit with state-contingent loans** could help
  - Unsuccessful in field experiment in Malawi – what does our model say?

Household Risk Management

- **Households' insurance coverage increases with wealth and age**
  - Health & long-term care insurance coverage increases with income
  - Health insurance increases with age
  - Flood insurance coverage increases with income (at state level)
  - Life insurance lapsation decreases with income – Fang/Kung (2012)
- Explanations?
  - Variation in cross section: Financial constraints, but also literacy, fixed costs, trust
  - Within household variation in **panel data: Financial constraints!**
- **Critique: What if households use informal instead of formal insurance?**
  - Townsend (1994), Risk and insurance in village India
    - Look at **consumption data** since households use informal insurance mechanisms
    - "... evidence that the landless are less well insured than their village neighbors in one of the three villages"
  - Blundell/Pistaferri/Preston (2008): In consumption data for U.S. households
    - "... full insurance of transitory shocks except among poor households"
- **Puzzle? – "The poor cannot afford insurance"**

  "[T]he near absence of derivatives markets for real estate ... is a striking anomaly that cries out for explanation and for actions to change the situation." – Shiller (2008)

Evidence on Corporate Risk Management

- **Size pattern in derivatives use**
  - Positive relation between size (and dividend yield) and hedging – Nance et al. (1993)
  - Derivatives use increases from 33% to 90% across firm size quartiles – Géczy et al. (1997)
- **Fuel price risk management by U.S. airlines** – Rampini/Sufi/Viswanathan (2013)
  - **Strong positive relation between net worth and hedging** in *panel data*
  - Dramatic decline in hedging as airlines approach distress (subsequently slow recovery)
- Still confused about financing and risk management – *Wall Street Journal* [Dec 5, 2012]

  > "Forward contracts are convenient for small businesses because they generally **don't have any upfront cost,** and business owners can lock in a forward contract up to a year ahead."
  >
  > "Certainly many small companies are still uncomfortable with hedging. Startups, which are generally strapped for resources, typically **can't afford it.**"

  - Financing vs. risk management trade-off reconciles seemingly contradictory statements

Conclusions

- **Household risk management**
  - Liquidity constraints, price, as well as trust, literacy, and salience as barriers
  - Most important reason for not buying insurance **"insufficient funds"**
- **Basic relation between financing and insurance/risk management**
  - Among Indian farmers, U.S. households, and in corporate America
    - ... more constrained are less well insured!