Target Behavior and Financing:
How Conclusive is the Evidence?

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"With no direction home
Like a complete unknown
Like a rolling stone"

– *Bob Dylan, Like a Rolling Stone*

1 Introduction

- Chang and Dasgupta simulate “rolling stones”:
  random financing decisions, with *no target capital structure.*

- Result: existing evidence for target capital structure is consistent with random decisions.

- Consequences: Either

  (1) Decisions are random and capital structure irrelevant
  $\Longleftrightarrow$ Miller and Modigliani were right
  (2) Tests for capital structure are extremely weak
  $\Longleftrightarrow$ Low power to distinguish randomness from structure

2 Theories of Capital Structure

"How do firms choose their Capital Structures? – We don't know."
— S. Myers, Editor of the *Journal of Finance*, 1984.

Is there an optimal capital structure that firms target?

- No, Miller and Modigliani (1958); <u>irrelevant</u>.
- Yes, Miller and Modigliani (1963); all debt optimal.
- Yes, Trade-Off theory: rising debt price offsets tax gain.
- Yes, Pecking Order theory: law of least effort.
- Yes, Market Timing theory: issue equity when overpriced.

The Modigliani-Miller Model

> *"How do you want this pizza cut, into quarters or eighths?"*
> *"Cut it in eight pieces. I'm feeling hungry tonight."*
> — Merton Miller on capital structure

Capital structure **irrelevant** if perfect, frictionless market and no taxes.

Proof: Financial transactions have NPV$=0$. QED.

M&M provides a strong null hypothesis to test all subsequent theories against. Chang and Dasgupta test current evidence against the M&M null.

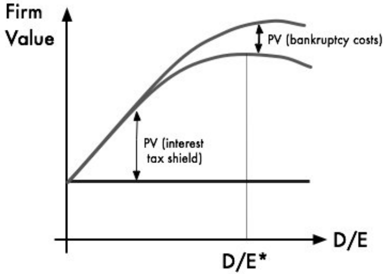
Clearly, frictionless assumptions are false. However:

— Perhaps M&M good first order approximation.
— Empirically, very little correlation in capital structure data.

Optimal Trade-off Theory

With tax, optimal to increase debt leveraging. As leverage increases, likelihood of default increases $\Rightarrow$price of debt rises.

Optimum target $\frac{D}{E}^*$ solves: $\qquad MB_{tax}\left(\frac{D}{E}^*\right) = MC_{debt}\left(\frac{D}{E}^*\right)$



Different firms have different marginal tax rates, different risk-levels

$\Longrightarrow$Different firms have different optimal targets.

$\Longrightarrow$Hard testing for optimality. Can test if firms mean-revert to $\frac{D}{E}^*$.

3 Tests for Target Behavior

Define $d_t := \frac{D_t}{D_t+E_t}$, optimal target d_t^*.

Model: Leverage follows AR(1) process:

$$d_t = \lambda d_t^* + (1-\lambda)d_{t-1} + \varepsilon_t$$

$1-\lambda$ is the speed of mean-reversion. If $1-\lambda < 1$, mean-reverting to d_t^*.

=> Simple test: estimate $1-\lambda$ from data, see if sufficiently less than 1.

However, what is d_t^*? This is unobserved, must be modeled:

$$d_{i,t}^* = \beta X_{i,t-1} + v_i$$

$X_{i,t}$ are time-varying firm characteristics, v_i are firm idiosyncratic errors.

Tests for Targets (Cont.)

The full model is thus

$$d_{i,t} = (1-\lambda)d_{i,t-1} + \beta\lambda X_{i,t-1} + \lambda v_i + \varepsilon_{i,t}$$

Estimate $1-\hat{\lambda}$ and $\hat{\beta}$ by OLS.

Joint test: is $1-\hat{\lambda}$ sufficiently small, *and* is overall regression significant?
(If $1-\lambda = 0.9$, reversion half-life of 6.6 years. Need $\lambda \lesssim 0.7$ to be economically meaningful).

However, serious problems with this test:

- Hard to test between persistence and actual mean-reversion: low power.
- Mechanical mean-reversion: a statistical artifact

4 Mechanical Mean-Reversion

Chang and Dasgupta show mean-reversion tests are flawed. Even if random financing decisions (50-50 coin-toss),

$$E(1-\hat{\lambda}) < 1$$

Intuition: if debt already high, adding more debt will not increase d_t much. Adding equity decreases d_t much more: asymmetric response due to ratio.

Proof: Suppose some amount y_t is being raised, either debt, $\Pr(Debt) = p$, or equity, $1-p$.

$$d_{t+1} - d_t = \begin{cases} \frac{D_t + y_t}{D_t + E_t + y_t} - \frac{D_t}{D_t + E_t}, & p \\ \frac{D_t}{D_t + E_t + y_t} - \frac{D_t}{D_t + E_t}, & 1-p \end{cases}$$

If define $k = \frac{y_t}{D_t+E_t}$,

$$d_{t+1} - d_t = \begin{cases} k\frac{1-d_t}{1+k}, & p \\ -k\frac{d_t}{1+k}, & 1-p \end{cases}$$

Expressing as an expectation,

$$E(d_{t+1} - d_t) = \frac{k(p-d_t)}{1+k}$$

When current leverage is low, or $p - d_t > 0$, then $E(d_{t+1} - d_t) > 0$. When leverage high, $p - d_t < 0$, we have $E(d_{t+1} - d_t)$.

Some simulations of d_t follow.

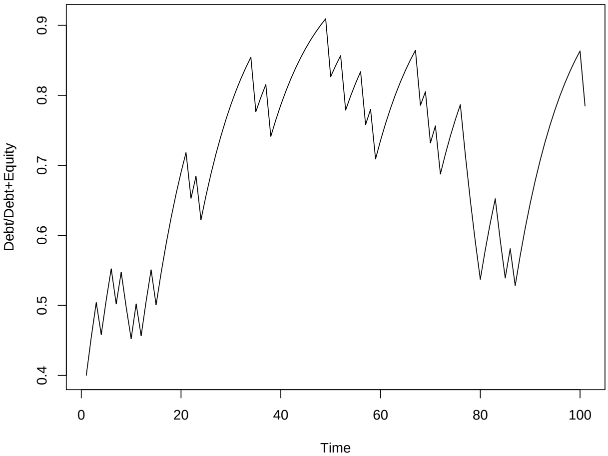


Figure 1: Sample path of $\frac{D_t}{D_t+E_t}$ with $\Pr(\text{debt}) = 0.8$, $k = 0.2$. No target level, just random financing.

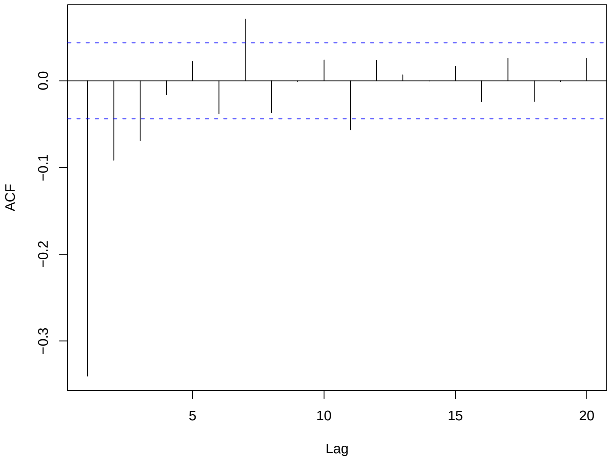


Figure 2: Auto-correlation function of Δd_t series. Negative auto-correlation (-35%) between $(d_{t+1} - d_t)$, $(d_t - d_{t-1})$. However, financing decisions between periods are *independent*.

5 Method

Chang and Dasgupta simulate random financing regimes based on COMPUSTAT data (1971-2004, 112035 observations, 0.5% winsorized).

In each simulation, there is no d_t^* target and financing decisions are independent across time and firm.

For each simulation, fit the model

$$d_{i,t} = (1 - \hat{\lambda}_{sim})d_{i,t-1} + \hat{\beta}\hat{\lambda}_{sim}X_{i,t-1} + \hat{\lambda}_{sim}v_i$$

and compare $\hat{\lambda}_{sim}$ to $\hat{\lambda}$ from actual COMPUSTAT data.

If $\hat{\lambda}_{sim}$ match $\hat{\lambda}$, empirical evidence consistent with random decisions.

Simulation regimes: Initial leverage $d_{i,0}$ used as starting point.

- **Coin Flip:** If need financing ("actual deficit"> 0) $\Pr(Debt\ \ Issue) = \frac{1}{2}$ If surplus cash, retires debt or equity with $\Pr(Debt\ \ Retire) = \frac{1}{2}$.

- **Empirical Flip:** If actual deficit positive, $\Pr(Debt\ \ Issue)$ =empirical probability across sample, $\overline{p} = \frac{1}{NT} \sum_i \sum_t I_{i,t}^{debt}$.

- **Coin Flip, Random Deficit:** Assumed % financial deficit y/A is randomly drawn from $i.i.d$ Normal with matched moments to data. $\Pr(Debt\ \ Issue) = \frac{1}{2}$

- **Empirical Flip, Random Deficit:** $\frac{y}{A} \sim N(\mu, \sigma^2)$, $Pr(Debt\ \ Issue) = \overline{p}$.

In actual deficit used, size of firm ($A_t = D_t + E_t$) remains same in simulations. Avoids equilibrium issues, but not endogeneity issues.

6 Results

Chang and Dasgupta use a very highly aggregated way to see mean reversion:

Average leverage $\overline{d}_t$ of "equity issuers" versus average of "non-issuers", plotted for $t = 0$ to 5 years.

"Equity issuers":= if net equity issue $>$ 5% in year 0.
"Non-issuers":= if net equity issue $<$5% in year 0.

Average $\overline{d}_t$ then tracked with various simulation rules.
Expect average of "non-issuers" to be flat (Law Large Numbers), average of "issuers" to mean revert to average.

$\hat{\lambda} \approx$ slope of line.

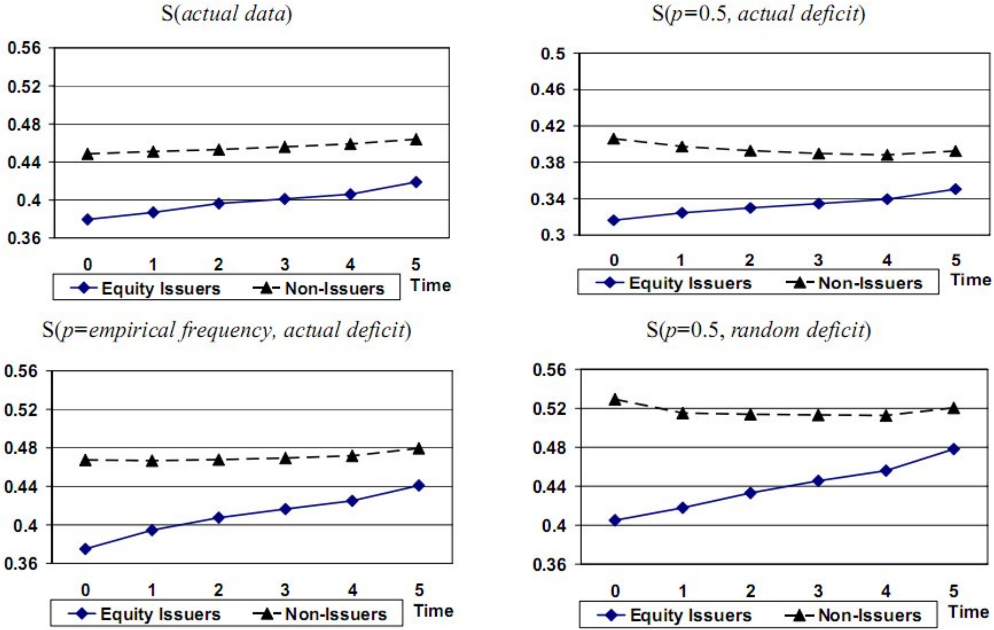


Figure 3: Average Leverage $\overline{d}_t$ of equity issuers and non-issuers.
Result: Actual data similar to simulations.

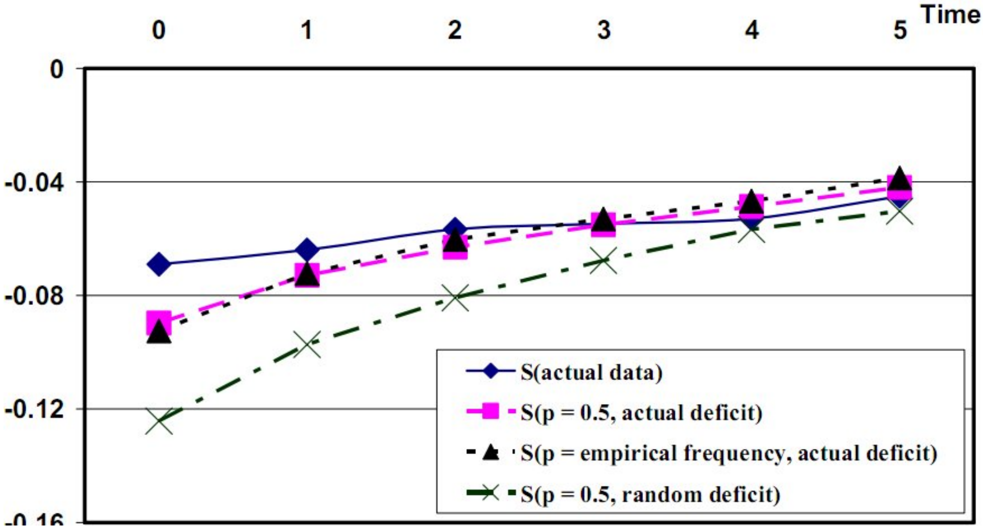


Figure 4: *Difference* in average leverage $\overline{d}_t$ of equity issuers and non-issuers. *Result*: Actual data matches the actual deficit simulations, particularly coin-flip and empirical frequency. Rates of mean reversion in all simulations match empirical reversion rate.

7 Result Consequences

- Results demonstrate that current mean-reversion evidence is consistent with random decisions.

  Two implications:

  - Perhaps the decisions *are* random. Data consistent with null.
  - Mean reversion test very weak to distinguish randomness from structure. Need improved tests.

- Looking only at leverage ratios is not enough and perhaps misleading (mechanical mean reversion).

- They suggest treating financing decisions as the dependent variable, regress against a separate assessment of economic significance.

8 Commentary

- Idea is excellent: simulate under the null (M&M), run existing tests under null data.

  Finance (esp. corporate) needs more of these studies. Our data is very noisy, easy to be fooled by randomness.

- Relies on very highly aggregated test of mean-reversion: "Issuers" vs "Non-Issuers". Little awkward.

  Instead: plot all estimated λ_{firm} against λ_{sim}, test for equality.

- Graphical "test" is good. Inclusion of a formal test of difference between curves would be better.

- Could use simpler bootstrap method for simulations, preserves more structure in data:

  Resample (cross-sectionally) from panel of actual firms financing decisions, recalculate time-series of leverage ratios.

  Similar to empirical flip, actual deficit simulation, maintains cross-sectional correlation.

- Writing style: hard to read early drafts. Better in the JF forthcoming version. Still appears very complicated on first read. Could be improved from simplification.

  The *idea* is very simple. The writing should also be simple.

Thank You! Now time for Questions.

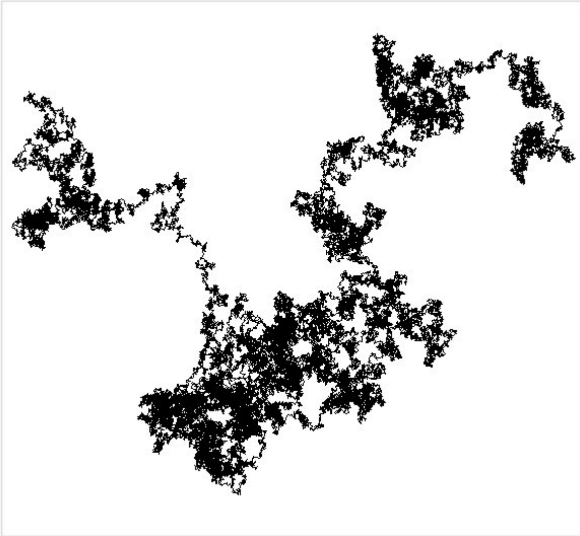


Figure 5: *A Brownian Motion.* If only financial markets behaved this nicely.