Capital structure notes

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1 Classical theories

Capital structure is an old topic and I feel really boring whenever I have to visit this old friend. There are several pillars in this *financing decision*: tradeoff theory, pecking order theory, and market timing.

Pecking order theory Shyam-Sunder and C. Myers (1999) propose two models to test pecking order theory and static tradeoff theory. For pecking order theory, they use the deficit and change in debt relation:

$$\Delta D_{it} = a + b_{PO} DEF_{it} + e_{it}$$

where $DEF = DIV + X + \Delta W + R - C$, where DIV is dividend payment, X is capital expenditure, ΔW is change in working capital, R is current portion of long-term debt at start of period, and C is operating cash flow. Deficit is the financial deficit of firms that inflow cash is not sufficient to pay for outflow cash. The pecking order theory predicts that $b_{PO} = 1$.

For static tradeoff theory, the regression is:

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$$\Delta D_{it} = a + b_{TA}\left(D^*_{it} - D_{it-1}\right) + e_{it}$$

where $D^*$is target debt ratio which is historical average of debt ratio. Firms should adjust to the target debt ratio, so tradeoff theory predicts that $b_{TA} = 1$.

The results support the pecking order theory. The pecking order theory also has higher power test, because it can reject the simulated data from the tradeoff theory, but tradeoff theory fails to reject the simulated data from pecking order theory.

Market timing Baker and Wurgler (2002) write one of the most influential paper about capital structure. They find that market timing affects firm leverage and the effect is persistent and lasts up to 10 years (market overvaluation in previous 10 years affect leverage now!!!). Thus, current capital structure is a cumulative result of past attempts to time the market.

The smartest thing in this paper is Baker and Wurgler (2002) find a new measure to distinguish between M/B (that could proxy for growth opportunity) and external-financing weighted average M/B ratio (to proxy for market timing attempt).

$$\left(\frac{M}{B}\right)_{efwa,t-1} = \sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} e_r + d_r} \cdot \left(\frac{M}{B}\right)_s$$

Notes that they drop $M/B > 10$ and if $weight < 0$ (when net issue <0), they set $weight = 0$.

This variable takes high values for firms that raised external finance when the M/B ratio was high and vice-versa. It captures two things in history: (1) overvaluation in history in M/B ratio and (2) debt and equity issue (in term of e and d, which are net equity and net debt issued).

Their main model includes both current investment opportunities and past attempts of market timing:

$$\left(\frac{D}{A}\right)_t = a + b\left(\frac{M}{B}\right)_{efwa,t-1} + c\left(\frac{M}{B}\right)_{t-1} + d\left(\frac{PPE}{A}\right)_{t-1} + e\left(\frac{EBITDA}{A}\right)_{t-1} + f\,log(S)_{t-1} + u_t$$

They always find a strong negative relation between leverage and their overvaluation timing attempts. In addition, the coefficient of $\left(\frac{M}{B}\right)_{t-1}$ is less significant or even positive (high growth firms need more external finance) , which proves that their new measure perform better to capture the market timing.

And the most interesting is the coeffcient of $\left(\frac{M}{B}\right)_{efwa,t-1}$ is at its place for up to 10 years after IPO, a very persistent effect.

Persistence in Capital Structure The paper I want to discuss now is Lemmon et al. (2008). The most important finding is their Figure 1. This figure shows the future 20-year evolution of leverage for 4 portfolios constructed by *sorting firms based on their current leverage*.

- Each year, they sort firms into quartiles according to leverage ratios: Very High, High, Medium, and Low. The formation year is year 0. Then we hold the portfolio composition constant for subsequent 20 years.
- Repeat these 2 steps for every year in the sample period (39 year so 39 sets of event-time average).
- Compute average leverage of each portfolio across 39 sets within each event year: year 0 to year +20.

What do we see?

- There is a *convergence tendency* in leverage to a moderate level (at middle).
- Despite the convergence, the leverage ratios are *remarkably stable* because the difference between groups still statistically and economically significant.
- Explain: the presence of a *transitory (i.e., short-run component)* that leads to a gradual convergence in leverage ratios, as well as a *permanent (i.e., long-run component)* that leads to highly persistent cross-sectional differences in leverage.
- Another property is adjusted R2 from traditional leverage regressions ranges from 18% to 29%, while the adjusted R2 of firm fixed effect is 60%, meaning that majority of variation in leverage is unexplained by previously identified determinants.
- In addition, the coefficients of previously identified determinants of leverage decrease in magnitude of 65%-85% on average after controlling for firm fixed effects and serially correlated errors. From this finding, later studies in corporate structure tend to use firm fixed effect and serial correlated errors in the model.
- Thus, they suggest that existing determinants of capital strucutre appear to explain a relatively small fraction of the variation in leverage.

Another important implication of their finding is firms tend to rebalance capital structure toward a largely *time-invariant target* (i.e., unobserved permanent component of leverage) rather than a time-varying target specification as in some other studies.

The role of initial leverage: $Leverage_{it} = (+)Leverage_{i0}$ where $Leverage_{i0}$ is first nonmissing value for leverage in data. The coefficient is positive and t-stat is large (>28). *Initial leverage* is the single most important determinant of future capital structure in the model.

Variance decomposition: the idea of variance decomposition is to see how much the sum of squares of the model could be explained by the factors in the model (such as firm FE, year FE, firm characteristics). The results show that most of the effect is from the firm fixed effect, not year fixed effect and firm characteristics.

- First, the results show that leverage contains an important *unobserved firm-specific component* that is not fully captured by existing determinants. In other words, controlling for previously identified determinants does not alleviate the concern over heterogeneous intercepts, a result with potentially important implications for empirical studies that we elaborate below.
- Second, the variance decomposition reinforces the finding that the *majority of the total variation in leverage is due to cross-sectional differences*, as opposed to time-series variation.

2 New-trending theories

2.1 A time-series trending of capital structure over 20th century

Graham et al. (2015) propose an increasing trend in aggregate leverage over the 20th century among unregulated firms (from 11% to a *peak of 47%* by early 1990s). The increase is quite popular in all sectors, all size, and all Fama French 12 industries. For regulated firms (i.e., utilities, railroad, telecommunications), the debt ratio seems to be stable. In addition, the fraction of assets held by regulated firms are decreasing. Thus, they find that the economy-wide leverage ratio is quite stable in general during 20th century. To some extent, this finding is also consistent with the persistence in capital structure in Lemmon et al. (2008).

A theoretical framework of aggregate leverage This model is inspired by Merton Miller (1977). The aggregate debt is determined by interaction of the *supply of securities by firms* (issue debt or equity) and *demands for these securites from investors*. Investment is assumed to be fixed so movements along the horizontal axis correspond to substitutions between debt and equity.

- The supply shows how firms issue debt relative to yield: it first increases because of tax shield and agency benefits, then slope down because of distress cost.
- The demand shows the investors' willingness to hold debt at different yields: different risk aversion, transaction cost, cash flow expectation, and personal tax leads to a upward-sloping demand. Investors demand higher yields to compensate for disavantage of holding debt.
- Some predictions:
  - When risk aversion is higher, persimistic cash flow expectation, and low personal tax rate grows, demand curve will flatten and aggregate debt increase.
  - Increase in supply of competing securities (e.g., government debt) shift the demand to left and up, leading to lower aggregate debt.
  - Development of financial market decrease the cost of transforming return streams from one security to another. The demand curve will be more elastic (flatter curve) and corporate debt usage increase more.

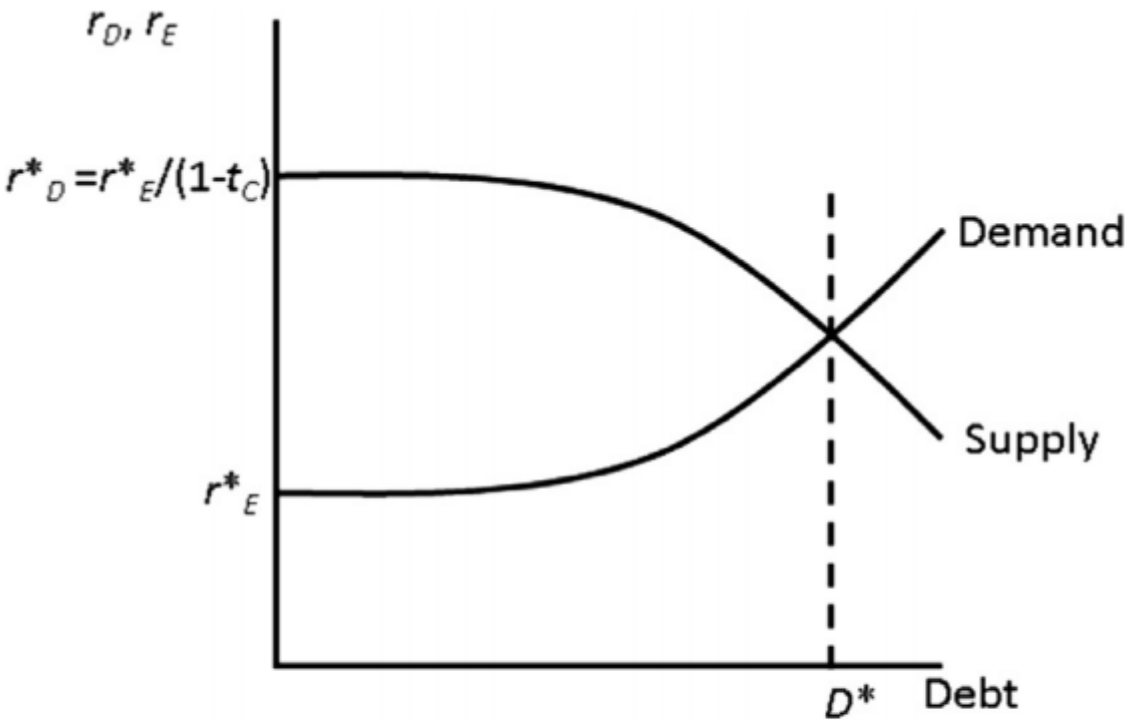

Fig. 6. Supply and demand for corporate debt. The figure shows theoretical demand and supply curves for corporate debt. On the horizontal axis is the aggregate quantity of corporate debt (D), on the vertical axis the risk-adjusted return on debt (r^*_D) and equity (r^*_E).

Figure 1: Aggregate leverage model

The channels Next, the authors attempts to answer the question why leverage ratio increases for unregulated firms. First, they use firm characteristics to explain the increase in leverage. They use characteristics those found to affect leverage such as sale, profitability, tangibility, M/B (growth opportunities), and earning volatility. In general, the introduction of Amex firms (1963) and Nasdaq (1973) makes size smaller, lower profits and less tangible assets, higher M/B, and more volatility. However, no characteristic could fully explain the increase in debt ratio among unregulated firms. In detail, the difference (i.e., they call this is *average residual*) between actual leverage and predicted leverage (from regression on firm characteristics) is large and significantly over time.

Finally, they consider the trend in *macroeconomic factors*. They find that government debt (Fed debt/GDP) and financial development (i.e., business credit and equity component of financial sector's output) are significantly correlated with the increase in aggregate leverage ratio. Higher financial development and lower government debt are positively related to corporate leverage. While the positive relation between financial development and corporate leverage is quite plausible, the negative relation between government debt and corporate debt could be explained by two reasons:

1. Government debt increases debt supply in the market (a substitute good) and shift the demand of corporate debt (to the left-up).

2. Government debt proxy for a lantent investment opportunity. A higher government debt is often found in downside economy, which seems to have lower growth opportunities for firms. Firms have less demand for external fundings so they have less leverage.

They test this macroeconomic explanation using an OLS regression:

$$Debt/Capital = MacroAggregateFactor + Control$$

where the *MacroAggregateFactor* is some important measures such as Output Finance (+) and Goverment Debt (-). The findings support the above arguments. The results are consistent when the authors use other dependent: first difference in Debt Ratio, Debt Issuance/Asset, Debt Issuance/Investment.

2.2 Peer effect

In literature, average industry leverage could affect the firms' capital structure. This is the very first evidence that firms could be affect by their peers when they decide the firms' capital structure. Leary and Roberts (2014) propose several interesting reasons why the firms often mimic their peers in financing decisions. Why firms imitate their peers?

- Managers are unsure of how to set optimal capital structure. The inputs are hard to measure and the true model is unknown. As such, managers consider the financing decisions and characteristics of peer firms as informative for their own financing decisions.

- Interactions between financial structure and product market competition can lead to financial policy mimicking. Chevalier and Scharfstein (1996) present a model in which firms with high leverage underinvest during an industry downturn and lose market share to more conservatively financed competitors. Thus, the fear of loss market share push firms to mimic their peers.
- Rational herding model (Devenow and Welch, 1996).

Method and results

- First, they criticize the use of industry leverage because of *reflection problem* (Manski, 1993). First, this reflection problem argue that firms in the same group tend to face similar institutions and have similar characteristics so they may end up with similar leverage. The second explanation is that firms' financial policies are partly driven by a response to their peers.
- They propose that using idiosyncratic return shocks (*raw return - expected return from market model*) are more appropriate to measure the peer effect.
- Leary and Roberts (2014)estimate the marginal effect of a change in peer firm leverage on firm i's own leverage, using peer firms' *idiosyncratic equity return shocks* as an instrument for their capital structures. Using 2SLS, they find that a one standard deviation increase in peer firms' leverage ratios is associated with a 10% increase in firm i's leverage ratio, larger than any other determinants.
- Small, young, less profitable, financial constrained firms often follow their more successful counterparts, but the industry leaders are insensitive to their less successful peers.

2.3 Overconfidence and Early-life experience

Malmendier et al. (2011) find that early-life experience of the CEOs during the Great Depression, which is the largest financial crisis in 20th century. Experienced this crisis, CEOs tend to be more risk averse because they find that using leverage is too risky. Thus, when they grew up, they tend to use leverage in a more conservative way rather than maximum benefits (from tax shield) could be obtained from debt.

In particular, Malmendier et al. (2011) expand the idea in their paper in 2008 that OC seem to believe that their firms are undervalued; thus, being reluctant to issue external finance because they think that external finance is too costly. As a result, they prefer internal finance to external finance (Y = Public Issues, OC's coefficient <0). If they have to raise external fund to cover financing deficit, they will choose debt than equity (Y=Debt, X = Financing Deficit * OC). In addition, if they have to use debt, they use it conservatively relative to available tax benefits.

- A confusing part of this paper is they further expand the paper to Great Depression CEOs and military-background CEOs.

- Great Depression CEOs are more conservative and appear to access risky capital markets more conservatively.
- In contrast, military-background CEOs tend to take more risky, using more leverage.
- To proxy for conservativeness of using debt, they use a variable namely $kink$ (hypothetical level of interest / actual interest paid). This variable captures the additional debt could be issued before expected marginal tax-shield benefits begin to fall. Thus, a higher $kink$ means that firms use debt more conservatively. In model, they use $kink$ as Y, coefficients of OC and Great Depression are positive.

2.4 Early-life fatal disasters

Some related puzzles in daily life:

- Not-yet-seen ghost people prefer to talk about ghost and after-life mysteries, while experienced people try to avoid talking about such stories.
- Accident-experienced (e.g., car) tend to drive safe, while newbie drivers tend to drive fast to enjoy the speed.

Bernile et al. (2017) apply the idea for early-life fatal disaster experience of the CEOs.

A non-monotonic relation: strength of experience An interesting story is when CEOs grow up during a fatal disasters. There are two types:

- CEOs who experienced the *disasters without extremely negative consequences*: behave more aggressively later
- and CEOs who just witnessed the *extreme downside of the disasters*: behave more conservatively later

These disasters affect how they decide important policies in firms such as leverage, cash holding, acquisition activity, and return volatility. As a result, CEOs' disaster experience and corporate policies have impacts on firm riskiness and cost of capital.

Compared to literature, this paper contributes by consider the strength of the experience rather than just yes/no question. It means that *how* he experienced the disasters in his early-life is also important. If the disaster is *a insignificant fatalities*, then CEOs may develop a higher risk tolerance. In contrast, those with exposure to *major fatal disasters* may behave more conservatively. Thus, this paper introduces *the non-linear relation between risk exposure and investor behavior*, compared to a linear relation in existing literature.

Method and results

- Disasters: i.e., including earthquakes, volcanic eruptions, tsunamis, hurricanes, tornadoes, severe storms, floods, landslides, and wildfires. Data is from Uni of South Carolina. Some states with most disasters are New York, Pennsylvania, Illinois.
- Early-life formative age: 5-15
- At CEO birth county: number of disaster fatalities/population
- The first method is panel regression with financing, investment (M&A) as dependent, the $Medium$ and $Extreme\,Fatality\,Experience$ as independent. They control for firm and CEO variables and fixed effects: state of birth, year of birth, year and firm fixed effects. They also control for the *historical incidence of disaster-related fatalities* in the CEO's county of birth over the period 1900 to 2010 to help us separate the effect of a CEO growing up in a "high-risk" county from actually having lived through a fatal disaster during his formative years. For example, a CEO may live in Kansas during his childhood but does not experience any disaster, although Kansas is called the "tornado belt".
- DiD: to eliminate the endogeneity

    1. CEOs that experienced major fatal disasters (treat) in their formative years relative to CEOs in unaffected neighboring counties (within 100 miles from the disaster) who did not experience any major disaster (control) between the ages of 5 to 15.
    2. Another test is exogenous event (CEO turnover) where the risk tolerances of the incoming and outgoing CEOs are different. In turn, the risk tolerance change will affect the corporate policies after the turnover events.
    3. This method suggests that CEO risk preferences may have causal impacts on corporate policies.

- To verify concern that he does not live in his birth county during 5-15:

    – Use 5-10 age
    – Verify whether they also received their Social Security number (SSN) in the same county
    – Placebo test: assign a random birth county to each CEO and find no statistically significant effects

Main findings

- A sample of 1,508 US-born CEOs from 1992 to 2012.

- Inverse U-shaped relation of early-life exposure to fatal disaster and corporate risk-taking. For example, *moderate exposure* CEOs have a 3.4% higher leverage ratio than firms whose CEOs experienced no fatal disasters. But *extreme exposure* CEOs have a 3.7% (7.1%) lower leverage than firms with no-fatal CEOs (*moderate exposure* CEOs).

- CEOs with *moderate disaster exposure* are more likely to meet net financing deficits with debts rather than equity, have lower credit rating, and pay higher interest expenses and bank-loan (and bond) spreads than *no-fatal* CEOs. *Moderate exposure* CEOs are also significantly more likely to go through bankruptcy. *Extreme* CEOs have opposite patterns, they tend use less debt and more retained earning to meet financing deficit. The model follows Shyam-Sunder and Myers (1999) and Frank and Goyal (2003): $\Delta Debt = FD + MediumFatal * FD + ExtremeFatal * FD$ (then replace Y by $\Delta Equity$ and RE). Here, net financial deficit (FD) is dividend and investment minus cash flows, show the deficit amount that CF is not enough to pay for dividend and investment.

- Similarly, CEOs with *moderate (extreme)* exposure hold significantly less (more) cash, announce more (fewer) acquisitions, are less (more) likely to pay for acquisitions with stock,[1] and are more (less) likely to announce unrelated acquisitions than no-fatal CEOs. They also earn worse M&A announcement returns.

- Moderate CEOs have higher volatility, especially idiosyncratic volatility, than CEO with no disaster experience, while CEOs with extreme disaster experience again display the opposite patterns.

2.5 How financing policies affect investment policies

There are several papers try to link the financing policies and the investment policies in firms. Uysal (2011) finds that:

- Overleverage →M&A: Firms with over-leverage relative to their target debt ratios seem to make less acquisitions. Interestingly, the effect is asymmetric: overleverage affects the M&A likelihood but underleverage does not affect the M&A likelihood.

- In cases they have to undertake acquisitions, they are likely to use less cash, acquire smaller targets, and pay lower premium. It means that the overleverage tends to affect the terms of the M&A.

- M&A →Leverage rebalance: Managers of overleveraged firms also actively rebalance their capital structures when they anticipate a high likelihood of making acquisitions.

  – The dependent: Issue Equities, Change in Leverage Deficit.

[1] Moderate CEOs prefer to pay by cash, which is contrast to Malmendier and Tate (2008) who find that CEOs with *high risk tolerance* tend to pay by stocks instead of cash. Thus, Malmendier and Tate (2008) conclude that the findings in their paper come from overconfident CEOs. Whether *moderate CEOs* are the OC in Malmendier and Tate (2008)?

  - Main independent is the Interaction between Overleverage and Probability of undertaking acquisitions.
  - The Probability of undertaking acquisitions:
    1. Likelihood undertake acquisition (Harford, 1999): using fitted value from the Probit model and the distribution to find the cutpoint of expected bidders are firms with fitted value > cutpoints (0.11)
    2. Industry M&A Liquidity: firms in industries with high M&A volume will acquire more
    3. Cluster Firm: equals one for firms locate in an industry cluster (higher probability to be acquirers). Not sure the meaning of Cluster Firm but it could mean a group of firms in a specific geographic region.
  - Results show that overleveraged Expected Bidders tend to issue equity and reduce Deficit.

- They also pursue the most value-enhancing acquisitions. The CAR of overleverage bidders tend to be higher, while the long-run stock price in following 5 years of overleveraged firms is not lower so there is no price reversal.

How to measure the target leverage? It is a 2-step procedure. First, they run a regression to *predict the target leverage* on determinants in literature. Second, they take the predicted value as target leverage and calculate the deviation from predicted target leverage as the main independent variable: $Leverage\,Deficit$. They find an asymmetric effect: only $Overleverage$ reduces acquisition likelihood while $Underleverage$ does not affect acquisition likelihood.

Actually, this finding could be explained by some alternative hypotheses:

- *FCF hypothesis*: overleveraged firms are monitored excessively so they tend to make more favorable deals. However, the FCF hypothesis is not fully consistent with the fact that the underleverage firms (which are prone to agency problems) do not suffer negative CAR reactions.
- *Financial synergy*, which is generated in acquisitions of low-financial-slack by high-slack firms: This hypothesis predicts that underleveraged (overleveraged) firms will undertake M&A more (less), but the finding so that this is only an asymmetric effect. In addition, underleveraged firms do not experience higher CAR, as predicted by financial synergy.
- *Wealth transfer* hypothesis: managers in overleveraged firms behave in the best interest of shareholders (rather than bondholders) so they will avoid M&A because favorable increase in wealth will belong to bondholders. The finding supports that overleveraged firms make less acquisitions but they predict a positive CAR, which contradicts a negative CAR-deficit relation of the wealth transfer hypothesis.

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