



# Mechanical mean reversion of leverage ratios ☆

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## Abstract

The leverage ratio of an average firm reverts to mean mechanically regardless of whether target leverage exists. This cautions against studies that use the ability of the leverage ratio (or deviation from target leverage) to predict future leverage changes to draw inference on capital structure theories.

## Introduction

Imagine a firm that is worth \$100, with \$80 equity and \$20 debt. If the firm issues \$3 of new equity and \$1 of new debt, its financing policy has a clear preference on equity issuance; yet the leverage ratio of the firm rises from 20% to 20.2%. Similarly, imagine another firm with \$80 debt and \$20 equity. If the firm issues \$3 debt and \$1 equity, despite the clear preference on debt financing, the leverage ratio falls from 80% to 79.8%.

The above examples demonstrate that the leverage ratio of a firm tends to revert to mean mechanically regardless of the firm's financing preference. Intuitively, the relative impact of leverage-enhancing activities (net debt issuance) versus leverage-reducing activities (net equity issuance and net retained earnings) is a monotonically decreasing function of leverage. Therefore, unless a firm adopts an extreme financing policy (such as never issuing debt), a high leverage ratio tends to decrease; the opposite is true for a low leverage ratio. This point can be illustrated using an accounting identity.

The mechanical mean reversion of leverage ratios blurs our understanding of corporate financing decisions. The trade-off theory, a classical view of capital structure theory, says that firms choose optimal target leverage ratios to balance bankruptcy risks with the tax benefits from debt financing.

To support this argument, many studies regress the change of leverage ratio on the lagged leverage ratio or on the deviation from target ratio – a higher deviation from target implies that the firm is more over-levered – and find a negative coefficient. This coefficient is usually used to infer the adjustment speed to “desired target ratio,” and its significance is regarded as evidence favoring the trade-off theory. (e.g., Taggart, 1977,

Auerbach, 1985, Fama and French, 2002, Flannery and Rangan, 2006). We do not dispute these empirical findings. Rather, we question how much of the leverage change in previous studies is due to mechanical mean reversion rather than firms' actual intentions.

To illustrate the mechanical mean reversion effect, we investigate the financing decisions by a large sample of firms in COMPUSTAT. We show that, among firms that do not reduce debt, higher levered firms issue significantly more debt than equity; yet their leverage ratios rise less than those of less levered firms. Therefore, depending on whether we study leverage ratio changes or financing decisions, we can reach opposite conclusions regarding capital structure theories. In fact, a regression of leverage changes on lagged leverage or on the deviation from target always yields a negative coefficient. This pattern persists even after we delete the top and bottom 25% firm-years ranked by leverage ratio, which suggests that our findings are not driven by outliers with extremely high or low leverage ratios. We thus conclude that leverage ratio changes per se are uninformative in revealing firm financing policies, and it is premature to interpret the reversion of leverage towards the mean as definite evidence supporting the trade-off theory. Whether there are target leverage ratios and intentional adjustment cannot be answered within this context.

Despite the large capital structure literature, the impact of the mechanical mean reversion of leverage, to our best knowledge, is little studied. Welch (2004) points out that equity issuance does not affect the leverage ratio of an all-equity firm, but he does not explore more generally how financing decisions can lead to mechanical mean reversion. Our evidence, both conceptual and empirical, suggests that this mechanism could have played an important role in previous studies.<sup>2</sup> Further work is needed to improve our understanding of corporate capital structure choices after properly controlling for the mechanical mean reversion.

## Section snippets

### An accounting identity

We use an accounting identity to explain why leverage can exhibit a mean reversion pattern mechanically. We adopt the following notations. Let  $A_t$ ,  $D_t$ ,  $E_t$ , and  $RE_t$  represent, respectively, asset, debt, equity, and retained earnings at time  $t$ . Let  $\Delta$  denote the difference operator. Through an accounting identity,

$A_t = A_{t-1} + \Delta D_t + \Delta E_t + \Delta RE_t$ , we can write the leverage ratio change as

$$\text{Leverage change} = \frac{D_t}{A_t} - \frac{D_{t-1}}{A_{t-1}} = \left[ \left( 1 - \frac{D_{t-1}}{A_{t-1}} \right) \frac{\Delta D_t}{A_t} \right] + \left[ -\frac{D_{t-1}}{A_{t-1}} \frac{\Delta E_t}{A_t} \right] + \left[ -\frac{D_{t-1}}{A_{t-1}} \frac{\Delta RE_t}{A_t} \right].$$

This equation describes how net debt...

### Empirical evidence

The above discussion suggests that the mean reversion pattern of leverage ratios could be uninformative in revealing firms' financing policies because it could be mechanical. A crucial question is whether this mechanical mean reversion has led prior studies to draw inferences on capital structure theories. Of particular relevance are some studies that propose the partial adjustment toward target leverage ratios. In various forms, prior studies usually regress the change of leverage ratio on the ...

## Discussion and concluding remark

Leverage ratio changes and financing decisions are two primary tools through which previous studies draw inferences regarding capital structure theories. Table 1 shows that they can lead to opposite conclusions. If we rely on financing decisions to draw inference, we can conclude that leverage ratio changes can be misleading because they revert to mean mechanically even though the financing decisions might not be consistent with the target ratio interpretation. Alternatively, if we believe that ...

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