

**The Speed of Adjustment to the Target Market Value Leverage is Slower  
Than You Think**

**Internet Appendix**

Qie Ellie Yin and Jay R. Ritter

forthcoming, *Journal of Financial and Quantitative Analysis*

July 2019

## Internet Appendix A: Proof for Propositions and Description of Simulation Procedure

### A.1. Proof for Proposition 1:

When the firm value growth rate is a constant  $g$  ( $g \neq 0$ ), equation (3) can be written as:

$$\text{Lev}_{it} \equiv \left(1 - \frac{g}{1+g}\right) \text{Lev}_{i,t-1} + \frac{g}{1+g} \times \frac{d_{it}}{g}. \quad (\text{A.1})$$

The partial adjustment model implies:

$$\text{Lev}_{it} = (1 - \lambda) \text{Lev}_{i,t-1} + \lambda \text{Lev}_{it}^* + \varepsilon_{it}. \quad (\text{A.2})$$

Based on (A.1):

$$\text{Cov}(\text{Lev}_{it}, \text{Lev}_{i,t-1}) = \left(1 - \frac{g}{1+g}\right) \sigma_L^2 + \frac{g}{1+g} \text{Cov}\left(\frac{d_{it}}{g}, \text{Lev}_{i,t-1}\right), \quad (\text{A.3})$$

where  $\sigma_L^2 = \text{Var}(\text{Lev}_{i,t-1})$ .

Based on (A.2):

$$\text{Cov}(\text{Lev}_{it}, \text{Lev}_{i,t-1}) = (1 - \lambda) \sigma_L^2 + \lambda \text{Cov}(\text{Lev}_{it}^*, \text{Lev}_{i,t-1}) + \text{Cov}(\varepsilon_{it}, \text{Lev}_{i,t-1}). \quad (\text{A.4})$$

Without loss of generality, we assume  $\text{Cov}(\text{Lev}_{it}^*, \text{Lev}_{i,t-1}) = \text{Cov}(\varepsilon_{it}, \text{Lev}_{i,t-1}) = 0$ . Thus (A.4)

can be simplified to:

$$\text{Cov}(\text{Lev}_{it}, \text{Lev}_{i,t-1}) = (1 - \lambda) \sigma_L^2. \quad (\text{A.5})$$

Equalizing (A.3) with (A.5):

$$\text{Cov}(\text{Lev}_{it}, \text{Lev}_{i,t-1}) = \left(1 - \frac{g}{1+g}\right) \sigma_L^2 + \frac{g}{1+g} \text{Cov}\left(\frac{d_{it}}{g}, \text{Lev}_{i,t-1}\right) = (1 - \lambda) \sigma_L^2.$$

Therefore,

$$\lambda = \frac{g}{1+g} \left[1 - \frac{\text{Cov}\left(\frac{d_{it}}{g}, \text{Lev}_{i,t-1}\right)}{\sigma_L^2}\right].$$

Denoting  $\beta = \frac{\text{Cov}\left(\frac{d_{it}}{g}, \text{Lev}_{i,t-1}\right)}{\sigma_L^2}$ , we have:

$$\lambda = \frac{g}{1+g} (1 - \beta). \quad (\text{A.6})$$

Roughly speaking,  $\beta$  means the marginal effect of actual leverage at time t-1 on the net debt change proportion if regressing the net debt change proportion on the lagged leverage.

## A.2. Proof for Proposition 2:

If the firm value growth rate is not constant, the form of equation (3) is unchanged:

$$\text{Lev}_{it} \equiv \left(1 - \frac{g_{it}}{1+g_{it}}\right) \text{Lev}_{i,t-1} + \frac{g_{it}}{1+g_{it}} \times \frac{d_{it}}{g_{it}}. \quad (\text{A.7})$$

Rewriting (A.7) based on the assumptions that  $\frac{d_{it}}{g_{it}} = w + \beta \text{Lev}_{i,t-1} + w_{it}$ , and  $\frac{g_{it}}{1+g_{it}} = z +$

$\delta \text{Lev}_{i,t-1} + z_{it}$ :

$$\begin{aligned} \text{Lev}_{it} &\equiv \left(1 - (z + \delta \text{Lev}_{i,t-1} + z_{it})\right) \text{Lev}_{i,t-1} + (z + \delta \text{Lev}_{i,t-1} + z_{it}) \times (w + \beta \text{Lev}_{i,t-1} + w_{it}) \\ &= (1 - z + z\beta + w\delta) \text{Lev}_{i,t-1} - \delta(1 - \beta) \text{Lev}_{i,t-1}^2 + (\delta w_{it} + \beta z_{it} - z_{it}) \text{Lev}_{i,t-1} + z_{it}w + z w_{it} + \\ & z_{it}w_{it}. \end{aligned}$$

$$\begin{aligned} \text{Then } \text{Cov}(\text{Lev}_{it}, \text{Lev}_{i,t-1}) &= (1 - z + z\beta + w\delta) \sigma_L^2 - \delta(1 - \beta) \text{Cov}(\text{Lev}_{i,t-1}^2, \text{Lev}_{i,t-1}) \\ &+ \text{Cov}[(\delta w_{it} + \beta z_{it} - z_{it}) \text{Lev}_{i,t-1}, \text{Lev}_{i,t-1}]. \end{aligned} \quad (\text{A.8})$$

If  $E(w_{it}) = E(z_{it}) = 0$ ,  $\text{Cov}(w_{it}, \text{Lev}_{i,t-1}) = \text{Cov}(z_{it}, \text{Lev}_{i,t-1}) = 0$ , then

$$\begin{aligned} &\text{Cov}[(\delta w_{it} + \beta z_{it} - z_{it}) \text{Lev}_{i,t-1}, \text{Lev}_{i,t-1}] \\ &= E[(\delta w_{it} + \beta z_{it} - z_{it}) \text{Lev}_{i,t-1}^2] - E[(\delta w_{it} + \beta z_{it} - z_{it}) \text{Lev}_{i,t-1}] E(\text{Lev}_{i,t-1}) \\ &= E\left((\delta w_{it} + \beta z_{it} - z_{it}) \text{Lev}_{i,t-1}^2\right) E(\text{Lev}_{i,t-1}^2) - 0 = 0. \end{aligned} \quad (\text{A.9})$$

$$\text{Cov}(\text{Lev}_{i,t-1}^2, \text{Lev}_{i,t-1}) = E(\text{Lev}_{i,t-1}^3) - E(\text{Lev}_{i,t-1}^2) E(\text{Lev}_{i,t-1}). \quad (\text{A.10})$$

Plugging (A.9) and (A.10) into (A.8):  $\text{Cov}(\text{Lev}_{it}, \text{Lev}_{i,t-1})$

$$= (1 - z + z\beta + w\delta) \sigma_L^2 - \delta(1 - \beta) [E(\text{Lev}_{i,t-1}^3) - E(\text{Lev}_{i,t-1}^2) E(\text{Lev}_{i,t-1})]. \quad (\text{A.11})$$

Equalizing (A.11) with (A.5):

$$(1 - z + z\beta + w\delta)\sigma_L^2 - \delta(1 - \beta)[E(\text{Lev}_{i,t-1}^3) - E(\text{Lev}_{i,t-1}^2)E(\text{Lev}_{i,t-1})] = (1 - \lambda)\sigma_L^2.$$

Therefore,

$$\lambda = z(1 - \beta) - w\delta + \delta(1 - \beta)f(\text{Lev}_{i,t-1}), \quad (\text{A.12})$$

where  $f(\text{Lev}_{i,t-1}) = \left[ \frac{E(\text{Lev}_{i,t-1}^3) - E(\text{Lev}_{i,t-1}^2)E(\text{Lev}_{i,t-1})}{\sigma_L^2} \right]$ ,  $z$ ,  $w$ ,  $\beta$ , and  $\delta$  are based on:  $\frac{d_{it}}{g_{it}} = w +$

$\beta\text{Lev}_{i,t-1} + w_{it}$ , and  $\frac{g_{it}}{1+g_{it}} = z + \delta\text{Lev}_{i,t-1} + z_{it}$ . In addition, based on these two equations,  $\beta$  and

$$\delta \text{ can be expressed as: } \beta = \frac{\text{Cov}\left(\frac{d_{it}}{g_{it}}, \text{Lev}_{i,t-1}\right)}{\sigma_L^2}, \quad \delta = \frac{\text{Cov}\left(\frac{g_{it}}{1+g_{it}}, \text{Lev}_{i,t-1}\right)}{\sigma_L^2}.$$

### A.3 Simulation Procedure for Section III:

We use the first year total book assets and leverage of each firm as the initial conditions. We use the book value of total assets and define leverage as the ratio of liabilities to total assets, but the results are insensitive to the inclusion of other liabilities in the definition of firm value and leverage. We assume that the firm value growth rate follows an exogenously given normal distribution  $g_{it}$  with mean and standard deviation of  $g^*$  and  $|g^*|$ .<sup>1</sup> The leverage process is generated from the partial adjustment model as specified in equation (1):

$$\text{Lev}_{it} = (1 - \lambda^*)\text{Lev}_{i,t-1} + \lambda^*\text{Lev}_{it}^* + \varepsilon_{it},$$

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<sup>1</sup> We restrict the random firm value growth rate  $g_{it} > -1$  because firm value cannot be lower than zero. Although the sign of the firm value growth rate changes over time in reality, most firms have positive firm value growth in most periods. For example, more than 95% of the U.S. firms have positive book assets rates in nine of ten periods. Therefore, to make the simulations simple, we temporarily assume that the random firm value growth rate has the same sign for all firm years following the assumptions in Proposition 1. We will consider different directions of the firm value growth rate in the robustness checks section (e.g., Figure 7).

where  $Lev_{it}^* \sim N(0.3, 0.3)$ ,  $\varepsilon_{it} \sim N(0, 0.1)$ ,  $\lambda^*$  is the assumed true speed of adjustment, and  $Lev_{i0}$  is the initial leverage of Compustat firms.<sup>2</sup> For a given distribution of  $g_{it}$ , the firm value growth process is generated from:

$$A_{it} = (1 + g_{it})A_{i,t-1},$$

with  $A_{i0}$  equal to the initial book value of total assets of Compustat firms when book leverage is used. Then debt at time  $t$  satisfies:

$$D_{it} = A_{it} \times Lev_{it},$$

The net debt change proportion is equal to:

$$\frac{d_{it}}{g_{it}} = \frac{\Delta D_{it}}{\Delta A_{it}} = \frac{D_{it} - D_{i,t-1}}{A_{it} - A_{i,t-1}}.$$

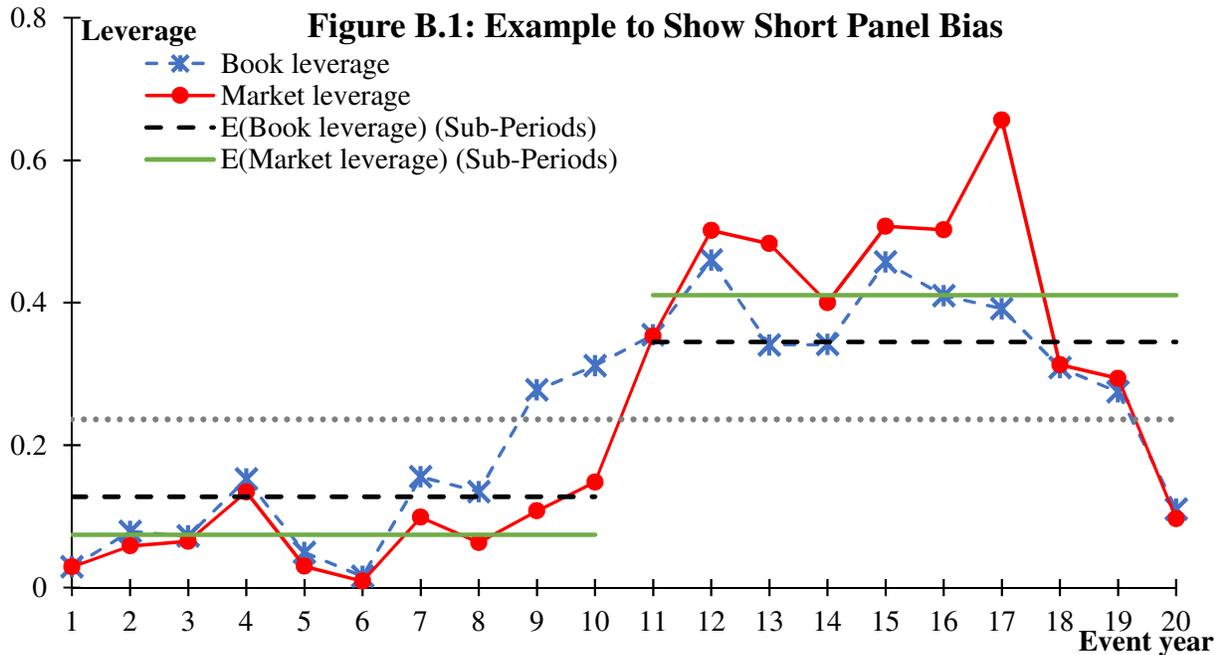
By calculating the variance of  $Lev_{i,t-1}$  and its covariance with  $\frac{d_{it}}{g_{it}}$ , we estimate the speed of adjustment  $\lambda$  based on equation (13) or equation (14) as in Section III.

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<sup>2</sup> Target leverage distribution is for the panel dataset and is not bounded between 0 and 1. Actual leverage is assumed to be censored between 0 and 1.

## Internet Appendix B: A Simulated Example to Show Short Panel Bias

In this appendix, we construct a simulated sample with 20-year observations of each firm. For a given firm, book leverage is generated from the partial adjustment model by assuming the true SOA is equal to 0.2. Also, the average book leverages over the earlier and later 10 years are different. We require that the average market leverage is the same as the average book leverage for the full period (20 years), but the average change in market leverage from period to period is larger due to larger stock price fluctuations than the variation of book assets growth. The estimated book and market SOAs are derived from equation (12) after considering the influence of firm-fixed effects and different directions of firm value growth. Figure B.1 presents one example in this simulation. Table B.1 shows the estimated book and market SOAs both for the full period and for two sub-periods.



**Table B.1: SOA Comparison between Full and Sub-Periods**

Time Length	Estimated Book SOA	Estimated Market SOA
Full Period	0.22	0.28
Sub-Period(1~10)	0.32	0.48
Sub-Period(11~20)	0.25	0.38

### Internet Appendix C: Endogeneity in the Partial Adjustment Model

Equation (11) in Section II.C includes firm-fixed effects in the partial adjustment model. However, considering a more generalized case that the target leverage can be determined by both time-variant and time-invariant firm-specific variables and there can be non-zero correlations of explanatory variables with error terms, the partial adjustment model will have the following form:

$$\text{Lev}_{it} = (1 - \lambda)\text{Lev}_{i,t-1} + \lambda\text{Lev}_{it}^* + \varepsilon_{it} = (1 - \lambda)\text{Lev}_{i,t-1} + \theta X_{i,t-1} + \gamma_i + e_{it}, \quad (\text{C.1})$$

with  $\text{Cov}(e_{it}, \text{Lev}_{i,t-1}) \neq 0$  and  $\text{Cov}(\theta X_{i,t-1} + \gamma_i, e_{it}) \neq 0$ . Then rewriting  $\text{Cov}(\text{Lev}_{it}, \text{Lev}_{i,t-1})$  based on equation (A.4) leads to the following expression for the SOA estimate:

$$\lambda_6 = \frac{1}{2} \left( \tilde{\lambda}_0 + \sqrt{\tilde{\lambda}_0^2 + 4 \frac{\sigma_{(\theta X_{i,t-1} + \gamma_i) + \text{Cov}(\theta X_{i,t-1} + \gamma_i, e_{it})}^2}{\sigma_L^2}} \right), \quad (\text{C.2})$$

where  $\tilde{\lambda}_0 = \lambda_0 - \frac{\text{Cov}(e_{it}, \text{Lev}_{i,t-1})}{\sigma_L^2}$ , and  $\lambda_0$  is the SOA estimate based on equation (5), (9), or (10).

Following the similar regression model as in Table 5 (Section V.C), Table C.1 presents the estimated book and market SOAs for U.S. firms based on equation (C.2) that considers more generalized endogeneity problems in the partial adjustment model. As shown, the book SOA estimate (16.5%), market SOA estimate (25.2%), and implied market SOA estimate (10.7%) after correcting for its upward bias are still close to the results as in Table 5.

**Table C.1: SOA Estimates Based on Equation (C.2)**

	Book Estimate	Market Estimate	Implied Market Estimate if $g^M = g^B$ and $\gamma^M = \gamma^B$
$\sigma(\text{lagged lev}), \%$	20.249	23.532	23.532
$\text{Cov}(\text{err, lagged lev}), (\%)^2$	15.690	26.048	26.048
$\sigma(\theta X + \gamma), \%$	2.450	<b>3.866</b>	<b>2.450</b>
$\text{Cov}(\text{err}, \theta X + \gamma), (\%)^2$	-0.144	<b>-0.087</b>	<b>-0.144</b>
$\lambda_4$ (in Table 4)	0.117	0.192	0.055
$\lambda_6$	0.165	0.252	0.107

### Internet Appendix D: Influence of Non-linearity and Other Economic Factors

*D.1. The influence of non-linearity between the net debt issuance proportion or the firm value growth rate and lagged leverage*

To account for the concern that the ratio  $d_{it}/g_{it}$  or  $g_{it}/(1 + g_{it})$  may have non-linear relationship with lagged leverage, we add the square terms of lagged leverage into the regressions of  $d_{it}/g_{it}$  and  $g_{it}/(1 + g_{it})$  on lagged leverage:

$$\frac{d_{it}}{g_{it}} = w_1 + \beta_1 \text{Lev}_{i,t-1} + u_1 \text{Lev}_{i,t-1}^2 + w_2 N_{it}^- + \beta_2 \text{Lev}_{i,t-1} N_{it}^- + u_2 \text{Lev}_{i,t-1}^2 N_{it}^- + w_{it},$$

$$\frac{g_{it}}{1+g_{it}} = z_1 + \delta_1 \text{Lev}_{i,t-1} + s_1 \text{Lev}_{i,t-1}^2 + z_2 N_{it}^- + \delta_2 \text{Lev}_{i,t-1} N_{it}^- + s_2 \text{Lev}_{i,t-1}^2 N_{it}^- + z_{it}.$$

where  $N_{it}^- = I(g_{it} < 0)$ . Then we derive the following form for the SOA:

$$\lambda_7 = z_1(\mathbf{1} - \beta_1) - w_1 \delta_1 + \delta_1(\mathbf{1} - \beta_1) f(\text{Lev}_{i,t-1}) + \mathbf{Adj}_{\text{different directions}} + \mathbf{Adj}_{\text{non-linearity}},$$

where  $f(\text{Lev}_{i,t-1}) = [E(\text{Lev}_{i,t-1}^3) - E(\text{Lev}_{i,t-1}^2)E(\text{Lev}_{i,t-1})]/\sigma_L^2$ ,  $\mathbf{Adj}_{\text{different directions}}$  represents the three terms related to negative firm value growth as in equation (10) or Table 4, and  $\mathbf{Adj}_{\text{non-linearity}}$  represents for all the components related to the square terms of lagged leverage:

$$\begin{aligned} \mathbf{Adj}_{\text{non-linearity}} = & -(s_1 w_1 + u_1 z_1) \frac{\text{Cov}(\text{Lev}_{i,t-1}^2, \text{Lev}_{i,t-1})}{\sigma_L^2} - [s_1(\beta_1 - 1) + u_1 \delta_1] \frac{\text{Cov}(\text{Lev}_{i,t-1}^3, \text{Lev}_{i,t-1})}{\sigma_L^2} \\ & - u_1 \delta_1 \frac{\text{Cov}(\text{Lev}_{i,t-1}^4, \text{Lev}_{i,t-1})}{\sigma_L^2} - [s_2(w_1 + w_2) + (u_2 + u_1)z_2] \frac{\text{Cov}(\text{Lev}_{i,t-1}^2 N_{it}^-, \text{Lev}_{i,t-1})}{\sigma_L^2} \\ & - [s_2(\beta_1 - 1 + \beta_2) + (u_2 + u_1)\delta_2] \frac{\text{Cov}(\text{Lev}_{i,t-1}^3 N_{it}^-, \text{Lev}_{i,t-1})}{\sigma_L^2} \\ & - [s_1 u_2 + s_2 u_1 + s_2 u_2] \frac{\text{Cov}(\text{Lev}_{i,t-1}^4 N_{it}^-, \text{Lev}_{i,t-1})}{\sigma_L^2}. \end{aligned}$$

Using this expression  $\lambda_7$ , we estimate the SOAs for book and market debt ratios of our Compustat sample firms. Internet Appendix Table 1 shows the results. As shown in Panel A, the square terms of lagged leverage only have slight influence on the SOA estimates, and the changes in the SOA estimates compared with those in Table 4 are around 0.01, which is

economically small. Panel B further compares the marginal effect of  $Lev_{i,t-1}$  on the dependent variable with or without the square terms of lagged leverage. As shown, when lagged leverage is around its mean value (i.e.  $Lev_{i,t-1}=0.4$ ), its marginal effects on book or market leverage are similar no matter whether we include the square terms of lagged leverage or not. Above all, non-linearity between  $d_{it}/g_{it}$  or  $g_{it}/(1 + g_{it})$  and lagged leverage does not have significant effect on the SOA estimates, and hence we use the linear models in our main analysis.

**Table D.1: Influence of Non-Linearity Between  $d_{it}/g_{it}$  or  $g_{it}/(1 + g_{it})$  and  $Lev_{i,t-1}$**

Panel A: SOA Estimates			
	Estimated Book SOA	Estimated Market SOA	Market SOA if $g_{it}^M = g_{it}^B$
$w_1$	0.258	0.264	0.270
$\beta_1$	0.075	0.356	0.620
<b><math>u_1</math></b>	<b>-0.118</b>	<b>-0.254</b>	<b>-0.514</b>
$z_1$	0.186	0.278	0.209
$\delta_1$	-0.158	-0.170	-0.256
<b><math>s_1</math></b>	<b>0.136</b>	<b>0.028</b>	<b>0.168</b>
$f(lev)$	0.947	0.849	0.849
Adj <sub>different directions</sub>	-0.005	0.048	-0.053
Adj <sub>non-linearity</sub>	0.055	0.017	0.016
Estimated SOA ( $\lambda_7$ )	0.125	0.196	0.030
Estimated SOA in Table 4	0.117	0.192	0.055
Panel B: Marginal Effect @ $Lev_{i,t-1}=0.4$			
	Book Leverage	Market Leverage	
For Debt Issuance Proportion Regression			
$\beta_1$ in Table 4	0.038	0.162	
$\beta_1 + 2u_1 Lev_{i,t-1}$	-0.019	0.153	
For Firm Value Growth Regression			
$\delta_1$ in Table 4	-0.034	-0.159	
$\delta_1 + 2s_1 Lev_{i,t-1}$	-0.049	-0.148	

*D.2. The influence of other economic factors on the net debt issuance proportion or the firm value growth rate*

In addition to the non-linearity issue,  $d_{it}/g_{it}$  or  $g_{it}/(1 + g_{it})$  may be correlated with some economic factors other than lagged leverage, such as investment opportunities, profitability, and R&D expenses, etc. To consider this issue, we add a matrix of firm characteristics into the regressions of  $d_{it}/g_{it}$  and  $g_{it}/(1 + g_{it})$  on lagged leverage:

$$\frac{d_{it}}{g_{it}} = w_1 + \beta_1 \text{Lev}_{i,t-1} + w_2 N_{it}^- + \beta_2 \text{Lev}_{i,t-1} N_{it}^- + fX_{i,t-1} + w_{it},$$

$$\frac{g_{it}}{1+g_{it}} = z_1 + \delta_1 \text{Lev}_{i,t-1} + z_2 N_{it}^- + \delta_2 \text{Lev}_{i,t-1} N_{it}^- + hX_{i,t-1} + z_{it},$$

where  $N_{it}^- = I(g_{it} < 0)$ , and we exclude the square terms of lagged leverage due to its small influence on the estimated SOA.

Because the estimated SOA in our paper is derived from calculating  $\text{Cov}(\text{Lev}_{it}, \text{Lev}_{i,t-1})$ ,  $X_{i,t-1}$  only affects the estimated SOA when it has non-zero correlation with lagged leverage. Otherwise,  $X_{i,t-1}$  vanishes in the SOA expression. To make it simple, we denote  $x = \text{Cov}(X_{i,t-1}, \text{Lev}_{i,t-1})/\sigma_L^2 \neq 0$  if  $X_{i,t-1}$  only contains one variable. Then, the regressions of  $d_{it}/g_{it}$  and  $g_{it}/(1 + g_{it})$  can be written as:

$$\frac{d_{it}}{g_{it}} = w_1 + (\beta_1 + fx)\text{Lev}_{i,t-1} + w_2 N_{it}^- + \beta_2 \text{Lev}_{i,t-1} N_{it}^- + w_{it},$$

$$\frac{g_{it}}{1+g_{it}} = z_1 + (\delta_1 + hx)\text{Lev}_{i,t-1} + z_2 N_{it}^- + \delta_2 \text{Lev}_{i,t-1} N_{it}^- + z_{it}.$$

Therefore, compared with the case without any economic factors in Table 4, we only need to change  $\beta_1$  to  $(\beta_1 + fx)$ , and change  $\delta_1$  to  $(\delta_1 + hx)$ . Moreover, if we have multiple variables in  $X_{i,t-1}$ , the adjustment term to  $\beta_1$  or  $\delta_1$  should be a sum of  $fx$  or  $hx$ , respectively. In other words, the influence of economic factors on the estimated SOA is only through its influence on  $\beta_1$  or  $\delta_1$  due to non-zero correlation with lagged leverage.

Based on the above analysis, we include a group of lagged economic factors in the regression of  $d_{it}/g_{it}$  and  $g_{it}/(1 + g_{it})$  on lagged leverage: MB ratio, log(real total assets), EBIT-assets ratio, Net PPE-assets ratio, R&D dummy, R&D-assets ratio, and rated dummy. Then we calculate the SOA estimates based on the following expression:

$$\lambda_8 = \mathbf{z}_1(\mathbf{1} - \boldsymbol{\beta}'_1) - \mathbf{w}_1\boldsymbol{\delta}'_1 + \boldsymbol{\delta}'_1(\mathbf{1} - \boldsymbol{\beta}'_1)\mathbf{f}(\text{Lev}_{i,t-1}) + \mathbf{Adj}_{\text{different directions}},$$

where  $\beta'_1 = \beta_1 + \sum_k f x_k$ , and  $\delta'_1 = \delta_1 + \sum_k h x_k$ . The results are presented in Internet Appendix Table 2.

As suggested by Panel A, even though most firm characteristics have non-zero covariance with lagged book or market leverage, the absolute values are small relative to the variance of lagged leverage. Except for the MB ratio and log(real total assets), the absolute value of  $x$  is close to zero or less than 1 for most economic factors. Despite of the small magnitude of  $x$ , we still estimate the SOAs based on the expression  $\lambda_8$ , and Panel B shows the estimated SOAs for book and market leverage ratios of the Compustat sample firms. Columns 1 and 2 in Panel B imply that, for both book and market leverage ratios, the economic factors have no material effect on the estimated SOAs compared with the results in Table 4.

Another concern about the upward bias of the market SOA is that, market leverage is not only a noisier version of book leverage because the market value of equity (and assets) is affected by economic factors like investment opportunities and R&D expenses, etc. Therefore, assuming  $g_{it}^M = g_{it}^B$  may not be enough when we correct for the upward bias of the market SOA. To address this issue, we regress  $g_{it}^M$  on  $g_{it}^B$  and a group of economic factors (MB ratio, log(real total assets), EBIT-assets ratio, Net PPE-assets ratio, R&D dummy, R&D-assets ratio, and rated dummy), and we replace  $g_{it}^M$  with the predicted value of such regression to correct for the upward bias of the market SOA. As shown in Column 3 of Panel B, replacing  $g_{it}^M$  with  $(m_0 g_{it}^B +$

$m_1 X_{i,t-1}$ ) instead of  $g_{it}^B$  changes the estimated SOA by 0.01 (from 0.055 in Table 4 to 0.066). If we further adjust for firm-fixed effects, the results are still similar to those in Table 5 of the main text. In summary, the influence of economic factors on the estimated SOA is small in an economic sense. After accounting for such influence, the estimated market SOA is still upward biased, and correcting for the upward bias results in a smaller market SOA compared to the book SOA

**Table D.2: Influence of Economic Factors**

Panel A: $x = \text{Cov}(X_{i,t-1}, \text{Lev}_{i,t-1})/\sigma_L^2$			
	Book Leverage	Market Leverage	
MB	-1.353	-3.014	
Log(real total assets)	1.704	0.985	
EBIT/total assets	-0.050	-0.067	
Net PPE/total assets	0.135	0.165	
R&D dummy	0.480	0.497	
R&D/total assets	-0.071	-0.089	
Rated dummy	0.400	0.148	
Panel B: SOA Considering Non-Zero $\text{Cov}(X_{i,t-1}, \text{Lev}_{i,t-1})$			
	Estimated Book SOA	Estimated Market SOA	Market SOA if $g_{it}^M = m_0 g_{it}^B + m_1 X_{i,t-1}$
$w_1$	0.356	0.310	0.323
$\beta'_1 = \beta_1 + \sum_k f x_k$	0.041	0.158	0.222
$z_1$	0.131	0.329	0.173
$\delta'_1 = \delta_1 + \sum_k h x_k$	-0.027	-0.153	-0.024
f(lev)	0.947	0.849	0.849
Adj <sub>different directions</sub>	0.001	-0.012	-0.060
Estimated SOA ( $\lambda_g$ )	0.111	0.203	0.066
Adjusted for firm-fixed effects	0.156	0.266	0.112