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Dynamics of financial leverage across firm life cycle in Chinese firms: an empirical investigation using dynamic panel data model

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Abstract

Background: This study tries to investigate how firms adjust their leverage policy across the firm's life cycle. For this purpose the study uses an extensive set of data of 867 A listed Chinese non-financial firms over a nineteen years period (1996-2014).

Methods: The study employs Arellano-Bover/Blundell-Bond dynamic panel data model to estimate adjustment rate of leverage and its determinants in three different life stages of Chinese firms. We find that adjustment rate of leverage varies for different life stages.

Results: In accordance with trade off theory of capital structure this study reports a low-high-low pattern of leverage across growth, maturity and decline stage of firms' life respectively. For total leverage, dynamic panel data reports highest adjustment rate for growing firms, followed by mature firms and firms in declining stage of their life.

Conclusions: Both short term and long term leverage report similar pattern of leverage's adjustment rate across the three stages of life cycle. The study provides useful insight in a unique market setting of Chinese financial markets.

Keywords: Firm life cycle, Leverage, Chinese firms, Dynamic adjustment, GMM

Background

This study investigates the dynamics of firm's capital structure across firm's life cycle. The seminal theory of Modigliani and Miller 1958 about capital structure irrelevance has created a ground for the development of a number of theories to explain the dynamics of capital structure which were followed by different empirical studies to prove or deny these theories. However, there are many questions still unanswered regarding variation in capital structure policies. One important consideration in this regard is firm life cycle. The preference of financing alternatives and evolution of firm revolves around its life cycle (Fluck 2000, Rocca et al. 2011). Life cycle affects firm's numerous characteristics. For example, Berger and Udell (1998) reported that life cycle affects the demand for financial products in market. Drobetza and Wanzenried (2006) provided evidence in dividend policy variations across firm's life cycle, and more recently, Connor and Byrne (2015) reported the influence of firm's life cycle on corporate

governance. This shows that corporate leverage policy should be considered for investigation under the changing life cycle of the firm so that policy makers are able to make changes in leverage policies according to changing life cycle conditions. In the past studies, researchers used univariate proxy for firm life cycle such as firm age or size to study how capital structure respond to dynamics of its life cycle (Berger and Udell 1998). Moreover, there are studies that confirm that firm does follow a target capital structure and firms adjust their leverage to an optimal level. Notable studies in this regard include studies conducted by Ahsan et al. (2016a), Getzmann et al. (2014), Bradley et al. (1984), and Bontempi and Golinelli (2001). Ahsan et al. (2016b) and Bontempi and Golinelli (2001) used unit root testing to confirm that a percentage of firm follow a target capital structure while Getzmann et al. (2014) used dynamic panel data model (GMM) to find that firm adjust their capital structure and estimated an adjustment rate for firms using generalized method of moment (GMM). More recently, Tian et al. (2015) using a sample of public sector manufacturing Chinese firms and studied their leverage adjustment across firm life cycle. This study differs from the study conducted by Tian et al. (2015) in various aspects. First, this study uses firm age, sales growth, and dividend payout ratio to measure firm life cycle while Tian et al. (2015) used cash flows to measure life cycle of the firm. Further, we employ dynamic panel data model to estimate adjustment rate of leverage while Tian et al. (2015) used fixed effect model. Our study further differs in sample size and sample period Tian et al. (2015) reported a different adjustment rate for leverage across birth (68.52%) and decline (48.72%) stages of firm's life cycle. Our approach of multivariate firm life cycle measurement is in accordance with Ahsan et al. (2016b). Ahsan et al. (2016b) found different adjustment rate for growing, mature, and declining firms while analyzing a large data set of Pakistani non-financial firms.

However the examination of leverage adjustment across firm life cycle lacks extensive research. For this purpose, this study follows Anthony and Ramesh (1992) and Ahsan et al. (2016b) and employ a multivariate approach in measurement of firm life cycle to an unbalanced data of 15,005 firm level observations (1996–2014) and categorize firms into three categories, i.e., growing firms, mature firms, and declining firms. Further, the study uses dynamic panel data model to estimate adjustment rate in these three life stages of firms and also examines various multilevel determinants of leverage (firm-level, industry-level, and country-level determinants).

The study contributes useful literature and insight on capital structure of an emerging economy. Further, the findings are of great importance while considering that prevalent financing alternatives in China are bank based loans and firms report lower long-term leverage ratio. This low-high-low pattern of leverage ratio across growth, maturity, and decline stage by Chinese firms indicates that leverage policy is in accordance with trade-off theory. The study found that adjustment rate for total leverage is 60-29-26% across growth, maturity, and decline stage. For short-term leverage adjustment rate is 90-78-88% across growth, maturity, and decline stages of firm life cycle. Long-term leverage reports an adjustment rate of 75-44-53% across growth, maturity, and decline stages. These findings suggest that in growth stage, there are more investment opportunities, and thus, leverage is vigorously altered by firms in growth stages.

China as a unique market setting

China as an emerging market and world's second largest economy make it a potentially distinctive setting to study the relationship between stock liquidity and capital structure. China is a unique setting to conduct such type of study. Due to its less sophisticated capital markets, bank as the major financing alternative and high ownership concentration make the relationship between life cycle and capital structure more crucial from research point of view.

Moreover, before 2004, shares of state-owned and legal entities could be traded in stock exchange. This situation is further complicated by the fact that control rights remain with Chinese government. Shares held by state-owned shareholders exceed other shares held by other shareholders (individuals and NSOEs) in Chinese companies. Guo et al. (2013) reported that by end of September 2006, largest shareholders who held 56% of shares were state shares controlled by Chinese government and other state asset management companies.

Capital markets and financing alternatives in China

The considerable economic restructuring and reform undergone by the Chinese economy over the last 30 years have led to a marked increase in the number of shareholding companies. Chinese firms, state-owned enterprises (SOEs), and non-state-owned enterprises (NSOEs). SOEs and NSOEs differ in the nature of their ownership, agency relations, and bankruptcy risks.

The stock market in China has become an increasingly important part of China's economy since the partial privatization of SOEs and the establishment of the Shanghai and Shenzhen Stock Exchanges in the early 1990s. The number of listed firms increased from 50 in 1992 to 1378 in 2004, with the total market value of publicly traded shares exceeding RMB (i.e., Renminbi, the Chinese currency) 3960 billion by the end of 2004. There were 353 NSOEs listed on the exchanges at the end of 2004, approximately 25% of the total number of listed firms. Although considerably smaller than SOEs, NSOEs had a total market value of RMB 479 billion by the end of 2004 or 12.1% of the total stock market value. Since 1979, China has launched a series of economic reforms to reorient its economy toward a market-based one. The most recent of these reforms is corporatization of previously owned SOEs. Corporatization involves initial public offering of a minority portion of state shares to individual investors who can trade their shares freely on the Shanghai and Shenzhen Stock Exchanges, while the majority ownership of these newly listed companies is still controlled by parent state enterprises. The government still remains the majority shareholder and retains two key control rights: the ultimate decision right concerning disposal of assets and mergers and acquisitions and the appointment of chief executive officers (CEOs) (Qian 1996).

Capital markets in China are young and less sophisticated in China as compared to other developed countries. Shanghai and Shenzan Stock exchanges were established in 1990, and it marks the beginning of securities market in China. China securities regulatory commission was introduced in 1992. Poncet et al. argue that capital market imperfections are prevalent in Chinese capital markets. Until 1998, the largest Chinese banks (most of them were state owned) were advised not to give credit to Chinese private companies. It was because of low political stature of these companies. Since 1998, these

impediments in financing due to political pecking order should have been alleviated. However, research evidence suggest that financing constraints for private Chinese companies are still there due to social and political factors (Huang 2003). Numerous research indicates that financial constraints are impediments to investment, growth, and survival of the company (Stein 2003, Hubbard 1998). This implies that Chinese firms (especially private firms) have fewer alternatives of debt financing.

The remainder of the study is arranged as follows. The "Background" section presents a review of prior study and the theoretical framework. Data description and research methodology constitute the "Methods" section. The "Results and discussion" section provides detailed analysis and discussion of the findings. In the "Conclusions" section, we provide a conclusion and some policy implications.

Literature review and theoretical framework

Life cycle and target leverage

There exist numerous studies that confirm that firms passes through various life stages starting from birth to a possible death. However, these studies vary as far as the number of stages in life cycles is concerned. For example, Chandler (1962) and Anthony and Ramesh (1992) suggest three life cycle stages of growth, maturity, and decline and argue that firms strategic approach and alternatives greatly varies across these three life cycles. Miller and Friesen (1980) suggested four life cycles, i.e., birth, growth maturity, and revival. Dickinson (2011) identified birth, growth, maturity, decline, and revival as five stages in life cycle of a firm. In the presence of all these differences, most of the theories and studies about life cycle agreed upon growth, maturity, and decline as three stages of firm life cycle. However, researches also have difference of opinion whether firms follow target leverage across various firm's life cycle stages. In light of this fact, this study provides a detailed literature about theories that explains firm's leverage adjustment and targeting across various stages of a firm's life cycle.

According to pecking order theory, in the context of asymmetric information and profitability, a firm would prefer internal financing, followed by less risky debt and equity in the last resort (Myers 1984, Myers and Majluf 1984). Thus, on the basis of pecking order theory of capital structure, a firm does not follow a target level of leverage and rather the firm follows a pattern in its leverage policy. Furthermore, a firm can improve its informativeness and profits thus changing its financing mix accordingly. During firm's early stage, information asymmetry is higher and profitability is lower. As time changes and growth approaches, information asymmetry is considerably reduced. However, in growth stages, earnings are not retained or firms have no or less retained earnings. In such times, firms tend to raise more debt as a source of financing its investment. As time of maturity approaches, firms tend to retain earnings and these are reasons for debt financing decreases. Moreover, in maturity, firms have less investment needs and thus firms may also raise equity in maturity stages because of less information asymmetry. During decline phase profit decreases and also the retained earnings. This compels firms to go again for debt financing. Thus Pecking Order Theory (POT) suggest that at growth stage debt financing will be higher, at maturity it will be moderate and at decline stage it will be higher again (see Table 1). On the basis of these arguments we formulate the following hypothesis about firm leverage across three stages of firm life cycle.

Table 1 Leverage pattern across firm's life cycle as suggested by capital structure theories

Capital structure theories	Leverage pattern		
	Growth	Maturity	Decline
Pecking order theory	High	Low	High
Trade-off theory	Low	High	Low
Agency cost theory	Low	High	High
Diamond's theory	Low	High	High
Market timing theory	?	?	?

H1: The firm follows high-low-high pattern of leverage across three stages of firm life cycle.

However, the competing trade-off capital theory (TOT) of capital structure postulates that in a perfect environment, a firm makes a trade-off between the associated benefits and cost with financing alternatives. Thus, on the basis of this trade-off analysis, a firm targets an optimal level of leverage. This is the static form of trade-off theory. Moreover, capital structure is affected by a number of exogenous and endogenous factors. These factors change over time especially across the stages of a firm life cycle. As a result, the firm tries to adjust its capital structure according to dynamic environment and this makes capital structure a dynamic decision (Fischer et al. 1989). According to TOT irrespective of a firm life stage, a firm should raise more debt to have a larger tax shield benefit; however, as debt increases, the firm bankruptcy and financial distress risk also increases. Thus, a firm always looks to achieve a breakeven point for its tax benefit and bankruptcy costs. Bankruptcy chances are higher in growth and decline stage of a firm life cycle; thus, during these stages a firm will avoid to raise more debt. Although more debt will result in higher tax benefits, the firm will avoid raising more debt during growth and decline stage. Thus, according to trade-off theory of capital structure, firm leverage is expected to follow a low-high-low pattern across three stages of firm's life cycle (Modigliani and Miller 1958, Modigliani and Miller 1963), (see Table 1).

H2: The firm's leverage follows a low-high-low pattern across three stages of firm's life cycle.

Another important theory is the agency cost theory. According to agency cost theory (ACT), managers and shareholders are at conflict with respect to the use of free cash flows and resources of the firms. These conflicts get more severe if there is a high amount of free cash flows in an organization. Jensen and Meckling (1976) suggest that these conflicts can be solved through the use of optimal level of debt, since debt repayment will eat up free cash flows and thus managers can be prevented from investing in value decreasing projects. When a firm is growing, there are more investment opportunities and less free cash flows at growth stage compel firm to raise more debt. At maturity stage, when investment opportunities shrink, the firm is expected to raise lesser debt. While at decline stage, debt acts as a controlling mechanism when a firm is at the helm of shrinking. Thus, according to ACT, firm leverage is expected to follow a high-low-high pattern across the three stages of firm life cycle but still agency theory gives no clear explanation of a targeted optimal capital structure (Jensen 1986).

H3: The firm follows a high-low-high pattern of leverage across the three stages of firm's life cycle.

Diamond (1989) suggests that firm reputation varies across firm's life, and thus, it can greatly explain firm's financing preferences across different stages of firm's life cycle. Growing firms have less history or past record and have low reputation. They are characterized by less debt capacity, and thus, this information asymmetry results in lower debt for firms in growing stages. At maturity and decline, a firm has a track record and history. At these stages, there is lesser information asymmetry and thus these firms have reputation. Based on these reasons, firms at maturity and decline stage of their lives raise more debt. As a result, Diamond suggests a low-high-high pattern of leverage across three life stages of firm's life cycle (see Table 1).

H4: The firm follows a low-high-high pattern of leverage across the three stages of firm's life cycle.

There is also a market timing theory of capital structure. The firms analyze market condition and change their capital structure policy according to market conditions. Baker and Wurgler (2002) suggest that capital structure can be explained through the development of bond and stock market. So according to this theory, it is not possible to predict a leverage pattern across firm's life cycle.

Variables' description

Table 2 represents description of all the explanatory variables and their relationship with leverage and leverage adjustment rate. For dependent variable of leverage, this study uses financial leverage following the empirical studies of Delcoure (2007), Sheikh and Qureshi (2014), Ahsan et al. (2016b), and Tian et al. (2015). The study uses three proxies of leverage: short-term leverage (SL) which is the ratio of short-term loan to total assets, long-term leverage (LT) is the ratio of long term loan to assets, and total leverage (TL) is the ratio of total liabilities to total assets.

Methods

In order to investigate capital structure and explanatory variables, this study uses an extensive set of data. The study uses the data of 867 A-listed firms listed on Chinese Stock exchanges. The data is annual and acquired from RESET Chinese database. Industry-level data is calculated from firm-level data. All the macroeconomic level data is collected from World Bank database. Data is collected over a period of 1996–2014. Data is panel consisting of 15,005 observations. Data is unbalanced with respect to time (year) and space (firms) dimensions.

We classify firms into three life stages, i.e., growing, mature, and declining firms. This study follows a multivariate methodology to divide firms into three categories (Anthony and Ramesh 1992). Univariate methodology is not used because it gives few measurement errors and is not driven by firm size effects and risk preferences. Numerous studies can be found which employed the multivariate methodology to classify firms into growth, mature, and decline categories (Teixeira and Santos 2006, Jenkins et al. 2004, Ahsan et al. 2016b). This study uses dividend payout ratio, firm's age, and firm's annual percentage change of sales for the classifications of firms into growing, mature, and declining firms. We calculate the median values of annual change in sales and dividend payout ratio for 5 years prior period. Then, we use the median values of sales, dividend

Table 2 Control variables, their proxies and proposed relationship with leverage

	Variable	Notation	Measurement	Relationship with leverage	Relationship with adjustment rate
Firm level	Tax shield	TS	Ratio of tax paid and gross profit	+	+
	Bankruptcy risk	ZS	Altman's Z score	+/−	+
	Business risk	BR	Annual change in net profit	+/−	+/−
	Non-debt tax shield	NDTS	Ratio of depreciation to total assets	−	?
	Agency cost	AGC	Ratio of operating expense over sales	+	?
	Growth	GR	Annual change in total assets	+/−	+
	Current profitability	CP	Net profit scaled by total assets	+/−	+
	Past profitability	PP	Retained earnings ratio	+/−	+
	Liquidity	LIQ	Ratio of current assets to current liabilities	+/−	+
	Tangibility	TANG	Ratio of net fixed assets to total assets	+	?
	Collateral value	CV	Ratio of gross fixed assets at cost to total assets	+	?
	Firm size	SIZE	Natural logarithm of firm's assets	+/−	+
Industry level	Industry leverage	IL	Mean of industry leverage	+	+
	Industry profitability	IP	Mean of industry profit	?	?
Country level	Inflation rate	IR	Annual inflation rate based on consumer prices	+	+
	Exchange rate	ER	Yearly exchange rate of rmb to us dollar	?	?
	Economic growth	EG	Annual per capita gdp rate	+/−	+
	Capital formation	CF	Ratio of gross capital formation to gdp	?	?

payout ratio, and age to classify the firms. We classify the firms according to a criteria based on three life cycle stages (Table 3).

This criterion is based on the fact that during growth stage, dividend payout ratio is low, firms have lower sales, and firms are relatively young. As firm grows toward maturity, dividend payout ratio increases so as the sales. At decline stage, dividend payout ratio is the highest, sales growth is the lowest, and firms are of old age. We assign a value of 1 to growing firms, 2 to mature firms, and 3 to declining firms We sum up the median values of sales growth, median values of dividend payout, and log values of age for each firm in a single year. The minimum value of this summation is 3, and the maximum value is 9. Based on these thresholds, we divide firms into three categories.

Growth firms: a firm having a composite yearly score of less than 4 is classified as a firm in growth stage

Table 3 Criteria for life cycle distribution

Stage	DP	SG	AGE
Growth	Low	High	Young
Maturity	Medium	Medium	Adult
Decline	High	Low	Old

DP dividend payout ratio, *SG* sales growth, *AGE* natural log of firm's age

Mature firms: a firm having a composite yearly score between 4 and 7 is classified as mature firm

Declining firms: firms having a composite yearly score of more than or equal to 8

As a calculation of median for sales growth and dividend payout ratio, we use the prior 5-year data; as a result, our yearly firm level observations reduces to 10,274 from 15,005. Yearly firm level observations for growing firms are 1539, for mature firms the observations are 7726, and for declining firms the number is 1009 firm year observations.

Table 4 reveals that dividend payout ratio is the lowest during growth stage and then starts to increase as firm matures and then reaches to highest ratio in the declining stage. Similarly, sales growth is highest for growing stage and then become lower in maturity and lowest during the declining stage. Youngest firms have lowest mean of age value, while firms in declining stage have the highest mean for age.

Statistical model and estimation strategy

According to Flannery and Rangan (2006), firms maintain a target leverage if there exist no market friction. In this context, we develop the following static model for leverage and explanatory variables.

Table 4 Descriptive statistics of firms classification variables

Variables	Observation	Mean	Standard deviation
Growth stage			
Dividend payout ratio (median)	1539	0.058	0.094
Sales growth (median)	1539	0.300	0.159
Age	1539	2.670	0.199
Mature stage			
Dividend payout ratio (median)	7726	0.202	0.244
Sales growth (median)	7726	0.138	0.191
Age	7726	2.873	0.201
Decline stage			
Dividend payout ratio (median)	1009	0.456	0.202
Sales growth (median)	1009	0.057	0.093
Age	1009	3.020	0.105

Sales growth is the median of annual sales growth for prior 5 years. Dividend payout ratio is the median of dividend payout ratio for prior 5 year. Age is the natural logarithm of firm's age

$$\begin{aligned} \mathrm{LEV} &= \beta_0 + +\beta_1 \mathrm{TS}_{it} + \beta_2 \mathrm{ZS}_{it} + \beta_3 \mathrm{BR}_{it} + \beta_4 \mathrm{NDTS}_{it} + \beta_5 \mathrm{AgC}_{it} + \beta_6 \mathrm{GROW}_{it} \\ &\quad +\beta_7 \mathrm{CP}_{it} + \beta_8 \mathrm{PP}_{it} + \beta_9 \mathrm{LIQ}_{it} + \beta_{10} \mathrm{TANG}_{it} + \beta_{11} \mathrm{CV}_{it} \beta_{12} \mathrm{SIZE}_{i_t} \\ &\quad +\beta_{13} \mathrm{INDLEV}_{j_t} + \beta_{14} \mathrm{INDP}_{j_t} + \beta_{15} \mathrm{INF}_t + \beta_{16} \mathrm{ER}_t + \beta_{17} \mathrm{EG}_t \beta_{18} \mathrm{CF}_t + e_{it} \end{aligned} \tag{1}$$

In Eq. 1, LEV_{it} is the firm i's leverage at time t. TS_{it} is the tax shield of firm i at time t. ZS_{it} is Altman's Z score of firm i at time t. BR_{it} represents business risk of a firm i at time t. NDTS_{it} is non-debt tax shield of a firm i at time t. AgC_{it} represents agency costs of a firm i at time t. GROW_{it} is the annual growth rate of a firm i at time t. CP_{it} represents current profit of a firm i at time t while PP_{it} is past profits of a firm i at time t. LIQ_{it} represents liquidity of a firm i at time t. TANG_{it} represents the tangibility ratio of a firm i at time t while CV_{it} is collateral value of a firm i at time t. SIZE_{it} is the firm i's size at time t. INDLEV_{jt} represents the industry leverage of an industry j at time t. INDP_{jt} is the industry mean profit of an industry j at time t. INF_t represents inflation rate at time t. ER_t is exchange rate at time t. EG_t represents economic growth at time t. CF_t is gross capital formation.

However, firms inhabit a market that is under the effects of frictions; thus, due to these market imperfections, it is difficult for a firm to immediately adjust to its target capital. This phenomenon becomes more relevant if we consider the adjustment costs associated with adjustment to a target leverage. Thus, another equation based on partial adjustment of leverage emerges.

$$\mathrm{LEV}_{it} - \mathrm{LEV}_{it-1} = \gamma(\mathrm{LEV}^*_{it} - \mathrm{LEV}_{it-1}) + \delta_{it} \tag{2}$$

LEV_{it} is firm i's leverage at time t and δ_{it} is the error term. By substituting Eq. 2 into Eq. 1, we get the following equation.

$$\begin{aligned} \mathrm{LEV}_{it} &= \beta_0\gamma + (1-\gamma)\mathrm{LEV}_{t-1} + \gamma\beta_1 \mathrm{TS}_{it} + \gamma\beta_2 \mathrm{ZS}_{it} + \gamma\beta_3 \mathrm{BR}_{it} + \gamma\beta_4 \mathrm{NDTS}_{it} \\ &\quad +\gamma\beta_5 \mathrm{AgC}_{it} + \gamma\beta_6 \mathrm{GROW}_{it} + \gamma\beta_7 \mathrm{CP}_{it} + \gamma\beta_8 \mathrm{PP}_{it} + \gamma\beta_9 \mathrm{LIQ}_{it} \\ &\quad +\gamma\beta_{10} \mathrm{TANG}_{it} + \gamma\beta_{11} \mathrm{CV}_{it} \gamma\beta_{12} \mathrm{SIZE}_{i_t} + \gamma\beta_{13} \mathrm{INDLEV}_{j_t} + \gamma\beta_{14} \mathrm{INDP}_{j_t} \\ &\quad +\gamma\beta_{15} \mathrm{INF}_t + \gamma\beta_{16} \mathrm{ER}_t + \gamma\beta_{17} \mathrm{EG}_t \gamma\beta_{18} \mathrm{CF}_t + \eta_i + \lambda_t + \upsilon_{it} \end{aligned} \tag{3}$$

η_i in Eq. 3 corresponds to firm-specific effects while λ_t is the time-specific effects. Simplifying Eq. 3, the following equation is obtained.

$$\begin{aligned} \mathrm{LEV}_{it} &= \beta_0\gamma + \rho\mathrm{LEV}_{t-1} + \delta_1 \mathrm{TS}_{it} + \delta_2 \mathrm{ZS}_{it} + \delta_3 \mathrm{BR}_{it} + \delta_4 \mathrm{NDTS}_{it} + \delta_5 \mathrm{AgC}_{it} \\ &\quad +\delta_6 \mathrm{GROW}_{it} + \delta_7 \mathrm{CP}_{it} + \delta_8 \mathrm{PP}_{it} + \delta_9 \mathrm{LIQ}_{it} + \delta_{10} \mathrm{TANG}_{it} + \delta_{11} \mathrm{CV}_{it} \\ &\quad +\delta_{12} \mathrm{SIZE}_{i_t} + \delta_{13} \mathrm{INDLEV}_{J_t} + \delta_{14} \mathrm{INDP}_{j_t} + \delta_{15} \mathrm{INF}_t + \delta_{16} \mathrm{ER}_t + \delta_{17} \mathrm{EG}_t \\ &\quad +\delta_{18} \mathrm{CF}_t + \eta_i + \lambda_t + \upsilon_{it} \end{aligned} \tag{4}$$

In Eq. 4, $\alpha = \gamma\beta_0$; $\rho = (1 - \gamma)$; $\delta_k = \gamma\beta_k$; and $\lambda_t \upsilon_{it} = \gamma e_{it}$

The study employs two-step generalized method of moments to estimate the dynamic Eq. 4 to address the issues of endogeneity. The study uses GMM's method of Arellano-Bover (1995)/Blundell-Bond (2000) to estimate Eq. 4. We estimate Eq. 4 across firm life cycle.

Table 5 Descriptive statistics

	SL	LL	TL	TS	ZS	BR	NDTS	AgC	GROW	CP	PP	LIQ	TANG	CV	SIZE	AGE	INDSL	INDLL	INDTL	INMP	INF	ER	EG	CF
Growth stage (no. of observations = 1539)																								
Mean	0.17	0.10	0.58	0.07	3.06	−0.06	0.03	0.05	0.18	0.04	0.52	1.34	0.26	0.53	22.05	2.67	0.17	0.10	0.59	0.05	2.83	7.07	9.93	45.00
Std. Dev.	0.15	0.11	0.26	3.51	20.25	28.64	0.02	0.07	0.47	0.16	2.82	1.32	0.19	0.21	1.33	0.20	0.07	0.05	0.20	0.96	2.04	0.77	1.97	2.91
Min	0.00	0.00	0.05	−134.83	−104	−177	0.00	0.00	−0.88	−2.98	−75.21	0.03	0.00	0.00	18.34	1.61	0.00	0.00	0.16	−0.92	−0.77	6.09	7.35	37.66
Max	2.50	0.80	5.42	15.79	551	1060	0.21	0.53	10.70	1.05	0.98	28.18	0.94	1.00	27.81	2.95	1.06	0.31	3.31	37.77	5.86	8.28	14.19	47.83
Maturity stage (no. of observations = 7226)																								
Mean	0.17	0.10	0.63	0.15	6.93	−0.40	0.03	0.06	0.81	0.06	0.47	1.39	0.24	0.55	21.89	2.87	0.17	0.10	0.60	0.04	2.68	7.17	9.90	44.65
Std. Dev.	0.22	0.11	1.04	1.46	140.73	27.26	0.02	0.07	44.09	0.81	5.79	2.76	0.19	0.22	1.34	0.20	0.06	0.06	0.31	0.61	1.96	0.83	1.92	3.10
Min	0.00	0.00	−0.19	−38.48	−515	−768	−0.03	0.00	−1.00	−20.6	−368.4	−5.13	0.00	0.00	14.08	1.61	0.00	0.00	0.16	−1.05	−0.7	6.09	7.35	37.66
Max	6.67	1.82	55.41	102	8070	1450	0.18	0.92	3850	44.22	0.99	205	0.92	1.00	28.04	3.22	0.75	0.49	6.07	37.77	5.86	8.28	14.19	47.83
Decline stage (no. of observations = 1009)																								
Mean	0.15	0.10	0.53	0.15	3.47	2.16	0.03	0.05	0.13	0.05	0.48	1.72	0.24	0.57	22.18	3.02	0.17	0.10	0.68	0.02	2.43	7.27	9.90	44.25
Std. Dev.	0.28	0.12	1.22	0.32	18.24	71.57	0.02	0.06	0.26	0.15	0.58	3.35	0.19	0.21	1.06	0.10	0.23	0.06	1.28	0.13	1.95	0.86	1.88	3.30
Min	0.00	0.00	0.01	−5.18	−14	−63.3	0.00	0.00	−0.77	−2.76	−10.94	0.06	0.00	0.02	17.58	2.80	0.02	0.00	0.25	−2.81	−0.7	6.09	7.35	37.66
Max	6.98	0.62	36.38	3.68	567	2250	0.14	0.44	2.46	0.90	0.97	89	0.86	0.98	25.26	3.22	6.98	0.31	36.38	1.23	5.86	8.28	14.19	47.83

SL is short-term leverage ratio between short-term loan and total assets. LL is long-term leverage ratio between long-term leverage and assets. TL represents total leverage which is a ratio of total liabilities and total assets. TS represents tax shield calculated by dividing tax payments on net profit. ZS is Z score. BR is business risk measured through operating expense divided by total sales. NDTS is non-debt tax shield calculated through the ratio of depreciation to total assets. Ag C represents agency costs. CP is current profit growth, calculated through annual growth rate of net profit. PP is retained earnings ratio as a proxy for past profit. LIQ is firm liquidity measured through the ratio of current assets and current liabilities. TANG is tangibility measured through the ratio of fixed assets to total assets. CV is collateral value, and it is the ratio of gross fixed assets at cost to total book value of assets. SIZE is the natural logarithm of firm's total assets. AGE is natural log of firm's age from the date of its listing. INDSL is industry short-term leverage measured from firm level short term leverage. INDLL is industry long-term leverage measured from firm level long-term leverage ratio. INDTL is industry total leverage measured from firm level total leverage. INMP is industry annual mean profit calculated from firm level net profit. INF is inflation rate. ER is exchange rate between RMB and US dollar. EG is economic growth measured through annual gross domestic product rate. CF is capital formation ratio to total GDP

Results and discussion

Descriptive statistics

Table 5 represents the descriptive statistics. From mean values of short term (SL) and long (LL) term leverage, it can be inferred that Chinese firms use more short term leverage than long term leverage. Mean value is highest for total leverage (TL). Table 5 shows as firms go toward maturity and decline stage its leverage increases except for long term leverage (LL). Mean value for total leverage (TL) is 0.58 during growth, 0.63 during maturity, and 0.53 during decline stage. This low-high-low pattern of total leverage (TL) is in line with the trade-off theory of capital structure. For tax shield (TS), the mean values increase from growth to maturity and remain the same for decline stage. Mean for bankruptcy probability (Z score (ZS)) is the highest during growth stage (6.93). Mean for agency costs (AgC = 0.06) is highest during growth stage so as the mean of firm's growth rate (GROW = 0.81). This is in line with agency theory. Agency conflicts are higher during growth stage of a firm. Further, mean of current profit (CP = 0.06) is highest during growth stage. It decreases as firm approaches decline stage (0.05). Another interesting descriptive statistic is the mean of past profit (PP). Past profits are measured through retained earnings. The mean of PP in growth stage is 0.52, 0.47 in mature stage, and 0.48 during decline stage. This shows that firm has high retained earnings during growth stage, and at maturity and decline stage, firm do not retained many earnings.

Correlation matrix

Tables 6, 7, and 8 represent correlation matrices of short-term, long-term, and total leverage, respectively. VIF corresponding to each explanatory variable is given at the end of each table. VIF is the variance inflation factor. VIF values are obtained after running OLS regression for all three proxies of leverage. All the VIF values are less than 10. The maximum values of VIF for short-term leverage correspond to capital formation (7.64); for long-term leverage, capital formation (CF) again reports the highest VIF of 7.55. For total leverage, exchange rate (ER) has the highest VIF value of 7.65. By looking at the correlation values and VIF values in Tables 6, 7, and 8, it can be inferred that there is no serious issue of multicolinearity.

Adjustment rate of leverage

Tables 9, 10, and 11 show regression results for short-term, long-term, and total leverage, respectively. These results were obtained using dynamic panel data model. Table 9 shows that for short-term leverage (SL), lagged short-term leverage (SL (L1)) shows a positive and statistically significant coefficients (0.091, 0.220, 0.340) for growth, maturity, and decline stage. This shows that Chinese forms follow a target level of short term leverage across all the three life stages of a firm life cycle. However, adjustment rate (1-coefficent) is highest for growing firms and lowest for firms in the decline stage. This shows that during that stage, firms tend to speedily adjust their leverage.

For long-term leverage (LL), Table 10 shows that coefficients for lagged leverage (LLL1) are not only positive but also statistically significant. This shows that firms in China follow a target level of long-term leverage. Adjustment rate (1-coefficient) is

Table 6 Correlation matrix (short-term leverage)

	SL	SL(L1)	TS	BR	NDTS	AgC	GROW	CP	PP	LIQ	tang	CV	SIZE	INDSL	INMP	INF	ER	EG	CF	VIF
SL	1																			1.73
SL(L1)	0.68	1																		1.24
TS	0.02	0.02	1																	1
BR	−0.01	0.01	0.00	1																1.01
NDTS	0.04	0.04	0.02	0.00	1															1.73
AgC	−0.03	−0.03	−0.02	−0.02	−0.08	1														1.1
GROW	−0.04	0.00	0.00	0.08	−0.10	−0.04	1													1.05
CP	−0.25	−0.19	−0.02	0.00	0.04	0.07	0.08	1												1.2
PP	0.00	0.01	−0.01	0.00	−0.01	0.01	0.01	0.03	1											1
LIQ	−0.31	−0.25	−0.01	−0.02	−0.28	0.18	0.03	0.14	0.01	1										1.53
tang	0.10	0.07	0.04	0.00	0.60	−0.12	−0.05	−0.17	0.00	−0.33	1									1.93
CV	−0.04	−0.02	0.00	0.01	0.45	−0.10	−0.05	0.11	−0.01	−0.43	0.46	1								1.62
SIZE	−0.19	−0.20	−0.02	0.01	0.03	−0.21	0.10	0.04	0.00	−0.20	−0.04	0.05	1							1.38
INDSL	0.31	0.25	0.03	0.00	0.04	−0.02	0.00	−0.06	0.00	−0.07	0.11	−0.01	−0.23	1						1.29
INMP	−0.02	−0.02	0.00	0.00	−0.02	−0.01	0.00	0.01	0.00	0.01	−0.01	−0.02	0.00	−0.05	1					1
INF	0.03	−0.01	−0.02	0.02	−0.02	0.00	0.01	0.07	0.01	0.01	−0.03	0.00	0.01	0.02	0.00	1				1.45
ER	0.14	0.11	0.04	−0.02	0.13	−0.05	0.04	0.00	0.01	−0.05	0.20	0.06	−0.34	0.40	−0.03	−0.09	1			7.51
EG	0.11	0.09	0.04	0.00	0.09	−0.05	0.08	0.08	0.02	−0.07	0.15	0.04	−0.22	0.32	−0.02	0.18	0.69	1		2.35
CF	−0.14	−0.10	−0.04	0.02	−0.11	0.04	−0.04	−0.02	−0.01	0.05	−0.18	−0.05	0.32	−0.40	0.03	−0.15	−0.90	−0.74	1	7.64

SL is short-term leverage ratio between short-term loan and total assets. LL is long-term leverage ratio between long-term leverage and assets. TL represents total leverage which is a ratio of total liabilities and total assets. TS represents tax shield calculated by dividing tax payments on net profit. ZS is Z score. BR is business risk measured through operating expense divided by total sales. NDTS is non-debt tax shield calculated through the ratio of depreciation to total assets. Ag C represents agency costs. CP is current profit growth, calculated through annual growth rate of net profit. PP is retained earnings ratio as a proxy for past profit. LIQ is firm liquidity measured through the ratio of current assets and current liabilities. TANG is tangibility measured through the ratio of fixed assets to total assets. CV is collateral value, and it is the ratio of gross fixed assets at cost to total book value of assets. SIZE is the natural logarithm of firm's total assets. AGE is natural log of firm's age from the date of its listing. INDSL is industry short term leverage measured from firm level short-term leverage. INDLL is industry long term leverage measured from firm level long-term leverage ratio. INDTL is industry total leverage measured from firm level total leverage. INMP is industry annual mean profit calculated from firm level net profit. INF is inflation rate. ER is exchange rate between RMB and US dollar. EG is economic growth measured through annual gross domestic product rate. CF is capital formation ratio to total GDP

Table 7 Correlation matrix (long-term leverage)

	LL	LL(L1)	TS	BR	NDTS	AgC	GROW	CP	PP	LIQ	TANG	CV	SIZE	INDLL	INMP	INF	ER	EG	CF	VIF
LL	1																			1.64
LL(L1)	0.84	1																		1.24
TS	−0.01	−0.01	1																	1
BR	0.00	0.01	0.00	1																1.01
NDTS	0.04	0.08	0.02	0.02	1															1.76
AgC	−0.25	−0.24	0.04	−0.01	−0.08	1														1.12
GROW	0.08	0.00	0.00	0.01	−0.07	−0.03	1													1.04
CP	−0.12	−0.09	−0.01	0.03	0.06	0.06	0.13	1												1.2
PP	−0.01	−0.01	0.00	0.00	−0.01	0.01	0.00	0.03	1											1
LIQ	−0.13	−0.17	−0.01	−0.02	−0.26	0.13	−0.02	0.13	0.01	1										1.26
TANG	0.19	0.21	0.00	0.04	0.59	−0.14	−0.04	−0.17	0.00	−0.29	1									1.93
CV	0.31	0.30	0.01	0.02	0.46	−0.14	−0.02	0.10	−0.01	−0.35	0.46	1								1.62
SIZE	0.20	0.21	−0.01	−0.01	0.04	−0.19	0.07	0.07	−0.01	−0.15	−0.06	0.04	1							1.32
INDLL	−0.07	−0.06	0.00	0.01	0.05	−0.01	0.02	−0.05	0.00	−0.07	0.10	−0.02	−0.24	1						1.24
INMP	−0.02	−0.01	0.00	0.00	−0.02	−0.01	0.00	0.01	0.00	0.01	−0.01	−0.02	0.00	−0.06	1					1
INF	−0.03	0.01	−0.02	0.00	−0.01	0.00	0.04	0.06	0.00	−0.01	−0.03	−0.01	0.01	0.04	0.00	1				1.43
ER	−0.01	−0.04	0.03	0.01	0.17	−0.05	0.02	0.02	0.01	−0.04	0.23	0.07	−0.35	0.40	−0.03	−0.08	1			7.5
EG	0.00	0.00	0.03	0.03	0.12	−0.05	0.06	0.08	0.02	−0.06	0.18	0.04	−0.23	0.33	−0.02	0.18	0.70	1		2.39
CF	0.03	0.04	−0.02	0.00	−0.15	0.05	−0.03	−0.03	0.00	0.05	−0.21	−0.07	0.32	−0.40	0.03	−0.16	−0.90	−0.74	1	7.55

Table 8 Correlation matrix total leverage

	TL	TL(L1)	TS	BR	NDTS	AgC	GROW	CP	PP	LIQ	TANG	CV	SIZE	INDTL	INMP	INF	ER	EG	CF	VIF
TL	1																			1.57
TL(L1)	0.90	1																		1.4
TS	0.01	0.00	1																	1
BR	0.02	0.03	0.00	1																1
NDTS	−0.13	−0.10	0.01	0.00	1															1.7
AgC	−0.22	−0.22	0.02	−0.01	−0.10	1														1.12
GROW	0.05	0.02	0.00	0.03	−0.02	−0.03	1													1.02
CP	−0.25	−0.18	−0.01	0.00	0.02	0.08	0.09	1												1.16
PP	−0.01	0.00	0.00	0.00	−0.01	0.01	0.00	0.03	1											1
LIQ	−0.25	−0.22	−0.01	−0.01	−0.04	0.03	−0.01	0.04	0.00	1										1.08
TANG	−0.05	−0.05	0.01	0.00	0.60	−0.14	−0.01	−0.17	0.00	−0.08	1									1.87
CV	−0.11	−0.12	0.01	0.01	0.43	−0.12	−0.01	0.09	−0.01	−0.11	0.45	1								1.4
SIZW	0.42	0.40	0.00	0.01	0.05	−0.18	0.05	0.05	−0.01	−0.11	−0.03	0.06	1							1.39
INDTL	0.01	0.00	0.01	0.01	0.04	−0.02	−0.02	−0.06	0.00	−0.03	0.10	−0.01	−0.21	1						1.24
INMP	−0.01	−0.01	0.00	0.00	−0.01	−0.01	0.00	0.01	0.00	0.00	−0.01	−0.02	0.01	−0.05	1					1
INF	0.01	0.02	−0.02	0.01	−0.01	−0.01	0.02	0.06	0.00	0.02	−0.03	0.00	0.01	0.04	0.00	1				1.46
ER	−0.09	−0.14	0.03	−0.01	0.15	−0.07	0.00	−0.02	0.00	−0.02	0.23	0.06	−0.30	0.40	−0.03	−0.08	1			7.65
EG	−0.04	−0.06	0.03	0.00	0.11	−0.06	0.03	0.05	0.01	−0.02	0.17	0.04	−0.19	0.33	−0.02	0.18	0.70	1		2.37
CF	0.08	0.12	−0.02	0.01	−0.14	0.07	0.01	0.01	0.00	0.02	−0.21	−0.06	0.28	−0.41	0.02	−0.16	−0.90	−0.74	1	7.61

Table 9 GMM estimation results for short-term leverage

	Growth			Maturity			Decline		
	Coef.	*z*	*P* > *z*	Coef.	*z*	*P* > *z*	Coef.	*z*	*P* > *z*
Adjustment rate	0.905			0.780			0.64		
SL(L1)	0.095	3.83	0.0000	0.220	6.88	0.000	0.340	4.24	0.000
TS	−0.004	−0.49	0.6210	−0.004	−1.12	0.262	0.018	1.95	0.052
BR	0.000	0.06	0.9550	0.000	2.66	0.008	0.000	−15	0.000
ZS	0.001	0.91	0.3610	0.000	−12.32	0.000	0.000	−0.37	0.714
NDTS	−0.763	−1.56	0.1180	−0.038	−0.17	0.867	−0.490	−2.76	0.006
AgC	−0.092	−0.6	0.5490	0.044	0.61	0.544	−0.577	−4.8	0.000
GROW	−0.031	−3.84	0.0000	−0.003	−0.65	0.515	−0.009	−1.84	0.066
CP	−0.187	−4.5	0.0000	−0.109	−4.11	0.000	−0.074	−2.29	0.022
PP	−0.011	−2.94	0.0030	−0.009	−2.18	0.029	−0.013	−4.49	0.000
LIQ	−0.083	−10.56	0.0000	−0.046	−8.98	0.000	−0.051	−7.47	0.000
TANG	−0.006	−0.34	0.7330	−0.025	−1.7	0.089	0.024	1.98	0.047
CV	−0.051	−2.63	0.0090	−0.034	−3.04	0.002	−0.018	−1.27	0.205
SIZE	0.003	0.31	0.7590	0.016	2.15	0.031	−0.005	−0.61	0.540
INDSL	0.506	5.77	0.0000	0.281	5.21	0.000	0.344	7.9	0.000
INMP	0.003	5.58	0.0000	0.002	4.36	0.000	0.113	7.01	0.000
INF	0.001	0.69	0.4880	0.002	2.92	0.004	0.000	0.57	0.569
ER	−0.019	−1.52	0.1280	0.010	1.5	0.134	−0.022	−3.25	0.001
EG	0.006	3.57	0.0000	−0.001	−0.94	0.345	−0.005	−4.43	0.000
CF	0.001	0.48	0.6280	−0.001	−0.87	0.385	−0.008	−6.46	0.000
_cons	0.199	0.68	0.4950	−0.231	−1.15	0.252	0.834	4.03	0.000

highest for firm in growing stage (0.752). The only difference is that long-term leverage (LL) unlike short term leverage (SL) reposts lowest adjustment rate for firms in maturity stage. This shows that firms adjust their long-term leverage more speedily during growth and decline stage.

For total leverage, Table 11 reports that all the three lagged leverage (TL L1) are positive as well as strongly significant. This shows that Chinese firms follow a target level of all three proxies of leverage (short term leverage, long term leverage, and total leverage). Total leverage (TL) reports the highest adjustment rate for growing firms (0.596) and lowest for firms in declining stage (0.26). This again confirms that firms in their growing stage tend to speedily adjust to their target level of leverage.

Thus, all three proxies of leverage regression results showed that firms in growing phase speedily fill the gap between actual and target leverage. The reason is that during growing stage, firms have highest investment opportunities and in order to avail these opportunities, there are vigorous adjustment of leverage. For declining stage, adjustment speeds are lowest because during this stage investment opportunities are less and firms do not need to quickly adjust their leverage positions. These adjustment speeds are in line with studies conducted by Getzmann et al. (2014), and Ahsan et al. (2016b). These studies found adjustment speed between 20 and 60% for Asian countries.

Table 10 GMM estimation results for long term leverage

	Growth			Maturity			Decline		
	Coef.	*z*	*P* > *z*	Coef.	*z*	*P* > *z*	Coef.	*z*	*P* > *z*
Adjustment rate	0.750			0.435			0.541		
LL(L1)	0.250	13.2	0.000	0.565	18.35	0.000	0.459	34.73	0.000
TS	−0.054	−9.4	0.000	0.000	−0.08	0.938	−0.008	−1.61	0.106
BR	−0.001	−1.57	0.117	0.000	−1.59	0.112	−0.001	−0.9	0.368
ZS	0.001	3.37	0.001	0.000	−0.27	0.789	−0.001	−4.72	0.000
NDTS	0.664	2.84	0.005	−1.103	−4.5	0.000	−0.845	−5.49	0.000
AgC	−0.037	−0.77	0.440	−0.020	−0.24	0.810	−0.043	−0.59	0.552
GROW	−0.007	−1.67	0.095	0.020	3.99	0.000	0.045	8.95	0.000
CP	−0.025	−1.2	0.231	−0.094	−4.97	0.000	−0.089	−4.37	0.000
PP	−0.003	−1.12	0.265	0.000	−3.92	0.000	−0.001	−0.31	0.755
LIQ	0.014	2.44	0.015	0.029	4.63	0.000	0.018	8.52	0.000
TANG	−0.023	−2.25	0.024	0.013	1.21	0.225	−0.018	−2.67	0.008
CV	0.049	3.67	0.000	0.055	5.79	0.000	0.046	6.23	0.000
SIZE	0.028	5.46	0.000	−0.012	−1.61	0.107	0.012	2.42	0.016
INDLL	0.353	5.19	0.000	0.478	6.77	0.000	0.467	16.03	0.000
INMP	−0.001	−1.96	0.050	0.000	1.23	0.217	0.009	0.7	0.482
INF	−0.001	−0.75	0.456	−0.001	−1.25	0.210	−0.001	−3.04	0.002
ER	0.042	5.02	0.000	−0.002	−0.32	0.751	0.015	3.43	0.001
EG	0.004	2.75	0.006	−0.002	−1.91	0.057	−0.003	−5.6	0.000
CF	0.006	3.8	0.000	−0.001	−0.68	0.497	−0.004	−4.06	0.000
_cons	−1.254	−7.27	0.000	0.290	1.39	0.164	−0.166	−1.24	0.215

Determinants of leverage

This section provides explanation for relationship between leverage and explanatory variables and adjustment of leverage due to these relationships. Table 9 reports a positive and statistically significant coefficient for tax shield (TS) during mature stage. This shows that during decline stages, non-financial firms in China increase short-term debt to gain more tax advantage during mature stage. However, Table 10 shows that tax shield shows a negative relationship with long-term leverage (LL) during decline stage. This might be due to the reason that short-term and long-term debt are negatively correlated (refer to correlation matrices), and thus, it can be inferred that during decline stages firms in China tends to raise less long-term leverage due to tax benefits they get from short term leverage. Table 9 shows that for higher earnings, volatility or business risk shows no association with short term leverage. However, Table 10 for long-term leverage (LL) shows that during growth and maturity, the relationship between business risk (BR) and long-term leverage is negative, and even at maturity stage, it has a negative significant relationship. This shows that as firms enter into maturity, firms realize its long-term profitability and this slows down adjustment in leverage. In decline stage, this relationship for long term leverage (LL Table 10) is positive and thus firm again try to speedily adjust their leverage. For bankruptcy risk (ZS), short-term leverage (SL; Table 9) shows a positive and significant coefficient explaining the disciplinary role of bankruptcy risk in short-term leverage adjustment for growth stage. Table 10 shows that for long-term leverage (LL; Table 10), bankruptcy risk (ZS) shows a positive and

Table 11 GMM estimation results for total leverage

	Growth			Maturity			Decline		
	Coef.	*z*	*P* > *z*	Coef.	*z*	*P* > *z*	Coef.	*Z*	*P* > *z*
Adjustment rate	0.594			0.286			0.268		
TL(L1)	0.406	8.99	0.000	0.714	19.08	0.000	0.732	22.95	0.000
TS	−0.032	−4.18	0.000	0.001	5.03	0.000	−0.002	−0.45	0.651
BS	−0.001	−0.59	0.555	0.000	−1.89	0.059	0.000	−9.27	0.000
ZS	0.000	1.34	0.180	0.000	−0.4	0.692	0.001	6.32	0.000
NDTS	−1.157	−3.71	0.000	−2.074	−7.17	0.000	−0.160	−0.53	0.598
AgC	−0.125	−1.49	0.135	0.104	1.08	0.278	−0.315	−3.62	0.000
GROW	0.005	3	0.003	0.004	1.34	0.182	0.088	7.25	0.000
CP	−0.145	−6.53	0.000	−0.183	−7.9	0.000	−0.247	−7.68	0.000
PP	−0.007	−1.51	0.132	−0.001	−5.19	0.000	−0.002	−0.51	0.607
LIQ	−0.102	−18.19	0.000	−0.002	−3	0.003	−0.007	−12.49	0.000
TANG	−0.003	−0.2	0.838	−0.016	−1.19	0.233	−0.046	−3.5	0.000
CV	−0.033	−2.71	0.007	0.022	1.94	0.052	0.032	3.12	0.002
SIZE	0.031	4.01	0.000	0.062	7.6	0.000	0.028	3.57	0.000
INDLL	0.062	6.99	0.000	0.018	2.01	0.044	0.000	0.05	0.959
INMP	0.001	1.4	0.160	0.002	7.56	0.000	−0.010	−0.56	0.578
INF	0.001	1.83	0.068	0.002	3.68	0.000	0.002	2.28	0.023
ER	0.036	3.75	0.000	0.054	8.57	0.000	0.024	3.22	0.001
EG	−0.001	−0.78	0.436	−0.002	−2.18	0.030	0.000	0.1	0.919
CF	0.003	1.77	0.078	0.004	3.73	0.000	0.002	1.58	0.115
_cons	−0.577	−2.42	0.016	−1.750	−8.61	0.000	−0.737	−3.41	0.001

significant coefficient during growth which becomes negative and significant during decline stage. This shows that during growth, firms speedily adjust their adjustment rate due to bankruptcy risk in an uncertain environment and this adjustment decreases during decline stage.

For total leverage (TL; Table 11), the bankruptcy (ZS) relationship lacks statistical significance; however, during decline stage, it reports a positive and significant relationship which confirms that leverage is speedily adjusted, and as total leverage include greater proportion of short term leverage, thus, it can be inferred that adjustment involves mainly the short term leverage adjustment during the decline stage for total leverage. Non-debt tax shield (NDTS) shows strong negative relationship with all three proxies of leverage (SL, LL, TL) during maturity and decline stages. This shows that firms in China have greater NDTS advantage as compared to tax shield during maturity and decline. This greater NDTS advantage coupled with less investment opportunities compel firms to raise more debts and thus report a lower adjustment rate during mature and decline stages. Agency costs (AgC) lack statistical significance for all three stages. However, for short-term and total leverage (SL-TL), this relationship is negative and significant in decline stage. This shows that during decline stage, there are not much investment opportunities that can create agency conflicts and firms do not raise more debt to increase its disciplinary role during decline stage. Negative association of growth opportunities (GROW) with short-term leverage (SL; Table 9) indicates that firms do not use short-term loan to finance their long-term investment opportunities,

and hence, it has a negative effect on firms leverage's adjustment rate for short-term leverage. On the other hand, growth opportunities (GROW) show positive and significant relationship with both short-term and total leverage (Tables 10 and 11) in almost all three stages of firm's life cycle. This indicates that to finance long-term investment opportunities, firms tend to raise long-term leverage and this increases adjustment rate for leverage especially during maturity stage.

Tables 9, 10, and 11 show that both current profit (CP) and past profit (PP) show negative and statistically significant association with short-term (SL), long-term (LL), and total leverage (TL) across all three life cycle stages. This is in line with pecking order theory (POT) that firms first uses internal funds to finance investment projects and then they opt for external financing. This negative relationship slows adjustment of leverage across all three stages of a firm's life cycle. We find mixed relationship for tangibility (TANG) and collateral value (CV).

However, during decline stage, collateral value shows a positive and significant relationship for long-term (LL) and total leverage (TL). This shows that high collateral value during decline stage gives firm better credit rating for bank financing and thus it speeds up leverage adjustment.

Firm's size (SIZE) shows a significant and positive association with leverage during all stages. This indicates bigger firms enjoy reputation and have better credit rating in line with trade-off theory. Thus, firm's size speeds up leverage adjustment across all three stages of firm's life cycle.

Industry leverage (INDSL, INDLL, and INDTL) shows positive and significant relationship with firm's leverage indicating that firm follows industry in its leverage decisions across all three stages of a firm's life cycle. However, industry profitability (INMP) shows both positive and negative relationship. For long-term leverage (Ll), industry profitability shows a negative relationship during growing stage, which is in line with pecking order theory (POT). This shows that as industry becomes more profitable so as the firm, firms tend to use internal funds to finance their investment opportunities and do not raise external funds.

Table 12 Sargan and Abond test results

	Number of groups	No. of instruments	Sargan Test	Abond Test
Short-term leverage				
Growth	218	95	0.163	0.3685
Maturity	651	95	0.2321	0.2784
Decline	168	95	0.4733	0.7261
Long-term leverage				
Growth	204	95	0.3057	
Maturity	600	95	0.033	0.095
Decline	150	95	0.3328	0.4291
Total leverage				
Growth	252	95	0.1517	0.1027
Maturity	699	95	0.3105	0.8352
Decline	190	95	0.4264	0.231

Inflation (INF) shows a positive and significant relationship with short-term (SL) and total leverage (TL) across all three stages of life cycle. This shows that due to the effects of inflation, firms speedily adjust their book leverages and thus inflation speeds up adjustment rate across all three stages. Exchange rate (ER) shows positive and significant coefficients for long-term (LL) and total leverage (TL). This relationship holds for all three stages of life cycle. This shows firms value exchange rate in their leverage adjustment decisions. As most of Chinese firms are export oriented, thus exchange rate has a role in high adjustment rate of Chinese firms. Both economic growth (EG) and capital formation (CF) show mixed results. In growth stage, they report negative while in maturity stage they show positive coefficients. Thus, during mature stages, firms are able to reap the benefits of economic growth and speedily adjust their leverage (Ahsan et al. 2016b).

In the end, Table 12 provides results of post estimation tests for GMM estimation. In all cases, the number of groups are higher than the number of instruments. The *p* values for both Sragan and Arelleano Bond test are insignificant which confirms the estimation through generalized method of moments.

Table 13 ANOVA

Variable	Stages			F Statistics	
	Growth	Maturity	Decline	*F* value	Prob > *F*
SL	0.17	0.17	0.15	35.23	0.000
LL	0.1	0.1	0.1	43.12	0.000
TL	0.58	0.63	0.53	65.34	0.000
TS	0.07	0.15	0.15	27.21	0.000
ZS	3.06	6.93	3.47	26.13	0.000
BR	-0.06	-0.4	2.16	27.12	0.000
NDTS	0.03	0.03	0.03	0.87	0.429
AgC	0.05	0.06	0.05	23.15	0.000
GROW	0.18	0.81	0.13	29.36	0.000
CP	0.04	0.06	0.05	21.47	0.000
PP	0.52	0.47	0.48	22	0.000
LIQ	1.34	1.39	1.72	33.19	0.000
TANG	0.26	0.24	0.24	27.15	0.000
CV	0.53	0.55	0.57	0.17	0.368
SIZE	22.05	21.89	22.18	24.12	0.000
AGE	2.67	2.87	3.02	13.14	0.000
INDSL	0.17	0.17	0.17	0.19	0.247
INDLL	0.1	0.1	0.1	0.14	0.637
INDTL	0.59	0.6	0.68	12.14	0.000
INMP	0.05	0.04	0.02	0.28	0.234
INF	2.83	2.68	2.43	19.58	0.000
ER	7.07	7.17	7.27	11.12	0.000
EG	9.93	9.9	9.9	0.53	0.186
CF	45	44.65	44.25	24.15	0.000

Table 14 Blundell and Bond GMM estimation for long-term leverage

	Growth			Maturity			Decline		
	Coef.	*Z*	*P* > *z*	Coef.	*z*	*P* > *z*	Coef.	*z*	*P* > *z*
Adjustment rate	0.735			0.420			0.536		
LL(L1)	0.265	5.31	0.000	0.580	12.560	0.000	0.464	6.33	0.000
TS	−0.062	−8.09	0.000	0.000	−0.630	0.527	−0.022	−5.26	0.000
BR	0.005	4.44	0.000	0.000	−0.310	0.753	−0.001	−2.16	0.031
ZS	−0.002	−3.49	0.000	0.000	−0.860	0.389	−0.001	−8.3	0.000
NDTS	0.522	3.04	0.002	−0.753	−2.830	0.005	−0.679	−4.18	0.000
AgC	0.016	0.18	0.860	0.026	0.320	0.750	−0.099	−1.32	0.187
GROW	−0.007	−2.21	0.027	0.027	4.300	0.000	0.010	2.29	0.022
CP	−0.066	−5.42	0.000	−0.103	−4.630	0.000	−0.102	−6.05	0.000
PP	0.000	−6.79	0.000	0.000	0.740	0.459	0.000	1.95	0.051
LIQ	0.020	6.67	0.000	0.027	4.310	0.000	0.014	8.83	0.000
TANG	−0.012	−3.72	0.000	0.003	0.230	0.817	−0.016	−2.66	0.008
CV	0.016	1.53	0.126	0.056	6.270	0.000	0.047	10.65	0.000
SIZE	0.024	5.36	0.000	−0.010	−1.400	0.161	0.042	8.44	0.000
INDLL	0.338	4.12	0.000	0.431	5.270	0.000	0.419	11.42	0.000
INMP	−0.004	1.96	0.043	0.000	1.140	0.270	−0.006	0.34	0.148
INF	−0.001	0.28	0.486	−0.002	0.240	0.586	0.000	0.48	0.476
ER	0.041	13	0.000	−0.005	−0.810	0.420	0.023	5.97	0.000
EG	0.003	3.83	0.000	0.001	0.990	0.324	0.000	−0.57	0.571
CF	0.001	3.22	0.001	−0.001	−0.820	0.413	−0.001	−1.69	0.091
_cons	−0.898	−6.75	0.000	0.214	0.970	0.332	−0.999	−6.84	0.000

ANOVA analysis and robust estimation

In order to add robustness to our findings, we conducted ANOVA analysis and estimated our equation with a more novel method of dynamic estimation (Blundell and Bond system estimation). Table 13 corresponds to robustness analysis.

Analysis of variance suggests that null hypothesis for most of the variables is rejected which suggest that means of different groups (across life cycle) are not equal. For one firm-specific variable non-debt tax shield (NDTS), the null hypothesis of difference of means cannot be rejected. For industry level for short-term and long-term leverage, there exists no significance difference of means.

Further, the Blundell and Bond GMM estimation is in conformance with our previous estimation of dynamic adjustment speed except for the short-term leverage. Both long-term and total leverage (Tables 14 and 15) reports results in consistency with our previous estimation.

For long-term leverage, Table 14 reports adjustment rates of 0.73, 0.42, and 0.53 for growth, maturity, and decline stages, respectively. The trend in dynamic adjustment rate for long-term leverage according to the system estimation (Blundell and Bond) is in accordance with our argument that adjustment of financial leverage is higher during the growth stage; it reduces toward maturity and then increases during the decline stage.

Similarly, Blundell and Bond estimation for total leverage (Table 15) shows that financial leverage in Chinese firms follows a high-low-high pattern across the three

Table 15 Blundell and Bond GMM estimation for total leverage

	Growth			Maturity			Decline		
	Coef.	*z*	*P* > *z*	Coef.	*z*	*P* > *z*	Coef.	*z*	*P* > *z*
Adjustment rate	0.604			0.287			0.278		
TL(L1)	0.397	6.730	0.000	0.713	10.870	0.000	0.722	7.630	0.000
TS	−0.687	−0.890	0.372	−0.060	4.870	0.000	−0.490	−2.520	0.012
BR	−0.218	−1.300	0.194	0.026	0.900	0.368	−0.160	−1.850	0.064
ZS	−0.195	−1.850	0.064	−0.001	−1.130	0.258	0.066	4.660	0.000
NDTS	1.250	−4.590	0.000	0.730	−5.080	0.000	1.120	−1.820	0.069
AgC	0.128	1.920	0.055	0.005	0.060	0.949	0.007	−1.820	0.069
GROW	0.005	2.750	0.006	0.007	5.010	0.000	0.003	3.820	0.000
CP	−0.173	−1.530	0.125	−0.147	−7.730	0.000	−0.213	−4.220	0.000
PP	−0.014	−2.460	0.014	−0.008	−3.190	0.001	−0.005	−2.100	0.035
LIQ	−0.102	−23.920	0.000	−0.101	−2.080	0.037	−0.716	−6.190	0.000
TANG	0.233	0.180	0.857	−3.449	−2.260	0.024	−2.999	−2.580	0.010
CV	−0.433	−6.340	0.000	−0.510	2.090	0.036	−0.689	2.780	0.005
SIZE	0.023	5.500	0.000	0.031	3.670	0.000	0.036	6.880	0.000
INDLL	0.062	3.250	0.000	0.058	4.210	0.000	0.038	3.140	0.000
INMP	0.004	1.370	0.287	0.002	0.376	0.145	0.002	0.852	0.129
INF	0.020	2.140	0.000	0.031	3.540	0.000	0.050	4.120	0.000
ER	0.038	3.870	0.000	0.039	4.780	0.000	0.035	3.160	0.002
EG	0.311	2.270	0.023	0.417	3.340	0.001	−0.039	−0.300	0.767
CF	0.147	1.910	0.056	0.222	3.600	0.000	0.071	1.070	0.284
_cons	−0.663	−3.100	0.002	−1.340	−4.040	0.000	−0.830	−5.880	0.000

stages of firm life cycle. Our ANOVA analysis and system GMM estimation add robustness to our results.

Conclusions

This study tries to investigate how firms adjust their leverage policy across the firm's life cycle. For this purpose, the study uses an extensive set of data of 860 A-listed Chinese non-financial firms over a 19-year period (1996–2014). The study uses Arellano-Bover/Blundell-Bond dynamic panel data model to estimate adjustment rate of leverage and its determinants in three different life stages of Chinese firms. We find that adjustment rate of leverage varies for different life stages. In accordance with the trade-off theory of capital structure, this study reports a low-high-low pattern of leverage across growth, maturity, and decline stage of firms' life, respectively. For total leverage, dynamic panel data reports highest adjustment rate for growing firm, followed by mature firms, and then firms in declining stage of their life. Both short-term and long-term leverage report similar pattern of leverage's adjustment rate across the three life cycles. The firm life cycle measure in this study is based on a multivariate technique using firm's age, sales growth, and dividend payout ratio.

The study finds that profitability is one of the integral determinants of leverage adjustment in China in line with pecking order theory. All determinants had implications for long-term and total leverage.

The study provides useful insight in young and unique market setting of Chinese financial markets and prevalent of bank loans in Chinese market. The study will help policy makers to increase financing options in debt abundant financial markets like China.

Authors' contributions

This study is conducted by AR, MW, and HY, to investigate the dynamics of leverage policy across firm's life cycle in China using innovative GMM technique. All the authors equally participated to conduct and write this research paper. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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