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Chinese Corporate Leverage Determinants*

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Abstract

Total debt in the People's Republic of China surged to nearly 290% as a ratio to GDP by the second quarter of 2016, mostly on account of non-financial corporate debt. The outpouring of credit to stem the impact of the global financial crisis accentuated industrial overcapacity in traditional sectors, such as steel, cement, and energy, while feeding asset bubbles in the property, equity and bond markets. At the Chinese corporate level, this has translated into weakened fundamentals and a fall in industrial profits, particularly of SOEs. As debtors struggle to service interest payments, non-performing loans (NPLs) have been on the rise. This paper assesses the financial fragility of the Chinese economy by looking at risk factors in the non-financial sector. We apply quantile regressions to a dataset containing all Chinese listed companies in Standard & Poor's IQ Capital database. We find higher sensitivity over time of corporate leverage to some of its key determinants, particularly for firms at the upper margin of the distribution. In particular, profitability increasingly acts as a curb on corporate leverage. At a time of falling profitability across the Chinese non-financial corporate sector, this eases the brake on leverage and may contribute to its continuing increase.

Keywords: Corporate Debt, People's Republic of China, debt Sustainability, Panel Quantile Regression.

JEL Classification Code: H30, G21, G01, H60.

1. Introduction

Corporate leverage in the People's Republic of China (PRC) accelerated in the aftermath of the global financial crisis, accentuating industrial overcapacity in traditional sectors and fueling asset bubbles in the property, stock and bond markets. Earnings and financial performance of companies have deteriorated, and with them the asset

quality of the Chinese financial sector holding the bulk of the corporate debt. Warnings about the dangers of excessive corporate leverage and financial sector vulnerability have been a staple of the international press since at least 2015, and also the Chinese authorities have recognized the problem.

Much of the debate on debt and financial sustainability in the PRC has centered on aggregate data and indicators, which suggest a marked rise in corporate debt and non-performing loans held by the domestic banking system. However, a macro focus tends to overlook heterogeneity and vulnerabilities at the micro level, which are relevant to policy formulation (Bernanke & Campbell, 1988). For example, recent market analysis associates the energy sector with the lowest return on capital and the largest increase in non-performing loan ratios among Chinese industries, suggesting that it should be a prime focus of authorities' monitoring efforts (S&P Global Market Intelligence, 2016).

Additional and more systematic insights can be gained from regression analysis of corporate balance sheet data. Early attempts, pre-dating the recent credit surge, can be found in the literature assessing the determinants of capital structure in the PRC (e.g. Chen, 2004, Huang & Song, 2006). It shows that the insights from modern finance theory of capital structure are borne out in the Chinese corporate

* The views expressed in this paper are those of the authors and do not necessarily reflect the views and policies of the Asian Development Bank (ADB) or its Board of Governors or the governments they represent.

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data, notwithstanding institutional differences compared to the US and European markets and the presence of financial constraints in the Chinese banking sector.²

This paper builds on this strain of literature to determine the drivers of non-financial corporate debt in the PRC during the credit surge since 2009. Focus is on the margins of the corporate distribution and on variations in the determinants of corporate leverage that could signal rising risk of financial distress particularly in these segments of the Chinese corporate landscape. This is accomplished through the use of panel and simultaneous quantile analysis, beyond the mean-based OLS regression analysis of previous approaches. The empirical investigation relies on Standard & Poor's IQ Capital database, which contains richly detailed historical balance sheet data and key financial indicators of Chinese companies up until 2015. The data and sources are summarized in Appendix.

We find that, over time, corporate leverage has become more sensitive to changes in some of its key determinants, particularly for firms at the upper margin of the distribution. In particular, profitability appears to have increased over time its impact as a curb on corporate leverage. Among the underlying reasons is the government-induced massive stimulus to stem the global financial crisis, which caused a significant decline in lending rates and incentivizes companies to borrow instead of relying on retained earnings as a source of funding. This eases the brake on leverage at a time when corporate profitability is falling, and likely contributes to further rises of corporate debt.

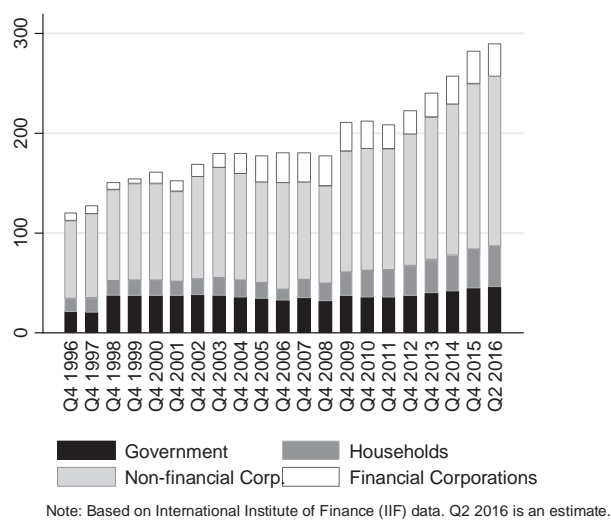
The paper is structured to provide a brief overview of rising leverage and financial risk in the PRC's corporate sector, in Section 2. This is followed, in Section 3, by a presentation of the empirical framework and the data used, and a discussion of the results achieved. The paper closes with lessons for policy and broader conclusions, in Section 4.

2. Corporate Leverage and Growing Financial Risk

Stable at roughly 40% of GDP in 2015, general government debt in the PRC is not particularly large compared to other emerging economies.³ However, total

debt across all sectors ballooned to nearly 290% by the second quarter of 2016 (Figure 1). The massive build-up of debt—mostly domestic—accelerated from the end of 2008 onward, when the government enacted unprecedented monetary and fiscal stimulus to stem the impact of the global financial crisis.⁴ Fiscal stimulus alone amounted to nearly CNY 6 trillion—or 18.5% of GDP—between 2008 and 2010 (Ferrarini et al., 2012).

Stimulus often was directed to the state-owned enterprises (SOEs) whose liabilities grew to 115% of GDP in 2015, or funneled through the policy and state-controlled commercial banks. The net effect of intervention was a significant though discontinuous fall in the benchmark lending rate, from nearly 7.5% in January 2008 to 5.3% by 2010 and 4.3% by the end of 2015 (Figure 2). The decline in the lending rate is likely to have altered the relative opportunity cost of the alternative funding sources for firms, and in particular between retained earnings and external debt.



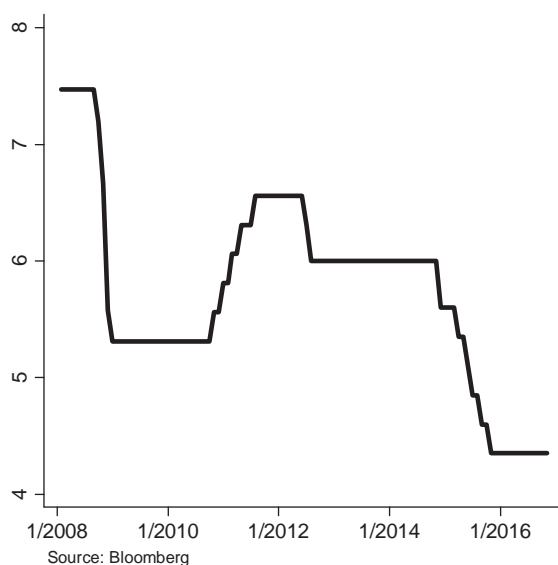
<Figure 1> PRC total debt (in percent of GDP)

² In particular, the state exerts vast control over the state-owned enterprises and the financial system, which reduces the likelihood and costs of financial distress compared to those facing the private corporate sector (Chen 2004, Borst and Lardy 2015).

³ Accounting for both explicit and contingent off-budget liabilities incurred by local governments through their financing platforms, the International Monetary Fund (IMF) estimates that the PRC's

public debt ratio is substantially higher, at 56% in 2015, and will rise to nearly 74% of GDP by 2021.

⁴ And grow it did: the PRC's real GDP expanded on average by nearly 9.2% each year between 2009 and 2013, while the United States, Japan and the euro area were struggling with 0.3% growth on average (ADO 2011, 2013).



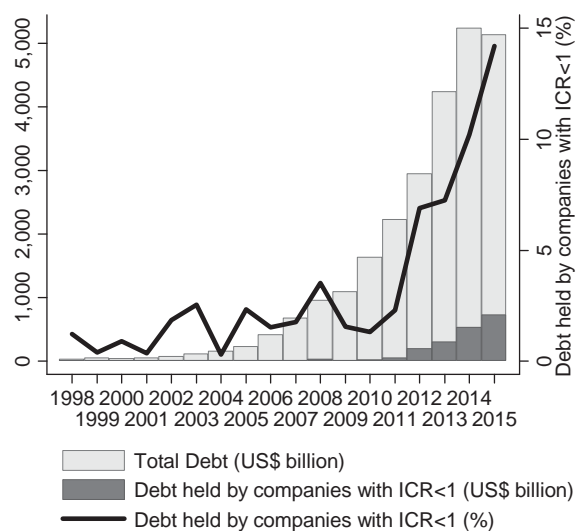
<Figure 2> PRC benchmark lending rate (%)

The PRC's credit to GDP gap—measuring banking risk and defined as the difference between the credit-to-GDP ratio and its long-term trend—reached 30.1 in the first quarter of 2016 (BIS, 2016). The Bank for International Settlements warns that this exceeds the gap of any other country it has been tracking, as well as that of the East Asian economies involved in the 1998 crisis and the United States' prior to the Lehman crisis. Moreover, the PRC's credit has expanded against the backdrop of a sharply slower economic growth in recent years, reflecting weaker external demand as well as authorities' steering efforts toward a more balanced, sustainable growth model.

The credit surge since 2009 worsened industrial overcapacity—hence profitability—in traditional sectors, such as steel, cement, and energy, while feeding asset bubbles in the property, equity and bond markets. At the Chinese corporate level, this has translated into weakened fundamentals and a sharp fall in industrial profits, particularly of SOEs. As debtors struggle to service interest payments, non-performing loans (NPLs) have been on the rise. Chinese official figures show NPLs continuously rising during the past four years, to 1.8% of total loans in the first quarter of 2016. However, the PRC does not follow standard international practice in recording NPLs, which tend to be understated as a result. Most analysts estimate that the NPL ratio exceeds 15% of total loans outstanding (CLSA, 2016; Fitch Ratings, 2016). This ratio does not include bad debt in the country's shadow banking system, which itself is estimated to have grown more than threefold between the

end of 2012 and the first quarter of 2016, to about 10% of bank assets (S&P Global Ratings, 2016a).

Data limitations notwithstanding, rising pressure in the Chinese corporate sector is best gauged at the firm level, as the share of total debt held by companies whose earnings (EBITDA) are insufficient to cover interest expenses. This ratio is seen spiking from 3.5% or less throughout the period from 1998 to 2011, to nearly 7% in 2012 and to more than 14% in 2015 (Figure 3).⁵



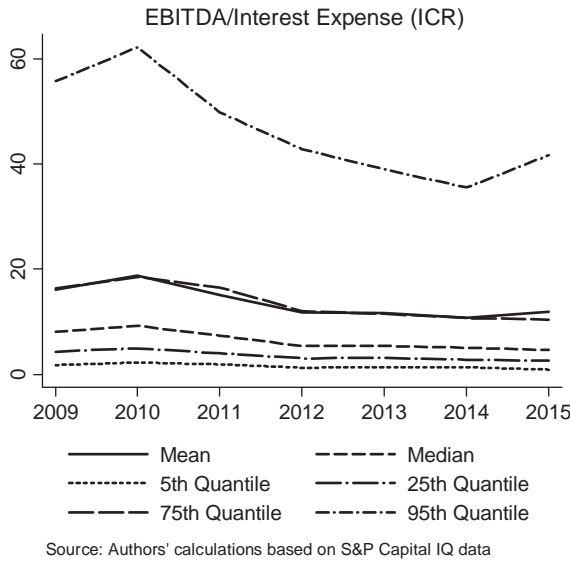
Source: Authors' calculations based on S&P Capital IQ

<Figure 3> Non-financial corporate debt at risk

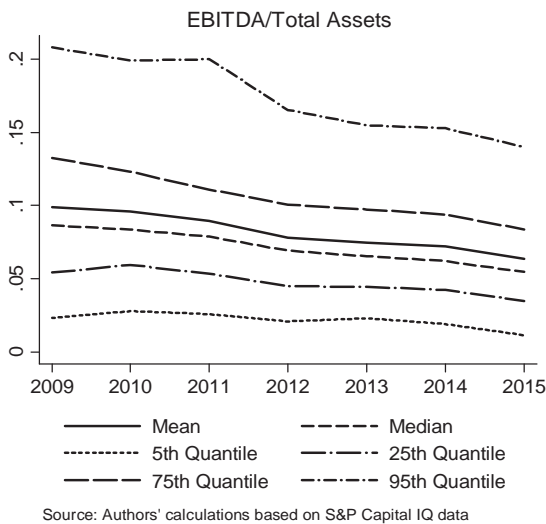
Breaking down the non-financial corporate distribution, the ICR can be seen deteriorating across corporate layers delineated by its 5th, 25th, 50th, 75th and 95th quantiles

⁵ Specifically, we derive this measure from the S&P Capital IQ database, described in Appendix. The S&P data extract accounts for all Chinese listed companies for the years between 1990 and 2015. Isolating non-financial companies with accounting data available, we are able to identify a sample of expanding size over time, from 52 companies in 1998 to 3,377 in 2015. Companies' interest coverage ratio (ICR) is defined as the ratio of earnings before interest, tax, depreciation and amortization (EBITDA) to interest expense. A company is considered to be at risk when EBITDA is insufficient to cover its interest expense in any given year, or ICR<1 (IMF 2016.) This threshold is arbitrary. Less conservative approaches have been to define at risk all debt owed by firms with ICR<2 (such as in IMF 2016). The US dollar amount of debt at risk in the Chinese non-financial corporate sector is then computed as the ratio of aggregate debt owed by companies with ICR<1 to total debt.

(Figure 4). Similarly, profitability has declined repeatedly between 2009 and 2015 at all five the quantiles (Figure 5). However, deterioration of these financial ratios is considerably stronger at the upper 95th quantile of Chinese non-financial corporate distribution, compared to the mean and lower quantiles, which suggests that regression analysis is to allow for heterogeneity in the PRC's corporate landscape.

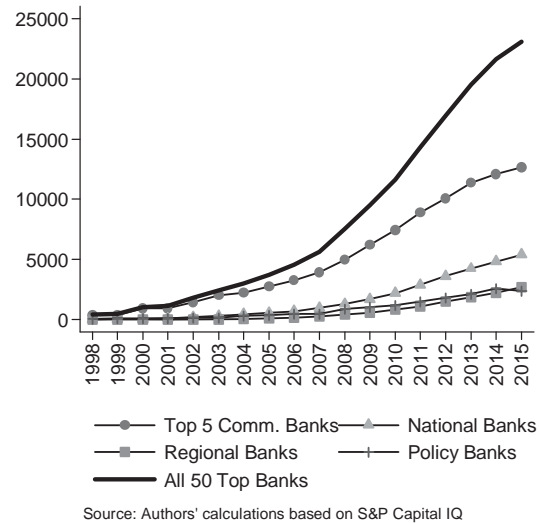


<Figure 4> Non-financial sector ICR quantiles



<Figure 5> Non-financial sector profitability

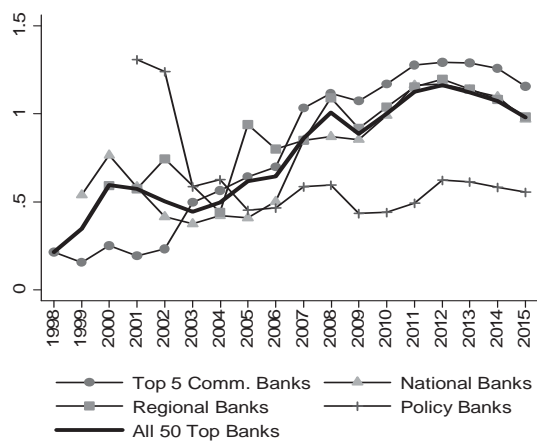
As a result of growing financial pressures in vast segments of the non-financial corporate landscape, the Chinese banking system now holds an unprecedented pile of loans that constitutes a large contingent burden and is fueling concerns about the growing risks of a disruptive adjustment to the Chinese economy, with international repercussions (ADB, 2016; Moody's, 2016). Based on current market reports, it is unclear to what extent the nation's banking system will be able to absorb weakening borrower credit quality without requiring a larger bail out operation by the state. Some evidence on banking sector performance can be evinced from the S&P data. We rank the top 50 banks according to their total asset holdings in 2015, and group them into four policy and commercial bank categories.⁶



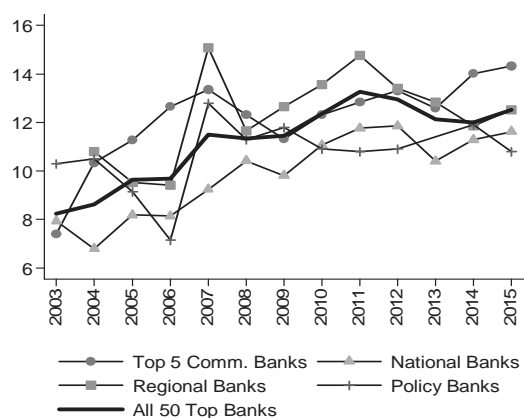
<Figure 6> Total Assets (group totals, USD billion)

⁶ Following S&P Global Ratings (2016b), we divide banks into the following categories:

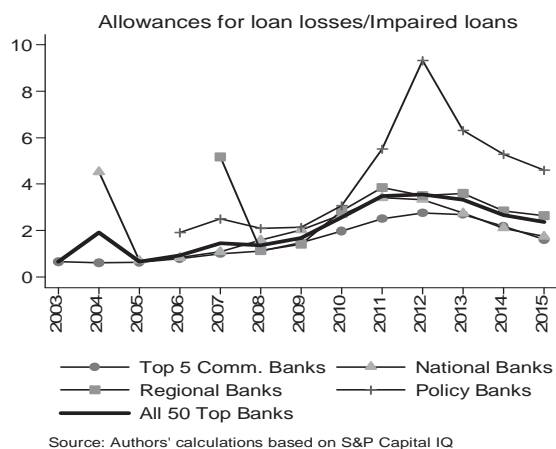
- (A) Top 5 commercial banks: the top five largest banks by far in terms of asset size and with the broadest branch network across the country;
- (B) National banks: large joint-stock commercial banks with a nationwide network;
- (C) Regional banks: smaller joint-stock commercial banks and the leading city or rural commercial banks; and
- (D) Policy banks: Agricultural Development Bank of China, China Development Bank Corporation, and The Export-Import Bank of China, which are used by the Chinese authorities to direct financing to certain economic sectors.



<Figure 7> Return on Assets (averages)



<Figure 8> Total Capital Ratios (average percent)



<Figure 9> Coverage ratio (group averages)

Financial indicator charts along this breakdown provide evidence of incipient vulnerability in the banking sector. Total assets surged across the sector, although at a progressively slowing rate since about 2010 (Figure 6). The top five commercial banks hold the bulk of assets, but credit growth involved all segments of the banking sector, including the regional banks. However, growth in revenues and net income did not keep up with that of assets, causing returns on assets (ROA) to drop significantly in the three years to 2015 (Figure 7). In the meantime, the banking sector failed to raise capital at the same pace as it was issuing credits, causing capital ratios to shrink between 2011 and 2014 (Figure 8). This is true in relation to average ratios for the 50 top banks taken together, not for the policy banks, which raised capital and saw their ratios increase over the same period. Lately, since 2015, the top 5 and other commercial banks have been raising capital in response to higher loan impairments. Nevertheless, the banking sector's efforts have been insufficient so far to stem against the continuing fall since 2012 of the ratio of loan losses allowance to impaired loans (Figure 9). Averaging 2.4 in 2015 across the top 50 banks, coverage appears to be adequate still, although the underestimation of impaired loans may grossly overstate this statistic.

In sum, S&P company data provides evidence of rising leverage in the Chinese non-financial corporate sector against the backdrop of falling returns and interest coverage ratios. The impact of deteriorating asset quality does not yet seem fully reflected in banks' balance sheets. However, weakening capital ratios since the 2009 credit surge and a sharp drop in returns on assets more recently appear to signal financial sector vulnerabilities, which are likely to sharpen against the trend of rising financial pressure in large segments of the PRC's corporate sector.

3. Determinants of Corporate Debt

Focus turns now to the determinants of corporate leverage in the PRC. Heterogeneity across the non-financial corporate sector implies that an aggregate, mean-based approach would be ill suited to identifying vulnerabilities, particularly those affecting firms at the margins of the corporate distribution. Our empirical approach thus entails quantile regression analysis, which we apply within the framework developed by the theoretical literature on corporate debt. This literature has identified a number of possible explanations for the capital structure of firms (Titman & Wessels, 1988; Harris & Raviv, 1991). According to models based on agency costs, firms choose their debt-equity ratio with a view to mitigate the possible conflicts of interest between equity holders and managers, and

between equity holders and debt holders. An important implication of these theories is that firms with limited scope for asset substitution are likely to have higher debt levels, because they face lower agency costs of debt. Corporation tax rules could also act as an incentive to issue debt to reduce tax liabilities. In general, firms might trade off the increasing agency and bankruptcy costs associated with high debt with the tax benefits of increased leverage.

An alternative explanation of capital structure is based on asymmetric information between investors and firm's insiders. Managers may choose a high debt-equity ratio in order to signal the good financial health of the firm. A high leverage would credibly convey the signal that the firm faces a low risk of bankruptcy. Finally, the pecking order theory of financing argues that firms will seek to avoid the higher cost of external debt and the dilution of equity capital associated with new equity issue. Firms will finance new investment internally in the first instance; once internal sources of finance are exhausted they will issue low-risk debt, and only as a last resort will they choose to issue new equity.

The empirical literature on corporate finance has identified a number of potential determinants of the capital structure choice. These determinants include profitability, size, growth opportunities, asset tangibility, non-debt tax shields, and volatility or business risk (see Titman & Wessels, 1988, Harris & Raviv, 1991). Profitability should have a negative effect on leverage according to the pecking order theory of capital structure. Bigger firms could face a lower risk of default than smaller firms because of the greater diversification of their investment. Furthermore, larger firms could have easier access to capital markets, and could borrow under better conditions than small firms. We would therefore expect a positive effect of firm size on debt. Growth opportunities can be seen as non-collateralizable assets: firms with sizeable growth opportunities may find it more difficult to borrow externally because of the asset substitution effect (Titman & Wessels, 1988). By contrast, a greater share of tangible assets should have an unambiguously positive effect on leverage because the assets can be used as collateral for loans. Non-debt tax shields, such as depreciation allowances, should have a negative influence on leverage because they reduce the incentive to issue external debt (DeAngelo & Masulis, 1980). Finally, volatility or business risk could be associated with the potential cost of financial distress, and should have a negative effect on leverage.

In our empirical analysis, we examine the determinants of the debt-equity ratio of firms (LEV), the interest coverage ratio (ICR) defined as the ratio between EBITDA and interest expense, the debt-earnings ratio (DTE), and Altman's Z-score (ZALT). The regression variables are

computed from the S&P Capital IQ database and include Chinese company panel data from 2009 to 2015.⁷

3.1. Panel Fixed Effects

Table 1 presents the results of estimating the model by panel fixed effects.⁸ The first three columns report estimates for total leverage (LEV), defined as the ratio of total debt to total assets, and for both long-term leverage (LLEV) and short-term leverage (SLEV) where we consider long-term debt and short-term debt only respectively. Profitability has a negative and significant coefficient, which is consistent with the pecking order theory of capital structure. Size has a positive and significant coefficient for total leverage LEV and for long-term leverage LLEV only. Neither asset growth (GROWTA) nor earnings volatility (EVOL) is significant for any of the measures of leverage. Asset tangibility (TANG) is positive and significant for all definitions of leverage, consistent with both the agency theory and the pecking order theory. Finally, non-debt tax shields (NDTS)—calculated as the ratio of total depreciation to total assets—are statistically significant but are only negative for long-term leverage. That is, non-debt tax shields seem to shorten debt maturity.

Our findings so far are broadly supportive of the agency and the pecking order theory of capital structure, and weakly also of the signaling theory, although they would not be able to discriminate conclusively between these alternative theories.

⁷ The database and variables are described and summarized in Appendix.

⁸ Hausman tests reject the random effects specification for all the estimated equations.

<Table 1> Capital Structure of non-financial firms, panel fixed effects

Variable	Total leverage	Long-term leverage	Short-term leverage	1/ Interest Coverage Ratio	Debt/Earnings Ratio	1/ Altman-Z score
	(1)	(2)	(3)	(4)	(5)	(6)
	LEV	LLEV	SLEV	(ICR) ⁻¹	DTE	(ZALT) ⁻¹
Prof	-0.208***	-0.092*	-0.094*			
(lagged) prof				-1.548***	-30.720***	0.01
size	0.023***	0.016***	-0.004	0.060**	1.558***	
(lagged) size						0.104**
growta	0.000	0.000	0.000	0.000	0.001	
(lagged) growta						-0.001
tang	0.210***	0.083***	0.096***	-0.13	4.222	
(lagged) tang						0.212
evol	0.000	0.000	0.000			
(lagged) evol				0.003	0.071	0.001*
ndts	0.545*	-0.365*	0.686**	2.374*	-42.104	
(lagged) ndts						-4.042
C	0.011	-0.041	0.116***	-0.009	-3.173	-0.199
N	6881	6881	6881	6751	6751	6747
Number of groups	983	983	983	983	983	983
R-squared	0.186	0.21	0.029	0.053	0.085	0.007
F-statistic	29.652	14.219	9.694	17.105	14.534	8.083
Hausman	36.37***	43.94***	52.38***	64.41***	57.83***	14.48*

Note: * p<0.05, ** p<0.01, *** p<0.001. Standard errors are robust and allow for intergroup correlation.

Regression variables are computed from S&P Capital IQ data, and include Chinese company data from 2009 to 2015.

Columns (4) to (6) of Table 1 examine potential determinants of key indicators of financial fragility of firms. Column (4) reports the results of estimating the equation for the inverse of the interest coverage ratio (ICR)⁻¹. Values of ICR less than one indicate that current earnings fall short of the interest expenses which are due, and therefore low values of ICR (or high values of its inverse (ICR)⁻¹) are an indicator of financial distress. Profitability and earnings volatility have been lagged to avoid potential endogeneity with the dependent variable. The fixed-effects estimates show that lagged profitability has a negative effect and non-debt tax shield a positive effect as expected. Size has a positive effect, which is consistent with its positive influence on leverage.

Column (5) of Table 1 looks at the debt-earnings ratio (DTE) as the dependent variable. This ratio too is used as an indicator of the potential financial distress of companies.

Profitability and earning volatility have again been lagged to avoid endogeneity. The only significant variables are profitability and size, with a negative and a positive coefficient, respectively, as expected.

Finally, column (6) gives the results of estimating the determinants of the inverse Altman's Z-score, (ZALT)⁻¹. The Z-score is a weighted average of five ratios: (i) working capital / total assets; (ii) retained earnings / total assets; (iii) earnings before interest and taxes / total assets; (iv) the market value of equity/ the book value of total liabilities; and (v) sales / total assets (Altman 1968). It is usually interpreted as a predictor of the probability that the company will go into bankruptcy within two years. High values of the inverse Z-score can thus be read as indicating low bankruptcy risk. All the regressors are lagged one period in the fixed effect regressions to avoid simultaneity bias. Among the statistically significant variables, size has a large

and positive coefficient, which indicates that size is associated with a lower probability of bankruptcy. Earnings volatility also has a positive and significant coefficient, but its effect is relatively modest in absolute value.

3.2. Quantile Regression Panel Data

The estimates in Table 1 allow for firm-specific, time-invariant fixed effects α_i to capture the unobserved heterogeneity across firms in the response of the dependent variable to the conditioning variables. A potential shortcoming of this approach is that it assumes a common response of the dependent variable to the explanatory variables for all firms. This can be a strong assumption, since the response of the dependent variable could be different across the distribution of firms. For example, variables such as the size of the firm or the share of tangible assets could play a different role depending on whether the firm is already highly leveraged or not. In this case, a more suitable approach to estimating the response of the dependent variables to the conditioning variables across the whole distribution of firms is to estimate the model by quantile regression (Koenker & Basset, 1978). Quantile regression estimation allows for different values of the regression coefficients across the different quantiles of the distribution of firms, and is therefore able to capture non-linearities in the response of the dependent variable to its determinants⁹.

Quantile regressions with fixed effects for panel data presents however the difficulty that quantile estimators with additive fixed effects may not have the same interpretation as cross-sectional regressions. The reason for this is that, using conventional notation, the distribution of $(Y_{it} - \alpha_i)|X_{it}$ is not order-isomorphic to the distribution of $Y_{it}|X_{it}$: an observation which lies in one of the low quantiles of the distribution with respect to Y_{it} may lie in one of the top quantiles of the distribution with respect to $(Y_{it} - \alpha_i)$, and *vice versa*. This creates difficulties for the interpretation of panel quantile regressions with additive fixed effects, since the results cannot be understood in the same manner as cross-sectional regressions.

The estimator developed by Powell (2014) is able to address this concern, and to yield estimation results which can be interpreted in the same manner as cross-sectional regressions. The regression outcomes are modeled as:

$$(1) Y_{it} = X'_{it}\beta(U_{it}^*)$$

where $U_{it}^* \sim U(0,1)$ and where $X'_{it}\beta(\tau)$ is strictly increasing in $\tau \in (0,1)$. The outcomes in (1) can be compared with other quantile estimators by setting $U_{it}^* = f(\alpha_i, U_{it})$. The causal effect of a change in the conditioning variable from x_1 to x_2 for a given τ is:

$$(2) x'_2\beta(\tau) - x'_1\beta(\tau)$$

where τ denotes the quantile of the distribution. Using (2), we can define the structural quantile function (SQF) for equation (1) as:

$$(3) S_Y(\tau|x) = x'\beta(\tau)$$

The identifying assumption for additive fixed effects models is the following:

$$(4) U_{it}|(X_{it}, \alpha_i) \sim U(0,1)$$

Powell's (2014) Quantile Regression Panel Data (QRPD) estimator relaxes (4), and only requires the weaker identification assumption:

$$(5) U_{it}^*|X_i \sim U_{is}^*|X_i \quad t, s = 1, 2, \dots, T$$

The SQF for the additive fixed effect model is $\alpha_i - x'\beta(\tau)$, whereas the SQF for the QRPD model is $x'\beta(\tau)$. As a result, the interpretation of the τ -th quantile for the QRPD is the same as for the cross-sectional distribution (or equivalently for the pooled quantile regression).

⁹ Fattouh et al. (2005, 2008) use quantile regression to study capital structure in the Republic of Korea and in the United Kingdom respectively.

<Table 2> Capital structure of non-financial firms, Quantile Regression Panel Data (QRPD)

Total Leverage					
Variable	5 th	25 th	50 th	75 th	95 th
prof	-0.105	-0.241	-0.232	-0.283**	-0.335
size	0.162***	6.189	0.057	0.023*	0.040
growta	0.000	0.000	0.000	0.000	0.000
tang	0.100	1.433	0.250	0.186***	0.091
evol	0.000	-0.001	0.000	0.000	0.000
ndts	0.496	2.488	0.784	0.526	0.427
N	6881				
No. of groups	983				
Long-term Leverage					
Variable	5 th	25 th	50 th	75 th	95 th
prof	0.000	-0.006	-0.005	-0.009	-0.160
size	0.247	0.012*	0.029***	0.044***	0.037
growta	0.000	0.000	-0.000***	0.000	-0.000***
tang	0.002	0.037**	0.082***	0.111**	0.177
evol	-0.001	0.000	0.000	0.000	0.029
ndts	0.066	-0.057	-0.223	-0.251	-0.047
N	6881				
No. of groups	983				
Short-term Leverage					
Variable	5 th	25 th	50 th	75 th	95 th
prof	-0.028	-0.140	-0.108	-0.255**	-0.343
size	0.229	5.029	0.035*	-0.008	-0.008
growta	0.000	-0.001	0.000	0.000	0.000
tang	0.011	0.025	0.019	0.044	0.042
evol	0.000	-0.002	0.000	0.000	0.001
ndts	0.111	0.319	0.896	1.987***	0.789
N	6881				
No. of groups	983				
1/ Interest Coverage Ratio					
Variable	5 th	25 th	50 th	75 th	95 th
(lagged) prof	-0.038	-0.179***	-0.641***	-0.904***	-0.043
size	0.001	0.024***	0.021	0.021	0.040
growta	0.000	0.000	0.000	0.000	0.000
tang	0.008	0.016	0.038	0.021	-0.046
(lagged) evol	0.000	0.000	0.001	0.002	8.185***
ndts	0.334	0.442*	0.116	-0.096	-0.448
N	6751				
No. of groups	983				
Debt/Earnings Ratio					
Variable	5 th	25 th	50 th	75 th	95 th
(lagged) prof	-0.332	-6.904*	-11.654***	-17.648***	-24.964***
size	7.527***	0.736	1.044***	1.256	1.061
growta	-0.001	-0.001	-0.001	0.008	-0.005
tang	1.768	1.955*	2.368***	2.532**	10.328
(lagged) evol	0.002	0.007	0.016	0.019	0.368
ndts	-1.324	-9.140	-14.305	-24.029	-41.029
N	6751				
No. of groups	983				
1/ Altman-Z score					
Variable	5 th	25 th	50 th	75 th	95 th
(lagged) prof	-0.210	-0.622***	-0.780***	-0.864***	-0.810
(lagged) size	9.591	0.053***	0.076	0.091***	0.081
(lagged) growta	0.000	0.000	0.000	0.000***	0.001
(lagged) tang	0.072	0.126***	0.186***	0.216**	0.273
(lagged) evol	0.010	0.000***	0.000	0.001	0.156
(lagged) ndts	-0.010	0.222	0.151	0.753	3.379
N	6747				
No. of groups	983				

Note: * p<0.05, ** p<0.01, *** p<0.001

Table 2 reports the results of quantile regression panel data estimation for our sample of non-financial companies. The findings reveal that the fixed-effects assumption of constant regression coefficients across the distribution of firms is not generally confirmed by the data. The estimated coefficients often vary across quantiles, although it is difficult to discern a clear pattern in the data across all the financial variables. Regarding capital structure, some of the strongest results are obtained for long-term leverage. Both size and the share of tangible assets are positive and statistically significant over the central quantiles of the distribution, with the first result consistent with the signaling theory of capital structure and the second with collateralizable assets ceasing to be relevant for firms with a very low or a very high leverage.

Lagged profits exert a strong and significance influence on financial ratios. The estimated coefficients are negative and significant for the inverse of ICR and for DTE, and increase in size for the upper quantiles of the distribution: higher profits therefore reduce the financial fragility of firms. They however increase the overall risk of bankruptcy as measured by the Z-score, which may also be consistent with signaling theory. Size tends to be associated with high debt-earnings ratios for firms in the left tail of the distribution and with lower Z-scores for firms in the central quantiles of the distribution. A higher share of tangible assets tends to be associated with larger debt-earnings ratios but with lower Z-scores.

The QRPD estimations illustrate that the assumption that regression coefficients are constant across the distributions

of firms may not be valid. The effects of the regressors on the debt-equity ratios or on financial ratios can be different in the middle ranges of the distributions of firms and on the tails. The findings from QRPD tend to be more supportive of signaling theories of capital structure than the fixed-effects estimates would suggest.

3.3. Simultaneous Panel Quantile Regressions

The Quantile Regression Panel Data approach of Section 3.2 has the advantage of being directly comparable to

cross-sectional quantile regression estimations in the interpretation of the regression coefficients, because of the weaker identifying assumption (5). Estimation by QRPD however still requires that the coefficients remain constant over time. DeAngelo and Roll (2015) found evidence that firm leverage exhibits significant variability over time. It is important therefore to investigate whether the responses of the dependent variables to their determinants vary along the economic cycle or over time. If this proves to be the case, then the assumption of constant coefficients would not be valid.

<Table 3> Capital structure of non-financial corporations: simultaneous panel quantile regressions (by year)

Dependent variable: Total Leverage (LEV)

Quantile	Variable	2009	2011	2013	2015
5 th	Prof	0.014	-0.178*	-0.285	-0.428***
	Size	0.002	0.012**	0.013***	0.014***
	Growta	0.000	0.000	0.000	0.000
	Tang	0.161***	0.168***	0.185***	0.141***
	Evol	0.000	0.001	0.001	0.000
	Ndts	0.088	-0.099	0.481	0.294
	C	-0.039	-0.082**	-0.099***	-0.090**
25 th	Prof	-0.281**	-0.461***	-0.620**	-0.722***
	Size	0.000	0.021**	0.021***	0.026***
	Growta	0.000	-0.001	0.000	0.000
	Tang	0.329***	0.282***	0.269***	0.282***
	Evol	0.000	0.000	0.000	-0.001
	Ndts	0.404	0.164	0.100	-0.135
	C	0.020	-0.075*	-0.060	-0.103*
50 th	Prof	-0.391***	-0.546***	-0.506***	-0.868***
	Size	0.002	0.035***	0.036***	0.039***
	Growta	0.000	0.000	-0.001*	0.000
	Tang	0.372***	0.294***	0.295***	0.279***
	Evol	0.000	0.000	0.000	0.000
	Ndts	0.394	0.858	0.229	0.159
	C	0.088*	-0.094***	-0.093**	-0.104*
75 th	Prof	-0.429**	-0.578***	-0.829***	-0.781***
	Size	0.003	0.026***	0.035***	0.050***
	Growta	0.000	-0.001	-0.002*	0.000
	Tang	0.339***	0.272***	0.244***	0.260***
	Evol	0.001	0.000	0.000	-0.001
	Ndts	0.978	1.248**	1.102	0.710
	C	0.173***	0.055	0.033	-0.100*
95 th	Prof	-0.678***	-0.731***	-1.117**	-1.051***
	Size	0.006	0.029***	0.033***	0.041***
	Growta	0.000	0.000	0.001	0.000
	Tang	0.229*	0.097	0.150***	0.062
	Evol	0.001	-0.001	0.000	-0.001
	Ndts	0.447	1.733***	1.154***	0.462
	C	0.386***	0.272***	0.246***	0.233**

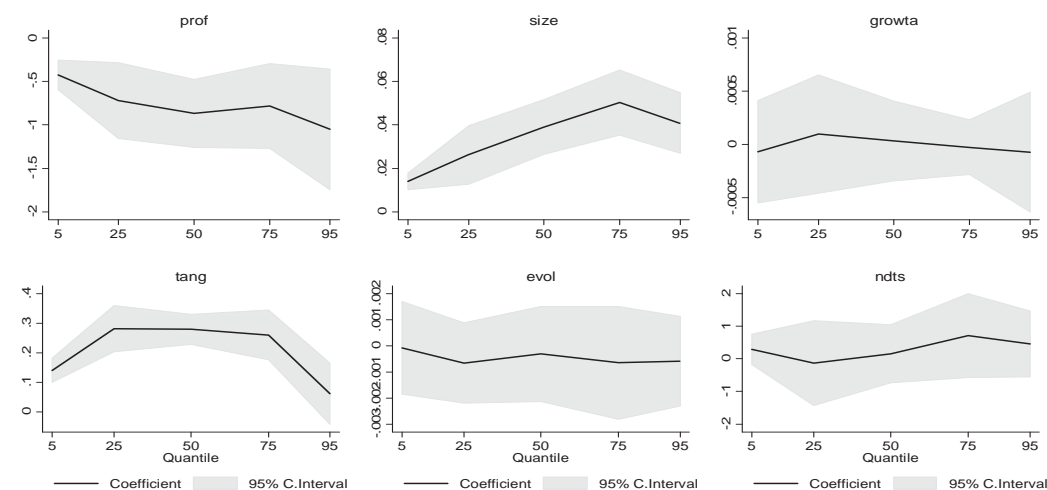
F-test on equality of coefficients					
Prof	7.119***	4.598**	2.874*	2.711*	
Size	0.247	4.537**	17.779***	13.064***	
Growta	0.628	0.495	1.883	0.331	
Tang	5.971***	6.174***	2.546*	4.168	
Evol	0.850	7.059***	3.223*	0.104	
Ndts	0.918	3.030*	1.675	0.358	
N	983	983	983	983	

Note: * p<0.05, ** p<0.01, *** p<0.001.

Table 3 shows the results of simultaneous panel regressions on total leverage for selected years from 2009 to 2015. Compared to QRPD, these estimations reveal that the effects of the explanatory variables on the response variables tend to vary over time, as well as across quantiles. For each year, the null hypothesis that the coefficients are constant across the distribution is often rejected by F tests. Profitability attracts a negative and significant coefficient which becomes larger in absolute value over time. Size is only significant for the more recent periods, whereas the effects of tangibility tend to be positive and significant across all time periods.

Similar results hold for long-term debt, where however profitability tends to play a less significant role, and for short-term debt. Lagged profitability also tends to exert an increasingly important role for the inverse of the interest coverage ratio ICR and for the debt-earnings ratio DTE. The influence of the share of tangible assets too becomes more significant in the more recent period. A strong cyclical effect appears to be present in the coefficients on the inverse Z-scores, with the coefficients for profitability and tangible assets increasing during the middle years of the sample for the central quantiles and then declining towards the end of the sample period.

Dependent variable: Total Leverage (lev) in 2015



Source: Authors' calculations based on S&P Capital IQ

<Figure 10> Simultaneous panel quantile regressions (dependent variable=lev; year=2015)

Figure 10 illustrates the changing values of the regressions coefficients for total leverage across quantiles of the distribution in 2015, the last year of the sample. In particular, the influence of profitability tends to increase in

absolute value for the top quantiles of the distribution and the influence of size tends to increase, whereas tangibility displays an inverted U-shaped pattern.

The combined results from QRPD and simultaneous panel regressions indicate that the assumptions of constant coefficients across firms and over time may not be valid for Chinese non-financial firms. A number of coefficients increase in size over time pointing to increased sensitivity of debt ratios to some of their determinants in recent years. This can be a potential cause for concern, since a deterioration in the variables which act as a restraining influence on debt ratios could see even greater increases in the leverage of Chinese corporations.

In particular, the simultaneous panel quantile regressions show that the role of profitability in reducing debt levels has grown in importance in the more recent period. At the same time, non-financial corporations have experienced a decline in their profitability in the more recent years. A reason for this finding can be traced to the aggressive intervention by Chinese policy authorities in the aftermath of the global financial crisis. The significant decline in the lending rate since 2008 has reduced the opportunity cost of external debt relative to retained earnings as sources of funding, thereby increasing firms' incentive to borrow in preference to internal sources of finance. Together with the decline in profitability over the same period, the decline in the opportunity cost of debt resulted in a heightened sensitivity of the firm capital structure to earnings.

The joint effect of the increased role of profitability for leverage and of the decline in profitability itself is thus likely to lead to larger debt ratios in the coming years. This result is of relevance for the future financial sustainability of Chinese firms. It is important to note that this conclusion could not have been obtained from an aggregate analysis of financial variables nor from a conventional fixed effects analysis, since it only emerges from a simultaneous quantile analysis where the regression coefficients are allowed to change over time.

4. Conclusions

Ever since the Chinese government chose to implement a large stimulus to support the economy in the wake of the financial crisis of 2008-09, corporate leverage has experienced a steep and sustained increase. The ratios of total debt and of credit to GDP have increased at the same time as corporate returns and interest coverage ratios have been weakening, raising concerns about growing systemic vulnerability within the Chinese financial system.

Based on the analysis of aggregate data, there is no clear evidence yet of weakening corporate performance onto the

Chinese financial sector. To an extent, this reflects the predominance of SOEs in the Chinese corporate landscape, and authorities' control over the financial system and its major players and institutions. Such a controlled environment has the ability to contain or delay the spillover of financial distress from the corporate to the financial sector for some period of time, but not indefinitely. Ultimately, growing systemic pressure constitutes a contingent liability to the state, and its realization would come to bear heavily on the public budget and debt ratios.

This paper assessed corporate sector fragility through panel regressions that relate leverage and other financial indicators to the determinants of capital structure, such as companies' size and profitability. The rationale for quantile regression analysis—of which we implement also the panel approach developed recently—is that it picks up vulnerabilities not just at the mean or median of the distribution, but also for the more marginal firms, which are those most exposed to negative shocks. Indeed, our analysis confirms that the sensitivity of leverage to its determinants varies across quantiles, with some areas of the distribution being affected much more strongly than others. We also find that some of the estimated coefficients have increased substantially in absolute size over time.

In particular, we find that profitability has a restraining effect on corporate leverage, the intensity of which has risen sharply over recent years. Possibly, this can be explained by a significant decline in lending rates in the wake of the massive stimulus program, which increased Chinese firms' incentive to borrow instead of relying on retained earnings as a source of finance. Against the backdrop of deteriorating profitability, this resulted in firms' heightened sensitivity of the capital structure to earnings. Ultimately, this finding raises some concern about the recent downward trend in corporate firms' profitability, because it implies that firms could react by taking on even larger levels of debt in the future. An uptick in corporate profitability in 2016—reflected in the latest data release but not in the above analysis—provides some relief in this regard.

In sum, the findings in this paper seem to confirm our hypothesis that financial sector based on aggregate indicators tend to overlook the increased vulnerability of the marginal non-financial firms in the Chinese corporate sector. The fragility of the system tends to be underestimated as a result, and may provide a sense of complacency about the stability of the Chinese financial system which is unwarranted in view of continuing weakness in the corporate system.

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Appendix : The S&P Capital IQ Database and Regression Variables

Variable	Description	Measurement
LEV	Total leverage	Ratio of total debt to total assets
LLEV	Long-term leverage	Ratio of long-term debt to total assets
SLEV	Short-term leverage	Ratio of short-term debt to total assets
ICR	Interest Coverage Ratio	Ratio of EBITDA (earnings before interest, taxation, depreciation, and amortization) to interest expense
DTE	Debt-to-Earnings	Ratio of total debt to EBITDA
ZALT	Altman's Z-score	The Z-score is a weighted average of five ratios: (i) working capital / total assets;(ii) retained earnings / total assets;(iii) earnings before interest and taxes / total assets;(iv) the market value of equity/ the book value of total liabilities; and (v) sales / total assets.
PROF	Profitability	Ratio of EBITDA to total assets
SIZE	Size	Natural logarithm of total assets
GROWTA	Growth opportunities	Ratio of revenue growth to total assets growth
TANG	Tangibility	Ratio of net property, plant, equipment and inventory to total assets
EVOL	Earning volatility	Change of operating income (absolute value of first differences)
NDTS	Non-debt tax shields	Ratio of depreciation and amortization (EBITDA-EBIT) to total assets

Note: As of November 2016, the S&P Capital IQ database¹⁰ covers more than 45,000 active companies—spanning 130 countries and several currencies. It also provides financial statement data for more than 800,000 private companies. Data on fundamentals cover equities, fixed income, capital structure, credit ratings, transactions, private equity firm profiles, ownership, and business relationships. It is accessible with a subscription: <https://www.capitaliq.com/>

For this study, we downloaded data for all private and public firms geographically located in the PRC that are considered operating as of September 2016. This includes 36 financial ratios, 24 standardized balance sheet and income statement items, as well as 10 indicators specific to banks. The data run from 1990 to 2015 and are expressed in US\$ millions, based on the platform's historical exchange rates.

For regression analysis, we retained data from 2009 to 2015 only and computed variables as described in the above table.

¹⁰See S&P Capital IQ Fundamentals. http://marketintelligence.spglobal.com/documents/products/SPCIQ_Fundamentals_v2.pdf and The S&P Capital IQ® Platform.http://marketintelligence.spglobal.com/documents/products/SPCIQ_Platform_v2.pdf