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Does firm efficiency matter for debt financing decisions? Evidence from the biggest manufacturing countries

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ABSTRACT

The paper examines the relationship between debt financing and firm efficiency and the moderating role of liquidity holding. We focus on countries that have strong manufacturing industries, specifically China, Germany, India and Japan. The study shows that the firms' efficiency relates positively to short-term and negatively to long-term debt financing. We document that companies with high productivity are likely to generate high cash flows and have more short-term financing capacity. On the contrary, high efficiency reduces the long-term borrowing since the short-term and internal financing are substitute for the external long-term capital. Besides, the results indicate that high short-term solvency weakens the relationship between the firms' efficiency and their long-term debt financing. Our paper suggests that a firm's capital structure is affected by different factors including the firm's efficiency. Therefore, in their debt financing decisions, managers should consider the firm's productivity level among other factors.

ARTICLE HISTORY

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KEYWORDS

Debt financing: firm efficiency; short-term solvency; capital structure theories

1. Introduction

Whereas corporate finance theories and some recent studies (Hassan & Samour, 2016; Huang & Song, 2006; Khémiri & Noubbigh, 2018; Le & Phan, 2017; Li & Islam, 2019; Memon, Rus, & Ghazali, 2015) explained the relationship between firm performance and capital structure, we choose to revisit this notion with different perspectives for the following reasons. First, prior studies show conflicting results on the association between firm performance and its capital structure choices. Extant literature show both negative (Baker & Wurgler, 2002; Bastos, Nakamura, & Basso, 2009; Drobetz & Wanzenried, 2006; Fama & French, 2012; Hall, Hutchinson, & Michaelas, 2004; Rajan & Zingales, 1995; Titman & Wessel, 1988; Yang, Lee, Gu, & Lee, 2010) and positive (Antoniou, Guney, & Paudyal, 2009; Espinosa, Maquieira, Vieito, & González, 2012; Huang & Song, 2006; Memon et al., 2015; Murray & Vidhan, 2009) relationship between firm capital structure and firm performance. This motivates further studies that adopt alternative indicators for firm performance.

Second, we represent performance by measures of firm efficiency and disaggregate debt financing decisions into two dimensions: short term and long term. Theories have

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different empirical implications with regard to different types of debt instruments. Accordingly, we analyze how firm efficiency relates to short-term, long-term and aggregate measures of debt. This provides added value to the analysis of the capital structure-performance nexus. The relationship between efficiency and debt financing decisions may depend on the type of debt financing. This is because short-term and long-term debts entail different costs and benefits to a firm. Recent studies also show that the nature and maturity of borrowing affect the persistence and strength of the relationship between borrowing and its determinants (Daskalakis, Balios, & Dalla, 2017).

Last but not least, the present study shows the moderating role of liquidity for the link between capital structure and efficiency. This is important for capturing the effect that short-term solvency risks put on the connection between financial leverage and firm performance. In addition to these, the paper uses data of countries that have the biggest share in the manufacturing industry. Our analysis includes firms from China, Japan, Germany and India. These countries cover a broad spectrum of the manufacturing industry in the world other than the United States. The choice of the countries is motivated by their leading positions in the manufacturing industries and their reputable manufacturing experiences with high concern for efficiency. We choose to exclude US manufacturers from the study sample because other recent studies have examined the topic with a primary focus on the United States (see for instance, Fama & French, 2012; Huang, Jiang, & Wu, 2018). Accordingly, with a panel data of listed production companies in the biggest manufacturing countries, the paper aims to show how firm efficiency relates to debt financing decisions and the moderating role of short-term solvency. We estimate efficiency using stochastic frontier true random effect (SF TRE) model, a model that disentangles time-varying inefficiency from firm-specific unobserved heterogeneity (Greene, 2005).

An important contribution of our paper is the variable that we apply as firm-specific determinant of capital structure. To researchers' knowledge, efficiency as a determinant of financing decision has not been sufficiently analyzed with empirical data. We show how firm productivity relates to the debt financing decisions and empirically tested the capital structure theories with this perspective. We document that firm efficiency relates to its financing choices according to the different debt financing sources, the shortmaturity and the long-maturity debts. The efficiency relates positively to the total debt and the short-term debt but negatively to the long-term debt. Our paper furnishes evidences in support of agency cost theory and pecking order theory, in the short-term and long-term financial structure, respectively. Generally, the pecking order theory dominates in our finding since the long-term financing is more important for the capital structure theories. Besides, other explanatory variables such as ROA and cash flows have negative relationship with debt financing supporting the pecking order view. Couple of studies (Barclay & Smith, 2005; Carmen & Joseph, 2009; Fama & French, 2005) also state that capital structure theories may not be exclusive but rather complementary. Thus, this paper shades light to the capital structure theories, with tests that focus on the split of debt financing between short term and long term.

The rest part of this paper is structured as follows. Section 2 explains the link between debt financing decisions and a firm's efficiency. This section also presents the hypotheses that our study aims to test. In section 3, we describe the data, estimation procedures and

the methodology of the present study. Section 4 presents results and discusses their implications. Section 5 provides concluding remarks.

2. Theory and hypothesis

Trade-off theory and pecking order theory are at the front line when it comes to theorizing capital structure decisions, which began to be popular after the Modigliani and Miller (1958) theory. These two prominent theories of capital structure provide opposing predictions on the relationship between firm performance and financing decisions. The trade-off model argues that profitable firms use more debt financing in their capital structure than unprofitable firms do. When firms perform better, the probability of financial distress declines (Kraus & Litzenberger, 1973) and thus, they are in a better position to use high debt capital. Besides, companies with higher earnings are more likely to use debt to take advantage of interest tax shields. On the contrary, the pecking order theory claims that higher financial performance should lead to less use of debt capital. Myers and Majluf (1984) suggest that companies in need of funds for investment prefer to apply internal capital first, followed by new debt, and finally new issues of equity. When earnings are higher, firms obtain more retained earnings available to finance investments. Consequently, they do not need to employ more leverage to finance the investment projects. Mina, Lahr, and Hughes (2013) also found that the probability of seeking external finance is significantly and negatively affected by the profitability of the firm. Accordingly, in times of high profitability, firms may tend to retain their earnings rather than issuing risky securities.

2.1. Firm efficiency and long-term debt financing

When using debt capital, firms gain advantages in various ways through providing tax shield (Modigliani & Miller, 1963), minimizing agency problems between firm managers and shareholders (Jensen & Meckling, 1976), and transmitting positive signals regarding firm productivity since managers possess inside information about the future productivity gains of the firm (Stephen Ross, 2012). However, the use of debt also leads a firm to incur costs related to potential bankruptcy. As the proportion of debt in the capital structure increases, the probability that the firm suffers bankruptcy becomes more. Higher default probabilities cause financial distress (Joseph & Andrew, 1981; Myers, 1977). Thus, a firm's long-term borrowing depends on the benefit it gains from the longterm debt and bankruptcy costs arising because of such borrowing. Companies borrow less if they are exposed to high probability of bankruptcy. Lenders also evaluate the credit worthiness of companies and do not grant loans for potentially bankrupt business. The implications of bankruptcy costs go beyond the firms that actually gone bankrupt because it affects the behavior of all of the firms in the economy, not just those that have gone bankrupt (Alcock, Finn, & Tan, 2012). Among other things, firm inefficiency is one of the important factors that put a firm into state of financial distress. High efficiency gives positive signals and shows the quality of firm to creditors. This, in turn, lowers firm's cost of debt financing, leading to a positive relationship between financial leverage and firm efficiency. On the other hand, pecking order theory argues that firm performance has negative relationship with the level of debt financing. This theory claims that

there exists hierarchy of financing where internal financing gets the preference, followed by debt financing and equity issuance is used as a last resort. Accordingly, efficient firms may rely less on debt capital since they can generate more internal capital.

H1: A firm's efficiency relates to the level of long-term debt either positively if trade-off theory empirically dominate or negatively if pecking order theory.

2.2. Firm efficiency and short-term financing

We build our premise with the logic that the factors that determine the amount of longterm debt financing a firm uses also affect the amount of short-term debt financing it applies. For instance, firms encounter financial distress due to short-term debts (shortterm insolvency) and long-term debt (bankruptcy) although the consequences may slightly vary. The use of short-maturity debt has the potential to reduce the agency problems associated with free cash flow (Stulz, 2000). By holding short-term claims on a project's cash flow, creditors have a strong position in determining whether the project continues. To mitigate the agency costs of managerial discretion, productive companies might use more short-maturity debt.

Short-term borrowing may affect firms' financial flexibility and increases their exposure to liquidity shocks (Almeida & Campello, 2007; Campello, Graham, & Harvey, 2010). There are at least two sources of risk associated with continually refinancing shortterm debt; default risk and interest rate risk. Since shorter debt maturity requires the firm to refinance frequently, it increases the firm's refinancing failure costs (Huang et al., 2018). Lenders do not wish to refinance the firm's short-term debt when it matures unless the prior loans are efficiently used and repaid on time. Thus, the threat of insolvency and the requirements of lenders motivate managers for achieving high organizational productivity. Besides, efficient firms can easily get trade credits because they are better candidates for raising spontaneous financing from vendors. This is because trade creditors also evaluate the creditworthiness of their customers when supplying goods and services on account. Generally, managerial efficiencies enhance organizational shortterm financing ability and we predict positive relationship between them. Thus, we set the hypotheses given below.

H2: Firm efficiency positively relates to its use of short-term financing.

2.3. The moderating roles of firm's short-term solvency

Studies (see, for instance, Coleman, Maheswaran, & Pinder, 2010) show that cash-flow volatility and financial flexibility are the most important determinants of debt levels. We assume that firms mitigate inefficiencies by managing their current assets holdings and that financing decisions integrate risk of refinancing and resource management efficiency. In the presence of excess liquidity, firms may decide to repay outstanding debts instead of extra borrowing. If funds are needed for investment, where the cash flows are high, managers incline to apply the internal capital instead of using debt financing. Similarly, although their firms have borrowing capacity and access for debt capital, managers also consider the liquidity holding before going for long-term borrowing.

Managers prefer to apply the accumulated internal funds for investment opportunities when liquid asset holding, relative to the short-term financial obligations, becomes high. Moreover, under the situation where short-term solvency is high and the risks of technical insolvency are low, firms may substitute short-term financing for long-term debt to enhance working capital efficiency. On the other hand, if financial flexibilities are high, firms may also make arrangements that lead to matching their capital structure with financial flexibility level. They are expected to undertake adjustments towards the desired capital structure level. Accordingly, firms with high productivity may increase financial leverage because they can tolerate more financial risks when the insolvency risks are low. This in turn affects the relationship between financial leverage and firm efficiency. Even though efficiency boosts firm's borrowing capacity and transmits positive information to creditors who provide loans, how it relates to the long-term debt financing decision is still contingent on the need for short-term solvency. Consequently, we state the hypothesis given below.

H3: Liquidity moderates the relationship between a firm's use of financial leverage (long-term debt) and its efficiency.

3. Data and methodology

3.1. Data

We obtained the data from the COMPUSTAT Database. We took the sample data of listed manufacturing firms in four countries over the period 2007–2017. The countries considered in the study are China, Japan, Germany and India, countries that are the biggest manufacturers in the world other than the USA. We excluded manufacturing firms from the USA from our sample because most studies in the area have already examined the case of the USA. We filtered the manufacturing firms from the rest of the firms in COMPUSTAT database and identified the industry subsector of the firms based on the Standard Industry Code (SIC). Our sample excludes observations that lack information about the inputs, i.e., capital invested and number of employees, and outputs needed for computing firm efficiency. All variables are winsorized at top 99% and bottom 1% to avoid the effect of extreme values. The above procedure yields a final sample of 27,260 firm-year observations, which we use to estimate the management efficiency and to examine its relationship with the financing decisions.

3.2. Variables measurement

We represent the dependent variable with three proxies: total debt ratio, short-term debt ratio and long-term debt ratio. The total debt financing is defined as the ratio of total liabilities to total assets, where the total liabilities consist of short-term debt, long-term debt and other liabilities reported in the balance sheet of the companies. The short-term debt financing is computed as debt in current liability (short-term financial debts, loans from credit institutions and part of long-term financial debt payable within the year) plus spontaneous financing (trade payable) divided by total assets. Finally, we determine the long-term debt financing by dividing the long-term debt reported in balance sheet (longterm financial debts such as loans, credits and bonds) for the total assets. The explanatory variables include firm efficiency and other firm characteristics which we insert as control variables in our models. *Annex A* shows the full definitions of the dependent and independent variables. In the next subsection, we explain how we estimate firm efficiency in the current study.

3.3. Firm efficiency

To operationalize these ideas, our model considers a firm whose production process requires a capital investment as well as effort exerted by a labor force (the workers). We gauge the efficiency using stochastic frontier analysis (SFA), true random effect (TRE) model, a frontier analysis suggested by Greene (2005). The TRE model separates timevarying inefficiency from firm-specific unobserved heterogeneity, which would have managerial implication for the firms. We choose to apply this efficiency model primarily since it enables us to handle the firm-specific time-invariant unobserved heterogeneity that would have distorted our measurement. In most frontier-based efficiency studies, capital and labor are used as input factors. Similarly, the present study applies capital invested and labor (number of employees) as inputs in the frontier model. The total revenue generated by the manufacturing firms serves as output variable in our model. First, we converted the financial values of inputs and outputs to common currency unit, USD. We also made inflation adjustment on the variables, taking the first year of study, fiscal year 2007, as base year. Cobb Douglass production function, with logged value of output and inputs, is mostly used by stochastic frontier studies. We also specify the same type of functional form. In our empirical analysis, we estimated a separate production function for each industry (as defined by the global industry classification) to account for the structural differences (e.g., in the production process or in industrial relation practices) among different sectors. The Cobb Douglass frontier function stated for the two inputs is represented in the following form.

$$\ln Y_{ft} = \alpha_f + \beta k \, \ln K_{ft} + \beta l \, \ln L_{ft} + V_{ft} + U_{ft}$$
(1)
$$V_{ft} \sim N(0, \sigma 2v), U_{ft} \sim N^+(0, \sigma 2u)$$

where
$$Y_{ft}$$
 is gross revenue of firm "f" at time "t". K_{ft} is capital invested balance in firm "f"
at the end of year "t". L_{ft} refers to number of employee in firm "f" during year "t". β is
unknown parameters to be estimated, αf is firm-specific time-invariant heterogeneity, V_{ft}
is two-sided normal error, and U_{ft} is one-sided non-negative inefficiency.

Note that, α_f represents firm-specific time-invariant heterogeneity, and U_{ft} is a timevarying inefficiency term. Greene's model assumes a two-sided normal error V_{ft} and a half-normal random term U_{ft} that represents a one-sided non-negative inefficiency term ($U_{ft} \ge 0$). The present study can evaluate the aforementioned equation by the maximum likelihood method.

We define firm efficiency within the stochastic frontier framework and the above production function as follows. To ensure that observed output lies below the stochastic frontier, we write the production function as:

$$Y_{ft} \le Exp(f(K,L)) * Exp(V_{ft})$$
(2)

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Theoretically,

$$Technical \ Efficiency = \frac{observed \ output}{potentialmaximum \ output}$$
(3)

$$Technical \ Efficiency = \frac{Exp(f(K,L)) * Exp(v_{ft}) * Exp(-U_{ft})}{Exp(f(K,L)) * Exp(v_{ft})}$$
(4)

$$Technical \ Efficiency = Exp(-U_{ft}) \tag{5}$$

Table 1 presents the parameter estimates obtained from SF panel TRE model estimation of our frontier model. β_L and β_K represent the coefficients for labor (number of employees) and capital (capital invested), respectively. All the input and output variables are changed into their natural logarithmic form. Therefore, the first-order coefficients are interpreted as elasticities of sales revenue for changes occurred in these input factors. The estimated first-order coefficients for all inputs are positive at 1% significance level but the coefficient of capital invested looks relatively high, as manifested by large beta coefficient. This suggests that manufacturing firms revenues are more elastic to the changes that occurred on capital invested. We have also reported the summary firm efficiency statistics of the firms, which we predicted by the SF panel TRE model. Table 2 shows the summary statistics of the procedures discussed in our methodology. Once we get the inefficiency term(u) for each observation from the Stata result, we computed the firm efficiency by calculating exp[-ûit].

The average efficiency of the manufacturing industry in the entire sample, for the period under investigation, is about 0.723 (72.3%). The mean efficiency scores slightly vary across the different subsectors and countries. However, there is not much gap among the average estimated technical efficiencies of manufacturing subsectors in some of the countries. On the bottom side, firms in semiconductors industry avoid inefficiency compared to the other subsectors and the variation of efficiency in this subsector looks relatively low. On the contrary, food and beverage industries and durable goods industries are found to bear the least efficient observation and these industries scored the lowest average efficiency in the observation. Generally, the result shows that there is more variation in efficiency level among the firms included in the current study. The highest performer attained an efficiency of 0.947 (94.7%) and the least performer achieved an efficiency of about 0.010 (1%), in the full sample.

3.4. Model specification

The extant literature provides a useful guide as to which factors are likely to play a key role in explaining financing decisions (see Rajan & Zingales, 1995). In a dynamic panel data approach, we analyze how a firm's efficiency relates to the level of debt financing that the manufacturing firms apply. The following equation states the baseline model that our study aims at testing.

Table 1. 5	tochastic fi	rontier – True i	random effect	regression results.						
Frontier	Material	Capital Goods	Auto Industry	Household Durable	Food & Bev.	Household Personal	Health Equip.	Techno Hardware	Semi-Conductor	AII
In(K)	0.489***	0.444***	0.476***	0.425***	0.536***	0.299***	0.481***	0.417***	0.398***	0.432***
	(0.008)	(0.010)	(0.014)	(0.008)	(0.006)	(0.027)	(0.014)	(0000)	(0.022)	(0.004)
In (L)	0.403***	0.368***	0.359***	0.402***	0.254***	0.449***	0.478***	0.435***	0.477***	0.398***
	(0.010)	(0.007)	(0.018)	(0.007)	(0.008)	(0.025)	(0.021)	(0.011)	(0.028)	(0.005)
Intercept	7.218***	8.306***	8.078***	8.177***	7.060***	11.062***	6.530***	8.242***	8.493***	8.466***
	(0.100)	(0.167)	(0.166)	(0.109)	(0.094)	(0.392)	(0.148)	(0.116)	(0.309)	(0.076)
σu	0.235***	0.197***	0.185***	0.251***	0.233***	0.202***	0.189***	0.222***	0.180***	0.219***
	(0.005)	(0.004)	(0.006)	(0.006)	(0.007)	(0.015)	(0.012)	(0.007)	(0.020)	(0.002)
σν	0.095***	0.098***	0.080***	0.079***	0.050***	0.086***	0.044***	0.112***	0.187***	0.094***
	(0.004)	(0.003)	(0.005)	(0.005)	(0.005)	(0.010)	(0.008)	(0.005)	(0.014)	(0.002)
~	2.476***	2.019***	2.297***	3.173***	4.683***	2.339***	4.347***	1.987***	0.958***	2.319***
	(0.007)	(0.006)	(0.010)	(0.010)	(0.010)	(0.021)	(0.017)	(0.011)	(0.032)	(0.004)
Firms	1,006	1,188	295	525	340	62	65	482	113	4076
Obs.	6,294	8,122	2,148	3,314	2,199	467	450	3,428	801	27,223
Wald χ^2	22933.52	15424.03	11395.30	28695.22	16702.40	2637.85	18172.68	19,089.53	2150.98	34678.31
*** p<0.01,	** p<0.05, *	p<0.1.								

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Table 2. Sum	imary of ei	ficiency estima	ates by industry	/ subsectors.						
	Material	Capital Goods	Auto Industry	Household Durable	Food & Bev.	Household Personal	Health Equip.	Techno Hardware	Semi-Conductor	AII
China										
Mean	0.758	0.775	0.801	0.761	0.716	0.798	0.828	0.750	0.841	0.766
Std.Dev.	0.179	0.170	0.157	0.162	0.187	0.125	0.108	0.190	0.075	0.173
Obs	1136	1298	291	406	298	33	63	573	134	4232
Germany										
Mean	0.598	0.719	0.717	0.651	0.668	0.622	0.731	0.733	0.793	0.700
Std.Dev.	0.296	0.189	0.221	0.203	0.186	0.144	0.194	0.222	0.165	0.220
Obs	234	572	163	164	53	26	82	180	153	1627
India										
Mean	0.723	0.747	0.773	0.726	0.622	0.758	0.759	0.651	0.860	0.720
Std.Dev.	0.226	0.203	0.192	0.213	0.281	0.203	0.167	0.276	0.038	0.228
Obs	2083	1286	409	1122	599	102	16	220	12	5849
Japan										
Mean	0.731	0.741	0.773	0.605	0.599	0.754	0.718	0.715	0.824	0.714
Std.Dev.	0.177	0.177	0.165	0.258	0.221	0.164	0.236	0.201	0.119	0.202
Obs	2859	4966	1291	1630	1252	306	290	2456	502	15552
All countries										
Mean	0.728	0.746	0.773	0.622	0.667	0.751	0.737	0.717	0.822	0.723
Std.Dev.	0.202	0.182	0.175	0.237	0.239	0.173	0.216	0.207	0.123	0.206
Obs	6312	8122	2154	2202	3322	467	451	3429	801	27260
*** p<0.01, **	o<0.05, * p<	0.1.								

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$$Debt_{ft} = \gamma Debt_{f(t-1)} + \beta Eff_{ft} + \sum_{j=1}^{m} \alpha_j Cntr_j ft + U_{ft}$$
(6)

where, Debt_{ft} is the level of debt financing in firm "f" for period t. Debt_{f(t-1)} is the lagged level of debt financing in firm "f" for period t. Eff_{ft} is the efficiency of firm "f" in period "t". Cntr_{jft} represents control variable "j" of firm "f" in the period "t". U_{ft} is unknown term, which consists of the unobserved firm-specific effects, λ_f , and the observation-specific errors, e_{ft}. The explanatory variable of interest in the present study is firm efficiency. Other firm-specific factors (firm size, liquidity, profitability, asset tangibility, free cash flows, investment opportunity) are set as control variables.

Our paper follows system GMM estimation, abond2 estimators for testing the underlying relationship. GMM eliminates the presence of unobserved firm-specific effects by taking first differences of the variables; captures the autoregressive nature of the data used and addresses the probable endogeneity of the explanatory variables. In addition to the built-in xtabond Stata command, xtabond2 implements system GMM. Along with the standard estimation results, xtabond2 reports the Sargan/Hansen test, Arellano–Bond autocorrelation tests, and various summary statistics.

4. Result

4.1. Summary statistics

Table 3 reports the summary statistics of the proxies of the main variables and other important factors in the present study. The total debt ratio (TD) is a financial ratio that indicates the level of debt applied by a business entity relative to the total assets of the entity. The average TD in the entire sample of manufacturing industry is 0.489 (48.9%), with more short-maturity debt proportion (14.9%) compared to the long-term debt (10.7%). Debt financing and firm efficiency slightly differ across the countries. On average, Chinese firms look relatively more efficient and less leveraged. It is common to measure short-term solvency by using cash ratios (a liquidity ratio) and cash holdings. Cash ratio indicates the ability of the company to meet its short-term obligations using the cash available. The average cash ratio for all sample data of the manufacturing

	China	Germany	India	Japan		All cou	ntries	
Variable	Mean	Mean	Mean	Mean	Mean	Std. Dev.	Min	Max
TD	0.420	0.539	0.543	0.482	0.489	0.207	0.073	0.955
LTD	0.049	0.125	0.132	0.081	0.090	0.107	0.000	0.510
STD	0.256	0.154	0.281	0.247	0.250	0.149	0.010	0.664
Eff.	0.766	0.700	0.720	0.714	0.723	0.205	0.010	0.947
TATO	0.614	1.070	1.075	1.016	0.970	0.478	0.109	2.695
ROA	0.047	0.062	0.079	0.044	0.053	0.063	-0.149	0.268
Cash Ratio	1.035	0.775	0.450	0.820	0.771	1.144	0.007	7.193
Cash Holding	0.215	0.157	0.088	0.177	0.163	0.129	0.003	0.606
Cash Flow	0.048	0.071	0.067	0.056	0.058	0.070	-0.169	0.271
Firm Size	19.876	20.328	17.507	20.093	19.518	1.975	10.266	26.871
Tangibility	0.256	0.216	0.349	0.284	0.289	0.159	0.010	0.730
Investment	0.045	0.049	0.060	0.035	0.043	0.042	0.000	0.230
Life Cycle	0.148	0.153	0.214	0.292	0.244	0.270	-1.009	0.809

Table 3. Descriptive statistics.

*** p<0.01, ** p<0.05, * p<0.1.

industries is 0.771 times and there exists high variation of liquidity among the firms as indicated by large standard deviation (1.144 times). There is also more disparity in the cash holding, ranging from 0.003 to 0.606, among the firms comprised in the study. Although we have not reported the table here, analysis of the correlation among independent variables shows that multicollinearity is not a serious issue in our study, as the coefficients are not that much larger. Most importantly, we find that the correlations between firm efficiency and liquidity measures are not significant. The two related measures of firm performance, ROA and efficiency, have a positive correlation coefficient of about 0.171. Although this coefficient looks significant, it is not that high to suggest that any pair of these variables is testing the same performance phenomena.

4.2. Financing decisions and firm efficiency

We next carry out an examination on how the debt financing decisions relates to firm efficiency. Accordingly, we test whether the levels of short-term, long-term and total debt have significant association with the firm efficiency. The three major columns in Table 4 report the results of the regression analyses that we run with three estimation techniques, with respect to the three proxies of the dependent variable and three estimation methods. In addition to the firm-specific factors, we include industry dummy, year dummy, country dummy in the regression equations as instrumental variables. More specifically, we examined how efficiency relates to debt financing by estimating the following equation using abond2 system estimator:

$$Debt_{ft} = \alpha + \gamma Debt_{f_{(t-1)}} + \beta 1Eff_{ft} + \beta 2ROA_{ft} + \beta 3Cash Flow_{ft} + \beta 4Cash Ratio_{ft} + \beta 5Size_{ft} + \beta 6Tang_{ft} + \beta 7Investment_{ft} + \beta k \sum Country_{dummy} + \beta m \sum industry_{dummy} + \beta n \sum year_{dummy} + e_{ft}$$
(7)

4.3. Short-term debt financing and firm efficiency

We find that the firm efficiency has a positive and statistically significant relationship with short-term debt financing (Table 4 column3) and total debt financing (Table 4 column 6). The result remains consistent under the GMM estimation, OLS regression and fixed-effect model. In the Abond2 GMM regression, we inserted lagged debt financing, efficiency, ROA, cash ratio and cash flows as endogenous factors and the other factors are put as instrumental variables. This enables us to control for endogeneity between debt financing and efficiency. Furthermore, we tested autocorrelations with Arellano Bonds tests AR1 and AR2. Our finding does not suffer from both problem of endogeneity and autocorrelations. According to the trade-off theory, firms with high efficiency hold high borrowing capacity because such firms bear lower anticipated costs of financial distress. The willingness of banks to provide debt capital will be determined by the probability of the loan's recoverability (Hall et al., 2004). Moreover, access to debt finance, in turn, positively affects firm performance especially for firms in industries with higher financial needs (Alvarez & Lopez, 2014). Similarly, financial constraints hinder the growth of firm's productivity, the efficiency of generating total output from all inputs (Liu & Li, 2017).

	(<i>.</i>						
		STD			D			LTD	
	Pooled OLS	Ħ	GMM (Abond2)	Pooled OLS	FE	GMM(Abond2)	Pooled OLS	FE	GMM(Abond2)
Dependent	(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)	(6)
Eff	0.030***	0.133***	0.117***	0.012***	0.082***	0.073***	-0.027***	-0.054***	-0.044***
	(0.003)	(0.006)	(0.008)	(0.003)	(0.006)	(0.007)	(0.002)	(0.004)	(0.005)
ROA	-0.131***	-0.358***	-0.275***	-0.272***	-0.463***	-0.442***	-0.068***	-0.073***	-0.055***
	(0.012)	(0.018)	(0.026)	(0.012)	(0.019)	(0.025)	(6000)	(0.014)	(0.018)
Cash Flow	-0.120***	-0.080***	-0.106***	-0.102***	-0.058***	-0.093***	-0.092***	-0.069***	-0.032***
	(0.011)	(0.012)	(0.016)	(0.010)	(0.011)	(0.014)	(0.008)	(6000)	(00.0)
Cash Ratio	-0.013***	-0.023***	-0.035***	-0.012***	-0.030***	-0.039***	-0.001**	0.001	-0.001
	(0000)	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)	(0000)	(0.001)	(0.001)
Size	0.001***	-0.007**	0.001	0.003***	0.026***	0.007***	0.002***	0.030***	0.003***
	(0000)	(0.004)	(0.001)	(0000)	(0.004)	(0.001)	(0000)	(0.003)	(0000)
Tangibility	-0.025***	-0.050***	-0.081***	-0.028***	-0.019	-0.059***	0.018***	0.093***	0.060***
	(0.004)	(0.015)	(0.010)	(0.004)	(0.017)	(0000)	(0.003)	(0.013)	(0.008)
Investment	0.017	-0.081***	-0.055**	0.238***	0.155***	0.213***	0.269***	0.204***	0.238***
	(0.015)	(0.020)	(0.022)	(0.016)	(0.021)	(0.025)	(0.014)	(0.020)	(0.019)
Debt _{f(t-1)}	0.849***	0.326***	0.481***	0.901 ***	0.541***	0.730***	0.842***	0.447***	0.682***
	(0.004)	(0.014)	(0.024)	(0.003)	(0.012)	(0.018)	(0.006)	(0.015)	(0.021)
Intercept	0.032***	0.274***	0.105***	0.004	-0.304***	-0.012	-0.011*	-0.541***	-0.030***
	(0.007)	(0.070)	(0.020)	(0.007)	(0.085)	(0.016)	(0.006)	(0.068)	(0.011)
Controls									
Firm	No	Yes	No	No	Yes	No	No	Yes	No
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Country	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
R ²	0.847	0.367		0.921	0.512		0.810	0.317	
x ² /F-test	4465.102	186.927	112.750	10658.997	322.702	344.642	2207.783	151.932	267.465
Sargan test (p-value)			0.000			0.000			0.000
Ar1 (p-value)			0.000			0.000			0.000
Ar2 (p-value)			0.424			0.333			0.861
Firms	4,017	4,017	4,017	4,017	4,017	4,017	4,017	4,017	4,017
Obs.	22,397	22,397	22,397	22,399	22,399	22,399	22,395	22,395	22,395
*** p<0.01, ** p<0.05, * p	<0.1.								

Table 4. How firm efficiency relates to debt financing.

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The novel aspect of our paper is that we explore the implications of efficiency, a measure of firm performance, for debt financing choices. This could be explained by the fact that firms consider how efficiently they used their economic resources before going for additional short-maturity debt capital. Short-term debts require a firm to refinance frequently (Huang et al., 2018) and this puts high pressure for efficiency on managers. Unless managers are efficient in dealing with funds obtained from short-term financing, it may lead to looking for more expensive sources of financing and surrendering positive NPV projects (Almeida, Campello, Cunha, & Weisbachet, 2014). Under some scenario, it may even force a firm to sell important assets at discounted prices and to liquidate its operations inefficiently. Thus, managers make more effort to enhance productivity when firms' reliance on short-term debt increases. Besides, use of short-term liabilities has the potential to reduce the agency problems associated with free cash flow (Stulz, 2000) leading to positive relationship between short-term debt financing and efficiency. To mitigate the agency costs of managerial discretion, productive companies use more short-maturity debt. Creditors also have a strong motivation to closely watch over firm's financial affairs when they grant short-term loans. Financial surplus (excess cash) increases agency costs, especially in firms with poor monitoring mechanisms. Generally, agency cost theories argue that debt that has a short maturity helps reduce these agency costs (Jensen, 1986). Thus, firms may increase short-maturity debt to mitigate potentially high agency cost expected under such circumstance. This leads to a positive relationship between firms' level of short-term debts and their efficiency.

4.4. Long-term debt financing and firm efficiency

We obtain statistically significant negative relationship between the efficiency and the long-term debt financing (see column 7-9 in Table 4). In these regards, our findings provide evidences in support of the pecking order model. The pecking order theory suggests that firms do not have capital structure targets. Firms apply debt capital only when retained earnings are exhausted and raise external equity capital only as a last resort. This theory assumes that internally generated funds are preferred to externally generated funds and hence productivity will be negatively associated with the amount borrowed by the firms. In other words, all things being equal, a firm that can generate more earnings will borrow less (Memon et al., 2015). Similarly, our result supports the pecking order theory's view with regard to profitability. ROA has a negative and statistically significant relationship with the level of debt financing in the models we estimate (see Tables 4 and 5). The long-term debt ratio has also negative relationship with firm efficiency. Besides, Table 4 shows that the operating cash flows relate negatively to all debt financing measures. Firms with high cash flow tend to decrease the use of debt capital because they have more internally generated funds. Studies also documented that financial deficits and surpluses are likely to influence capital structure adjustment (Byoun, 2008). According to the studies, adjustments mostly happen when firms have high debt ratio with a financial surplus or when they have low debt ratio with a financial deficit.

Furthermore, our analysis shows that firm characteristics such as firm size, tangibility (asset structure), and long-term investment are also important in financing decisions as suggested in Rajan and Zingales (1995). Firm size positively relates to the long-term debt

		1 (. /						
		STD			D			LTD	
Dependent	Pooled OLS (10)	FE (11)	GMM (Abond2) (12)	Pooled OLS (13)	FE (14)	GMM(Abond2) (15)	Pooled OLS (16)	FE (17)	GMM(Abond2) (18)
TATO	0.012***	0.033***	0.018**	0.003**	0.006	-0.031***	-0.003***	-0.014***	-0.014***
	(0.001)	(0.006)	(0.007)	(0.001)	(0.006)	(0.007)	(0.001)	(0.004)	(0.005)
ROA	-0.130***	-0.256***	-0.189***	-0.267***	-0.385***	-0.339***	-0.084***	-0.111***	-0.084***
	(0.012)	(0.019)	(0.024)	(0.012)	(0.020)	(0.026)	(6000)	(0.014)	(0.018)
Cash Flow	-0.124***	-0.072***	-0.097***	-0.102***	-0.049***	-0.077***	-0.093***	-0.075***	-0.039***
	(0.011)	(0.013)	(0.015)	(0.010)	(0.011)	(0.014)	(0.008)	(0000)	(0000)
Cash Ratio	-0.012***	-0.028***	-0.035***	-0.012***	-0.034***	-0.043***	-0.001***	0.003***	-0.001
	(0000)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0000)	(0.001)	(0.001)
Size	0.001***	0.006	-0.001*	0.003***	0.030***	0.002***	0.002***	0.025***	0.003***
	(0000)	(0.004)	(0.001)	(0000)	(0.005)	(0.001)	(0000)	(0.004)	(0000)
Tangibility	-0.011***	-0.077***	-0.050***	-0.023***	-0.047***	-0.078***	0.010***	0.104***	0.038***
	(0.004)	(0.016)	(600.0)	(0.004)	(0.018)	(6000)	(0.003)	(0.014)	(0.007)
Investment	0.007	-0.090***	-0.054***	0.235***	0.156***	0.242***	0.273***	0.215***	0.258***
	(0.015)	(0.021)	(0.020)	(0.016)	(0.022)	(0.024)	(0.015)	(0.020)	(0.018)
Debt _{f(t-1)}	0.833***	0.384***	0.568***	0.898***	0.580***	0.793***	0.843***	0.453***	0.705***
	(0.005)	(0.015)	(0.021)	(0.003)	(0.012)	(0.017)	(0.006)	(0.015)	(0.020)
Intercept	0.047***	0.064	0.182***	0.013**	-0.336***	0.133***	-0.034***	-0.464***	-0.052***
	(0.006)	(0.079)	(0.019)	(900.0)	(0.095)	(0.018)	(0.005)	(0.070)	(0.012)
Controls									
Firm	No	Yes	No	No	Yes	No	No	Yes	No
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Country	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
R ²	0.846	0.300		0.921	0.492		0.808	0.301	
χ²/F-test	4457.895	137.336	140.626	10658.557	291.362	353.720	2179.363	129.760	342.115
Sargan test (p-value)			0.000			0.000			0.000
Ar1 (p-value)			0.000			0.000			0.000
Ar2 (p-value)			0.297			0.251			0.785
Firms	4,017	4,017	4,017	4,017	4,017	4,017	4,017	4,017	4,017
Obs.	22,397	22,397	22,397	22,399	22,399	22,399	22,395	22,395	22,395
*** p<0.01, ** p<0.05, * p	<0.1.								

Table 5. Robust tests with alternative efficiency proxy.

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financing. The impact of asset structure (the proportion of assets that are fixed) on financing decisions looks similar to size. One of the fundamental factor affecting financing decision is capital budgeting decision, usually referred to as long-term investment (Stephen Ross, 2012). Investment has a significant positive effect on the firm's debt financing decisions. Theories also claim that financing decisions are required to accomplish investment projects that a firm wants to undertake. When capital expenditures are high, organizations need additional external financing and they prefer debt financing compared to external equity financing (Myers & Majluf, 1984). Similarly, but in the reverse direction, Cambini and Rondi (2011) reported that increases in financial leverage have positive impact on firms' investment suggesting that the strategic use of debt to discipline the manager's lack of commitment has a favorable counterpart in mitigating the underinvestment problem.

4.5. Robustness tests

To check the robustness of the results, we further estimate our models using alternative proxies for efficiency. Here, we used total asset turnover ratio as proxy for firm efficiency. Asset turnover ratios are important indicators of how effectively a company manages its assets to generate revenue. If a firm has too much investment in assets, its operating capital will be too high and it becomes inefficient in its asset management. Generally, this ratio indicates how efficiently a company uses its assets to generate revenue. Table 5 shows the result of the robustness test. The relationship between long-term debt finance and firm efficiency remains negative with alternative proxy for efficiency and across different regression methods. Looking at the facts in Table 5, the sign of estimated coefficients and statistical power from regressions of efficiency on debt ratios looks somehow the similar under the alternative measures of efficiency. The overall effect of firm efficiency on capital structure, long-term debt financing, in particular, looks negative. When we compare the debt appetite of the manufacturing firms, the efficient firms exhibited less use of long-term debts in their capital structure than inefficient ones did. Generally, the pecking order theory dominates in the result we document since the findings on most explanatory variables and the long-term indicator of capital structure (i.e., LTD) appear to confirm with the prediction of this theory.

4.5.1. Why firm efficiency relates negatively to the LTD financing?

Efficient firms are likely to have higher operating cash flows. As stated by the pecking order theory, the need for external financing decreases when firms generate more internal funds. To check whether this is the case in our study, we tested how firm efficiency relates to the operating cash flows. Using ordered Probit and Tobit regression, we empirically analyzed whether efficient firms are likely to generate higher internal capital that can substitute the additional external financing needed. Table 6 reports the regression results. The results indicate that profitable and efficient firms are more likely to have higher internally generated capital. Firms with higher internal financing sources do not apply more financial leverage. In the regression analysis shown in previous tables (4 and 5), we find significant negative association between operating cash flows and the level of long-term debt financing. Efficiency increases funds obtained from internal financing sources and the firms'

	Positive (Cash Flow	Higher C	ash Flow
	Probit	Tobit	Probit	Tobit
Eff.	0.632***	0.169***	0.402***	0.304***
	(0.062)	(0.015)	(0.049)	(0.069)
ROA	7.996***	1.923***	10.634***	11.332***
	(0.241)	(0.051)	(0.199)	(0.252)
Lifecycle	0.131***	0.065***	0.115***	0.099**
	(0.028)	(0.008)	(0.027)	(0.045)
Firm Size	0.112***	0.025***	0.034***	0.001
	(0.010)	(0.002)	(0.007)	(0.009)
Cash Flow _{f(t-1)}			0.022***	0.038***
			(0.008)	(0.010)
$Cut1_{\beta_0/\beta_0}$	2.200***	-0.009	0.742***	1.437***
	(0.217)	(0.050)	(0.155)	(0.210)
$Cut2_{\beta_0}$			1.546***	
			(0.155)	
$Cut3_{\beta_0}$			2.252***	
			(0.155)	
$Cut4_{\beta_0}$			3.076***	
			(0.155)	
σ_u / σ_u^2	0.356**	0.166***	0.228**	0.617***
	(0.025)	(0.004)	(0.016)	(0.019)
X ²	2392.462	3187.888	5293.567	3651.090
left-censored observations		4,428		13,484
uncensored observations		22,659		9,149
right-censored observations		0		0
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Firms	4,060	4,060	4,053	4,053
Obs.	27087	27087	22633	22633

Table 6.	Efficiency	and o	perating	cash	flows:	Probit	and	Tobit	regression.

*** p < 0.01, ** p < 0.05, * p < 0.1.

access to spontaneous short-term financing. Since these financing sources reduce the need for external funds, the long-term debt financing negatively relates to efficiency.

Although they have more borrowing capacity and their financial performances are sound according to creditors' evaluation, companies prefer to apply internal funds before going for long-term borrowing. Accordingly, the other explanation for the negative relationship between long-term debt financing and firm efficiency relates to the substitution effect. If firms raise more short-term capital, the proportion of the long-term debts in the total capital will be low. Putting it differently, short-term financing can be substituted for long-term financing. Our analysis shows that efficient firms apply more shortmaturity debts. It looks that high efficiency entails generating more cash flows and more use of short-term financing. This, in turn, decreases the need for long-term borrowing and reduces its proportion in the total capital. Thus, our result furnishes strong support in favor of pecking order theory of capital structure.

4.6. The moderating role of short-term solvency

One of the important objectives in our study is to investigate how short-term solvency or liquidity moderates the relationship between efficiency and financing decisions. We measure short-term solvency based on the cash ratio and cash holdings of each observation. We computed the cash ratio by dividing the cash plus short-term investment

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balances for the total current liabilities. It indicates the firm's ability to meet short-term obligations. Cash holding refers to the cash balance deflated by total assets and it shows the proportion of the liquid assets in the total assets. Table 7 presents the regression results, where the cash ratio acts as moderators in the models. It is generally assumed that cash ratio is a good proxy for short-term solvency. When it is high, insolvency risks are low and the firm is not financially constrained. We estimate the equation below for examining the moderating role of liquidity.

$$Debt_{ft} = \alpha + \gamma Debt_{f_{(t-1)}} + \beta 1Eff_{ft} + \beta 2Eff X \ cash \ ratio_{ft} + \beta 3ROA_{ft} + \beta 4Cash \ Flow_{ft} + \beta 5Cash \ Ratio_{ft} + \beta 6Size_{ft} + \beta 7Tang_{ft} + \beta 8Investment_{ft} + \beta k \sum Country_{dummy} + \beta \sum industry_{dummy} + \beta n \sum year_{dummy} + e_{ft}$$
(8)

The coefficients of the interaction variable, the interaction of cash ratio and efficiency, are statistically significant at 1% significance level in the models we tested. This suggests that the interaction between liquidity and firm productivity influences the level of long-term debt. The finding shows that firms with high productivity and high cash ratio tend to

		LTD	
	Pooled OLS	FE	GMM(Abond2)
Dependent Var.	(1)	(2)	(3)
Eff.	-0.031***	-0.063***	-0.050***
	(0.003)	(0.005)	(0.005)
Cash Ratio	-0.005****	-0.008***	-0.009***
	(0.001)	(0.002)	(0.002)
Eff X Cash Ratio	0.006***	0.015***	0.009***
	(0.001)	(0.003)	(0.002)
ROA	-0.070***	-0.080***	-0.051***
	(0.009)	(0.014)	(0.017)
FCF	-0.092***	-0.070***	-0.031***
-	(0.008)	(0.009)	(0.009)
Size	0.002***	0.030***	0.003***
	(0.000)	(0.003)	(0.000)
Tangibility	0.018***	0.093***	0.055***
	(0.003)	(0.013)	(0.007)
Investment	0.270***	0.206***	0.240***
	(0.014)	(0.020)	(0.018)
Debt _{f(t-1)}	0.843***	0.446***	0.691***
	(0.006)	(0.015)	(0.020)
Intercept	-0.007	-0.529***	-0.024**
	(0.006)	(0.068)	(0.011)
Controls			
Firm	No	Yes	No
Year	Yes	Yes	Yes
Industry	Yes	No	Yes
Country	Yes	No	Yes
R ²	0.810	0.320	
χ²/F-test	2164.245	145.638	7550.56
Sargan test (p-value)			0.000
Ar1 (p-value)			0.000
Ar2 (p-value)			0.880
Firms	4,017	4,017	4,017
Obs.	22,395	22,395	22,395

 Table 7. Moderating role of liquidity.

*** p<0.01, ** p<0.05, * p<0.1.

apply more long-maturity debts than firms with low cash ratio do (see Table7 and Table8). Firms with high efficiency borrow more long-term debt when they have high financial flexibility. Our results show that efficiency relates negatively to the long-maturity debts. However, the cash ratio weakens the relationship suggesting that short-term solvency moderates how efficiency relates to the long-term debt financing decisions.

4.7. Robustness test

To check for the robustness of the result, we applied alternative indicator for liquidity. In Table 8, we repeat the above moderation analysis using cash holding as proxy for the moderator. Here, we substituted cash holding for the cash ratio and estimated the following equation.

$$Debt_{ft} = \alpha + \gamma Debt_{f_{(t-1)}} + \beta 1Eff_{ft} + \beta 2Eff \ X \ Cash \ holding_{ft} + \beta 3ROA_{ft} + \beta 4Cash \ Flow_{ft} + \beta 5Cash \ Holding_{ft} + \beta 6Size_{ft} + \beta 7Tang_{ft} + \beta 8Investment_{ft} + \beta kCountry_{dummy} + \beta \sum industry_{dummy} + \beta n \sum year_{dummy} + e_{ft}$$
(9)

		LTD	
	Pooled OLS	FE	GMM(Abond2)
Dependent	(4)	(5)	(6)
Eff.	-0.041***	-0.076***	-0.059***
	(0.003)	(0.006)	(0.007)
Cash holding	-0.063***	-0.090***	-0.102***
	(0.010)	(0.018)	(0.017)
Eff X Cash holding	0.082***	0.138***	0.103***
	(0.013)	(0.022)	(0.022)
ROA	-0.069***	-0.078***	-0.055***
	(0.009)	(0.014)	(0.017)
FCF	-0.092***	-0.069***	-0.024***
	(0.008)	(0.009)	(0.009)
Size	0.002***	0.030***	0.003***
	(0.000)	(0.004)	(0.000)
Tangibility	0.017***	0.094***	0.051***
	(0.003)	(0.014)	(0.007)
Investment	0.269***	0.205***	0.243***
	(0.014)	(0.020)	(0.019)
Debt _{f(t-1)}	0.843***	0.445***	0.683***
	(0.006)	(0.015)	(0.020)
Intercept	-0.004	-0.512***	-0.015
	(0.006)	(0.068)	(0.011)
Controls			
Firm	No	Yes	No
Year	Yes	Yes	Yes
Industry	Yes	No	Yes
Country	Yes	No	Yes
R ²	0.810	0.321	
χ ² /F-test	2171.502	148.369	22526.11
Sargan test (p-value)			0.000
Ar1 (p-value)			0.000
Ar2 (p-value)			0.869
Firms	4,018	4,018	4,018
Obs.	22,396	22,396	22,396

 Table 8. Robustness test for moderating role: alternative liquidity measure.

*** p<0.01, ** p<0.05, * p<0.1.

Table 8 shows the result of regression analysis concerning the moderating role of cash holding. Generally speaking, the direction and significance of most coefficients remain the same implying that our results are robust. Firms that keep more cash do not encounter difficulty of settling their financial obligation as it becomes due. Thus, when their short-term solvency risks are low, productive firms incline to use more long-maturity debt since they can afford high financial leverage. Overall, the manufacturing firms with high productivity use long-term liabilities more when their liquidity is high than when it is low. The firms maintained high long-term capital structure in the period the efficiency is high and the risk of insolvency is low. During such period, financial distress risks are less and the companies hold more borrowing capacity. In this regard, the actions pursued by the firms look consistent with the prediction of the trade-off theory. With increase of cash flexibility, firms appear to reduce the downward adjustment on their long-term debt financing attributable to increase of productivity. Putting differently, the negative relationship between LTD and efficiency can be justified by the pecking order theory. However, the argument in favor of this theory will be weak for firms with high cash holdings. Thus, our empirical analysis provides strong support for the pecking order model especially when the firms' financial flexibility is low.

For further test on robustness, we conduct several alternative estimation methods to analyze the moderating role of cash ratio and cash holding. Table 9 reports a battery of robustness exercises conducted to test the sensitivity of our main results to the use of alternative measures of financing decisions and different subsamples clustered on country basis. We run dynamic panel regression using abond2 estimator to test whether our findings are still consistent for the sample of manufacturing firms across the biggest manufacturing countries. The main result is robust in all of the four countries and the coefficients remain statistically significant. The result highlights that the relationship between firm productivity and debt financing decisions does not vary among the four countries. Generally, we checked the sensitivity of our main results to the use of alternative measures of financial flexibility, to the use of different estimation methods and for subsample by countries. We also control for the industry differences and year effects by applying industry dummy and years dummy, respectively. Furthermore, we avoid endogeneity problem using the GMM specifications and we also check autocorrelations. Our main findings are the same using different analysis and with robustness tests that we conducted.

5. Conclusions

Researchers have conducted various studies to identify what determines the capital structure of a firm. In a similar view, we analyzed the relationship between firm efficiency and corporate debt financing decisions using a panel dataset of manufacturing firms in the biggest manufacturing countries. We followed dynamic panel data methods for examining the underlying relationship. Dynamic panel data models are suggested for overcoming problems of autocorrelations, heteroscedasticity in the data, and endogeneity of independent variables. In this regard, GMM estimators generate the most reliable regression results for dynamic panel model and are commonly applied in the areas of finance related to our study.

		LT	D	
	China	Germany	India	Japan
Dependent Var.	(7)	(8)	(9)	(10)
Eff.	-0.036***	-0.123***	-0.080***	-0.039***
	(0.011)	(0.029)	(0.012)	(0.006)
Cash Ratio	-0.009***	-0.015***	-0.016***	-0.008***
	(0.003)	(0.005)	(0.004)	(0.002)
Eff X Cash Ratio	0.012***	0.016	0.020***	0.008***
	(0.005)	(0.011)	(0.005)	(0.003)
ROA	0.007	0.040	-0.041	-0.098***
	(0.033)	(0.058)	(0.033)	(0.022)
FCF	-0.057***	-0.087***	-0.066***	-0.012
	(0.021)	(0.040)	(0.017)	(0.010)
Size	0.006***	0.000	0.002**	0.002***
	(0.001)	(0.002)	(0.001)	(0.001)
Tangibility	0.005	0.112***	0.067***	0.045***
	(0.012)	(0.034)	(0.014)	(0.009)
Investment	0.179***	0.142*	0.291***	0.224***
	(0.034)	(0.085)	(0.034)	(0.026)
Debt _{f(t-1)}	0.756***	0.686***	0.690***	0.722***
	(0.039)	(0.044)	(0.031)	(0.024)
Intercept	-0.062**	0.095***	0.013	-0.012
	(0.026)	(0.048)	(0.021)	(0.012)
Controls				
Firm	No	No	No	No
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
χ ² /F-test	2972.362	935.821	3161.969	5063.497
Sargan test (p-value)	0.007	0.000	0.037	0.000
Ar1 (p-value)	0.000	0.000	0.000	0.000
Ar2 (p-value)	0.985	0.463	0.757	0.913
Firms	1,223	207	976	1,611
Obs.	2,911	1,274	4,474	13,736

Table 9. Further test for robustness: dynamic panel regression for subsample of country.

*** p<0.01, ** p<0.05, * p<0.1.

Our results suggest that firms with higher efficiency apply less long-term and more short-term debt financing. Efficient companies generate more internal cash flows and have more potential to raise higher short-term debt capital since their risk of illiquidity is less. When firms apply more short-term financing, they decrease the use of long-term borrowing suggesting that the former substitutes the later. Besides, we obtain that the relationship between long-term debt financing and firm efficiency becomes weak when firms have high financial flexibility. Prior studies found that when financial surpluses are high, firms are more likely to adjust their long-term debt ratios downwards (Byoun, 2008; Smith, Chen, Anderson, & Cahan, 2015). However, our results indicate that efficient firms incline to increase their long-term indebtedness than short-term obligations when their financial flexibility is high. Firms with high productivity adjust their long-term debt ratio upwards when their financial flexibility increases.

Studies state that the capital structure theories may not be exclusive but rather complementary (see, for example, Barclay & Smith, 2005; Carmen & Joseph, 2009; Fama & French, 2005). Similarly, our paper provides empirical evidence supporting two models of capital structure: pecking order model and agency cost theory. However, the pecking order theory's dominates in our finding since the long-term 126 🛞 T. S. LEGESSE AND H. GUO

financing is more important in the capital structure theories. According to the pecking order theory, firms favor short-term over long-term debt and they generally favor retained earnings than external financing (Fama & French, 2012). To this end, our paper suggests that firm's capital structure is affected by various factors including the firm's efficiency. In their debt financing decisions, managers should consider the firm's productivity level among other factors.

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Variable	Meaning	Definition
TD	Total debt ratio	Total liabilities divided by total assets on balance sheet date
LTD	Long term debt ratio	The ratio of long-term debt to total assets on balance sheet date
STD	Short-term financing	Short-term debts plus trade payables divided by total assets on balance sheet date
Eff.	Firm efficiency	Efficiency scores estimated by SFA with TRE model, regression
ROA	Return on Assets	Earnings before interest and tax (EBIT) for a period divided by total assets at the end of the period.
Size	Firm size	Total assets in million USD. In regression, we use natural logarithm of total assets, In (asset).
Cash Ratio	Cash ratio	The ratio of cash and short-term investment to total current liabilities, on balance sheet date
Cash Holding	Cash holding	Cash balance deflated by total assets on balance sheet date
Tang.	Asset tangibility	The ratio of net PPE to total assets, on balance sheet date
Cash Flow	Operating cash flow	Net cash flow from operating activities, during the fiscal year deflated by total assets
Investment	Capital expenditures	Capital expenditure during a period deflated by the total assets balance at period end
Life cycle	Firm life cycle	Retained earnings divided by total assets, we follow proxy similar to DeAngelo (2006)

Annex A. Variable definitions