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Determinants of Capital Structure in Singapore's Manufacturing Industry

Parvinder Arora
S P Jain School of Global Management, Australia

Lalit Bagucandani
S P Jain School of Global Management, Australia

Ying Liu
S P Jain School of Global Management, Australia

Abstract

This study investigates the relationship between firm value and capital structure, and its determinants in Singapore's manufacturing sector from 2002-2011, and explores whether these determinants remain the same across different industry segments. Our result shows a strong correlation between debt ratio and firm value, and shows that most Singapore firms are also moving towards reducing debt in capital structure, which may be an indication that firms are trying to optimise their debt position to maximise the firm value, given the nature of Singapore's economy. A fixed effects panel estimation model reveals that key determinants are tangibility (+ve), size (+ve), profitability (-ve) and non-debt tax shield (-ve), which are similar to those identified in earlier studies in the context of other economies. Tangibility and non-debt tax shield are common determinants across the industrial sector and consumer goods sector. The empirical results are mostly explained by trade-off theory.

Keywords: *Capital Structure, Firm Value, Singapore, Panel Estimation Model*

Introduction

It is an established fact that one of the primary objectives of a firm is maximisation of value for its shareholders (Jensen, 2001; Grossman and Stiglitz, 1977). Managers attempt to achieve this objective through various financing and operating decisions (Taggart, 1977; Myers and Majluf, 1984). These decisions are of utmost importance because they form the canvas for a firm's strategy. Managers often achieve better control over value maximisation through financing decisions rather than operating decisions due to disagreement between managers and investors about decisions in operating the firm, even if liquidation is preferred by investors as an operating decision (Harris and Raviv, 1990; Stulz, 1990). A common managerial approach to wealth maximisation through financing decisions sparks questions in a researcher's mind: how do financing decisions lead to value maximisation? Is there a relationship between capital structure and firm value? What determines a firm's capital structure? Over the years, researchers have debated the significance of the choice of capital structure by firms in order to explore the answers to these questions.

Various capital structure theories and empirical studies have emerged in an attempt by researchers to explain variation in capital structure over time, and its determinants in a firm, across industries or regions. Notable theoretical contributions have been made by Modigliani and Miller (1958; 1963), Jensen and Meckling (1976), Miller (1977), Myers (1977, 1984), Myers and Majluf (1984), Graham (2000), Baker and Wurgler (2002), and Welch (2004); whereas empirical evidence has come from studies by Friend and Lang (1988), Barton *et al.* (1989), Bos and Fetherston (1993), Michaelas *et al.* (1999), Booth *et al.* (2001), Abor (2005), Berger and Bonaccorsi (2006), and Kyerboach-Coleman (2007). These studies have uncovered similarities and differences in terms of the relevance and impact of capital structure across geographies and industries, however, the majority of empirical studies focus on western countries (e.g. Titman and Wessels, 1988; Rajan and Zingales, 1995; Drobetz and Wanzenried, 2006, etc.); and few examine Asian countries (Chen, 2004; Koh *et al.*, 1993). Most of the notable Asian studies are not very recent.

The aim of this paper is two-fold: first, to identify the determinants of capital structure in Singapore's manufacturing industry in the context of a more recent period, 2002-2011; and second, to examine the correlation between capital structure and firm value, if any, during the same period. The study focuses primarily on the manufacturing sector in Singapore. The manufacturing sector, being a capital-intensive sector, is perceived as having high level of leverage. This sector holds significance for Singapore's economy. The paper also generates a comparison between two industry segments within the manufacturing sector, namely industrials and consumer goods in terms of the key determinants of capital structure and their impact. The remainder of the paper is structured as follows: the following section briefly outlines the literature and develops hypotheses. Section 3 describes the method and data. Section 4 analyses the results and last section draws some conclusions.

Literature Review and Hypotheses Development

Modern capital structure theory evolved from the revolutionary paper of Modigliani and Miller (M&M) published in 1958. They contended that in a perfect market the capital structure of a firm is irrelevant to the value of a firm, determined by its earning power and the risk of its underlying assets, and independent of the way it chooses to finance its

investments or distributes dividends (Modigliani and Miller, 1958). They subsequently noted that the value of the levered firm may be more, however, because of the existence of the tax shield (Modigliani and Miller, 1963). Myers (1977) developed static trade-off theory, and asserted that "*a firm attempts to balance the value of interest tax shields against bankruptcy cost*". Both tax-based and agency-cost-based models belong to the static trade-off model as supported by Jensen and Meckling (1976), Miller (1977), Kim (1978), Bradley *et al.* (1984), Jensen (1986), and Harris and Raviv (1990).

Ross (1977) developed signalling theory which is based on the concept of asymmetric information and its impact in determining the optimal capital structure. In practice, firms with high leverage are at greater risk of being subjected to financial distress and filing for bankruptcy (Opler and Titman, 1994), which makes firms reluctant to raise funds through debt financing.

Myers (1984) suggested pecking order theory which is based on the premise that the order of preferences reflects the relative costs of finance from these sources. Baker and Wurgler (2002) claim that market timing is the important determinant of capital structure and argue that capital structure is best understood as the cumulative effect of past attempts to time the market.

Jensen (1986) proposed free cash flow theory which explained the conflicts of interest between shareholders and managers over payout policies when an organisation generates substantial free cash flow. In addition to debt holders and shareholders, leverage affects a firm's non-financial stakeholders, including clients, employees and dealers, as appellants to a firm's cash flow (Titman, 1984; Sarig, 1998).

Several empirical studies have attempted to reflect on variables/factors that may contribute or impact decisions related to the capital structures of a firm. Factors of common interest include inflation, debt rate, taxation, asset structure, macroeconomics, firm size, tangibility, cost of financial distress and profitability.

We applied these theories to the Singapore manufacturing industry, based on the current literature reviewed in this section, in order to develop testable hypotheses.

Tangibility and Leverage

Trade-off and agency theories predicate, and the majority of empirical studies indicate, that leverage is positively correlated with firm tangibility (e.g. Titman and Wessels, 1988; Rajan and Zingales, 1995; Harris and Raviv, 1991; Hovakimian *et al.*, 2001; Kayhan and Titman, 2006; Drobetz and Wanzenried, 2006; De Jong *et al.*, 2008; Alderson and Betker, 1995; Flannery and Rangan, 2006). Tangible assets often reduce bankruptcy costs due to a higher liquidation value which reduces financer risk in case of firm default. Jensen and Mecking (1976) argued that a firm may invest in high risk investment after the issuance of debt to exploit the optional nature of equity and transfer wealth from creditors to shareholders. A firm possessing high tangible assets can use these assets as collateral, which eliminates the lender's risk of suffering such agency costs of debt. Firms with greater collateral value of assets are more capable of issuing secured debt without revealing much information about future earnings. Harris and Raviv (1991) argued that the low information asymmetry related to tangible assets makes equity less costly. The firms with higher levels of asset tangibility are thus generally larger firms that can issue

equity at fair prices, and do not then need to issue debt to finance new investment. We therefore propose the following hypothesis:

H_1: *Tangibility has a positive relationship with leverage*

Profitability and Leverage

The relationship between a firm's profitability and leverage is ambiguous. The static trade-off theory suggests a positive relationship between profitability and leverage, because a highly profitable firm has more reason to issue debt which reduces its tax burden. The expected bankruptcy costs are lower and interest tax shields are more valuable for profitable firms. Firms with higher profits relative to investment also benefit from the discipline that debt provides in mitigating the free cash flow problem (Jensen, 1986). Empirical evidence has been found by various researchers, including Jensen (1986), Hovakimian (2004), Hovakimian *et al.* (2001, 2004), and Drobetz and Wanzenried (2006).

The pecking order theory and agency theory suggest a negative relationship. Myers (1984) argues that firms prefer internal finance over external funds. Debt is raised when internal funds are insufficient. Profitable firms with self-generated funds do not need to rely on external sources. Due to information asymmetries between the firm and outsiders, firms will also prefer internal over external financing, because the cost for external capital may be greater for the firm. Jensen (1986) and Williamson (1988) defined debt as a discipline to ensure that managers pay out profits rather than build empires. For firms with free cash flow, or high profitability, large debt can restrain management discretions. Various empirical studies find similar results (De Jong and Veld, 2001; Flannery and Rangan, 2006; Kester, 1986; Rajan and Zingales, 1995; Titman and Wessels, 1988). In the context of Singapore, Koh *et al.* (1993) also saw profitability as significantly negatively related to debt. We therefore propose the following hypothesis:

H_2: *Profitability has a negative relationship with leverage*

Size and Leverage

Size is the most common variable used in empirical studies and mixed results of relationship between firm size and leverage have been found. On the one hand, there is a negative relationship between firm size and leverage. Due to low information asymmetry, financing is easily available to mature large firms compared to smaller firms, which find it costly to address information asymmetries with lenders and financiers. Consequently smaller firms are offered less capital or offered capital at significantly higher costs, which discourages the use of outside financing. Large firms face lower adverse selection and possess the flexibility to easily issue equity compared to small firms where adverse selection problems are severe. Empirical evidence for this is found by Johnson (1998), Kester (1986), and Titman and Wessels (1988).

On the other hand, a positive relationship is found between size and leverage. Large firms are expected to borrow more to maximise their tax benefit from debt through diversification and have a lower probability of bankruptcy or default. Large firms also enjoy an established reputation supported by high credit rating in debt markets and consequently face lower agency costs of debt. These arguments are confirmed by many

empirical studies, such as Flannery and Rangan (2006), Friend and Lang (1988), Hovakimian *et al.* (2001), MacKay and Phillips (2005), Mao (2003), Titman and Wessels (1988), Rajan and Zingales (1995), Kayhan and Titman (2007), De Jong *et al.* (2008), and Drobetz and Wanzenried (2006). Koh *et al.* (1993) also identified a positive correlation between leverage and firm size in a Singapore context. Therefore, we propose the following hypothesis:

H_3: *Size has a positive relationship with leverage*

Growth and Leverage

Both static trade-off theory and agency cost theory predict a negative relationship between firm growth and leverage. If the management objective is to pursue growth, then shareholder interests tend to meet interests for firms with high growth opportunities. Under contract, debt serves to limit the agency costs of managerial discretion for firms lacking investment opportunities. Debt has its own agency cost. Myers (1977) found that firms with growth opportunities should use less debt in order to mitigate agency problems. Firms with high leverage ratios might have a tendency to undertake activities contrary to the interests of debt holders. To compensate for this risk, debt holders would charge a higher risk premium and impose debt covenants which would restrict the liberty of managers in a firm. To avoid such debt related agency costs, growing firms are expected to be less reliant upon debt finance. As growth opportunities increase, the cost of financial distress also increases and firms prefer to issue equity when stocks are overvalued. Various empirical studies performed by Titman and Wessels (1988), Rajan and Zingales (1995), Hovakimian *et al.*(2001), Kayhan and Titman (2007), Drobetz and Wanzenried (2006), De Jong *et al.* (2008), Flannery and Rangan (2006), Hovakimian (2004), Johnson (1998), Mao (2003), Myers (1977), Maksimovtc *et al.* (1999), and Miao (2005) find that leverage is negatively correlated with firm growth opportunities. Therefore, we propose the following hypothesis:

H_4: *Growth has a negative relationship with leverage*

Business Risk and Leverage

Income variation, or earnings volatility, is considered an inherent risk in the operations of a firm, suffering from poor management practices. With an increase in income variation, the possibility of firm default increases and a firm will have to pay a risk premium to outside providers of funds. Eventually, firms may have to arrange funds at high cost to service the debt or face the risk of bankruptcy. Risky firms prefer less debt, as the present value of the costs of financial distress increases with the probability of being financially distressed. Firms with highly volatile earnings thus borrow the least and prefer equity to debt. The majority of empirical studies have found that leverage is negatively correlated with firm business risk, earnings volatility or the cost of financial distress (Titman and Wessels, 1988; Kremp *et al.*, 1999; Booth *et al.*, 2001; DeMiguel and Pindado, 2001; De Jong *et al.*, 2008). Therefore, we propose the following hypothesis:

H_5: *Business risk has a negative relationship with leverage*

Non-Debt Tax Shied (NDTS) and Leverage

NDTS is a tax deduction for depreciation and investment tax credits. De Angelo and Masulis (1980) contended that NDTS are surrogates for the tax benefits of debt financing. A firm with large NDTS tends to have less debt in the capital structure. Various empirical studies by DeAngelo and Masulis (1980), Leary and Roberts (2005), DeMiguel and Pindado (2001), and Mao (2003) find that leverage is negatively correlated with a firm's NDTS. Therefore, we propose the following hypothesis:

H_6: *Non-debt tax shied has a negative relationship with leverage*

Liquidity and Leverage

According to pecking order theory, firms with high liquidity tend to borrow less. Managers can influence liquid assets in favour of debt holders thereby increasing the agency cost of debt. A negative relationship between liquidity and leverage is expected, and we propose the following hypothesis:

H_7: *Liquidity has a negative relationship with leverage*

Firm Value and Leverage

Although Modigliani and Miller (1985) demonstrated that financial leverage is unrelated to firm value, many studies provide evidence of their correlation, either positive or negative. For example, Dalbor et al. (2007), Cheng and Tzeng (2011), Sudiyatno *et al.* (2012), and Altan and Arkan (2011) report a positive relationship; while Aggarwal and Zhao (2007), Rayan (2008), and Aggarwal *et al.* (2011) find a negative correlation. Fama and French (1998) and Lundstrum (2009) point out that the value of a leveraged firm is greater than that of an unleveraged firm. A positive relationship between firm value and leverage is thus expected, and we propose the following hypothesis:

H_8: *An increase in leverage for a firm increases firm value*

Methodology and Measurement of Variables

Data Collection

The data used in this paper comes mainly from the Bloomberg database, and the COMPUSTAT Global database is used wherever it is needed to complete the missing data. Only active firms in the Industrials and Consumer Goods sectors, listed on the Singapore Stock Exchange (SGX), are considered for study. The principle of maximising the number of firms and the inclusion of at least one business cycle were adopted. A trade-off is expected between the time period and number of firms which can be included in the study due to the availability of data. Data was cleaned by eliminating firms with any breaks in the time series or using financial reporting standards other than SG GAAP/IFRS in the time series. Data was further transformed by Winsorising at 0.5% by removing extreme values to reduce the effect of potentially spurious outliers. The final data set comprises a balanced panel of 137 firms in the Industrials sector and 63 firms in the Consumer Goods sector for the period 2002-2011.

Research Method 1—Analysis of Determinants of Capital Structure

In this paper we establish the following equation as the basic regression model for the overall sample, and also for two sub-samples, industrial and consumer goods:

$$LEV_{it} = \alpha + \beta_1 TANG_{it} + \beta_2 PROF_{it} + \beta_3 SIZE_{it} + \beta_4 GROW_{it} + \beta_5 RISK_{it} + \beta_6 NDTS_{it} + \beta_7 LIQD_{it} + \mu_{it}$$

In this equation, the dependent variable is leverage (LEV). Following previous studies (Titman and Wessels, 1988; Demirguc-Kunt and Maksimovic, 1999, Booth *et al.*, 2001; and Hall *et al.*, 2004), we define leverage as the book value of long term debt over the market value of total assets. The market value of total assets is calculated as the book value of total assets minus the book value of equity plus the market value of equity. The book value of long term debt is used as a surrogate instead of the market value of debt because very few SGX listed firms have publicly traded debt issues and the interest payments for debt are tax-deductible which provides tax shields. Tax shields are not affected by the market value of the debt and thus the market value of debt is irrelevant.

The independent variables include tangibility (TANG), which is defined as net fixed assets over book value of total assets; profitability (PROF), which is measured as ratio of earnings before interest, tax, depreciation and amortization (EBITDA) over total assets; firm size (SIZE), measured as a natural log of sales; growth opportunities (GROW), which is measured as Tobin Q -- a ratio of the market value of a firm to the replacement cost of assets (Rajan and Zingales, 1995 and Booth *et al.*, 2001); business risk (RISK), which is defined as the absolute difference between the annual percentage change in operating income and the average of this change over the sample period; non-debt tax shield (NDTS), defined as annual depreciation charges over total assets (Wald, 1999); and liquidity (LIQD), measured as total current assets divided by total current liabilities.

To address the issue of correlated residuals, six different models are estimated: panel OLS, AR (1), fixed effect cross section, random effects cross section, period fixed effects and period random effects. These models are then compared based on the explanatory power of the model, R^2, the remaining error, Durbin Watson statistic for autocorrelation, and Hausman specification, to test the significance of one estimation model against another (fixed effect vs. random effect). The Wald joint test was performed by combining all the variables to test joint significance.

Research Method 2— Analysis of Relationship between Firm Value and Capital Structure

In order to examine the correlation between capital structure and firm value, we conduct a simple investigative relationship to test correlation, descriptive statistics, and panel unit root test.

In this analysis, the dependent variable is firm value (FVAL). Tobin Q is chosen as a surrogate for firm value because it takes risk into account and is not as likely to mislead the results as other measures. Tobin Q is defined as the ratio of the market value of a firm divided by the book value of its assets (Chung and Pruitt, 1994).The explanatory variables are debt ratio (DRAT), which is calculated as a ratio of book value of total liabilities to total assets (Cheng *et al.*, 2010; Lin and Chang, 2011); firm size (SIZE), which is measured by the natural log of total assets; growth (SGRO), calculated as the annual

percentage change in sales; and risk value (RVAL), measured as the ratio of the market value of equity to the book value of equity.
DRAT = a x FVAL + b x SIZE + c x SGRO + d x RVAL

The data set is tested for multi-collinearity because the presence of multi-collinearity reduces the predictive power of independent variables. Multi-collinearity is checked by carrying out a correlation test. The test results indicate that there is little concern about the problem of multi-collinearity among independent variables (see Table 7). Panel unit root tests are performed to confirm that variables are stationary in order to avoid spurious regression and error in residuals. Various tests are adopted in our paper: the Levin-Lin-Chu (LLC) (Levin *et al.*, 2002), the Im-Pesaran-Shin (IPS) (Im *et al.*, 2003), the Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979) and the PP-Fisher Chi-square (Phillips and Perron, 1988). Variables have stationary characteristics since the null of the unit root is mostly rejected, especially in the case of the LLC test (see Appendix Table 3).

Analysis and Results

Determinants of Capital Structure

Results of Correlation

The correlation matrix table (Table 1) provides a comparison of correlations between leverage and explanatory variables for industrial, consumer goods and overall data sets.

Table 1: Result of Correlation Matrix (determinants of capital structure analysis)

	LEV	TANG	PROF	SIZE	GROW	RISK	NDTS	LIQD
LEV-O	1.000							
LEV-I	1.000							
LEV-C	1.000							
TANG-O	0.317	1.000						
TANG-I	0.323	1.000						
TANG-C	0.263	1.000						
PROF-O	-0.007	0.094	1.000					
PROF-I	-0.046	0.167	1.000					
PROF-C	0.022	0.058	1.000					
SIZE-O	0.175	-0.041	0.199	1.000				
SIZE-I	0.201	-0.034	0.264	1.000				
SIZE-C	0.150	-0.034	0.207	1.000				
GROW-O	-0.058	-0.057	-0.336	-0.129	1.000			
GROW-I	-0.038	-0.045	-0.390	-0.107	1.000			
GROW-C	-0.101	-0.080	-0.376	-0.195	1.000			
RISK-O	-0.004	-0.001	-0.059	-0.149	-0.054	1.000		
RISK-I	-0.051	-0.031	-0.132	-0.137	-0.044	1.000		
RISK-C	0.101	0.056	-0.026	-0.161	-0.068	1.000		
NDTS-O	-0.052	0.459	-0.110	-0.169	0.175	0.021	1.000	
NDTS-I	-0.065	0.505	0.078	-0.127	0.168	0.006	1.000	
NDTS-C	-0.038	0.316	-0.303	-0.265	0.201	0.042	1.000	
LIQD-O	-0.133	-0.185	0.004	-0.281	-0.028	-0.004	-0.111	1.000
LIQD-I	-0.129	-0.190	-0.058	-0.321	-0.014	-0.010	-0.121	1.000
LIQD-C	-0.222	-0.208	0.111	-0.130	-0.098	-0.039	-0.098	1.000

Note:(1) LEV= leverage, TANG= tangibility, PROF= profitability; SIZE= net sales, GROW= growth opportunity, RISK= business risk, NDTS= non-debt tax shield, LIQD= liquidity.
(2) Variable-O: Overall for 200 firms; Variable-I: 137 industrial sector firms; Variable-C: 63 consumer goods firms.

A positive and significant relationship is identified between tangibility and leverage in all cases. Conversely, Wiwattanakantang (1999) argued that tangibility is insignificant in Singapore firms due to the high level of government ownership. Most empirical studies support the positive relationship, however, because tangibility can be collateralized for debt. Tangible assets have less specificity, which supports their increasing use as collateral to reduce a lender's risk (Williamson, 1988). Trade-off, pecking order and agency theories also predict the positive relationship.

A significantly negative relationship between profitability and leverage is found in the industrial sector and the overall data set, which is consistent with Wiwattanakantang (1999). Pecking order theory states that firms use internal sources to fund growth when profits are high, predicting a negative relationship. Singapore has a mature banking sector which makes long term loans easily accessible for firms, and due to the substantial capital gains in the secondary markets Singapore firms are also attracted by equity financing. Singapore's corporate tax structure encourages firms to use equity finance more than debt finance, however. In addition, firms prefer retained profit because it is the quickest and easiest source of finance for most firms, compared with the issue of new equity.

The relationship between firm size and leverage is positive in all cases. This is inconsistent with Wiwattanakantang (1999), who argued that Singapore firms receive government support and face less risk of financial distress irrespective of size. Trade-off and agency theories predict the positive relationship, however, and show that the large firms more often choose long term debt and small firms choose short term debt (Marsh, 1982). The evidence from developed countries also suggests a positive relationship.

There is an insignificantly negative relationship between growth opportunities and leverage in all cases, which confirms the prediction of trade-off and agency theories, however Wiwattanakantang (1999) saw a significant relationship in Singapore industry.

The result shows a negative relationship between business risk and leverage in the industrial sector and overall sample, confirming the trade-off and pecking order theories; while a positive relationship is seen in the consumer goods sector, which can be explained by agency theory. Both non-debt tax shield and liquidity have a negative relationship with leverage in all cases, which is consistent with Wiwattanakantang (1999).

In order to confirm the correlation results and estimate the coefficient of each determinant, we ran six different regression models further.

Comparison of Regression Models

The results of a comparison of various models for the overall sample, the industrial only sample and the consumer goods only sample, are reported in Tables 2, 3, and 4 respectively. The cross sectional fixed effect model has the highest explanatory power (R^2) and lowest root mean square error. The Durbin Watson statistics are relatively high for this model, which signifies less issue with serial correlation. The results of the Hausman test indicate that the random effects models can be rejected in favour of fixed

effect models at the 5% significance level. The period effects models are ruled out due to the weak explanatory power of the model. Wald joint tests with combined coefficients for the models are significant at the 5% significance level. We can thus conclude that the significance and correlation identified by the cross sectional fixed effect model are accurate and reflects Singapore manufacturing (the overall sample), the industrial segment and the consumer goods segment.

Table 2: Regression Results for Overall sample

Dependent Variable: LEV						
Indep. Var.	Pooled OLS	AR(1)	Fixed Effects Cross Section	Random Effects Cross Section	Period Fixed Effects	Period Random Effects
C	-0.010 (-0.987)	-0.014* (-1.762)	0.008 (0.489)	-0.007 (-0.497)	-0.011 (-1.010)	-0.010 (-0.989
TANG	0.242*** (18.181)	0.123*** (11.000)	0.240*** (13.766)	0.236*** (15.415)	0.238*** (17.758)	0.242*** (18.221)
PROF	-0.055*** (-4.810)	-0.030*** (-3.412)	-0.018* (-1.769)	-0.027*** (-2.740)	-0.053*** (-4.668)	-0.055*** (-4.821)
SIZE	0.024*** (7.349)	0.011*** (4.144)	0.006 (0.876)	0.016*** (3.402)	0.024*** (7.498)	0.024*** (7.365)
GROW	-0.001 (-0.274)	0.001 (0.301)	-0.001 (-0.625)	-0.001 (-0.338)	7.04E-05 (0.038)	-0.001 (-0.275)
RISK	0.002 (0.953)	0.001 (0.407)	0.001 (0.825)	0.001 (0.730)	0.002 (1.078)	0.002 (0.955)
NDTS	-0.891*** (-9.830)	-0.366*** (-5.062)	-0.387*** (-3.770)	-0.532*** (-5.619)	-0.898*** (-9.903)	-0.891*** (-9.851)
LIQD	-0.001 (-1.433)	-0.001 (-0.854)	-0.001 (-0.165)	-0.001 (-0.505)	-0.001 (-1.316)	-0.001 (-1.436)
No. of obs.	1915	1722	1915	1915	1915	1915
R^2	0.1854	0.5128	0.5393	0.1240	0.193	0.185
F-stat.	62.013***	225.391***	9.709***	38.548***	28.337***	62.013***
Wald X^2	434.093***	--	214.483***	272.780***	422.922***	436.001***
Root MSE	0.097	0.074	0.077	0.078	0.097	0.097
DWStat.	0.718	1.992	1.224	1.087	0.709	0.718
HausmanX^2	--	--	--	27.489***	--	16.439**

Note: LEV= leverage, TANG= tangibility, PROF= profitability; SIZE= net sales, GROW= growth opportunity, RISK= business risk, NDTS= non-debt tax shield, LIQD= liquidity;
t-statistics in parentheses;
***, and *** indicate significance at the 10%, 5%, and 1% levels, respectively;
Source: Authors' calculation.

Table 3: Regression Results for Industrials-only sample

Dependent Variable: LEV						
Indep. Var.	Pooled OLS	AR(1)	Fixed Effects Cross Section	Random Effects Cross Section	Period Fixed Effects	Period Random Effects
C	-0.014 (-1.173)	-0.020** (-1.983)	-0.002 (-0.065)	-0.017 (-1.013)	-0.016 (-1.265)	-0.015 (-1.182)
TANG	0.274*** (17.066)	0.136*** (9.704)	0.261*** (12.172)	0.260*** (13.998)	0.269*** (16.642)	0.272*** (16.927)
PROF	-0.171*** (-6.294)	-0.107*** (-4.844)	-0.078*** (-2.872)	-0.108*** (-4.183)	-0.164*** (-6.010)	-0.168*** (-6.189)
SIZE	0.033*** (8.111)	0.018*** (5.158)	0.015 (1.594)	0.027*** (4.352)	0.034*** (8.212)	0.033*** (8.165)
GROW	-0.001 (-0.611)	0.001 (0.117)	-0.001 (-0.582)	-0.001 (-0.477)	-0.001 (-0.211)	-0.001 (-0.452)
RISK	-0.002 (-1.117)	-0.001 (-0.802)	-0.001 (-0.313)	-0.001 (-0.610)	-0.002 (-0.989)	-0.002 (-1.067)
NDTS	-1.048*** (-9.250)	-0.403*** (-4.313)	-0.491*** (-3.705)	-0.681*** (-5.637)	-1.068*** (-9.425)	-1.056*** (-9.335)
LIQD	-0.001 (-0.297)	-4.49E-05 (-0.057)	0.001 (0.185)	0.001 (0.169)	-0.001 (-0.179)	-0.001 (-0.253)
No. of obs.	1313	1180	1313	1313	1313	1313
R^2	0.233	0.529	0.550	0.149	0.242	0.231
F-stat.	56.611***	164.125***	10.006***	32.648***	25.899***	56.097***
Wald X^2	396.277***	--	170.041***	230.999***	384.988***	392.874***
Root MSE	0.100	0.077	0.081	0.082	0.100	0.100
DW Stat.	0.740	1.920	1.234	1.095	0.725	0.734
Hausman X^2	--	--	--	20.349***	--	7.635

Note: LEV= leverage, TANG= tangibility, PROF= profitability; SIZE= net sales, GROW= growth opportunity, RISK= business risk, NDTS= non-debt tax shield, LIQD= liquidity;
t-statistics in parentheses; ***, and *** indicate significance at the 10%, 5%, and 1% levels, respectively;
Source: Authors' calculation.

Table 4: Regression Results for Consumer Goods-only sample

Dependent Variable: LEV						
Indep. Var.	Pooled OLS	AR(1)	Fixed Effects Cross Section	Random Effects Cross Section	Period Fixed Effects	Period Random Effects
C	0.018 (0.992)	0.009 (0.605)	0.014 (0.531)	0.013 (0.560)	0.017 (0.928)	0.018 (0.988)
TANG	0.141*** (6.265)	0.099*** (18.044)	0.183*** (5.959)	0.165*** (6.184)	0.137*** (6.020)	0.143*** (6.239)
PROF	-0.015 (-1.317)	-0.012 (-1.417)	-0.006 (-0.543)	-0.007 (-0.713)	-0.015 (-1.335)	-0.015 (-1.312)
SIZE	0.015*** (3.005)	0.004 (0.931)	-0.001 (-0.029)	0.007 (1.017)	0.016*** (3.088)	0.015** (2.993)
GROW	-0.004 (-1.514)	-0.004* (-1.808)	-0.004 (-1.336)	-0.004 (-1.541)	-0.004 (-1.494)	-0.004 (-1.507)
RISK	0.012** (2.543)	0.006 (1.614)	0.156*** (3.695)	0.015*** (3.507)	0.012** (2.570)	0.012** (2.532)
NDTS	-0.364** (-2.545)	-0.214* (-1.912)	-0.216 (-1.407)	-0.251* (-1.733)	-0.348** (-2.403)	-0.364** (-2.534)
LIQD	-0.010*** (-3.943)	-0.005** (-2.499)	-0.002 (-0.492)	-0.005* (-1.667)	-0.010*** (-3.939)	-0.010*** (-3.926)
No. of obs.	602	542	602	602	602	602
R^2	0.142	0.473	0.495	0.112	0.148	0.142
F-stat.	14.054***	59.695***	7.558***	10.683***	6.351***	14.053***
Wald X^2	98.375***	--	65.678***	74.987***	96.306***	97.556***
Root MSE	0.083	0.063	0.067	0.067	0.082	0.083
DW Stat.	0.735	2.158	0.732	1.094	0.732	0.735
HausmanX^2	--	--	--	8.729	--	3.962

Note:LEV= leverage, TANG= tangibility, PROF= profitability; SIZE= net sales, GROW= growth opportunity, RISK= business risk, NDTS= non-debt tax shield, LIQD= liquidity;
t-statistics in parentheses;
***, and *** indicate significance at the 10%, 5%, and 1% levels, respectively;
Source: Authors' calculation.

For Singapore manufacturing, overall and the industrial sector (subsample), the coefficients of tangibility, profitability, size and NDTS are significant at a 1% level in all models, except size in the cross section fixed effect model. It may be concluded that large firms use more short term finance and less long term finance. Although various regression models used, the sign for coefficients (positive/negative) is the same across all the models:

- There is a positive relationship between tangibility and leverage: Hypothesis H_1 is true.
- There is a negative relationship between profitability and leverage: Hypothesis H_2 is true.
- There is a positive relationship between size and leverage: Hypothesis H_3 is true.
- There is a negative relationship between NDTS and leverage: Hypothesis H_6 is true.

In the consumer goods sector (subsample), the coefficient of tangibility, size, growth opportunities, risk, NDTS and liquidity were significant at the 1% level in most models,

while only tangibility and risk are found positively related to leverage in the cross section fixed effect model:

- There is a positive relationship between tangibility and leverage: Hypothesis H_1 is true.
- There is a positive relationship between business risk and leverage. This is unusual; however agency theory explains the relationship to some extent.

Comparison of Industrial and Consumer Goods Sectors

In a nut shell, the key determinants of capital structure in Singapore's manufacturing industry are tangibility, profitability, size and NDTS, however, we saw some striking similarities and differences between the Singapore industrial and consumer goods sectors.

It can be seen that mean leverage in the industrials sector is 8.7%, and it is 5.8% in the consumer goods sector (see Appendix Table 1), which is explained by the high debt financing required to fund the asset base required for the industrials sector (e.g. electronic and electrical equipment, construction and materials) in comparison to the consumer goods sector (e.g. food and beverages, personal and household goods).

In Table 3 and 4 (Fixed Effects Cross Section column), we can see the differences and similarities of each determinant between two sectors. Tangibility is slightly higher in the industrials sector due to high tangible asset needs. There is a similar positive relationship between tangibility and leverage across both sectors which shows that firms with high collateral can easily raise long/short term debt to meet financing needs. Profitability is negatively related in both sectors, which confirms pecking order theory, however, profitability is insignificant in the consumer goods sector. Size is insignificantly related to leverage in both sectors, however a negative relationship is found in the consumer goods sector which means that smaller firms rely on short term debt to meet financing needs. There is a negative and insignificant relationship between growth opportunities and leverage in both sectors, indicating that growth firms use less debt since they do not wish to expose themselves to possible restrictions imposed by lenders. Business risk is positive and significant in the consumer goods sector, while an insignificant and negative relationship is found in the industrials sector. One possible explanation for the unusual positive relationship is that relative strength of agency and bankruptcy costs determines the sign of relationship (Bennet and Donnelly, 1993). A negative relationship between NBTS and leverage is found in both sectors, but is insignificant in consumer goods sector. This suggests that high depreciation leads to low profitability. Liquidity is negatively related to leverage in both sectors, but insignificant in the industrials sector. A strong relationship signifies that consumer goods firms prefer their liquid assets for financing rather than long term loans.

Comparison of Singapore and Other Asia Pacific Economies

Most of the earlier studies into the determinants of capital structure have been conducted in developed economies, the US, the UK, Europe and Australia, although some contemporary studies in China and Asia Pacific economies were undertaken in the last 15 years. Table 5 shows the comparison of leverage and determinants across countries, which provides a macro-comparison across Asia Pacific economies and also assists in testing the robustness of findings in this paper compared to others.

Table 5: Comparison of Leverage and other Variables across Asian Countries

Variable / Country	Mean								Obs.	Period	Author/s
	LEV	**TANG**	**PROF**	**SIZE**	**GROW**	**RISK**	**NDTS**	**LIQD**			
China	0.170	0.435	0.071	4.260	1.019	0.038	--	1.848	108	1997-2001	De Jong, *et al.* (2008)
	0.068	0.494	0.051	8.807	0.269	1.122	0.772	--	462	1995-2000	Chen (2004)
Hong Kong	0.099	0.324	0.009	6.990	1.176	0.086	--	2.561	110	1997-2001	De Jong, *et al.* (2008)
Indonesia	0.189	0.427	0.122	6.060	1.272	0.059	--	2.377	177	1997-2001	De Jong, *et al.* (2008)
Singapore	0.093	0.354	1.897	4.560	1.326	0.06	--	1.897	310	1997-2001	De Jong, *et al.* (2008)
	0.240	0.351	0.083	12.02	1.524	--	0.033	1.852	211	1993-2001	Rataporn, *et al.* (2004)
	0.078	***0.301***	***0.065***	***2.088***	***1.245***	***1.034***	***0.032***	***2.285***	***1915***	***2002-2011***	***This Paper***
Malaysia	0.087	0.408	0.068	5.140	1.274	0.062	--	2.049	498	1997-2001	De Jong, *et al.* (2008)
	0.269	0.380	0.068	12.51	2.010	--	0.028	1.818	584	1993-2001	Rataporn, *et al.* (2004)
Thailand	0.174	0.452	0.094	7.520	0.994	0.053	--	1.665	244	1997-2001	De Jong, *et al.* (2008)
	0.444	0.433	0.106	14.51	1.362	--	0.044	1.533	277	1993-2001	Rataporn, *et al.* (2004)

Source: Authors' compiled.

We note that the key determinants are consistent across the Asia Pacific, however, there are few slight and explainable differences: 1) Singapore has low leverage compared to other countries, because these countries are experiencing high economic growth and an increased reliance of firms on debt to finance growth; 2) compared to China and Thailand, Singapore firms seem to possess fewer tangible assets, because the Singapore manufacturing industry is predominantly comprised of electronics which attracts low capital assets; and 3) Thailand and China have relatively high profitability due to lower labour costs which significantly affects cost of goods sold in manufacturing firms.

Capital Structure and Firm Value

Debt Characteristics of Firms

Table 6 reports the number of firms by debt ratio from 2002 to 2011. 71% of firms have a debt ratio between 0.25 and 0.75 in Singapore, and42% are between 0.25 and 0.5. It is noted that the number of firms with a debt ratio of 0.25-0.5 has increased by 6% and there is a corresponding reduction of 7% in a number of firms with debt ratios of 0.5-0.75. This suggests that more firms are transitioning to lower debt, which confirms the pecking order theory. Electronic and electrical equipment and general industrials have the highest debt ratio, followed by personal and household goods, food and beverages, and the construction and materials sectors (see Appendix Table 4).

Table 6: Debt Characteristics of firms from 2002 to 2011

Firm Class		2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	Average
Debt <=0.25	Nos	44	43	47	41	42	34	32	36	31	39	38.9
	%	22.0	21.5	23.5	20.5	21.0	17.0	16.0	18.0	15.5	19.5	19.45
0.25<Debt<0.50	Nos	82	96	91	85	84	86	84	87	84	70	84.9
	%	41.0	48.0	45.5	42.5	42.0	43.0	42.0	43.5	42.0	35.0	42.45
0.5<Debt<0.75	Nos	52	45	47	53	61	59	61	55	63	66	56.2
	%	26.0	22.5	23.5	26.5	30.5	29.5	30.5	27.5	31.5	33.0	28.1
Debt >0.75	Nos	10	16	14	20	13	20	23	22	22	22	18.2
	%	11.0	8.0	7.5	10.5	6.5	10.5	11.5	11.0	11.0	12.5	10.0

Source: Authors' calculation.

Correlation between Firm Value and Debt Ratio

The mean firm value was at its maximum in 2005-06 due to the strong economic growth which supports the manufacturing activities. The highest debt ratio is also seen in 2006, where firms depend upon the debt financing to fund the growth (see Appendix Table 2).

There is a strong positive correlation between firm value and debt ratio (see Table 7), indicating that firm value increases with an increase in debt. This is supported by the static trade-off theory that firms attempt to optimise their capital structure by balancing the tax shield effect of debt against an increase in bankruptcy cost due to debt in order to maximise shareholder value.

Table 7: Result of Correlation Matrix (capital structure and firm value analysis)

	FVAL	RVAL	SGRO	SZAT	DRAT
FVAL	1.000000				
RVAL	0.041882	1.000000			
SGRO	0.017719	0.005021	1.000000		
SZAT	-0.121003	0.072623	0.019356	1.000000	
DRAT	0.834897	-0.023679	-0.000597	-0.080281	1.000000

Note: FVAL= firm value, RVAL= risk value, SGRO= sales growth, SZAT= size of asset, DRAT= debt ratio.
Source: Authors' calculation.

Conclusion

This paper investigated the relationship between firm value and capital structure, and its determinants in Singapore's manufacturing industry. The manufacturing sector was chosen because of its significance for Singapore. The studies available in a Singapore (or Asia) context were conducted long in the past and we felt there was need for such a study due to the economic events of the recent past when the manufacturing sector was hit badly. Thirdly, the paper attempts a comparative analysis of two industry segments within the manufacturing sector.

We found that there is a strong correlation between debt ratio and firm value. Interestingly, the analysis showed that most Singapore firms are also moving towards reducing debt in capital structure, which may be an indication that firms are trying to optimise their debt position to maximise the firm value, given the nature of Singapore's economy.

Our results also show that the key determinants of leverage in Singapore are similar across different industry segments (industrial and consumer Goods), and the determinates identified are similar to those identified in earlier studies in the context of other economies. Tangibility, for example, has been found to have a positive effect on leverage and it appears that collateral influences all bank borrowing, whether short term or long term. Secondly, a negative relationship between profitability and leverage suggests that firms probably tend to depend more upon equity financing more than debt financing. This is possible considering the mature stock market in Singapore. In fact, a two-fold increase in the number of listed firms in the past decade indicates that firms have been raising more equity, although this relationship has not been the focus of this study. Thirdly, a positive relationship was found between firm size and leverage, but it may not have a major impact due to its small coefficient. As a matter of fact, most of the firms in the sample are small firms that probably depend upon short-term debt instead of long-term debt to obtain financing. Another significant result is that the non-debt tax shield consistently demonstrated a negative relationship with leverage, which may mean that firms who have access to the non-debt tax shield may not be tempted to raise debt for the simple reason that they enjoy the benefits of the debt tax shield. The empirical results are mostly explained by trade-off theory.

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Appendices

Appendix Table 1: Summary of Statistics (determinants of capital structure)

Overall	**LEV**	**TANG**	**PROF**	**SIZE**	**GROW**	**RISK**	**NDTS**	**LIQD**
Mean	0.078	0.301	0.065	2.088	1.246	1.035	0.032	2.285
Median	0.031	0.273	0.080	2.045	1.014	0.576	0.026	1.675
Maximum	0.625	0.947	0.647	5.006	37.816	9.873	0.432	45.435
Minimum	0.000	0.000	-5.579	-2.469	0.000	0.000	0.000	0.033
Std. Dev.	0.108	0.195	0.213	0.755	1.322	1.312	0.029	2.663
Obs.	1915	1915	1915	1915	1915	1915	1915	1915
Industrials	**LEV**	**TANG**	**PROF**	**SIZE**	**GROW**	**RISK**	**NDTS**	**LIQD**
Mean	0.087	0.313	0.069	2.047	1.210	1.207	0.033	2.359
Median	0.038	0.283	0.076	2.016	1.005	0.698	0.027	1.659
Maximum	0.625	0.947	0.422	5.006	37.816	9.873	0.432	45.435
Minimum	0.000	0.001	-1.830	-1.050	0.354	0.000	0.000	0.033
Std. Dev.	0.114	0.206	0.118	0.765	1.320	1.474	0.029	3.074
Obs.	1313	1313	1313	1313	1313	1313	1313	1313
Consumer Goods	**LEV**	**TANG**	**PROF**	**SIZE**	**GROW**	**RISK**	**NDTS**	**LIQD**
Mean	0.059	0.277	0.058	2.179	1.323	0.658	0.030	2.124
Median	0.016	0.260	0.091	2.120	1.036	0.398	0.025	1.696
Maximum	0.595	0.940	0.647	4.749	20.99	3.938	0.371	9.667
Minimum	0.000	0.000	-5.579	-2.469	0.000	0.000	0.000	0.047
Std. Dev.	0.089	0.164	0.338	0.726	1.325	0.726	0.027	1.385
Obs.	602	602	602	602	602	602	602	602

Source: Authors' calculation.

Appendix Table 2: Summary of Statistics (firm value and capital structure analysis)

		2002-11	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002
FVAL	Mean	1.240	0.974	1.124	1.099	1.335	1.474	1.519	1.159	1.234	1.365	1.105
	Median	1.008	0.885	0.992	0.964	0.823	1.171	1.106	1.041	1.082	1.166	0.963
	Std. Dev.	1.722	0.443	0.584	0.539	4.281	1.042	2.744	0.550	0.618	0.704	0.524
RVAL	Mean	1.140	0.902	1.055	1.106	0.567	1.670	0.129	0.783	1.186	1.313	1.113
	Median	0.825	0.645	0.902	0.819	0.493	1.174	0.113	0.837	0.953	1.084	0.708
	Std. Dev.	3.311	0.940	3.860	1.044	1.805	2.916	0.422	4.597	1.649	3.274	1.839
SGRO	Mean	0.357	0.501	0.132	2.249	0.095	2.241	1.717	0.137	1.362	0.157	0.132
	Median	0.076	0.062	0.107	2.175	0.016	2.127	0.912	0.093	0.129	0.087	0.060
	Std. Dev.	6.352	5.055	0.349	0.712	0.448	0.675	6.523	0.574	16.550	0.415	0.545
SZAT	Mean	2.193	2.375	2.272	0.762	2.227	0.175	2.182	2.156	2.116	2.074	2.039
	Median	2.092	2.232	2.162	-0.040	0.707	0.125	2.086	2.058	2.009	1.976	1.925
	Std. Dev.	0.676	0.706	0.738	10.129	0.707	0.457	0.664	0.640	0.618	0.616	0.619
DRAT	Mean	0.487	0.446	0.432	0.425	0.578	0.449	0.643	0.494	0.473	0.473	0.459
	Median	0.437	0.412	0.387	0.390	0.427	0.437	0.458	0.466	0.466	0.453	0.448
	Std. Dev.	0.973	0.249	0.258	0.250	1.815	0.247	2.369	0.388	0.252	0.268	0.227
Observations		1936	185	196	195	198	196	190	197	194	192	193

Source: Authors' calculation.

Appendix Table 3: Results of Panel Unit Root Tests

	LLC	IPS	ADF	PP
FVAL	-21.1798***	-5.06934***	580.704***	938.785***
DRAT	-22.2619***	-3.83629 ***	547.479***	624.859***
SZAT	-15.1935***	1.66826	393.646	565.402***
SGRO	-20.1477***	-9.22887***	683.572***	1307.80***
RVAL	-25.9555***	-5.60964***	603.998***	1015.46***

Note: *** indicates significance at 1% level.
Source: Authors' calculation.

Appendix Table 4: Debt Characteristics by Industrials

Industry	Debt <=0.25	0.25<Debt<0.50	0.5<Debt<0.75	Debt >0.75
Electronic & electrical Equipment	3%	8%	4%	1%
General Industrials	3%	9%	5%	1%
Industrial Engineering	1%	3%	1%	1%
Industrial Transportation	2%	4%	2%	1%
Support Services	2%	3%	2%	1%
Construction & Materials	2%	4%	5%	1%
Automobile & Parts	0%	1%	1%	0%
Food & Beverages	4%	6%	2%	2%
Personal & Household Goods	3%	6%	6%	1%
Total	**19%**	**42%**	**28%**	**9%**

Source: Authors' calculation.