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Does Leverage and Efficiency Affect Each Other

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This paper uses the Stochastic Frontier Analysis(SFA) to estimate the firm efficiency in Taiwan manufacturing firms from 2000 to 2009, Moreover, we applied the least square dummy variable (LSDV) and Quantile Regression Method to examine the effect of leverage on efficiency and the effect of efficiency on leverage respectively. The empirical results show as follows: Firstly, leverage is negatively related to technical efficiency in all industries, which does not support the agency cost hypothesis but support the non-interest tax hypothesis.. Secondly, technical efficiency is positively related to leverage in textile industry, which support the efficiency-risk hypothesis, while significantly negatively in electronic and chemical industries, which support the franchise-value hypothesis, Thirdly, the higher level of leverage can strength the positive effect of technical efficiency on leverage in textile industry, while weaken the negative effect in electronic and chemical industries, which does not support the franchise-value hypothesis. Fourthly, the lower level of leverage can weaken the negative effect of technical efficiency on leverage in electronic and chemical industries, which support the franchise-value hypothesis, while from positive effect to negative effect, which does not support the efficiency-risk hypothesis and the franchise-value hypothesis. This finding can provide insight into the firm production and debt finance decision to maximize the firm value.

Keywords: Stochastic Frontier Analysis, least square dummy variable, Quantile Regression Method, the agency cost hypothesis, the efficiency-risk hypothesis, the franchise-value hypothesis, non-interest tax shield hypothesis.

1. Introduction

In corporate finance decision, there are many related theories to explore the effect of leverage on firm values. In static trade-off theory, no matter what the M&M(1963) model or Miller(1973) model, if we Do not consider bankruptcy costs, there exist the tax shield effect only if the present value of the tax shields is positive during debt financing, Miller (1977)., Myers (1974)., Miles and Ezzell (1980)., Harris and Pringle (1985)., Damodaran (1994)., Ruback (2002) and Fernandez (2004) ., support this argument. If we further consider bankruptcy costs, it would not change the empirical results only the estimated coefficient of leverage becomes smaller, which indicates that bankruptcy costs influence the effect of leverage on firm values substantially. In dynamic trade-off theory, if we consider the bankruptcy costs and the agency costs simultaneously before the firm reaches its optimal capital structure during debt financing, the leverage is still positively related to the firm values. Thus, we can infer that the maximizing-value firm will not use its debt to equity ratio in excess of the

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optimal capital structure, which indicates that firm value can also increase with the level of debt usages.

When exploring the effect of leverage on firm values, the dependent variable is the firm values, however, Zavgren (1985), Keasey and Watson (1987), and Becchetti and Sierra (2003) have emphasized the importance of non-financial data as predictors of company failures. Will the empirical results be different from the previous studies if we use efficiency to substitute for the firm values, Moreover, most of the previous studies emphasize the uni-directional effect of the leverage to performance. However, Berger and Bonaccorsi di patti (2006) , Margaritis and Psillaki (2007) examined the bi-directional relationship between capital structure and firm performance. Will the results of effect of leverage on firm performance be changed if we examine the reverse relationship？ The objective in this paper is to explore whether leverage and efficiency affect each other. Specifically, we will employ single-stage procedure to estimate the inefficiency effects, because the two-stage estimation procedure is unlikely to provide estimates which are as efficient as those that could be obtained using a single-stage estimation procedure.

The first objective of this paper is to investigate whether and to what extent the capital structure has an effect on technical efficiency, The empirical results show that capital structure is negatively related to technical efficiency to all industries, but significantly in textile industry only. The second objective of this paper is to investigate whether and to what extent technical efficiency has an effect on capital structure, The empirical results show that technical efficiency is significantly negatively related to firm capital structure in electronic and chemical industries, while insignificantly positively related in textile industry. The third objective of this paper is to examine whether the different leverage level affects the effect of efficiency on capital structure, The empirical results show that technical efficiency is significantly negatively related to capital structure in electronic and chemical industries on leverage level below 40%. While technical efficiency influence capital structure from positively to negatively from leverage level above 45% to leverage level below 45% in textile industry.

This paper contributes to the extant literature in corporate finance in two respects. Firstly, we use technical efficiency as performance measurement other than accounting data, moreover, we are the first to use SFA and single-stage procedure to estimate technical efficiency. Secondly, with a view to examine the relationship between the technical efficiency and capital structure exactly, other than efficiency-risk hypothesis and franchise-value hypothesis, we put forward the interest tax shield hypothesis to test the effect of leverage on technical efficiency on the one hand, and propose the non-interest tax shield hypothesis to test the effect of technical efficiency on capital structure on the other hand.

The text of the paper is organized as follows: section 2 is literature review and developing hypotheses, section 3 is research design, section 4 is empirical results and discussion, and the conclusion is presented in section 5 .

2. Literature Review and Developing Hypotheses

In this paragraph, we will expound the causal relationship between leverage and technical efficiency, the effect of leverage on technical efficiency and the effect of technical efficiency on leverage respectively.

2.1 Causal Relationship

In corporate finance literature review, there are many studies which examine the effect of leverage on the firm performance. However, many researchers have asserted that firm production efficiency is another indicator for measuring firm performance which may affect the capital structure. Zavgren (1985) argued that business failures will not be predicted accurately if econometric models only rely on financial statement information. Becchetti and Sierra (2003) find if the stochastic frontier model is used to measure the productive efficiency, then productive inefficiency is a significant ex ante indicator of business failure. Watson (1987) reports that better predictions for small company failures are obtained from models using non-financial data rather than conventional financial indicators.

No matter what causal relationship analysis mentioned above, it will be subject to uni-directional causal relationship analysis. However, there may exist a bi- causal relationship. Berger and Bonaccorsi di Patti (2006) examined the bi-directional relationship between capital structure and firm performance for the US banking industry using a parametric measure of profit efficiency as an indicator of (inverse) agency costs while Margaritis and Psillaki (2007) investigated a similar relationship for a sample of New Zealand small and medium sized enterprises using a technical efficiency measure derived from a non-parametric Shephard (1970) distance function. In this paper we use a directional distance function approach on a sample of Taiwan firms from three different manufacturing industries to examine whether capital structure and efficiency affect each other.

2.2 The Effect of Leverage on Technical Efficiency

As we know, there are a few non-financial measurements for performance, these measurements are based on different viewpoints, including production, cost, revenue and proficiency aspects. In this paper, we consider the production aspect to measure firm performance.

2.2.1 Agency Costs Hypothesis

2.2.1.1 Capital Structure and Agency Costs

Jensen and Meckling (1976) used the agency relationship and agency costs to explain the existence of optimal capital structure at the firm level. They argue that separation of firm's control (management) from its ownership may create conflicts of interest between agents and costs to the firm, defined as *agency costs of equity*, since managers may be engaged in value non-maximizing activities and/or transferring firm resources for personal benefits. In a related paper, Parrino and Weisbach (1999) empirically estimate that the agency costs of debt are too small to offset the tax

benefits. However, debt not only can mitigate the manager-shareholder conflict, but also can reduce the agency costs of equity by means of the following methods. Firstly, It can reduce the agency costs of equity by raising the manager's share of ownership in the firm. Secondly, It can achieve the same goal by reducing the amount of 'free' cash available to managers to engage in the pursuits (Jensen, 1986) since debt commits the firm to pay out cash.

Debt can create an "asset substitution effect", which is described as"The equity holder let management invest the more risk projects than debt holders anticipated without their agreement. If the high risk projects are done well, the debt holders may only gain regular returns. Hence, all the other extra benefits are distributed to equity holders. On the contrary, if these projects break down, the debt holders must share the losses jointly with the equity holders. With a view to protecting themselves, debt holders must monitor the firm (imposing monitoring costs) and impose covenants (covenant costs) (Jensen & Meckling,1976 ; Long & Malitz, 1985 ; Barnea, Haugen & Senbet,1985 ; Skinner, 1993). Besides, debt can cause "under-investment problems" as well, which is described as" After the debt holders lend funds to the firm, if management find out that all the benefits derived from investment projects will be distributed to debt holders only, they will give up all the investment projects profitable to the firm(Myers, 1997 ; Barnea et al.,1985 ; Titman & Wessels,1988 ;Skinner,1993). Both of these problems mentioned above can be described as agency costs of debt , which may result in reducing the value of firm with them.

Due to the agency costs attached to both debt and equity, an optimal capital structure is obtained in the agency approach by trading-off the agency costs of equity (the benefit of debt) against the agency costs of debt and by minimizing the total agency costs involved in issuing debt and equity (Titman 2000 ; Myers 2001)

Therefore, we can infer that the maximizing-value firm will not use its debt to equity ratio in excess of the optimal capital structure, In this situation, firm value can also increase with increasing the level of debt usages. Based on above analysis we follow the previous studies and propose **the agency cost hypothesis (H1)**: Leverage positively influence on firm performance before reaching the firm's optimal capital structure.

2.2.1.2 Technical Inefficiency and Agency Costs

Leibenstein (1966) showed how different principal-agent objectives, inadequate motivation and incomplete contracts become sources of (technical) inefficiency measured by the discrepancy between maximum potential output and the firm's actual output. He termed this failure to attain the production or technological frontier as X-inefficiency. Berger and Bonaccorsi di Patti (2006) use a parametric measure of profit efficiency as an indicator of (inverse) agency costs to examine the bi-directional relationship between capital structure and firm performance while Margaritis and Psillaki (2007) use a technical efficiency measure derived from a non-parametric Shephard (1970) distance function to investigate a similar relationship.

Following Leibenstein (1966) we use technical or X-inefficiency as a proxy for the (inverse) agency costs arising from conflicts between debt holders and equity holders

or from different principal-agent objectives. These conflicts will give rise to resource misallocations and potential output will be sacrificed. Besides, we measure performance by employing a directional distance function approach and define the technological frontier as a benchmark for each firm's maximum possible output for its given set of input, and that would be realized if agency costs were minimized.

We consider technical efficiency to be a reasonable (inverse) proxy for the agency costs due to managers pursuing their own objectives rather than maximizing shareholder value.

2.2.2 Interest Tax Shield Hypothesis

As we know, the tax shield can be classified into interest tax shield and non-interest tax shield. Regarding interest tax shield, Booth et al.,(2001) and, Mutenheri and Green (2002) found that the level of tax benefits is significantly and positively related to debt uses. Van Horne (1998) and Barclay et al., (1999) supported this positive relationship. However, Hussain and Nivorozhkin (1997) found that the relationship is negative and non-significant. Moreover, Myers (1999) argued that the expected realizable value of future interest tax shields actually decreases as the amount of debt in the capital structure increases. In this case, firms may not continue to borrow just because they want to take advantage of tax shields from debt financing. Barclay et al.,(1999) , Myers (1999) pointed out that a company benefits from interest tax shields depends on whether it has other tax shields such as investment tax credit, depreciation, research and development expense or tax loss carry forwards. In Taiwan, the average interest rate for loans is 3.88% from 2001 to 2009, compared to non-interest tax shield, based on the clause of upgrading Taiwan industry, which offer 20% tax deduction on average. Therefore, the more take advantage of interest tax shield. the more inefficient to firm. Based on foregoing analysis, we propose the interest tax shield hypothesis **(H2)**: leverage is negatively related to technical efficiency.

2.3 The Effect of Technical Efficiency on Leverage

In finance literature, Demsetze et al., (1973, 1996), Berger and Bonaccorsi (2006), Margaritis and Psillak (2008) explored the effect of the efficiency on capital structure. In this paper, other than the efficiency-risk hypothesis and franchise-value hypothesis, we will propose the non-interest tax shield effect hypothesis to strengthen the explanation of the effect of efficiency on capital structure.

2.3.1 Theories of Reverse Causality from Efficiency to Capital Structure

A testable prediction of the classic models is that increasing the leverage ratio should result in lower agency costs of outside equity and improved firm performance, all else held equal. However, when leverage becomes relatively high, further increases generate significant agency costs of outside debt – including higher expected costs of bankruptcy or financial distress – arising from conflicts between bondholders and shareholders.

As noted, prior research on agency costs seldom take into account the possibility of reverse causation from performance to capital structure, which may result in

simultaneous-equations bias. We propose two hypotheses of reverse causation based on violations of the Modigliani-Miller perfect-markets assumption. It is assumed that various market imperfections (e.g., taxes, bankruptcy costs, asymmetric information) result in performance move the optimal equity capital ratio marginally up or down.

2.3.2 Efficiency-Risk Hypothesis

Firm performance may also affect the choice of capital structure. Under the *efficiency-risk hypothesis*, more efficient firms choose lower equity ratios than other firms, all else equal, because higher efficiency reduces the expected costs of bankruptcy and financial distress. Under this hypothesis, higher profit efficiency generates a higher expected return for a given capital structure, and the higher efficiency substitutes for equity capital to some degree in protecting the firm against future crises. This is a joint hypothesis, that i) efficiency is strongly positively associated with expected returns, and ii) the higher expected returns from high efficiency are substituted for equity capital to manage risks.

Regarding the first part of the hypothesis, i.e., that efficiency is strongly positively associated with expected returns in firms, efficiency has been found to be significantly positively correlated with returns on equity and returns on assets (see for example, Berger & Mester 1997), Other evidence suggests that efficiency is relatively stable over time (see for example, DeYoung, 1997), therefore, a finding of high efficiency tends to yield high future expected returns.

Regarding the second part of the hypothesis – that higher expected returns for more efficient firms are substituted for equity capital – follows from a standard Altman z-score analysis of firm insolvency (Altman 1968). High expected returns and high equity capital ratio can each serve as a buffer against portfolio risks to reduce the probabilities of incurring the costs of financial distress/bankruptcy, therefore, firms with high expected returns due to high efficiency can hold lower equity ratios

According to the above analysis, firms with higher efficiency will have higher expected returns, and a higher expected return allows the firm to have a lower equity ratio for a given z-score, so that more efficient firms may choose lower equity capital ratios. Berger and Bonaccorsi di Patti (2006) also proposed and supported the similar argument. Based on the above argument, we follow the previous studies and put forward the efficiency-risk hypothesis **(H3)**: Efficiency is positively related to the Leverage.

2.3.3 Franchise-Value Hypothesis

The *franchise-value hypothesis* focuses on the income effect of the economic rents generated by efficiency on the choice of capital structure. Under this hypothesis, more efficient firms choose higher equity capital ratios, other things constant, to protect the rents or franchise value associated with high efficiency from the possibility of liquidation. Higher efficiency may create economic rents if the efficiency is expected to continue in the future, and shareholders may choose to hold extra equity capital to protect these rents, which would be lost in the event of liquidation, even if the liquidation involves no overt bankruptcy or distress costs. The *franchise-value hypothesis* is also a joint

hypothesis that efficiency is a source of rents, and that firms hold additional equity capital to prevent the loss of these rents in the event of liquidation.

Related literature to this field, Titman (1984), Titman and Wessels (1988), Keeley (1990), Petersen & Rajan (1995) supports the notion that firms hold additional equity capital to protect franchise value. Based on the above argument, we follow the previous studies and propose the franchise-value hypothesis (**H4)**: Efficiency is negatively related to Leverage.

These two hypotheses yield opposite predictions from one for the effects of leverage on efficiency to another for the effect of efficiency on leverage. The two individual effects may be thought of as substitution and income effects. Under the *efficiency-risk hypothesis*, the expected earnings from high efficiency substitute for equity capital in protecting the firm from the expected costs of bankruptcy or financial distress, whereas under the *franchise-value hypothesis*, firms try to protect the income from high efficiency by holding additional equity capital. We will examine the individual effect based on different leverage level and the net effect based on all sample firms respectively.

2.3.4 Non-interest Tax Shield Hypothesis

Regarding non-interest tax shield, based on Bradley et al. (1984), Titman and Wessels (1988), Schoubben and Van Hulle (2004), Du and Dai (2004), Mat Nor and Ariffin (2006) empirical tests, they suggest that non-interest tax shelters are positively correlated with debt ratios. However, Barclay et al.,(1999) , Myers (1999) pointed out that a company benefits from interest tax shields depends on whether it has non-interest tax shield. Bathala and Carlson (1995) contended that non-interest tax shelters sometimes serve as substitutes for interest tax deductions. Firms that have more of the non-interest tax shelters may decide to decrease the use of debt financing in their capital structure. Besides, as mentioned above, the average interest rate for loan is somewhat low, which bring the lower interest tax shield to firm through debt finance. Nevertheless, compared to non-interest tax shield, based on the clause of upgrading Taiwan industry, which offer 20% tax deduction on average on investment tax credit, depreciation, research and development expense and tax loss carry forwards. Therefore, the more efficient firms, the less use of debt finance, Based on foregoing analysis, we propose the non-interest tax shield hypothesis **(H5)**: Non-interest tax shelters has substitution effect and income effect for interest tax shields in Taiwan, the more efficient firms, the less use of debt finance. Therefore,, technical efficiency is negatively related to leverage.

3. Research Design

3.1 Sample

The sample in this study consisted of 309 electronic companies, 51 textile companies and 57 plastics and chemical companies. All companies are listed in Taiwan Securities Exchange (TSE) that provide annual report from 2000-2009 consecutively. The data were collected from audited annual reports that were published at TSE that can be found at Taiwan Economic Journal (TEJ). For the purpose of accurate analysis, we

deleted all the firms with negative values added and having a incomplete and inconsistent record on the variables included in the analysis over the 10 year period. Besides, since some variables are scaled by total fixed assets, we must delete a few of observations that included negative values for one of those variables. As a result, we deleted 138 companies for electronic industries, 32 companies for textile industries and 11 companies for plastics and chemical industries,The remainder is total 236 companies and 2230 observations in this study.

3.2 The Statistical Model

In this study, we applied the Translog production function, single-stage procedure for SFA and the Maximum-Likelihood estimated to estimate the technical efficiency for individual firm in sample period. Then, employ least square dummy variable (LSDV) or fixed effect model (FEM) to estimate the bi-directional causal relationship between technical efficiency and leverage using pooled cross-section and time-series data. The choice between the random and the fixed effects formulation should depend on the statistical properties of the estimators. A specification test developed by Hausman (1978) is available based on the concept under the hypothesis of no correlation. According to H-Value from test statistic, we have used the FEM model for our analysis.

3.3 Empirical Model

3.3.1 Technical Efficiency Estimates

As we know, we can estimate the technical efficiency for every firm from the viewpoint of cost, revenue and production. In this study, we use the viewpoint of production to estimate the technical efficiency, the reasons why we use production viewpoint to estimate the technical efficiency, which can be generalized as the following two points, Firstly, Unlike the cost or revenue viewpoint, if it is used to estimate the cost or revenue efficiency, we must consider the influence of prices for inputs or selling price for product on it, as a result, it is apt to be fluctuated with factor markets, product markets and capital markets. Whereas, if we employ production viewpoint to estimate the technical efficiency, we may consider the ratio of quantity for inputs to quantity for outputs, in other words, we can consider the efficiency of outputs to inputs only. Secondly, the cost or revenue efficiency is not a proper indicator for measuring the agency costs, due to the prices for inputs or selling price for product is apt to be influenced by market factors. Moreover, it is difficult for manager to control it. However, production efficiency is under manager control completely, therefore, it is a proper indicator for measuring the agency costs. Based on the foregoing analysis, we decide to use the viewpoint of production to estimate the technical efficiency. We use the following two equations to estimate:

$$\ln(Y) = \beta_0 + \beta_1 \ln(L) + \beta_2 \ln(K) + \beta_3 (\frac{1}{2}\ln(L))^2 + \beta_4 (\frac{1}{2}\ln(K)^2) + \beta_5 \ln(L)\ln(K) + \nu_i - \mu_i \ldots\ldots\ldots(1)$$

$$\mu_i = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_T Z_{Ti} + W_i = g(Z_i) + W_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where, $\ln(Y_i) = \beta_0 + \beta_1 \ln(L) + \beta_2 \ln(K) + \beta_3 (\frac{1}{2}\ln(L))^2 + \beta_4 (\frac{1}{2}\ln(K)^2) + \beta_5 \ln(L)\ln(K)$ is Translog production function, Y_i is the value added, which are composed of salaries, interests, rents , taxes and EAIT. L(labor)and K(capital) are two inputs, The labor input is measured by the total number of full-time equivalent employees and working

proprietors whereas capital is measured by the firm's fixed tangible assets. V_i is the symmetric component of the error term, U_i is technical inefficiency, which is the function of Z_i, Z_i is a vector of exogenous variables, which can affect the technical inefficiency. Z_i includes the following variables, and we measure it as follows:

LEV is the debt to total assets ratio, Profitability (PR) is measured by the ratio of profits (EBIT) to total assets, Intangibles (INT) are measured by the ratio of intangible assets to total assets, Asset structure (TAN) is measured as the ratio of fixed tangible assets divided by the total assets of the firm, Firm size (SIZE) is measured by the logarithm of the firm's sales.

3.3.2 The Effect of Leverage on Performance (Efficiency)

$$EFF_i = \alpha_0 + \alpha_1 LEV_i + \alpha_2 LEV^2 + \alpha_3 Z_{1i} + \mu_i \quad \text{.....(3)}$$

Where *EFF* is the firm efficiency measure obtained from (1) and (2) above, *LEV* is the debt to total assets ratio; Z_1 is a vector of control variables, which include *PR, TAN, INT,SIZE* and *OWN. PR, TAN, INT* and *SIZE* are measured the same way as (2), while *OWN* is measured by the ratio of top ten ownership holdings to total shares. and u_i is a stochastic error term.

According to the agency cost hypothesis the effect of leverage (LEV) on efficiency should be positive. However, the possibility exists that at sufficiently high leverage levels, the effect of leverage on efficiency may be negative. The quadratic specification in (3) is consistent with the possibility that the relationship between leverage and efficiency may not be monotonic, viz. it may switch from positive to negative at higher leverage.

The variables included in Z_1 control for firm characteristics. More specifically, we assume that profitability, asset structure, growth opportunities, size and ownership structure are likely to influence firm efficiency. The literature reference and the expected sign between firm characteristics and firm efficiency are discussed as follows:

Regarding profitability, Fama and French (2002), Titman and Wessels (1988) argued that profitability is positively related to efficiency, thus, we expect a positive effect of (past) profitability on efficiency: more profitable firms are generally better managed and thus are expected to be more efficient. In regarding asset structure, we expect a positive relationship between asset structure and efficiency: more capital intensive firms are expected to use better technology and thus be more efficient. With regard to intangibles, this variable may be considered as an indicator of future growth opportunities (see Titman & Wessels, 1988; Michaelas et al., 1999; Ozkan, 2001). We would generally expect that companies with plentiful growth opportunities will tend to adopt faster and better. Regarding firm size, the effect of this variable on efficiency is likely to be positive as larger firms are also expected to use better technology, be more diversified and better managed. A negative effect may be observed in situations where there will be loss of control resulting from inefficient hierarchical structures in the management of the company (see Williamson, 1967). We would thus: generally expect a positive effect of size on efficiency. As to ownership structure, in general, a positive relation between ownership concentration and firm efficiency is expected as

large owners or block owners may be more capable of monitoring and aligning management to their objectives which in turn should result in higher firm values (see Jensen & Meckling, 1976; Shleifer & Vishny, 1986; Short, 1994; Jirapon & Gleason 2007). This effect is expected to be stronger in countries with weak investor protection and therefore more likely to be statistically significant (Pedersen & Thomsen, 2003). Thus our testable hypothesis is that firms with concentrated ownership have less severe agency conflicts which in turn result in better firm performance.

3.3.3 The Effect of Efficiency on Leverage

$$LEV_i = \beta_0 + \beta_1 EFF_i + \beta_2 Z_{2i} + \nu_i \quad (4)$$

where Z_2 is a vector of factors other than efficiency that correlate with leverage and v_i is a stochastic error term. Under the efficiency-risk hypothesis, efficiency has a positive effect on leverage, i.e. $B_1 > 0$; whereas under the franchise-value hypothesis, the effect of efficiency on leverage is negative, i.e. $B_1 < 0$. We use quantile regression analysis to examine the capital structure choices of different efficiency in terms of these two competing hypotheses. This is in line with Myers (2001) who emphasized that there is no universal theory but several useful conditional theories describing the firm's debt-equity choice.

The variables included in Z_2 control for firm characteristics that are likely to influence the choice of capital structure (see Harris & Raviv, 1991; Rajan & Zingales, 1995). They are the same variables used in the agency cost model such as size, asset structure, profitability, growth opportunities and ownership structure. The literature reference and the expected sign between firm characteristics and firm efficiency are discussed as follows:

Regarding firm size, as larger firms are more diversified and tend to fail less often than smaller ones, we would expect that: size will be positively related to leverage. However Rajan and Zingales (1995) argue that size may act as a proxy for the information outside investors have, as a result, informational asymmetries are lower for large firms which implies that large firms may be in a better position to issue informationally sensitive securities such as equity rather than debt. size may also have a negative effect on leverage.

Regarding asset structure, the existence of asymmetric information and agency costs may induce lenders to require guarantees materialized in collateral (Myers, 1977; Scott, 1977; Harris & Raviv, 1990). Thus, we would expect that: tangibles should be positively related to debt, However, if firms with lots of tangibles tend to rely more on internal funds generated from these assets which in turn discourages them from turning to external financing. In this situation, firms with more tangible assets will choose lower debt in their capital structure.

With regard to profitability, Myers (1984) and Myers and Majluf (1984) argued that firms will prefer to finance new investments with internal funds rather than debt, thus, they predict a negative relationship between profitability and leverage. According to the pecking order theory, there should be a negative relationship between past profitability and leverage. On the contrary, the trade-off and contracting cost theories

predict a positive relation between profitability and leverage. Thus it is also possible that: there will be a positive relation between profitability and leverage.

Regarding intangible assets, these can be considered as future growth opportunities (Titman & Wessels 1988; Michaelas et al., 1999; Ozkan, 2001). Myers(1977) argued that the underinvestment problem pushes creditors to reduce their supply of funds to this type of firm. Besides, firms with expected growth opportunities would keep low leverage in order to avoid adverse selection and moral hazard costs associated with the financing of new investments with new equity capital. Thus we would generally expect: a negative relationship between debt and growth opportunities.

As to ownership structure, firms where shareholders rights are weak are expected to carry more debt in their capital structure (Jirapon & Gleason, 2007). This is consistent with agency cost theory. Thus, we would expect a positive relationship between dispersed ownership and leverage. On the contrary, when leverage is high this increases the risk of bankruptcy which may then induce managers to lower debt. In this case, the effect will be negative (Friend & Lang ,1988, and Friend & Hasbrouck, 1988).

4. Empirical Results and Discussion

4.1 Descriptive Statistics

Table. 1 descriptive statistics for all industries

	Computer			Textile			Chemical		
	Mean	StDev	Median	Mean	StDev	Median	Mean	StDev	Median
Output(Y)	3199254	1141498	631014	1444163	2763138	369708	3403088	10720974	576173
Labor(L)	1071	27380	395	1082	1347	539	970	2228	401
Profit	2208426	8571047	343107	718671	1837298	897510	2272653	8016283	225626
Intangibles	1491836	4660116	4660116	1151942	2474119	2635759	16936371	51338835	3011481
Tangibles	5573381	34202161	34201922	3111468	4482403	882990	6980238	19257887	985465
Total assets	21052023	68231229	68230639	15354102	14784487	3616246	24737213	71479875	4690358
Total Debt	7396134	23398372	23397706	5576884	5286041	1527078	8621589	25333961	1289436
Technical efficiency	0.0698	0.0905	0.0455	0.3648	0.2705	0.2569	0.2179	0.2127	0.1498
Y/L	2535	3411	1682	997	720	788	2447	2442	1425
K/L	1987	4092	1317	3513	6140	2148	5251	5228	3069
PR	0.0991	0.0686	0.0880	0.0319	0.0530	0.0212	0.0666	0.0666	0.0550
INT	0.7993	0.1562	0.8423	0.6492	0.1801	0.6654	0.6624	0.6626	0.6670
TAN	0.2007	0.1562	0.1577	0.3508	0.1801	0.3346	0.3376	0.3374	0.3330
LEV	0.3502	0.1483	0.3424	0.3592	0.1885	0.3435	0.3127	0.3123	0.3081
OWN	15.8984	9.0430	14.4900	20.1588	9.0339	19.4550	19.9316	12.5134	18.8400
SIZE	15.3809	1.5025	15.1048	15.1598	1.2489	15.0156	15.0478	1.3825	14.8918

Table1 indicates that on average, firms in chemicals industry are much larger and more capital intensive than firms in the computer and textile industries, while firms in the computer industry not only carry more debt in their capital structure and show higher profitability as well as growth opportunities (intangible). They also have more dispersed ownership structure. This observation is consistent with the prediction of the Mahrt-smith (2005) model.

Table.2 The Pearson correlation of TE to LEV and control variable for industries

Variable / Industry		TE	LEV	LEV*LEV	PR	INT	TAN	SIZE	OWN
Electronic		1	.031	.039	.328**	.316**	-.316**	.602**	.086**
	TE		.197	.106	.000	.000	.000	.000	.000
Textile		1	-.144	-.222**	.942**	.811**	-.811**	.452**	-.138
	TE		.077	.006	.000	.000	.000	.000	.090
Chemical		1	-.054	-.064	.692**	.341**	-.341**	.673**	.026
	TE		.303	.224	.000	.000	.000	.000	.615

**. and *.are at 0.01 and 0.05 significance level, significant related.

Table2 indicates clearly, the correlation of LEV to TE is negative but insignificantly in textile and chemical industries, while the correlation of LEV to TE is positive but insignificantly in electronic industry. TAN are significantly negatively correlated to TE in all industries, while PR, INT,SIZE and OWN are also significantly positively correlated to TE in all industries.

4.2 The Effect of Leverage on Technical Efficiency

Table,3 TE regression on LEV for all Industries

Variables / Industries	Con	LEV	PR	tan	LEV*LEV	SIZE	OWN
Electronic	-0.461 0.000***	-0.068 0.145	0.388 0.000***	-0.132 0.000***	0.035 0.577	0.035 0.000***	0.000 0.005
Textile	0.443 0.000***	-0.410 0.003***	3.971 0.000***	-0.459 0.000***	0.539 0.001***	-0.001 0.811	0.002 0.004***
Chemical	-1.147 0.000***	-0.151 0.336	1.923 0.000***	-0.137 0.001***	-0.015 0.945	0.088 0.000***	0.000 0.786

Note:1. Dependent variable : TE
2.*,**,*** denote 10%, 5% and 1% significant level respectively

Table3 shows LEV is negatively related to TE in all industries but significantly in textile industry only, which are inconsistent with Jensen and Meckling (1976), Myers (1977), Jensen (1986), Myers (2001), Berger and Bonaccorsi di patti (2006) and does not support **H1** we proposed. but supports **H2** we put forward.

This is an interesting result, based on classical agency costs, leverage is negatively related to agency costs but positively related to firm value, however, as discussed in section 2.2, in Taiwan, the non-interest tax shield not only can serve as the substitute for interest tax shield, but also greater far from interest tax shield. the more take advantage of interest tax shield. the more inefficient to firm, therefore, leverage is negatively related to technical efficiency.

TAN are significantly negatively related to TE in all industries, the result is inconsistent

with our prediction. Based on most previous empirical results, tangibles are positively related to leverage and firm values. However, as concluded above, leverage is negatively related to technical efficiency, as a result, tangibles is negatively related to technical efficiency.

PR is significantly positively related to TE in all industries, the results are consistent with our prediction. SIZE is also significantly positively related to TE in electronic and chemical industries, because they are much larger in scale than textile industry. Therefore, they can capture the effect of economies of scale, the result is consistent with our prediction. OWN is positively related to technical efficiency, which imply that ownership structure is positively related to firm performance, the result conform to the convergence of interest hypothesis.

4.3 The Effect of Technical Efficiency on Leverage

Table 4. LEV regression on TE for all Industries

Variables / Industries	Con	TE	PR	TAN	SIZE	OWN
Electronic	-0.088 0.036**	-0.188 0.000***	-0.645 0.000***	-0.106 0.000***	0.035 0.000***	0.001 0.622
Textile	-0.905 0.000***	0.286 0.148	-1.50 0.078*	0.73 0.002***	0.069 0.000***	0.001 0.819
Chemical	-0.323 0.002***	-0.235 0.000***	-0.408 0.019**	-0.227 0.000***	0.051 0.000***	0.001 0.048**

Note:1. dependent variable: LEV
2. *,**,*** denote 10%, 5% and 1% significant level respectively

Table.4 shows TE is positively related to LEV in textile industry, which is consistent with Berger and Bonaccorsi (2006) and support the efficiency-risk hypothesis (**H3**). TE is significantly negatively related to LEV in electronic and chemical industries, which is in harmony with Demsetz et al(1996), Berger and Bonaccorsi (2006) and support the franchise-value hypothesis(**H4)** , non-interest tax shield (**H5)** we proposed. why the more efficient firms, the less use debt finance, the reason is as same as section 4.2 discussed above.

PR is significantly negatively related to LEV and SIZE is significantly positively related to LEV in all industries, the results are in harmony with our prediction. TAN is significantly positively related to LEV in textile industry, which is in line with our prediction, while TAN is significantly negatively related to LEV in electronic and chemical industries , which is not in line with our prediction. Firms in the textile industry has larger tangible than firms in the electronic and chemical industries, therefore, the effect of tangible on leverage is positive in this industry.

4.4 The Effect of Technical Efficiency on Leverage Based on LEV Above 45%

Table5, LEV regression on TE based on LEV above 45% for all Industries

Variables / Industries	Con	TE	PR	TAN	SIZE	OWN
Electronic	0.533 0.000***	-0.025 0.611	-0.267 0.000***	-0.034 0.123	0.002 0.516	0.000 0.679
Textile	0.843 0.001***	0.492 0.014**	-2.437 0.001***	0.72 0.002***	-0.004 0.825	0.000 0.843
Chemical	0.454 0.002***	-0.1113 0.330	-0.042 0.871	-0.059 0.342	0.002 0.872	0.002 0.000***

Note:1. dependent variable: LEV
2. *,**,*** denote 10%, 5% and 1% significant level respectively

If we examine the effect of TE and control variables on LEV, table5 display clearly that the results are as same as table 4. The little variation are follows: first: the effect of technical efficiency on leverage is form positively but insignificantly to positively and significantly on textile industry. Second: the effect of technical efficiency on leverage is significantly and negatively but insignificantly on electronic and chemical industries. It implies that the level of leverage can increase the intensity of the effect of technical efficiency on leverage on textile industry, while can decrease the intensity of the effect of technical efficiency on leverage on electronic and chemical industries, but cannot change the direction of influence between technical efficiency and leverage.

4.5 The Effect of Technical Efficiency on Leverage Based on LEV Below 45%

Table.6 LEV regression on TE based on LEV below 45% for all Industries

Variables / Industries	Con	TE	PR	TAN	SIZE	OWN
Electronic	**0.076** **0.038****	**-0.077** **0.081***	**-0.304** **0.000*****	**-0.02** **0.207**	**0.016** **0.000*****	**0.000** **0.679**
Textile	**-0427** **0.001*****	**-0.237** **0.075***	**1.409** **0.021****	**0.72** **0.002*****	**0.045** **0.000*****	**0.004** **0.001*****
Chemical	**-0.199** **0.018****	**-0.091** **0.051****	**-0.255** **0.051**	**-0.056** **0.141**	**0.034** **0.000*****	**0.0013** **0.980**

Note:1. dependent variable: LEV
2. *,**,*** denote 10%, 5% and 1% significant level respectively

If we examine the effect of TE and control variables on LEV, table6 display clearly that the results are as same as table 4. The little variation are follows: first: the effect of technical efficiency on leverage is form positively but insignificantly to negatively and significantly on textile industry. Second: the effect of technical efficiency on leverage is form negatively related at 1% significant level to negatively related at 10% and 5% significant respectively on electronic and chemical industries. It implies that the level of leverage can decrease the intensity of the effect of technical efficiency on leverage on electronic and chemical industries, and can change the direction of influence between technical efficiency and leverage on textile industry.

5. Conclusion and Implication

5.1 Conclusion

In this paper, We use performance model and Leverage model to test the agency cost hypothesis (H1), interest-tax shield hypothesis (H2) efficiency-risk hypothesis (H3), franchise-value hypothesis (H4) and non-interest shield hypothesis (H5) , where H1 and H2 are used to test the effect of leverage on technical efficiency, while H3, H4 and H5 are used to examine the effect of technical efficiency on leverage. The empirical results show that leverage is negatively related to technical efficiency in all industries but significantly in textile industry only, which are contradicted with Jensen and Meckling (1976), Myers (1977), Jensen (1986), Myers (2001), Berger and Bonaccorsi di patti (2006) and does not support **H1** we proposed, but supports **H2** we put forward. This may be attributed to that Taiwan authorities offer the credit incentive for investment, research and development, acceleration depreciation and loss carry-forward to all industries. As a result, the non-interest tax shield exert the more influence than interest tax shield to the effect of leverage on technical efficiency.

Regarding the effect of technical efficiency on leverage, the empirical results show technical efficiency is positively related to leverage in textile industry, which is consistent with Berger and Bonaccorsi (2006) and support the efficiency-risk hypothesis (**H3**). Technical efficiency is significantly negatively related to leverage in electronic and chemical industries, which is in harmony with Demsetz et al.,(1996), Berger and Bonaccorsi (2006) and support the franchise-value hypothesis(**H4)** and **H5** we proposed, why the more efficient firms, the less use debt finance, the reason is as same as foregoing discussion.

Regarding how the level of leverage to influence the effect of technical efficiency on leverage, the empirical results display as follows: if leverage ratio is above 45%, the level of leverage can increase the intensity of the effect of technical efficiency on leverage on textile industry, while can decrease the intensity of the effect of technical efficiency on leverage on electronic and chemical industries, but can not change the direction of influence between technical efficiency and leverage. While if leverage ratio is below 45%, the level of leverage can decrease the intensity of the effect of technical efficiency on leverage on electronic and chemical industries, and can change the direction of influence between technical efficiency and leverage on textile industry. It imply that the efficiency-risk hypothesis and franchise-value is not suited for different industries.

Based on the results, we can come to the following conclusion: firstly, not all finance theory can be applied properly in different industry, because we must consider firm and industry characteristics. Secondly, manager make finance decision must consider the interest tax shield and non- interest tax shield simultaneously to maximize the firm values. Thirdly, other than accounting data, firms had better measure the performance from viewpoint of production efficiency to examine whether firm use the resources efficiently or not.

5.2 Implication

This paper provide manager insight into following viewpoint, firstly, beside the traditional accounting performance measure, firm must use production efficiency measure to examine whether input and output conform with efficiency, so as to assure firm' resources for best use. Secondly, Chief Finance Officer (CFO) making finance decisions must consider the interest tax shield and non- interest tax shield simultaneously to maximize the firm values.

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