

“How microeconomic factors influence Vietnam’s listed manufacturing firm value”

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HOW MICROECONOMIC FACTORS INFLUENCE VIETNAM'S LISTED MANUFACTURING FIRM VALUE

Abstract

It is meaningful to identify and quantify the impact of business microeconomic factors on firm value, not only for enterprises, but also for the industry, which contributes to the economic growth of the whole country. This paper aims to find evidence of how microeconomic factors relate to the value of manufacturing firms, helping businesses behave and adjust towards the goal of value maximization. This study applies three commonly used estimators with panel data, namely OLS, FEM and REM, using data obtained from FiinPro (a data providing company) and Vietstock on 691 companies listed on Vietnam's two stock exchanges from 2008 to 2015; This was a sensitive period of world financial crisis, and Vietnamese manufacturing firms had a really hard time to overcome the difficulty in a global economy downturn. This paper found that (1) firm size, growth opportunities and financial leverage negatively affect firm value; (2) there is no evidence that operating cash flow, cash liquidity and intellectual capital affect firm value; (3) the estimation results confirm the non-linear relationship (order 3) between the directors' share ownership ratio and corporate value; (4) state ownership and foreign ownership ratios have a negative effect on Vietnamese listed manufacturing firms during the period, but (5) there is no optimal number of BOD members. The findings help to measure the extent of the positive and negative impact of various factors, making it easier to find solutions to improve business value by promoting positive factors and preventing negative factors.

Keywords

Vietnamese manufacturing firms, impact of microeconomic factors, firm value, value-added intellectual capital, ownership

JEL Classification

G12, G32, G34

INTRODUCTION

Identifying factors that can positively affect corporate value is very important to enhancing the value of a company and helps to solve the basic problem of "how to maximize the benefits of the company shareholders". As for macro factors, after finding their influence on business value, an entrepreneur can choose the best option and make decisions related to business activities to suit the business context, to achieve the best performance in objective external conditions. Meanwhile, after identifying the influence of micro factors on business value, the entrepreneur can personally control and manage those factors proactively without waiting for market adjustment. Therefore, identifying and quantifying the impact of the microeconomic factors of the business is extremely important.

In Vietnam, during business operation, issues such as capital management, spending allocation, personnel decisions, cash flow adjustment, dividend policy, etc. are decided by business leaders based on their self-analysis and data from their own firms during specific periods. Very few researches deeply analyze and give proofs regarding the trend for the whole industry. Therefore, the specific measures applied

in each enterprise are sometimes subjective, imposed, and even somewhat impulsive if compared with the general context, and sometimes not really appropriate.

For this reason, it is absolutely necessary to obtain general studies, to point out broad trends across the industry, so that theoretical frameworks and empirical evidence can be established for the adjustment of policies and strategies in enterprises, helping them to improve their operation quality and thereby increase their value. One of the specific things to do right away is to have studies that show real evidence about the relationship between the microeconomic factors in each industry and the enterprise value of that industry, thereby becoming a guideline for businesses to behave and adjust towards the goal of maximizing value.

The manufacturing industry is considered to be important in promoting GDP growth in Vietnam. Improving the value of industrial production enterprises is not only meaningful for the enterprises themselves to improve their image and mobilize capital, but also has great significance for the whole industry, by helping to promote economic growth of the whole country. This study focuses on manufacturing enterprises, excluding commercial, service and financial enterprises because there are differences between the two groups. Manufacturing enterprises have fewer intangible factors, which are difficult to determine and measure compared with service enterprises, so the market value of enterprises seems to be less variable and different from the intrinsic value.

The period of 2008–2015 was important, not only for the world economy, but also for Vietnamese economy, because many serious events occurred during this time, including (1) Global Financial Crisis, which began in the United States with the collapse of the housing market, and spread very fast to other parts of the world, leading to a severe economic slowdown and (2) Great Recession, which was the most severe economic downturn since the Great Depression of the 1930s. Although the recession in the USA lasted only from December 2007 to June 2009, many people felt its effect about 5-6 years later. (3) the Rise of Emerging Markets, namely India, Brazil and China, who had strong economic growth and played crucial role in the global economy. (4) Volatility of Oil Price with oil prices reaching historic highs in 2008 and then dropping sharply in 2014–2015, dramatically affecting the global economy, especially for oil-producing countries and manufacturing industries. Therefore, this paper focuses on the impact of microeconomic factors on the value of Vietnamese manufacturing firms during 2008–2015 to see clearly the typicality of this period.

The timeframe after that (2016–2022) was another period that was greatly impacted by the COVID-19 pandemic, so the effect of microeconomic factors on the value of manufacturing firms is totally different and should be considered separately in another study to avoid misunderstanding.

1. LITERATURE REVIEW AND HYPOTHESES

Intrinsic value and market value are two main concepts of firm value that have been mentioned in the previous literature. Intrinsic value can be understood to be the real value of an enterprise, including other variables such as trademarks, copyrights, etc., which accurately reflects market prices of shares. Intrinsic value is the basic factor that determines the market price, but in addition, there are many other factors outside the scope of the business such as the economic, political and

social situation domestically and internationally, even psychological factors and the subjective assessment of investors have a remarkable impact. The market value of an enterprise fluctuates around its intrinsic value, but in a certain period, the market value may be higher or lower than the intrinsic value. Although the market price fluctuates continuously, it often revolves around the intrinsic value and cannot be very different from the intrinsic value.

The intrinsic value of an enterprise is determined in various ways with numerous different

approaches, but the intrinsic value is also highly subjective depending on the implementer. The process of collecting data and applying valuation models to determine the intrinsic value of businesses objectively and accurately is faced with many difficulties. Consequently, in the following sections of this paper, enterprise value is measured on the basis of Tobin's Q index, based on Fauver and Naranjo's (2010) study, where Tobin's Q is computed as follows:

$$\text{Tobin's } Q = \frac{a + b - c}{b}, \quad (1)$$

where a – owner's equity market value, b – assets' book value, c – owner's equity book value.

The Tobin's Q index was proposed by James Tobin in 1969. His idea is to get the market value divided by the replacement value of a company's assets. If it is greater than 1 then the Q index indicates that this company has growth prospects and should accelerate growth. Conversely if Q is less than 1, the company will reduce investment. Later, Chung and Pruitt (1994) proposed the formula to determine the approximate value of Tobin's Q as:

$$Q = \frac{MVE + DEBT + PS}{TA}, \quad (2)$$

where MVE – market value of equity, $DEBT$ – liabilities and book value of long-term debt, PS – market price of preferred stock, and TA – total assets.

Various theoretical and practical studies have been conducted throughout the world on the influence of some micro-factors on firm value, but they mostly stop at a few single factors. There are few that synthesize many factors in one study. Besides, the research scope within manufacturing firms is almost nonexistent. Some prominent studies on different factors' impact on firm value can be mentioned, such as Chu-Sheng (2003) (market portfolio risk, portfolio size, book/market value (HML) and momentum factor (UMD)); Vassalou (2003) (market portfolio risk and GDP future growth rate); Simpson and Ramchander (2008) (market portfolio risk, portfolio size SMB and book value/market value (HML)); Aretz et al. (2010) (effect of momentum); Soon-Ho Kim et al. (2012)

(liquidity risk, maturity difference, payment risk difference); Berger (2003) (owner and agent costs); Coad (2007), Davidsson et al. (2009) (growth rate); Oliveira et al. (2010) (intangible assets in financial statements of non-financial firms). To date, virtually no research in the world comprehensively mentions all the above micro factors in relation to firm value, especially firms in Vietnam.

In Vietnam, how individual factors relate to firm value has been tested in a number of studies.

Vũ Thị Bích Hà and Đặng Ngọc Hùng (2022) uses tabular data with 5706 observations, in companies listed on the Vietnamese stock market in the period of 2009 – 2019 and multivariate regression to detect the appropriateness of accounting information which tends to increase, but has a negative effect on firm value, and find that the size of the firm has a positive effect on the enterprise value while capital structure has a negative relationship on the enterprise value. Phạm Thị Thúy Hằng (2022) examines the impact of corporate social responsibility (CSR) and confirms that basing on the value at 374 nonfinancial companies listed on the Ho Chi Minh City Stock Exchange (HOSE) and the Hanoi Stock Exchange (HNX) from 2010 to 2016, the findings reveal that CSR positively impact firm value. Lê Hoàng Vinh et al (2022) evaluates the moderating role of tax and financial distress on the impact of financial leverage on firm value for the case of non-financial firms listed in Viet Nam. The research sample is determined by purposive sampling method, including 504 companies in the period 2015-2020, and accordingly the authors used secondary data collected from audited financial statements of companies. Based on the conclusion about robustness and stability, the GLS estimation results confirmed that firm value is positively affected by the financial leverage, but it is negatively affected by tax and financial distress. In addition, financial distress as a moderating variable increased the positive impact of financial leverage on firm value, while the moderating role of tax on this impact is insignificant.

Phạm Đức Hiếu and Nguyễn Thị Minh Giang (2022) study the impact of human resource accounting disclosure on the value of non-financial enterprises listed on the Vietnamese stock market and shows that there is a statistically significant

positive impact between human resource accounting information disclosure and firm value. Lê Thị Công Ngân (2021) points out the factors affecting the criteria for determining enterprise value, thereby proposing some orientations to improve the criteria for determining the value of forestry enterprises. The study finds out that there are two groups of factors affecting the value determination of forestry enterprises, namely the group of common factors and the group of production characteristics of forestry enterprises. Besides macro and micro factors, forestry enterprises have their own business characteristics such as long production cycle, diversity, difficult terrain for production, seasonal production and special characteristics of forests and forest land.

Lê Đức Hoàng et al (2021) investigates the impact of stock liquidity on firms' value and shows that an increase in stock liquidity leads to increase in firm value. Võ Minh Long (2018) investigates the impact and the threshold of capital structure in general and terms in particular to the firm value of joint stock companies listed on Ho Chi Minh City Stock Exchange (HSX) and shows that the capital structure in general and the termly capital structure in particular make a positive impact on firm value. In addition, it is also found that the threshold of capital structure affects the firm value maximization.

Lê Hoàng Vinh and Nguyễn Thị Tố Loan (2017) did a research on the impact of profits on the value of non-financial enterprises listed on the Ho Chi Minh Stock Exchange (HOSE) and shows that profitability has a positive effect of firm size and the opposite of capital structure showing the level of debt utilization. Nguyễn Ngọc Huy and Trương Thị Mỹ Trâm (2016) tests the relationship between dividend policy and firm value with data including 920 observations of companies listed on the Ho Chi Minh City Stock Exchange which demonstrates that there is a nonlinear relationship between dividend policy and firm value; cash dividend policy has a great impact on enterprise value; stock dividend has little impact and is not statistically significant.

Do Van Thang and Trinh Quang Thieu (2010) found a close relationship between firm value and financial structure, concretely: (1) There is a rela-

tion (order 3) between firm value and the debt/equity ratio; (2) When the debt ratio rises but is less than 105%, firm value increases, but when the debt ratio is greater than 105%, the negative effect happens; (3) At a debt ratio of 105%, the firms' capital structure will be optimal.

Nguyen Thi Lien Hoa et al. (2015) proved a non-linear relationship between cash holdings in Vietnamese enterprises from 2008 to 2013. The results show that there is a 2nd and 3rd order non-linear relationship between the performance of the business and the cash to total assets ratio of an enterprise. Vietnamese firms have a tendency to hold cash up to a certain percentage, and adjust to the optimal cash ratio for themselves.

Pham Hong Huu Thai (2013) uses data of 646 listed companies in two Vietnamese stock exchanges from 2011 to 2012. State ownership was found not to affect firm value on the stock market. Meanwhile, that research shows that as foreign ownership ratio and the firm size increase, the value of a firm also increases, and the state ownership ratio does not explain the volatility of the firm value (variable Q). In addition, increasing private ownership does not increase firm value and vice versa. The reason may be that in the years after the 2008–2013 crisis, Vietnam's stock market went down, negatively affecting Tobin's Q (most companies have a Tobin's Q coefficient of less than 1). When enterprises change their ownership structure, there should also be a delay to improve the value of enterprises.

Trinh Thi Phan Lan (2015) explores how risk management affects firm value by surveying past studies and finds that risk management positively affect firm value.

Other studies in Vietnam have focused on the impact of some micro-factors on stock prices, rather than studying the effects of these factors on firm value directly (Vo Xuan Vinh, 2014; Nguyen Thi Thuc Doan, 2011; Nguyen Viet Dung, 2009; Nguyen Thu Thuy, 2008).

From the summary of previous research experiences in countries around the world and in Vietnam on the influence of each micro-factor on the value of manufacturing enterprises, the re-

Table 1. Hypotheses and references

| Hypothesis | Empirical studies | Theoretical studies |
|--|--|--|
| Hypothesis 1: Firm size and value are positively related | Berger & Patti (2006), Le Phuong Lan (2016) | Zeitun et al. (2007), Fauver & Naranjo (2010), Putu et al. (2014) |
| Hypothesis 2: Operating cash flow positively impacts firm value | Rahman & Mohd-Saleh (2001), Le Phuong Lan (2016) | Fauver & Naranjo (2010), Zararee & Al-Azzawi (2014) |
| Hypothesis 3: Growth opportunities positively affect firm value | Hermuningsih (2013) | Fauver & Naranjo (2010) |
| Hypothesis 4: Financial leverage influences firm value negatively | Modigliani and Miller (1963), Jensen and Meckling, 1976), Le Phuong Lan (2016) | Iavorskyi (2013), Vintilă and Gherghina (2013), Fauver and Naranjo (2010), Lins (2003) |
| Hypothesis 5: Liquidity has negatively impacted firm value | Loncan and Caldeira (2014), Le Phuong Lan (2016) | Jensen and Meckling (1976) |
| Hypothesis 6: Intellectual capital positively affects firm value | Chen (2011), Evisson (1997) | Wang (2014), Chen et al. (2008) |
| Hypothesis 7: Director ownership and firm value present a non-linear relationship | Shleifer and Vishny (1988) | Shleifer and Vishny (1988), Ang et al. (2000), Jensen and Meckling (1976), Lins (2003) |
| Hypothesis 8: 8a: The relationship between state ownership and firm value is U-shaped (non-linear). 8b: Foreign ownership ratio and firm value have an inverted U-shaped relationship (non-linear) | Le and Phung (2013), Tran et al. (2014), Mao (2015), Le Phuong Lan (2016) | Yu (2010) |
| Hypothesis 9: 9a: Corporate value receives a negative impact of the dual position of Chairman of the Board of Directors and (General) Director 9b: Board size and firm value present a non-linear relationship. 9c: There is a non-linear relationship between the percentage of non-executive board members and firm value | Vo and Nguyen (2014), Coles et al. (2008) | Zöllner (2014) |

search hypotheses will be put forward, including the following factors: Firm size, cash flow, growth opportunities, capital structure, liquidity, intellectual capital, director ownership, ownership structure, company governance.

2. METHOD

This study uses three commonly used estimators with panel data: ordinary least squares (OLS), fixed effects model (FEM) and random effects model (REM).

2.1. Ordinary Least Squares (OLS)

In the OLS model, the coefficients do not change, all intercepts and slopes are assumed to be the same across entities (individuals, businesses, countries, etc.); In this way, the spatial and temporal axes of the panel data are ignored, the data is aggregated, and OLS is estimated (Akbar et al., 2011).

If the individual effects (cross effects or time effects) do not exist ($u_i = 0$), the OLS produces efficient and uniform estimators.

$$Y_{it} = \alpha + X_{it}^T \cdot \beta + \varepsilon_{it} \quad (u_i = 0). \quad (3)$$

2.2. Fixed Effects Model (FEM)

The FEM model considers the fixed effects of individuals or time periods, or both. In this model, a fixed effect of i individuals using $i-1$ dummy variables is considered. The functional form of the one-way fixed-effects model (of an individual) is as follows:

$$Y_{it} = (\alpha + u_i) + X_{it}^T \cdot \beta + \varepsilon_{it}, \quad (4)$$

where u_i is the specific fixed effect of an individual or time period, and the error ε_{it} follows the IID distribution law $(0, \sigma^2)$.

2.3. Random Effect Model (REM)

The one-way random effects model is as follows:

$$Y_{it} = \alpha + X_{it}^T \cdot \beta + (u_i + \varepsilon_{it}). \quad (5)$$

Unlike the FEM model, the idiosyncrasies of entities (u_i) are assumed to be random, which are uncorrelated with the independent variables, and

part of the overall random error ($u_i + \varepsilon_{it}$). This study uses a random effects model when it is believed that discrepancies between entities have an influence on the dependent variable.

All variables, both dependent and explanatory, used in the model are summarized below:

- Tobin's Q: representing firm value, following Fauver and Naranjo (2010).

Tobin's Q = (market value of equity + book value of assets – book value of equity)/book value of assets.

- Firm's size (*Size*) is expressed by total assets. To prevent the estimated coefficient from being too small, this variable is computed by taking total assets' natural logarithm.
- Cash flow impact (*CFO*): is measured by taking cash flow from operating activities divided by net sales.
- The growth opportunity of a business is often expressed by R&D costs. However, this entry is not presented in the financial statements, so the capital expenditure to net sales (*Capex*) ratio is used instead. Investment costs in purchasing and upgrading fixed assets represent growth opportunities for the business (Fauver & Naranjo, 2010). Businesses that perceive business expansion opportunities will invest more in fixed assets, so a high ratio usually reflects a high growth opportunity.
- Capital structure (*Leverage*) = total debt/total assets.
- Cash ratio (*Liquid*) is measured by taking cash and cash equivalents divided by short-term debt, showing the ability of the business to pay due debts or payable immediately.
- Value added intellectual capital (*VAIC*):

VAIC is a coefficient proposed by Pulic (2000), which can be used to measure the extent to which “a firm creates added value based on the intellectual efficiency or intellectual resources” (Stahle et al., 2011).

The calculation of VAIC has been adjusted due to certain differences in accounting standards in the presentation and disclosure of the financial statements' information of public companies in Vietnam. Huselid (1995) demonstrated that selling and administrative expenses are sufficient to represent salary costs, so in this study, selling and administrative expenses will be used to represent salary costs.

The calculation of VAIC is explained as follows:

$$\text{Value added (VA)} = EC + OP + D + A, \quad (6)$$

where *OP* – operating profit (before taxes and interest), *EC* – salary expense, *D + A* – depreciation expense.

$$\text{Human capital efficiency (HCE)} = \frac{VA}{HC}, \quad (7)$$

where *HC* – human capital, measured by labor cost (*EC*).

Structural Capital Efficiency:

$$SCE = \frac{SC}{VA} = \frac{VA - HC}{VA}. \quad (8)$$

Capital Employed Efficiency:

$$CEE = \frac{VA}{CE}. \quad (9)$$

In which, *CE* is the capital used, calculated by the value of total assets minus short-term liabilities.

The VAIC coefficient is equal to the sum of three efficiency indicators:

$$VAIC = HCE + SCE + CEE.$$

- State ownership rate (*SO*) and foreign ownership ratio (*FO*) are two variables that stand for ownership.
- To represent the separation of management and ownership in the enterprise, the variable individual ownership of directors (*OWNCEO*) is used to avoid inconsistencies in the collected data (because if the ownership ratio is taken Ownership of the board of directors may encounter heterogeneity due to the difference in the formation of the board. In some enter-

prises, the board of directors is at the firm level, but in some cases, the board of directors includes members from branches, agents).

- The variable representing the duality of the Chairman of the Board of Directors (*CEOCHAIR*), along with other tools used to evaluate corporate governance, represents the concentration of power. *CEOCHAIR* is a dummy variable, which takes value of 1 if CEO is also the Chairman of the Board, and 0 otherwise.
- Size of Board of Directors (*BoardSize*) and non-executive board members (*NED*) are also used to test the relationship with firm value.

Non-executive members include, but are not necessarily independent members. In addition, specialist BOD members are still considered to be non-executive BOD members.

The variables SO^2 , FO^2 , $BoardSize^2$, NED^2 , SO^3 (which are the squares of *SO*, *FO*, *BoardSize*, *NED*, and the cube of *SO*, respectively) are put in the model to test hypotheses about the U-shaped/inverted U-shape/non-linear relationship between state ownership ratio, foreign ownership ratio, board size, ratio of non-executive board members and firm value, respectively.

Data for this paper are obtained from FiinPro database and Vietstock. Data of 691 companies listed on the two stock exchanges of Vietnam, namely *HOSE* and *HNX* in the period 2008–2015 are extracted. The 7-year data are used as this is the period in which the whole world suffered from severe financial crisis, and Vietnam manufacturing firms endured hard times, when all micro-factors were experiencing serious difficulties. The paper focused on the impact of those factors in this peri-

od on firm value to try to see the problem in a special situation, which Vietnam is obviously part of.

The data collected includes financial indicators (such as market capitalization, total assets, common share book value, net revenue, net cash flow from operating activities, expenditure on purchases of fixed and long-term assets, cash ratio, financial leverage, (*EBIT*), selling expenses, administrative expenses, short-term debt, market value to book value ratio) and state ownership rate, as well as foreign ownership ratio. Companies listed in the FiinPro database are classified as per the Industry Classification Benchmarking “ICB” standard, which was developed by Dow Jones and FTSE.

Enterprises listed after 2008 were removed from the sample to create fixed table data instead of pivot table data. Similar to Yu et al. (2010), enterprises with negative EBIT are excluded from the sample so that the values of the VAIC variable and the VAIC components are not negative.

The data set of FiinPro does not provide details of directors board and executive board, so the annual reports of enterprises obtained from <http://finance.vietstock.vn/> are used. The data collected from the annual report involves: the number of Board of Directors members, the number of the Board of Directors non-executive members, the ownership proportion of the Director (General Director), and information of whether the Chairman of the Board of Directors is holding the position of Director/General Director or not. In some cases, the prospectus and financial statements are used as a substitute for, or in addition to, the annual report.

Table 2 summarizes the classification of the research industry sample.

Table 2. Industry structure of the sample

Source: Compiled by authors.

| Industry (Level 1, per IBC) | No. of observations | Rate | No. of firms | Rate |
|-----------------------------|---------------------|---------|--------------|---------|
| Basic materials | 327 | 18.15% | 52 | 18.51% |
| Consumer goods | 298 | 16.54% | 44 | 15.66% |
| Medical equipment | 82 | 4.55% | 13 | 4.63% |
| Industrial commodities | 925 | 51.33% | 146 | 51.96% |
| Technology | 68 | 3.77% | 11 | 3.91% |
| Utilities | 102 | 5.66% | 15 | 5.34% |
| Total | 1802 | 100.00% | 281 | 100.00% |

3. RESULTS

Table 3 summarizes some statistical descriptions of the variables. Tobin's Q shows the correlation between a firm's market and book value, with an average value of 1.38. Although there may be a slight difference in the calculation method, in general, the market value of Vietnamese manufacturing enterprises is smaller than that of some countries in the region such as Singapore (2.03), Malaysia (1.77) or China (1.41). This shows that generally book value is less than market value.

Table 3. Statistic description

| Variable | No. of Obs | Mean | Std Dev | Min | Medium | Max |
|------------------|------------|------|---------|--------|--------|-------|
| <i>TobinsQ</i> | 1802 | 1.38 | 0.65 | 0.60 | 1.17 | 6.42 |
| <i>Size</i> | 1802 | 6.27 | 1.29 | 3.10 | 6.23 | 11.18 |
| <i>CFO</i> | 1802 | 0.06 | 0.40 | -12.97 | 0.05 | 2.96 |
| <i>Capex</i> | 1802 | 0.11 | 0.63 | -0.43 | 0.03 | 20.90 |
| <i>Leverage</i> | 1802 | 0.54 | 0.21 | 0.00 | 0.57 | 0.97 |
| <i>Liquid</i> | 1802 | 0.50 | 1.00 | 0.00 | 0.18 | 14.64 |
| <i>VAIC</i> | 1802 | 4.11 | 3.39 | 1.23 | 3.22 | 39.91 |
| <i>SO</i> | 1802 | 0.29 | 0.25 | 0.00 | 0.30 | 0.91 |
| <i>FO</i> | 1802 | 0.08 | 0.13 | 0.00 | 0.02 | 0.49 |
| <i>OWNCEO</i> | 1802 | 0.04 | 0.07 | 0.00 | 0.01 | 0.65 |
| <i>CEOCHAIR</i> | 1802 | 0.35 | 0.48 | 0.00 | 0.00 | 1.00 |
| <i>BoardSize</i> | 1802 | 5.50 | 1.11 | 3.00 | 5.00 | 11.00 |
| <i>NED</i> | 1802 | 0.53 | 0.19 | 0.11 | 0.57 | 1.00 |

Among the manufacturing industries, the utility sector has a number of indicators that outperform the rest, such as operating cash flows, investment in fixed assets, cash solvency, intellectual capital, state ownership and non-executive members. However, the firm value of this industry is only the third most appreciated by the market. The market has the highest evaluation of consumer goods enterprise value, followed by medical equipment manufacturing and trading enterprises.

Table A1 (see Appendix) summarizes the results of OLS regression. Model 1 analyzes the linear effects of independent variables on *Tobin's Q*. Model 2 studies the quadratic non-linear relationships between state ownership rate, foreign ownership rate, board size, ratio of non-executive directors and firm value by adding SO^2 , FO^2 , $BoardSize^2$ and NED^2 variables. Model 3 adds the variables $OWNCEO^2$ and $OWNCEO^3$ to explore the N-shaped/non-linear relationship between director's ownership and firm value.

The large *F*-statistics, *p*-value < 1% show the appropriateness of the models. When adding variables from model 1 to model 3, the adjusted R^2 values all increased, although the increase was quite modest, showing that the variables in the following model are good to explain the variation of *Tobin's Q*.

The OLS regression results from model 1 to model 3 in table A1 (in appendices) show a significant positive impact of the size of firms, operating cash flow and duality on firm value while financial leverage significantly negatively affects firm value. The non-linear relationship between the director ownership ratio, state ownership ratio, foreign ownership ratio and firm value, respectively, is also confirmed through statistically significant estimates in models 2 and 3. However, there was very little evidence supporting the impact of growth opportunity, quick solvency, board size and non-executive directors' percentage on firm value through the OLS estimation.

However, the consistency and effectiveness of the coefficients in panel data analysis using pooled OLS is often questioned because pooled OLS models do not take into account unobserved effects or individual effects (Baltagi, 2005). To solve this problem, random-effects and fixed-effects models are used.

Table A2 (see appendices) summarizes the estimated results using the random effects model. Breusch-Pagan LM test results for all 3 models confirm that the REM random effects model is better than the pooled OLS.

Table A3 (see appendices) summarizes the estimated results using FEM. The large *F*-statistics, *p*-value < 1% show the appropriateness of the models. The *F* test for all 3 models confirm that the FEM model is better than OLS.

It demonstrates that signs of the estimated coefficients and the significance level in the REM and FEM models are quite similar. To decide which REM or FEM is more appropriate, Hausman or Sargan-Hansen (*xtoverid*) tests are performed. FEM is found to be better than both OLS and REM.

In the regression results table with the FEM model (see table A3 in appendices), all 3 models confirm that the variables *CFO*, *Capex*, *Liquid*, *BoardSize*

Table 4. Correlation matrix

| | TobinsQ | Size | CFO | Capex | Leverage | Liquid | VAIC | SO | FO | OWNCEO | CEOCHAIR | BoardSize | NED |
|------------------|----------|----------|----------|---------|----------|----------|----------|----------|---------|----------|----------|-----------|-----|
| <i>TobinsQ</i> | 1 | | | | | | | | | | | | |
| <i>Size</i> | 0.0849* | 1 | | | | | | | | | | | |
| <i>CFO</i> | 0.1017* | 0.0332 | 1 | | | | | | | | | | |
| <i>Capex</i> | -0.0383 | 0.1043* | 0.0233 | 1 | | | | | | | | | |
| <i>Leverage</i> | -0.4392* | 0.2669* | -0.1163* | 0.0258 | 1 | | | | | | | | |
| <i>Liquid</i> | 0.2602* | 0.0071 | 0.1503* | 0.0249 | -0.5336* | 1 | | | | | | | |
| <i>VAIC</i> | 0.0443 | 0.1386* | 0.1144* | 0.2627* | -0.1689* | 0.3231* | 1 | | | | | | |
| <i>SO</i> | -0.0580 | 0.0763* | 0.0565 | -0.0476 | 0.0250 | 0.1167* | 0.0879* | 1 | | | | | |
| <i>FO</i> | 0.4038* | 0.3802* | 0.0718* | 0.0260 | -0.2985* | 0.1696* | 0.0012 | -0.1240* | 1 | | | | |
| <i>OWNCEO</i> | 0.0558 | -0.1195* | -0.0910* | -0.0387 | 0.0208 | -0.0986* | -0.1059* | -0.3860* | 0.0369 | 1 | | | |
| <i>CEOCHAIR</i> | 0.0978* | -0.1138* | -0.0672* | -0.0510 | -0.0332 | -0.0364 | -0.0678* | -0.1958* | 0.0130 | 0.3741* | 1 | | |
| <i>BoardSize</i> | 0.1458* | 0.3266* | 0.0131 | 0.0284 | -0.0315 | 0.0171 | -0.0861* | -0.1639* | 0.3205* | 0.0543 | 0.0433 | 1 | |
| <i>NED</i> | 0.0599 | 0.0963* | 0.0509 | 0.0882* | -0.1786* | 0.1498* | 0.1501* | -0.0601 | 0.0653* | -0.1416* | -0.3136* | 0.0784* | 1 |

and *CEOCHAIR* have no significant impact on *Tobin's Q*. The variables *Size*, *Leverage* and *VAIC* negatively influence *Tobin's Q* at the significance level of 1%, 1% and 10%, respectively, in all 3 models. The estimation results of models 2 and 3 demonstrate that no significant non-linear relationship between *SO* and *FO* with *Tobin's Q* exists. Instead, *SO* and *FO* both negatively affect *Tobin's Q*. In contrast, the estimation results confirm that there exists a non-linear relationship between *OWNCEO* and *NED* and *Tobin's Q* but with different shapes. *Tobin's Q* relates to *OWNCEO* in a cubic function. The diagram showing relations between *NED* and *Tobin's Q* is a concave parabola because the slopes of *NED* are positive and those of *NED*² are negative. In other words, as the *NED* increases, *Tobin's Q* will gradually increase up to the maximum point, then decrease.

To determine the maximum point at which the effect direction of *NED* on *Tobin's Q* changes, the following equations with parameters estimated in model 3 with *FEM* estimation are used (*x* is *NED*, *y* is *Tobin's Q*):

$$y = 0.3708 \cdot x - 0.4244 \cdot x^2. \quad (10)$$

$$\begin{aligned} \frac{dy}{dx} &= 0.3708 - 2 \cdot 0.4244 \cdot x = \\ &= 0.3708 - 0.8488 \cdot x. \end{aligned} \quad (11)$$

$$\begin{aligned} \frac{dy}{dx} = 0 &\Leftrightarrow 0.3708 - 0.8488 \cdot x = \\ &= 0 \Leftrightarrow x = 0.44. \end{aligned} \quad (12)$$

Thus, when the proportion of non-executive *NED* members increases, *Tobin's Q* will increase and reach its maximum value at the point where *NED* = 44%, then as *NED* continues to increase, *Tobin's Q* will gradually decrease (see Figure 1).

To determine the minimum and maximum points at which the effect direction of *OWNCEO* on *Tobin's Q* changes, consider the following equations with the parameter estimated in model 3 of *FEM* (*y* is *Tobin's Q*, *z* is *OWNCEO*):

$$Y = -1.1884 \cdot z + 7.6861 \cdot z^2 - 9.0909 \cdot z^3. \quad (13)$$

$$\begin{aligned} \frac{dy}{dz} &= -1.1884 + 2 \cdot 7.6861 \cdot z - \\ &- 3 \cdot 9.0909 \cdot z^2 = -1.1884 + \\ &+ 15.3722 \cdot z - 27.2727 \cdot z^2. \end{aligned} \quad (14)$$

$$\begin{aligned} \frac{dy}{dz} &= -1.1884 + 15.3722 \cdot z - \\ &- 27.2727 \cdot z^2 = \\ &= 0 \Leftrightarrow z = 0.09 \text{ or } z = 0.47. \end{aligned} \quad (15)$$

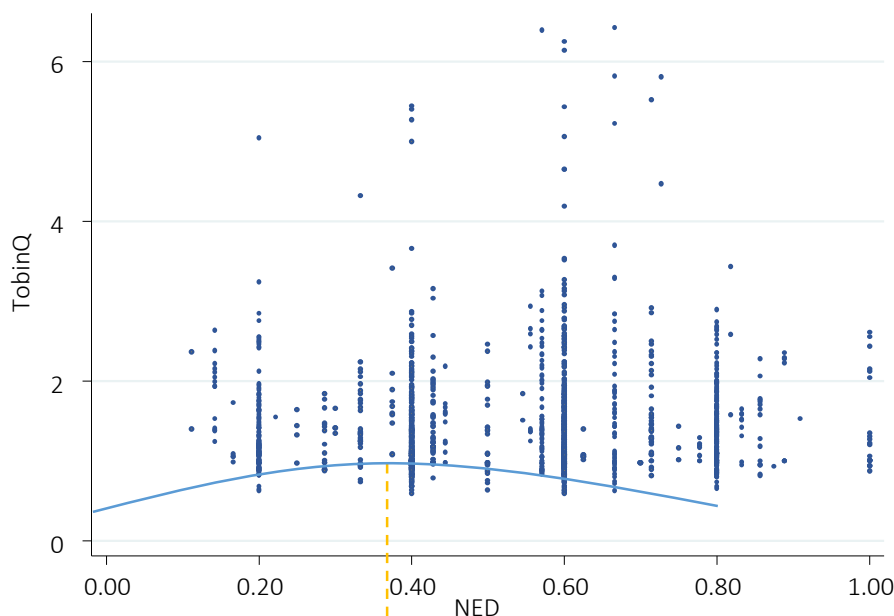


Figure 1. Relationship between *NED* and *Tobin's Q*

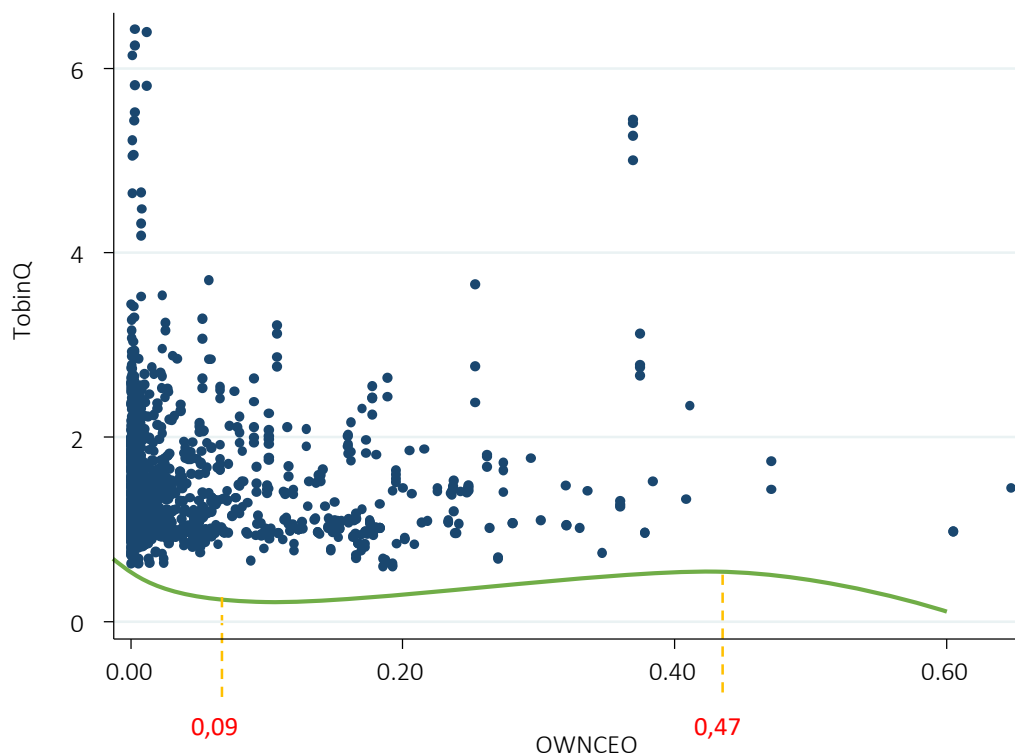


Figure 2. Relationship between *OWNCEO* and *Tobin's Q*

Thus, when the director ownership ratio increases from 0% to about 9%, the firm value decreases; an increase in director ownership between 9% and 47% will make the value of the firm go up; and after 47%, the firm value will decrease again (see Figure 2).

From the estimation results by *FEM* model (see table A4 in the appendices), the slope coefficient *VAIC* is negative, contrary to the expectation. Three sub-coefficients may affect *Tobin's Q* in different directions and the signs of each coefficient are different between models. The *OLS* model shows that human capital *HCE* significantly negatively affects *Tobin's Q* while structural capital *SCE* has significantly positively impact this dependent variable. However, according to the *FEM* estimation results, which is considered more appropriate than *OLS* and *REM* following its test results, no significant impact of *HCE* human capital efficiency and *SCE* structural capital efficiency on *Tobin's Q* is found. The significant negative impact of *VAIC* on *Tobin's Q* has not come from the elements of intellectual capital, in fact, but from *CEE* financial capital.

The estimated results with the components of *VAIC* also show that the remaining factors have

the same impact as the estimated results with *VAIC*, contributing to increasing the reliability of the research results.

3.1. Sector level analysis

Table A5 (see appendices) summarizes the results of model estimation of micro-factors affecting firm value (*Tobin's Q*) of 6 sectors. Under the branches there are three model selection tests: F, Breusch-Pagan LM and Hausman (or Sargan-Hansen). Basing on these tests' results, the most suitable model is selected. Specifically, the *REM* model is suitable for the Basic Materials sector data, while for the remaining sectors, *FEM* is preferred.

Test results show the influence of the micro-factors on the manufacturing firm values specifically in each sector as follows:

Size negatively affects firm value because the slope of the variable *Size* is negative in all 6 models, although it does not reach significance in all models.

No evidence was found to support the idea that operating cash flows have an impact on firm value of all six industries.

The effect of investment opportunity is not uniform across sectors as the sign of Capex varies across models.

As financial leverage goes up, the value of all firms goes down.

The slope of *VAIC* is negative and significant in the Consumer Goods and Utilities sectors. However, as analyzed earlier, this negative effect is not due to the intellectual capital factors (*HCE* and *SCE*) in the *VAIC* but to the tangible and financial capital (*CEE*) factors. Consequently, it is not possible to confirm that intellectual capital negatively influences firm value.

The effects of state ownership and foreign ownership also vary across sectors. Most notably, the state ownership rate and firm value in the Technology and Utilities sectors have a non-linear relationship, but the parabolic form is inverted (the Technology sector has a concave form, while the Utilities sector has convex form). This result implies different state divestment policies in different sectors.

The effect of director ownership is most apparent in the Consumer Goods industry.

The effect of duality is also different in both magnitude and direction, the sign of the estimator being negative in 3 sectors and positive in the other 3 sectors.

Board size doesn't significantly affect firm value across 6 sectors.

The rate of non-executive BOD members negatively impacts Tobin's Q in the Industrial Goods industry.

4. DISCUSSION

Research results find a negative relationship between size and firm value. This result suggests that the disadvantages of large scale outweigh its benefits. The benefits per additional unit of scale are probably gradually decreasing, leading to less benefits for listed manufacturing companies, which must have a relatively large scale to meet listing

requirements. Instead, the research results reinforce the view on problems that arise from having large business scale, such as low performance and agency problems.

The negative impact of financial leverage on firm value in most cases did not support the MM theory of optimal capital structure. The experimental results also show that the signal theory of Ross (1977) is not correct in the case of listed manufacturing firms in Vietnam. Instead, the pecking order theory and the view of Fama and French (1988) can be supported by the results, that high debt is a bad signal about the company's prospects, because future profits will be negatively affected, some of the cash flow is used to repay debt and the amount of capital used for future investments decreases.

This research shows that operating cash flow and fixed asset investment cash flow do little to explain firm value. It also asserts that holding a higher ratio of cash hurts business value.

This is the first study in Vietnam using the *VAIC* approach to examine the influence of intellectual capital on firm value. Although the study provides little evidence on the role of intellectual capital in pushing firm value to go up, its influence still has a solid theoretical foundation supported by considerable experimental evidence throughout the world. This article thereby highlights the increasing role of intangible resources in enterprises and points out that this role may not be fully realized by investors in Vietnam's stock market.

The test results show that enterprises can enhance their value by influencing the ownership structure, namely the state ownership ratio, foreign ownership ratio and director ownership ratio. The non-linear relationship between director ownership ratio and firm value can be considered as evidence supporting both the argument of Jensen and Meckling (1976) that "agency costs decrease as director ownership increases" and the entrenched hypothesis that a too high director ownership ratio will incur entrenched costs.

Given the literature review, it can be seen that this paper is among the few studies in the world to study the non-linear relationship between board size and firm value, and between the proportion of

independent board members and firm value. The findings for the BOD variables are consistent with international practices and Vietnam's legal regulations on corporate governance. Specifically, the size of the Board of Directors doesn't affect enterprise value, so there is no basis to object to the regulation that the number of BOD members ranges from 3 to 11 people. Furthermore, the range above also contains the value that Jensen (1993) and Lipton and Lorsch (1992) consider optimal (7-9 members).

The Vietnam Ministry of Finance also has flexible regulations on having Chairman of the Board

of Directors concurrently working as General Director: not encouraging concurrence but still allowing it if it is approved by the general meeting of shareholders. The rationality of this flexibility can be guessed when the results show that the dimension of the impact of duality on firm value is different across sectors. Finally, the rate of non-executive board members that the research results found to be good for firms is about 44%, which is higher than the minimum 33.33% prescribed by law. This means that firms can change the structure of the Board of Directors to achieve the ratio close to the optimal level without violating the provisions of the law.

CONCLUSION

This study has met the aims of finding evidence about the relationship between microeconomic factors and the value of manufacturing firms, using three commonly used estimators: OLS, FEM and REM. The results from models have demonstrated that firm size, financial leverage and director ownership can affect firm value negatively, the impact of operating cash flows and cash liquidity on firm value of all 6 sectors was not found. Moreover, intellectual capital doesn't affect firm value significantly under the FEM model. While state ownership ratio and foreign ownership ratio generally have a negative impact on enterprise value, the degree of influence varies across industries. Most notably, the state ownership rate has a non-linear relationship with enterprise value in the Technology and Utilities sectors. In addition, there exists a U-shape non-linear relationship (order 3) between director ownership ratio and firm value. Although the effect of director ownership is most apparent in the Consumer Goods industry, the effect of duality is also different in both magnitude and direction. Finally, while board size does not affect firm value significantly across sectors, the proportion of non-executive directors board members impact Tobin's Q negatively in the Industrial Goods sectors.

Those findings can serve as a basis for scholars to refer to, and businesses to apply in adjusting management strategies and policies to with a view to maximizing shareholder benefits, or maximizing the value of stocks. Those solutions may include reducing the bad impact of size on firm value, reducing the rate of cash payment, changing equity ownership structure, adjusting director ownership ratio and strengthening corporate governance through the board of directors. Further studies in the future can go deeper into each of the solutions.

AUTHOR CONTRIBUTIONS

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Validation: Phuong Lan Le.

Visualization: Phuong Lan Le.

Writing – original draft: Phuong Lan Le.

Writing – review & editing: Phuong Lan Le.

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APPENDIX A

Table A1. Impact of factors on Tobin's Q: Pooled OLS model

| Independent variable | Model 1 | | Model 2 | | Model 3 | |
|----------------------|------------------------|--------|------------------------|--------|------------------------|--------|
| | Intercept | t | Intercept | t | Intercept | t |
| Size | 0.0584 *** | 4.35 | 0.0787 *** | 5.86 | 0.0739 *** | 5.49 |
| CFO | 0.0742 ** | 2.27 | 0.0802 ** | 2.50 | 0.0747 ** | 2.33 |
| Capex | -0.0358 * | -1.67 | -0.0317 | -1.50 | -0.0337 | -1.60 |
| Leverage | -1.1714 *** | -13.67 | -1.2630 *** | -14.86 | -1.2413 *** | -14.60 |
| Liquid | 0.0169 | 1.04 | 0.0135 | 0.84 | 0.0124 | 0.78 |
| VAIC | -0.0057 | -1.32 | -0.0070 | -1.64 | -0.0071 * | -1.66 |
| OWNCEO | 0.3655 * | 1.76 | 0.5997 *** | 2.90 | -1.8997 ** | -2.37 |
| OWNCEO2 | | | | | 12.4280 *** | 2.73 |
| OWNCEO3 | | | | | -12.7780 ** | -2.08 |
| SO | -0.0002 | 0.00 | 1.1325 *** | 6.29 | 1.0591 *** | 5.86 |
| SO2 | | | -1.8055 *** | -6.54 | -1.7795 *** | -6.46 |
| FO | 1.1791 *** | 9.24 | -0.5643 * | -1.67 | -0.5901 * | -1.75 |
| FO2 | | | 3.8840 *** | 5.20 | 3.9424 *** | 5.29 |
| BoardSize | 0.0082 | 0.63 | -0.1410 | -1.58 | -0.1316 | -1.47 |
| BoardSize2 | | | 0.0109 | 1.65 | 0.0105 | 1.60 |
| NED | -0.0152 | -0.20 | -0.3685 | -1.13 | -0.3745 | -1.15 |
| NED2 | | | 0.3160 | 1.06 | 0.3065 | 1.03 |
| CEOCHAIR | 0.3655 *** | 3.46 | 0.0904 *** | 2.94 | 0.1066 *** | 3.44 |
| _cons | 1.4763 | 14.60 | 1.9513 *** | 6.45 | 1.9860 *** | 6.58 |
| N | 1802 | | 1802 | | 1802 | |
| Adjusted R2 | 0.2905 | | 0.3160 | | 0.3200 | |
| | F(12,1789) = 62.46 *** | | F(16,1785) = 53.00 *** | | F(18,1783) = 48.08 *** | |

Note: *, **, and *** represent the 10%, 5%, and 1% significance levels, respectively.

Table A2. The impact of factors on Tobin's Q: REM model

| Independent variable | Model 1 | | Model 2 | | Model 3 | |
|----------------------|------------------------|--------|------------------------|--------|------------------------|--------|
| | Intercept | z | Intercept | z | Intercept | z |
| Size | -0.0067 | -0.45 | -0.0027 | -0.18 | -0.0029 | -0.20 |
| CFO | -0.0028 | -0.20 | -0.0026 | -0.19 | -0.0023 | -0.17 |
| Capex | -0.0011 | -0.12 | -0.0010 | -0.11 | -0.0013 | -0.15 |
| Leverage | -0.8034*** | -11.97 | -0.8162*** | -12.12 | -0.7969*** | -11.82 |
| Liquid | -0.0072 | -0.89 | -0.0070 | -0.86 | -0.0072 | -0.88 |
| VAIC | -0.0030 | -1.03 | -0.0027 | -0.92 | -0.0027 | -0.90 |
| OWNCEO | 0.2370** | 1.99 | 0.2367** | 1.97 | -1.3282*** | -2.69 |
| OWNCEO2 | | | | | 8.5045*** | 3.26 |
| OWNCEO3 | | | | | -10.0307*** | -3.05 |
| SO | -0.1134*** | -2.75 | -0.0800 | -0.61 | -0.0851 | -0.65 |
| SO2 | | | -0.0438 | -0.22 | -0.0455 | -0.23 |
| FO | -0.2896*** | -3.07 | -0.4740** | -2.23 | -0.4394** | -2.07 |
| FO2 | | | 0.4796 | 0.98 | 0.4415 | 0.90 |
| BoardSize | -0.0049 | -0.53 | 0.0179 | 0.38 | 0.0208 | 0.44 |
| BoardSize2 | | | -0.0018 | -0.51 | -0.0021 | -0.60 |
| NED | -0.0669 | -1.46 | 0.3193* | 1.84 | 0.3354* | 1.94 |
| NED2 | | | -0.3715** | -2.32 | -0.3938** | -2.47 |
| CEOCHAIR | -0.0122 | -0.66 | -0.0109 | -0.59 | -0.0104 | -0.56 |
| _cons | 1.9722*** | 20.22 | 1.7973*** | 10.19 | 1.8020*** | 10.24 |
| N | 1802 | | 1802 | | 1802 | |
| | chi2(12)=215.82*** | | chi2(16)=223.16*** | | chi2(18)=235.16*** | |
| Breusch and Pagan LM | chibar2(01)=3582.72*** | | chibar2(01)=3508.12*** | | chibar2(01)=3486.47*** | |

Note: *, **, and *** represent the 10%, 5%, and 1% significance levels, respectively.

Table A3. The impact of factors on Tobin's Q: Fixed effects model

| Independent Variable | Model 1 | | Model 2 | | Model 3 | |
|----------------------|----------------------|-------|----------------------|-------|----------------------|-------|
| | Intercept | t | Intercept | t | Intercept | t |
| Size | -0.0503*** | -3.06 | -0.0480*** | -2.91 | -0.0469*** | -2.85 |
| CFO | -0.0105 | -0.79 | -0.0107 | -0.80 | -0.0102 | -0.77 |
| Capex | 0.0000 | 0.00 | -0.0005 | -0.06 | -0.0008 | -0.09 |
| Leverage | -0.6106*** | -8.70 | -0.6075*** | -8.64 | -0.5917*** | -8.41 |
| Liquid | -0.0081 | -1.03 | -0.0079 | -0.99 | -0.0079 | -1.00 |
| VAIC | -0.0052* | -1.77 | -0.0052* | -1.76 | -0.0050* | -1.72 |
| OWNCEO | 0.2360** | 2.00 | 0.2262* | 1.92 | -1.1884** | -2.41 |
| OWNCEO2 | | | | | 7.6861*** | 2.98 |
| OWNCEO3 | | | | | -9.0909*** | -2.81 |
| SO | -0.1058** | -2.54 | -0.2309* | -1.77 | -0.2299* | -1.76 |
| SO2 | | | 0.1994 | 1.00 | 0.1948 | 0.97 |
| FO | -0.4626*** | -4.84 | -0.4139** | -1.97 | -0.3858* | -1.84 |
| FO2 | | | -0.1469 | -0.30 | -0.1759 | -0.36 |
| BoardSize | -0.0117 | -1.27 | 0.0298 | 0.65 | 0.0314 | 0.68 |
| BoardSize2 | | | -0.0032 | -0.94 | -0.0034 | -1.01 |
| NED | -0.0612 | -1.35 | 0.3542** | 2.10 | 0.3708** | 2.20 |
| NED2 | | | -0.4023** | -2.58 | -0.4244*** | -2.72 |
| CEOCHAIR | -0.0266 | -1.47 | -0.0255 | -1.41 | -0.0255 | -1.40 |
| _cons | 2.2207*** | 21.73 | 1.9900*** | 11.36 | 1.9887*** | 11.38 |
| N | 1802 | | 1802 | | 1802 | |
| | F(12,1509)=17.11*** | | F(16,1505)=13.38*** | | F(18,1503)=12.45*** | |
| F test | F(280,1509)=47.01*** | | F(280,1505)=45.17*** | | F(280,1503)=45.06*** | |
| Hausman | chi2(12)=276.09*** | | | | | |
| Sargan-Hansen | | | chi2(16)=164.6*** | | chi2(18)=164.23*** | |

Note: *, **, and *** represent the 10%, 5%, and 1% significance levels, respectively.

Table A4. Impact of factors on Tobin's Q: Elements of VAIC

| Independent Variable | Pooled OLS | | REM | | FEM | |
|----------------------|------------------|--------|-----------------|--------|------------------|-------|
| | Intercept | t | Intercept | z | Intercept | t |
| Size | 0.0809 *** | 6.12 | 0.0000 | 0.00 | -0.0587 *** | -3.54 |
| CFO | 0.0558 * | 1.82 | -0.0003 | -0.03 | -0.0082 | -0.63 |
| Capex | -0.0021 | -0.11 | -0.0031 | -0.33 | -0.0051 | -0.58 |
| Leverage | -1.3372 *** | -16.43 | -0.8113 *** | -11.74 | -0.5322 *** | -7.44 |
| Liquid | 0.0121 | 0.80 | -0.0078 | -0.94 | -0.0089 | -1.13 |
| HCE | -0.0204 *** | -3.90 | 0.0005 | 0.15 | -0.0003 | -0.09 |
| SCE | 0.4949 *** | 5.60 | -0.0607 | -1.07 | -0.0367 | -0.66 |
| CEE | 0.6054*** | 13.20 | -0.0418 | -1.13 | -0.177 2*** | -4.69 |
| OWNCEO | -1.7199 ** | -2.25 | -1.3292 *** | -2.66 | -1.0530 ** | -2.15 |
| OWNCEO2 | 11.5829 *** | 2.67 | 8.4697 *** | 3.20 | 6.9395 *** | 2.71 |
| OWNCEO3 | -11.9561** | -2.05 | -9.9457 *** | -2.98 | -8.1769** | -2.54 |
| SO | 0.8432 *** | 4.88 | -0.0658 | -0.50 | -0.2461* | -1.90 |
| SO2 | -1.4483 *** | -5.49 | -0.0813 | -0.40 | 0.2183 | 1.10 |
| FO | -0.8068 ** | -2.51 | -0.4544 ** | -2.11 | -0.3782* | -1.81 |
| FO2 | 4.0453 *** | 5.70 | 0.5473 | 1.11 | -0.1335 | -0.28 |
| BoardSize | -0.0650 | -0.76 | 0.0179 | 0.38 | 0.0231 | 0.51 |
| BoardSize2 | 0.0058 | 0.91 | -0.0018 | -0.50 | -0.0027 | -0.82 |
| NED | -0.1626 | -0.52 | 0.3237 * | 1.85 | 0.3741 ** | 2.23 |
| NED2 | 0.1051 | 0.37 | -0.3831 ** | -2.37 | -0.4223 *** | -2.73 |
| CEOCHAIR | 0.0857 *** | 2.89 | -0.0061 | -0.32 | -0.0222 | -1.22 |
| _cons | 1.2712 *** | 4.33 | 1.8362 *** | 10.20 | 2.1256 *** | 12.05 |
| N | 1802 | | 1802 | | 1802 | |
| | F(20,1781)=56.92 | | chi2(20)=238.81 | | F(20,1501)=12.51 | |

Note: *, **, and *** represent the 10%, 5%, and 1% significance levels, respectively. The results of 3 model selection tests show that FEM is the most suitable: F-test: F(280, 1503) = 40.97***. Breusch and Pagan LM: chibar2(01) = 2980.35***. Hausman: chi2(20) = 161.11***.

Table A5. Impact of factors on Tobin's Q in each sector

| Sector | Basic Material | | Consumer goods | | Medical equipment | | Industrial Commodities | | Technology | | Utilities | |
|-------------------------|------------------------------|-------|-----------------------------|-------|---------------------|-------|------------------------------|-------|---------------------|-------|----------------------|-------|
| F test | F(51,257) = 49.73*** | | F(43,236) = 24.38*** | | F(12,51) = 24.54*** | | F(145,761) = 74.8*** | | F(10,39) = 24.65*** | | F(14,69) = 313.00*** | |
| Breusch – Pagan LM test | $\chi^2(01) = 565.87^{***}$ | | $\chi^2(01) = 338.25^{***}$ | | $\chi^2(01) = 0.00$ | | $\chi^2(01) = 1415.89^{***}$ | | $\chi^2(01) = 0.00$ | | $\chi^2(01) = 0.00$ | |
| Hausman/Sargan-Hansen | $\chi^2(18) = 36.94$ | | $\chi^2(18) = 36.94^{***}$ | | – | | $\chi^2(18) = 178.10^{***}$ | | – | | – | |
| Selected model | REM | | FEM | | FEM | | FEM | | FEM | | FEM | |
| | Intercept | z | Intercept | t | Intercept | t | Intercept | t | Intercept | t | Intercept | t |
| Size | -0.0268 | -1.30 | -0.0714 | -0.98 | -0.0235 | -0.15 | -0.0471 *** | -3.83 | -0.0375 | -0.45 | -0.2189 *** | -8.61 |
| CFO | -0.0460 | -0.98 | -0.0980 | -0.41 | -0.4567 | -1.61 | -0.0020 | -0.27 | 0.0054 | 0.11 | 0.0108 | 1.28 |
| Capex | -0.0976 *** | -2.63 | 0.2881 | 0.81 | 0.4361* | 1.87 | -0.0121 | -0.83 | -0.0839 | -0.35 | -0.0015 | -0.71 |
| Leverage | -0.4908 *** | -5.67 | -1.9565 *** | -5.90 | -1.3856 *** | -3.56 | -0.1198** | -2.06 | -0.7745*** | -3.25 | -0.2919 *** | -4.33 |
| Liquid | -0.0310*** | -3.05 | 0.0339 | 0.65 | -0.2023 ** | -2.40 | -0.0095 | -0.68 | -0.0640 | -1.47 | 0.0007 | 0.30 |
| VAIC | -0.0006 | -0.18 | -0.1037 *** | -3.25 | -0.0099 | -0.32 | -0.0039 | -1.29 | -0.0127 | -0.86 | -0.0052 *** | -5.19 |
| OWNCEO | -1.0484 | -1.53 | 6.8065 ** | 2.05 | -5.0700 | -0.50 | -0.2507 | -0.68 | -3.0871 | -1.05 | 15.28 | 0.79 |
| OWNCEO2 | 4.2640 | 1.22 | -49.57 ** | -2.05 | 54.52 | 0.52 | 0.1880 | 0.08 | -25.88 | -0.62 | -2233.80 | -0.67 |
| OWNCEO3 | -4.2218 | -1.04 | 101.54 ** | 2.33 | -111.20 | -0.53 | 0.3772 | 0.13 | 121.43 | 0.86 | 8819.81 | 0.67 |
| SO | 0.0757 | 0.38 | -0.8541 | -1.41 | 0.9378 | 0.80 | -0.0533 | -0.55 | 14.08 *** | 3.62 | -0.1634 * | -1.92 |
| SO2 | -0.0838 | -0.27 | 0.3843 | 0.38 | -4.2791* | -1.90 | -0.0419 | -0.29 | -28.975 *** | -3.67 | 0.2839 ** | 2.51 |
| FO | 1.0149 *** | 3.17 | -2.0891 ** | -2.63 | -1.5148 | -1.50 | 0.0980 | 0.56 | 0.4689 | 0.97 | 0.2029 | 0.79 |
| FO2 | -2.7748*** | -3.26 | 2.6650 | 1.55 | 4.1796** | 2.14 | -0.5327 | -1.30 | -2.4088 | -1.13 | -0.5413 | -0.72 |
| BoardSize | -0.0700 | -0.70 | 0.2031 | 0.99 | -0.2359 | -0.94 | -0.0451 | -1.23 | 0.0497 | 0.49 | 0.0252 | 0.09 |
| BoardSize2 | 0.0062 | 0.76 | -0.0159 | -1.09 | 0.0134 | 0.74 | 0.0030 | 1.07 | -0.0045 | -0.72 | -0.0039 | -0.14 |
| NED | -0.0962 | -0.38 | 1.0020 | 1.37 | 0.3998 | 0.57 | -0.2313 * | -1.81 | 0.1252 | 0.35 | 0.1525 | 0.34 |
| NED2 | 0.0106 | 0.04 | -1.0884 | -1.65 | -0.5595 | -0.90 | 0.1898 | 1.56 | -0.0686 | -0.22 | -0.0768 | -0.24 |
| CEOCHAIR | 0.0470 ** | 2.14 | -0.1594 | -1.61 | -0.1483* | -1.78 | 0.0164 | 1.15 | 0.1193 ** | 2.39 | -0.0546 ** | -2.39 |
| _cons | 1.8790 *** | 5.73 | 3.1301 *** | 3.85 | 3.6959 *** | 3.35 | 1.8248 *** | 13.21 | 1.7107 *** | 2.87 | 3.0910 *** | 4.45 |
| N | 327 | | 298 | | 82 | | 925 | | 68 | | 102 | |
| | $\chi^2(1,11) = 11.11^{***}$ | | F(18,236) = 8.96 *** | | F(18,51) = 3.00 *** | | F(18,761) = 4.06 *** | | F(18,39) = 6.23 *** | | F(18,69) = 10.21 *** | |

Note: *, **, and *** represent the 10%, 5%, and 1% significance levels, respectively.