English Abstract

Parsimonious Measurement of Dynamic Capabilities

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ABSTRACT

While there have been consensus on the definition of dynamic capabilities, their empirical studies are still at infancy. Measurement of dynamic capabilities is important as a firm can diagnose how efficiently it can respond to changes in external environment compared to its competitors in the same industry. Based on the notion of the higher and lower level of capabilities, this study proposes an indicator which allows a firm to understand a snapshot of its dynamic capabilities (higher capabilities), by measuring the relative volatility of its operating margin (i.e. a proxy of zero-level capabilities) against industry average, shown in β_1 for the whole period, β_{inc} for industry's growth (economic boom) period, and β_{dec} for industry's decline (economic recession) period. For empirical validation, petroleum/refining industry in the North America is investigated during 1990-2012 using quarterly performance. Applied to the resulting 53 firms, ideal scenario for β_1 is less than one but more than zero, which demonstrates the firm's ability to remain stable and low volatility relative to the industry's fluctuation. Ideal β_{inc} is more than one, meaning that the firm is able to exploit opportunities. Realistic β_{dec} is more than zero and less than one, showing that the firm is able to minimize loss. Regression results also indicates that firms survived until the end of study period have more desirable average β_1, β_{inc}, and β_{dec} values and have more firms in the desired β_{inc} and β_{dec} area compared to firms that did not survived, showing that firms survived have more capacity of dynamic capabilities.

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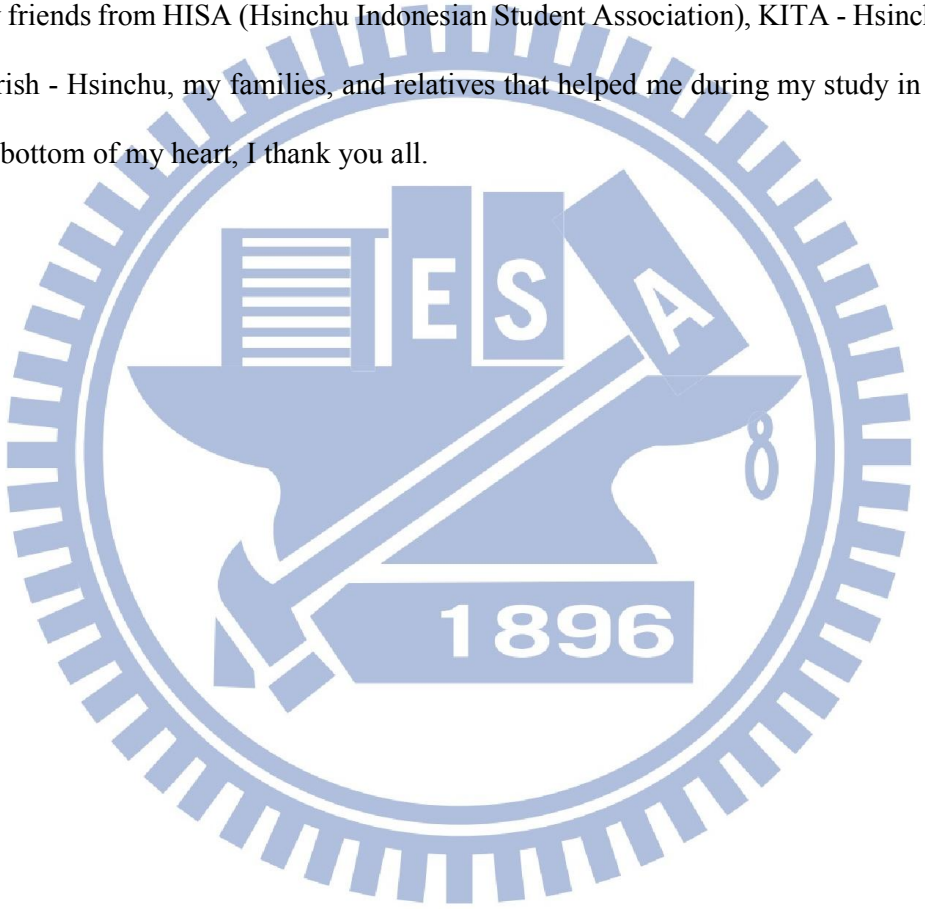
I would like to extend my sincere gratitude firstly to my research advisor, Prof. Kang, for her insights and guidance. Then, GMBA professors, faculties, and staffs, other NCTU and NTHU professors for the first class education. I would also like to thank my friends GMBA colleagues (especially my GTS group) for the sharing, discussions, and experiences. Last but not least, I thank my friends from HISA (Hsinchu Indonesian Student Association), KITA - Hsinchu, Holy Spirit Parish - Hsinchu, my families, and relatives that helped me during my study in Taiwan, from the bottom of my heart, I thank you all.



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I. Introduction

1.1. Research Subject and Objective

This study concerns with the operationalization of dynamic capabilities, and the objective or purpose of this research is to construct a model to measure dynamic capabilities.

1.2. Research Motivation

While there has been a certain degree of consensus in the definition of dynamic capabilities, lacking of empirical research is pointed out as the weakness of dynamic capabilities (Barreto, 2010). Additionally, most of empirical literature mainly uses field, archival, surveys, and/or interviews data collection method, which may be time-consuming, difficult to replicate, and compare with other research as well. Furthermore, the nature of empirical studies mentioned above requires so-called "experts" so that it is not easy for a firm to apply the theory of dynamic capabilities to their practice, widening the gap between the theory and practice in strategic management.

Thus, this study identifies the needs to develop a first-gate indicator, which can be employed relatively easily by firms, a complementary measurement to the existing literatures. For the purpose, the current study proposes a model which can employ ready-to-use data, that is, financial statements, by identifying the link between lower (e.g. operational) and higher (e.g. dynamic) level capabilities.

These reasons and author's personal motivation to study strategic management deeper drive the author to write this thesis.

1.3. Research Structure

As mentioned before, the research objective of this study is to construct a model to operationalize dynamic capabilities. This study is structured as follows. Firstly, relationship between dynamic capabilities and financial statement is specified and defined. Based on this relationship, a model which can empirically measure a firm's dynamic capabilities compared to its competitors in the same industry is constructed. The trend of firm's and its industry's zero level capabilities are observed utilizing moving average method, whereas regression analysis is employed to measure the relationship between the firm's and its industry's zero level capabilities trends. Financial statement data needed is collected from Wharton Research Data Services (WRDS), using the quarterly Compustat Dataset.

II. Literature Review

In this chapter, brief history about the definition of dynamic capabilities is introduced first, followed by the review of empirical research.

2.1. Research on the Definition of Dynamic Capabilities

The notion of dynamic capabilities has started from Teece et al. (1997) which pointed out the insufficiency of Resource Based View (RBV) Barney (1986, 1991) in supporting sustainable competitive advantage in global competitive market. As an extension of RBV, Teece et al. (1997) emphasize changing business environment and the role of strategic management, which are not covered in RBV strategy. Teece et al. (1997) also stated factors of a firm's distinctive competence and dynamic capabilities, which are managerial and organizational processes, shaped by its asset position, and paths.

Figure 1 shows the framework of dynamic capabilities proposed by Teece et al. (1997). In this model, dynamic capabilities are embedded in managerial and organizational processes, which are the way things are done in a firm, or what might be referred to as its routines, or patterns of current practice and learning. The roles of managerial and organizational processes are (i) coordination / integration, (ii) learning, and (iii) reconfiguration / transformation: (i) Coordination / integration is how efficient the managers must coordinate and integrate activity inside firm in accordance to the changing business environment; (ii) Learning is repetition and experimentation that leads to better and quicker performance of tasks; (iii) A firm must be able to perform internal and external reconfiguration / transformation as well, to address rapid changing environment.

In the same figure, asset position refers to assets that a firm has, in relation with the market, such as its current specific endowments of technology, intellectual property, complementary assets, customer base, and its external relations with suppliers and complementary. Paths are in congruence with the evolutionary economics theory, where a firm can go depends on paths ahead (opportunities, strategic alternatives available to the firm, and the presence or absence of increasing returns) or current position (routines, path dependencies, organizational learning, and evolutionary paths) they adopted in the past. Then, managerial and organizational processes are shaped by asset position and paths. Thus, what a firm's and its competitors can do, as well as where they can go are constrained by their positions and paths (Teece et al., 1997).

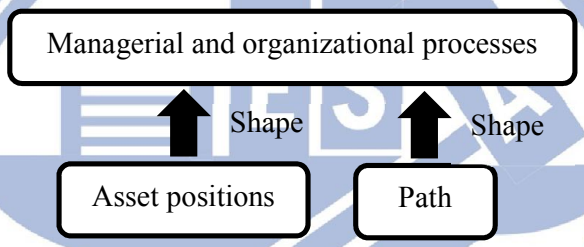


Figure 1: Dynamic capabilities essences

Source: Teece et al. (1997)

While Teece et al. (1997)'s definition focuses on dynamic capabilities directly working on assets as to integrate, build, and reconfigure internal and external competences, other studies define them as higher level capabilities in the context of the hierarchy of capabilities (Zollo and Winter (2002), Winter (2003), and Zahra et al. (2006)). In this hierarchy, dynamic capabilities modify zero level capabilities, such as operating routines (Zollo and Winter, 2002), ordinary capabilities (Winter, 2003), or substantive capabilities (Zahra et al., 2006). Zero level capabilities in these studies are related to a firm's daily operations, characterized as highly patterned, repetitive, and routine tasks. Figure 2 illustrates the hierarchy of capabilities.

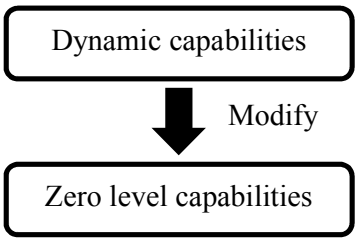


Figure 2: Hierarchy of Capabilities

Source: Zollo and Winter (2002), Winter (2003), and Zahra et al. (2006)

2.2. Relationship between Dynamic Capabilities, Zero Level Capabilities, and Industry

Based on the relationship between managerial and organizational processes, asset position, and paths (Teece et al., 1997) and hierarchy of capabilities (Zollo and Winter, 2002; Winter, 2003; Zahra et al., 2006) concept, the relationship between dynamic capabilities, zero level capabilities, and industry can be defined. Teece et al. (1997) mentioned, asset position refers to assets that a firm has related with the market, while paths means that where a firm can go depends on its paths ahead (opportunities) or its current position. Thus, asset position and paths described the industry that the firm is in. Asset position and paths shaped managerial and organizational processes, in which dynamic capabilities are resident in. Thus, the industry the firm is in also shapes dynamic capabilities.

Dynamic capabilities extend, modify, create, and transform zero level capabilities, while managerial and organizational processes are the way things (routines or patterns) are done or in a firm. Routines and patterns are zero level capabilities. So dynamic capabilities with managerial and organizational processes are all higher level capabilities. Positions (market) and paths (opportunities) are constructed by all firms in the same industry. The industry the firm is in must be constructed by a collection of all firms' zero level capabilities in that industry as well (Teece et al., 1997; Zollo and Winter; 2002; Winter, 2003; Zahra et al., 2006).

Based on notions above, this study suggest to operationalize dynamic capabilities by measuring the relative volatility of a firm's zero level capabilities against the ones of an industry, where it competes in (collection of all firms' zero level capabilities).

2.3. Empirical Research on Dynamic Capabilities

The next table shows some of the existing empirical researches on dynamic capabilities.

Table 1: Literatures on dynamic capabilities empirical studies

Authors	Year	Size	Period	Industry	Method
Song, Droge, Hanvanich, and Calantone	2005	466 Surveys	Formed 1990 - 1997	U.S. joint ventures	Survey, SEM
Døving and Gooderham	2008	254 firms		Norwegian small firm accountancy	Survey, OLS regression
Rothaermel and Hess	2007	81 firms	1980	Pharmaceutical firms	Field/Archival, Negative Binomial Regression
Adner and Helfat	2003	30 companies	1977 - 1997	U.S. petroleum industry Financial Reporting System (FRS) financial data	Field/Archival, ANOVA
Macher and Mowery	2009	93 manufacturing processes	1995 - 2001	Semiconductor manufacturing	Field/Archival, regression
Helfat	1997	26 firms		R&D expenditures of the largest U.S. energy firms (primarily petroleum companies)	Field/Archival, regression
Marcus and Anderson	2006	108 grocers		US retail food industry	Survey, regression
McKelvie and Davidsson	2009	803 firms	1997 - 2000	13% manufacturing firms, 68% service firms and the remaining 19% retail or wholesale firms	Survey, regression
Newbert	2005	817 entrepreneurs		US Panel Study of Entrepreneurial Dynamics (PSED)	Survey, binary logistic regression
Agarwal and Selen	2009	449 samples (77 pilot round, 372 main round)		Telecommunications service provider and its partnering organizations	Field/Archival, CFA, SEM
Allred, Fawcett, Wallin, and Magnan	2011	980 surveys			Survey, interview, CFA, SEM
Kohlbacher	2013	67 firms		Austrian metal and machinery corporations with at least 50 employees	Survey, regression
Nair, Rustambekov, McShane, and Fainshmidt	2013	167 firms		MNE subunits in the People's Republic of China	Field/Archival, linear regression
Stadler, Helfat, and Verona	2013	244 firms	1993 - 2006	Upstream oil industry in the United States	OLS regression
Schilke	2013	279 firms		Chemicals, machinery, and motor vehicle industries in Germany	Survey, interview, OLS regression
Danneels	2008	77 firms	2000, 2004	U.S. public manufacturing firms	Survey, CFA
Kale and Singh	2007	175 firms		U.S. firms from industries engaged in alliances	Survey, CFA

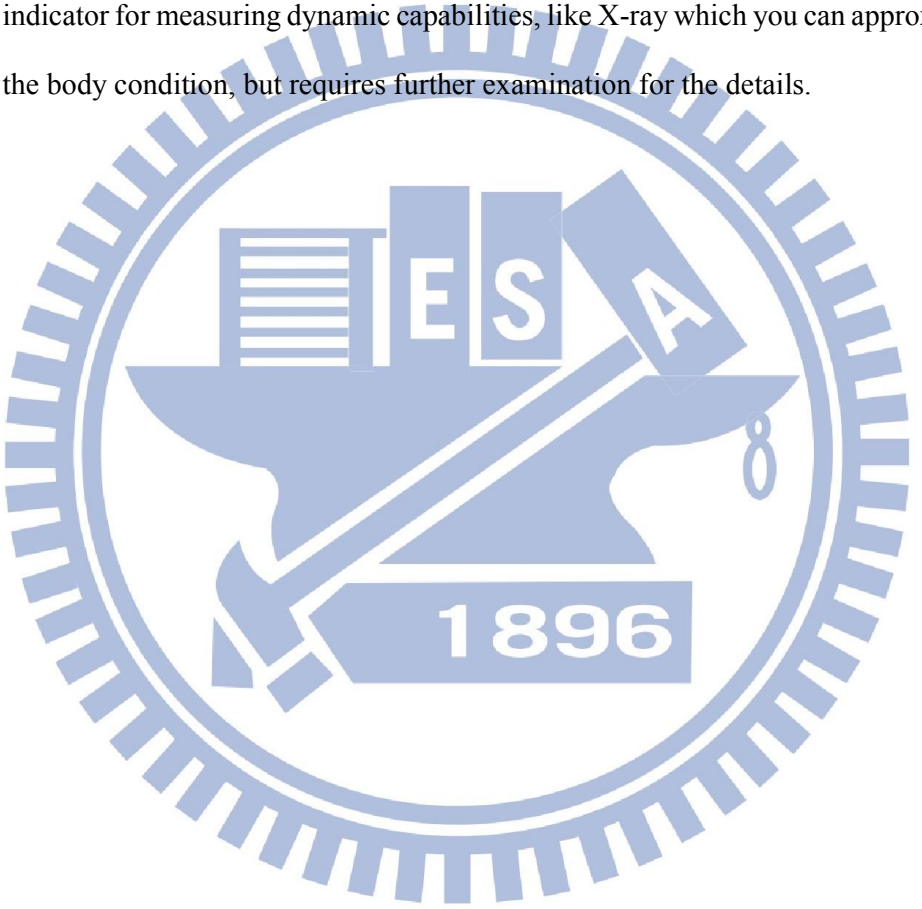
As observed in Table 1, existing empirical studies mostly employ survey-based approach by focusing on a specific capability. However both of these characteristics put a challenges for firms to employ dynamic capabilities in this fast-changing business environment, with widening the gap between academia and practice in strategic management: it may take a long time only for measuring dynamic capabilities of a firm. When a firm finally measures its dynamic capabilities, the business environment has already changed, missing the right timing to apply the wisdom learned from results of the measurement.

First of all, it is challenging to draw a boundary of a specific dynamic capability as the interaction between units within a firm becomes more complicated than before. For instance, the boundary of a R&D dynamic capability (e.g. Helfat, 1997) may not be easily decided by considering technological knowledge and physical assets as R&D becomes more closely related to market than before.

Second, while dynamic capabilities are context-driven (Winter, 2003), the extensive employment of survey-based methods in empirical literature brings the full exposure to the weakness of survey including inflexibility, subjective in nature, superficial, and artificial (Babbie, 2013). In addition, survey is difficult to replicate due to large scale of the survey and response rate. For instance, in order to increase the generalizability of their work, Slater, Olson, and Hult (2006) sample 380 marketing executives from manufacturing and service businesses operating in 20 different 2-digit SIC code industries. In Song et al.'s (2005) research there is a need to eliminate inappropriate response research, from 971 response to 466 usable response (response rate = 48%). Some of the empirical study of dynamic capabilities that utilized survey method took time for data collection, for instance, from 1990 to 1997 (Song et al., 2005). Danneels (2008) took 2 years, in 2000 and in 2004. Furthermore, measurement researches also

seem to be firm/industry specific, meaning that empirical research is in a particular industry only, based on the topic of the research. Thus do not allow comparison between companies.

Thus, this study aims at proposing the indicator for measuring dynamic capabilities utilizing available financial data as a complement for existing methods, which firms may employ easily and quickly to grasp the picture of their performance. The indicator proposed here works as a first-gate indicator for measuring dynamic capabilities, like X-ray which you can approximately diagnose the body condition, but requires further examination for the details.



III. Research Methodology

3.1. Proposed Model

Based on the literature review, the current study proposes the model (Figure 3) to operationalize dynamic capabilities, by measuring the relative volatility of the performance of a firm's operation, as a proxy of zero level capabilities, compared to industry performance.

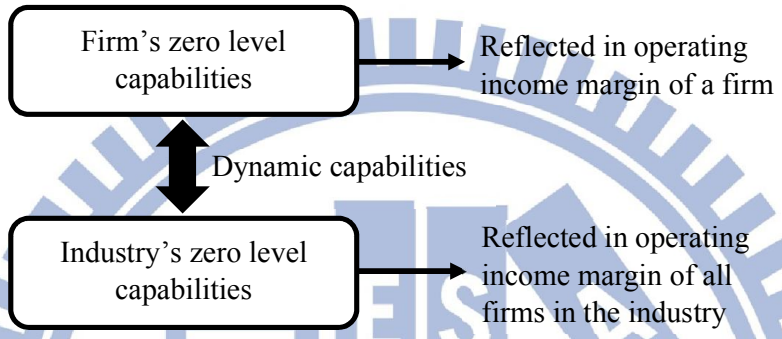


Figure 3: Proposed model

3.2. Dynamic Capabilities Measurement Model

This study signify zero level capabilities with "operating income margin" in the financial statement data. Fraser and Ormiston (2010) described operating income margin as "a measure of overall operating efficiency, incorporates all of the expenses associated with ordinary business activities". Operating income margin is also a "profitability ratio", which measures overall performance of a firm and its efficiency in managing assets, liabilities, and equity. Thus, it is appropriate in describing a firm's zero level capabilities, as zero level capabilities are patterned, repetitive, routine, and related to the firm's operation. The formula for operating income margin is as follows.

$$Operating\ income\ margin = \frac{Operating\ income}{Net\ sales} \quad (1)$$

Operating income are sales revenue less the expenses related to the normal functions of a business (e.g. COGS, SGA, R&D, or Depreciation and Amortization). Net sales are total sales revenue less sales return and sales allowances.

To represent the industry the firm is in, all of firms' operating income margin per quarter is weighted by the firm's net sales (weighted average), representing its market share in that industry because every firm contributes unequally to the market.

Using operating income margin, challenges in survey-based measurement can be avoided. Financial statements are standardized, regulated, and verifiable, so subjectivity found in survey can be nullified. Financial statement data is also digitally readily available, such as in financial websites, firms' annual reports in their own websites, or U.S. SEC (Securities and Exchange Commission) website. For this research, data is taken from Compustat database from Standard & Poor's, provided by Wharton Research Data Services (WRDS).

Moving average method is utilized to indicate the trend of a firm's and its industry zero level capabilities. It is a method to smooth a time series data, reducing random variation, so that historical and long term trend of a time series data can be observed. Longer period of the arithmetic mean resulted in smoother time series trend. For this study, the period to calculate moving average is 4 quarters, to try to capture the yearly cyclical or seasonal effects. Since the number of data taken (from year 1990 to 2012) is even, "centered moving average" is used. In the following example, Chevron Corp. operating income margin from 1st quarter of 1990 to 4th quarter of 2012 is taken. The moving average method removes huge variations found in 1995Q4, 1998Q4, and 2001Q4.

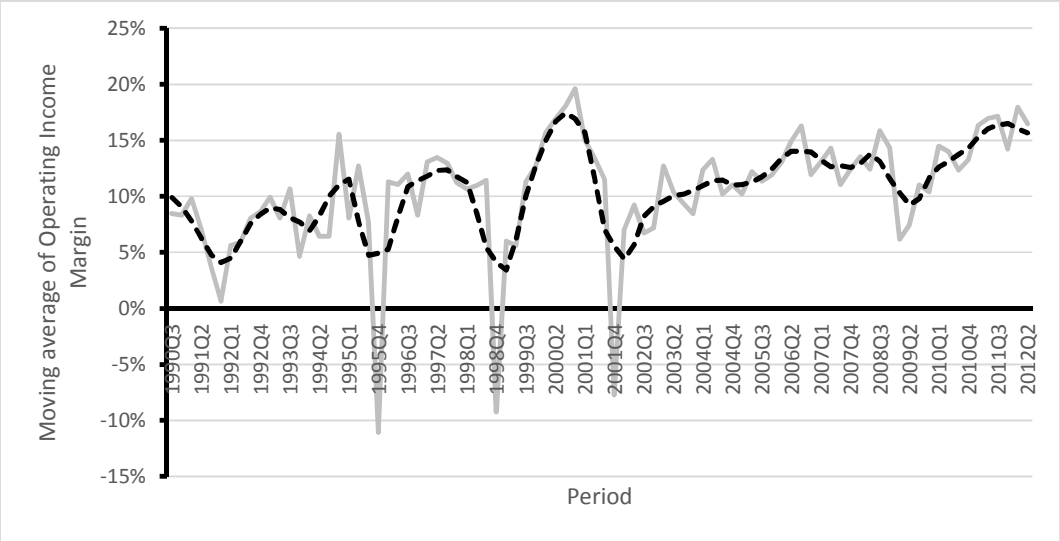


Figure 4: Chevron Corp's 4Q moving average

To measure dynamic capabilities, the relative volatility between the trends of a firm's zero level capabilities with the trends of the industry, this study proposed linear regression method. Regression analysis develops a mathematical model or equation to describe a relationship between the variable to be forecast (dependent variable) with the variable related to that dependent variable (independent variable). The linear regression equation for this research is as follows.

$$y = \beta_0 + \beta_1 x \quad (2)$$

y = average of a firm's operating income margin within 4 quarters in the industry

x = average of weighted average of all firms' operating income margin within 4 quarters in the industry

β_0 = intercept, or average of a firm's operating income margin within 4 quarters if there is no trend or change in industry operating income margin within 4 quarters (isolated from industry)

β_1 = the capacity for dynamic capabilities of a firm

Variable β_1 is the capacity for dynamic capabilities of a firm, it measures overall performance of dynamic capabilities within an environment (e.g. industry), and also representing systematic influence and evolutionary fitness (Helfat, 2007).

Based on the previous linear regression equation (2), table 2 displays the interpretation of β_1, which shows the relationship between changes in firm's operating income margin when industry's operating income margin changes by 1. This study proposes that firms that have dynamic capabilities remain stable, unresponsive, and less volatile relative to the exposure of fluctuating industry the firm is in. Thus, ideal scenario for a firm is to have β_1 value between 0 and 1 ($0 < \beta_1 < 1$), as shown in figure 6.

Moreover, it is highly undesirable for a firm to have β_1 larger than 1 or smaller than -1 ($\beta_1 > 1$ and $\beta_1 < -1$). Because this means that the firm's operating income margin are highly volatile and changes higher than the changes in industry's operating income margin.

Table 2: Interpretation of β_1

Capacity for Dynamic Capabilities	When industry's operating income margin changes by 1,
$\beta_1 > 1$	a firm's operating income margin **positively** changes **by more than 1**
$\beta_1 = 1$	a firm's operating income margin **positively** changes **by 1**
$0 < \beta_1 < 1$	a firm's operating income margin **positively** changes **by less than 1**
$\beta_1 = 0$	a firm's operating income margin **does not change**
$-1 < \beta_1 < 0$	a firm's operating income margin **negatively** changes **by less than 1**
$\beta_1 = -1$	a firm's operating income margin **negatively** changes **by 1**
$\beta_1 < -1$	a firm's operating income margin **negatively** changes **by more than 1**

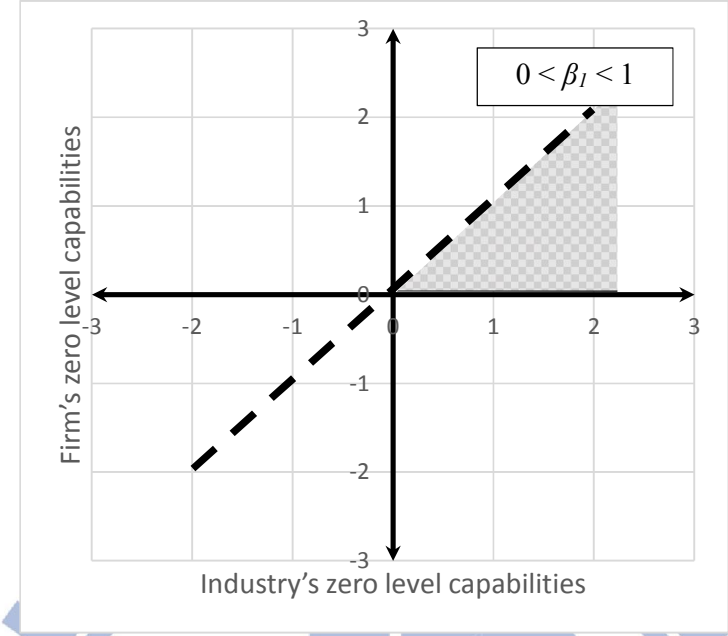


Figure 5: Desirable area for capacity of dynamic capabilities

Furthermore, by modifying the first regression equation (2), the firm's trend of operating income margin when the industry's trend is in growth period (economic boom) or decline period (economic recession) can be observed. First, the industry's trend is divided into two categories, the growth and decline period. The gray color shows the period of growth, the white color shows period of decline.

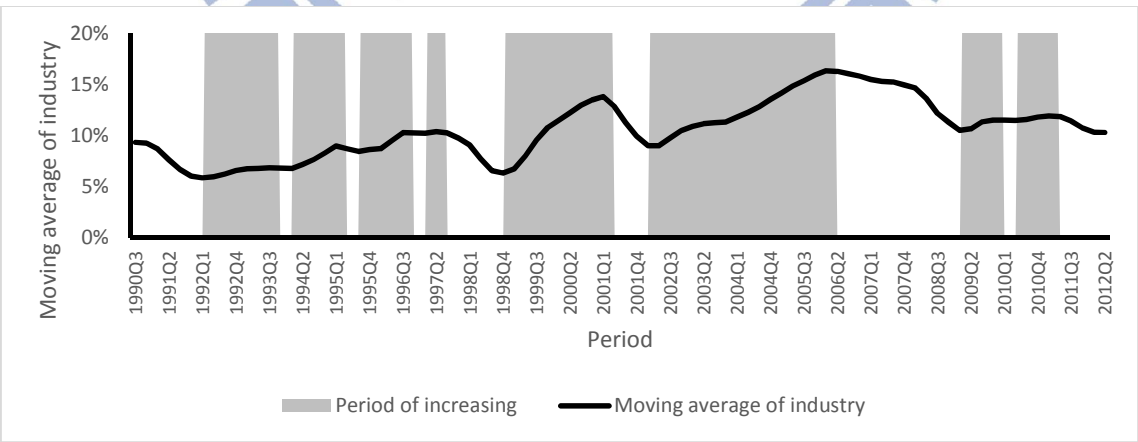


Figure 6: Growth and decline period of the industry

Then a dummy variable, "*i*" is introduced into the regression equation. Variable "*i*" is indicating whether the trend of industry is growing or declining (1 shows growing, 0 declining). The second linear regression model is as follows.

$$y = \beta_0 + \beta_1.x + \beta_2.i + \beta_3.x.i \quad (3)$$

Equation if the industry has increasing growth is as follows ($i = 1$).

$$y = \beta_0 + \beta_1.x + \beta_2.1 + \beta_3.x.1$$

$$y = (\beta_0 + \beta_2) + (\beta_1 + \beta_3).x$$

To simplify:

$$y = \beta_{0inc} + \beta_{inc}.x \quad (4)$$

y = average of a firm's operating income margin within 4 quarters in the industry during the period of growth in the industry

x = average of weighted average of all firms' operating income margin within 4 quarters in the industry during the period of growth in the industry

β_{0inc} = intercept, or average of a firm's operating income margin within 4 quarters if there is no trend or change in industry operating income margin within 4 quarters (isolated from industry)

β_{inc} = the capacity for dynamic capabilities of a firm during the period of growth in the industry

Then, equation if the industry has decreasing growth is as follows ($i = 0$).

$$y = \beta_0 + \beta_1.x + \beta_2.0 + \beta_3.x.0$$

$$y = \beta_0 + \beta_1.x$$

To simplify:

$$y = \beta_{0dec} + \beta_{dec}.x \quad (5)$$

y = average of a firm's operating income margin within 4 quarters in the industry during the period of decline in the industry

x = average of weighted average of all firms' operating income margin within 4 quarters in the industry during the period of decline in the industry

β_{0dec} = intercept, or average of a firm's operating income margin within 4 quarters if there is no trend or change in industry operating income margin within 4 quarters (isolated from industry)

β_{dec} = the capacity for dynamic capabilities of a firm during the period of decline in the industry

Based on the second regression experiment and equation (4), table 3 shows the interpretation of β_{inc} during the period of growth in the industry. Firms that have dynamic capabilities is able to exploit opportunities presented during the economic boom. With the growth in the industry's operating income margin, the firm is able to increase its operating income margin. Ideal scenario for a firm is to have β_{inc} value larger than 1 ($\beta_{inc} > 1$), as shown in figure 8. This means that the firm's operating income margin is increasing higher than the industry.

It is highly undesirable for a firm to have negative β_{inc} or β_{inc} smaller than -1 ($\beta_{inc} < -1$). Negative β_{inc} means that the firm's operating income margin is declining during the period of growth in the industry. Then β_{inc} smaller than -1 means that the firm's operating income margin is declining higher during the period of growth in the industry.

Table 3: Interpretation of β_{inc}

Capacity for Dynamic Capabilities	When industry's operating income margin changes by 1,
$\beta_{inc} > 1$	a firm's operating income margin **positively** changes **by more than 1**
$\beta_{inc} = 1$	a firm's operating income margin **positively** changes **by 1**
$0 < \beta_{inc} < 1$	a firm's operating income margin **positively** changes **by less than 1**
$\beta_{inc} = 0$	a firm's operating income margin **does not change**
$-1 < \beta_{inc} < 0$	a firm's operating income margin **negatively** changes **by less than 1**
$\beta_{inc} = -1$	a firm's operating income margin **negatively** changes **by 1**
$\beta_{inc} < -1$	a firm's operating income margin **negatively** changes **by more than 1**

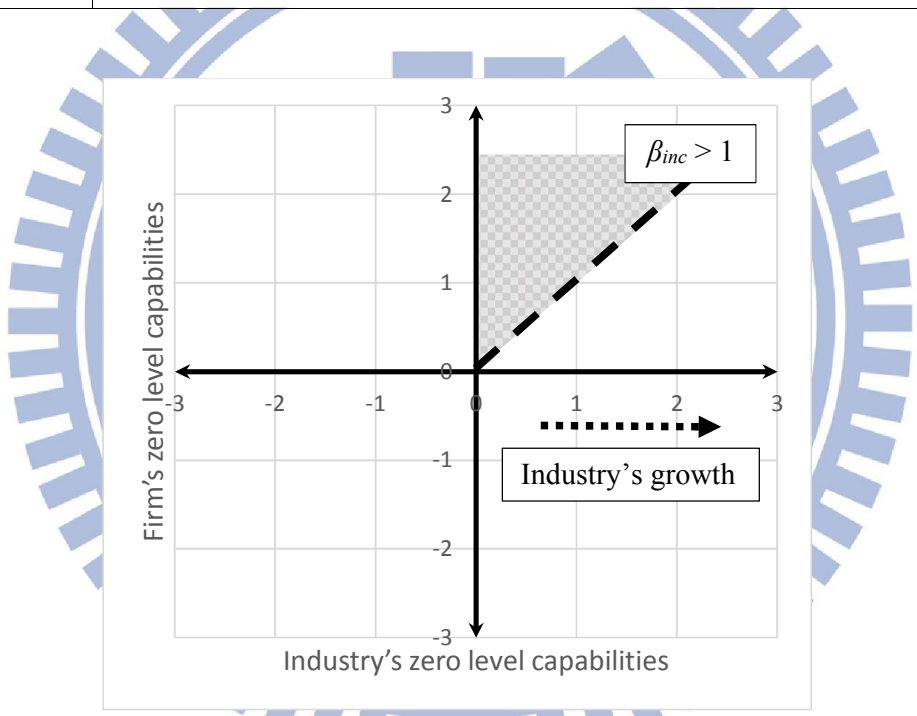


Figure 7: Desirable area for capacity of dynamic capabilities during industry's growth

Based on equation (5), table 4 shows the interpretation of β_{dec} during the period of decline in the industry. Highly preferable in this case is β_{dec} to be negative and as low as possible ($\beta_{dec} < -1$), showing an improving operating income margin during the period of decline in the industry (economic recession). However, this case may be very difficult to realize, so the most realistic option is to pursue β_{dec} more than zero and less than one ($0 < \beta_{dec} < 1$), meaning that firms that

have dynamic capabilities is able to minimize their loss during the period of decline in the industry.

On the other hand, the unwanted scenario for the firm is for β_{dec} to be larger than 1 ($\beta_{dec} > 1$). This means that the firm's operating income margin is decreasing higher than the industry.

Table 4: Interpretation of β_{dec}

Capacity for Dynamic Capabilities	When industry's operating income margin changes by 1,
$\beta_{dec} > 1$	a firm's operating income margin **negatively** changes **by more than 1**
$\beta_{dec} = 1$	a firm's operating income margin **negatively** changes **by 1**
$0 < \beta_{dec} < 1$	a firm's operating income margin **negatively** changes **by less than 1**
$\beta_{dec} = 0$	a firm's operating income margin **does not change**
$-1 < \beta_{dec} < 0$	a firm's operating income margin **positively** changes **by less than 1**
$\beta_{dec} = -1$	a firm's operating income margin **positively** changes **by 1**
$\beta_{dec} < -1$	a firm's operating income margin **positively** changes **by more than 1**

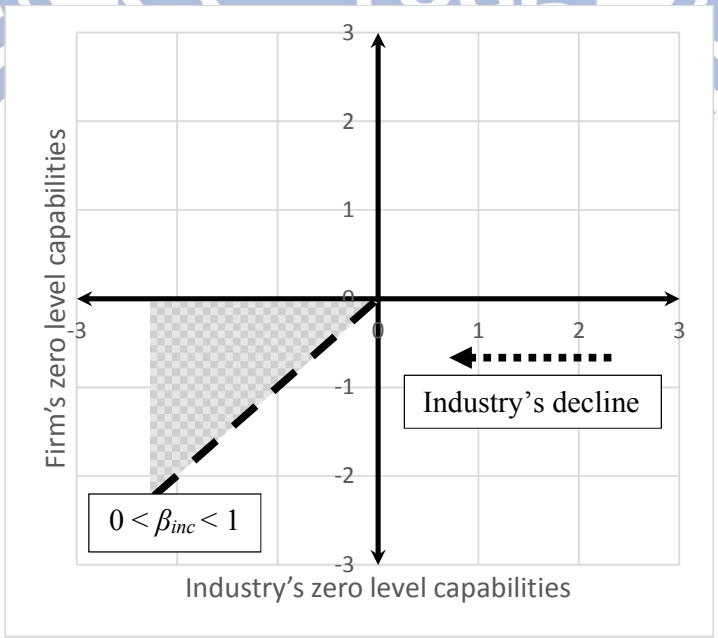


Figure 8: Desirable area for capacity of dynamic capabilities during industry's decline

3.3. Data

Data consist of quarterly performance of petroleum refining industry (SIC code 2911) in North America during 1990-2012 obtained from Compustat (Wharton Research Data Services (WRDS)). As operating income margin are used, data item “OIADPQ -- Operating Income After Depreciation – Quarterly” are used for operating income, while “SALEQ -- Sales/Turnover (Net)” are used for net sales. All of the calculation employed “R” software. Among 93 firms downloaded, only firms which have operated for 5 years consecutively were left for analysis considering that 50% of US firms stop existing within 5 years (SBA). In this way, the study could prevent from possibilities to include firms with scatted or short-term performance, which may be challenging to discuss firms’ dynamic capabilities to deal with changes. Thus, the resulting set include 53 firms.

IV. Results and Discussions

4.1. Industry's Operating Income Margin

During 1990 to 2012 period, the moving average of industry operating income margin shows mild fluctuations: firstly shows a decrease from 1990Q3 to 1992Q1, then an increase from 1992Q1 to 1996Q3, before a decrease again until 1998Q4 and an increase to 2001Q1. After decreasing for a short period, the industry's operating margin increases until its peak in 2006Q1, then decrease until 2009Q2, before increase slightly again until the end of observed period (2012Q2).

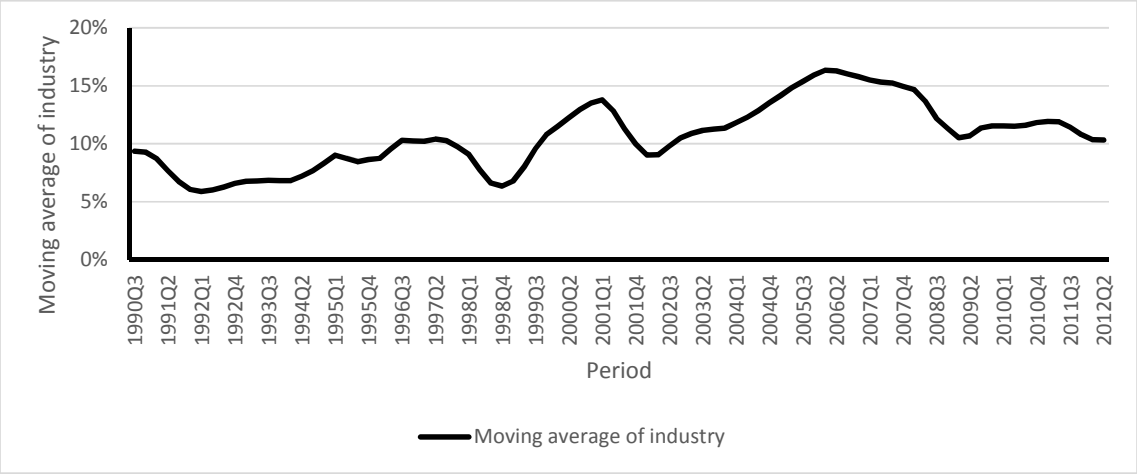


Figure 9: Four quarter moving average of industry's operating income margin

4.2. Descriptive Statistics and Regression Results

As mentioned in the previous section, this study employs two regression experiments to measure capacity for dynamic capabilities: (1) Calculating the relative volatility between a firm's and industry's zero level capabilities (β_1) in the whole period, and (2) Calculating the firm's trend of operating income margin when the industry's trend is in growth (β_{inc}) or decline (β_{dec}) period. Table 5 shows descriptive statistics of firms used in this study. Then, table 6 shows the regression results of these two regressions.

Table 5: Descriptive statistics

No	Firms	Sales (in million)	Operating income margin					
			Mean	St Dev	Var	Min	Max	Median
	Industry Average	9681.181	0.11	0.03	0.00	0.05	0.18	0.11
1	ALON USA ENERGY INC	1110.472	0.02	0.06	0.00	-0.14	0.14	0.03
2	AMOCO CO	6142.611	0.10	0.03	0.00	0.01	0.15	0.10
3	ARABIAN AMERICAN DEVELOPMENT	16.528	0.03	0.11	0.01	-0.43	0.32	0.02
4	ATLANTIC RICHFIELD CO	3908.548	0.10	0.11	0.01	-0.48	0.20	0.11
5	BP PLC	50968.422	0.09	0.05	0.00	-0.05	0.28	0.08
6	CALUMET SPECIALTY PRODS -LP	551.570	0.04	0.04	0.00	-0.04	0.13	0.05
7	CHEVRON CORP	26883.902	0.11	0.05	0.00	-0.11	0.20	0.11
8	CHEVRON PHILLIPS CHEM CO LLC	2491.684	0.03	0.06	0.00	-0.19	0.13	0.04
9	CONOCO INC	6784.348	0.08	0.04	0.00	-0.02	0.13	0.09
10	CROWN CENTRAL PETROL -CL B	389.920	0.00	0.04	0.00	-0.08	0.06	0.00
11	CVR ENERGY INC	1136.895	0.07	0.08	0.01	-0.14	0.22	0.07
12	DELEK US HOLDINGS INC	1101.297	0.03	0.04	0.00	-0.05	0.10	0.03
13	DIAMOND SHAMROCK INC	700.454	0.04	0.03	0.00	-0.02	0.13	0.04
14	ECOPETROL SA	7612.895	0.33	0.06	0.00	0.20	0.41	0.33
15	ENI SPA	23961.206	0.19	0.06	0.00	0.00	0.37	0.19
16	EXXON MOBIL CORP	55361.630	0.11	0.03	0.00	0.04	0.18	0.10
17	FINA INC -CL A	927.258	0.04	0.03	0.00	-0.07	0.12	0.05
18	FRONTIER OIL CORP	539.146	0.01	0.18	0.03	-1.13	0.26	0.03
19	GAZPROM OAO	26654.656	0.34	0.06	0.00	0.23	0.53	0.34
20	GIANT INDUSTRIES INC	295.005	0.04	0.06	0.00	-0.25	0.13	0.04
21	HESS CORP	4166.583	0.08	0.06	0.00	-0.06	0.35	0.07
22	HOLLYFRONTIER CORP	865.643	0.06	0.05	0.00	-0.11	0.19	0.06
23	HUNTWAY REFINING CO	26.973	0.04	0.09	0.01	-0.27	0.23	0.05
24	HUSKY ENERGY INC	1869.105	0.20	0.08	0.01	-0.03	0.38	0.22
25	IMPERIAL OIL LTD	3528.101	0.12	0.04	0.00	-0.04	0.21	0.13
26	LUKOIL OIL COMPANY	15821.023	0.17	0.05	0.00	-0.04	0.24	0.18
27	MAPCO INC	714.899	0.08	0.03	0.00	0.02	0.14	0.08
28	MOBIL CORP	14436.750	0.06	0.02	0.00	-0.02	0.11	0.07
29	MURPHY OIL CORP	2310.499	0.07	0.05	0.00	-0.20	0.19	0.07
30	NUSTAR ENERGY LP	541.995	0.26	0.19	0.04	0.02	0.59	0.19
31	PETROBRAS ENERGIA PARTICIPAC	713.490	0.18	0.08	0.01	-0.10	0.30	0.20
32	PETROBRAS-PETROLEO BRASILIER	19807.703	0.23	0.07	0.00	0.08	0.40	0.23
33	PETRO-CANADA	2088.486	0.13	0.09	0.01	-0.10	0.33	0.11
34	PETROCHINA CO LTD	42488.931	0.21	0.11	0.01	0.07	0.40	0.19
35	PREMCOR REFINING GROUP INC	1409.546	0.02	0.04	0.00	-0.05	0.18	0.02
36	QUAKER STATE CORP	227.831	0.03	0.02	0.00	0.00	0.08	0.03
37	REPSOL SA	14878.926	0.10	0.05	0.00	0.01	0.32	0.08
38	ROYAL DUTCH SHELL PLC	54326.848	0.10	0.04	0.00	-0.11	0.19	0.10
39	SHELL CANADA LTD -CL A	1358.279	0.12	0.06	0.00	-0.06	0.26	0.14
40	STATOIL ASA	16227.314	0.23	0.06	0.00	0.08	0.36	0.23
41	SUNCOR ENERGY INC	2633.706	0.14	0.08	0.01	-0.10	0.31	0.15
42	SUNOCO INC	4972.890	0.03	0.03	0.00	-0.13	0.09	0.03
43	TESORO CORP	2534.588	0.04	0.04	0.00	-0.05	0.13	0.04
44	TEXACO INC	9706.468	0.04	0.03	0.00	-0.07	0.09	0.04
45	TOSCO CORP	2360.826	0.05	0.03	0.00	-0.01	0.16	0.04
46	TOTAL PETROLEUM OF N AMERICA	607.121	0.01	0.03	0.00	-0.05	0.08	0.01
47	TOTAL SA	37341.087	0.12	0.06	0.00	0.00	0.27	0.13
48	ULTRAMAR DIAMOND SHAMROCK	2022.117	0.05	0.02	0.00	-0.01	0.11	0.05
49	UNITED REFINING CO	520.210	0.03	0.05	0.00	-0.07	0.14	0.02
50	USX CORP-CONSOLIDATED	5577.354	0.05	0.04	0.00	-0.08	0.12	0.06
51	VALERO ENERGY CORP	10387.718	0.05	0.04	0.00	-0.06	0.15	0.05
52	WESTERN REFINING INC	1827.153	0.05	0.06	0.00	-0.03	0.18	0.03
53	YACIMIENTOS PETE FISCALES SA	2278.224	0.24	0.12	0.01	0.06	0.78	0.21

Table 6: Regression Results

No	Firm	Regression 1		Regression 2			
		β_0	β_1	$\beta_0 inc$	β_{inc}	$\beta_0 dec$	β_{dec}
1	ALON USA ENERGY INC	-0.12***	1.09***	-0.17***	1.55***	-0.09	0.83*
2	AMOCO CO	0.04**	0.73***	0.05**	0.63**	0.02	0.88***
3	ARABIAN AMERICAN DEVELOPMENT	-0.05*	0.72***	-0.08*	0.94**	-0.02	0.53
4	ATLANTIC RICHFIELD CO	-0.11**	2.47***	-0.07*	2.17***	-0.14	2.73**
5	BP PLC	0.1***	0	0.05	0.4	0.15***	-0.34
6	CALUMET SPECIALTY PRODS -LP	-0.03	0.55**	-0.08*	0.79**	0.02	0.29
7	CHEVRON CORP	0.01	0.87***	0.02	0.8***	0.01	0.92***
8	CHEVRON PHILLIPS CHEM CO LLC	-0.07	0.78**	-0.05	0.66	-0.1	0.97*
9	CONOCO INC	-0.01	0.95***	-0.04	1.16***	0.01	0.75*
10	CROWN CENTRAL PETROL -CL B	-0.03***	0.35**	-0.04**	0.32*	-0.06***	0.76***
11	CVR ENERGY INC	0.03	0.29	-0.1*	1.36***	0.09*	-0.18
12	DELEK US HOLDINGS INC	-0.06**	0.72***	-0.14**	1.35***	-0.02	0.38
13	DIAMOND SHAMROCK INC	0.03**	0.16	0.03*	0.05	0.02	0.26
14	ECOPETROL SA	0.38***	-0.45	-0.54	7.37**	0.43***	-0.8
15	ENI SPA	0.07***	1.06***	0.04**	1.27***	0.08**	0.9***
16	EXXON MOBIL CORP	0	1.03***	0	1***	0	1.06***
17	FINA INC -CL A	-0.04**	1***	-0.07***	1.4***	-0.02	0.74**
18	FRONTIER OIL CORP	-0.15***	1.55***	-0.04*	0.68***	-0.25***	2.33***
19	GAZPROM OAO	0.29***	0.27	0.21***	0.78***	0.34***	0.02
20	GIANT INDUSTRIES INC	0.04***	0.03	0.06***	-0.15	0.01	0.17
21	HESS CORP	-0.05***	1.15***	-0.04***	1.03***	-0.06**	1.26***
22	HOLLYFRONTIER CORP	0.02*	0.37***	0.03**	0.24**	0.01	0.49***
23	HUNTWAY REFINING CO	0.01	0.35	-0.07*	1.12***	0.13**	-1.02*
24	HUSKY ENERGY INC	0.16***	0.46*	0.21***	-0.05	0.1**	0.92**
25	IMPERIAL OIL LTD	0.01*	0.98***	0.02***	0.83***	0	1.1***
26	LUKOIL OIL COMPANY	0.08***	0.7***	0.12***	0.47	0.03	0.96***
27	MAPCO INC	0.13***	-0.7***	0.13***	-0.62***	0.13***	-0.69*
28	MOBIL CORP	0.01*	0.61***	0.03**	0.45***	0	0.83***
29	MURPHY OIL CORP	0	0.69***	-0.01	0.76***	-0.01	0.63***
30	NUSTAR ENERGY LP	0.64***	-2.93***	0.66***	-2.48*	0.57***	-3.08**
31	PETROBRAS ENERGIA PARTICIPAC	0.18***	-0.01	0.12*	0.67	0.13*	0.04
32	PETROBRAS-PETROLEO BRASILIER	0.07**	1.31***	0.1**	1.33***	0.04	1.35***
33	PETRO-CANADA	-0.11***	2.29***	-0.08***	2.15***	-0.13***	2.4***
34	PETROCHINA CO LTD	0.16***	0.76	0.1	1.61**	0.19**	0.18
35	PREMCOR REFINING GROUP INC	-0.05***	0.78***	-0.07***	0.93***	-0.03	0.61**
36	QUAKER STATE CORP	0	0.34*	-0.02	0.57**	0.02	0.14
37	REPSOL SA	0.02	0.8***	-0.01	1.24***	0.04***	0.42***
38	ROYAL DUTCH SHELL PLC	0.05***	0.41***	0.06***	0.41***	0.05***	0.42***
39	SHELL CANADA LTD -CL A	0.02	1.01***	-0.01	1.34***	0.05*	0.6**
40	STATOIL ASA	0.02	1.69***	0	1.71***	0.05	1.6***
41	SUNCOR ENERGY INC	0.04**	0.91***	0.05	0.88**	0.04*	0.93***
42	SUNOCO INC	-0.01	0.31***	-0.03***	0.55***	0.02**	0.09
43	TESORO CORP	0.02**	0.17*	0.01	0.22*	0.03*	0.12
44	TEXACO INC	-0.04***	0.95***	-0.03***	0.85***	-0.06***	1.13***
45	TOSCO CORP	0.05***	-0.03	0.05***	-0.08	0.04*	0.15
46	TOTAL PETROLEUM OF N AMERICA	0.03*	-0.23	0.05***	-0.46**	0.01	0.01
47	TOTAL SA	-0.08***	1.75***	-0.1***	1.94***	-0.06***	1.59***
48	ULTRAMAR DIAMOND SHAMROCK	0.05***	0.04	0.05***	0.02	0.04*	0.14
49	UNITED REFINING CO	-0.02	0.34**	-0.02	0.33**	-0.01	0.34
50	USX CORP-CONSOLIDATED	-0.02*	0.86***	-0.01	0.74***	-0.04**	1.12***
51	VALERO ENERGY CORP	0.06***	-0.07	0.06***	-0.1	0.06***	-0.04
52	WESTERN REFINING INC	-0.01	0.43*	-0.06**	0.73***	0.03	0.19
53	YACIMIENTOS PETE FISCALES SA	0.08	1.73***	0.02	2.78***	0.1***	0.91***

4.3. Regression Analysis in the Whole Period

The first regression experiment results show that of 53 companies in the experiment, most of it, 32 firms (60%) are in the ideal $0 < \beta_1 < 1$ range, demonstrating that they have dynamic capabilities, as they are able to be less volatile relative to the fluctuation in the industry. Examples of firms included in this range are CHEVRON CORP, GAZPROM OAO, LUKOIL OIL COMPANY, PETROCHINA CO LTD, REPSOL SA, and ROYAL DUTCH SHELL PLC.

Then 1 firm (2%) is in the $\beta_1 = 1$ range, moving with the same direction and changes as the industry's. Only 1 firm (2%) is in the $\beta_1 = 0$ range, which means that this firm is not affected by changes in industry's operating income margin.

On the other hand, there are 13 firms (25%) that are highly volatile and their operating income margin changes higher than the industry's, 12 firms in the $\beta_1 > 1$ range and 1 firm in the $\beta_1 < -1$ range. Examples of firms included in this range are ENI SPA, EXXON MOBIL CORP, PETROBRAS-PETROLEO BRASILIER, STATOIL ASA, and TOTAL SA. There are also 6 firms (11%) in the undesirable $-1 < \beta_1 < 0$ range, as this firm performs in different direction (negatively) than the industry.

Table 7: Sorted β_1 for the first regression

Capacity for Dynamic Capabilities	Firm	β_0	β_1
$\beta_1 > 1$	ATLANTIC RICHFIELD CO	-0.11	2.47
	PETRO-CANADA	-0.11	2.29
	TOTAL SA	-0.08	1.75
	YACIMIENTOS PETE FISCALES SA	0.08	1.73
	STATOIL ASA	0.02	1.69
	FRONTIER OIL CORP	-0.15	1.55
	PETROBRAS-PETROLEO BRASILIER	0.07	1.31
	HESS CORP	-0.05	1.15
	ALON USA ENERGY INC	-0.12	1.09
	ENI SPA	0.07	1.06
	EXXON MOBIL CORP	0.00	1.03
	SHELL CANADA LTD -CL A	0.02	1.01
$\beta_1 = 1$	FINA INC -CL A	-0.04	1.00
$0 < \beta_1 < 1$	IMPERIAL OIL LTD	0.01	0.98
	CONOCO INC	-0.01	0.95
	TEXACO INC	-0.04	0.95
	SUNCOR ENERGY INC	0.04	0.91
	CHEVRON CORP	0.01	0.87
	USX CORP-CONSOLIDATED	-0.02	0.86
	REPSOL SA	0.02	0.80
	PREMCOR REFINING GROUP INC	-0.05	0.78
	CHEVRON PHILLIPS CHEM CO LLC	-0.07	0.78
	PETROCHINA CO LTD	0.16	0.76
	AMOCO CO	0.04	0.73
	ARABIAN AMERICAN DEVELOPMENT	-0.05	0.72
	DELEK US HOLDINGS INC	-0.06	0.72
	LUKOIL OIL COMPANY	0.08	0.70
	MURPHY OIL CORP	0.00	0.69
	MOBIL CORP	0.01	0.61
	CALUMET SPECIALTY PRODS -LP	-0.03	0.55
	HUSKY ENERGY INC	0.16	0.46
	WESTERN REFINING INC	-0.01	0.43
	ROYAL DUTCH SHELL PLC	0.05	0.41
	HOLLYFRONTIER CORP	0.02	0.37
	HUNTWAY REFINING CO	0.01	0.35
	CROWN CENTRAL PETROL -CL B	-0.03	0.35
	QUAKER STATE CORP	0.00	0.34
	UNITED REFINING CO	-0.02	0.34
	SUNOCO INC	-0.01	0.31
	CVR ENERGY INC	0.03	0.29
	GAZPROM OAO	0.29	0.27
	TESORO CORP	0.02	0.17
	DIAMOND SHAMROCK INC	0.03	0.16
	ULTRAMAR DIAMOND SHAMROCK	0.05	0.04
	GIANT INDUSTRIES INC	0.04	0.03
$\beta_1 = 0$	BP PLC	0.10	0.00
$-1 < \beta_1 < 0$	PETROBRAS ENERGIA PARTICIPAC	0.18	-0.01
	TOSCO CORP	0.05	-0.03
	VALERO ENERGY CORP	0.06	-0.07
	TOTAL PETROLEUM OF N AMERICA	0.03	-0.23
	ECOPETROL SA	0.38	-0.45
	MAPCO INC	0.13	-0.70
$\beta_1 < -1$	NUSTAR ENERGY LP	0.64	-2.93

4.4. Regression Analysis in Growth and Decline Period of the Industry

During the growth period, 18 firms (34%) are in the $\beta_{inc} > 1$ range. Examples of firms included in this range are ECOPETROL SA, ENI SPA, PETROBRAS-PETROLEO BRASILIER, PETROCHINA CO LTD, REPSOL SA, STATOIL ASA, and TOTAL SA. ECOPETROL SA has the highest β_{inc} with 7.37. These firms are shown to have dynamic capabilities, as they are able to exploit opportunities in the economic boom and gain higher changes in operating income margin. Only 1 firm (2%) is in the $\beta_{inc} = 1$ range, gaining the same increase in operating income margin as the industry. Furthermore, most of the firms, 27 firms (51%) are in the $0 < \beta_{inc} < 1$ range, which means they gain increase in their operating income margin, albeit lower than the industry.

However, 7 firms (13%) are in the undesired range, 6 firms (11%) in the $-1 < \beta_{inc} < 0$ range and 1 firm (2%) in the $\beta_{inc} < -1$ range. Their operating income margin changed negatively along with industry. These firms have decrease in their operating income margin despite the growth in the industry. Firms in this range are, for instance, GIANT INDUSTRIES INC, HUSKY ENERGY INC, MAPCO INC, NUSTAR ENERGY LP, TOSCO CORP, TOTAL PETROLEUM OF N AMERICA, and VALERO ENERGY CORP.

In the decline period, 7 firms (13%) manage to have increase in their operating income margin albeit decline in the industry, 5 firms in the $-1 < \beta_{dec} < 0$ range and 2 firms in the $\beta_{dec} < -1$ range. These firms are VALERO ENERGY CORP, CVR ENERGY INC, BP PLC, MAPCO INC, ECOPETROL SA, HUNTWAY REFINING CO, and NUSTAR ENERGY LP. Then, 11 firms (21%) are in the undesired $\beta_{dec} > 1$ range, they incur more loss than the industry. Most of the firms, 35 firms (66%), can minimize loss compared to the industry as they are in the $0 < \beta_{dec} < 1$ range.

Table 8: Sorted β_{inc} for the second regression (growth period in industry)

Capacity for Dynamic Capabilities	Firm	$\beta_0 inc$	β_{inc}
$\beta_{inc} > 1$	ECOPETROL SA	-0.54	7.37
	YACIMIENTOS PETE FISCALES SA	0.02	2.78
	ATLANTIC RICHFIELD CO	-0.07	2.17
	PETRO-CANADA	-0.08	2.15
	TOTAL SA	-0.10	1.94
	STATOIL ASA	0.00	1.71
	PETROCHINA CO LTD	0.10	1.61
	ALON USA ENERGY INC	-0.17	1.55
	FINA INC -CL A	-0.07	1.40
	CVR ENERGY INC	-0.10	1.36
	DELEK US HOLDINGS INC	-0.14	1.35
	SHELL CANADA LTD -CL A	-0.01	1.34
	PETROBRAS-PETROLEO BRASILIER	0.10	1.33
	ENI SPA	0.04	1.27
	REPSOL SA	-0.01	1.24
	CONOCO INC	-0.04	1.16
	HUNTWAY REFINING CO	-0.07	1.12
	HESS CORP	-0.04	1.03
$\beta_{inc} = 1$	EXXON MOBIL CORP	0.00	1.00
$0 < \beta_{inc} < 1$	ARABIAN AMERICAN DEVELOPMENT	-0.08	0.94
	PREMCOR REFINING GROUP INC	-0.07	0.93
	SUNCOR ENERGY INC	0.05	0.88
	TEXACO INC	-0.03	0.85
	IMPERIAL OIL LTD	0.02	0.83
	CHEVRON CORP	0.02	0.80
	CALUMET SPECIALTY PRODS -LP	-0.08	0.79
	GAZPROM OAO	0.21	0.78
	MURPHY OIL CORP	-0.01	0.76
	USX CORP-CONSOLIDATED	-0.01	0.74
	WESTERN REFINING INC	-0.06	0.73
	FRONTIER OIL CORP	-0.04	0.68
	PETROBRAS ENERGIA PARTICIPAC	0.12	0.67
	CHEVRON PHILLIPS CHEM CO LLC	-0.05	0.66
	AMOCO CO	0.05	0.63
	QUAKER STATE CORP	-0.02	0.57
	SUNOCO INC	-0.03	0.55
	LUKOIL OIL COMPANY	0.12	0.47
	MOBIL CORP	0.03	0.45
	ROYAL DUTCH SHELL PLC	0.06	0.41
	BP PLC	0.05	0.40
	UNITED REFINING CO	-0.02	0.33
	CROWN CENTRAL PETROL -CL B	-0.04	0.32
	HOLLYFRONTIER CORP	0.03	0.24
	TESORO CORP	0.01	0.22
	DIAMOND SHAMROCK INC	0.03	0.05
	ULTRAMAR DIAMOND SHAMROCK	0.05	0.02
$-1 < \beta_{inc} < 0$	HUSKY ENERGY INC	0.21	-0.05
	TOSCO CORP	0.05	-0.08
	VALERO ENERGY CORP	0.06	-0.10
	GIANT INDUSTRIES INC	0.06	-0.15
	TOTAL PETROLEUM OF N AMERICA	0.05	-0.46
	MAPCO INC	0.13	-0.62
$\beta_{inc} < -1$	NUSTAR ENERGY LP	0.66	-2.48

Table 9: Sorted β_{dec} for the second regression (decline period in industry)

Capacity for Dynamic Capabilities	Firm	$\beta_0 dec$	β_{dec}
$\beta_{dec} > 1$	ATLANTIC RICHFIELD CO	-0.14	2.73
	PETRO-CANADA	-0.13	2.40
	FRONTIER OIL CORP	-0.25	2.33
	STATOIL ASA	0.05	1.60
	TOTAL SA	-0.06	1.59
	PETROBRAS-PETROLEO BRASILIER	0.04	1.35
	HESS CORP	-0.06	1.26
	TEXACO INC	-0.06	1.13
	USX CORP-CONSOLIDATED	-0.04	1.12
	IMPERIAL OIL LTD	0.00	1.10
	EXXON MOBIL CORP	0.00	1.06
$0 < \beta_{dec} < 1$	CHEVRON PHILLIPS CHEM CO LLC	-0.10	0.97
	LUKOIL OIL COMPANY	0.03	0.96
	SUNCOR ENERGY INC	0.04	0.93
	CHEVRON CORP	0.01	0.92
	HUSKY ENERGY INC	0.10	0.92
	YACIMIENTOS PETE FISCALES SA	0.10	0.91
	ENI SPA	0.08	0.90
	AMOCO CO	0.02	0.88
	MOBIL CORP	0.00	0.83
	ALON USA ENERGY INC	-0.09	0.83
	CROWN CENTRAL PETROL -CL B	-0.06	0.76
	CONOCO INC	0.01	0.75
	FINA INC -CL A	-0.02	0.74
	MURPHY OIL CORP	-0.01	0.63
	PREMCOR REFINING GROUP INC	-0.03	0.61
	SHELL CANADA LTD -CL A	0.05	0.60
	ARABIAN AMERICAN DEVELOPMENT	-0.02	0.53
	HOLLYFRONTIER CORP	0.01	0.49
	REPSOL SA	0.04	0.42
	ROYAL DUTCH SHELL PLC	0.05	0.42
	DELEK US HOLDINGS INC	-0.02	0.38
	UNITED REFINING CO	-0.01	0.34
	CALUMET SPECIALTY PRODS -LP	0.02	0.29
	DIAMOND SHAMROCK INC	0.02	0.26
	WESTERN REFINING INC	0.03	0.19
	PETROCHINA CO LTD	0.19	0.18
	GIANT INDUSTRIES INC	0.01	0.17
	TOSCO CORP	0.04	0.15
	ULTRAMAR DIAMOND SHAMROCK	0.04	0.14
	QUAKER STATE CORP	0.02	0.14
	TESORO CORP	0.03	0.12
	SUNOCO INC	0.02	0.09
	PETROBRAS ENERGIA PARTICIPAC	0.13	0.04
	GAZPROM OAO	0.34	0.02
	TOTAL PETROLEUM OF N AMERICA	0.01	0.01
$-1 < \beta_{dec} < 0$	VALERO ENERGY CORP	0.06	-0.04
	CVR ENERGY INC	0.09	-0.18
	BP PLC	0.15	-0.34
	MAPCO INC	0.13	-0.69
	ECOPETROL SA	0.43	-0.80
$\beta_{dec} < -1$	HUNTWAY REFINING CO	0.13	-1.02
	NUSTAR ENERGY LP	0.57	-3.08

4.5. Firms Survival

Table 10 provide list of firms that survived until the end of this study's data set (in 2012Q4) and their capacity of dynamic capabilities. Of the 53 firms in the data set, 31 firms survived until 2012Q4. The remaining 22 firms that did not survived until 2012Q4 are subjected to either mergers or acquisitions. Their capacity of dynamic capabilities are shown in table 11. In both tables, β are marked by gray color if it is in the desirable range. Our study considers that dynamic capabilities are related to a firm's survival. Firms that have dynamic capabilities have higher chance to survive.

Table 10 shows that all of the firms' β from regression 1 and 2 experiment results with the exception of 1 firm (EXXON MOBIL CORP) have capacity of dynamic capabilities since their β are in the desirable range in at least 1 of the 3 regressions scenario (whole, growth, or decline in industry period). However, EXXON MOBIL CORP regression results are shown to have β of almost 1 in the 3 scenarios, appearing to be performing almost the same with the industry fluctuations.

In the same table, 21 of 31 firms (68%) that are in the desired range of $0 < \beta_1 < 1$. Table 11 have the same results, among firms that did not survive 15 of 22 firms (68%) are in the desired β_1 range. However, if their average β_1 values are compared, the survived firms are less volatile and less responsive to the fluctuating industry (average $\beta_1 = 0.59$), compared to firms that did not survive (0.65), showing more capacity of dynamic capabilities.

Concerning growth period in the regression 2 results, of the firms that survived, 12 of 31 firms (39%) are in the desired $\beta_{inc} > 1$ range with average β_{inc} of 1.04. Of the firms that did not survived, only 6 firms (27%) are in range, with average of 0.67. So firms that survived have more firms

and percentage in the desired area and averaged more value of β_{inc}, showing better ability to exploit opportunities in industry's growth.

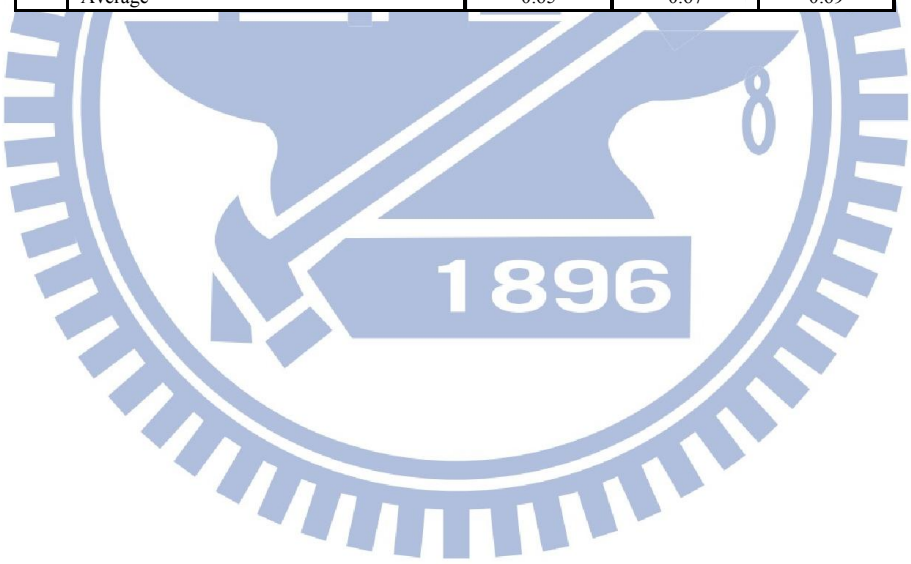
If the decline period is observed, both tables show that more firms have β_{dec} in the desired range, compared to firms in β_1 and β_{inc} desired range. Most of the firms' β_{dec} in both tables are in the desired area (the desired range is set to $\beta_{dec} < 1$, consists of highly preferable $\beta_{dec} < -1$ and realistic option $0 < \beta_{dec} < 1$), among the survived firms, 25 firms (81%) are in the desired range of $\beta_{dec} < 1$, more than firms that did not survived (17 firms, 77%). Survived firms also have preferable average of β_{dec} with 0.46, compared to 0.69 from firms that did not survived. Presenting that firms that survived have more firms and percentage averaged less value of β_{dec}, showing better ability to minimize loss in industry's decline.

Table 10: Firms survived until 2012Q4

No	Firm	Regression 1	Regression 2	
		β1	βinc	βdec
1	ALON USA ENERGY INC	1.09***	1.55***	0.83*
2	ARABIAN AMERICAN DEVELOPMENT	0.72***	0.94**	0.53
3	BP PLC	0	0.4	-0.34
4	CALUMET SPECIALTY PRODS -LP	0.55**	0.79**	0.29
5	CHEVRON CORP	0.87***	0.8***	0.92***
6	CVR ENERGY INC	0.29	1.36***	-0.18
7	DELEK US HOLDINGS INC	0.72***	1.35***	0.38
8	ECOPETROL SA	-0.45	7.37**	-0.8
9	ENI SPA	1.06***	1.27***	0.9***
10	EXXON MOBIL CORP	1.03***	1***	1.06***
11	GAZPROM OAO	0.27	0.78***	0.02
12	HESS CORP	1.15***	1.03***	1.26***
13	HOLLYFRONTIER CORP	0.37***	0.24**	0.49***
14	HUSKY ENERGY INC	0.46*	-0.05	0.92**
15	IMPERIAL OIL LTD	0.98***	0.83***	1.1***
16	LUKOIL OIL COMPANY	0.7***	0.47	0.96***
17	MURPHY OIL CORP	0.69***	0.76***	0.63***
18	NUSTAR ENERGY LP	-2.93***	-2.48*	-3.08**
19	PETROBRAS-PETROLEO BRASILIER	1.31***	1.33***	1.35***
20	PETROCHINA CO LTD	0.76	1.61**	0.18
21	REPSOL SA	0.8***	1.24***	0.42***
22	ROYAL DUTCH SHELL PLC	0.41***	0.41***	0.42***
23	STATOIL ASA	1.69***	1.71***	1.6***
24	SUNCOR ENERGY INC	0.91***	0.88**	0.93***
25	SUNOCO INC	0.31***	0.55***	0.09
26	TESORO CORP	0.17*	0.22*	0.12
27	TOTAL SA	1.75***	1.94***	1.59***
28	UNITED REFINING CO	0.34**	0.33**	0.34
29	VALERO ENERGY CORP	-0.07	-0.1	-0.04
30	WESTERN REFINING INC	0.43*	0.73***	0.19
31	YACIMIENTOS PETE FISCALES SA	1.73***	2.78***	0.91***
	Average	0.59	1.04	0.46

Table 11: Firms that did not survived until 2012Q4

No	Firm	Regression 1	Regression 2	
		β1	βinc	βdec
1	AMOCO CO	0.73***	0.63**	0.88***
2	ATLANTIC RICHFIELD CO	2.47***	2.17***	2.73**
3	CHEVRON PHILLIPS CHEM CO LLC	0.78**	0.66	0.97*
4	CONOCO INC	0.95***	1.16***	0.75*
5	CROWN CENTRAL PETROL -CL B	0.35**	0.32*	0.76***
6	DIAMOND SHAMROCK INC	0.16	0.05	0.26
7	FINA INC -CL A	1***	1.4***	0.74**
8	FRONTIER OIL CORP	1.55***	0.68***	2.33***
9	GIANT INDUSTRIES INC	0.03	-0.15	0.17
10	HUNTWAY REFINING CO	0.35	1.12***	-1.02*
11	MAPCO INC	-0.7***	-0.62***	-0.69*
12	MOBIL CORP	0.61***	0.45***	0.83***
13	PETROBRAS ENERGIA PARTICIPAC	-0.01	0.67	0.04
14	PETRO-CANADA	2.29***	2.15***	2.4***
15	PREMCOR REFINING GROUP INC	0.78***	0.93***	0.61**
16	QUAKER STATE CORP	0.34*	0.57**	0.14
17	SHELL CANADA LTD -CL A	1.01***	1.34***	0.6**
18	TEXACO INC	0.95***	0.85***	1.13***
19	TOSCO CORP	-0.03	-0.08	0.15
20	TOTAL PETROLEUM OF N AMERICA	-0.23	-0.46**	0.01
21	USX CORP-CONSOLIDATED	0.86***	0.74***	1.12***
22	ULTRAMAR DIAMOND SHAMROCK	0.04	0.02	0.14
	Average	0.65	0.67	0.69



V. Conclusions

5.1. Conclusions

This study firstly found a gap based on the review of existing dynamic capabilities' empirical researches. Firstly it is difficult to decide a boundary for a specific dynamic capability. Then, since most of existing dynamic capabilities' empirical researches employ survey-based approach by focusing on a specific capability, it is difficult and time consuming to measure dynamic capabilities of a firm in a fast-changing business environment, where the environment is always changing and fluctuating. The firm may miss the opportunities and timing to adapt or perform corrective adjustment in order to sustain its competitive advantage or to survive in the business environment.

Thus based on this need, this study proposes a complement for existing dynamic capabilities measurement methods, a first-gate indicator for measuring dynamic capabilities to superficially examine firms' dynamic capabilities. Utilizing available and objective financial data, which firms may employ easily and quickly, a firm is able to measure their performance in comparison with its competitors. Using this indicator, a firm can quickly measure itself and found whether or not it have dynamic capabilities compared to others. Then, further detailed inspection can be made, and corrective actions can be done. This method enhances firms' ability to adapt.

The indicator is based on the relationship between managerial and organizational processes, asset position, and paths (Teece et al., 1997) and hierarchy of capabilities (Zollo and Winter, 2002; Winter, 2003; Zahra et al., 2006) concept, considering the influence of industry on a firm. This study developed two regression methods to operationalize dynamic capabilities by measuring relative volatility of a firm's operating income margin against industry's

performance. The first regression method measures overall capacity for dynamic capabilities. The second regression method measures capacity for dynamic capabilities depending on economic boom or recession, demonstrating firm's ability to exploit opportunities and adapt in improving or declining period of industry.

For validation, the measurement data consist of 53 firms of petroleum and refining industry in North America during 1990-2012 (quarterly performance). In the first regression experiment, this study contends that firms with higher dynamic capabilities have less volatility of their operating income margin. Thus, the ideal scenario for β_1 is to be less than one but more than zero, which demonstrates the firm's ability to remain stable and low volatility relative to the industry.

For the second experiment, this study contends that firms with higher dynamic capabilities are able to achieve higher increase of operating income margin than the industry during economic boom and less decrease of operating income margin during economic recession. Thus, ideal β_{inc} is more than one, since it means that the firm is able to exploit opportunities with the growth in industry. For β_{dec}, value less than zero is highly preferable, firm's operating income margin is improving despite decline in industry. However, the most realistic is for β_{dec} more than zero and less than one, since attaining value less than zero may be highly challenging.

If firms' survival are observed, firms that survived until 2012Q4 have more desirable average β_1, β_{inc}, and β_{dec} values than the firms that did not survived. Firms that survived until 2012Q4 also have more firms in the desired β_{inc} and β_{dec} area. This results demonstrate that firms that survived have more capacity of dynamic capabilities, showing less volatile and less responsive

to the fluctuating industry compared to firms that did not survive, better ability to exploit opportunities in industry's growth, and minimize loss during the industry's decline.

5.2. Research Limitations

The independent variable in these two regression analysis, the industry, is only composed of all firms' operating income margin per quarter is weighted by the firm's net sales (weighted average) in the industry. This independent variable may not directly capture the influence or exposure of all components in other industry and the whole business environment, such as the customers, suppliers, government, financial, or economic situation. However, this independent variable may be useful in comparing firms' performances or efficiencies related to zero level capabilities (firms' operation, tasks, routines, or processes).

5.3. Future Research

Further research can be done by applying regression experiments in this study to different types of industries. Other industries firms' survival rate can be compared with the regression experiments results and to the results used in this study (SIC 2911).

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Resume

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CAREER OBJECTIVE

A professional driven to build a career in challenging position, in which I can apply my MBA education, operation, and project management skills to significantly help the firm and make an impact.

QUALIFICATION SUMMARY

- ➔ Background education in management (MBA) and engineering (Mechatronics)
- ➔ Foundation and experience in operations management (Understand Production, Engineering, QC, PPIC, Warehousing, Marketing, Supply Chain, Delivery, Billing business flow)
- ➔ Capable in managing efficiency projects
- ➔ Capable in Financial Management, Accounting, Economics, and Revenue Management
- ➔ Capable in product development planning and quality management system (APQP, FMEA, PPAP, and OEE)
- ➔ Capable in performing business analytics and managerial statistics **(using R & SPSS statistics software)**
- ➔ **Engineering software:** AutoCAD, SolidWorks, ProEngineer, Catia
- ➔ **Language: Indonesian:** Native Speaker, **English:** Proficient, **Chinese:** Fair

EDUCATION

Taiwan
Sept 2012 - Jul 2014
National Chiao Tung University (國立交通大學) - Full scholarship
Global Master of Business Administration (企業管理碩士) Score: 88.71/100

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2004 - 2008
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Mechatronics Engineering (機電工程) Score: 3.21/4

EXPERIENCE

Taiwan
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National Chiao Tung University (國立交通大學)
Research assistant in "Dynamic Capabilities" topic: Using financial data to measure the relative volatility of a firm's operating margin against industry average

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production
King Duan Industrial Co., Ltd. (金鍛工業股份有限公司)
Internship: Forging product development planning, design, engineering, and

Indonesia
2011 - 2012
Fajar Paper
Operations Management Department
Main responsibilities:
- ➔ Production efficiency
- ➔ Evaluation (allow or not) of company spare parts and service purchase requests
- ➔ Assist Operations Director decision making by providing data and analysis

Projects:
- ➔ Fiber screen basket cost saving project by recoating and refurbishment
- ➔ Computerization and standardization of incoming raw material data input, calculation, and pricing
- ➔ Assistant key user of SAP Sales and Distribution module
- ➔ Improve raw materials storage efficiency by bale press machine installation

Indonesia 2009 - 2011	**Asia Pulp & Paper (APP)** **Efficiency Team and Electric Instrument Engineer** Projects and responsibilities: → Sheeter machine total efficiency project → Toyota Way training to operators to increase work process efficiency and waste awareness → Fiber cleaner control modification → Cut size machine roll tension control modification proposal → Field instruments preventive, reactive maintenance, troubleshooting, installation, and calibration
Swiss Mar - Jun 2007	**FHS St. Gallen, Rapid Product Development Institute** **Internship:** 3D printing design using CAD software and production