東海大學管理學院財務金融研究所

碩士論文

實質選擇權對投資與現金流量敏感度之研究

The Impact of Real Options on Investment-Cash Flow Sensitivity

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本人 裴氏梅 (學號: G06440701)已完全了解學術倫理之定義。僅此聲明，本人呈交之碩士論文絕無抄襲或由他人代筆之情事。若被揭露具有違背學術倫理之事實或可能，本人願自行擔負所有之法律責任。對於碩士學位因違背學術倫理而被取消之後果，本人也願一併概括承受。

立證人： 裴氏梅 (簽名)

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摘要

雖然投資-現金流敏感度（ICFS）在公司財務文獻中多所討論，但這種關係的研究尚未存在一致的結果，而且大多數過去文獻都基於現金流量觀點。本文使用台灣證券交易所 2001-2017 年期間的上市公司為樣本，探討實質選擇權對 ICFS 的影響。本文主張投資與內部現金流量間的關係，可能必須從現金流量與投資兩個方向來考慮。在檢測本文的樣本後，實證結果發現：第一，實質選擇權會增加投資與內部現金流的敏感度。第二，在控制財務限制之下（從現金流面來看），實質選擇權（從投資面來說）亦為解釋敏感度的重要解釋變數。 第三，實質選擇權可以擴大財務限制對投資與現金流敏感度的影響。

關鍵字: 實質選擇權，投資-現金流量的敏感度，財務限制，台灣市場

Abstract

Although Investment-Cash Flow Sensitivity (ICFS) is well documented in the corporate finance literature, results of this relationship are controversial and most of the previous papers based on cash flow viewpoint. Using a sample of firms listed in Taiwan Stock Exchange over the period 2001-2017, this paper investigates the impact of real options on ICFS. We argue that the relationship between investment and internal cash flow has to be considered from both aspects: Cash flow and investment. After examining our sample, we have some interesting results. First, real options increase the sensitivity of investment on internal cash flow. Second, under controlling financial constraints (From the cash flow aspect), real options (From the investment aspect) is also an important explanatory variable. Third, real options can expand the effect of financial constraints on Investment-Cash flow sensitivity.

Key words: Real options, investment-cash flow sensitivity, financial constraints, Taiwan market

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1. Introduction

Firm investment and financing decisions or Investment-cash flow sensitivity (Hereafter ICFS) is one of the most popular topics in Corporate Finance Research. One important insight of this work is information asymmetry. It all began with a research of Modigliani and Miller (1958). They are famous with the capital structure irrelevance principle. This theorem states that in the absence of taxes, bankruptcy costs, agency costs, and asymmetric information, and in an efficient market, the value of a firm is unaffected by how that firm is financed. But in reality, it is the opposite. There are presences of taxes, bankruptcy costs, agency costs, and asymmetric information and our market is definitely not an efficient market. Therefore, the value of a firm or the return of an investment plan is definitely affected by how that firm is financed. To confirm with reality, Myers and Majluf (1984) come up with pecking order theory: The cost of financing increases with asymmetric information. Financing comes from three sources: internal funds, debt and new equity. Companies prefer their financing funds because it is the cheapest one. If internal resources are not enough to implement the investment plans, companies will consider to take debt and raising equity is the last option. Hence, investment, somehow, relies on internal cash flow. Especially, with financially constrained firms the relationship between investment and internal cash flow should be more sensitive. Since then, there is the opening of a non-ending debate about ICFS.

The beginning of this persistent debate is Fazzari, Hubbard, and Petersen (1988) (Hereafter FHP). From investment Q model discuss determinants of investment FHP (1988) confirms that in the imperfect market, investment does not just rely on investment opportunities but internal cash flow. Furtherly, they divided the full sample into subsamples according to dividend policy, with high dividend firms assumed less likely to face financial constraints. Their findings showed that cash flow tends to affect the investment of low dividend firms significantly more than that of high-dividend firms. This result is a big hit in the corporate finance literature which confirms that ICFS can be a measure of financial constraints. Various paper re-examine the relationship between investment and financing decision and have the result in line with FHP (1988) (Kato, Loewenstein & Tsay (2002), Perotti & Gelfer (2001), Laeven (2003), Aggarwal & Zong (2006); Whited, 1992; Hoshi, Kashyap & Scharfstein, 1991; Kashyap, Lamont & Stein, 1994; Mizen &

Vermeulen, 2005). FHP's literature is widely accepted until the research of Kaplan and Zingales (1997) (Hereafter KZ). They challenge FHP (1988)'s result by using FHP (1988)'s sample of 49 low-dividend paying firms, which are represented the highest constrained finance group, to re-examine the relationship between financing constraints and ICFS. They use the qualitative and quantitative definition for financially constrained status to divide these 49 firms into subsamples (Firms are never constrained, firms are possibly constrained, firms are likely constrained…) and find the consistent result that firms that appear less financially constrained exhibit significantly greater sensitivities than firms that appear more financially constrained. The results of KZ (1997) about ICFS were subsequently confirmed by several studies (Cleary, 1999; Cleary, Povel & Raith, 2007).

Until now, ICFS is still a topic of constant controversy. Researchers, they recheck firm investments and financing decisions in different markets and they investigate every possible determinant which can affect this relationship. Shen and Wang (2005) state that having a strong bank relationship can reduce the asymmetric information, this implies investment is more sensitive to cash flow when a firm has a weak bank relationship. With financial constraints concept is when a firm is not easy to access external capital or the cost of capital is relatively high, Mulier, Schoors, and Merlevede (2016) uses a new and simple index of level financial constraints, firms that pay higher interest rates on their debt are considered as a member of financial constraints group. They realize this group shows the highest sensitivity of investment on internal cash flow. Country and global development facilitate are also discussed, which can remove barriers of financing for individual firms since there will be many financial resources and the protection of government (Larkin, Ng & Zhu, 2018). The appearance of institutional investors in a specific company not only help to mitigate asymmetric information between insider and outsider but also can improve monitoring so that reduce agency problem. Hence, Institutional investors with longer investment horizons have a negative impact on ICFS (Attig et al., 2012).

Researching in family ownership by surveying panel data of 1206 Taiwanese firms for the time period 1999 to 2008, Hung and Kuo (2011) have an interesting result. They indicate family control increases the ICFS because of greater information asymmetry. The reason leads to this result are agency problem between majority and minority and concentrated ownership which

allow managers to manipulate earnings for private reasons. Another research basing on time series, Chen and Chen (2012) research Investment-cash flow sensitivity of US market follows with time series, realize that this relationship has declined, even during the financial crisis 2007-2009. Therefore, they agree with KZ (1997) and confirm their work by concluding that investment-cash flow sensitivity cannot be a good measure of financial constraints.

After all these researches and debates, until now we have not had a unified result. However, previous articles have a common thing that is they almost see this Investment-Cash flow relationship from information asymmetry which affects companies if they want to take external resources. In another word, most of the previous researches just only focus on the cash flow aspect. But, what about the investment aspect? What if a company has a high information asymmetry? It means they are not easy to take external finance and in literature, it means their investments will more rely on internal resources. However, what if this company does not have many investment options? Or a company which has a lot of investment opportunities but face highly financial constraints then decide to give up or delay these investment plans? In these cases, Investment-Cash flow will still be the same that so sensitive? Consequently, Investment also plays an extremely important role in this relationship. In addition, when we consider ICFS, we should consider from two aspects (Cash flow and Investment) in parallel.

Recently researchers have begun to notice about the importance of investment in the relationship of investment and internal cash flow through agency cost manner. Firms over-invest when they have positive free cash flows (Chen, Sun & Xu, 2016). The psychology literature to behavioral corporate finance and find that managers, as a special group, are more likely to exhibit optimism than ordinary people (Landier & Thesmar, 2009). Optimistic managers exhibit higher ICFS than do non-optimistic managers (Lin, Hu & Chen, 2005). In addition, on average top executives' overconfidence leads to increased ICFS (Huang et al., 2011; Ben Mohamed, Fairchild & Bouri, 2014). These papers mostly discuss ICFS through agency problem which states that especially in weak monitoring firms, managers prefer to hold cash to invest in their own objectives to build empires and increase the size of the assets under their control (rather than distribute it to shareholders) (Jensen, 1986). We can clearly see that until now there has not had a truly

comprehensive study about Investment-Cash flow sensitivity from investment aspect which can combine the impact insider and outsider factors of a company to its investment strategy.

Let take an overview look about investment. Investment decisions are strategic and managers will base on the return of that investment can create. This includes the value of an investment project includes a fixed path for the estimated future cash flows (Net Present Value) and the value of adjustment following the changing of decision call Real Options Value (ROV). Real option's value will rise with its underlying uncertainty and with firm's managerial flexibility to react with changing of environment or decide the right timing like expand, abandoning, altering or staging projects (Ramezani, 2011). Therefore, real options involve a lot of information about investment decisions and strategies concluding outside (Uncertainty environment, new information coming and changing) and inside (Managers' strategies to react for these effects). Say so, real options seem to be the most appropriate comprehensive determinant representing for investment strategy which we are finding. Consequently, in this paper, we examine the impact of Real Options on ICFS. We try to fill a huge gap in Investment-Cash flow theory by trying to answer three questions: First, Does Investment through Real options plays an important role in ICFS? Second, under controlling financial constraints in ICFS, do Real options still have explanation space? Third, if Real options can interpret the impact of financial constraints on ICFS?

By analyzing above questions, this study contributes to several literatures. First, we are the first paper, in our knowledge, directly investigating the relationship of investment and internal cash flow from investment strategy view point through real options. Second, we complement and extend the literature that states ICFS has to be discussed from both aspects: Cash flow and investment because these two factors have mutual interaction. Previous studies mainly focused on cash flow view point. Third, we extend the body of research that investigates the effect of real options on the impact of financial constraints on Investment-Cash Flow Sensitivity and find out real options can extend the impact of financial constraints on ICFS.

The remainder of this paper is organized as follows. Next, we are going to discuss our main variable, real options, in section 2. In section 3, we will introduce about how we select data and use methodology based on Q-investment model; we will present and discuss our empirical result in section 4 and robustness check in section 5. The last part is conclusion shown in section 6.

2. Discuss about real options

Traditional views of corporate capital budgeting state that firms make investment decisions based on the Net Present Value (NPV) of projects which included a fixed path for the future cash flows. Managers will decide to invest in this project if NPV exceeds the cost of the investment. This approach has an important assumption that managers are passively committed to the investment and excluded all the changing environment. However, in fact, market conditions change over time and managers have to adjust their decisions based on specific situations since these change may affect estimated cash flows, discount rates and therefore affect NPV of that project. Hence, the new approach of corporate capital budgeting shows that the value of an investment project included two parts: Net present value (NPV) plus the value of real options (ROV). The appearance of real options techniques to value infrastructure projects not only add the shortcoming of discounted cash flow analysis and become a better project evaluation tool (Kulatilaka & Wang, 1996) but also represent for investment strategy.

Although some time based on the environment, a firm may delay our investment due to waiting for another good time, real options can turn a negative investment project into a good project in a correct timing manner. For example, opening Seven-Eleven stores on the campus does not seem profitable for a school since there are not many students during summer and winter vacation. However, with Option to Switch, they can design the special Seven-Eleven stores for schools which only open according to the student's school hours. This not only helps to reduce clerks' salary but also can keep students and school staffs convenient and it turns to be a profitable project. In addition, with the option power, managers can abandon a fail project to gather resources immediately for the next investment. This will increase the probability of investment. And sure, with a successful investment plan, managers will not just say: "it is good, it is profitable" but they will definitely expand this project, invest more so that will increase investment level.

Firms with higher real options value hold more cash on hand (Ramezani, 2011), seem they want to prepare resources for ready to invest immediately whenever they have opportunities. Real

options can through agency conflicts lead to reduce leverage and shorten debt to overinvest in risky investment projects (Mauer, 2001). Therefore, real options should increase investment and by that, we predict that real options have a positive effect on ICFS.

Real option's value changes with two main factors, its underlying uncertainty and firm's managerial flexibility to react with changing of environment or decide the right timing like expand, abandoning, altering or staging projects (Copeland & Antikarov, 2001). Discuss uncertainty, previous researches have studied some models to explain how uncertainty firm's investment and ICFS but the results are still controversial. In uncertainty environment, managers seem to hesitate to invest, and in addition, there is a higher value on the option of waiting so that companies likely reduce their current level of investment. Investigating economic policy uncertainty, Wang, Chen, and Huang (2014) find that when the degree of uncertainty is higher, firms stand to lower their investment and vice versa. Therefore, as the uncertainty increase, ICFS significant declines (Inoue, Kani & Nakashima, 2018; Xie, 2009).

Nevertheless, when uncertainty increases, not every firm decreases its investment level since wise leaders have the ability to identify good investment opportunities in the uncertainty (Knight, 1921). Landier and Thesmar (2009) show that managers are more likely to be optimism than ordinary people so that they may see the stock market collapse as an opportunity. Like John F. Kennedy, the 35th President of the United States, said "When written in Chinese, the word 'crisis' is composed of two characters. One represents danger and the other represents opportunity", uncertainty also creates opportunities. In addition, uncertainty can higher the estimated profit margin, therefore, increase investment level (Abel, 1983). By real options model, Meng and Wang (2005) reveal that increasing project earning volatility increases the investment probability. Through this approach, we can predict that uncertainty has a positive impact on investment and therefore increase the sensitivity of investment on internal cash flow. From another view to explain the impact of uncertainty on ICFS, Sterken, Lensink, and Bo (2001) investigate Dutch listed firms, they realize firms facing high uncertainty rely more on internal cash flow. After applying a GMM-estimator, their results still robust: Higher uncertainty intensifies the use of internal cash flow. This inverse phenomenon can be explained by in uncertainty environment

firms could be faced with a large external financing premium (Boyle & Guthrie, 2003). Hence, in this paper, we predict uncertainty has a positive impact on ICFS.

Real options also have become more valuable when managers have the flexibility to respond to new information. Another factor of real options is managerial flexibility or the options of managers. Behavioral corporate finance has been discussed in Corporate finance literature for quite a time. Chen, Sun, and Xu (2016) show that firms are likely to over-invest when they generate positive inflow. Optimistic managers believe that a firm's projects under their control are better than they actually are so that they will attribute a higher expected return to these projects (Ben Mohamed, Fairchild & Bouri, 2014). Overconfident and optimistic managers will lead to increase ICFS (Lin, Hu & Chen, 2005; Huang et al., 2011; Ben Mohamed, Fairchild & Bouri, 2014). Managers themselves have had a tendency to invest rather than distribute to shareholders, so that when the higher managerial flexibility they have, the more investment opportunities will be created and processed lead to increase ICFS.

3. Sample selection and Methodology

Our sample consists of listed firms over the 2001–2017 period. Firms with data in the Taiwan Economic Journal (TEJ) are included. Similar to other papers, we exclude depository receipts and financial industry. In addition, we also exclude the Building Construction industry which includes 56 firms (1125 firm-year observations). Since in this paper, we are discussing the relationship between investment and the internal cash flow but the investment behavior of this industry seems different from the others. We use the widely used measure of a firm's investment is capital expenditure as purchased fixed assets (Property, plant, and equipment) in each calendar year. However, the Building Construction industry, they are quite special. Because they run the business on these fixed assets so in their financial statements, most of the fixed assets are not included in fixed asset items but in Inventory item and in Property for rent item or in some companies in properties for investment item. There is no uniformity in the expression of purchased fixed assets for this industry so that we exclude these companies. Besides, we also drop observations which have incomplete data. Finally, we obtain a final sample of 10454 firm-year observations representing 839 unique firms.

3.1. Identify Real option's value:

A firms' Real options value will be affected by changing of its underlying uncertainty and with the flexibility of managers (Copeland & Antikarov, 2001; Ramezani, 2011). Modern firms, they invest in various sets of underlying assets which bearing different risks (Systematic risk or individual risk) so that it is difficult to measure for the risk of the individual firm. In literature, researchers mainly use five definitions of uncertainty named as the volatility of daily stock return, the volatility of sales growth rate, the volatility of cash flow growth rate, beta and idiosyncratic volatility (Bulan, 2005; Xie, 2009; Ramezani, 2011). We can clearly distinguish these variables in two 2 categories that are the volatility of sales growth rate and cash flow growth rate representing for individual risk and beta and idiosyncratic volatility (taken from the standard deviation of the residual of CAPM) representing systematic risks. In this paper, we adopt two definitions of risk but with a little bit adjustment. The first definition for uncertainty we used the standard deviation of yearly firm's beta estimated from the preceding 5 years' data (V1). As we all know beta indicates whether the investment of a specific firm is more or less volatile than the market as a whole. However, in this paper, besides want to compare the volatility of a firm with the market, we also want to see how this firm's risk volatile which seems more appropriate for the measure of uncertainty. The second definition of uncertainty is the standard deviation of yearly sales growth rate calculated from data for the preceding 5 years' data (V2) which represents for business activities of each company.

For the second factor of real options, managerial flexibility, there are many measures of this proxy related to allocating value to flexibility have revolutionized financial-market decision making such as managers' control right (Kalcheva & Lins, 2007), managers' ownership stakes since large shareholders can affect firms' value and decisions (Maury & Pajuste, 2005), institutional environment, expenditure on investment activities or R&D activities (Ramezani, 2011)… To be honest, it is not easy to capture managerial flexibility, room for adapting investment decisions, including timing and scale. Managers' control right or ownership may be can represent managers have an important voice when making decisions but they really use this power to exercise these options or not, that is another question. In addition, we are discussing real options so that managerial flexibility here should be a variable can measure managers'

investment decision ability and exercise for real. Therefore, investment cash flow, which in each calendar year firms actually spend for investment activities, seems more suitable for this variable. Hence, to simplify, in this paper we use expenditures on investment activities (over sales to control for size) represent for managerial flexibility (F).

Next, the median value of the volatility and flexibility are adopted as standards to divide firms into four distinct quadrants (Figure 1) as: high uncertainty-high flexibility (HH), high uncertainty-low flexibility (HL), low uncertainty-high flexibility (LH), and low uncertainty-low flexibility (LL). Take our first definition of the value of real options for example, in each calendar year the median of the volatility of firm's Beta (V1) and the managerial flexibility (F) are used to divide firms to each of the four quadrants, resulting in four subsample named as HHV1F as the highest value of real options, HLV1F as ambiguous value which has high uncertainty but lack of discretion to exercise real options, LHV1F, similarly, as ambiguous value which has low underlying uncertainty but high managerial flexibility, and LLV1F as the lowest value of real options. Similarly, with the volatility of sale growth rate (V2) and the managerial flexibility (F), we also can divide our sample into four real options value group as HHV2F, HLV2F, LHV2F, LLV2F.

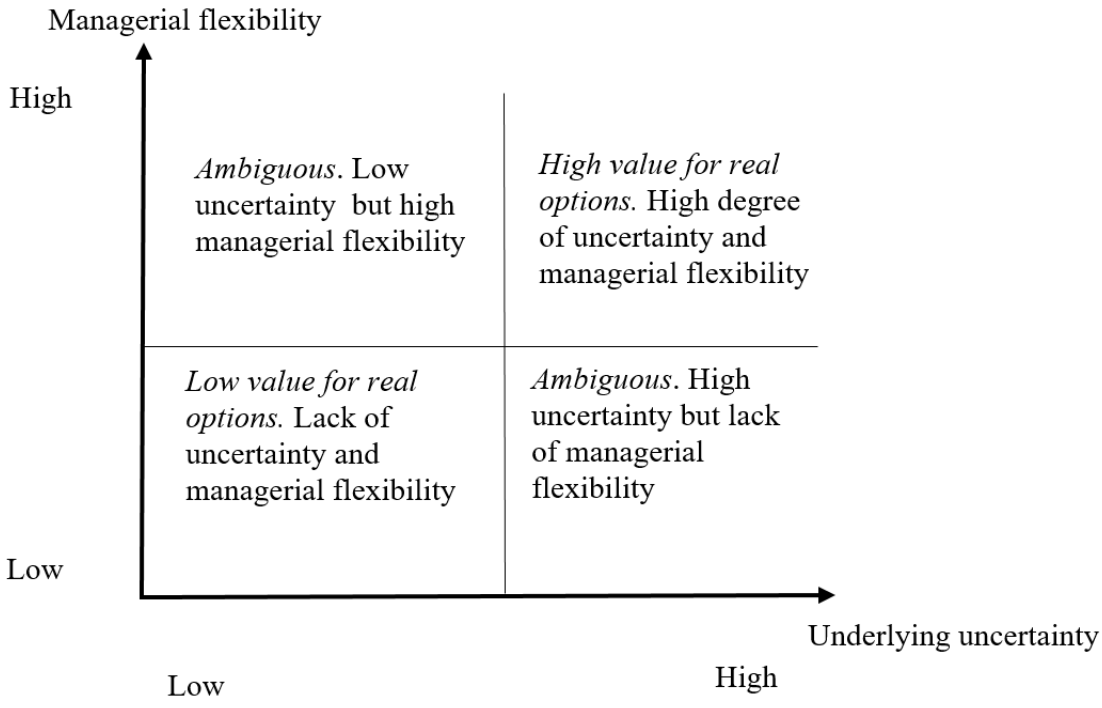

Figure 1: Real options four distinct quadrants

Table 1: Variables definition

Dependent variable	
I/TA	Investment cash flow defined as capital expenditure cash flow over the lag of total asset
Independent variables	
CF/TA	Cash flow define as net income plus depreciation over the lag of total asset
Real options variables:	
Volatility-flexibility measures:	
Beta (V1)	Standard deviation of yearly firm's Beta estimated from the preceding 5 years' data
Sales growth rate (V2)	Standard deviation of yearly sales growth rate calculated from data for the preceding 5 years' data
Managerial flexibility (F)	Firm's investment cash flow divided by its sales
Financial constraint measures:	
PID	Paid interest debt divided by total asset
AGE	Firm's age
Control variables	
Q	Market value plus Total debt divided by total asset
G_Sale	Sale growth rate
Lev	Leverage ratio defined as total debt divided by total asset
Atang	Tangibility ratio defined as fixed asset divided by total asset
Size	Natural log of total asset
Slack	Defined as cash and equivalence divided by total asset

3.2. Measure of financial constraints

Financial constraints also have been discussed for a long time so that there is a variety of classification standards have been used to distinguish financially constrained and unconstrained firms. FHP (1988) use the sensitivity of investment on internal cash flow to measure the level of financial constraints. Contrast with FHP (1988), KZ (1997), Whited and Wu (2006), Hadlock and Pierce (2010) conducts their own index to indicate the level of financial constraints such as KZ index, WW index, SA index, respectively. Hahn and Lee (2009) use asset size, payout ratio, bond rating and commercial paper rating to capture financial constraints proxy. Guariglia and Yang (2016) adopt KZ index, WW index, firm's age and firm's size to represent for financial constraints proxy and find out firms are facing constraints seem to have higher sensitivities of under-investment to free cash flow. Lee and Park (2016) take payout ratio, firm size, bond ratings,

paper ratings when they examine the impact of financial constraints on board governance through corporate cash holding decision. Other papers use interest rates on debt (Mulier, Schoors & Merlevede, 2016) and leverage ratio since constrained firms normally take higher level of debt (Schauer, Elsas & Breitkopf, 2019).

We can see that there are various methods applied for measuring financial constraints and the most favorite methods can be mentioned are using KZ index, WW index and SA index which are calculated by following models. For example, KZ index is taken from below model:

$$KZ\ index = -1.001909 \times \frac{CF}{Net\ asset} + 0.2826389\ \times\ Q + 3.139193 \times \frac{Debt}{Equity}$$

$$-39.3678\ \times \frac{Dividend}{Net\ asset} - 1.314759 \times \frac{Cash}{Net\ asset}$$

(1)

In this model, the coefficients (-1.001909, 0.2826389, 3.139193…) are fixed and taken from the results of regression run from US data, which may not be suitable for Taiwan market. Same situation for WW index and SA index. Besides, bond ratings and paper ratings data are incomplete so we hardly approach financial constraints by this way.

On the other hand, firm size and age play the guiding role of financial constraint level, financial constraints decrease sharply from young companies to becoming mature companies (Hadlock & Pierce, 2010). In addition, the most important corporate financing sources in Taiwan are bank loans (Shen & Lin, 2016) so that leverage ratio is an important index when we discuss financing decisions in Taiwan market.

As a result, in this paper, we adopt two widely used measures for Taiwan market which are paid interest leverage ratio (We abbreviate as PID) and the firm's age (AGE) to define if a firm is financially constrained. For the first measure, many previous papers use leverage ratio which defined as total debt over the total asset to capture financial constraints level. However, when we look into this item, total debt, it includes two part: interest-bearing debts and account payable items. Higher account payable amount does not mean their solvency is bad yet sometimes it means this company has some power in the market. For example, Amazon in average their total debt ratio accounts for 80% but their account payable accounts for more than 60% on average.

Therefore, with only less than 20% paid interest debt ratio, Banks always open their doors to welcome Amazon to be their VIP customers. Hence, paid interest debt ratio (PID) seems more appropriate to capture ability accessing external finance: the higher ratio of paid interest debt is, the higher level of financial constraints seems to be. For the second definition of financial constraints, firm's age, young firms might not have a sufficiently long track record so that might have higher asymmetric information (Guariglia & Yang, 2016). Consequently, we suppose the older a firm is, the less financially constrained that firm will have.

3.3. Methodology

In this paper we follow a common methodology applied by previous researchers (Fazzari, Hubbard, and Petersen (1988), Baker, Stein, and Wurgler, Rauh, and others) in ICFS, Q-Investment model as follow:

$$\frac{I_{i,t}}{TA_{t-1}} = \alpha_0 + \beta_1 \frac{CF_{i,t}}{TA_{i,t-1}} + \beta_2 Q_{i,t} + \beta_3 G_{Sale_{i,t}} + \beta_4 Lev_{i,t} + \beta_5 Atang_{i,t} + \beta_6 Size_{i,t}$$
$$+\beta_7 Slack_{i,t} + \varepsilon_{i,t} \quad (2)$$

We use panel data to procedure fixed two ways (Year and firm) estimates besides scaling these measures by total assets to enable comparability between different observations (Bradrania, Westerholm & Yeoh, 2016). Base on Q-Investment model, we in turn examine the impact of real options on ICFS through adding different level of real options groups on the regression:

$$\frac{I_{i,t}}{TA_{t-1}} = \alpha_0 + \beta_1 \frac{CF_{i,t}}{TA_{i,t-1}} + \beta_2 \frac{CF_{i,t}}{TA_{i,t-1}} \times D_{Real\ options} + \beta_3 Q_{i,t} + \beta_4 G_{Sale_{i,t}} + \beta_5 Lev_{i,t}$$
$$+\beta_6 Atang_{i,t} + \beta_7 Size_{i,t} + \beta_8 Slack_{i,t} + \varepsilon_{i,t} \quad (3)$$

In the regression (3), $D_{Real\ options}$ represents for dummy variables for four groups of the value of real options (HHV1F for the highest value of real options group, HLV1F and LHV1F for the ambiguous value of real options groups, LLV1F for the lowest value of real options group):

HHV1F equal 1 if V1 is equal or greater than the median value in each calendar year and F is equal or greater than the median value in each calendar year, and 0 otherwise. HLV1F equal 1 if V1 is equal or greater than the median value in each calendar year and F is smaller than the

median value in each calendar year, and 0 otherwise. LHV1F equal 1 if V1 is smaller than the median value in each calendar year and F is equal or greater than the median value in each calendar year, and 0 otherwise. LLV1F equal 1 if V1 is smaller than the median value in each calendar year and F is smaller than the median value in each calendar year, and 0 otherwise. Similar process is applied when we use the second definition of the value of real options (HHV2F, HLV2F, LHV2F, LLV2F).

In this regression, we want to observe the coefficient β_2 to see if the different groups level of the value of real options will have different impact on ICFS.

Next, to answer the second question under controlling financial constraints in ICFS, do Real options still have explanation space? We simultaneously control the impact of financial constraints and real options on the ICFS:

$$\frac{I_{i,t}}{TA_{t-1}} = \alpha_0 + \beta_1 \frac{CF_{i,t}}{TA_{i,t-1}} + \beta_2 \frac{CF_{i,t}}{TA_{i,t-1}} \times Financial\ constraints + \beta_3 \frac{CF_{i,t}}{TA_{i,t-1}} \times D_{Real\ options}$$

$$+\beta_4 Q_{i,t} + \beta_5 G_{Sale_{i,t}} + \beta_6 Lev_{i,t} + \beta_7 Atang_{i,t} + \beta_8 Size_{i,t} + \beta_9 Slack_{i,t} + \varepsilon_{i,t} \qquad (4)$$

As discussed above, in the regression (4) financial constraints represents for PID and AGE. The higher level of PID (paid interest debt ratio) is, the more constrained firms can face. Young companies tend to have more difficulty in excessing to external resources.

In this regression (4), firstly we want to observe the coefficient β_2 to re-examine the effect of financial constraints on ICFS in Taiwan market from 2001 to 2017. Next, engaging the interaction of CF*Real options into the regression, we want to observe the coefficient β_2 and β_3 to investigate whether a company highly faces financial constraints but has a different level of the value of real options has any changing in the sensitivity of investment on internal cash flow.

Further, we analyze how real options can interpret the impact of financial constraints on ICFS through three factors interaction of Cash flow with Financial constraints and real options:

$$\frac{I_{i,t}}{TA_{t-1}} = \alpha_0 + \beta_1 \frac{CF_{i,t}}{TA_{i,t-1}} + \beta_2 \frac{CF_{i,t}}{TA_{i,t-1}} \times Financial\ constraints + \beta_3 \frac{CF_{i,t}}{TA_{i,t-1}}$$
$$\times Financial\ constraints \times D_{Real\ options} + \beta_4 Q_{i,t} + \beta_5 G_{Sale_{i,t}} + \beta_6 Lev_{i,t}$$
$$+\beta_7 Atang_{i,t} + \beta_8 Size_{i,t} + \beta_9 Slack_{i,t} + \varepsilon_{i,t} \quad (5)$$

In this regression (5), we mainly observe the coefficient β_3 to find out the impact of financial constraints on ICFS in different level of the value of real options groups.

4. Empirical results

4.1. Descriptive analysis:

The descriptive statistic of different variables included are the number of observations, mean, standard deviation, minimum and maximum are shown in table 2 and table 3. Since we want to contrast the ICFS by the level of real options, we divide the full sample into four groups per each measure of real options in table 2 to analyze each group's investment behavior.

As mentioned, in this paper we will use two definitions of Real options: the first definition is by V1 (Uncertainty representing by standard deviation of Beta preceding 5 years) and Managerial flexibility (F), the other is by V2 (Uncertainty representing by standard deviation of Sale growth rate from preceding 5 years) and Managerial flexibility (F).

Firstly, we discuss subsamples following V1 and F with the highest value of Real Options (HHV1F), the lowest value of Real Options (LLV1F) and two ambiguous value (HLV1F and LHV1F). The highest value of Real Options group included 2528 observations with a high degree of uncertainty and managerial flexibility characteristics. We can see firms of this group have the highest volatility (0.3116), the highest degree of managerial flexibility (0.1444) and these firms also have the highest level of investment (9.03%). On the contrary, the lowest value of Real Options group included 2688 observations with a low degree of uncertainty and managerial flexibility characteristics. We can see firms of this group have the lowest volatility (0.1355), the lowest degree of managerial flexibility (0.0156) and these firm also have the lowest level of investment (only 1.67%). From here, we can recognize a phenomenon: Real options can increase

the investment level. For the ambiguous value groups, HLV1F with high volatility (0.2801) but lack of discretion to exercise real options (0.0152) and LHV1F with low option value (0.1353) but high managerial flexibility (0.132). we find that LHV1F group has clearly higher investment level (8.14%) than those of HLV1F group (1.67%). Through this result, it seems managerial flexibility has a greater influence on the company's investment plan if compare to uncertainty. These results are also consistent when we use the second definition based on V2 and F. As reported V2 defined as Standard deviation of yearly sales growth rate calculated from data for the preceding 5 years and our sample examined period from 2001 to 2017 which means our data for this variable have to be taken from 1997 to 2017 (Included two biggest financial crisis in history: 1997 Asian financial crisis and Financial crisis of 2007–2008). Hence, this variable V2 having large volatility is reasonable since, with some specific companies, there may be years of unprofitable business, but in the following years, there may be a sudden growth. Although we use the second definition of real options with large volatility, our results are completely consistent with the first definition. The highest value of real options group (HHV2F) has the highest level of investment (9.12%) and the lowest value of real options group (LLV2F) has the lowest level of investment (1.67%). For the ambiguous value groups, the high managerial flexibility group (LHV2F) has obviously higher investment level (8.14%) than those of the high uncertainty group (HLV2F) (1.61%)

Table 2: Subsample statistic descriptive

Subsample	N Obs	Variable	Mean	Std Dev	Minimum	Maximum
		I/TA	0.0903	0.0910	0.0007	2.0629
HHV1F	2528	V1	0.3116	0.3600	0.1542	9.5952
		F	0.1444	0.2488	0.0313	6.6111
		I/TA	0.0160	0.0158	0.0000	0.2648
HLV1F	2693	V1	0.2801	0.0923	0.1548	2.2775
		F	0.0152	0.0106	0.0000	0.0470
		I/TA	0.0814	0.0729	0.0011	0.9725
LHV1F	2542	V1	0.1353	0.0468	0.0006	0.2452
		F	0.1320	0.1749	0.0316	4.5288
		I/TA	0.0167	0.0159	0.0000	0.1400
LLV1F	2688	V1	0.1355	0.0453	0.0003	0.2448
		F	0.0156	0.0108	0.0000	0.0488
		I/TA	0.0912	0.0895	0.0007	0.9725
HHV2F	2294	V2	0.8456	6.1371	0.1136	143.7436
		F	0.1531	0.2538	0.0313	6.6111
		I/TA	0.0161	0.0166	0.0000	0.2648
HLV2F	2550	V2	0.4197	0.7177	0.1137	13.3352
		F	0.0145	0.0105	0.0000	0.0484
		I/TA	0.0814	0.0761	0.0020	2.0629
LHV2F	2776	V2	0.1104	0.0466	0.0113	0.2324
		F	0.1259	0.1757	0.0314	4.5947
		I/TA	0.0167	0.0152	0.0000	0.1400
LLV2F	2831	V2	0.1145	0.0457	0.0097	0.2287
		F	0.0161	0.0108	0.0000	0.0488

Notes: This table presents statistic descriptive for four groups of the value of real options each definition. For the first definition of the value of real options we have HHV1F, HLV1F, LHV1F, LLV1F and for the second definition of the value of real options we have HHV2F, HLV2F, LHV2F, LLV2F. I stands for investment cash flow defined as capital expenditure cash flow, TA represents for total assets, V1 is standard deviation of yearly firm's Beta estimated from the preceding 5 years' data, V2 is standard deviation of yearly sales growth rate calculated from data for the preceding 5 years' data, F denotes managerial flexibility measured as investment cash flow divided by its sale.

In table 3, we present the statistic descriptive of all variables in our model and in this time we will separate our full sample into subsamples based on financial constraints level to see the characteristics of financially constrained firms and financially unconstrained firms. In panel A we divided our sample by paid interest debt ratio (PID). If a firm has PID higher than or equal the PID median in each calendar year will belong to high PID ratio (financial constraints group), otherwise will be long to low PID ratio (financially unconstrained group). Q (Tobin's q) that is the ratio between a physical asset's market value and its replacement value is taken to measure a firm's valuation from the view of outsiders. When Q is greater than 1, it means investors expect this firm will have high growth level in the future. From our results, regardless of which group (high PID or low PID ratio) we all observe that in average Q is greater than 1 which is consistent with Huang et al. (2011); in addition, low PID ratio group (financially unconstrained group) has higher Q (1.4554). Through this result, we can guess firms with higher market value can easily excess to external resources even though now these companies have lower sale growth rate (0.0781). About internal cash flow (CF), this variable shows operational status which in some special year can be negative. financially unconstrained group has higher internal cash flow level (0.0995) and have lower debt ratio from outside (0.3159) since internal cash flow is crucial sources to repay the debt so that outside lender will be more willing to fund for high internal cash flow firms (Mulier, Schoors & Merlevede, 2016). Or in other explanation these firms, they themselves own enough internal cash flow (0.0995) so that they are not necessary to take a lot of debt from outside (0.3159). On the contrary, financial constraints group has lower internal cash flow (0.059) which may not enough for distributions, hence they already took higher debt level (0.5274), that's why these companies may face more difficult when excessing external cash flow. In addition, financially unconstrained group hold more cash on hand (0.1862) than low PID ratio group (0.1055).

In panel B, we use the firm's age to measure for financial constraints. Similar to PID ratio, we use the median value in each calendar year to define young and mature firms. If a firm's age greater than or equal the median value, that firm is considered an as a mature company, otherwise will be considered as young companies. In panel B, the results show that young companies group has higher sale growth (0.0849) because, in the view of investors, young companies will have

higher growth opportunities in the future (Q value is 1.4612 higher than Q value of mature companies group (1.14)). Besides, young firms create a higher level of internal cash flow but with higher volatility and these firms also hold a higher level of cash on hand because young firms might not have a sufficiently long track record so that might have higher asymmetric information (Guariglia & Yang, 2016); therefore, they have to prepare for investment opportunities. Contrast with young companies group, mature companies' business has gone into regulation so that on average these companies create a lower level of internal cash flow (0.0676) but more stable than young companies. Since the minimum value of the internal cash flow of mature companies (-0.3392) much lower those of young companies (-0.8739), the standard deviation value of the internal cash flow of mature companies (0.0713) much lower those of young companies (0.1012). In addition, mature companies are larger (16.0219), have more tangibility (0.3459) and these companies hold less cash and equivalent since mature firms can easily to take external cash flow when they need.

Table 3: Statistic descriptive

Panel A: PID	Low PID ratio (Unconstrained firms) (N=5221)				High PID ratio (Constrained firms) (N=5230)			
Variable	Mean	Std. Dev	Minimum	Maximum	Mean	Std. Dev	Minimum	Maximum
I/TA	0.0413	0.0518	0.0000	0.7220	0.0589	0.0803	0.0000	2.0629
CF/TA	0.0995	0.0921	-0.5621	1.1750	0.0590	0.0785	-0.8739	1.1723
Q	1.4554	0.9280	0.3292	19.0053	1.1375	0.4517	0.4870	7.2895
G_Sale	0.0781	0.5436	-0.9131	30.2192	0.0791	0.3955	-0.9573	10.0622
Size	15.6454	1.3150	9.8297	21.6757	16.2028	1.3819	11.1389	21.9492
Atang	0.2633	0.1632	0.0002	0.9573	0.3682	0.1836	0.0007	0.9630
Lev	0.3159	0.1456	0.0090	0.9762	0.5274	0.1237	0.2096	0.9976
Slack	0.1862	0.1367	0.0008	0.8724	0.1055	0.0876	0.0002	0.6852
Panel B: AGE	Mature firms (Unconstrained firms) (N=5365)				Young firms (Constrained firms) (N=5086)			
Variable	Mean	Std. Dev	Minimum	Maximum	Mean	Std. Dev	Minimum	Maximum
I/TA	0.0439	0.0605	0.0000	2.0629	0.0566	0.0748	0.0000	0.9725
CF/TA	0.0676	0.0713	-0.3392	1.1750	0.0915	0.1012	-0.8739	0.6905
Q	1.1400	0.5078	0.3292	7.2895	1.4612	0.9060	0.3926	19.0053
G_Sale	0.0727	0.5777	-0.9573	30.2192	0.0849	0.3348	-0.9088	7.7655
Size	16.0219	1.3698	12.4999	21.9492	15.8214	1.3779	9.8297	21.4123
Atang	0.3459	0.1761	0.0012	0.9630	0.2841	0.1816	0.0002	0.9573
Lev	0.4341	0.1637	0.0108	0.9859	0.4087	0.1785	0.0090	0.9976
Slack	0.1136	0.0959	0.0004	0.7692	0.1799	0.1359	0.0002	0.8724

Notes: This table presents statistic descriptive of subsamples based on financial constraints measured by PID (Paid interest debt ratio) (Panel A) and measured by AGE (Firm age) (Panel B). I denotes investment cash flow defined as capital expenditure cash flow, TA represents for total assets, CF is cash flow define as net income plus depreciation, Q represents Tobin's Q measured as market value plus total debt divided by total asset, G_Sale is sale growth rate, Size stands for firm size captured by the nature log of total asset, Atang is tangibility ratio defined as fixed asset divided by total asset, Lev is leverage ratio defined as total debt divided by total asset, Slack is cash and equivalence divided by total asset.

4.2. Empirical result

In table 4 we are going to examine the impact of Real Options on ICFS. In the model (1), we basically re-examine Q-Investment model, from the model (2) to model (5) we, in turn, check the influence of Real Options groups (HHV1F, HLV1F, LHV1F, LLV1F).

In the same line with a variety of researchers and one more time confirm the work of Myers and Majluf (1984) that the firm's investment activity relies on internal cash flow. With the coefficient is positive (β =0.1673) and significant at 1% level, the higher internal cash flow is, the higher firms will invest.

For control variables, Q which represent for investment opportunities has a positive impact on a firm's investment (β =0.0103). Corporate investment depends on the existence of growth opportunities. Higher sale growth firm will focus more on investing (β =0.0088). To fund an investment project, the company may use internal cash flow, take debts or issue stocks. However, with asymmetric information between insiders and outsiders, companies prefer internal cash flow or take debts if have investment opportunities (Myers & Majluf, 1984) so that higher leverage level may imply this firm has higher investment level (β =0.0379). Tangibility and firms' size also has a positive impact on a firm's investment (β =0.1619 and β =0.0038 respectively). A firm's fund usages are many, maybe investment, maybe paying a dividend or maybe holing cash and equivalent depending on situations. Therefore, the more companies hold cash and equivalent (Slack), the fewer companies will invest (the coefficient β= -0.01677).

Next, we will engage real options into this Q-Investment model to see if real options can interpret ICFS. From model (2) to (5), coefficient of CF still remains positive and significant at 1% level. The interaction of CF and HHV1F has the highest positive coefficient (β =0.1979) and significant at 1% level. This result shows us when firms are belonging to HHV1F group (which has the highest investment level), the sensitivity of investment on internal cash flow increases 0.1979. In addition, the interaction of CF and LLV1F has a negative coefficient (β =-0.21065) and significant at 1% level. It means when firms are belonging to LLV1F group (which has the lowest investment level), the sensitivity of investment and internal cash flow decreases 0.21065. As Mauer (2001) mentioned, real options lead companies to actively reduce leverage and shorten debt to overinvest in risky investment projects. Therefore, real options increase ICFS. For the

others, ambiguous groups (HLV1F and LHV1F), the coefficient with CF are respectively β =-0.2149 and β =0.1493. The HLV1F group, which has a high uncertainty level but managers do not have many options, has a low level of investment so that decrease ICFS. The LHV1F group, which has low uncertainty level and managers also have many options, has a higher level of investment so that increase ICFS. All these variables are significant at 1% level. Through these results, we can surmise that managerial flexibility has a greater impact on ICFS and to confirm this idea we will go deeper to find out how managerial flexibility and uncertainty affect to ICFS. All others control variables (Q, G_Sale, Leverage, Atang, Size, and Slack) basically have the same result with the model (1).

In this part (Table 5), we will go deeper to examine the impact of managerial flexibility and uncertainty on ICFS. When firms have high flexibility, investment's uncertainty will increase investment and cash flow sensitivity since the coefficient of interaction of CF and V1 and D_F (Equal 1 if F is greater than or equal F's median, else 0) is 0.27873 and significant at 1% level (model (1)). When firms have high volatility, investment's flexibility will also increase investment and cash flow sensitivity since the coefficient of interaction of CF and F and D_{V1} (Equal 1 if V1 is greater or equal V1's median, else 0) is 1.02165 and significant at 1% level (model (2)). Hence, both managerial flexibility and uncertainty have a positive impact on ICFS. These results confirm previous researches that state optimistic managers will increase ICFS (Lin, Hu, & Chen, 2005; Huang, Jiang, Liu, & Zhang, 2011; Ben Mohamed, Fairchild, & Bouri, 2014). On the contrary many previous papers researched about uncertainty and ICFS, our result in line with Meng and Wang (2005) and Sterken, Lensink and Bo (2001), uncertainty increase ICFS. The reasons maybe uncertainty environment increase investment probability or another explanation for this phenomenon is in uncertain terms the bank will tighten liquidity so that firms will have to rely on their own internal cash flow. In model (3), we want to know between managerial flexibility and uncertainty, which one plays a greater role in this effect. When we survey both of these factors at the same time, we can obviously see that managerial flexibility has a greater impact on ICFS with coefficient β =1.71675 much higher than those of uncertainty (β =0.06115). All are significant at 1% level. Managerial flexibility rather than volatility is the main effect of ICFS. The implication is that firms with high managerial flexibility will invest more even though a firm's real options are not valuable.

Table 4: Regression result (Real options (V1F))

Variable	Estimate (1)	Estimate (2)	Estimate (3)	Estimate (4)	Estimate (5)
Intercept	-0.09169	-0.08882	-0.09881	-0.09458	-0.08573
	(0.0029***)	(0.0034***)	(0.0011***)	(0.0019***)	(0.0048***)
CF	0.167299	0.115498	0.231051	0.133222	0.212289
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
CF*HHV1F		0.197979			
		(<.0001***)			
CF*HLV1F			-0.21497		
			(<.0001***)		
CF*LHV1F				0.149319	
				(<.0001***)	
CF*LLV1F					-0.21065
					(<.0001***)
Q	0.010349	0.009955	0.009817	0.009965	0.00991
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
G_Sale	0.008769	0.009112	0.008141	0.008715	0.009673
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Lev	0.037879	0.038362	0.035988	0.037583	0.039827
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Atang	0.161969	0.155738	0.155301	0.156884	0.154698
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Size	0.003815	0.003834	0.00449	0.004068	0.003531
	(0.0197**)	(0.0173**)	(0.0053***)	(0.0121**)	(0.0286***)
Slack	-0.01677	-0.01493	-0.01688	-0.01618	-0.01386
	(0.052*)	(0.079*)	(0.047**)	(0.0586*)	(0.1034)
Firm fixed effect	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes
R-Square	0.4013	0.4194	0.4192	0.4115	0.4174
N-Observation	10451	10451	10451	10451	10451

Notes: This table reports results from running the regression (3). HHV1F represents for the highest value of real options group, HLV1F and LHV1F are the ambiguous value of real options groups, LLV1F is the lowest value of real options group. CF is cash flow define as net income plus depreciation, Q represents Tobin's Q measured as market value plus total debt divided by total asset, G_Sale is sale growth rate, Size stands for firm size captured by the nature log of total asset, Atang is tangibility ratio defined as fixed asset divided by total asset, Lev is leverage ratio defined as total debt divided by total asset, Slack is cash and equivalence divided by total asset.

P-value in parentheses

*P<0.1, ** P<0.05, ***P<0.01

Table 5: Regression result (Uncertainty and flexibility) (V1)

Variable	Estimate (1)	Estimate (2)	Estimate (3)
Intercept	-0.09112	-0.11817	-0.10903
	(0.0028***)	(<.0001***)	(<.0001***)
CF	0.13466	0.0947	-0.02649
	(<.0001***)	(<.0001***)	(0.0054***)
CF*V1*D_F	0.27873		
	(<.0001***)		
CF*F*D_{V1}		1.02165	
		(<.0001***)	
CF*V1			0.06115
			(0.0002***)
CF*F			1.71675
			(<.0001***)
Q	0.010098	0.010653	0.010634
	(<.0001***)	(<.0001***)	(<.0001***)
G_Sale	0.00865	0.00827	0.00914
	(<.0001***)	(<.0001***)	(<.0001***)
Lev	0.037784	0.02975	0.015555
	(<.0001***)	(<.0001***)	(<.0001***)
ATang	0.15914	0.15122	0.11724
	(<.0001***)	(<.0001***)	(<.0001***)
Size	0.0039	0.00595	0.00651
	(0.016**)	(0.0002***)	(<.0001***)
Slack	-0.01718	-0.01441	-0.01005
	(0.0442**)	(0.0841*)	(0.158)
Firm fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
R-Square	0.4141	0.4407	0.593
N-Observation	10451	10451	10451

Notes: This table reports results from running the regression to examine the impact of managerial flexibility (F) and uncertainty (V1) on ICFS. D_F denotes dummy variable equal 1 if managerial flexibility (F) is equal or greater than the median value in each calendar year, 0 otherwise, D_{V1} is dummy variable equal 1 if uncertainty (V1) is equal or greater than the median value in each calendar year, 0 otherwise, CF is cash flow define as net income plus depreciation, Q represents Tobin's Q measured as market value plus total debt divided by total asset, G_Sale is sale growth rate, Size stands for firm size captured by the nature log of total asset, Atang is tangibility ratio defined as fixed asset divided by total asset, Lev is leverage ratio defined as total debt divided by total asset, Slack is cash and equivalence divided by total asset.

P-value in parentheses

*P<0.1, ** P<0.05, ***P<0.01

In this paper, we totally agree with previous papers, financial constraints play an important role in ICFS, but financial constraints causing the impact is from the cash flow aspect. Firms facing higher financial constraints will be more difficult to access external capital, that's why will be more reliant on internal cash flow when they have new investment opportunities. However, in this paper, we examine the impact of Real Options on ICFS and Real Options represents for the other aspect, investment. These are two aspects that are completely independent of each other; therefore, it is a huge shortcoming if we only discuss ICFS from one aspect. Consequently, in this part, we will simultaneously discuss both aspects at the same time.

We already examined the impact of Real Options on ICFS in the earlier part. Hence, now first we will re-examine the relationship of financial constraints and ICFS. We use the most widely used measure of financial constraints for the Taiwan market are PID (paid interest leverage ratio) and AGE (Firm's age). As we will see in table 6, model (1) to model (5) we will use the measure of FC (Financial constraints) is PID and model (6) to model (10) we will use the measure of FC is AGE. Firstly, let discuss PID. We can see that in Taiwan market, from 2001 to 2017, financial constraints increase the sensitivity of investment and internal cash flow (coefficient of interaction between CF and FC is 0.57424 and significant at 1% level). This imply that firms facing financial constraints will difficultly excess to external finance so that when they have a new investment opportunity the investment will more rely on internal cash flow (FHP, 1988; Whited, 1992; Hoshi, Kashyap & Scharfstein, 1991; Kashyap, Lamont & Stein, 1994; Mizen and Vermeulen, 2005). From model (2) to model (5) we start to simultaneously discuss financial constraints and Real Options at the same time. We observe that the real options and financial constraints are individual explanation variable on ICFS, one cannot replace the other one. In this part, we find out some interesting results, in the model (2) we can see financial constraints increase the sensitivity of investment on internal cash flow (β =0.5297) and the highest real options value group also increase ICFS (β =0.18935). This result shows us a firm facing financial constraints will more rely on internal cash flow, and if this firm they have a high level of real options (have many opportunities and options to process), in this case, the investment of this firm will much more rely on internal cash flow. In the model (3) financial constraints increase ICFS (β =0.55829) and

the ambiguous real options value group (High volatility -Low managerial flexibility) reduce this sensitivity (β =-0.2115). It means when a firm facing a high level of financial constraints will more rely on internal cash flow but at the same time, this firm has a lower level of real options (lower investment level) will decrease ICFS. In the model (4) financial constraints increase ICFS (β =0.58282) and the ambiguous real options value group (Low volatility -High managerial flexibility) increase ICFS (β =0.15162). Similar to facing financial constraints situation but with higher managerial flexibility lead to a higher level of investment, in this case, investment also more relies on internal cash flow. And in the model (5) financial constraints increase ICFS (0.55302) and the lowest real options value group reduce ICFS (β =-0.20563). This tells us when a firm faces financial constraints but this firm also does not have real options' value, these firms will not rely on the internal cash flow that much. All the results are significant at 1% level. These results tell us when we consider simultaneously both aspects (Cash flow and Investment) at the same time, the sensitivity of investment and internal cash flow will be different. It means this Investment-Cash flow relationship is not just depending on whether firms can easily access to external capital, it also depending on if firms have investment strategies or in another word, if firms have real options value. From model (6) to (10) we use another definition of financial constraints: AGE and the results are totally consistent with the first definition. In this table we have an important conclusion: under the control of financial constraints on ICFS, there still has space for interpretation of the Real Options.

To answer the question of how Real options can interpret the impact of financial constraints in ICFS, we add to our model interaction CF*FC*Real Options and the result are shown in table 7. With the same pattern with table 6, model (1) to (5), we will examine the first definition of financial constraints (PID), and from model (6) to model (10) we will examine the second definition of financial constraints (AGE).

In the model (1), the same as the result with table 6, financial constraints increase ICFS (β =0.57424). From model (2) to (5) we, in turn, engage Real options into financial constraints and ICFS relationship. The highest real options value group (HHV1F) increases the impact of financial constraints on ICFS (β =0.7917). On the contrary, the lowest real options value group reduce the impact of financial constraints on ICFS (β =-1.05966). These results are totally

reasonable. Let think about a firm with a high value of real options that has investment opportunities and options when to invest, when it faces financial constraints it will more rely on internal cash flow than the others. Same as firms with a high value of real options will hold more cash on hand and especially with firms which face financial constraints (Ramezani, 2011). For the ambiguous real options value group, the impact of financial constraints on ICFS is also different. For high uncertainty-low flexibility group reduces the impact of financial constraints on ICFS (β =-0.94868) and low uncertainty–high flexibility group increases the impact of financial constraints on ICFS (β =0.51291). All these variables are significant at 1% level. Real options not only can interpret the impact of financial constraints on ICFS but also extend the impact of financial constraints on ICFS. For the second definition of financial constraints (AGE), the results are still totally consistent and all the results are significant at 1% level.

Tobe more clear about how different between real option value groups on the impact of financial constraints on ICFS, we further run regression examining the impact of financial constraints (AGE) for subsample which included the highest and the lowest value of real options (HHV1F, LLV1F) and for robust the result we also do the same process for HHV2F and LLV2F (The second measure for the value of real options) in table 8.

Firstly, let discuss about the first measure for the value of real options (HHV1f and LLV1F). we can see that for both groups, financial constraints all have negative affect to ICFS. It means the more mature a firm is, the less financially constrained that firm may face or in another word, financial constraints increase ICFS. This result is consistent with all above we analyzed and previous papers. However, the impact of financial constraints on ICFS of HHV1F group (β=-0.00536) is much more pronounced than those of LLV1F group (β=-0.00055). This result is also consistent when we use the second measure for the value of real options. The impact of financial constraints on ICFS of HHV2F group (β=-0.00847) is also more pronounced than those of LLV1F group (β=-0.00013). Moreover, the coefficient of CF and financial constraints in LLV2F group is even insignificant. These result one more time confirm that real options not just can interpret but extent the impact of financial constraints on ICFS.

5. Robustness checks

For the robust test, from table 9 to table 12, we use the second measure for defining the value of real options: uncertainty is defined by the standard deviation of yearly sales growth rate calculated from data for the preceding 5 years' data (V2) and managerial flexibility (F) to re-examine our results. we find consistent results with the first measure of real options.

In table 9 we make robustness check for the regression (3) which investigate the impact of real options on ICFS. We find the consistent result with table 4: the highest real options value group (HHV2F) increase the sensitivity of investment on internal cash flow (β=0.1943), the lowest real options value group (LLV2F) decrease ICFS (β=-0.224), the ambiguous group HLV2F (High uncertainty environment but managers do not have much flexibility to exercise) decrease ICFS (β=-0.2302) and the other ambiguous group LHV2F (Low uncertainty but managers have the discretion to exercise) increase ICFS (β=0.1877).

To confirm the role of uncertainty and managerial flexibility on the impact of real options on ICFS, we process the robustness check by using V2 with F and the results are presented in table 10. Consistent with the results in table 5, both uncertainty environment and managerial flexibility increase ICFS but managerial flexibility has a greater effect on ICFS when compare with uncertainty environment.

We also use the second definition of real options (V2F) to re-examine simultaneously the impact of real options (Investment aspect) and financial constraints (Cash flow aspect) on the relationship of investment and internal cash flow sensitivity. The same process is adopted, we use PID and AGE are variables of financial constraints and four real options groups (HHV2F, HLV2F, LHV2F, and LLV2F). Our results are consistent with the results of table 6, shown in table 11: Financial constraints have a positive effect in ICFS, this means the investment will be more reliant on internal cash flow for the firm facing higher financial constraints. However, ICFS also is affected by the value of the real options of that firm. This result one more time confirms our discussion: to have a comprehensive view of the relationship between investment and internal cash flow, we have to be considered from both aspects: Cash flow and investment.

Table 12 reports robust results for the regression (5) examining how real options can interpret the impact of financial constraints in ICFS by adding the interaction of CF*FC (PID and AGE)* Real options (The second definition of real options V2F). Our results are consistent with the results of Table 7: Real options can expand the effect of financial constraints on ICFS. Firms which have a high value of real options (HHV2F) is more reliant on the internal cash flow when they face financial constraints and firms which have a low value of real options (LLV2F) do not rely much on the internal cash flow when they face financial constraints.

Table 6: Regression result (Financial constraints, real options (V1F))

Variable	FC (Financial constraints) defined as PID					FC (Financial constraints) defined as AGE				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept	-0.0916	-0.08886	-0.0986	-0.09453	-0.08579	-0.10794	-0.10238	-0.11762	-0.11376	-0.10057
	(0.0027***)	(0.0031***)	(0.001***)	(0.0018***)	(0.0044***)	(0.0005***)	(0.0008***)	(0.0001***)	(0.0002***)	(0.001***)
CF	0.06605	0.02436	0.13159	0.02994	0.11371	0.26808	0.20024	0.34819	0.24983	0.3033
	(<.0001***)	(0.0525*)	(<.0001***)	(0.0182**)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
CF*FC	0.57424	0.5297	0.55829	0.58282	0.55302	-0.004	-0.00332	-0.00459	-0.00469	-0.00363
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
CF*HHV1F		0.18935					0.19416			
		(<.0001***)					(<.0001***)			
CF*HLV1F			-0.2115					-0.21983		
			(<.0001***)					(<.0001***)		
CF*LHV1F				0.15162					0.15621	
				(<.0001***)					(<.0001***)	
CF*LLV1F					-0.20563					-0.20798
					(<.0001***)					(<.0001***)
Q	0.012597	0.012045	0.012011	0.012241	0.012084	0.009365	0.009145	0.008675	0.008794	0.009021
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
G_Sale	0.00751	0.00794	0.00693	0.00744	0.00844	0.00912	0.0094	0.00853	0.00913	0.00998
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Lev	0.020679	0.022476	0.019296	0.02012	0.023218	0.034133	0.035239	0.031644	0.033175	0.036397
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Atang	0.15872	0.15301	0.15225	0.15351	0.15174	0.16233	0.15616	0.15557	0.15708	0.15512
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Size	0.00413	0.00412	0.00478	0.00439	0.00384	0.00514	0.00494	0.00603	0.00564	0.00474
	(0.0109**)	(0.0099***)	(0.0028***)	(0.0063***)	(0.0164**)	(0.0018***)	(0.0023***)	(0.0002***)	(0.0006***)	(0.0035***)
Slack	-0.01502	-0.0134	-0.01519	-0.0144	-0.01225	-0.01451	-0.01309	-0.0143	-0.01351	-0.01185
	(0.0791*)	(0.1122)	(0.0716*)	(0.0894*)	(0.1467)	(0.0922*)	(0.1233)	(0.0919*)	(0.1136)	(0.1635)
Firm fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.4118	0.4283	0.4291	0.4223	0.4271	0.4038	0.421	0.4224	0.4148	0.4194
N	10451	10451	10451	10451	10451	10451	10451	10451	10451	10451

Notes: This table reports results from running the regression (4). FC is financial constraints, PID represents paid interest ratio, AGE is firm age, other variables basically same as table 4.

P-value in parentheses: *P<0.1, ** P<0.05, ***P<0.01

Table 7: Regression result (CF x FC x Real options) (V1F)

Variable	FC (Financial constraints) defined as PID					FC (Financial constraints) defined as AGE				
	.(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept	-0.0916	-0.083	-0.09469	-0.09473	-0.08311	-0.10794	-0.10107	-0.10903	-0.10803	-0.09992
	(0.0027***)	(0.0059***)	(0.0017***)	(0.0018***)	(0.0058***)	(0.0005***)	(0.0009***)	(0.0004***)	(0.0004***)	(0.0011***)
CF	0.06605	0.0707	0.06934	0.06494	0.0663	0.26808	0.25731	0.28772	0.28539	0.26503
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
CF*FC	0.57424	0.3164	0.82686	0.46844	0.78804	-0.004	-0.00501	-0.00293	-0.00572	-0.00249
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(0.0001***)
CF*FC*HHV1F		0.7917					0.00604			
		(<.0001***)					(<.0001***)			
CF*FC*HLV1F			-0.94868					-0.00653		
			(<.0001***)					(<.0001***)		
CF*FC*LHV1F				0.51291					0.00402	
				(<.0001***)					(<.0001***)	
CF*FC*LLV1F					-1.05966					-0.00626
					(<.0001***)					(<.0001***)
Q	0.012597	0.011587	0.011738	0.012213	0.011412	0.009365	0.00881	0.008483	0.00886	0.008849
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
G_Sale	0.00751	0.00799	0.00686	0.00753	0.00891	0.00912	0.00942	0.00853	0.00926	0.01022
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Lev	0.020679	0.019881	0.010789	0.017672	0.024446	0.034133	0.034015	0.0318	0.033228	0.034839
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
ATang	0.15872	0.15606	0.15458	0.15443	0.15093	0.16233	0.15768	0.15719	0.15855	0.15654
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Size	0.00413	<.0001	0.00487	0.00446	0.0037	0.00514	0.0049	0.00545	0.00525	0.00476
	(0.0109**)	(0.0145**)	(0.0024***)	(0.0057***)	(0.0207**)	(0.0018***)	(0.0026***)	(0.0008***)	(0.0013***)	(0.0035***)
Slack	-0.01502	-0.01389	-0.01637	-0.01716	-0.01641	-0.01451	-0.0143	-0.01472	-0.01423	-0.01366
	(0.0791*)	(0.0999*)	(0.0526*)	(0.0439**)	(0.0517*)	(0.0922*)	(0.0935*)	(0.0844*)	(0.0968*)	(0.1095)
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.4118	0.4271	0.4265	0.4176	0.4279	0.4038	0.4165	0.416	0.4102	0.4152
N-Observation	10451	10451	10451	10451	10451	10451	10451	10451	10451	10451

Notes: This table reports results from running the regression (5). FC is financial constraints, PID represents paid interest ratio, AGE is firm age, other variables basically same as table 4.

P-value in parentheses: *P<0.1, ** P<0.05, ***P<0.01

Table 8: Subsample with Financial constraints

Subsample Variable	HHV1F Estimate	LLV1F Estimate	HHV2F Estimate	LLV2F Estimate
Intercept	-0.22332	-0.01243	-0.12812	-0.00955
	(0.0102**)	(0.3956)	(0.0944*)	(0.4524)
CF	0.39839	0.0602	0.45337	0.03368
	(<.0001***)	(<.0001***)	(<.0001***)	(0.0034***)
CF*AGE	-0.00536	-0.00055	-0.00847	-0.00013
	(0.015**)	(0.0809*)	(<.0001***)	(0.7148)
Q	0.01058	0.000807	0.007788	0.002551
	(0.0007***)	(0.2194)	(0.0152**)	(<.0001***)
G_Sale	0.03106	0.00105	0.03043	0.01214
	(<.0001***)	(0.0017***)	(<.0001***)	(<.0001***)
Lev	0.131961	0.004107	0.074004	0.001704
	(0.0009***)	(0.2217)	(0.0163**)	(<.0001***)
ATang	0.24963	0.01168	0.18941	0.00927
	(<.0001***)	(0.0015***)	(<.0001***)	(0.0044***)
Size	0.01069	0.00153	0.00519	0.00024
	(0.0486**)	(0.0865*)	(0.2666)	(0.7592)
Slack	0.00416	-0.01887	0.04311	-0.01731
	(0.9007)	(<.0001***)	(0.1396)	(<.0001***)
Firm fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
R-Square	0.4213	0.6278	0.5092	0.6765
N	2255	2460	2294	2831

Notes: This table reports results from running the regression for subsamples of four groups of the value of real options. HHV1F represents for the highest value of real options group, HLV1F and LHV1F are the ambiguous value of real options groups, LLV1F is the lowest value of real options group. CF is cash flow define as net income plus depreciation, AGE is financial constraints variable represents for firm age, Q represents Tobin's Q measured as market value plus total debt divided by total asset, G_Sale is sale growth rate, Size stands for firm size captured by the nature log of total asset, Atang is tangibility ratio defined as fixed asset divided by total asset, Lev is leverage ratio defined as total debt divided by total asset, Slack is cash and equivalence divided by total asset.

P-value in parentheses

*P<0.1, ** P<0.05, ***P<0.01

Robust test

Table 9: Regression result (Real options (V2F))

Variable	Estimate	Estimate	Estimate	Estimate	Estimate
Intercept	-0.0917	-0.0958	-0.0959	-0.0886	-0.0887
	(0.0029***)	(0.0016***)	(0.0015***)	(0.0036***)	(0.0035***)
CF	0.1673	0.101	0.2543	0.1393	0.1969
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
CF*HHV2F		0.1943			
		(<.0001***)			
CF*HLV2F			-0.2302		
			(<.0001***)		
CF*LHV2F				0.1877	
				(<.0001***)	
CF*LLV2F					-0.224
					(<.0001***)
Q	0.010349	0.010263	0.009822	0.009576	0.00984
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
G_Sale	0.0088	0.0085	0.0099	0.0093	0.008
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Lev	0.037879	0.034388	0.039968	0.041334	0.035946
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Atang	0.162	0.1572	0.152	0.1543	0.1569
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Size	0.0038	0.0043	0.0043	0.0037	0.0038
	(0.0197**)	(0.008***)	(0.0079***)	(0.022**)	(0.0193**)
Slack	-0.0168	-0.0141	-0.0193	-0.0168	-0.0114
	(0.052*)	(0.0965*)	(0.0231**)	(0.0487**)	(0.1821)
Firm fixed effect	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes
R-Square	0.4013	0.4183	0.4219	0.4148	0.417
N-Obs	10451	10451	10451	10451	10451

Notes: This table reports robust results for the regression (3). HHV2F represents for the highest value of real options group, HLV2F and LHV2F are the ambiguous value of real options groups, LLV2F is the lowest value of real options group. CF is cash flow define as net income plus depreciation, other control variables basically same as table 4.

P-value in parentheses

*P<0.1, ** P<0.05, ***P<0.01

Table 10: Regression result (Uncertainty and flexibility) (V2F)

Variable	Estimate	Estimate	Estimate
Intercept	-0.0886	-0.1182	-0.1098
	(0.0039***)	(<.0001***)	(<.0001***)
CF	0.1625	0.0947	-0.014
	(<.0001***)	(<.0001***)	(0.1069)
CF*V2*D_F	0.0136		
	(<.0001***)		
CF*F*D_{V2}		1.0217	
		(<.0001***)	
CF*V2			0.0044
			(0.0045***)
CF*F			1.714
			(<.0001***)
Q	0.010328	0.010653	0.010652
	(<.0001***)	(<.0001***)	(<.0001***)
G_Sale	0.0086	0.0083	0.0089
	(<.0001***)	(<.0001***)	(<.0001***)
Lev	0.036771	0.02975	0.014866
	(<.0001***)	(<.0001***)	(<.0001***)
Atang	0.1614	0.1512	0.1171
	(<.0001***)	(<.0001***)	(<.0001***)
Size	0.0037	0.006	0.0066
	(0.024**)	(0.0002***)	(<.0001***)
Slack	-0.0182	-0.0144	-0.0104
	(0.0342**)	(0.0841*)	(0.1431)
Firm fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
R-Square	0.4044	0.4407	0.5928
N	10451	10451	10451

Notes: This table reports results from running the regression to examine the impact of managerial flexibility (F) and uncertainty (V2) on ICFS. D_F denotes dummy variable equal 1 if managerial flexibility (F) is equal or greater than the median value in each calendar year, 0 otherwise, D_{V2} is dummy variable equal 1 if uncertainty (V2) is equal or greater than the median value in each calendar year, 0 otherwise, CF is cash flow define as net income plus depreciation, other control variables basically same as table 4.
P-value in parentheses
*P<0.1, ** P<0.05, ***P<0.01

Table 11: Regression result (Financial constraints, real options (V2F))

Variable	FC (Financial constraints) defined as PID					FC (Financial constraints) defined as AGE				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept	-0.0916	-0.09561	-0.09572	-0.08856	-0.0887	-0.10794	-0.11029	-0.1144	-0.10724	-0.10374
	(0.0027***)	(0.0015***)	(0.0014***)	(0.0033***)	(0.0032***)	(0.0005***)	(0.0003***)	(0.0002***)	(0.0004***)	(0.0007***)
CF	0.06605	0.00619	0.15465	0.03974	0.09901	0.26808	0.19209	0.3704	0.25458	0.28958
	(<.0001***)	(0.6297)	(<.0001***)	(0.0014***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
CF*FC	0.57424	0.54828	0.55847	0.56658	0.55046	-0.004	-0.00357	-0.00454	-0.0046	-0.00369
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
CF*HHV2F		0.189					0.19168			
		(<.0001***)					(<.0001***)			
CF*HLV2F			-0.22697					-0.2343		
			(<.0001***)					(<.0001***)		
CF*LHV2F				0.18574					0.19341	
				(<.0001***)					(<.0001***)	
CF*LLV2F					-0.21789					-0.22153
					(<.0001***)					(<.0001***)
Q	0.012597	0.012412	0.012015	0.011801	0.012009	0.009365	0.009384	0.008694	0.008419	0.008938
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
G_Sale	0.00751	0.00729	0.00863	0.00806	0.00682	0.00912	0.0088	0.01029	0.00973	0.00834
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Lev	0.020679	0.018061	0.023214	0.02433	0.01951	0.034133	0.031085	0.035747	0.037123	0.03251
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
ATang	0.15872	0.15418	0.14902	0.15119	0.15397	0.16233	0.15755	0.15228	0.15451	0.15734
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Size	0.00413	0.00457	0.00457	0.00401	0.00408	0.00514	0.00546	0.00578	0.00523	0.005
	(0.0109**)	(0.0043***)	(0.0042***)	(0.0123**)	(0.0109**)	(0.0018***)	(0.0008***)	(0.0003***)	(0.0013***)	(0.0021***)
Slack	-0.01502	-0.01255	-0.01754	-0.0151	-0.00985	-0.01451	-0.01216	-0.01675	-0.01423	-0.00935
	(0.0791*)	(0.137)	(0.037**)	(0.0742*)	(0.2441)	(0.0922*)	(0.1525)	(0.0478**)	(0.0948*)	(0.2721)
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.4118	0.4279	0.4318	0.4251	0.4267	0.4038	0.4202	0.425	0.4181	0.4191
N Obs	10451	10451	10451	10451	10451	10451	10451	10451	10451	10451

Notes: This table reports robust results for the regression (4). FC is financial constraints, PID represents paid interest ratio, AGE is firm age, other variables basically same as table 9. P-value in parentheses: *P<0.1, ** P<0.05, ***P<0.01

Table 12: Regression result (CF x FC x Real options) (V2F)

Variable	FC (Financial constraints) defined as PID					FC (Financial constraints) defined as AGE				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept	-0.0916	-0.1067	-0.10712	-0.10237	-0.10215	-0.10794	-0.10835	-0.10629	-0.09984	-0.10172
	(0.0027***)	(0.0005***)	(0.0005***)	(0.0007***)	(0.0008***)	(0.0005***)	(0.0004***)	(0.0005***)	(0.001***)	(0.0009***)
CF	0.06605	0.19241	0.29567	0.26073	0.2821	0.26808	0.27237	0.28701	0.27877	0.26677
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
CF*FC	0.57424	-0.00283	-0.00371	-0.00488	-0.00376	-0.004	-0.00573	-0.00217	-0.00548	-0.00299
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(0.0007***)	(<.0001***)	(<.0001***)
CF*FC*HHV2F		0.77334					0.0046			
		(<.0001***)					(<.0001***)			
CF*FC*HLV2F			-0.54044					-0.007		
			(<.0001***)					(<.0001***)		
CF*FC*LHV2F				0.97668					0.00673	
				(<.0001***)					(<.0001***)	
CF*FC*LLV2F					-0.91136					-0.00707
					(<.0001***)					(<.0001***)
Q	0.012597	0.011895	0.011428	0.011818	0.011542	0.009365	0.009328	0.008032	0.007955	0.009174
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
G_Sale	0.00751	0.00815	0.01026	0.00978	0.00866	0.00912	0.00904	0.01043	0.00981	0.00839
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Lev	0.020679	0.019021	0.011798	0.017132	0.022308	0.034133	0.031702	0.035378	0.036042	0.031143
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Atang	0.15872	0.15814	0.15945	0.1532	0.15887	0.16233	0.16019	0.15489	0.15394	0.15775
	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)	(<.0001***)
Size	0.00413	0.00527	0.00532	0.00543	0.00471	0.00514	0.0053	0.00525	0.00481	0.00494
	(0.0109**)	(0.0012***)	(0.0012***)	(0.0008***)	(0.0039***)	(0.0018***)	(0.0012***)	(0.0013***)	(0.0031***)	(0.0024***)
Slack	-0.01502	-0.01529	-0.01757	-0.01496	-0.01354	-0.01451	-0.01376	-0.01644	-0.01491	-0.01183
	(0.0791*)	(0.0722*)	(0.0405**)	(0.0777*)	(0.1134)	(0.0922*)	(0.1082)	(0.0538*)	(0.0799*)	(0.1654)
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.4118	0.4198	0.4101	0.4226	0.4127	0.4038	0.4108	0.4171	0.4184	0.4165
N	10451	10451	10451	10451	10451	10451	10451	10451	10451	10451

Notes: This table reports robust results for the regression (5). FC is financial constraints, PID represents paid interest ratio, AGE is firm age, other variables basically same as table 9. P-value in parentheses: *P<0.1, ** P<0.05, ***P<0.01

6. Conclusion

The relationship of investment and internal cash flow is well documented in the literature of corporate finance but the results are mix and most of the previous researches started from the cash flow aspect. Because of information asymmetry which affects companies accessing external resources so that investment level will be more reliant on internal cash flow whenever they have a new investment project. It seems reasonable but only one-sided (Only focus on cash flow aspect). In the literature, there are some studies having attention about investment aspect on ICFS indirectly through agency problem causing over investment. However, there has not had a truly comprehensive study about Investment-Cash flow sensitivity from investment aspect which can combine the impact insider and outsider factors of a company to its investment strategy like real options. In addition, to have a comprehensive understanding of the relationship between investment and internal cash flow, we simultaneously consider both aspects: Cash flow and investment.

Using a sample of firms listed in Taiwan Stock Exchange over the period 2001-2017 and adjusted Q-investment model, this paper investigates the effect of investment strategy, real options, on ICFS. Firstly, to fulfill the shortcoming of the literature of ICFS, we examine the impact of real options on ICFS and find out with a different level of real options, investment level will have different sensitivity on internal cash flow, real options increase ICFS. Between two factors of real options (Uncertainty and managerial flexibility), managerial flexibility rather than volatility is the main effect of ICFS. The implication is that firms with high managerial flexibility will invest more even though a firm's real options are not valuable. After simultaneously engaging both aspects (real options representing for investment strategy and financial constraints representing for cash flow) at the same time, we one more time confirm the work of Fazzari, Hubbard, and Petersen (1988) stating the high financial constraints firms can face, the more sensitivity of investment on internal cash flow would be; besides, we find out under controlling financial constraints, there is still have room for real options' explanation on ICFS. This result shows us real options and financial constraints are both important individual keys to explain ICFS, one cannot replace the other. Do not stop there, real options can expand the impact of financial constraints on the sensitivity of investment on internal cash flow. This implies firms

with the same financial constraints but having a different level of real options will have the different sensitivity of investment on internal cash flow. These findings are our contribution to the study of ICFS.

Our paper provides a comprehensive view of the relationship between investment and internal cash flow from the investment aspect (Real options) and cash flow aspect (Financial constraints). However, the most favorite methods to capture financial constraints such as KZ index, WW index, SA index cannot be applied for Taiwan market. Further studies may research to conduct an index which can represent for financial constraints of Taiwan market.

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