THE SENSITIVITIES BETWEEN CASH FLOW AND INVESTMENT CONSUMPTION, INDUSTRIAL AND PROPERTY & CONSTRUCTION

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ABSTRACT

The aim of this research is to examine the sensitivities of cash flow to investment when firms are financially constrained and unconstrained. Investment decisions of financial constrained firms depend on the availability of internal finance which has a cost advantage over new debt or equity finance while investment of the firms under financial unconstraint depend on investment demand without limitation to access the funds both internally and externally. In this study, we selected companies listed on the Stock Exchange of Thailand, using data from 2001 to 2013. The sample contains 205 companies from 3 business sectors which are Industrials, Property & Construction and Consumer Products. Our findings are consistent with the theoretical prediction on the sensitivity of investment-cash flow which indicates that the constrained firms have higher sensitivity of cash flow to investment than the unconstrained firms.

KEY WORDS: CASH FLOW / INVESTMENT / CONSTRAINED / UNCONSTRAINED

28 pages

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CHAPTER I
INTRODUCTION

In perfect capital market, all firms have equal access to capital market hence; firms' investment decisions are independent of its financial condition. In contrast, the real world capital market is imperfect where internal and external fund are not perfect substitutes, investment decision may depend on financial factors, such as the availability of internal finance, access to new debt or equity finance, or the functioning of particular credit markets. For example, a firm's internal cash flow may affect investment spending because of a "financing hierarchy" in which internal funds have a cost advantage over new debt or equity finance. Under these circumstances, firms' investment and financing decisions are interdependent. In case that firm relies heavily on internal sources of fund to finance their new investment, we may find that investment is highly correlated with profits or internal generated cash flow.

Financial constraints may limit the ability of the firms to access external fund, therefore, firms are unable to invest unless the internal fund is available. It is therefore important to study to what extent and how financial constraints affect firm's investment behavior. An issue that has received particular attention is the sensitivities of investment to cash flow.

Theoretically, sensitivities of cash flow to investment depend on two conditions. First, when firm faces financial constraint, firm has the limitation to access external funds, therefore, its investment would depend on the availability of internal fund which cause the high sensitivity of cash flow to investment. Second, firm with financial unconstraint would have an easy access to external fund hence its investment would depend on the investment opportunities (Q Theory). In this case, there would be less sensitivity of cash flow to investment.

Following Fazarri et al. (1988) and Kaplan and Zingales (1995) in their literature, they add a cash flow variable to a standard Q model of investment, and investigate the differences of sensitivity of cash flow to investment among sub-

samples of firms, a common finding is that there is a stronger correlation between investment and cash flow for firms considered more likely to face financial constraints. This finding has often been referred as evidence of imperfect capital market.

However, there are more recent literatures of Hovakimian and Titman (2003), Almeida and Campello (2007) which questioned whether the sensitivity of a firm's investment to its own cash flow provides a useful indicator of financial constraints. Even under perfect capital markets, cash flow sensitivity may result from measurement error in Tobin's Q.

Based on the work of Fazarri et al. (1988), if firms are financially constrained, investment-cash flow sensitivities are affected by asset tangibility. Refer to the Almeida and Campello (2007), they examine hypotheses about the relation between investment-cash flow sensitivities, assets tangibility and financial constraints and argue that pledgeable assets support more borrowings, which in turn allows for further investment in pledgeable assets. They use this credit multiplier to identify the impact of financial frictions on corporate investment. The multiplier suggests that investment-cash flow sensitivities should be increasing in the tangibility of firms' assets (a proxy for pledgeability) but only if firms are financially constrained. This argument implies a non-monotonic effect of tangibility on cash flow sensitivities: at low level of tangibility, the sensitivity of investment to cash flow increases with asset tangibility, but this effect disappears at high level of tangibility. This implies that the relationship between capital spending and cash flows is non-monotonic in the firm's asset tangibility. We found tangibility had no effect on the cash flow sensitivities of financial unconstrained firms.

In this study, we use a switching regression estimation to allow for endogenous selection into "financially constrained" and "financially unconstrained" categories via maximum likelihood methods and all data we collect from the Stock Exchange of Thailand during 2001 – 2013. Our sample focuses on the following industries; Industrials, Property & Construction, and Consumer Products.

Our results provides the explanation on the interaction between cash flow and investment that each of the variables, etc., Growth, Cash Flow, Tangibility and the interaction between Cash Flow and Tangibility significantly impact to investment for

the constrained firms while the unconstrained firms show insignificant. We summarize that there is the higher sensitivity of cash flow to investment for the constrained firms comparing to the firms that can freely access to the external source of fund. This relationship can be explained that the constrained firms which are smaller and have lower of long-term debt ratio and financial slack have limit to access the external fund so that their investment is highly correlated to the internal cash flow as shown in our summary result. These firms may face the higher cost of capital to acquire new debt, since they are small in size to gain the creditability from the investor.

On the contrary, unconstrained firms which are huge in size and have high level of financial slack are independently able to access the external fund. In addition, if those unconstrained firms have higher growth opportunity, they would have more chance to invest in the project, on the other hand, the constrained firms would have less chance even when they have the same level of growth opportunity due to the limitation of external fund. Moreover, the results from our test indicates that the firms with more tangibility are financially unconstrained due to their tangible assets can be pledgeable to support more borrowings from external source of fund as tangibility can be used as the credit multiplier.

The organization of this paper is as follows. Section 1 gives an introduction. Section 2 provides literature reviews. Section 3 discusses research methodology and data. Section 4 provides empirical results. Section 5 is the Robustness check and Section 6 is the conclusion.

CHAPTER II
LITERATURE REVIEW

2.1 Theories

Tobin's Q is the economics theory of investment behavior where 'q' represents the ratio of the market value of a firm's existing shares to the replacement cost of the firm's physical assets. It states that if Tobin's q is greater than 1.0 then the market value is greater than the value of the company's recorded assets. This suggests that the market value reflects some unmeasured or unrecorded assets of the company hence additional investment in the firm would make sense because the profits generated would exceed the cost of firm's assets. High Tobin's q values encourage companies to invest more in capital because they are "worth" more than the price they paid for them. On the other hand, if Tobin's q is less than 1, the market value is less than the recorded value of the assets of the company. This suggests that the market may be undervaluing the company if q is less than one ($q < 1$), the firm would be better off selling its assets instead of trying to put them to use. The variable "Q" is used as a proxy for investment opportunity in our study.

In the perfect capital market, all firms have equal access to capital markets, firms' financial structure is irrelevant to investment because external funds provide a perfect substitute for internal capital hence firms' investment decision would depend solely on investment demand or investment opportunities (Q). Regarding to the empirical study on perfect capital market that firm can simply access to external fund with no restriction (financial unconstraint), therefore firms would invest in the project that has higher return over the cost of capital. The implication is that the firm's generated cash flow should not affect an investment decision.

In contrast, in the imperfect capital market, internal and external capitals are not perfect substitutes; investment may depend on financial factors, such as the availability of internal finance, access to new debt or equity finance, or the functioning of particular credit markets (financial constraint). For example, a firm's internal cash

flow may affect investment spending because of a “financing hierarchy” in which internal funds have a cost of advantage over new debt or equity finance. Under these circumstances, firms’ investment and financing decisions are interdependent.

Based on the view of an imperfect capital market when firms are financially unconstrained which imply that firms have no limitation to access the external funds same as the perfect capital market, their investment decision is also based on investment opportunities hence the internal generated cash flow should not affect an investment decision. The indicators to judge whether the firms are financial unconstraint include big asset size, reputation, high tangible assets etc. since these factors can be used to support more borrowing. In addition to the Fazarri, Hubbard, and Petersen (1988), they show that firms which have much enough of free cash flow can also decide to invest by investment opportunities. We can use growth as one of the factors to identify investment opportunities which measured by the ratio of stock market capitalization and debt to total assets of the firms. If there are high percentages in growth, those firms would increase their investment, therefore, growth is positive correlation with investment.

2.2 Empirical studies

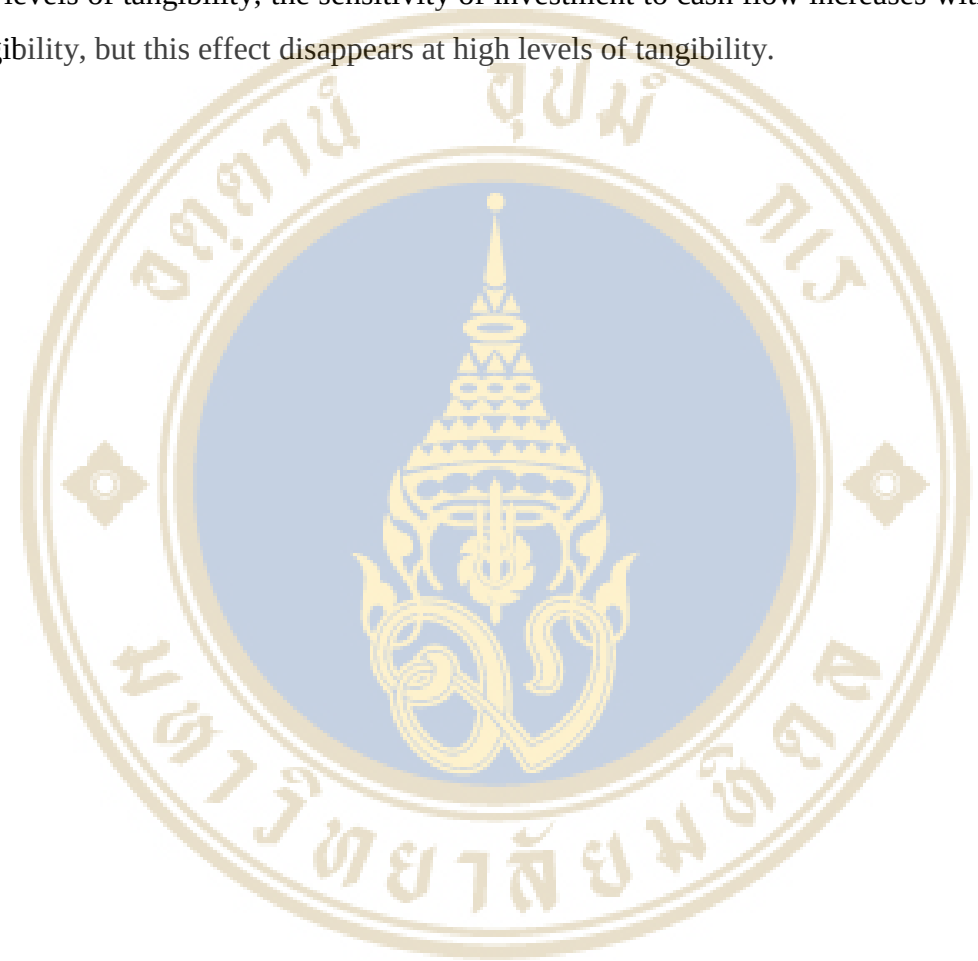
Fazarri et al. (1988) paper which mainly focuses on the financial constraints since in the real world the capital market is imperfect, internal and external funds are not perfect substitutes. Their study shows that there are many factors which limit the firm’s ability to access external funds such as growth, reputation and firm size. For example, small firms often face higher external financing cost than mature companies with well-known prospect, hence the investment cash flow is sensitive for small firms and the financial constraint will limit the firms’ investment which will have great effect on the growth and investment behavior of the small and immature firms. According to these studies, liquidity constraints have been offered as an explanation for the pattern in the size distribution of firms and the relation between size and growth.

Kaplan and Zingales (1995) study a relationship between corporate investment and cash flow to test for the presence and importance of financial constraints. They undertake an in-depth analysis of the 49 low-dividend firms identified by Fazarri et al. (1988) as having unusually high investment-cash flow sensitivity. Based on their study, in only 15% of firm-years is there some question as to firm's ability to access internal or external funds to increase investment. They disagree that firms with high financial constraint would have greater investment-cash flow sensitivity than firms with less financial constraint. They conclude that the higher sensitivity of investment-cash flow cannot be interpreted as evidence that firms are more financially constrained.

Hovakimian and Titman (2003) paper examines the importance of financial constraints for firm investment expenditures by looking at the relationship between investment expenditures and proceeds from voluntary asset sales in financially healthy US manufacturing companies. Specifically, they examines whether asset sales have a greater influence on investment expenditures for firms that are likely to be financially constrained. Assets sales may provide a cleaner indicator of liquidity than cash flow since it appears not to be positively correlated with future investment opportunities. The cross-sectional differences in firm investment expenditures are examined using an endogenous switching regression model with unknown sample separation, which does not require and a priori classification of firms or knowledge of their financial constraints. They find that after controlling for investment opportunities and cash generated from operations, cash obtained from assets sales is a significant determinant of corporate investment. Moreover, the sensitivity of investment to proceeds from assets sales is significantly stronger for firms that are likely to be associated with characteristics associated with financial constraints.

Almeida and Campello (2007) aim to identify whether financing frictions affect corporate investment by explore the idea that variables that increase a firm's ability to obtain external financing may also increase investment when firms have imperfect access to credit. One such variable is the tangibility of firm's assets. Assets that are more tangible sustain more external financing because such assets mitigate contractibility problem: tangibility increase value that can be captured by creditors in default state. Building on Kiyotaki and Moore's (1997) credit multiplier, they show

that investment-cash flow sensitivities are increasing in the tangibility of constrained firms' assets. Based on their study, financial frictions affect investment decisions. However, they find that tangibility has no effect on the cash flow sensitivities of financially unconstrained firms. Crucially, asset tangibility itself affects the credit status of the firm, as firms with very tangible assets may become unconstrained. This argument implies a non-monotonic effect of tangibility on cash flow sensitivities: at low levels of tangibility, the sensitivity of investment to cash flow increases with asset tangibility, but this effect disappears at high levels of tangibility.



CHAPTER III
METHODOLOGY

3.1 Data selection

Our data selection approach is similar to that of Almeida and Campello (2007). We collect all data from the Stock Exchange of Thailand (SET) during 2001-2013. Based on the papers we use as references in our study, their samples focus on manufacturing firms so that we apply the same in our research. Besides, the total size of manufacturing firms in US is bigger than Thailand's so that we extend our samples to cover the following industries: Industrials, Property & Construction, and Consumer Products. The industries we select as our sample have the similar firm's characteristic since they mainly use the assets in generating revenue (assets base). This can be implied that those firms would use the cash flow generated to invest in the assets using in operation.

We require that the firms in our sample appear for at least four consecutive years in the data. Following , we first eliminate firm-years for which the value of the capital is less than one billion baht and those displaying real asset or sales growth exceeding 100%. This first selection rule eliminates very small firms from the sample.

The second rule eliminates those firm-years registering large jump in business structure (size and sales); these are typically indicative of mergers, companies under rehabilitation, and other major corporate events.

3.2 Relationship model of investment, cash flow and asset tangibility

3.2.1 Specification

Following Almeida and Campello (2007), we studied a model of investment demand, developing the traditional investment equation with a proxy for asset tangibility and an interaction term that allows the effect of cash flows to vary with asset tangibility.

Our empirical model is written as:

$$Investment_{i,t} = \propto_1 . Q_{i,t-1} + \propto_2 . CashFlow_{i,t} + \propto_3 . Tangibility_{i,t} + \propto_4 . (CashFlow \times Tangibility)_{i,t} + \sum_i \propto_5^i . firm_i + \sum_i \propto_6^i . year_i + \varepsilon_{i,t} \quad (1)$$

Firms and Year capture firm- and year-specific effects, respectively. Our model estimation strategy allows the coefficient vector α to vary with the degree to which the firm faces financial constraints.

Equation (1) is a direct linear measure of the influence of tangibility on investment-cash flow sensitivities, note that its interactive form makes interpretation of the estimated coefficient less obvious. In particular, if one wants to assess the partial effect of cash flow on investment, one has to read off the result from $\alpha_2 + \alpha_4 \times$ Tangibility.

We use the equation to assess whether or not the value of α_4 is positive and negative significant for the firms that are financially constrained. If any show that significant, it can be indicated that there are significant financial constraints and have a real effect on the firm's investment, whereas, the Company has no financial constraint, if the value of α_4 is insignificant.

3.2.2 Model estimation

We need to identify financially constrained and unconstrained firms. Following the work of Fazarri, Hubbard, and Petersen (1988), the standard approach in the literature is to use exogenous, conditions that are hypothesized to be associated with the scope of financing frictions that firm appearance [see Almeida and Campello

(2007) for recent examples of this strategy]. After firms are sorted into constrained and unconstrained groups, Equation (1) could be separately estimated across those different categories.

One of the central predictions of our theory, however, is that the financial constrained status is endogenously related to the tangibility of the firm's assets. Therefore, we need an estimator that incorporates the effect of tangibility both on cash flow sensitivities and on the constrained status. We use a switching regression model with unknown sample separation to estimate our investment regressions. This model allows the probability of being financially constrained to depend on asset tangibility and variables used in the literature (e.g., firm size and growth opportunities). As explained next, the model simultaneously estimates the equations that predict the constraint status and the investment spending of constrained and unconstrained firms.

3.2.2.1 The switching regression model with endogenous constraint selection

Switching regression estimations allow for endogenous selection into ‘‘financially constrained’’ and ‘‘financially unconstrained’’ categories via maximum likelihood methods. Our test follows Almeida and Campello (2007) very closely.

We assume that there are two different investment regimes which are regime 1 and regime 2. Investment regime 1 is classified as financially constrained which investment may be more sensitive to the availability of internal funds than regime 2 that is classified as financially unconstrained. The model is composed of the following system of equations:

$$I_{1it} = X_{it}\alpha_1 + \Sigma_{1it} \quad (2)$$

$$I_{2it} = X_{it}\alpha_2 + \Sigma_{2it} \quad (3)$$

$$y_{it}^* = Z_{it}\phi + u_{it} \quad (4)$$

Equations (2) and (3) are the structural equations of the system; they are essentially two different versions of our baseline Equation (1). We compress the notation for brevity, and let X_{it} = ($Q_{i,t-1}$, Cash $Flow_{i,t}$, $Tangibility_{i,t}$, (Cash Flow* $Tangibility)_{i,t}$) be the vector of exogenous variables, and α be the vector of coefficients

that relates the exogenous variables in X to investment ratios I_{1it} and I_{2it}. Differential investment behavior across firms in regime 1 and regime 2 will be captured by differences between α_1 and α_2.

Equation (4) is the selection equation that establishes the firm's likelihood of being in regime 1 or regime 2. The vector Z_{it} contains the determinants of a firm's propensity of being in either regime. Observed investment is given by:

$$I_{it} = I_{1it} \quad \text{if} \quad y_{it}^* < 0 \qquad (5)$$
$$I_{it} = I_{2it} \quad \text{if} \quad y_{it}^* \geq 0$$

Where y_{it}^* is a latent variable that weight the likelihood that the firm is in the first or the second regime.

The parameters α_1, α_2 and ϕ are estimated through maximum likelihood. In order to estimate those parameters, we assume that the error terms Σ_1, Σ_2 and u are jointly normally distributed, with a covariance matrix that allows for nonzero correlation between the shocks to investment and the shocks to firm's characteristics. The extent to which investment spending differs across the two regimes and the likelihood that firms are assigned to either regime are simultaneously determined.

We note that in order to fully identify the switching regression model we need to determine which regime is the constrained one and which regime is the unconstrained. The algorithm specified in Equations (2) - (5) creates two groups of firms that differ according to their investment behaviors, but it does not automatically tell the econometrician which firms are constrained.

One advantage of our approach is that it allows us to use multiple variables to predict whether firms are constrained or unconstrained in the selection Equation (4). In contrast, the traditional method of splitting the sample according to a priori characteristics is typically implemented using one characteristic at a time. In particular, the estimation of the selection equation allow us to assess the statistical significance of a given factor assumed to proxy for financing constraints, while controlling for the information contained in other factors.

3.3 Variables

We define our dependent and independent variables for the investment equation and selection variables for the regime selection equation similar to Hovakimian and Titman (2003) and Almeida and Campello (2007).

3.3.1 Dependent variables: Investment

Investment is defined as the ratio of capital expenditures to the beginning-of-period property plant and equipment. The capital expenditures could be classified by 2 measurements as follows;

1) Capital expenditures 1 (Capex 1) is derived from the sum of the end-of-period property plant and equipment and depreciation expense during the period, then minus the beginning-of-period property plant and equipment.

Variable	Formula
Capex1	= $[(PPE_t + Depreciation_t) - PPE_{t-1}] / PPE_{t-1}$

2) Capital expenditures 2 (Capex 2) is derived from cash flow from investing activities

Variable	Formula
Capex2	= Net investment from statement of cashflows / PPE_{t-1}

3.3.2 Independent variables

3.3.2.1 Main investment equation – Equation (1)

1) Investment Opportunities (Q)

Q is our basic proxy for investment opportunities, equal to the sum of the stock market capitalization and the book value of debt divided by the book value of total assets at the beginning of period.

Variable	Formula
Q	= (Stock market cap_{t-1} + Total $liabilities_{t-1}$) / Total $assets_{t-1}$

2) Cash flow (CF)

Cash flow is the sum of the net profit and depreciation during the year divided by the beginning-of-period property plant and equipment.

Variable	Formula
CF	= (Net profit + $Depreciation_t$) / PPE_{t-1}

Normally, if the firm's borrowing ability is high enough, the firm becomes financially unconstrained and its investment–cash flow sensitivity is low. This implies that further changes in tangibility will have no impact on the investment–cash flow sensitivity of a firm that is financially unconstrained.

3) Tangibility (Tang)

Tangibility is defined as the book value of plant, property and equipment (PPE) divided by the total assets as in the research of Qiu and La (2010) and Campello and Giambona (2010). We use four different sets of instruments to study the relationship between cash-flow and tangibility that affects to capital expenditure.

We measured the tangibility by 4 variables;

Model	Variables	Formula
Model 1	Tang1	= PPE_t /Total $assets_t$
Model 2	Tang2	= (PPE_t + $Cash_t$ + Short-term $investment_t$) / Total $assets_t$
Model 3	Tang3	= (PPE_t + $Cash_t$ + Short-term $investment_t$ + Accounts $receivable_t$) / Total $assets_t$
Model 4	Tang4	= (PPE_t + $Cash_t$ + Short-term $investment_t$ + AR_t + $Inventories_t$) / Total $assets_t$

4) Cash Flow × Tangibility (CF*Tang)

This term is a main variable and captures our credit multiplier effect. Theoretically, it should be a positive significant coefficient for financial constrained firms. In contrast, it is not significant for financial unconstrained firms.

3.3.2.2 Regime selection equation – Equation (2) – (5)

5) Log Book Assets

Log Book Assets is the natural logarithm of the total assets in thousand as a proxy for the firm's size. If the firms have more assets size, there is more opportunity to have financial unconstraint

Variable	Formula
Log_book_asset	= ln(Total assets)

6) Long term Debt

It is the ratio of long term debt to total asset. The firms which have more long-term debt are more likely to have financial unconstraint.

Variable	Formula
Long-term debt	= Long-term debt / Total assets

7) Growth Opportunities (Q)

It is the ratio of the sum of the stock market capitalization and the book value of debt to the book value of total assets at the beginning of period.

Variable	Formula
Q	= (Stock market cap$_{t-1}$ + Total liabilities$_{t-1}$) / Total assets$_{t-1}$

8) Financial Slack

It is equal to the sum of cash and short term investment divided by the beginning-of-period total assets. Firms with ample cash reserve are not liquidity constrained since their investment is not limited by a lack of finance therefore, the firms with higher financial slack are more likely to be unconstrained.

Variable	Formula
Financial slack	= (Cash$_t$ + Short-term investment$_t$) / Total assets$_{t-1}$

CHAPTER IV
RESULTS

As the results returned from the switching regression estimation shown in Table 4.1, Panel A shows the results from the main investment equation of both constrained and unconstrained firms using different measurements of Investment (Capx1 and Capx2) and Tangibility (Tang1, Tang2, Tang3 and Tang4). Panel B contains the results from the regime selection equation. In this panel, each of the columns corresponds to a particular measure of Investment and Tangibility. In addition, the last row of Panel B reports the number of observations and F-stat with level of significant for the test of null hypothesis that a single investment regime – as opposed to two regimes (constrained versus unconstrained) – is sufficient to describe the data.

Table 4.1: Investment-cash flow censitivity: Endogenous constraint selection

Panel A: Main regression

Investment Tangibility	Capx1 Tang1	Capx1 Tang2	Capx1 Tang3	Capx1 Tang4	Capx2 Tang1	Capx2 Tang2	Capx2 Tang3	Capx2 Tang4
Constrained								
Growth	0.015 ***	0.014 ***	0.015 ***	0.016 ***	0.009 *	0.008 *	0.007	0.011 **
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Cash Flow	0.007 ***	-0.002	0.001	0.003	-0.004 *	-0.004	-0.002	-0.035 ***
	(0.002)	(0.003)	(0.003)	(0.005)	(0.003)	(0.003)	(0.002)	(0.007)
Tangibility of Assets	-0.106 ***	-0.098 ***	-0.032	-0.089 ***	0.126 ***	0.139 ***	0.178 ***	0.213 ***
	(0.021)	(0.022)	(0.021)	(0.027)	(0.026)	(0.027)	(0.026)	(0.037)
CF * Tangibility	0.306 ***	0.161 ***	0.108 ***	0.011 *	-0.060 ***	-0.046 ***	-0.009 **	-0.005 ***
	(0.040)	(0.018)	(0.016)	(0.007)	(0.017)	(0.008)	(0.005)	(0.009)
Observation	2183	2183	2183	2183	2061	2061	2060	2062
F-Stat	35.67 ***	44.33 ***	24.44 ***	15.47 ***	12.08 ***	18.39 ***	13.43 ***	34.89 ***
R-Squared	0.09	0.09	0.08	0.05	0.04	0.04	0.03	0.16
Unconstrained								
Growth	-0.566	-0.568	-0.461	-0.334	0.173	0.118	0.097	0.116
	(0.393)	(0.360)	(0.296)	(0.260)	(0.170)	(0.169)	(0.174)	(0.153)
Cash Flow	0.064	0.113	0.115	-0.216	-0.235	-0.229	-0.206	-1.222 ***
	(0.054)	(0.082)	(0.090)	(0.298)	(0.202)	(0.219)	(0.223)	(0.476)
Tangibility of Assets	3.047	1.838	0.411	-1.843	0.570	2.467	3.050	5.351
	(2.569)	(1.770)	(1.212)	(2.445)	(3.340)	(2.750)	(2.480)	(3.644)
CF * Tangibility	0.363	0.152	0.071	0.472	2.123	0.518	0.262	1.675 ***
	(0.488)	(0.201)	(0.068)	(0.440)	(2.851)	(0.831)	(0.344)	(0.614)
Observation	2199	2199	2199	2199	2199	2199	2199	2199
F-Stat	0.83	1.01	1.15	1.18	0.79	1.05	1.36	5.16 ***
R-Squared	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.14

*Note: ***, **, * Significant at the 1%, 5%, and 10% level, respectively. Figures in parentheses are standard errors.*

Panel B: Endogenous selection regression - Regime selection variables

Investment Tangibility	Capx1 Tang1	Capx1 Tang2	Capx1 Tang3	Capx1 Tang4	Capx2 Tang1	Capx2 Tang2	Capx2 Tang3	Capx2 Tang4
	Constrained	Constrained	Constrained	Constrained	Constrained	Constrained	Constrained	Constrained
Log Book Assets	-0.080 ***	-0.075 ***	-0.076 ***	-0.084 ***	-0.188 ***	-0.188 ***	-0.186 ***	-0.180 ***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
Long Term Debt	-1.033 ***	-1.050 ***	-1.085 ***	-1.106 ***	-1.193 ***	-1.198 ***	-1.192 ***	-1.209 ***
	(0.101)	(0.101)	(0.099)	(0.099)	(0.111)	(0.111)	(0.111)	(0.112)
Growth Opportunities	-0.031 ***	-0.030 ***	-0.031 ***	-0.025 ***	-0.049 ***	-0.050 ***	-0.059 ***	-0.049 ***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)
Financial Slack	-1.107 ***	-1.063 ***	-1.105 ***	-1.183 ***	-2.149 ***	-2.183 ***	-2.166 ***	-2.170 ***
	(0.052)	(0.052)	(0.051)	(0.051)	(0.098)	(0.099)	(0.099)	(0.099)
Observation	2199	2199	2199	2199	2198	2198	2198	2198
F-stat	167.13 ***	156.94 ***	171.71 ***	194.31 ***	242.77 ***	246.00 ***	246.90 ***	234.54 ***

*Note: ***, **, * Significant at the 1%, 5%, and 10% level, respectively. Figures in parentheses are standard errors.*

For each of the estimations reports in Panel B, (one for each of the 8 proxies for the Investment and Tangibility), the dependent variable is coded 1 for assignment into investment regime 1, and 0 for assignment into investment regime 2. Firms assigned into investment regime 1 are classified as financially constrained, and those assigned into investment regime 2 are classified as financially unconstrained. This classification is based on theoretical priors about which firm' characteristics are likely to be associated with financial constraints. Consider the results from the selection regression (Panel B), all of the variables classified the firms into unconstrained regime. The estimators of the selection equation indicates the firms that are larger and have higher long-term debt ratio, greater investment opportunities, higher level of financial slack are more likely to be financially unconstrained.

Panel A explains the relationship of the independent variables (Growth, Cash Flow, Tangibility of Assets and CF*Tangibility) to the Investment. Based on the results from the selection model in Panel B, the independent variables show little or no response to the Investment for the unconstrained firms due to the result from the statistical test are insignificant (P-value). In contrast, the constrained firms show significant coefficients in most of the estimations at significant level of 1%, 5% and 10% respectively.

CHAPTER V
ROBUSTNESS CHECK

5.1 Regression model with *ex ante* constraint selection

Almeida and Campello (2007) uses ex ante constraint selection and least square regression of investment equation by implementing a sorting scheme as follows;

- Scheme #1: we use total assets of firms in every year to rank firms and classify firms as financial constraint if their ranking is less than or equal to 30 percentile (≤30%) or as financial unconstraint if their ranking is greater than or equal to 70 percentile (≥70%).

As the result shown in Table 5.1, it reports inconsistent outcome that doesn't aligned with the theories hence we cannot properly interpret the result from the standard regression. In conclusion, based on the constraint selection by using the sorting scheme the standard regression is not appropriate to use as a methodology for the test of investment and cash flow sensitivity if compares to the switching regression which presents more reliable result.

Table 5.1: Investment-cash flow sensitivity: *Ex ante* constraint selection

Dependent Variable	Independent Variables					
Investment	*Q*	Cash Flow	Tangibility	Cash Flow* Tangibility	*R^2*	*N*
Panel A : Capital expenditure is measured by Capex 1						
Financial Constraints Criteria						
1. *Firm Size (Capex1_Tang1)*						
Constrained Firms	-0.038	0.097 **	-0.182 *	0.119	0.139	667
	(0.044)	(0.016)	(0.262)	(0.035)		
Unconstrained Firms	0.314 **	0.015 *	2.282 **	3.214 ***	0.006	664
	(0.054)	(0.005)	(0.578)	(0.418)		
2. *Firm Size (Capex1_Tang2)*						
Constrained Firms	-0.039	0.098 ***	-0.352	0.071 **	0.142	667
	(0.036)	(0.007)	(0.151)	(0.016)		
Unconstrained Firms	0.363 **	0.012	2.040 **	0.595 *	0.006	664
	(0.072)	(0.008)	(0.329)	(0.164)		
3. *Firm Size (Capex1_Tang3)*						
Constrained Firms	-0.028	0.109 ***	-0.338 *	0.016 ***	0.144	667
	(0.034)	(0.011)	(0.100)	(0.002)		
Unconstrained Firms	0.349 **	0.021 *	2.054 **	0.341 *	0.002	664
	(0.073)	(0.007)	(0.444)	(0.123)		
4. *Firm Size (Capex1_Tang4)*						
Constrained Firms	-0.025	0.085	-0.626 **	0.037	0.137	667
	(0.032)	(0.055)	(0.120)	(0.058)		
Unconstrained Firms	0.369 *	0.112 ***	2.284 **	-0.145 ***	0.001	664
	(0.090)	(0.006)	(0.377)	(0.010)		

*Note: ***, **, * Significant at the 1%, 5%, and 10% level, respectively. Figures in parentheses are standard errors.*

Table 5.1: Investment-cash flow sensitivity: *Ex ante* constraint selection (Cont.)

Dependent Variable	Independent Variables					
Investment	*Q*	Cash Flow	Tangibility	Cash Flow* Tangibility	*R*^2	*N*
Panel B : Capital expenditure is measured by Capex 2						
Financial Constraints Criteria						
1. *Firm Size (Capex2_Tang1)*						
Constrained Firms	0.105	0.047	-0.297	-0.150	0.003	667
	(0.084)	(0.067)	(0.910)	(0.193)		
Unconstrained Firms	-1.041 *	-0.147 **	1.602	-9.076	0.069	664
	(0.336)	(0.028)	(0.854)	(3.360)		
2. *Firm Size (Capex2_Tang2)*						
Constrained Firms	0.140	0.101	-0.729	-0.330 ***	0.000	667
	(0.101)	(0.039)	(0.670)	(0.020)		
Unconstrained Firms	-1.256 *	-0.125 *	2.402 *	-2.022	0.067	664
	(0.378)	(0.033)	(0.604)	(0.769)		
3. *Firm Size (Capex2_Tang3)*						
Constrained Firms	0.116	0.068	-0.999	-0.149	0.000	667
	(0.093)	(0.063)	(0.694)	(0.092)		
Unconstrained Firms	-1.333 *	-0.174 *	2.530 *	-0.754	0.073	664
	(0.365)	(0.027)	(0.507)	(0.533)		
4. *Firm Size (Capex2_Tang4)*						
Constrained Firms	0.088	0.002	-0.015	0.034	0.001	667
	(0.056)	(0.014)	(0.733)	(0.074)		
Unconstrained Firms	-1.495 *	-0.927 ***	3.716 ***	1.366 ***	0.224	664
	(0.380)	(0.006)	(0.373)	(0.002)		

*Note: ***, **, * Significant at the 1%, 5%, and 10% level, respectively. Figures in parentheses are standard errors.*

CHAPTER VI
CONCLUSION

This paper examines the Investment-Cash flow sensitivity using the switching regression estimations to allow for endogenous selection into "financially constrained" and "financially unconstrained" categories via maximum likelihood methods. As the results providing in this paper, we summarize that there is the higher sensitivity of cash flow to investment for the constrained firms comparing to the firms that can freely access to the external source of fund. This relationship can be explained that the constrained firms which are smaller and have lower of long-term debt ratio and financial slack have limit to access the external fund so that their investment is highly correlated to the internal cash flow as shown in our summary result. These firms may face the higher cost of capital to acquire new debt, since they are small in size to gain the creditability from the investor.

On the contrary, unconstrained firms which are huge in size and have high level of financial slack are independently able to access the external fund. In addition, if those unconstrained firms have higher growth opportunity, they would have more chance to invest in the project, on the other hand, the constrained firms would have less chance even when they have the same level of growth opportunity due to the limitation of external fund. Moreover, the results from our test indicates that the firms with more tangibility are financially unconstrained due to their tangible assets can be pledgeable to support more borrowings from external source of fund as tangibility can be used as the credit multiplier.

Based on our study, the limitation of this paper is the data selection which we limit our samples in only 3 industries, which are Consumer Products, Property & Construction and Industrials. These limitations affect the result from switching regression which causes us to remove some selection variables as explained in Appendix B Alternative Selection Variables. In addition, these samples may not be well- represented for Thailand Stock Market.

Further research should probably consider data selection from various industries. The result would better illustrate the firm characteristics (constrained or unconstrained) in Thailand Stock Market.

REFERENCES

Almeida, H., & Campello, M. (2007). Financial Constraints, Asset Tangibility, and Corporate Investment The Review of Financial Studies / v 20 n 5 2007, 31.

Campello, M., & Giambona, E. (2010). Asset Tangibility and Capital Structure Asset Tangibility and Capital Structure, 26.

Fazarri, S. M., Hubbard, R. G, & Petersen, B. C. (1988). Financing Constraints and Corporate Investment Brookings Papers on Economic Activity, 1: 1988, 65.

Hovakimian, G., & Titman, S. (2003). Corporate Investment with financial constraints: Sensitivity of investment to funds from voluntary asset sales NBER WORKING PAPER SERIES, 28.

Kaplan, S. N., & Zingales, L. (1995). Do financing constraints explain why investment is correlated with cashflow NBER WORKING PAPER SERIES, 33.

Kiyotaki, N., & Moore, J. (1997). Credit Cycles. The Journal of Political Economy, 105, 37.

Qiu, M., & La, B. (2010). Firm Chalacteristics as Deterinants of Capital Structure in Australia Int.J. of the Economics of Business, 17, 10.

APPENDICES

Appendix A Data

We select data from 3 industries in SET which are Industrials, Property & Construction and Consumer Products and their market capitalization are approximately 4.6%, 16.5% and 1.1% of the total market capitalization in SET, respectively. Each industries consist of various sectors as shown in Table A.1.

Table A.1: Industries and sectors

No.	Industry and sector	
1	**INDUS**	**Industrials**
	AUTO	Automotive
	IMM	Industrial Materials & Machinery
	PAPER	Paper & Printing Materials
	PETRO	Petrochemicals & Chemicals
	PKG	Packaging
	STEEL	Steel
2	**PROPCON**	**Property & Construction**
	CONMAT	Construction Materials
	PROP	Property Development
	PF&REIT	Property Fund & REITs
	CONS	Construction Services
3	**CONSUMP**	**Consumer Products**
	FASHION	Fashion
	HOME	Home & Office Products
	PERSON	Personal Products & Pharmaceuticals

We have total 2,199 samples. The results of summary statistic data on our observations using in the regression for each variables are shown in Table A.2.

Table A.2: Statistic test

Variables	Observation	Mean	Standard error	Min	Max
Capex1	2199	0.387	2.734	-2.060	96.950
Capex2	2199	-0.398	4.894	-92.380	97.130
Q	2199	1.283	1.504	0.180	22.140
CF	2199	0.942	4.154	-48.500	81.290
Tang1	2199	0.332	0.225	0.000	2.150
Tang2	2199	0.415	0.229	0.000	2.250
Tang3	2199	0.549	0.257	0.000	2.610
Tang4	2199	0.801	0.201	0.000	2.620
CF_Tang1	2199	0.094	0.531	-3.770	21.690
CF_Tang2	2199	0.180	0.889	-14.710	30.890
CF_Tang3	2199	0.222	1.313	-41.460	34.450
CF_Tang4	2199	0.630	2.974	-41.460	49.990
Log_book_assets	2199	14.955	1.295	11.210	19.900
Long-term debt	2199	0.053	0.113	0.000	1.140
Fin_slack	2199	0.098	0.219	0.000	8.410

Appendix B Alternative selection variables

Our first test on the switching regression found the conflict of interpretation between the selection variables to sort the firms into regime 1 (first component regression) or regime 2 (second component regression) as shown in Table B.1. It shows that the selection variables which are “payout_ratio” and “tang1”, theoretically indicate that the firms with more payout ratio and tangibility are more likely to be unconstrained, sort the firms into regime1, as the result, the regime 1 is represented as “unconstrained firms” but it reports significant P-value on the estimation that conflicts with the theory that the estimation appears insignificant for the unconstrained firms.

Table B.1: The switching regression before remove "payout_ratio" and "tang1" variables

Selection regression

Investment Tangibility	Capx1 Tang1
	Unconstrained
Log Book Assets	-0.058 ***
	(0.009)
Long Term Debt	-1.123 ***
	(0.099)
Growth Opportunities	-0.035 ***
	(0.007)
Financial Slack	-0.730 ***
	(0.052)
Payout Ratio	0.035 ***
	(0.002)
Tang 1	1.704 ***
	(0.050)
Observation	2199
F-stat	319.55 ***

Main regression

Investment Tangibility	Capx1 Tang1	
	Constrained	**Unconstrained**
Growth	-0.517	0.015 ***
	(0.353)	(0.004)
Cash Flow	0.064	0.007 ***
	(0.049)	(0.002)
Tangibility of Assets	3.604	-0.097 ***
	(2.795)	(0.020)
CF * Tangibility	0.343	0.305 ***
	(0.479)	(0.039)
Observation	2198	2182
F-Stat	0.91	36.36 ***
R-Squared	0.02	0.10

*Note: ***, **, * Significant at the 1%, 5%, and 10% level, respectively. Figures in parentheses are standard errors.*

Then we test in the particular samples which we believe that they are the constrained firms. As shown in Table B.2, we select 5 constrained firms which our selection criteria are low long-term debt ratio and unwell-known firms to test "payout_ratio" and "tang1" variables in the switching regression.

Table B.2: Selected constrained firms

Firm	AVG_Payout ratio	AVG_tang1	AVG_tang2	AVG_tang3	AVG_tang4	AVG_Long_term
Constrained	**3.457**	**0.246**	**0.378**	**0.514**	**0.782**	**0.002**
BTNC	8.963	0.190	0.197	0.312	0.522	0.007
CEN	1.671	0.217	0.348	0.521	0.761	0.000
FANCY	1.500	0.539	0.757	0.854	0.972	0.000
GLAND	2.337	0.252	0.470	0.556	0.761	0.000
SAWANG	1.841	0.053	0.151	0.370	0.929	0.000

Table B.3 displays the result from the selection equation using only "payout_ratio" and "tang1" as the selection variables. It shows significant P-value on the estimation in the regime 1 being classified as "unconstrained firm" but in the regime 2 being classified as "constrained firm" appears insignificant. This proves that those two variables are not reliable selection variables to use in the selection regression. As all those reasons, we decide to remove "payout_ratio" and "tang1 (2, 3 and 4)" variables from our selection variables.

Table B.3: The switching regression with only "payout_ratio" and "tang1" variables

Selection regression

Investment Tangibility	**Capx1 Tang1**
	Unconstrained
Payout Ratio	0.013 **
	(0.006)
Tang 1	0.836 *
	(0.455)
Observation	58
F-stat	4.68 **

Main regression

Investment Tangibility	**Capx1 Tang1**	
	Constrained	**Unconstrained**
Growth	0.006	-0.062 ***
	(0.067)	(0.005)
Cash Flow	0.108 **	0.193 ***
	(0.060)	(0.001)
Tangibility of Assets	-0.302	-0.639 ***
	(0.360)	(0.061)
CF * Tangibility	-0.588	2.766 ***
	(0.373)	(0.006)
Observation	57	56
F-Stat	1.02	0.00 ***
R-Squared	0.40	1.00

*Note: ***, **, * Significant at the 1%, 5%, and 10% level, respectively. Figures in parentheses are standard errors.*