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The Relationship Between Investment and Fund Raising: An Empirical study to Japanese Manufacturing Firms

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Abstract

This paper applies Within3SLS to estimate simultaneous equations for panel data of Japanese manufacturing firms to investigate the relationship between investment and fund raising. A negative interrelationship between current leverage and investment is detected.

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1 Introduction

According to the Modigliani-Miller Theorem (MM Theorem), corporate investment behavior is independent of the capital structure in a perfect market. However in an imperfect market, investment behavior can be restricted by financing. In the area of corporate finance theory, there are two opposed theorems about the relation between investment behavior and financing. One is the pecking order hypothesis which suggests that investment is financed first by retentions, then by debts and by equities only as a last resort because of hierarchy costs. The other one is the trade off hypothesis which insists that capital structure decision is a static trade-off between the tax advantage of debt and costs for bankruptcy risk.

As discussed above, empirical researches also draw two opposed conclusions. Recently, there are more empirical literatures to support the pecking order hypothesis. Tong and Green (2005) support the pecking order hypothesis over the trade-off hypothesis using Chinese listed companies'data. However in their paper the relation between investment and financial leverage is inconclusive. Baskin (1989) and Allen (1993) find that there is a positive interrelation between financial leverage and investment in the US and Australia respectively. However as mentioned by Adedeji (1998), pecking order hypothesis does not make a definitive prediction about the interrelation between investment and financial leverage. In his paper, the results obtained show that there is no significant interaction between financial leverage and investment. While investment has a positive influence on financial leverage, financial leverage does not have a significant influence on investment. The interrelations between them are complicated. For instance, higher leverage can increase bankruptcy risk and push ahead investment projects. Adversely, as a fund raising method, debt can arise with increasing investment. It is noted that Adedeji (1998) uses 3SLS to estimate his model with cross section data. This paper applies the method of Within 3SLS summarized by Baltagai (2001) to estimate the simultaneous equation models using Japanese manufacturing firms' panel data from 1994 to 2005. As it is well known, the Japanese investment behavior is slackening in growth after the Bubble economy collapses. Therefore, it is important to investigate how corporate finance affects investment behavior.

In section 2, I introduce my model and the method. Section 3 presents results and section 4 concludes. Data set is described in the appendix.

2 The Model and Method

In this section, just as suggested by Adedeji (1998), simultaneous equations are used to investigate the interrelations between investment and leverage. Benito and Young (2007) indicate that a firm can adjust financial pressure through dividends, new equity issuance and real investment decision, using the UK listed firms' data. Although Adedeji (1998) considers investment, leverage, dividends as dependent variables in his simultaneous equations, I do not consider the dividends and new equity issuance as dependent variables in my model for a technique puzzle. I find that there are so many observations of dividends are zero in my samples that they can not be ignored[1], which means that the distribution of dividends is truncated at zero from left side. It is necessary to apply Tobit model if dividend is used as a dependent variable. In addition, the capital market system of Japan is different from United Kingdom and US. Just mentioned by Hirota (1999) and Hosono (2003), the UK is similar to the US and they are described as market-oriented economies. Dividends often fluctuate with profitability. On the other hand, Japan is described as a bank-oriented economy, whose stock market is rigid comparatively. I find that Japanese firms' dividends are persistent, in other words, dividends of current term are dependent on those of previous term and independent of the other variables such as profitability, investment and so on. The managers and shareholders prefer stability of dividends. I call it a permanent dividends system peculiar to the Japanese capital market. Therefore a dynamic Tobit model is necessary if a lagged dependent variable is included as a regressor when unobserved heterogeneity is present. It is difficult to assume the distribution of unobservable individual effect[2], when the maximum likelihood method is used. Similar to dividends, the new equity issuance is a dummy variable. If the new equity issuance is used as a dependent variable, a logit model or a probit model is necessary to be applied in simultaneous equations.

The simultaneous equation models are described as follows. I suggest that the firm can control the current aggregate investment and leverage simultaneously, according to the other exogenous variables.

[1] I find that there are 17.0% observations of dividends are zero in the Chemistry industry. Other industries, 26.0% in Electrical appliances, 16.1% in Food, 30.5% in Machinery, 22.1% in Metal, 21.9% in Motor, 17.1% in Pottery, 35.7% in Steel, 36.9% in Textile.

[2] Although a semiparametric approach is suggested by Honore and Kyriazidou (2000) without assumptions on the distribution of the unobserved effect and a more single method is demonstrated by Loudermilk (2007) to solve dynamic Tobit model, their equations are single equations. Up to this point, there is no explicit method can be applied in simultaneous equations.

$$(I/K)_{i,t} = \alpha_0 + \alpha_1 Lev_{i,t} + \alpha_2 Lev_{i,t-1} + \alpha_3 Ret_{i,t-1} + \alpha_4 ROA_{i,t} + \alpha_5 q_{i,t} + \alpha_6 NED_{i,t} + \alpha_7 Div_{i,t} + \alpha_8 GD_t + \phi_i + \mu_{i,t} \tag{1}$$

$$Lev_{i,t} = \beta_0 + \beta_1 (I/K)_{i,t} + \beta_2 Ret_{i,t-1} + \beta_3 ROA_{i,t} + \beta_4 r_{i,t} + \beta_5 Baddebt_{i,t} + \beta_6 NED_{i,t} + \beta_7 Div_{i,t} + \psi_i + \epsilon_{i,t} \tag{2}$$

Model (1) represents three fund raising methods for investment according to the pecking order theorem, previous term's retention, current term's debt and new equity issuance. Model (2) represents variables which affect leverage.

The variables are described in the following and the data set description is shown in the Appendix in detail. The subscript i denotes firms and t denotes time. $I_{i,t}$ is net investment and $K_{i,t}$ is tangible capital. $Lev_{i,t}$ is current leverage. In my model, $(I/K)_{i,t}$ and $Lev_{i,t}$ are endogenous variables. $Lev_{i,t-1}$ is previous term's leverage. Increasing $Lev_{i,t-1}$ can reduce or push ahead the investment project. $Ret_{i,t-1}$ is previous term's retention per capital. Increasing $Ret_{i,t-1}$ can relax current financial distress and accelerate the investment. $ROA_{i,t}$ is current income per asset. $q_{i,t}$ is Tobin's q, which denotes the investment opportunity. $NED_{i,t}$ is a dummy variable for new equity issuance. As a last resort, new equity issuance can increase investment and reduce the leverage because of the increment of net assets. $Div_{i,t}$ is dividend per equity. Interest $r_{i,t}$ denotes borrowing cost. The variables described above only represent the properties of the money demand side. As one of the properties of the money supply side, $Baddebt_{i,t}$ is the ratio of bad performing loans of banks. Increasing $Baddebt_{i,t}$ can cause credit crunch of bank and reduce the firm's leverage. As is well known, 40 trillion Japanese yen Government Bond was issued in 1998 and government expenditure expanded since 1998. GD_t is a dummy variable and applied to test whether government expenditure suppress the private investment, which is called crowding out. ϕ_i and ψ_i denote the unobservable individual specific effects, $\mu_{i,t}$ and $\epsilon_{i,t}$ denote the remainder disturbances.

In this paper I apply the method summarized in chapter 7 of Baltagai (2001) to estimate panel data simultaneous equations. Firstly, the variance-covariance matrix across equation (1) and (2) is necessary to be estimated, using the method of Within 2SLS and Between 2SLS respectively. Subsequently, apply Within 3SLS to estimate the simultaneous equations.

The instrumental variable set is described in the following and the subscript i is omitted for simplification. $(I/K)_{t-3}$, $(I/K)_{t-2}$, $(I/K)_{t-1}$, Lev_{t-3}, Lev_{t-2}, Ret_{t-2}, Div_{t-1}, ROA_{t-1}, q_{t-1}, r_{t-1} are in the instrumental variable set. The other exogenous variables NED_t, $Baddebt_t$, GD_t and constant term are leaved in the set.

The estimation processes are programmed using matrix computation.

3 Results

In this paper, model (1) and model (2) are estimated using Japanese manufacturing firms' financial statements data from Nihon Keizai Shimbun's NEEDS database. The firms are classified into nine industries[3].

The results are represented in Table 1-3. The upper half of each Table represents the estimation of model (1) and the lower half represents the model (2). The Comparison of the main results with the previous evidence is represented in Table 4.

Significant negative interrelationship between investment and current leverage can be detected in Chemistry, Food, Metal, Pottery, and Textile industries. Although, as represented in Table 4, Benito and Young (2007) also find a negative relation between investment and leverage, their model is a single equation. They only conclude that leverage has a negative influence on investment. Adedeji (1998) applies simultaneous equations and concludes that leverage does not have a significant influence on investment, While investment has positive influence on leverage.

According to the upper half of each Table 1-3, we can see that the previous term's leverage does not have a unique influence on the investment. As one of the fund raising methods, previous term's retention has a positive effect on investment behavior. Current return does not have a unique influence on investment. Tobin's q has a significant positive effect on investment in Electrical appliances, Machinery, and Motor industries. As another one of the fund raising methods, new equity issuance has a significant positive effect on investment in Food and Pottery industries. Opposite to Benito and Young (2007), Adedeji (1998), the positive relation between investment and dividends can be detected in the electrical appliances, and Steel industries. The crowding out can be detected explicitly in Chemistry, Metal, and Steel industries.

According to the lower half of each Table 1-3, we can see that increasing previous term's retention can relax current financial distress. The increase of current ROA can also relax current financial distress in Electrical appliances, Metal, Pottery, and Steel industries. The decrease of interest cannot stimu-

[3]Chemistry (80), Electrical appliances (71), Food (69), Machinery (80), Metal (58), Motor (30), Pottery (41), Steel (35), Textile (33). The numbers of samples in each industry are represented in the parentheses.

late corporate borrowing in any industry, just as we know the policy of zero interest installed by Japan Bank could not stimulate corporations to borrow for investment. Corporate borrowing is restricted by bad performing loans of banks in Pottery and Steel industries. New equity issuance increases net assets and decreases leverage. Opposite to Adedeji (1998), Benito and Young (2007), Tong and Green (2005), the negative relationship between dividends and leverage is detected in Pottery and Steel industries.

4 Conclusions

This study applies Within3SLS to estimate simultaneous equations for panel data and concludes a negative interrelationship between current leverage and investment. In addition, it is detected explicitly that the previous term's retention can relax current financial distress and accelerate the investment. New equity issuance can also contribute to investment behavior. Japanese corporate borrowing was reduced after the Bubble collapse in spite of decreasing interest. Japanese corporate borrowing is restricted because of bad performing loans, which is the most important reason why investment behavior was slackening in growth after the Bubble economy collapsed. Finally, the relation of dividends and investment as well as the relation between dividends and leverage is detected to be opposite to previous research for UK, China etc, because of a dividend system which is peculiar to Japanese capital market.

Appendix

The subscript i is omitted for simplification.

Net investment I_t can be calculated using the formula $I_t = K_t - K_{t-1} + \delta K_{t-1}$. The physical depreciation rate δ employs the results calculated by Hayashi (1991) for nonresidential buildings, structures, machinery, transportation equipment, instruments tools and land respectively.

K_t is tangible capital.

Lev_t uses the ratio of total debt and net asset to net asset.

Ret_{t-1} uses the ratio of previous term's retention to the K_t.

ROA_t uses the ratio of current income to net asset.

q_t uses the ration of market value to book value.

NED_t employs 1 if new equity is issued in current term, and 0 for otherwise.

Div_t is the total of interim dividend per equity and term-end dividend per equity.

GD_t employs 0 from 1994 to 1997 and 1 from 1998 to 2005.

r_t is calculated by formula (payment for interest + amortization of bond premium)/(short-term loans + commercial paper + long-term loans + bond + convertible bond).

$Baddebt_t$ employs the ratio of bad performing loans of main bank[4].

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[4]The definition of main bank is very complicated. The firm may borrow the money from more than a bank. In this paper, according to Japan Company handbook, The highest percent loan lender is consider to be the main bank

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Table 1: 3SLS estimation for Chemistry, Electrical appliances, Food industry

	Chemistry	Electrical appliances	Food
Lev_t	$-2.43E-2^{***}(-4.38)$	$-1.26E-2^{***}(-3.21)$	$-2.33E-2^{***}(-3.82)$
Lev_{t-1}	$7.89E-3^{***}(2.66)$	$-2.78E-3^{*}(-1.71)$	$-6.30E-4(-0.703)$
Ret_{t-1}	$0.167^{*}(1.89)$	$-1.97E-3(-0.06)$	$-0.336(-0.153)$
ROA_t	$0.440^{**}(2.41)$	$-6.68E-2^{***}(-3.00)$	$0.184^{***}(4.36)$
q_t	$4.90E-3(1.34)$	$1.06E-2^{***}(4.36)$	$3.57E-3(0.615)$
NED_t	$6.27E-3(0.554)$	$1.14E-2(0.970)$	$6.97E-2^{***}(3.19)$
Div_t	$-3.02E-3(-1.26)$	$7.81E-3^{***}(3.56)$	$2.17E-3(0.462)$
GD_t	$-2.77^{***}(-3.29)$	$-1.06E-2(-1.25)$	$-2.28E-3(-0.377)$
$(I/K)_t$	$-19.6^{*}(-1.93)$	$-5.77(-1.46)$	$-37.9^{***}(-2.86)$
Ret_{t-1}	$1.93(0.325)$	$-1.09^{*}(-1.74)$	$-13.9^{*}(-1.68)$
ROA_t	$22.6^{*}(1.79)$	$-2.71^{***}(-6.60)$	$7.27^{***}(2.92)$
r_t	$19.7(1.49)$	$-10.4(-1.07)$	$-2.66(0.129)$
$Baddebt_t$	$-4.73(-0.595)$	$-2.43(-0.81)$	$-3.07(-0.436)$
NED_t	$-0.391(-0.546)$	$-6.43E-2(-0.245)$	$2.85^{***}(2.37)$
Div_t	$-0.215(-1.39)$	$2.55E-2(0.486)$	$9.34E-2(0.412)$

Note: The t value is represented in the parentheses

$***$ *denotes significant at* 0.01 *level*

$**$ *denotes significant at* 0.05 *level*

$*$ *denotes significant at* 0.10 *level*

Table 2: 3SLS estimation for Machine, Metal, Motor industry

	Machine	Metal	Motor
Lev_t	$6.97E-4(0.06)$	$-3.15E-2^{***}(-3.88)$	$3.74E-2(1.26)$
Lev_{t-1}	$3.60E-3(0.621)$	$-6.70E-5(-0.044)$	$9.28E-3(0.471)$
Ret_{t-1}	$-1.74(-0.386)$	$7.64E-2(0.241)$	$0.683^{***}(4.80)$
ROA_t	$8.08E-2(0.989)$	$-0.225^{*}(-1.87)$	$-0.239^{**}(-2.14)$
q_t	$1.32E-2^{**}(2.11)$	$1.30E-3(0.208)$	$1.11E-2^{*}(1.90)$
NED_t	$1.13E-2(0.313)$	$2.43E-3(0.113)$	$-2.24E-3(-0.127)$
Div_t	$3.83E-3(0.656)$	$7.47E-3(0.895)$	$-6.54E-3^{**}(-2.10)$
GD_t	$1.09(0.346)$	$-3.11E-2^{*}(-1.69)$	$-1.02E-2(-0.760)$
$(I/K)_t$	$-13.4(-0.955)$	$-25.5^{***}(-4.69)$	$5.50(1.14)$
Ret_{t-1}	$-2.38^{*}(-1.69)$	$-0.704(-0.886)$	$-7.99^{***}(-4.32)$
ROA_t	$-2.34(-0.766)$	$-7.64^{**}(-2.46)$	$0.727(0.516)$
r_t	$74.8(1.21)$	$-1.00E-2(-0.150)$	$0.204(0.026)$
$Baddebt_t$	$-10.5(-0.703)$	$0.291(1.17)$	$2.18(0.079)$
NED_t	$0.188(0.127)$	$-6.43E-2(-0.245)$	$-0.280(-1.31)$
Div_t	$-2.25E-2(-0.088)$	$2.55E-2(0.486)$	$7.76E-2^{**}(2.41)$

Note: refer to Table 1.

Table 3: 3SLS estimation for Pottery, Steel, Textile industries

	Pottery	Steel	Textile
Lev_t	$-0.100^{**}(-2.22)$	$-4.41E-2(-1.34)$	$-4.03E-2^{***}(-5.88)$
Lev_{t-1}	$1.18E-2(0.632)$	$4.69E-2^{**}(2.01)$	$-9.70E-4(-0.143)$
Ret_{t-1}	$0.725^{***}(3.17)$	$7.89E-2(0.738)$	$0.390^{***}(3.75)$
ROA_t	$3.39E-2(0.111)$	$-0.294(-1.42)$	$-7.37E-2(-0.666)$
q_t	$-3.23E-3(-0.199)$	$1.52E-2(0.998)$	$-3.75E-2(-1.15)$
NED_t	$6.75E-2^{**}(2.50)$	$-9.80E-3(-0.045)$	$-3.35E-2(-0.831)$
Div_t	$9.25E-3(1.19)$	$1.44E-2^{*}(1.84)$	$2.40E-2(1.28)$
GD_t	$-1.27E-2(-0.477)$	$-2.95E-2^{**}(-1.96)$	$-4.18E-3(-0.209)$
$(I/K)_t$	$-3.54^{***}(-5.18)$	$30.3^{***}(3.41)$	$-21.5^{***}(-6.59)$
Ret_{t-1}	$-3.39^{***}(-5.51)$	$-11.2^{***}(-5.54)$	$-7.03^{***}(-5.57)$
ROA_t	$-3.49^{***}(-7.01)$	$-8.20^{***}(-3.41)$	$0.195(0.122)$
r_t	$7.91^{**}(2.14)$	$-27.7(-1.50)$	$-9.85(-0.533)$
$Baddebt_t$	$-3.91^{***}(-3.09)$	$-19.2^{**}(-2.54)$	$7.91(1.11)$
NED_t	$-0.223^{*}(-1.91)$	$0.367(0.694)$	$-0.797(-0.989)$
Div_t	$-9.22E-2^{***}(-3.23)$	$-0.427^{**}(-2.19)$	$0.243(0.953)$

Note: refer to Table 1.

Table 4: Comparison of the main results with the previous evidence

	Tong and Green (2005)	Benito and Young (2007)	Adeedeji (1998)	Zhu (2009)
Sample firms	China	UK	UK	Japan
Investment and Leverage	?	-	+	-
Leverage and Dividends	+	+	+	-
Investment and Dividends	?	-	-	+
Investment and Profitability	?	+		?
Leverage and Profitability	-			-

Note: + denotes significant positive relation. - denotes significant negative relation. ? denotes inconclusive. Blank means that the relation is not discussed in the literature.