KY Publications
RESEARCH ARTICLE
Vol.4.Issue.4.2017
Oct-Dec

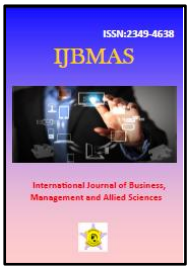
IJBMAS
www.ijbmas.in

INTERNATIONAL STANDARD SERIAL NUMBER INDIA
ISSN:2349-4638

INTERNATIONAL JOURNAL OF BUSINESS, MANAGEMENT AND ALLIED SCIENCES (IJBMAS)
A Peer Reviewed International Research Journal

U-shaped Relationship between Investment and Cash flows: Panel Data Evidence from Indian Manufacturing Firms*

Dr. SUCHETA GAUBA
Assistant Professor, Department of Commerce, Lakshmibai College, University of Delhi
E-mail: sucheta.gauba@outlook.com



ABSTRACT
The past decades have seen the growth of various countries from unknown to known, "under-developed" to "developed" and some still developing. Investment being the backbone of any growing economy has attracted the researchers worldwide. Since the seminal article of Modigliani and Miller (MM) in 1958, a number of researches have been carried out to understand the interaction of investment, financing and dividend decisions. Ironically, a large number of studies undertaken with Modigliani and Miller (MM) as a base have shown a divergence in results from MM's results. The present study empirically examines the existence of a non-monotonic relationship between investment and cash flow. Panel data model with balanced dataset has been estimated for a sample of 176 large sized Indian companies for 1994-95 to 2008-09. A square and cubic term of cash flows has been included in investment equation to capture U-shaped relationship. The investment and internal funds (cash flows) have been found to have a U-shaped relationship. These findings are consistent with the U- shaped investment curve introduced by Cleary et al (2006).

KEYWORDS: Corporate Investment, non-monotonic relationship, *investment-cash flow sensitivity*
JEL Classification: G31, E22

I INTRODUCTION

The issue of capital structure has been examined extensively in the past decades to understand the importance of various sources of finance in financing capital expenditure decisions. Modigliani and Miller (1958)[1] show that when a firm is operating in perfect markets, financing policies and capital structure decisions are irrelevant in maximizing firm value; and the firm's value-maximizing real investment decisions are independent of its financing decisions. However, the authors' conclusion may not hold good in the current scenario, as the recent literature has contended that most firms operate in incomplete or imperfect markets, and external funds are more expensive than internal funds.

* This paper is based on author's doctoral thesis submitted to University of Delhi.

As the results of existence of market imperfections, investment decisions are found not independent of financing decisions and capital structure decisions. Donaldson (1961)[2] shows that managers list retained earnings, debt and outside equity in decreasing order of priority for raising funds to finance investment decisions. This financing hierarchy is popularly known as pecking order of financing choices. Various other authors including, Mayer (1988)[3], Fazzari et al. (1988)[4] and Kaplan and Zingales (1997)[5] have supported pecking order theory over independence of financing and investment decisions. Indeed, the relationship between cash flow and fixed investment expenditures has attracted immense attention by the researchers over the years.

However, most of the studies till 1990's have been postulating a monotonic relation between investment and cash flows. The contradictory results of Kaplan and Zingales (1997)[6] and Cleary (1999)[7] with those of Fazzari et al. (1988)[8] further deepen the thought of reconcilement. Kaplan and Zingales's (2000)[9]findings also suggest that investment- cash flow sensitivities may increase under certain assumptions as financing constraints are relaxed. They also state that these investment-cash flow sensitivities may not necessarily be monotonic. Further, Povel and Raith (2001)[10]find a U-shaped relationship between investment and cash flows. This study intends to test a non-monotonic relationship between these two variables (in Indian context) because of absence of any distinction between constrained and unconstrained firms in the data set.

II MATERIALS AND METHODS

The present study primarily aims to study the financing of capital expenditures in Indian corporate sector to examine the relationship between financing and capital expenditure decisions. It is hypothesized that investment decisions of firms are sensitive to cash flows and there is a U-shaped relationship between investment and cash flows. This has been elaborated as follows:

a. Accelerator -cash flow theory of investment is applicable in Indian corporate sector.
b. Internal funds (operating cash flows) have a significant relationship with change in net fixed assets.
c. There is a U-shaped relationship between change in net fixed assets (investment) and operating cash flows.

This is a secondary data based study for which the relevant details have been extracted from database maintained by Centre for Monitoring Indian Economy (Prowess). Large sample of 176 companies as these are more actively involved in capital (investment) expenditures thereby rendering authenticity to the results. Government companies run as commercial enterprises by the government have also been included in the sample subject to sample selection criteria. The following qualifying criterion has been applied to select companies in the study:

- Continuity of Operations over the study period from 1994-95 to 2008-09.
- Consistent Data Availability for the fourteen-year study period.
- Common and Consistent Accounting Year throughout the fourteen years.

Panel data model has been used with balanced dataset. The classical regression (Ordinary Least Squares) results have been estimated using LIMDEP Software, Version 7.0. Further, fixed effects model has been examined wherever, LM test statistic favors fixed effects/ random effects model over classical regression. A choice between fixed and random effects model has been made as suggested by Hausman Test statistic. Additionally, fixed effects results have been presented for both 'group dummy' and 'group dummy and period effects'. In the present study, the issue of heteroskedasticity has been addressed by scaling down the dependent and independent variables by beginning of the year value of net fixed assets. Hence, no specific tests had to be carried out. Correlation matrix for various independent variables has been estimated for the sample to analyze the existence and extent of multicollinearity. Moreover, Durbin-Watson statistic has been estimated to checkauto-correlation.

To analyse investment cash flow sensitivity with Indian dataset, the model used by Clark et al (1979)[11]with U.S. based data and by Gangopadhyay, Lensink and Molen (2001)[12]has been used in the study. In the model Clark et al integrated accelerator and internal funds as follows:

$$I = f(\text{output, internal liquidity}) \quad \text{.....(eq. 1)}$$

Where "I" is investment, output represents accelerator and cash flow from operating activities have been used as a proxy for internal funds.

This model has been chosen considering its aptness in current Indian context. First, there is a need for integrating capital market imperfections in the analysis consequent to the period of financial sector reforms. Second, various Indian studies have supported the influence of capital market imperfections on financing patterns. All the variables have been divided by capital stock at the beginning of the year (K). This has been done to remove the scale effects from the data and tackle the common problem of heteroskedasticity in such a heterogeneous sample. A similar practice of scaling down the variables has been adopted by various other researchers like Fazzari et al (1988)[13], Athey and Laumas (1994)[14], Gangopadhyay, Lensink and Molen (2001)[15]and so on. The impact of inflation has been suitably addressed by adjusting all the nominal variables by 1993-1994 Wholesale Price Index (WPI) for manufacturing industries. The data for the same has been sourced from the Office of the Economic Adviser, Ministry of Commerce and Industry, Government of India.

In order to further dwell on this postulate, a square and a cubic term in the regression to capture the higher order relationship between cash flow and investment to empirically check for existence of U-shaped relationship between investment and cash flow. In this case the estimated equation has been written as follows along with the corresponding results.

For Panel OLS

$$\Delta F_{it} = \alpha + \beta_1 \Delta Y_{it} + \beta_2 \Delta I_{it} + \beta_3 CFO_{it} + \beta_4 FEQ_{it} + \beta_5 FB_{it} + \beta_6 TC_{it} + \beta_7 LAG\Delta F_{it} + \beta_8 LAG\Delta Y_{it} + \beta_9 (CFO_{it})^2 + \beta_{10}(CFO_{it})^3 + v_{it};\ v_{it} \sim IID\ (0, \sigma_v^2) \quad \text{.....(eq.2)}$$

Where

ΔF_{it}	=	Change in net fixed assets of firm I in period t
ΔY	=	Change in output
ΔI	=	Change in inventory
CFO	=	Cash flow from operating activities
CFO^2	=	Square term of Cash flow from operating activities
CFO^3	=	Cubic term of Cash flow from operating activities
FEQ	=	Flow of equity
FB	=	Flow of borrowings
TC	=	Trade credit and Acceptances
LAG ΔF	=	Change in net fixed assets in the period t-1
LAG ΔY	=	Change in output in the period t-1
V	=	Error term

For Fixed Effect Model (Group Dummy)

Similar results have been found for fixed effects model with both 'group dummy' and 'group dummy and period effects' taken together. The enhanced equation for 'group dummy' variables is given below along with the results displayed in Table 4.

$$\Delta F_{it} = (\alpha + \mu_i) + \beta_1 \Delta Y_{it} + \beta_2 \Delta I_{it} + \beta_3 CFO_{it} + \beta_4 FEQ_{it} + \beta_5 FB_{it} + \beta_6 TC_{it} + \beta_7 LAG\Delta F_{it} + \beta_8 LAG\Delta Y_{it} + \beta_9 (CFO_{it})^2 + \beta_{10}(CFO_{it})^3 + v_{it};\ v_{it} \sim IID\ (0, \sigma_v^2) \quad \text{.....(eq.3)}$$

For Fixed Effects Model (Group Dummy and Period Effects)

Lastly, the equation for Fixed Effects Model (Group Dummy and Period Effects) and its results reiterating the U-shaped relationship have been displayed below in Table 5.

$$\Delta F_{it} = \alpha + \beta_1 \Delta Y_{it} + \beta_2 \Delta I_{it} + \beta_3 CFO_{it} + \beta_4 FEQ_{it} + \beta_5 FB_{it} + \beta_6 TC_{it} + B_7 LAG\Delta F_{it} + \beta_8 LAG\Delta Y_{it} + \beta_9 CFO_{it}^{\ 2} + \beta_{10} CFO_{it}^{\ 3} + \sum_{t=1997}^{2009} \delta_t T_t + v_{it}\ ;\ v_{it} \sim IID\ (0, \sigma_v^2) \quad \text{.....(eq.4)}$$

III RESULTS AND DISCUSSION

The panel data regression estimation has been conducted for set of sample observations. The correlation matrix presented in Table 1 does not indicate high correlation amongst any of the independent variables with a cut-off correlation coefficient of 0.7 as per Bhattacharya (2007).

Table 1: Correlation Matrix

	F	Y	CHG_I	CFO	FEQ	FB	TC
F	1	0.15202	0.17156	-0.0261	0.2821	0.3943	0.14165
Y	0.15202	1	0.24478	0.24052	0.09885	0.06432	0.68675
CHG_I	0.17156	0.24478	1	-0.0774	0.11004	0.40016	0.26156
CFO	-0.0261	0.24052	-0.0774	1	-0.1775	-0.2527	0.28029
FEQ	0.2821	0.09885	0.11004	-0.1775	1	0.11413	0.0274
FB	0.3943	0.06432	0.40016	-0.2527	0.11413	1	0.03933
TC	0.14165	0.68675	0.26156	0.28029	0.0274	0.03933	1

In OLS results, Durbin - Watson statistic have indicated absence of autocorrelation amongst the explanatory variables. Lagrange Multiplier favored use of using fixed/random effects model over ordinary least squares or classical regression. As a next step, a highly significant Hausman's test statistic has favoured fixed effect model to serve the purpose for Indian sample. Moreover, when the effects and regressors may be correlated, a fixed effects model would generate consistent results while the random effects model would generate inconsistent results. The fixed effects results with 'group dummy' have been discussed in the following paragraphs.

(t-statistic in parentheses)

Table: 2: Empirical Findings with Ordinary Least Squares and Fixed Effects Model

Variables	OLS/Classical Regression	Fixed Effects Group Dummy
Constant	0.003	
	(0.144)	
Y	0.004	0.02
	(1.381)	(5.379)*
CHG_I	-0.08	-0.12
	(-1.919)***	(-2.712)*
CFO	0.11	0.09
	(4.312)*	(2.971)*
FEQ	1.73	1.62
	(13.730)*	(12.263)*
FB	0.49	0.45
	(19.984)*	(17.595)*
TC	0.07	0.099
	(3.353)*	(3.159)*
LAGF	-0.001	-0.004
	(-0.089)	(-0.244)
LAGY	-0.003	-0.006
	(-1.673)***	(-1.726)***
R^2	0.23	0.29

*, ** and *** indicate the coefficient is statistically significant at 1%, 5% and 10% significance level.

It has been found that R^2 is 0.23 in OLS panel results and improves to 0.29 with fixed effects model. Though the AIC value close to zero indicates that the model is correctly specified, a justification for low R^2 is required. Equations expecting a monotonic relationship between investment and cash flow usually have poor explanatory power (low adjusted R squares) because of pooling observations of positive and negative cash flow together. In fact, this finding takes closer to the hypothesis that fixed investments bear a U-shaped relationship with cash flows in Indian corporate sector.

To find the relationship between cash flow and investment levels, this study first takes the most instinctive way, i.e. to plot cash flow against investment in the sample. The entire sample has been first arranged by CFO/K, which is cash flow of the firm, scaled by capital, and splitting the sample into deciles of CFO/K. The mean of ΔF/K (net fixed investment of the firm scaled by capital stock at the beginning of the year) has then been calculated and plotted against the mean of CFO/K of each decile. The plot has easily envisaged the relationship between cash flow and investment of each sample in this study. Another additional plot is provided where the absolute value of ΔF/K is plotted against CFO/K. To supplement the first set of plots, this second set of plots would visualize how investment responds to cash flow levels. This would clearly indicate the sensitivity between investment and cash flow as displayed in Figure 1.

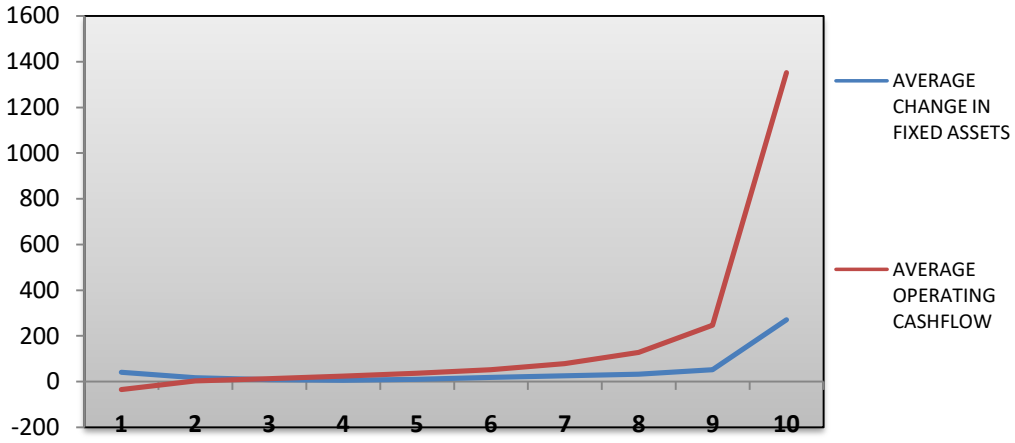


Figure 1: Average Change in Net Fixed Assets and Average Operating Cash flow Divided in Deciles

The Figure 1 clearly visualizes the U-shaped fixed investment curve against cash flow level ranging from negative to zero and finally turning to positive. The Average Change in Net Fixed Assets against each decile of Average Operating Cash flow has been presented in Figure 2 below.

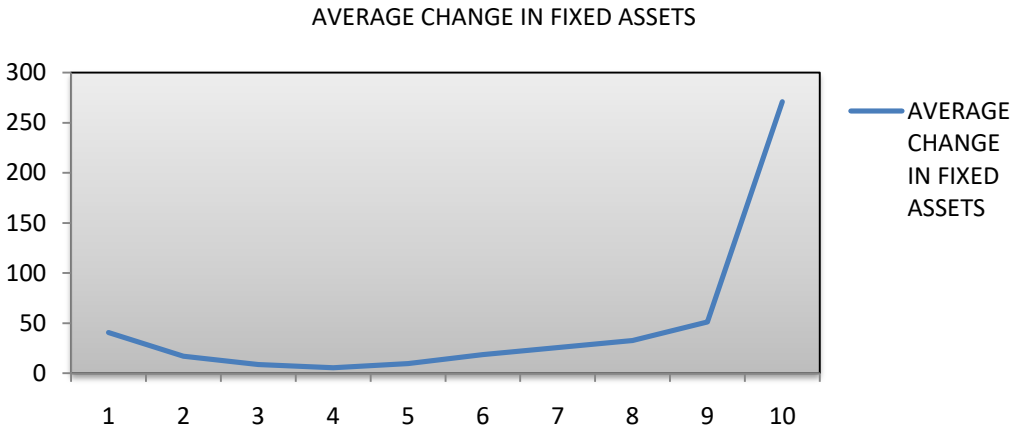


Figure 2: Average Change in Net Fixed Assets against each Decile of Average Operating Cash flow

Figure 2 depicts average change in net fixed assets against each decile of cash flow to clearly highlight the U-shape of investment curve. But this visual relationship needs to be verified with empirical results and the same has been dealt with in the following paragraphs. The results have been presented for OLS, "Fixed Effects with Group Dummy and "Fixed Effects with Group Dummy and Period Effects".

Table: 3: Panel OLS with Higher Powers of Cash flows

Variables	Estimates/ coefficients	t-statistic
Constant	-0.015	-0.746
Y	0.018	4.175*
CHG_I	-0.12	-2.831*
CFO	0.151	4.699*
FEQ	2.074	12.630*
FB	0.494	20.314*
TC	0.071	3.453*
LAGF	0.026	1.366
LAGY	-0.015	-3.748*
CFOSQ	-0.052	-3.903*
CFOCUBE	0.006	3.248*
R^2	0.24	
Lagrange Multiplier Test Statistic		7.96 (df=1, Prob value=0.004)
Hausman Test Statistic		76.80 (df=10, Prob Value=0.00)

*, ** and *** indicate the coefficient is statistically significant at 1%, 5% and 10% significance level.

The Table 3 shows panel OLS results for aggregate sample after adding cash flow square and cash flow cube. All the other variables of the equation have been explained earlier except Cash flow from operating activities square and cube. These variables have been added to check for existence of the U-shaped relationship between investment and cash flow by focusing on the sign and significance of the coefficient of cash flows. All the three variables, namely, cash flow from operating activities (CFO), cash flow from operating activities square (CFO^2) and cash flow from operating activities cube (CFO^3) are significant at 1 percent level of significance. As postulated, CFO has a positive coefficient which turns to be negative with CFO squareand finally returns to be positive with CFO cube. Hence, the U-shaped relationship between investment and cash flow has been reinstated by empirical findings.

Table: 4: Fixed Effects 'with Group Dummy' and 'with Group Dummy and Period Effects' with Higher Powers of Cash flows

Variables	Fixed Effects with Group Dummy		Fixed Effects with Group Dummy and Period Effects	
	Estimates/ Coefficients	t-statistic	Estimates/ Coefficients	t-statistic
Constant			-0.124	-4.814*
Y	0.029	5.389*	0.029	5.385*
CHG_I	-0.144	-3.076*	-0.143	-3.038*
CFO	0.132	3.550*	0.133	3.566*
FEQ	1.98	11.451*	1.938	11.179*
FB	0.458	17.868*	0.455	17.633*
TC	0.109	3.475*	0.12	3.753*
LAGF	-0.016	-0.808	-0.017	-0.859
LAGY	-0.007	-1.814***	-0.007	-1.851***
CFOSQ	-0.049	-3.554*	-0.047	-3.399*
CFOCUBE	0.005	2.673*	0.005	2.565***
R^2		0.29		0.30

*, ** and *** indicate the coefficient is statistically significant at 1%, 5% and 10% significance level.

As displayed by Table 4, a positive and significant coefficient for cash flow, a negative and significant coefficient for cashflow squareand a positive and significant coefficient for cash flow cube indicate that the relationship between investment and cash flow is non-linear and U-shaped. Cleary et al (2006)[19]and few other researchers have discussed the U-shaped relationship between these two variables. The evidence of the U-shaped relationship between internal cash flow and investment was found in different countries using international data by the above-mentioned studies.

While analyzing the relationship between investment and cash flow, it may be comprehended that the relationship of the two would be a positive line starting from zero cash flow if only internal funds are available for investment. It is only possible for investment to be positive with zero or negative cash flow when firms have access to external funds. The conventional understanding of relationship between investment and cash flow does not discriminate between the positive and negative cash flows and believes that investment is linearly linked to cash flow, which means that increase in cash flow availability would allow the firms to invest greater funds in capital expenditures. However, this understanding may not be true on the negative side of cash flow. The existence of asymmetric information makes the firms with cash flows below certain levels (negative cash flow) to increase investment with future expectation of increase in cash flows. Cleary et al. (2006)[20]present that when a firm's cash flow is lower than a certain level, "an increase in investment improves the firm's ability to repay its debt and also increases the investor's payoff if the firm defaults. Other things equal, the investor can then accept a smaller promised repayment in order to break even, which reduces the risk of default for the firm." Empirically, the paper argues that most previous literature exclude financially weak firms and thus postulate and conclude a monotonic relationship between cash flow and investment.

As the review of the literature show, the nature of the cash flow/ investment relationship is, at best, not completely clear. In this study, the major thrust is to study the relationship of investment and cash flow itself, following Cleary et al. (2006) and testing the relationship between cash flow and investment of firms directly without classifying firms into financially constrained and unconstrained firms.

Another important thing is that inclusion of higher powers of cash flow has improved the goodness of fit, lending even more support to a non-linear relationship between investment and cash flow. As Cleary et al. (2006)[21]argue different dimensions of "financial constraints" would have very different implications for investment behavior. This empirical finding of U-shape curve on one hand helps to explain the previous opposing empirical results in the literature and accept the hypothesis of this study on the other.

IV CONCLUSION

In the wake of globalized markets, liberalized trade regimes, economic recessions and challenges presented by atrocious natural calamities, Indian corporate sector has been undergoing a dramatic transformation. Investment opportunities have expanded beyond the geographical borders thereby strengthening the significance of various sources of finance especially internally generated cash flows. In this scenario, an empirical finding on existence of non-monotonic U-shaped relationship between investment and cash flows in the developing economy of India serve an interesting purpose. The status of cash flows may be used by investors not only as an indicator of future prospects but also a firm's plan to indulge in fresh capital expenditures.

ACKNOWLEDGEMENT

The author conveys a special thanks to Prof. JawaharLal for his valuable inputs and constant guidance and to University of Delhi for the facilities.

REFERENCES

[1] Modigliani, F. and M. Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment", American Economic Review 48, 1958, 261-297

[2] Donaldson, G., "Corporate Debt Capacity: A Study of Corporate Debt Policy and the Determination of Corporate Debt Capacity", Boston, Division of Research, Harvard Business School, 1961
[3] Mayer, C., "New Issues in Corporate Finance", European Economic Review, Vol. 32, 1988, pp 1167- 1189
[4] Fazzari, Steven, Hubbard, R. Glenn and Petersen, Bruce C., "Financing Constraints and Corporate Investment," NBER Working Papers 2387, National Bureau of Economic Research, Inc., September 1988
[5] Kaplan, S. and Zingales, L, "Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?," Quarterly Journal of Economics 20, 1997, 169-215
[6] Kaplan and Zingales, 1997, op. cit.
[7] Cleary, Sean, "The Relationship between Firm Investment and Financial Status", Journal of Finance, Volume LIV, No. 2, April 1999, p.p. 673-692
[8] Fazzari, Hubbard and Petersen, 1988, op. cit.
[9] Kaplan, S. N. &Zingales, L. 2000, 'Investment-Cash Flow Sensitivities are not Valid Measures of Financing Constraints', Quarterly Journal of Economics, vol. 115, issue: 2, pp: 707-712.
[10] Povel, P. &Raith, M. 2001, 'Optimal Investment under Financial Constraints: The Roles of Internal Funds and Asymmetric Information', *AFA 2002 Atlanta Meetings; Institute of Financial Studies*, Working Paper, No. 0103, October, http://ssrn.com/abstract=269497.
[11] Clark, Peter K.; Greenspan, Alan and Goldfeld, Stephan M., "Investment in the 1970s: Theory, Performance and Prediction" Brookings Papers on Economic Activity, Volume No. 1, 1979, pp. 73-124
[12] Gangopadhyay, S., Lensink, R. and Van Der Molen, R., "Business Groups, Financing Constraints and Investment", CCSO Quarterly Journal, Vol. 3 No. 4, 2001
[13] Fazzari, Hubbard and Petersen, 1988, op. cit.
[14] Athey and Laumas, 1994, op. cit.
[15] Gangopadhyay, Lensink and Molen, 2001, op. cit.
[16] Fazzari, Hubbard and Petersen, 1988, op. cit.
[17] Athey, M. J. and Laumas, P. S., "Internal Funds and Corporate Investment in India", Journal of Development Economics, Vol. 45, 1994, pp. 287-303
[18] Gangopadhyay, Lensink and Molen, 2001, op. cit.
[19] Cleary, Sean, Paul Povel, and Michael Raith, "The U-Shaped Investment Curve: Theory and Evidence" Journal of Financial and Quantitative Analysis, 2006
[20] Ibid.
[21] Ibid.