ANNALS of the ORADEA UNIVERSITY.
Fascicle of Management and Technological Engineering, Volume VII (XVII), 2008

MULTIFACTORIAL MODELS OF INVESTMENT WITH FINANCIAL VARIABLES

Catalin DROB
University of Bacau
e-mail: catad@ub.ro

Keywords: investments, models, capital

Abstract: The purpose of this study is to present the main investment models that have financial variables included into their structures. Some of these financial variables are the Q variable, the cash-flow, debt, profits, etc. Starting with the investment models based on financial variables, the empirical evidence has brought to light that between these variables and the level of investments there is a strong relationship that varies according to the level of financial constraints that affect the enterprise.

1. INTRODUCTION

The multifactorial models, unlike the unifactorial models, have more than one exogenous variable. The multifactorial investment models, that show the weight of financial variables on the level of investments of the companies, have in their structure two or more variables and at least one is of a financial nature: cash-flow, debt, profits, etc.

2. MULTIFACTORIAL MODELS OF INVESTMENT WITH FINANCIAL VARIABLES

The most renowned investment models that show the weight of financial variables in the level of investments within companies are the ones that include the cash-flow variable (CF).

The relationship between investment and cash flow was widely studied by many economists and researchers like: John Meyer, Edwin Kuh, Steven Fazzari, Glenn Hubbard and Bruce Petersen, Steven Kaplan and Luigi Zingales etc. A large literature dating back almost 50 years has found a positive relationship between company cash flows and investment.

The interpretation of the correlation between investments and cash-flow has sparked a lot of controversy in the specialized literature. According to some authors, this correlation is blamed on the financial constraints that affect the companies. According to others the correlation is the result of the asymmetry between the internal and external information. The list of arguments is not exhaustive and the discussions on this subject are not over.

Generally, such a model can be described by the following relation:

$$\left(\frac{I}{K}\right)_{it} = a + b\left(\frac{X}{K}\right)_{it} + c\left(\frac{CF}{K}\right)_{it} \quad (1)$$

where:

(I/K) – the ratio of firm's investment in year *t* to its working capital;

X – exogenous variable, different from the CF, being considered influential for investments (sales, output, q, etc);

CF – the cash-flow realized by the firm.

For example, the Q-cash-flow model argues that investments carried out by the company vary according to two important variables: Q and the cash-flow [4]:

$$\left(\frac{I}{K}\right)_{it} = a + \frac{1}{b}Q_{it} + c\left(\frac{CF}{K}\right)_{it} \quad (2)$$

where:

Q – the ratio of the market value of the firm to the replacement cost

S. Fazzari, G. Hubbard and B. Petersen consider that, if there weren't any financial constraints, the variable Q could by itself justify the investment behavior of the company.

This would be possible if the market were perfect. Under this assumption, Modigliani and Miller considered that internal funds availability should play no role on investment decisions.

In reality, the enterprises act in an imperfect market. Each company is facing these kinds of constraints to a different extent, and this explains the presence of the cash-flow variable in the investment models. The greater the constraints are, the closer the link is between the investments and the cash-flow.

The financial constraints that affect a company are a consequence of the fact that internal and external enterprise funds are not interchangeable, this showing that the Modigliani-Miller theorem does not stand. The theorem claims that both internal and external funds are represented by the same costs.

In an article published in 2003, Raj Aggarwal and Sijing Zong (Kent State University) have proposed a modified version of the Q-cash-flow model [1]:

$$\left(\frac{I}{K}\right)_{it} = a + b\left(\frac{M}{B}\right)_{it} + c\left(\frac{CF}{K}\right)_{it} \quad (3)$$

where:

M – the market price of the company's stock;

B – the book value of the stocks.

In this model, the ratio M/B shows the growth opportunity of the company. The greater the *M* market value of the company's stocks is, the greater the investment appetite of the company is.

Using data about the investment activity of a number of companies based in four developed countries (U.S.A., Great Britain, Japan and Germany), between 1997 and 2001, Raj Aggarwal and Sijing Zong have come to the conclusion that the level of investment is directly and closely linked to the level of cash-flow, and the greater the financial constraints are, the stronger this correlation will be.

Introducing a new variable into the Q-cash-flow model that will show the effect of past investments on present investments, will transform this model into a *lag*:

$$\frac{I_{it}}{K_{i(t-1)}} = a_0 + a_1\frac{I_{i(t-1)}}{K_{i(t-2)}} + a_2 Q_{i(t-1)} + a_3\frac{CF_{it}}{K_{i(t-1)}} \quad (4)$$

The use of *lag* models, intended to include the effects modified in time, is justified by the fact that a stimulus regarding capital (i.e. capital getting cheaper) can make itself noticeable after a certain period of time (the increase in demand for that capital good and the decrease of the price of capital do not happen simultaneously).

If the company in question has contracts for the procurement of capital goods, but which are not yet in progress, then, another variable is being added into the equation, $CONK_{it}$, that represents the value dimension of these contracts [3]:

$$\frac{I_{it}}{K_{i(t-1)}} = a_0 + a_1\frac{I_{i(t-1)}}{K_{i(t-2)}} + a_2 Q_{i(t-1)} + a_3\frac{CF_{it}}{K_{i(t-1)}} + a_4\frac{CONK_{it}}{K_{i(t-1)}} \quad (5)$$

where:

$CONK_{it}$ – the value of contracts for the procurement of capital goods sealed by company *i* in year *t,* not paid and not in progress.

The future progress of these contracts will generate new investments of capital goods.

To verify this model, Robert E. Carpenter and Alessandra Guariglia have analyzed the investment activity of 722 companies from Great Britain during 1982 and 1999. The conclusions that the two authors have gathered take into account the fact that while surrounded by asymmetrical information, the investment model based on the variable Q cannot show all the investment opportunities. The use of variable $CONK_{it}$ within the investment models by there two researchers has enabled a more precise screening of investment opportunities. This variable screens out the investment opportunities from within the company, not from outside the company.

Based on this model, it has been inferred that there is an inversely proportional relationship between cash-flow and investments, on one hand, and the size of the company on the other (the smaller the company is, the stronger the relationship will be, and the bigger the company is, the weaker the effect of the cash-flow-investments will be).

Another model that shows the effect of financial variables on the level of companies' investments is built using the accelerator's classical investment model, described by the following relation:

$$\frac{I_{it}}{K_{i(t-1)}} = a_0 + a_1 \frac{\Delta S_{it}}{K_{i(t-1)}} \tag{6}$$

where:

ΔS – the change in output sales between period *(t-1)* and period *t*.

By introducing the CF variable into the accelerator's model, we get a model that is considered able to show the effect of financial variables on the level of companies' investments [4]:

$$\frac{I_{it}}{K_{i(t-1)}} = a_0 + a_1 \frac{\Delta S_{it}}{K_{i(t-1)}} + a_2 \frac{CF_{i(t-1)}}{K_{i(t-1)}} \tag{7}$$

In a study carried out in 2000, the vice-president of the Financial Sector Operations at the World Bank, Luc Laeven, has analyzed the effects of the financial system's liberalization and the financial constraints of the company's investment. In this study, the following investment model is used [6]:

$$\frac{I_{it}}{K_{i(t-1)}} = a_0 + a_1 \frac{I_{i(t-1)}}{K_{i(t-2)}} + a_2 MPK_{it} + a_3 FIN_{it} \tag{8}$$

where:

MPK_{it} – the marginal product of a company's *i* capital at time *t*;

FIN_{it} – financial variable of company *i* at time *t* (cash-flow, profit etc.).

For a more precise view of the effect of the imperfect financial markets on this model, we can add another independent variable D_{it}:

$$\frac{I_{it}}{K_{i(t-1)}} = a_0 + a_1 \frac{I_{i(t-1)}}{K_{i(t-2)}} + a_2 MPK_{it} + a_3 FIN_{it} + a_4 \frac{D_{it}}{K_{it}} \tag{9}$$

where:

D_{it} – the company's debts at time *t*.

The study carried out by Luc Laeven has taken into account the investment activity of 394 companies in 13 developed countries, between 1988 and 1998. The conclusions of this study have brought to light that the liberalization of the financial system contributes to the decrease of market imperfections. The investments grow less dependent on the financial restrictions. This liberalization has a positive effect especially on the smaller

companies and a less obvious effect on bigger companies, because the latter receive preferential treatment from banks, and are not overly dependent on internal funds.

3. CONCLUSIONS

In the last 50-60 years more multifunctional models have been suggested that show the variable effect on the level of companies' investment. These models have brought to light the importance of financial variables, especially of internal funds, on the capital goods' investments. The most empirical evidence shows that there is a positive correlation between financial variables that reflect the internal funds of a company and the level of investments. This statement is proved, empirically, by many studies. For example, S. Bond has shown that between 1970 and 1994, 93% of fixed investments in Great Britain, 96% in U.S.A., 80% in Germany and 70% in Japan have been achieved by internal funds [2]. The financial constraints that affect the companies have a strong influence on the correlation between investments and financial variables. The greater the constraints are, the stronger the link between the investments and the cash-flow will be.

REFERENCES

[1] Aggarwal, R., Zong, S., – "Internal cash flows and investment decisions: empirical evidence from the G4 countries", International Finance Review, No. 4, 2003;

[2] Bond, S., Reenen, J. V., – "Microeconometric models of investment and employment", Oxford University and Institute for Fiscal Studies, Fiscal Studies,1999;

[3] Carpenter, R. E., Guariglia, A., – "Cash flow, investment, and investment opportunities: New tests using UK panel data", Royal Economic Society Annual Conference, Working Papers, No.94, 2003;

[4] Fazzari, S. M., Hubbard, R. G., Petersen, B. C., – "Financing constraints and corporate investment" Brookings Papers on Economic Activity, No.1, 1988;

[5] Latruffe, L., – "Investment and financial constraints of Polish farmers", Agricultural Economics Society Annual Conference, Working Papers No.01-04, London, 2004;

[6] Laven, L. – "Does financial liberalization relax financing constraints on firms?", The World Bank, Policy Research Working Paper, No. 2467, 2000.