THE COMPARATIVE ANALYSIS OF THE INVESTMENT MODELS FROM EMPIRICAL POINT OF VIEW

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Abstract: The purpose of this article is to compare the main models of investment especially from empirical point of view. Generally, the higher is the number of independent variables that are included in these models the better are the empirical results obtained based on these models. However, we can not say with certainty which investment model is better than others. In principle, the comparative analysis of these models confirms the superiority of the multifactorial models against the unifactorial investment models.

1. INTRODUCTION

For the study of the investment behavior of the firms, over time, several investment models were used. Among these models, in this comparative analysis were taken into account the following types of investment models:

- the accelerator model;
- the neoclassical model;
- the cash flow model;
- the Q (Tobin) model;
- the Q-cash flow model;
- the accelerator-cash flow model;
- the accelerator-cash-flow lag model.

2. BRIEF DESCRIPTION OF THE MAIN INVESTMENT MODELS

The accelerator model establishes that investment demand is directly determined by the demand for output. This model considers that the demand for capital goods is mainly determined by the forecasted level of production [3]:

$$I_t = a_0 + a_1(Y_t - Y_{t-1}) = a_0 + a_1\Delta Y \qquad (1)$$

where:

I_t – the investments in period t;

Y_t, Y_{t-1} – the production in period t, and $t-1$.

The neoclassical model of investment considers the optimal capital stock as main determinant of the investments. In this case, the demand for new investments depends by the level of production, by the relative price of capital goods, by the capital cost etc. [3]:

$$I_t = a_{0} + a_1\Delta K_t = a_{0} + a_1\Delta\left(\frac{p_t Y_t}{c_t}\right) \qquad (2)$$

where:

$\Delta K_t = K^* - K$;

K^* – the optimal capital stock;

K – the capital stock;

p – the production selling unit price;

c – the capital cost.

According to the cash flow model, the investments depend mainly on cash-flow. In other words, the investments are determined by the amount of internal funds, by the past and current level of the profits [3]:

$$\left(\frac{I}{K}\right)_t = a_0 + a_1\left(\frac{CF}{K}\right)_t \tag{3}$$

where:

CF_t – the cash-flow realized by the firm in period t;

The Tobin's Q model is based on the idea that the demand for investments varies proportionally to the ratio of the estimated market value of the firm and the replacement value of the capital owned by that firm. This ratio is known in literature as the Q factor [3]:

$$\left(\frac{I}{K}\right)_t = a_0 + a_1 Q_t \tag{4}$$

The Q-cash flow model results from the combination of two basic models: of the Tobin's Q model and of the cash flow model [3]:

$$\left(\frac{I}{K}\right)_t = a_0 + a_1 Q_t + a_2\left(\frac{CF}{K}\right)_t \tag{5}$$

The accelerator - cash flow investment model establish that the investments depend on the changes of the level of sales (ΔS), on the cash flow (CF) and on the interest rate (d) [3]:

$$\frac{I_t}{K_{(t-1)}} = a_0 + a_1 \frac{\Delta S_t}{K_{(t-1)}} + a_2 \frac{CF_t}{K_{(t-1)}} + a_3 d_t \tag{6}$$

The accelerator-cash-flow lag model: against previous model, this model introduces in the equation of the investment model both the influence of the past investments and of the past cash-flow on the present investments [3]:

$$\frac{I_t}{K_{(t-1)}} = a_0 + a_1 \frac{I_{(t-1)}}{K_{(t-2)}} + a_2 \Delta_{it} + a_3 \Delta Y_{(t-1)} + a_4 \frac{CF_t}{K_{(t-1)}} + a_5 \frac{CF_{(t-1)}}{K_{(t-2)}} \tag{7}$$

3. THE ANALYSIS OF THE INVESTMENT MODELS FROM EMPIRICAL POINT OF VIEW

The verosimility and the validity of the investment models can be judged mainly on their ability to explain the investment behavior in the past and to make predictions for future. In recent years there have been realized several comparative studies that tried to test the validity of these models.

The beginnings of such researches can be attributed to the well-known economists Dale Jorgensen and Calvin Siebert which, in 1968, have tested the basic investment models, from empirical point of view. These researches have conducted to the idea that the neoclassical model reflects the investment behavior of firms in the best way [6].

Other researches were been undertaken by the Charles Bischoff, in 1969 [1]. This economist has compared the unifactorial investment models on the example of American firms, taking into account their activity in the period 1953-1968. He concluded that the modified neoclassical model can be considered the best unifactorial investment model which can be used for explaining investment behavior, followed by the accelerator model. To the same conclusion reached and Maurice Clark in 1979.

In 1973, John Elliott, based on own researches upon investment model, reached to a different conclusion. He found that the most consistently investment model from empirical point of view is the accelerator model, followed by the cash-flow model [4]. Similar somewhat results was obtained by Robert Eisner who claimed the superiority of the accelerator - cash flow model against other investment models [2].

According to the researches undertaken in 1998 by Steven Fazzari, Glenn Hubbard and Bruce Petersen, the models derived from the accelerator theory and from the neoclassical theory can be used, in practice, with good results [5].

Regarding the validity of the models based on the variable Q, the studies have shown that even if it they are well grounded in theory, the empirical results obtained using this kind of models are not very satisfactory.

The testing of the investment models based on the financial variables have brought to light the sensitivity of the investment behavior, at the firms level, against these variables that is even greater as the firms are smaller and younger. Steven Fazzari, Glenn Hubbard and Bruce Petersen have found that cash flow tends to have an increasing effect on the investments. However, the empirical results obtained using investment models based on financial variables are rather satisfactory than good [5].

Perhaps the most conclusive results were obtained when were used the lag type models, especially the accelerator-cash-flow lag model. Taking into account the delayed effects produced by certain variables, such as production or cash-flow, led to obtaining a high degree of verosimility of results.

The synthesis of the comparative analysis of the main investment models from empirical point of view is given in the following table:

Type of investment model	Mathematic equation of the model	Exogenous variables	Verosimility of the empirical results
Accelerator model	$I_t = a_0 + a_1(Y_t - Y_{t-1}) =$ $= a_0 + a_1\Delta Y$	ΔY	Satisfactory to the good
Neoclasiccal model	$I_t = a_0 + a_1\Delta K_t =$ $= a_0 + a_1\Delta\left(\dfrac{p_t Y_t}{c_t}\right)$	ΔK, respective: p, Y, c	Good
Cash-flow model	$\left(\dfrac{I}{K}\right)_t = a_0 + a_1\left(\dfrac{CF}{K}\right)_t$	CF	Satisfactory
Q (Tobin) model	$\left(\dfrac{I}{K}\right)_t = a_0 + a_1 Q_t$	Q	bad
Q-cash-flow model	$\left(\dfrac{I}{K}\right)_t = a_0 + a_1 Q_t + a_2\left(\dfrac{CF}{K}\right)_t$	Q, CF	Satisfactory
Accelerator--cash-flow model	$\dfrac{I_t}{K_{(t-1)}} = a_0 + a_1\dfrac{\Delta S_t}{K_{(t-1)}} +$ $+ a_2\dfrac{CF_t}{K_{(t-1)}} + a_3 d_t$	ΔS, CF, d	Good
Accelerator--cash-flow lag model	$\dfrac{I_t}{K_{(t-1)}} = a_0 + a_1\dfrac{I_{(t-1)}}{K_{(t-2)}} +$ $+ a_2\Delta_{it} + a_3\Delta Y_{(t-1)} +$ $+ a_4\dfrac{CF_t}{K_{(t-1)}} + a_5\dfrac{CF_{(t-1)}}{K_{(t-2)}}$	I, ΔY, CF	Good to the very good

4. CONCLUSIONS

In principle, the comparative analysis of the investment models, from empirical point of view, confirms the superiority of the multifactorial models against the unifactorial investment models. However, the inclusion of too many variables in the mathematic equation of the model can lead to the phenomenon of multicollinearity between these variables with negative effects on the results obtained based of these models.

We can not say with certainty which model is better than others. A number of economic variables which can be included in the investments models, with good results, are specific only for certain industries.

However, we can say definitely that the investments behavior depends on, in decisive manner, by some determinants of investment, such as the output produced, the stock of capital and the cash flow etc.

The manner in which these variables are combined with others specific economic variables of a particular economy or a certain activity in order to realized a best model capable to explain the investment behavior depend on, quite enough, the understanding and the experience of the researchers.

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