Acta Mathematica et Informatica Universitatis Ostraviensis

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Acta Mathematica et Informatica Universitatis Ostraviensis, Vol. 11 (2003), No. 1, 91--94

Persistent URL: http://dml.cz/dmlcz/120596

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ABSTRACT. Most central banks in the industrialised nations, including that of the Czech Republic, use the interest rates as the prime instrument of macroeconomic control of aggregate demand and hence inflation. An integral part of such a macroeconomic policy should be a promotion of investment. Optimisation behaviour of firms respects interest rates, output and capital prices when looking for a desired capital stock level. That is why a common form of a partial adjustment investment model is specified in a neo-classical way as optimising a demand for capital. Using the transition economy data of the Czech Republic, relevant models are estimated.

1. Introduction

Most central banks in the industrialised nations, including that of the Czech Republic, use the interest rates as the prime, and in some cases exclusive, instrument of macroeconomic control of aggregate demand and hence inflation. An integral part of such a macroeconomic policy should be a promotion of investment. Interest rates clearly affect the cost of capital which, in the long-run, adjusts optimally. Supposing a process of partial adjustment, the actual level of capital is adjusted to a desired value. As a base of investment models an adaptive schema may be used

$$I_t = \lambda K_t^* + (\delta - \lambda)K_{t-1}, \tag{1}$$

where I_t are gross investment outlays, K_t is a capital stock, optimal amount of which is denoted K_t^*. The rate of physical deterioration is assumed to be δ. Usually, actual and desired levels of capital stock are not always equal. The process of partial adjustment is supposed to be realised by which the value K_t is adjusted to the desired (or target) value K_t^*. The speed of adjustment between K_t^* and K_{t-1} is λ.

Key words and phrases: Interest rate macroeconomic policy, optimisation behaviour of firms, maximisation of profits, panel data, rational expectations.

The paper was written under the financial support of GA R 402/01/0161 and of the project CEZ:J18/98:311401001.

Alternative theories of investment differ in the way how the desired value is modelled and what factors are supposed to affect the speed of adjustment. Considering the investment being determined by relative prices and depreciation as a constant fraction of the level of capital stock as a hypothesis compatible with the interest rates based macroeconomic policy, the neo-classical models are formulated based on well-defined optimising techniques maximising profit subject to a given production function. Profits π at time t are defined as

$$\pi_t = Y_t - wL_t - rK_t$$

where Y is the output, w is the wage rate, r is the cost of capital services, L is the quantity of labour, K is the quantity of capital services. The maximisation of profit subject to a production function constraint

$$Y_t = f(L_t, K_t) \tag{2}$$

is an optimisation problem which can be re-formulated by the help of the Lagrangian multiplier procedure as

$$\frac{\partial Y_t}{\partial K_t} = r, \qquad \frac{\partial Y_t}{\partial L_t} = w \tag{3}$$

representing marginal product of K and L respectively. So, the optimal capital stock K^* is obtained by finding the level of capital at which its marginal product equals the real user cost.

For an econometric implementation, a specific form of a production function has to be assumed. According to experiences, a contemporaneous Czech Republic industry, and especially the machinery, for which an application is presented here, can be described well by the help of the Cobb - Douglas production function with a constant return to scale (see[5]). It means

$$Y_t = AK^\alpha L^\beta$$

instead of (2). Further, according to (3) we have $\alpha(Y_t/K_t) = r$ what can be solved for the optimal capital stock as

$$K_t^* = \alpha\frac{1}{r}Y_t.$$

From (1) we can derive

$$I_t = \lambda(K_t^* - K_{t-1}) + \delta K_{t-1} = \lambda I_{nt} + \delta K_{t-1};$$

net investment I_{nt} is supposed to be proportional to K_t^*: $I_{nt} = \theta K_t^*$, hence

$$I_t = \lambda\theta K_t^* + \delta K_{t-1} = \varphi\alpha(Y/r) + \delta K_{t-1} \tag{4}$$

with $\varphi = \lambda\theta$. A sequence of investment orders can be involved into the model using an index j to distinguish the lags (details in [1]). Then, instead of (4), a more general formula is

$$I_t = \sum_{j=1}^{\infty} \varphi\alpha(Y/r)_{t-j} + \delta K_{t-1} \tag{5}$$

2. Microeconomic Application

The panel data for 24 Czech machinery firms comprising the years 1996, 97, 98 were available. Using an appropriate panel data regression technique (classregression, software SORITEC, [9]) to model (4), following results were found (standard errors in parenthesis).

$$\begin{aligned} I_{96} &= \underset{(9257)}{9068.88} - \underset{(.009)}{.020}(Y/r)_{95} + \underset{(.08)}{.26}K_{95} \\ I_{97} &= \underset{(9257)}{9068.88} - \underset{(.009)}{.18}(Y/r)_{96} + \underset{(.06)}{.18}K_{96} \\ I_{98} &= \underset{(9257)}{9068.88} - \underset{(.007)}{.005}(Y/r)_{97} + \underset{(.05)}{.11}K_{97} \end{aligned}$$

$$\mathrm{R-Squared} = .264238 \qquad \mathrm{No.\ obs} = 72$$

$$\mathrm{F-statistic}(6,\ 65) = 3.89064 \qquad \text{Significance level} = .002221$$

Performing the statistical verification we can see a partial relevance, for years 96 and 97 but not 98, of the hypothesis made. Individual regressions give similar results with better R-Squared and F-statistic values.

Year 1996:

$$I_{96} = \underset{(14017)}{4128.52} - \underset{(.008)}{.019}(Y/r)_{95} + \underset{(.07)}{.26}K_{95}$$

$$\mathrm{R-Squared} = .4291 \qquad F(2,\ 21) = 7.89235 \qquad \mathrm{Significance} = .002778$$

Year 1997:

$$I_{97} = \underset{(13164)}{4518.69} - \underset{(.008)}{.18}(Y/r)_{96} + \underset{(.05)}{.19}K_{96}$$

$$\mathrm{R-Squared} = .3610 \qquad F(2,\ 21) = 5.93303 \qquad \mathrm{Significance} = .009067$$

Year 1998:

$$I_{98} = \underset{(20558)}{18764.3} - \underset{(.009)}{.006}(Y/r)_{97} + \underset{(.07)}{.10}K_{97}$$

$$\mathrm{R-Squared} = .0947 \qquad F(2,\ 21) = 1.09808 \qquad \mathrm{Significance} = .351913$$

An interpretation of estimated parameters is not unambiguous. Parameter δ of physical deterioration of capital varies from 0.10 to 0.26. Parameter φ is, in all cases negative, what makes a proposed interpretation impossible.

3. Macroeconomic Application

Macroeconomic variables concerning investment, capital and output are the aggregates of relevant microeconomic events. Hence, similar model based relations should be expected. But estimating model (4) using quarterly 90 - years data of the Czech economy, such an assumption is evidently unsupportable. On the other hand, a rational expectations hypothesis (REH), relating aggregate investment to expected inflation - ruled by the interest rate policy, seems repeatedly (see [6]) to be valid.

We have, for example,

$$INF_t = -29.9 + 0.25Y_{t-1} - 0.03M2_{t-1}$$
$$\quad (10.6) \quad (0.06) \quad (0.01) \quad \text{R-squared} = 0.41$$
$$I_t = -55.2 + 35.4\,D + 0.5\,Y_t \; -0.9\,E_{t-1}INF_t$$
$$\quad (21.6) \quad (4.8) \quad (0.1) \quad (0.4) \quad \text{R-squared} = 0.77$$

(I is for investment, Y output, $M2$ money supply, D dummy variable to distinguish fourth quarters, $E_{t-1}INF_t$ is the inflation in period t as it was expected in the period $t-1$) with the REH acceptable according to the χ^2-test (see e.g. [3]).

4. Conclusions

By the performing of interest rate macroeconomic policy, a massive investment is desired, but it is not a necessary logical consequence of such a policy. a targeted support to the investment process must be given. The results found here show a certain compatibility between the macroeconomic policy of CR and an investment in machinery. It can be explained by the fact that machinery is a traditional branch and the back-bone of the Czech industry so it is supported primary. But the microeconomic sphere in common is still on its way to meaningful changes. That is also why the aggregate data do not follow a similar formula of behaviour. As the most part of investors are those coming from abroad, it is not surprising that they are following the most visible macroeconomic features of the country what results into the verification of REH.

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