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INVESTMENT PLANS, INNOVATIONS AND REVISION COSTS IN FINNISH MANUFACTURING

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Abstract

In this paper the reasons for revisions of announced investment plans are analyzed theoretically and empirically. In earlier studies by the author it was shown that investment plans and final investments differ systematically from each other. The theoretical framework is based on neoclassical investment theory, rational expectations and partial adjustment of investment plans. The effects of uncertainty are also studied.

The empirical results show that investment plans are endogeneous to the firm and can change as the picture of demand or relative prices of factors of production change. So, the information set relevant to the determination of investment plans can be defined with conventional investment theory. According to the estimation results, reactions to shocks decrease when the survey horizon shortens. This supports the hypothesis on the increasing revision costs of investment plans as the realization time approaches. The results concerning demand uncertainty give some support to the theoretical result that an increase in demand uncertainty may reduce investments.

Tiivistelmä

Tässä keskustelualoitteessa tarkastellaan teoreettisesti ja empiirisesti syitä investointisuunnitelmien muutoksiin. Kirjoittajan aiemmissa tutkimuksissa on todettu, että investointisuunnitelmat ja lopulliset investoinnit poikkeavat systemaattisesti toisistaan. Tutkimuksen teoreettinen kehikko perustuu uusklassiseen investointiteoriaan, rationaalisiin odotuksiin ja investointisuunnitelmien hitaaseen sopeutukseen. Myös epävarmuuden vaikutusta investointisuunnitelmiin tutkitaan.

Empiiriset tulokset osoittavat, että investointisuunnitelmien muutokset riippuvat kysynnän ja tuotannontekijöiden hintojen yllättävistä muutoksista. Niinpä yrityksen investointisuunnitelmien kannalta tärkeä informaatiojoukko voidaan rajata tavanomaisella investointiteorialla. Estimointitulosten mukaan shokkien vaikutukset investointisuunnitelmiin pienenevät, kun tiedusteluetäisyys lyhenee. Tämä tukee hypoteesia investointisuunnitelmien muutoskustannusten kasvusta, kun investointien toteuttamisaika lähenee. Kysyntäepävarmuutta koskevat tulokset tukevat jossain määrin sitä teoreettista tulosta, että kysyntäepävarmuuden kasvu vähentää investointeja.

Contents

1 Introduction

The aim of this paper is to develop a model for revisions on announced investment plans.* It has been shawn that investment plans and final investment differ systematically from each other (McKelvey, 1980; Pyyhtiä, 1989) because there are innovations in the relevant information sets and because the realization of plans is seldom completely successful in respect of timing and volume. On the other hand, the costs of revising plans increase as the time of implementation approaches and so it pays to carry out the project even though its expected profitability has deteriorated substantially. In such cases, final investments may not be optimal with regard to the very latest information.

From previous research (Pyyhtiä, 1989), we know the accuracy of investment plans in the Bank of Finland's survey data on fixed investment by manufacturing firms decreases subtantially as the length of the survey horizon increases. The survey is conducted twice a year in May and November and covers investment plans for the current and following year and realized investment in the previous year. There are considerable changes in investment plans between the three longest survey horizons but minor ones for the shortest survey horizon. Taking this as a point of departure, it is then natural to test what kind of innovations influence investment plans and to what information set firms react.

The major problems addressed in this article are: a) What is the information set on which the revision of manufacturing investment plans depends?; b) How do announced investment plans respond to new unanticipated information? and c) What is the significance of future demand uncertainty as regards investment plans?

I develop Modigliani's and Weingartner's (1958) investment realization function, using innovations to explain changes in investment plans so that the determination of optimal investment plans conforms with the neoclassical theory of investment, rational expectations and partial adjustment of investment plans. In addition, the effects of demand uncertainty are studied empirically. Demand

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uncertainty is studied because demand has played an important role in investment functions in Finland (Koskenkylä, 1958) and because suitable survey data on demand expectations are collected by the Confederation of Finnish Industries (CFI).

Discussion on the demand uncertainty and investment demand of a firm facing a downward-sloping demand curve has been contradictory. Pindyck (1982) showed that in the case of a risk-neutral firm an increase in demand uncertainty increases the optimal capital stock when there are convex adjustment costs associated with the capital stock. Abel (1983), however, pointed out that the result could not be generalized.

Nickel (1978) has shown that, with a constant elasticity demand curve and constant adjustment costs, increasing demand uncertainty will decrease investment for the risk-neutral firm. When the marginal revenue product of capital is equal to marginal cost, the marginal revenue product of capital is concave with respect to the random component of the demand variable.

According to the theorem of Rottschid and Stiglitz (1970), it can also be shown that risk-averse behaviour is bound to a lower capacity level and the optimal capacity level is, in fact, a declining function of the degree of risk aversion.

2 Revision of Investment Plans as a Function of New Information

We assume that the firm's investment plans are the result of the same kind of optimizing process as final investments (Hicks, 1946). Plans are endogeneous to the firm and can change before realization as a function of exogeneous information. Investment plans are conditional expectations about future realizations of investments. In addition, it is assumed that there are costs associated with disequilibrium and the revision of announced investment plans.

The objective function of the firm is assumed to be exponential (Whittle, 1981). The firm maximizes the expected present value of the net cash stream

$$\Pi(t) = \max_{K,L} E(t)\theta\exp[0.5\theta(\sum_{t=0}^{\infty} R^t P*(t))], \quad (1)$$

where E(t) refers to the conditional expectation E(t) (X(t)) = EX(t)|Ω(t), conditional on the time-specific information set Ω(t). θ is the Arrow-Pratt relative risk aversion measure, which can have values θ = 0, θ > 0 and θ < 0 corresponding to risk-neutral, risk-preferring and risk-averse attitudes on the part of the optimizer.

R is a discount factor of the form 1/(1+r), where r is the discount rate and t is time. P* is the cash stream and is of the form P*(t) = pQ(K(t),L(t)) – wL(t) – qI(t), where p is the price of production, the volume of production Q is a function of the capital stock K and the labour input L, w is the labour cost, q is the price of capital goods and I is the volume of fixed investment.

We write the revision cost function of the planned capital stock as follows:

$$V(t) = \max_{K,L} E(t)\theta\exp[0.5\theta(\sum_{t=0}^{\infty} R^t P*(t) - g(KP(t,t-1) - K*(t))^2 - d(KP(t,t-1) - KP(t,t-2))^2)], \quad (2)$$

where g and d are adjustment parameters and K*(t) is the desired capital stock.

In the notation K(t) = KP(t,t–1) + v(t) with $v(t) \sim N(0,s_v^2)$, where KP(t,t–1) is a planned value of the capital stock K(t), when

the plan is made in the period t−1. The term KP(t,t−2) is also a planned value of the capital stock for the period t, but the plan is made a period earlier in (t−2).

The firm makes a sequence of plans KP(t,t−1) designed to chase a stochastic target variable K*(t). K(t) is observed and K*(t) is linearly related to the exogeneous variables X*(t).

$$K^*(t) = h_0 X^*(t) + u(t) \text{ with } u(t) \sim N(0, s_u^2). \tag{3}$$

In the equation, h_0 is a parameter vector reflecting the desired relationship between variables X*(t) and K*(t) and u(t) is a normally distributed disturbance term. The observation matrix X*(t) is the information set for the determination of the optimal capital stock.

The value of the firm is maximized when the firm minimizes the expected quadratic costs of the disequilibrium and revision of planned capital stock (Kennan, 1979).

$$V(t) = \min_{KP} E\theta\exp[0.5\theta(\sum_{t=0}^{\infty} R^t(k(KP(t,t-1) - K^*(t))^2 + l(KP(t,t-1) - KP(t,t-2))^2]. \tag{4}$$

In the loss function the first loss factor is the disequilibrium cost arising from the deviation of the planned capital stock from the desired capital stock and the second loss factor is the cost arising from changing announced investment plans. The idea is that large changes in investment plans become relatively more expensive than small changes, since the latter can be carried out with normal staff and in normal working time. The revision costs of investment plans include, for instance, costs arising from the acquisition of information, planning and the cancellation of commitments.

Moreover, as a rule, the revision costs of investment plans increase as the realization time of the investment plans approaches. At the end of the planning horizon the revision costs may exceed the disequilibrium costs, so it is no longer profitable to change plans as the result of some price or demand shock. Thus, it is also possible that final investments are not in harmony with latest information. This phenomenon is usually described in investment equations with lags. At the firm level the revision costs of investment plans can also be fixed, lump sum costs, but there are

good grounds for assuming that at industry level the adjustment costs are an increasing function of plans.

The solution is based on the method of undetermined coefficients where the general form of the solution is first guessed and the total time period is solved on the basis of the law of iterated projections. The solution is (Salmon, 1983).

$$KP(t,t-1) = \lambda_1 KP(t,t-2) + (1-\lambda_1)\left(1 - \frac{R\lambda_1}{1 - Rl\theta s_v^2}\right) \sum_{i=0}^{\infty}\left(\frac{R\lambda_1}{1 - Rl\theta s_v^2}\right)^i E(t)K^*(t+i), \tag{5}$$

where λ_1 is the stable root of the characteristic equation. The equation follows the conventional partial adjustment rule with the difference that adjustment to the optimum is influenced by the attitude to risk and uncertainty about the realization of the investment plans. We can write an equation for the investment plans taking into account that KP(t,t−1) = (1−δ)K(t−2) + IP(t,t−1):

$$IP(t,t-1) - \lambda_1 IP(t,t-2) = (1-\lambda_1)\left(1 - \frac{R\lambda_1}{1 - Rl\theta s_v^2}\right) \sum_{i=0}^{\infty}\left(\frac{R\lambda_1}{1 - Rl\theta s_v^2}\right)^i E(t)K^*(t+i) \tag{6}$$

$$- (1-\lambda_1)(1-\delta)K(t-2) + w(t), \text{ where } w(t) \sim N(0, s_w^2).$$

According to equation (6), the revision of the announced investment plans depends on the difference between the expected future levels of desired capital stock and the existing capital stock.

The risk parameter θ is connected multiplicatively to the variance terms. If we assume that the attitude of the firm towards risk is neutral so that θ is zero, uncertainty does not affect the behaviour of the firm at all. In this case the firm can protect itself from the losses associated with the profit stream or investment activity. If the firm is risk-averse the speed of adjustment is related positively to the absolute value of the risk parameter, which means that increasing risk-averse behaviour reduces the speed of adjustment of the capital stock to the optimal level.

3 Empirical Model

Equations (3) and (6) form the framework for testing problems (a–c). The desired capital stock K*(t) is assumed to depend linearly on the observation matrix X*(t). The observation matrix constitutes the factors determining the optimal investment and capital stock of the firm in conventional investment theory. The information lag is assumed to be the normal official statistics publication lag. The information set the firm uses may be partly unknown to the econometrician. The observation matrix X(t) that we test, a subset of the complete information set X*(t) (equation (3)), contains the following time series

$$X(t) = \{Q(t),\ JC(t),\ W(t),\ UC(t),\ IN(t)\} \qquad (7)$$

where Q(t) is demand, JC(t) is the user cost of capital, W(t) is total labour cost, UC(t) is future demand uncertainty and IN(t) is rational expectation innovation in demand.

The basic function we use in testing the problems a–c noted above takes the form

$$IP(t,t-1) - m\ IP(t,t-2) = a_1 + (1-m) \sum_{i=2}^{n} h_i X_{t,i}^{s} + \varepsilon(t), \qquad (8)$$

where $X_{t,i}^{s}$ is a surprise connected with the variable $X_{t,i}$ of the observation matrix X(t) and explains the difference of the desired capital stock K*(t) and the existing capital stock K(t–2) on the right-hand side of equation (6). The error term $\varepsilon(t)$ includes the effects of failure in the realization of the investment plans as well as the incompleteness of the information set.

The reaction of the plans to the shock $X_{t,i}^{s}$ depends on the size of the adjustment parameter m (equation (8)) and the parameter vector h. We noticed earlier (equation (6)) that, in addition to changes in the degree of uncertainty, the attitude of the firm towards risk can also affect the parameter values. It was pointed out that the increasing risk–averse behaviour of the firm reduces the speed of adjustment of the capital stock to the optimal level, which means smaller reactions to shocks.

There are some problems associated with the expected signs of the parameters. The positive sign of demand (Q) and the negative sign of user cost (JC) are quite clear, but the sign of wages (W) is not self-evident (Koskenkylä, 1985). Depending on the parameters of the production function and the price elasticity of demand, it can vary from positive to negative.

4 Estimation Results of the Realization Function

In the estimations the expectation formation hypotheses used are static and rational ones. In the static case all changes in information are interpreted as shocks when the change is measured by one-year periods. Shocks of a permanent nature can be assumed to occur in a period of such length (Buck, Gahlen, Gerhäusser, 1987).

The rational expectations production innovations are calculated from a business survey of the Finnish economy. ARIMA innovations are also calculated. The demand uncertainty UC is measured by the variance of production expectations from the business survey (cross section of firms) and the moving variance of manufacturing output.

The total change in investment plans (realization less plans) for the two longest survey horizons serves as the dependent variable. The exogeneous variables selected as a result of the earlier analysis (Pyyhtiä, 1989) are, in the case of demand, manufacturing output from the data of the CFI survey and, in the case of costs and prices, user costs calculated with the average lending rate and with the interest rate derived from balance sheet statistics, total compensation per hour, the price of energy, gross cash flow and the marginal interest rate on central bank debt.

In the estimations it is first assumed that the value of the coefficient of lagged investment plans (m) on the left-hand side has a value one (equation (8)). This means that the innovation has no effect on the investment plans. If the values of the parameter estimates of the exogeneous shock variables differ significantly from zero the unity assumption must be rejected. The estimation strategy has been selected to mitigate the multicorrelation problem arising from the possible high correlation between investment plans and shocks.

According to the estimation results it is clear that the unity restriction is not valid (Table 1). The results also confirm the previous view that adjustment to unanticipated shocks slows when the survey horizon shortens (Table 2). The result is in line with the assumption that the adjustment costs increase when the survey horizon shortens. The values of the parameter estimates of static demand shocks fall by almost a half when the survey horizon shortens by six months. The signs of the parameter estimates are as

anticipated (those of demand factors positive and those of cost factors negative). In the case of wages, a fall in the parameter estimates of at least the same magnitude as that of the coefficient of the demand shock can be observed. By contrast, the parameter estimates of capital costs hardly change at all when the survey horizon shortens by six months.

The results obtained are interesting. The average lag between changes in wages and demand and investments is longer than the lag following changes in capital costs. This would suggest that monetary policy affects investments over a time-span, on average a year. However, it is difficult to draw conclusions because, in addition to the rate of interest, companies' capital costs are affected by fiscal policy measures and anticipated changes in the rate of inflation (Koskenkylä, 1985).

It can be observed that the incorporation of an uncertainty variable and rational expectations innovation additively in the realization function hardly increases the explanatory power at all. According to the t-values the parameter estimate of the uncertainty variable differs significantly from zero in one case (Table 1) and the sign is negative. A similar result was obtained when examined by manufacturing sectors. The more parsimoneus model, where all changes in the data are thought of as an innovation, accounted for most of the explanation and no room was left for explanation by special rational expectations innovation. These experiments provide some suport for the view that demand uncertainty has a negative effect on investment plans in the case of the sample used. The result is not, however, clear cut and the effects of uncertainty can be connected multiplicatively to the innovation parameters instead of additive explanation (equation (6)). This leaves room for further research.

Table 1. **Realization Functions under Uncertainty about Demand (equation (8))**

Manufacturing

Dependent variables: A) final investments (${}_tIRQ^s_{t+1}$) less plans made in the spring of the previous year (${}_tIPF^s_{t-1}$)
B) final investments (${}_tIRQ^a_{t+1}$) less plans made in the autumn of the previous year (${}_tIPF^a_{t-1}$)

Independent variables: demand, prices of factors of production and "uncertainty" about demand (change $X_t - X_{t-2}$)

Variables in real terms
Estimation period: 1969–1984
Estimation method: OLS
t-values in parentheses

Estimated equations

	A)				B)			
Surprise and "uncertainty" variables	${}_tIRQ^s_{t+1} - {}_tIPF^s_{t-1} = a_1 + \sum_{i=2}^{5} a_i(X_{t,i} - X_{t-2,i})$				${}_tIRQ^a_{t+1} - {}_tIPF^a_{t-1} = a_1 + \sum_{i=2}^{5} a_i(X_{t,i} - X_{t-2,i})$			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Demand	253.0	256.3	239.1	271.7	160.4	150.6	128.6	147.0
	(5.00)	(6.39)	(4.84)	(5.27)	(5.32)	(5.24)	(4.02)	(4.69)
User cost	-121.1	-159.0	-91.15	-92.57	-95.39	-91.12	-112.4	-120.0
	(2.20)	(3.22)	(1.90)	(1.63)	(2.91)	(2.58)	(3.59)	(3.46)
Wages	-125.2	-145.3	-181.8	-155.0	-64.09	-46.14	-58.19	-38.69
	(3.00)	(4.85)	(4.67)	(3.38)	(2.63)	(2.19)	(2.35)	(1.41)
Uncertainty	-0.136+D5	-214.9	0.680+D5	-7.000	0.107+D5	80.80	-0.286+D5	9.308
	(1.12)	(2.5)	(1.62)	(0.19)	(1.48)	(1.33)	(1.06)	(0.43)
Constant	1215	1839	1689	1352	462.9	178.4	531.0	351.2
	(3.05)	(4.77)	(3.93)	(3.11)	(2.03)	(0.65)	(1.61)	(1.38)
R2C	0.839	0.885	0.855	0.821	0.802	0.796	0.786	0.769
SEE	682.0	575.8	647.4	719.6	407.4	413.4	423.5	439.5
F	31.32	44.95	35.10	27.99	23.24	22.50	21.33	19.62
DW	2.23	2.63	1.67	1.96	2.93	2.92	2.61	2.69

Critical values of the F-test, H_0: $a_i = 0$, when i = 1, ..., 5

$F_{0.95}$ (5,11) = 3.20

$F_{0.99}$ (5,11) = 5.32

"Uncertainty" (UC) and rational expectation innovation variables (IN)

(1) Variance of output expectations (UC)
(2) Deviation of output expectations (IN)
(3) Moving variance of output (UC)
(4) Standard deviation of ARIMA forecast (IN)

5 Estimates of the Adjustment and Innovation Parameters

To complete the examination of the realization function we present estimates of the adjustment parameters and short- and long-term innovation coefficients. These estimations are used to examine the relative size of the weighting parameters in the loss function and the dependence of the parameters on the survey horizon. We also noticed that there is not any good justification for restricting the parameter of lagged investment plans to one in the earlier estimations and the parameter is estimated freely (equation (8)).

The estimation results are shown in Table 2. In addition to lagged investment plans, innovations in demand and prices are used as explanatory variables. It can be seen that the estimate of the adjustment parameter deviates from one in total manufacturing and in all the main sectors except the metal and engineering industries, where investment plans have been observed to be very stable.

The heteroscedasticity tests used were White's test and the Lagrange Multiplier test. Heteroscedasticity is not a significant problem in the estimated models. The t-values corrected for heteroscedasticity do not change significantly as a rule. As regards the Lagrange multiplier test, the hypothesis on the homoscedasticity of the residuals could not be rejected in any case.

Short- and long-term effects of static demand and price innovations on investment plans and the "target" capital stock are presented in Table 3. The results are comparable to those in previous investment studies (Koskenkylä, 1985) according to which the long-term effects of innovations are clearly larger than the short-term effects. This is due to the short-term adjustment costs of investment plans.

The estimation results confirm the above result that the adjustment to shocks slows when the survey horizon shortens. Demand innovations have a very clear-cut influence on investment plans. As can be seen from Table 3, a 1 per cent increase in demand increases investment plans concerning the following year by 2.9 per cent and the long-term "target" capital stock by 14 per cent in total manufacturing. The response of investment plans to a 1 per cent increase in wages is –0.7 per cent and to a 1 per cent increase in user cost –0.04 per cent.

Table 2. **Realization Functions of Investment Plans by Manufacturing Sector.** Estimation results of the adjustment cost parameters (equation (8))

Dependent variable: final investments (${}_tIRQ^{s,a}_{t+1}$)
Independent variables: A) investment plans made in the spring of the previous year (${}_tIPF^{s}_{t-1}$) or
B) investment plans made in the autumn of the previous year and demand, user cost, wages (surprise $X_t - X_{t-2}$)
Variables in real terms, logarithmic form
Estimation period: 1972–1984
Estimation method: OLS

Estimated equations

	A) ${}_tIRQ^{s}_{t+1} = a_1 + a_2, {}_tIPF^{s}_{t-1} + \sum_{i=3}^{5} a_i(X_{t,i} - X_{t-2,i})$				B) ${}_tIRQ^{a}_{t+1} = a_1 + a_2, {}_tIPF^{a}_{t-1} + \sum_{i=3}^{5} a_i(X_{t,i} - X_{t-2,i})$			
Investment plans	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
${}_tIPF^{s}_{t-1}$	0.793	0.542	1.030	0.652				
	(5.15)	(2.45)	(11.80)	(3.41)				
	(6.30)	(2.98)	(19.29)	(5.45)				
${}_tIPF^{a}_{t-1}$					0.826	0.816	0.950	0.822
					(11.60)	(6.14)	(6.84)	(6.16)
					(17.03)	(6.38)	(7.87)	(9.53)
Surprise variables								
Demand	2.889	0.893	4.726	2.326	1.454	0.742	1.246	1.784
	(3.77)	(0.59)	(8.43)	(2.94)	(4.51)	(0.92)	(1.63)	(3.33)
	(4.19)	(0.72)	(20.84)	(3.78)	(6.80)	(1.23)	(2.25)	(5.11)
User cost	-0.042	-0.290	0.122	-0.005	-0.060	-0.239	-0.007	0.006
	(0.84)	(2.21)	(3.13)	(0.09)	(2.66)	(3.29)	(0.15)	(0.15)
	(1.39)	(2.67)	(4.38)	(0.17)	(3.95)	(4.02)	(0.25)	(0.14)
Wages	-0.661	-0.178	-1.830	-1.405	-0.062	0.219	-0.733	-0.864
	(1.34)	(0.46)	(5.25)	(1.06)	(0.26)	(1.06)	(1.35)	(0.95)
	(2.48)	(0.66)	(7.28)	(1.11)	(0.37)	(1.30)	(2.90)	(1.23)
Constant	1.941	3.820	-0.108	2.956	1.585	1.543	0.427	1.494
	(1.39)	(2.19)	(0.16)	(1.91)	(2.44)	(1.45)	(0.39)	(1.37)
	(1.68)	(2.61)	(0.26)	(3.08)	(3.58)	(1.47)	(0.46)	(2.11)
R^2C	0.801	0.414	0.966	0.596	0.948	0.810	0.922	0.809
SEE	0.096	0.194	0.056	0.142	0.048	0.115	0.084	0.098
DW	1.364	1.825	2.333	1.423	2.788	1.939	1.249	1.854
LM	0.068	1.330	2.525	0.081	1.206	3.616	0.028	0.118

$x^2_{0.95}(1) = 3.84$ 1 = manufacturing 3 = metal and engineering industries
2 = forest industries 4 = other manufacturing industries

t-ratios are in parentheses immediately below the coefficient estimates, below them are White's t-ratios adjusted for heteroscedasticity

Table 3. **Parameter estimates of the realization function***

A) Investment plans made in the spring of the previous year
B) Investment plans made in the autumn of the previous year

	A)				B)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Adjustment cost parameters	0.793	0.543	1.030	0.652	0.826	0.816	0.950	0.822
Effects of innovations on short-term investment plans								
Demand	2.889	0.893	4.726	2.326	1.454	0.742	1.246	1.784
User cost	-0.042	-0.290	0.122	-0.005	-0.060	-0.239	-0.007	0.006
Wages	-0.661	-0.178	-1.830	-1.405	-0.062	0.219	-0.733	-0.864
Effects of innovations on long-term "target" capital stock (parameter hi)								
Demand	13.96	1.950	-157.5	6.684	8.356	4.033	24.92	10.02
User cost	-0.203	-0.633	-4.067	-0.014	-0.345	-1.299	-0.140	0.034
Wages	-3.193	-0.389	61.00	-4.037	-0.356	1.190	-14.66	-4.854

1 = manufacturing
2 = forest industries
3 = metal and engineering industries
4 = other manufacturing industries

* Estimation results are presented in Table 2

There are large differences across manufacturing sectors. For instance the effect of an increase in user cost is largest in the forest industries, –0.3 per cent, and the long-term effect is –0.6 per cent, and this effect stays as large when the survey horizon shortens by six months. The effects of demand and wages are larger and user costs smaller than in earlier investment function studies (Koskenkylä, 1985). However, the estimation results with real user cost in the forest industries are of the same magnitude as in earlier studies.

6 Concluding Remarks

Testing the response of investment plans to innovations in information clearly shows that investment plans are endogenous to the firm and can change as the picture of demand or relative prices of factors of production change. So the information set can be outlined with conventional investment theory and the original hypothesis on the nature of the plan data receives support. According to the parameter estimates, reactions to shocks decrease when the survey horizon shortens. This supports the hypothesis on the increasing revision costs of investment plans as the realization time approaches. The effects of demand and wages are larger and real user costs smaller than in earlier investment studies.

The exact nature of expectations formation of firms remains open. The most parsimonous model, where all changes in information were thought to be innovations, accounted for most of the explanation and results with additional "rational" expectations innovations were poor. Testing the expectation hypothesis is, however, problematic. Adjustment costs are associated with investment plans, the joint test procedure cannot be avoided.

The test results with demand uncertainty left much room for further research. The scarcity of degrees of freedom limited the econometric testing and only "old fashioned" uncertainty variables in additive form could be used. The results deviated clearly from each other, not least because of measurement problems. However, the results gave some support to the theoretical outcome, i.e. that an increase in demand uncertainty may decrease investments.

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