BANK OF FINLAND
DISCUSSION PAPERS

14/94

Ilmo Pyyhtiä

Economics Department
27.6.1994

Investment Plans, Innovations and Credit Market Deregulation

Empirical results with the Finnish data

SUOMEN PANKIN KESKUSTELUALOITTEITA • FINLANDS BANKS DISKUSSIONSUNDERLAG

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ISBN 951-686-411-2
ISSN 0785-3572

Suomen Pankin monistuskeskus
Helsinki 1994

Abstract*

This paper is an extension of earlier studies by the writer on the influence of innovations on investment plans. It examines the effects of a change in the financial market regime on the revision of investment plans.

The innovations in economic data were measured with the error terms of the VAR model. The VAR model was estimated to demand, user cost of capital and total labour costs in the manufacturing industry. Innovation terms calculated in this way were added to the OLS model, in which the realized investments of manufacturing firms are explained by survey data on investment plans collected by the Bank of Finland. In the earlier studies of the writer innovations are formed using ARIMA models and survey data.

The estimation results confirm the findings of the earlier revision models of investment plans. Unpredicted economic innovations alter investment plans and the signs of the estimated coefficients are the expected ones, positive for demand innovations and negative for capital cost and wage cost innovations. The conclusion drawn is that financial market liberalization has not influenced the revision of investment plans. The parameters of the investment plan model are also stable after financial market liberalization.

Tiivistelmä

Tämä keskustelualoite täydentää kirjoittajan aiempia tutkimuksia uutisten vaikutuksista teollisuuden investointisuunnitelmiin. Tarkastelun kohteena ovat rahoitusmarkkinoiden vapautumisen vaikutukset investointisuunnitelmien toteutumiseen.

Uutisia eli teollisuusyritysten kannalta yllättäviä tapahtumia mitattiin VAR-mallin jäännöstermeillä. VAR-mallissa käytettiin muuttujina kysyntää, pääoman käytön hintaa ja kokonaistyövoimakustannuksia. Mallin jäännöstermit lisättiin tavanomaiseen regressiomalliin, jossa teollisuuden kiinteitä bruttoinvestointeja selitettiin Suomen Pankin investointitiedusteluista saaduilla investointisuunnitelmilla. Aiemmissa tutkimuksissa uutisia approksimoitiin ARIMA-malleilla ja suhdannetiedusteluaineistolla.

Estimointitulokset tukevat aiempia havaintoja investointisuunnitelmien muutoksista. Uutiset eli yllättävät havainnot saavat yritykset muuttamaan investointisuunnitelmiaan. Mallin kerroinestimaattien merkit ovat odotettuja, positiivisia kysyntäyllätyksille, negatiivisia pääomakustannuksille ja kokonaistyövoimakustannuksille. Estimointitulosten perusteella ei voida osoittaa, että rahoitusmarkkinoiden liberalisoiminen olisi vaikuttanut investointisuunnitelmien toteutumiseen. Investointisuunnitelmien toteutumismallin parametrien stabiilisuutta koskevaa hypoteesia ei voida hylätä rahoitusmarkkinoiden vapauttamisen jälkeisenä aikana.

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* Paper presented at the 21st CIRET Conference in Stellenbosch, South Africa, October 6–9, 1993

Contents

1 Introduction

This paper is an extension of earlier studies by the writer on the influence of innovations on investment plans. It examines the effects of a change in the financial market regime on the revision of investment plans.

The liberalization of the Finnish financial markets began in the early 1980s. Prior to that banks' average lending rates were controlled, which led to credit rationing. The central bank regulated the commercial banks' lending through a system of central bank money quotas.

Deregulation in the domestic markets started with the lessening of interest rate controls in 1983. The regulation of capital movements were relaxed in the beginning of 1980, when the forward market was opened.

Financial market liberalization did not have much impact on the availability of finance in the manufacturing industries in the late 1980s as the financing of manufacturing investments was usually accorded first priority during the era of credit rationing. More important for the determination of manufacturing investment was the liberalization of capital movements. This was reflected in a large increase in direct investment abroad.

The innovations in economic data were measured with the error terms of the VAR model. The VAR model was estimated to demand, user cost of capital and total labour costs in the manufacturing industry. Innovation terms calculated in this way were added to the OLS model, in which the realized investments of manufacturing firms are explained by survey data on investment plans collected by the Bank of Finland. In the earlier studies of the writer innovations are formed using ARIMA models and survey data.

The estimation results confirm the findings of the earlier revision models of investment plans. Unpredicted economic innovations alter investment plans and the signs of the estimated coefficients are the expected ones, positive for demand innovations and negative for capital cost and wage cost innovations. The conclusion drawn is that financial market liberalization has not influenced the revision of investment plans. The parameters of the investment plan model are also stable after financial market liberalization.

2 Description of the Model

The effect of innovations on the revision of investment plans by manufacturing firms is studied using a simple regression framework. Realized investments are explained by investment plans and by unpredicted news, referred to here as "innovations". The hypothesis we consider is that investment plans change only as a result of unpredicted developments in the relevant information set for the firm. The writer has previously tested this hypothesis more thoroughly (Pyyhtiä, 1989). The point of departure here is to test the hypothesis using a more up-to-date data set and a different estimation method.

The testing equation is of the form

$$I_{(t)} = a_1 + a_2\ IP_{(t,t-1)} + a_3\ INQ_{(t)} + a_4\ INC_{(t)} + a_5\ INW_{(t)} + e_{(t)}, \quad (1)$$

where I is gross fixed investment, a are parameters, IP are survey data on investment plans in year t collected in year t-1 and IN are innovations in the relevant data set. The testing function is based on the profit-maximizing behaviour of the firm in the framework of the neoclassical investment theory. Changes in investment plans give rise to adjustment costs, which are observed to increase as the planning horizon shortens (Pyyhtiä, 1991).[1]

The relevant information set for the firm includes factor prices, the price of capital (user cost), total labour costs and a variable describing general demand on the markets. The information set is at the general level and no firm-specific factors are studied.

3 Estimation Methods

In forming the innovation terms the expectation formation hypothesis of the firm is assumed to be rational. The expectations of the firm are estimated within the VAR framework, where the error terms of each equation describe the innovations of the different variables. The above-mentioned manufacturing factor prices and production are used as a data set. The estimated VAR model was the following vector

$$Q(t) = \left(Q(t),\ C(t),\ W(t)\right)', \quad (2)$$

where Q(t), C(t) and W(t) are the observation vectors of demand, user costs and labour costs. The estimations are made at the total manufacturing level and by main manufacturing sectors. All the data are converted into logarithmic difference form before the estimations.

The initial investment plan revision equation (1) is estimated with OLS, where investment plans and the above-mentioned error terms are the explanatory

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[1] The theoretical equation is of the form

$$I_{(t)} = a_1 + \lambda\ IP_{(t,t-1)} + (1-\lambda) \sum_{i=1}^{n} h_i\ X^{S}_{t,i} + \varepsilon_{(t)},$$

where $X^{s}_{(t,i)}$ is a surprise connected with the variable $X_{(t,i)}$ of the observation matrix $X_{(t)}$ and explains the difference between the desired capital stock $K^{*}_{(t)}$ and the existing capital stock $K_{(t-2)}$. The error term $\varepsilon_{(t)}$ includes the effects of failure in the realization of the investment plan as well as the incompleteness of the information set. The reaction of the plans to the $X_{(t,i)}$ shock depends on the size of the adjustment parameter λ and the parameter vector h. The equation is derived from the value function of the firm, in which the adjustment of the capital stock includes quadratic disequilibrium and revision costs.

variables. The stability of the parameters is studied before and after financial market liberalization.

4 Empirical Results

Estimation results are presented in table 1 and fitted regression values in the charts in the appendices. The left-hand (A) side of the table shows the results where the investment plans for the longest survey horizon (plans made in the spring of the previous year) are used as explanatory variables. The right-hand (B) side of the table shows the estimation results obtained for a shorter survey horizon (plans made in the autumn of the previous year). The innovation terms are the same in both estimations and are used without a lag and with a one year lag.

Estimation results conform with the previous estimations carried out with a larger data set and using a different estimation method (Pyyhtiä, 1989). The parameter estimate of planned investments differs significantly from one, when investment plans concerning the next year's investments are used as an explanatory variable. This implies that investment plans are revised before their realization. Again, it can be observed that revisions of investment plans can be explained by innovations in the relevant information sets. Innovations with a one year lag are clearly more significant. These are real innovations due to the publishing lags of the statistics. This conforms with the previously verified hypothesis that revision costs of investment plans increase with the shortening of the investment planning horizon. The latest innovations do not lead to any adjustment in investment plans. In most cases, the coefficients of the investment plans differ very significantly from zero. Likewise, the innovations terms typically receive the expected sign, the demand variable a positive sign and factor price variables a negative sign. For total wage costs, a negative sign implies the short-term liquidity influence.

It can be seen that investment plans overestimate the changes in final investments in all sectors of manufacturing. This suggests that investment plans are poor forecasts of turning points in developments in realized investments. Plans are particularly poor forecasts in other manufacturing industries (manufacturing excluding the forest and metal and engineering industries). Innovation in demand is a significant explanatory variable in all sectors of the manufacturing industry, when a one year lag is used. The sign is always positive, as expected. The user cost of capital is significant with a one year lag in all sectors except other manufacturing and receives the expected negative sign. Total wage costs receive the expected negative sign (liquidity effect) in most cases but the parameter estimates are not significant. In this respect the results have changed compared to the earlier studies with the same data set but with fewer observations. On the other hand, the influence of capital costs has increased.

When the survey horizon of the investment inquiry shortens by half a year to one year the coefficient of the investment plans does not as a rule differ significantly from zero and the revisions of the investment plans are mostly white noise processes. However the coefficient of the investment plans differs significantly from one in the forest industries and other manufacturing and the user cost of capital receives a significant parameter estimate in these industries.

Table 1. **Innovations and revisions of the investment plans**

Manufacturing (1), Forest industries (2), Metal and engineering industries (3),
Other manufacturing industries(4)
Dependent variables: Gross fixed investment according to the survey
Independent variables: Investment plans made in the spring of the previous year (A),
Investment plans made in the autumn of the previous year (B),
Innovations in demand, cost of capital and labour.
Variables: Logarithmic differences in real terms
Estimation period: 1971–1991
Estimation methods: VAR and OLS
t-values in parentheses

	(A)				(B)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Investment plans, previous spring	0.550 (4.30)	0.588 (4.28)	0.671 (4.92)	0.140 (1.28)				
Investment plans, previous autumn					1.014 (6.22)	0.816 (7.36)	1.047 (5.95)	0.664 (3.11)
Innovations[1] in demand (t)	1.150 (1.82)	0.735 (1.49)	1.246 (1.91)	−0.230 (−0.23)	0.445 (0.92)	0.141 (0.47)	−0.412 (−0.65)	−0.033 (−0.03)
t−1	1.302 (2.09)	0.739 (1.58)	1.388 (1.91)	3.622 (3.89)	−0.611 (−0.97)	0.333 (0.98)	−0.214 (−0.30)	0.882 (0.86)
User cost of capital (t)	−0.714 (−0.67)	−1.301 (−0.86)	−1.175 (−1.01)	−2.998 (−3.00)	−1.071 (−1.26)	−1.856 (−1.74)	−1.100 (−1.05)	−2.462 (−2.34)
t−1	−2.194 (−2.28)	−3.917 (−2.88)	−2.664 (−2.53)	−0.191 (−0.20)	−0.913 (−1.20)	−1.954 (−2.18)	0.180 (0.16)	−0.481 (0.44)
Total labour costs (t)	−0.638 (−0.80)	−0.268 (−0.56)	−0.881 (−1.258)	0.479 (0.49)	−0.342 (−0.55)	0.502 (1.66)	−0.097 (−0.15)	0.633 (0.62)
t−1	−0.837 (−1.09)	0.114 (0.31)	−1.001 (−1.35)	−1.521 (−1.60)	0.913 (1.36)	0.365 (1.45)	0.005 (0.01)	0.313 (0.32)
R^2	0.814	0.757	0.814	0.791	0.864	0.899	0.810	0.740
ρ_1	−0.28	−0.23	0.24	−0.16	−0.38	−0.36	−0.11	−0.57
ρ_2	−0.03	0.17	−0.34	0.11	0.16	0.16	−0.59	0.34
CHOW*	0.377	0.760	0.763	1.26	1.32	1.93	1.64	2.30

ρ_1 = First order autocorrelation coefficient of the residual.
ρ_2 = Second order autocorrelation coefficient of the residual.

[1] Innovations are residuals of the VAR model.

* Parameter stability test for the forecast period 1986–1991 $F_{.95}^{6,7} = 3.87$

5 Influence of Financial Market Liberalization

The estimation results show that, according to the model applied, firms' investment behaviour did not change significantly after the liberalization of the financial markets in Finland. The hypothesis of the stability of the parameters cannot be rejected after the liberalization of the financial markets. The stability of the parameters was measured with the Chow test and the t-test calculated for the forecasts of the equation. The Chow test values are shown at the bottom of table 1 and β-coefficients and confidence intervals of the forecasts in the appendices.

Different liquidity variables can be used in the investment equation as a measure of credit rationing. Here the production variable and wage cost variable can be interpreted as such. The sign of the wage cost variable is negative in all manufacturing sectors, indicating the short-term liquidity influence. The β − coefficients in the appendix show that the change from a credit rationing regime to a deregulated financial markets regime in the late eighties was not large. However, the coefficients do decrease somewhat, which could be due to easier credit availibility. The conclusion is, however, very unclear.

6 Concluding Remarks

The estimation results confirm the earlier finding that innovations lead to revisions of the original investment plans. This has now been tested in a new framework using the latest data. The VAR model innovations conform with rational expectations and the results are very interesting as concerns testing the expectation formation hypothesis. This gives very strong support for the rational expectations hypothesis.

The other finding in the paper is that the liberalization of the financial markets has had very little influence on the determination of investments in the manufacturing sector. It is found that the influence of liquidity in the investment equation has decreased. This could imply that the credit constraint also limited manufacturing sector investment in some way before the liberalization of the financial markets.

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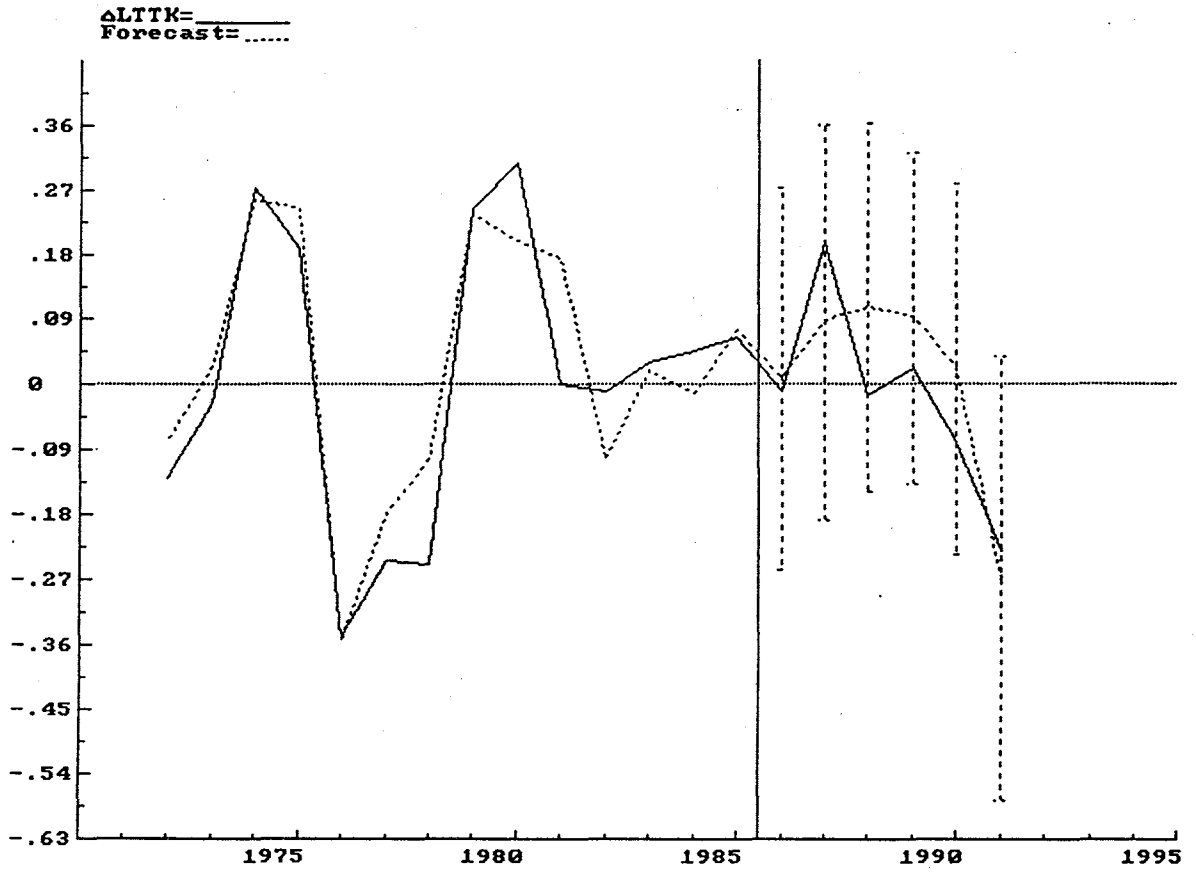
Pyyhtiä, Ilmo (1991) **Investment Plans, Innovations and Revision Costs in Finnish Manufacturing**, Bank of Finland, Discussion Papers 19/91 and the 20th CIRET Conference in Budabest 1991.

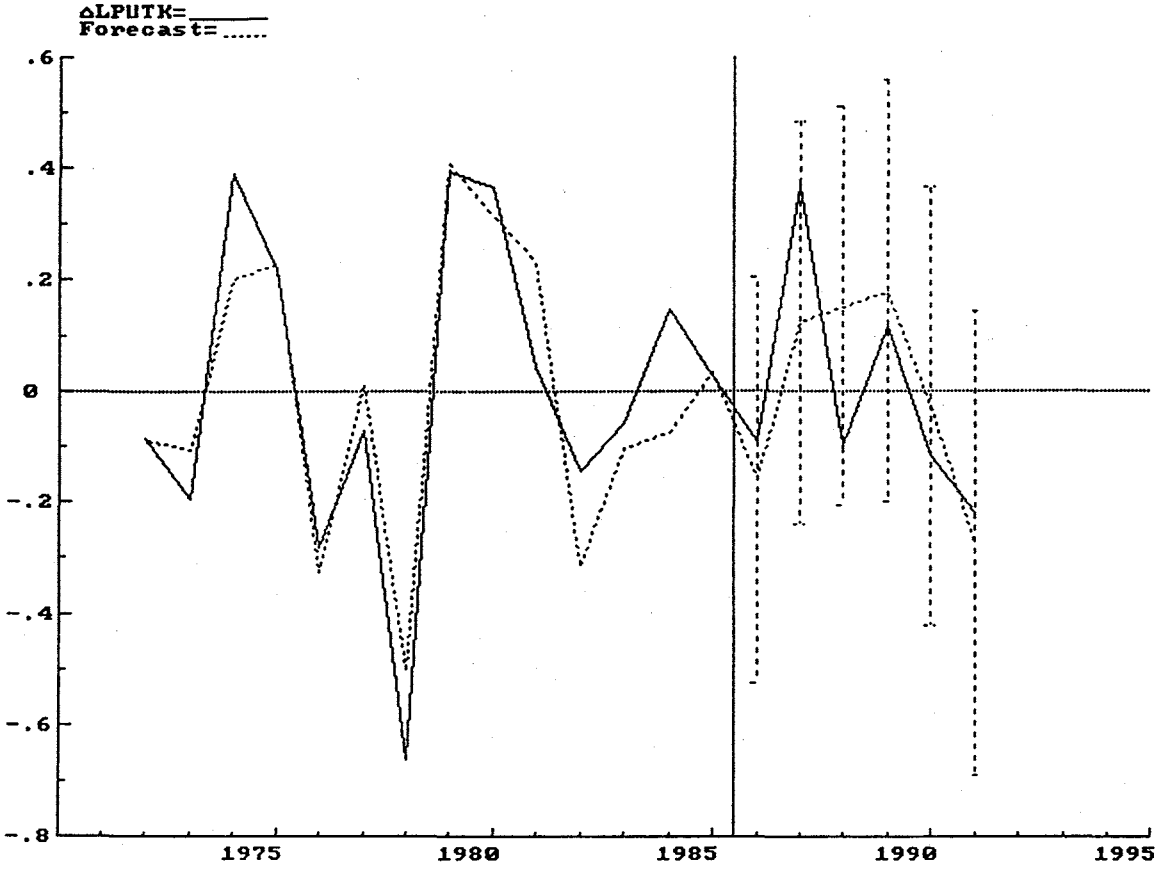
Appendix

Manufacturing investments (ΔLTTK)
Estimation results, equation (1)

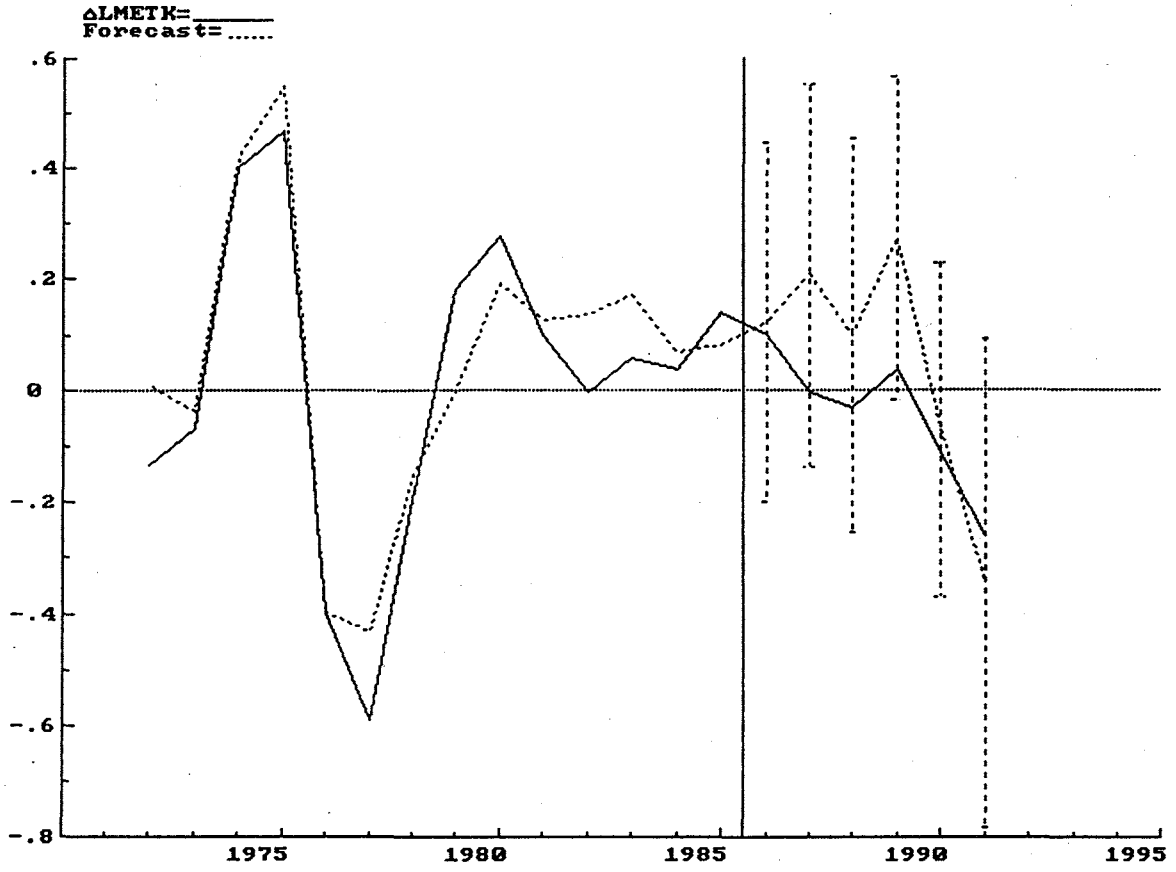


ΔLTTK = Final investments according to the survey
Forecast = estimation results and ex ante forecast
Data in logarithmic difference form

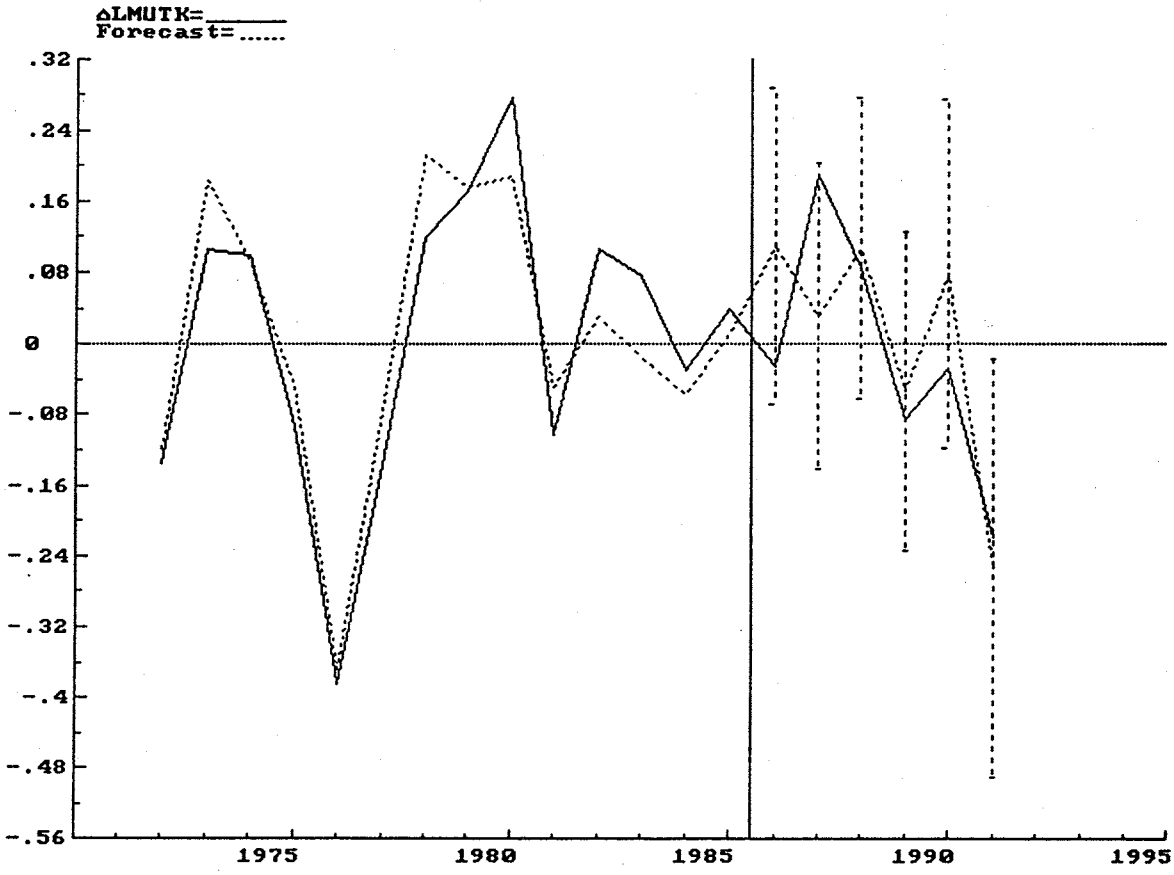
Investments of forest industries (ΔLPUTK)
Estimation results, equation (1)



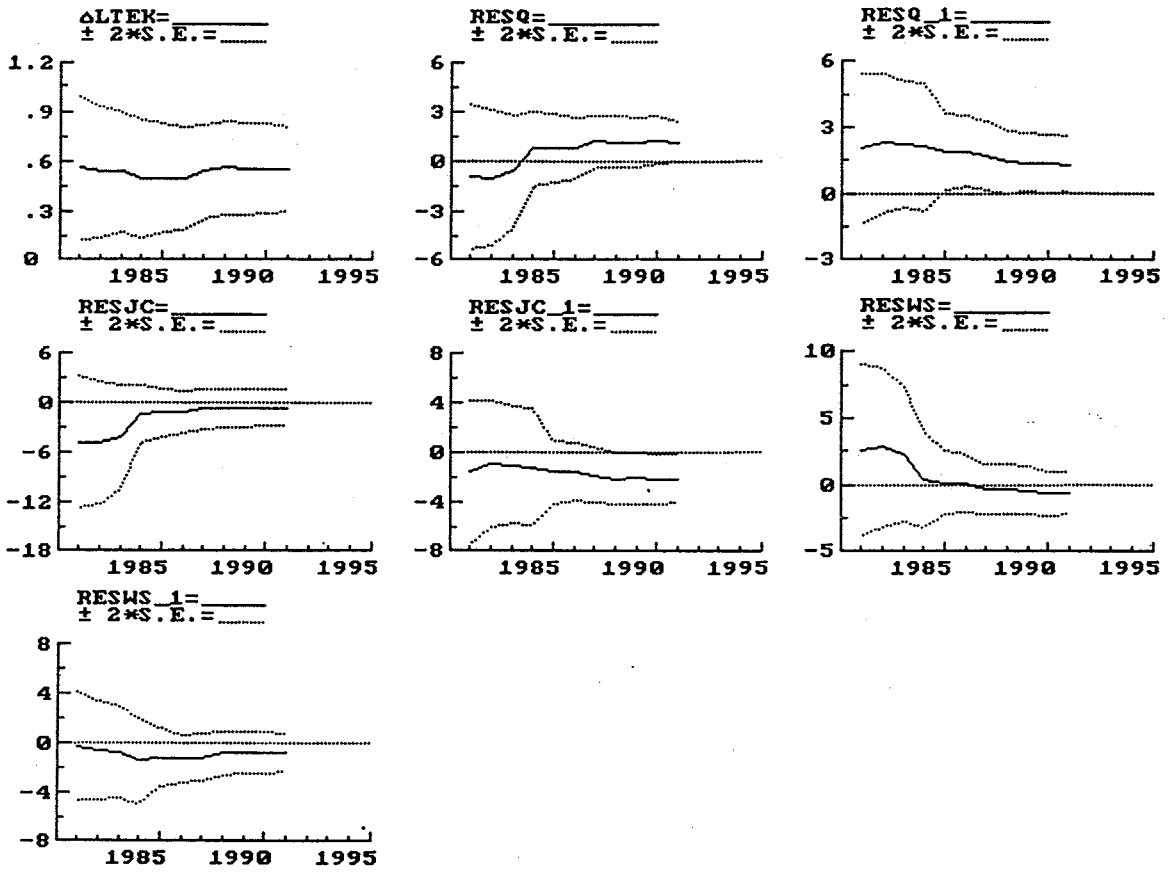
Investments of metal and engineering industries (ΔLMETK)
Estimation results, equation (1)



Investments of other manufacturing industries (ΔLMUTK)
Estimation results, equation (1)

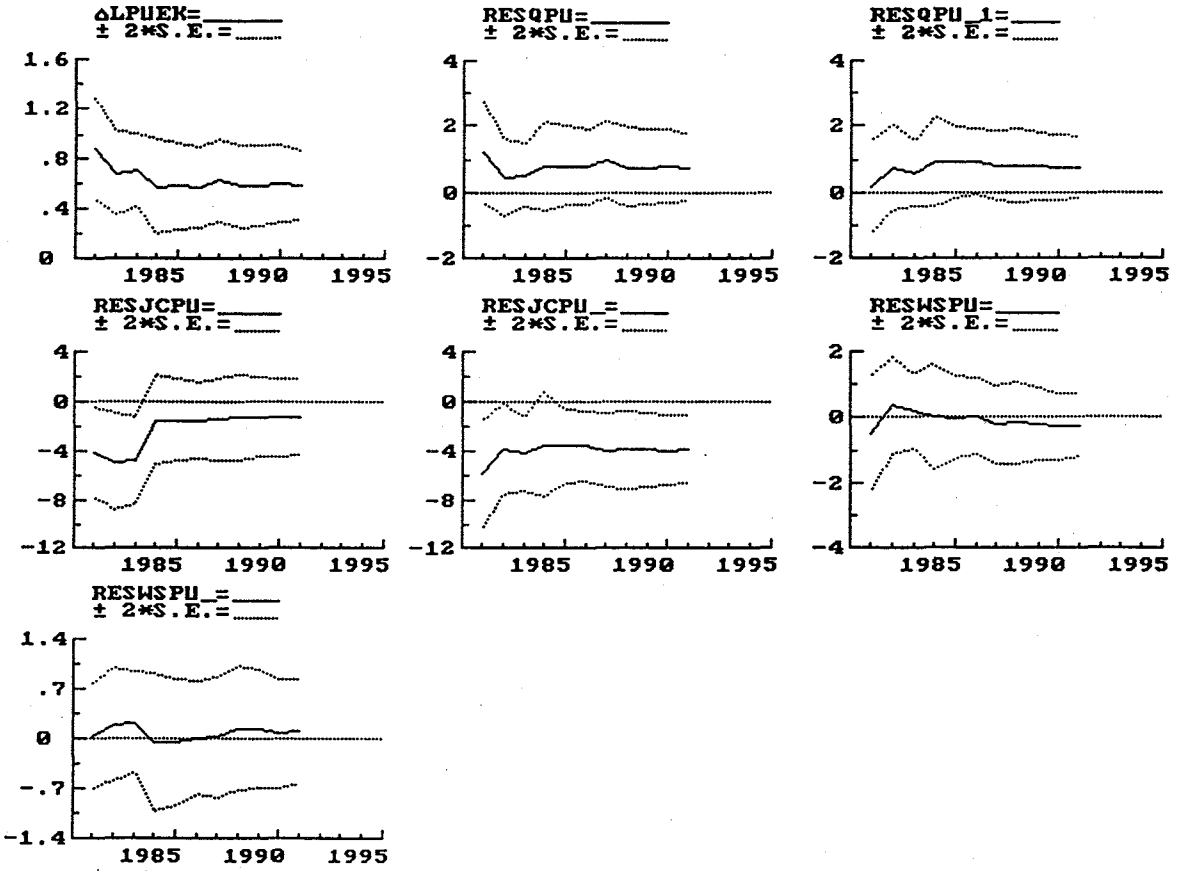


Manufacturing investments
β-coefficients of different explanatory variables, equation (1)

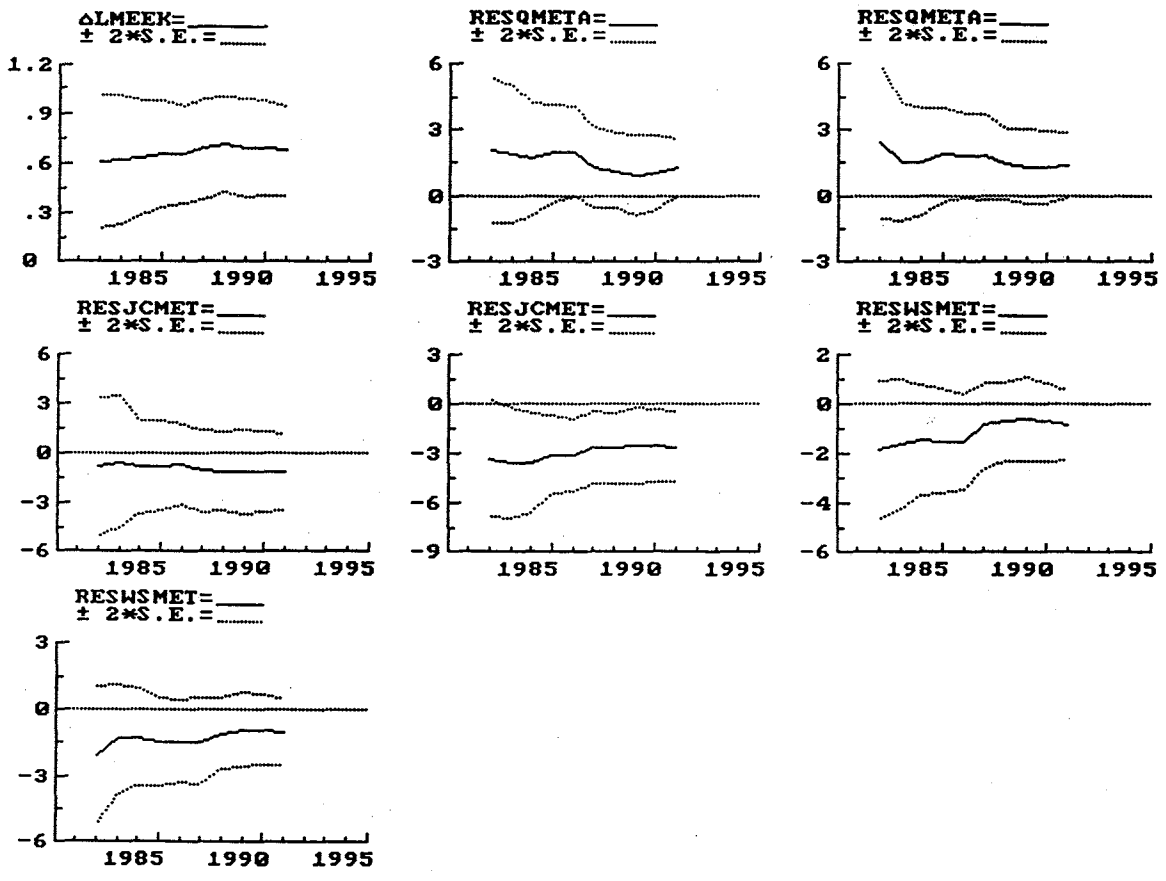


ΔLTEK = data collected in the spring of the previous year on investment plans
RESQ = innovation in demand
RESJC = innovation in user cost
RESWS = innovation in total labour costs

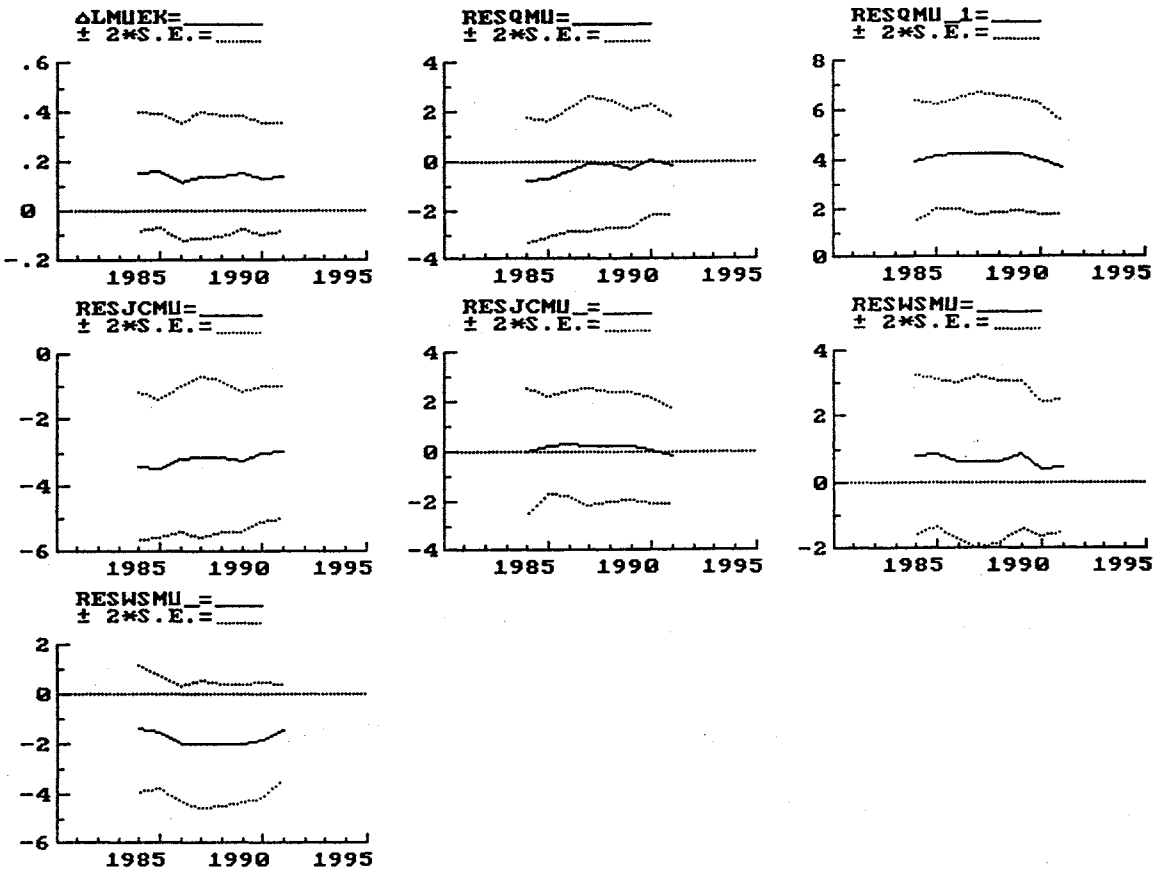
Investments of forest industries
β-coefficients of different explanatory variables, equation (1)



Investments of metal and engineering industries
β-coefficients of different explanatory variables, equation (1)



Investments of other manufacturing industries
β-coefficients of different explanatory variables, equation (1)



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