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THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
Lönnrotinkatu 4 B, 00120 Helsinki 12, Finland, tel. 601322

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Markku Rahiala*, Timo Teräsvirta
and Vesa Kanniainen

FACTORS AFFECTING FIRMS' EMPLOYMENT PLANS IN FINNISH MANUFACTURING INDUSTRIES†

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* Department of Statistics, University of Helsinki.

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**Abstract**. The increasing unemployment has been a growing concern in most western economies, including Finland. In this paper the problem of the nature of unemployment in Finland in the eighties is investigated using business survey data and continuation ratio models. These models are well suited to analyzing micro data where the values of the categorical variables are ordered. In this case, the questions of the business survey contain such an ordering: "increases" > "stays the same" > "decreases". An additional advantage is that the parameters of the continuation ratio models used in the paper can be estimated by standard procedures (GLIM).

In this paper the continuation ratio models are applied to business survey data from three sectors of the Finnish manufacturing industries. The results indicate that of the two principal explanations to the causes of unemployment considered here, both the Keynesian and the classical hypothesis receive support from the data. The notion of Keynesian unemployment is strongest in metal and engineering and 'other' industries whereas the classical hypothesis receives more support in forest industries. However, since the variables in this study are changes, it is not possible to conclude that the level of real wages has been too high in the Finnish forest industries in the eighties.

**Keywords**. Business survey data, causes of unemployment, continuation ratio model, generalized linear model (GLIM), Goodman-Kruskal gamma coefficient, ordinal categorical data

## 1. INTRODUCTION

For more than a decade the increasing unemployment has been a growing concern in most western economies. Doubling of the average rate of unemployment in the OECD countries during the last fifteen years has taken place simultaneously with a slowdown of the economic growth and the growth of productivity. These phenomena have much to do with the strong supply shocks caused by steep increases in the real price of energy in the 1970's. On the other hand, there does not seem to be much hope of a corresponding downturn in current unemployment in spite of the falling price of energy. The causes of the present situation are therefore a pressing research problem.

It may be argued that providing new permanent jobs has become more expensive for the firms relative to using more capital. In that case, the nominal wages have been insufficiently adjusted for changes in prices of other inputs of production or in indirect labour costs. The unemployment is then of the "classical" type. A competing argument is that the slowdown in aggregate demand has caused a lower rate of growth for the output. This has implied a smaller number of new jobs than had otherwise been the case. The resulting unemployment is often referred to as Keynesian unemployment.

In this paper the problem of the nature of unemployment in Finland in the eighties is investigated using business survey data and continuation ratio models; see for example Agresti (1984, p. 114-117). The choice of model family is based on the fact that the (usually trichotomous) answers to the questions of the survey contain an ordering: "increases" > "stays the same" > "decreases". The results of the paper indicate that both the Keynesian and the classical hypothesis receive support from the data. The notion of Keynesian unemployment is strongest in metal and engineering and 'other' industries whereas the classical hypothesis is in the forefront in forest industries. However, this does not necessarily translate into an argument that real wages have on the average recently been too high in forest industries in Finland.

The plan of the paper is as follows: Section 2 presents previous results in this area obtained from the French and German business surveys. In section 3 the basic idea of this investigation and properties of the data set are discussed. The continuation ratio model is introduced in section 4 and the empirical results presented in section 5. Section 6 offers some comments and conclusions.

## 2. STUDYING LABOUR DEMAND WITH BUSINESS SURVEY DATA

Answers from business surveys have, among other things, been utilized for analyzing the structure of unemployment. Starting from a disequilibrium model of Malinvaud (1982), Bouissou et al. (1984, 1986) have analyzed the French labour market with data from the quarterly survey of INSEE. The analysis is strongly based on two special questions on possible constraints on the production of the firm. One of them reveals whether a firm has supply constraints on its goods market and the other one whether there are constraints on its labour market. The combination of these dichotomous (yes/no) answers classifies the firm into one of four possible disequilibrium regimes, two of which (no supply constraints on the goods market) correspond to the classical and Keynesian unemployment. A firm's probability of appearing in these four regimes is explained using a conditional logit model. The explanatory variables of the model are a surprise demand indicator based on two consecutive surveys (see also König et al., 1981; Nerlove, 1983; Rahiala and Teräsvirta, 1986) and some macroeconomic variables. The unanticipated demand seems to be an important factor in explaining the disequilibrium regimes.

König and Zimmermann (1985) have studied the labour demand in Germany using data from the business survey of the Ifo-Institut für Wirtschaftsforschung. They have analyzed answers to the October 1980 "special question" in which the firms are asked whether their number of employees will increase/stay the same/decrease during the next 12 months. If it is not expected to increase, the firms are asked to choose a main reason for that from a set of alternatives. The bottom line of the analysis is that lack of demand is the principal reason for increased unemployment in Germany in the eighties.

The questionnaire of the Finnish business survey is somewhat different from those of INSEE and Ifo-Institut. Therefore, our way of investigating the causes of Finnish unemployment will not be the same as that of Bouissou et al. (1984, 1986) or König and Zimmermann (1985). Before proceeding to the analysis of Finnish business survey data, we should emphasize that causes of unemployment have also been empirically analyzed in the framework of disequilibrium macro theory. A recent example of such a macro analysis of unemployment in the OECD countries is Bean et al. (1986). It also contains references to other work in the area. The idea of the study has been to construct and estimate a single model for all countries and compare the results. The authors conclude that both the classical and the Keynesian hypothesis are supported by the macro time series data analyzed in their paper. A similar conclusion will be reached in our micro analysis to which we now turn.

## 3. BACKGROUND INFORMATION

### 3.1. Formulation of the problem

The Finnish business survey is conducted quarterly by the Confederation of Finnish Industries and, among other things, it contains questions on the firms' demand for labour (see Appendix 1). The firms are inquired about the trend of their labour force during the last quarter: has the number of employees increased/stayed the same/decreased? There is a similar question about their employment plans or expectations for the next quarter. By comparing the answers of a firm from two consecutive surveys it is possible to observe when the firm has been obliged to revise its employment plans during a quarter. A Keynesian explanation of such an event would be that the firm has encountered an unexpected change in demand during that quarter. The classical view would be that a change in profitability, real wages in particular, has caused the unplanned change in employment.

The Finnish business survey does not contain a direct question on the demand of the products of a firm, but some questions can be used as proxies for that; for discussion see Rahiala and Teräsvirta (1986). Since 1980 there has been a question on profitability in the questionnaire (see Appendix 1). This makes it possible to investigate whether the unemployment in different branches of manufacturing in Finland has been of Keynesian or classical type.

The idea is to take the surprises in employment plans and try to relate them to surprises in demand and changes in profitability. However, the theory of implicit labour contracts rejects the spot market view of employment and wage determination. Taking that into account, the fluctuations in the number of employees should be attached to permanent or at least long-lived demand shocks rather than to purely transitory ones. Thus only the effect of non-transitory demand shocks on employment is considered in the paper. Another consequence of that theory is that lack of association between short-term profitability changes and employment does not constitute a strong basis for rejecting the classical view of unemployment. Nevertheless, we want to point out that the contrary does not hold: a significant association between short-term profitability and employment would seem to support the classical explanation. In this paper we cannot in fact separate profitability changes into long-lived and transitory ones because there is no sound empirical basis for doing that.

The Finnish questionnaire also contains a question (Question C in Appendix 1) on idle production capacity in the firm, and there is a question concerning production bottlenecks as well (Question BN). In answering the latter one, there is a possibility to indicate that production in the near future is expected to be constrained by lack of skilled labour. Combining the response to that possibility with the reply to the capacity question it might at first seem possible to construct a disequilibrium regime indicator similar to that of Bouissou et al. (1984, 1986). Note, however, that the Finnish bottleneck question inquires about expectations of firms, not about the actual situation as the INSEE survey does.

## 3.2. The data

The answers to most questions in the Finnish business survey are trichotomous. Presently, about 500 firms participate in the survey, and the number of returned questionnaires is around 480. Compared to the business tests of INSEE or Ifo-Institut this is a small number. Questions relevant in this survey are listed in Appendix 1. The firms are asked to give "seasonally adjusted" answers and the limits of the "stays the same" interval are defined to be ± 2 %. The questionnaires have to be returned by March, June, September, and December 15, respectively, that is, just before the end of each quarter. Because the number of observations (firms) in each survey is small, it is necessary to aggregate answers from several periods in order to have a sufficiently large sample for making inferences with our statistical methods. The periods have been chosen in such a way that different phases of the business cycle within each industrial sector are represented in the aggregate. This has been done in order to have both positive and negative demand shocks in the sample. For obvious reasons, we have avoided consecutive quarters. Only periods following the introduction of the profitability question, the third quarter of 1980, have been considered. The following quarters have been aggregated together for the three sectors in the analysis:

Metal and engineering industries: 1982/4, 1983/4, 1985/1, 1985/4
Forest industries: 1982/1, 1982/3, 1983/4, 1985/2
Other industries[1)]: 1981/4, 1983/1, 1983/3, 1985/2

The qualitative nature of the answers causes some measurement problems which will be discussed next.

### 3.3. Constructing variables

Our theory requires that we should be able to measure unanticipated demand shocks of the firms as well as surprises in employment plans and changes in profitability. Assume that we have a trichotomous (increases (=1)/ stays the same (=2)/ decreases (=3)) proxy variable for demand. A variable measuring unanticipated demand shocks $SD_t = D_t - D_t^*$ can then be constructed from the demand $D_t$ and its expectation a quarter ago, $D_t^*$, according to the following table:

(1)

| | | $D_t^*$ 1 | 2 | 3 |
|---|---|---|---|---|
| $D_t$ | 1 | 3 | 2 | 1 |
| | 2 | 4 | 3 | 2 |
| | 3 | 5 | 4 | 3 |

To take an example, $SD_t = 5$ means that the firm has badly overestimated the demand for its products, i.e. a large negative unanticipated demand shock has occurred. (The constructed scale is strictly ordinal and does not imply that the "distances" between consecutive values of $SD_t$ be equal; see Rahiala and Teräsvirta (1986)). As was pointed out previously, a firm is not supposed to revise its employment plans, if it believes the demand shock to be transitory. To take account of this notion, we modify $SD_t$ by forming

$$(2) \qquad S^P D_t = \begin{cases} 3 & \text{if } D_t = 1,\ D_{t+1}^* = 3 \\ & \text{or } D_t = 3,\ D_{t+1}^* = 1 \\ SD_t & \text{otherwise} \end{cases}$$

where $S^P D_t$ stands for a non-transitory unanticipated demand shock. In this variable, shocks that are expected to be followed by a demand change to the opposite direction obtain value three (no shock), because the firm obviously expects the shock to be transitory.

So far we have not indicated how to measure demand and demand expectations which are not explicitly inquired in the survey. Two proxy questions for demand are available, namely, incoming new orders, $S_t$, and the volume of exports, $E_t$. Our previous experience (Rahiala and Teräsvirta, 1986) leads us to cautiously expect the export volume to be the better alternative of the two. This is confirmed by the empirical evidence reported in section 5.

The next problem is the profitability question $R_t$ because it involves a time span of one year instead of the customary one quarter used in almost all of the other questions. One might be willing to argue that $R_t$ and $R_{t-1}$ jointly carry some information about the profitability development during the last quarter. Thus, one possibility of quantifying this information would be to construct a "difference" $DR_t = R_t - R_{t-1}$ using coding technique (1). The question of a proper way of making use of the information in question $R_t$ will be ultimately settled using empirical evidence; see section 5.

Our coding technique is also very well suited for the construction of a variable for the revisions of employment plans. Let $L_t$ be the trend of the labor force during the last quarter and $L^*_{t+1}$ the corresponding plan for the next quarter. Then $SL_t = L_t - L^*_t$, constructed by coding technique (1) measures directly the revision of the employment plan during quarter t. It has already been suggested that transitory demand shocks be ignored in the analysis. It may be plausible to do the same for transitory changes in labour force. This is possible by forming a variable $S^PL_t$ to represent these changes using the construction principle already applied in forming (2).

## 4. STATISTICAL METHODS

### 4.1. The continuation ratio model

In this section we shall discuss the model to be employed in relating changes in employment to unanticipated demand shocks and profitability. For firm i, let $x_t^{(i)}$ be the vector of all factors that are believed to affect the revision of employment plans $SL_t^{(i)}$. We shall study the conditional probabilities

$$\pi_j^{(i)}(x) = P(SL_t^{(i)} = j|x_t^{(i)} = x) \ , \ j = 1,\ldots,5$$

with varying x-conditions. First, assume that all firms within the same industrial sector have a common conditional distribution, i.e., $\pi_j^{(i)}(x)$ is independent of i. Second, suppose that the same conditional distributions apply for all periods t. The revisions $SL_t^{(i)}$ are assumed independent of each other (conditionally on $x_t^{(i)}$ for different firms and for the same firm for periods that are at least one quarter apart. As a result, the superscript i is dropped from our notation.

As already mentioned, $SL_t$ (and $S^PL_t$) are ordinal with five levels. We may thus define

$$(3) \qquad \delta_j(x) = \frac{\pi_j(x)}{\pi_1(x)+\ldots+\pi_j(x)}, \quad j = 2,\ldots,5$$

corresponding to the so-called continuation ratios (cf. Fienberg 1980, pp. 114-116 or Agresti, 1984, p. 114)

$$1 - \delta_j(x) = \frac{\pi_1(x)+\ldots+\pi_{j-1}(x)}{\pi_1(x)+\ldots+\pi_j(x)}, \qquad j = 2,\ldots,5.$$

The variables $\delta_j(x)$, defined by (3) can take on any value within the interval (0,1) independently of each other. Any set of $\delta_j$-values ($j = 2,\ldots,5$) corresponds to a well-defined probability distribution with the restriction $\pi_1(x)+\ldots+\pi_5(x) = 1$. Thus it is natural (cf. Agresti, 1984, Fienberg, 1980, Rahiala and Teräsvirta, 1986) to postulate that x would affect $\delta_j(x)$ through the formula

$$(4) \qquad f(\delta_j(x)) = \mu_j + \beta'x \ , \ j = 2,\ldots,5 \ ,$$

where $\beta$ is a fixed parameter vector and f is an increasing function mapping the interval (0,1) to the whole real line.

## 4.2. Estimation of parameters

Let $n_j$ denote the observed frequency of firms in the response category $SL_t = j$ with explanatory factors $x_t = x$, $j = 1,\ldots,k$. From (3), $\delta_1(x) = 1$ and

$$\pi_j(x) = (1-\delta_k(x)) \ \ldots \ (1-\delta_{j+1}(x)) \ \delta_j(x), \quad j = 1,\ldots,k.$$

The likelihood function determined by $n_1,\ldots,n_k$ will thus be of the form

$$(5)\qquad L_{n_1,\ldots,n_k}(\beta,\mu_2,\ldots,{}_k) \simeq \prod_{j=1}^{k} \pi_j(x)^{n_j}$$

$$= \prod_{j=1}^{k} [(1-\delta_k(x)) \ldots (1-\delta_{j+1}(x))\ \delta_j(x)]^{n_j}$$

$$= \prod_{j=2}^{k} \delta_j(x)^{n_j}(1-\delta_j(x))^{n_1+\ldots+n_{j-1}}$$

$$= \prod_{j=2}^{k} \delta_j(x)^{n_j}(1-\delta_j(x))^{[n_1+\ldots n_j] - n_j}$$

with $\delta_j(x) = f^{-1}(\mu_j+\beta'x)$. Likelihood (5) resembles formally a likelihood defined by (k-1) mutually independent binomial observations. The model (4) can thus be handled in the Generalized Linear Model (GLIM) framework and its parameters estimated using the GLIM-programme, cf. Baker and Nelder (1978). Following Rahiala and Teräsvirta (1986), the estimated standard errors are not reported here, because the importance of different explanatory factors in $x_t$ can be better evaluated by likelihood ratio tests. Test statistics can be easily calculated with the help of the deviance measures produced by GLIM.

At least two possible link functions can be considered. They are the logit-transformation

$$(6)\qquad f(\delta) = \log(\delta/(1-\delta))$$

and the complementary log-log-transformation

$$(7)\qquad f(\delta) = \log(-\log(1-\delta)).$$

Transformation (7) has the advantage that model (4) will behave consistently in aggregation of categories as can be deduced by combining the results of Läärä and Matthews (1985) and McCullagh (1980). On the other hand, link (6) has certain appeal because of its symmetry. Therefore we shall treat the two link functions (6) and (7) on equal footing.

The situation may in fact be generalized to contain even a larger number of possible link functions by defining

$$(8)\qquad f_\lambda(\delta) = \log\lambda^{-1}[(1-\delta)^{-\lambda} - 1].$$

Aranda-Ordaz (1981) originally introduced (8) for binary response models but this link function can also be applied to the more general case considered here. Setting $\lambda = 1$ in (8) yields (6) whereas letting $\lambda \to 0$ gives (7).

The models will be estimated using (8) for a grid of values for $\lambda$ between zero and unity.

## 4.3. Special problems

In general, firms have a tendency of choosing the "no change"-category too often, especially in questions concerning expectations. Theil and

Jochems (1959) already observed this: for more recent discussion, see e.g. Batchelor (1982), Nerlove (1983), and Teräsvirta (1986). This tendency is also obvious in the Finnish business survey. Therefore, following Rahiala and Teräsvirta (1986), we have included special level parameters $\alpha_2$, $\alpha_3$ and $\alpha_4$ for the cases where $L_t^* = 2$ and $SL_t = 2,3$ or 4, respectively, in model (4). They are annexed to the model by including corresponding indicator variables in the explanatory vector $x_t$.

To apply model (4), the frequencies of firms for each combination of $SL_t$ (or $S^PL_t$) and $x_t$ are needed. There are several candidates for entries into vector $x_t$. The number of observations is not large so that some form of pre-screening of data before fitting any models is desirable. To this end, we have calculated all possible two-dimensional marginal frequency tables from each contingency table considered. The idea is to preclude false interpretations of the observed frequency distributions. Because all our tabulation criteria are ordinal, we have computed the Goodman-Kruskal gamma-coefficients (cf. Agresti, 1984, pp. 159-165) to measure the association between the categorizing variables. We have also used the two-dimensional tables to omit from further consideration all explanatory variables that do not seem to have any association whatsoever to $SL_t$ ($S^PL_t$).

## 5. EMPIRICAL RESULTS

### 5.1. Preliminary inspection of the data

As noted in section 3, it is not a priori clear what is the best way of using questions $R_t$ and $R^*_{t+4}$ for explaining the variation in $S^PL_t$. We can think of forming at least six different explanatory variables, namely $R^*_{t+4}$, $R^*_{t+3}$, $DR^*_{t+4} = R^*_{t+4} - R^*_{t+3}$, $R_t$, $R_{t-1}$ and $DR_t = R_t - R_{t-1}$. In this situation, preliminary screening techniques of the type just described are useful. By cross-tabulating all six variables against $S^PL_t$ in metal and engineering industries we obtain the ordinary ($\gamma$) and standardized $t = \gamma / \hat{\sigma}_\gamma$ (gammas divided by their estimated standard deviations) gamma-coefficients in Table 1.

Table 1 shows that the associations between $R^*_{t+4}$ and $R^*_{t+3}$ on one hand and $S^PL_t$ on the other have the negative sign and they are weaker than the association between $R_t$ and $S^PL_t$. We may conclude that firms do not revise their employment decisions on the basis of *expected* changes in profitability but rather on the basis of *realized* changes. This finding seems to support the view expressed by Nickell (1978). He is skeptical of the dynamic models of labour demand which assume an increasing marginal cost of engagement or disengagement of workers at the margin. These models imply that it is optimal to respond to expected changes in profitability (or demand) and spread the adjustment of labour over a period of time. Nickell suggests that the cost per worker associated with either hiring or firing does not increase with the rate at which workers flow in or out. Then the demand for labour obviously only responds to realized rather than expected changes in profitability. Thus we shall use $DR_t$ on one hand and $R_t$ and $R_{t-1}$ jointly on the other as explanatory variables for $S^PL_t$. Studying two-way marginal tables also suggests that a trichotomous scale would be better for $DR_t$ than the five-grade scale (1). The reason are the low observed frequencies for the extreme values of $DR_t$.

As a result, category $DR_t = 1$ is merged to $DR_t = 2$, and category $DR_t = 5$ to $DR_t = 4$, respectively. This trichotomous coding technique has previously been used by Anderson Jr. et al. (1958) and more recently by e.g. König et al. (1979, 1981). The problem of choosing a demand proxy is also solved with the help of two-way marginal tables. We have computed the gammas between $S^PL_t$ and $S^PS_t$ and between $S^PL_t$ and $S^PE_t$ for all three sectors. The results are in Table 2. From the table it may be concluded that $S^PL_t$ seems at least as strongly associated to $S^PE_t$ as to $S^PS_t$. Consequently, we shall use $E_t$ as the proxy for the unobserved demand $D_t$.

After tentatively selecting the explanatory variables we still have to choose the dependent variable which can be either $SL_t$ or $S^PL_t$. One might be tempted to think that transitory revisions of employment plans probably have some other rationale behind them than changes in profitability or unexpected demand shocks. This idea would favour $S^PL_t$. Nevertheless, results from using both $SL_t$ and $S^PL_t$ will be reported. The measures of association to $S^PE_t$, $R_t$ and $R_{t-1}$ appears in Table 3. The differences between $SL_t$ and $S^PL_t$ are rather small the main reason being simply that transitory revisions of employment decisions have been very rare. Our prior belief that $S^PL_t$ would be more strongly associated to $S^PE_t$ and $R_t$ than $SL_t$ is not contradicted by the results.

## 5.2. Main results

After preliminary inspection of data and contraction of the set of potential explanatory variables we are now ready to build continuation ratio models for $S^PL_t$. The first problem in that framework is whether we ought to use $DR_t$ or $R_t$ and $R_{t-1}$ jointly to measure changes in the profitability of firms. To solve this question, we have estimated models of type (4) with link function (6) for $S^PL_t$ for each sector. Model I has $S^PE_t$ and the trichotomous version of $DR_t$ as explanatory factors whereas Model II contains $S^PE_t$, $R_t$ and $R_{t-1}$. The models have been parameterized so that $\mu_j$, $j = 1,2,\ldots,5$, correspond to the lowest level of each factor and the other parameters are contrasts to these lowest levels. The models do not contain any interaction terms. The test results are summarized in Table 4. The table makes use of abbreviations: $S^PE_t = 0$, for instance, stands for the hypothesis that all the contrast parameters corresponding to the variable $S^PE_t$ equal zero.

From Table 4 it is rather obvious that $DR_t$ does not measure the profitability development in a satisfactory way. We prefer Model II to Model I in this respect. In all sectors, both profitability and unexpected non-transitory demand shocks seem to be significant factors in explaining revisions of firms' employment plans.

In metal and engineering industries, the data seem to give slightly more support to the Keynesian than to the classical view whereas the situation is clearly the opposite in forest industries. In the latter, the emphasis seems to be on profitability rather than demand. The export prices of timber, pulp and paper may vary dramatically, causing abrupt short-term changes in the profitability of forest industry enterprises. These short-term price fluctuations have considerable impact on profitability of these firms because of sticky nominal wages. Note, however, that the data and our analysis are related to changes. Therefore, it seems difficult to argue that the average level of the real wages in forest industries would have been so high in the eighties as to cause classical unemployment.

An interesting detail is that in metal and engineering as well as other industries $R_t$ is the profitability variable affecting the employment whereas in forest industries it is $R_{t-1}$. Thus in forest industries, employment is only adjusted to profitability after a lag. This observation is consistent with the results of Rahiala and Teräsvirta (1986): they found a negative relationship between inventories of finished products and the differences between production plans and actual production (production surprises) in forest industries. Inventories can thus have acted as a buffer against demand surprises and changes in profitability. A similar relationship was completely absent in metal and engineering as well as other industries which fits well together with the no-lag situation observed here.

## 5.3. Generalizing the link function

As pointed out earlier, we have no prior reasons to favour either one of the link functions (6) or (7). To explore the situation more thoroughly, we calculated the deviances for link function (8) with $\lambda$ = 0, 0.1, 0.3, 0.5, 0.7, 0.9 and 1 for all the branches. The results are contained in Table 5. The goodness of fit seems to be an increasing function of $\lambda$ except in other industries where the difference in deviance between $\lambda = 0$ and $\lambda = 1$ is negligible.

To illustrate the impact of the choice of the link function on the test results, we also display the values of the likelihood ratio statistics for some hypotheses in Table 6. We also report results from a model in which $SL_t$ instead of $S^PL_t$ is the dependent variable.

On the basis of Tables 5 and 6 we prefer the combination of link (6) and $S^PL_t$ as the dependent variable to other alternatives. The choice is made even easier by the fact that the values of the likelihood ratio test statistics are largest for this combination. Consequently, there is no need to modify the earlier conclusions based on Table 4.

Finally, we would like to remark that it is natural to expect the dependence between $S^PE_t$ and $S^PL_t$ to be monotonic and the association positive. To ensure this, the contrast parameters in model (4) corresponding to $S^PE_t$ must increase with an increasing level of this variable. Fortunately, there has been no need to apply constrained optimization of the likelihood, because all our unconstrained estimates already satisfy this restriction.

## 6. CONCLUSIONS

The purpose of this paper has been to discover the most important factors in a firm's employment policy. We have proceeded by accommodating our methods of analysis to the limitations set by the questionnaire of the Finnish business survey. Furthermore, instead of directly studying the connections of firms' employment plans to demand and profitability, we have thought it more fruitful to investigate what makes firms to *revise* their employment plans during the observation period (a quarter). Posing the problem this way constitutes a tougher test for the underlying theory than just studying the associations between the employment plans and the explanatory factors proposed by the theory.

As already mentioned in section 5, both the Keynesian and the classical theory receive support from the data. In metal and engineering as well as in other industries, the non-transitory unexpected changes in demand (proxied by exports) seem to be the single most important factor affecting the demand for labour. The profitability development appears almost as important, but the formulation of the profitability question, its time span in particular, is perhaps not optimal for the purpose of our study.

Nevertheless, in forest industries the demand for labour is clearly most influenced by the profitability development. This is quite natural, because the export prices may vary considerably in these industries. The indebtedness of the firms in that branch and large capital and other fixed costs make the profitability vary on an even amplified scale. Reported changes in profitability are thus probably larger within the forest sector than in other sectors of manufacturing. The observed delay in the effects of profitability changes might be interpreted as a sign of aversion of unnecessary layoffs, i.e., a kind of labour hoarding. The lag may be related to the negative relationship between production plan surprises and inventories in forest industries observed earlier (Rahiala and Teräsvirta, 1986).

The concordance between the theories and the observations is slightly improved when transitory revisions of employment plans are omitted from consideration. This is true for both the Keynesian and the classical theory. Although the effects of the omission are relatively small, the improvements further strengthen our belief that the firm-level associations detected and reported in this paper are not purely coincidental.

Footnote:

1) "Other industries" are a heterogeneous category containing all the industries neither included in metal and engineering nor forest industries. Lack of data has prevented a more detailed breakdown into industries although it might have been both informative and interesting from the point of view of this study.

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## Appendix 1. Questions of the Finnish business survey relevant in this paper

### A.1.1. Questions used in the empirical analysis

| Symbol | Question |
|---|---|
| $L_t$ | Is the number of your employees at the moment larger than/the same as/smaller than 3 months ago? |
| $L^*_{t+1}$ | Do you expect the number of your employees to be larger/ the same/smaller 3 months from now? |
| $S_t$ | Do you consider the amount of new orders received by your company during this quarter to be larger than/the same as/ smaller than during the previous quarter? |
| $S^*_{t+1}$ | Do you expect the amount of new orders your company will receive during the next quarter to be larger than/the same as/ smaller than during this quarter? |
| $E_t$ | If you export, do you consider the volume of exports of your company this quarter to be larger than/the same as/smaller than last quarter? |
| $E^*_{t+1}$ | Do you expect the volume of your exports next quarter to be larger than/the same as/smaller than this quarter? |
| $R_t$ | Do you consider the profitability of your company (measured by the gross margin) this quarter to be better than/the same as/ worse than at the same time previous year? |
| $R^*_{t+4}$ | Do you expect the profitability of your company a year from now to be better than/the same as/worse than this quarter? |

## A1.2. Questions only mentioned in the text

| Symbol | Question |
|---|---|
| C | Does your company have idle production capacity at the moment (Yes/No)? |
| BN | Do you expect any of the following production bottlenecks to slow down the production of your company in the near future?<br>- lack of skilled labour (Yes/No)<br>- insufficient production capacity (Yes/No)<br>- lack of engineers and technicians (Yes/No)<br>- lack of raw materials (Yes/No)<br>- credit problems (Yes/No)<br>- other factors. Which? ______________________________ |

Table 1. Goodman-Kruskal gamma coefficients ($\gamma$) and standardized gamma coefficients (t) between $S^PL_t$ and several profitability variables in metal and engineering industries

| $S^PL_t$ | $R^*_{t+4}$ | $R^*_{t+3}$ | $DR^*_{t+4}$ | $R_t$ | $R_{t-1}$ | $DR_t$ |
|---|---|---|---|---|---|---|
| $\gamma$ | -0.207 | -0.229 | 0.007 | 0.278 | 0.142 | 0.146 |
| t | -2.6 | -2.8 | 0.0 | 3.7 | 1.8 | 1.7 |

Table 2. Goodman-Kruskal gamma coefficients ($\gamma$) and standardized gamma coefficients (t) between $S^PL_t$, and $S^PS_t$ and $S^PE_t$, respectively, in all three sectors of manufacturing industries

| | $S^PL_t$ | $S^PS_t$ | $S^PE_t$ |
|---|---|---|---|
| Metal and engineering industries | | | |
| | $\gamma$ | 0.246 | 0.404 |
| | t | 3.4 | 5.1 |
| Forest industries | | | |
| | $\gamma$ | 0.181 | 0.236 |
| | t | 1.8 | 2.2 |
| Other industries | | | |
| | $\gamma$ | 0.188 | 0.257 |
| | t | 3.4 | 3.8 |

Table 3. Goodman-Kruskal gamma coefficients ($\gamma$) and standardized gamma coefficients (t) between $SL_t$ and $S^PL_t$, and three explanatory variables in all three sectors of manufacturing industries

| | | $S^PE_t$ | $R_t$ | $R_{t-1}$ |
|---|---|---|---|---|
| Metal and engineering industries | | | | |
| $SL_t$ | $\gamma$ | 0.366 | 0.243 | 0.122 |
| | t | 4.5 | 3.3 | 1.5 |
| $S^PL_t$: | $\gamma$ | 0.404 | 0.278 | 0.142 |
| | t | 5.1 | 3.7 | 1.8 |
| Forest industries | | | | |
| $SL_t$: | $\gamma$ | 0.208 | 0.108 | 0.322 |
| | t | 2.0 | 1.0 | 3.2 |
| $S^PL_t$: | $\gamma$ | 0.236 | 0.129 | 0.364 |
| | t | 2.2 | 1.2 | 3.6 |
| Other industries | | | | |
| $SL_t$: | $\gamma$ | 0.249 | 0.154 | 0.017 |
| | t | 3.8 | 2.5 | 0.2 |
| $S^PL_t$: | $\gamma$ | 0.257 | 0.146 | -0.001 |
| | t | 3.8 | 2.2 | -0.0 |

Table 4. Deviances, Likelihood Ratio test statistics, the corresponding degrees of freedom (df) and p-values for null hypotheses of no explanatory power of various factors for $S^PL_t$ in two models with link function (6)

| Hypothesis | Deviance | LR | df | p |
|---|---|---|---|---|
| **Metal and engineering industries** | | | | |
| Model I | 133.2 | | 130 | |
| $DR_t = 0$ | | 1.9 | 2 | 0.387 |
| $S^PE_t = 0$ | | 20.5 | 4 | 0.0004 |
| Model II | 179.6 | | 228 | |
| $R_t, R_{t-1} = 0$ | | 14.2 | 4 | 0.007 |
| $R_t = 0$ | | 7.2 | 2 | 0.027 |
| $S^PE_t = 0$ | | 20.6 | 4 | 0.0004 |
| **Forest industries** | | | | |
| Model I | 96.35 | | 113 | |
| $DR_t = 0$ | | 6.7 | 2 | 0.035 |
| $S^PE_t = 0$ | | 7.9 | 4 | 0.095 |
| Model II | 126.6 | | 184 | |
| $R_t, R_{t-1} = 0$ | | 19.8 | 4 | 0.0005 |
| $R_t = 0$ | | 2.6 | 2 | 0.272 |
| $S^PE_t = 0$ | | 9.6 | 4 | 0.048 |
| **Other industries** | | | | |
| Model I | 198.5 | | 168 | |
| $DR_t = 0$ | | 5.5 | 2 | 0.063 |
| $S^PE_t = 0$ | | 12.8 | 4 | 0.012 |
| Model II | 278.9 | | 289 | |
| $R_t, R_{t-1} = 0$ | | 11.8 | 4 | 0.019 |
| $R_t = 0$ | | 9.3 | 2 | 0.010 |
| $S^PE_t = 0$ | | 12.1 | 4 | 0.017 |

Table 5. Deviance measures for the Aranda-Ordaz transformation (8) with $\underline{S}^{P}L_{t}$ as the dependent variable

| $\lambda$ | Metal and engineering industries | Forest industries | Other industries |
|---|---|---|---|
| 0.0 | 184.3 | 130.8 | 278.5 |
| 0.1 | 183.9 | 130.1 | 278.7 |
| 0.3 | 182.7 | 129.1 | 279.0 |
| 0.5 | 181.9 | 128.4 | 279.0 |
| 0.7 | 181.1 | 127.6 | 279.1 |
| 0.9 | 180.4 | 127.1 | 279.3 |
| 1.0 | 179.6 | 126.6 | 279.5 |
| Degrees of freedom | 228 | 184 | 289 |

Table 6. Deviance and Likelihood Ratio test statistics for null hypotheses of no explanatory power of various factors for $S^P L_t$ and $SL_t$ in a model with link functions (6) and (7)

| Dependent variable | $S^P L_t$ | | $S^P L_t$ | | $SL_t$ | |
|---|---|---|---|---|---|---|
| Link function | (6) | | (7) | | (6) | |
| | Deviance | LR | Deviance | LR | Deviance | LR |
| Metal and engineering industries | | | | | | |
| Model II | 179.6 | | 184.3 | | 197.8 | |
| $R_t$, $R_{t-1}$ = 0 | | 14.2 | | 14.2 | | 12.4 |
| $S^P E_t$ = 0 | | 20.6 | | 17.0 | | 17.0 |
| Forest industries | | | | | | |
| Model II | 126.6 | | 130.8 | | 140.6 | |
| $R_t$, $R_{t-1}$ = 0 | | 19.8 | | 16.8 | | 14.8 |
| $S^P E_t$ = 0 | | 9.6 | | 7.0 | | 8.1 |
| Other industries | | | | | | |
| Model II | 279.5 | | 278.5 | | 299.6 | |
| $R_t$, $R_{t-1}$ = 0 | | 11.8 | | 11.6 | | 10.6 |
| $S^P E_t$ = 0 | | 12.1 | | 12.9 | | 12.5 |

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ELINKEINOELÄMÄN TUTKIMUSLAITOS (ETLA)
The Research Institute of the Finnish Economy
Lönnrotinkatu 4 B, SF-00120 HELSINKI Puh./Tel. (90) 601 322

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