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Suomen Pankin
kansantalouden osasto

Bank of Finland
Economics Department

PAAVO PEISA AND HEIKKI SOLTTILA

OUTPUT, WAGES AND THE DEMAND FOR LABOUR: SOME EVIDENCE FROM PANEL DATA

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ABSTRACT

Using a sample of small and medium sized firms, we investigate the relationship between wages and employment. Our data reveal a stable cross-section correlation between wages and productivity, consistent with the neoclassical demand for labour theory in general and the Cobb-Douglas assumptions in particular. These results do not indicate anything about the direction of causation. A positive correlation between wages and productivity can arise from capital-labour substitution as wages change but other explanations are also plausible. Intervening variables are for example a particular concern in the analysis of panel data.

In this paper, we adopt the generalized random effects framework put forward by Chamberlain. A series of exogeneity tests gives some support to the neoclassical notion that at the micro level, wages affect employment and productivity but not vice versa. The evidence presented in this paper is rather weak, however, and our data do not reject a restriction to a purely static relationship. In this specification, parameter estimates are not neoclassical.

The wage-elasticity estimates obtained from the neoclassical cost-minimization model are of order 0.2 - 0.4, which is quite reasonable. Our results give support to the hypothesis that measurement errors have biased some of the earlier elasticity estimates from panel data towards 1.

INFORMATION: Seija Määttä, tel. 183 2519

CONTENTS

1 INTRODUCTION

Wages and productivity tend to grow together, while output and employment show rather different trends in different countries and at different times. A comparison of recent developments in major OECD countries suggests a negative correlation between real wages and employment. It is often argued that the direction of causation runs from wages to employment and productivity and hence, that unemployment is best explicable in terms of real wage rigidity. This somewhat neoclassical notion has evoked much policy discussion and economic research in many European countries, most notably in the U.K. (For some research examples, see Bruno and Sachs (1985), Symons and Layard (1983) and Layard and Nickell (1985).)[1]

Most econometric studies of the wage - employment relationship are based on aggregate time series evidence. Indispensable and useful as these studies are, the evidence as a whole leaves the impression that almost any theory and almost any set of parameter values is likely to be consistent with aggregate time series. The difficulty of obtaining well-determined parameter estimates for the employment equation can be illustrated by considering the macroeconomic models of the Finnish economy. In different models, the definitions of the variables and data used in estimation are roughly taken comparable. Nevertheless, the long run response of labour demand and employment to a permanent one per cent increase in real wages varies between zero and three per cent.

In this paper, the wage-employment relationship is discussed from a microeconomic point of view using panel data information for a sample of Finnish manufacturing firms over a period 1976 - 82. Earlier Dormont and Sevestre (1984) and Mairesse and Dormont (1985), have used disaggregated panel data in investigating the elasticity of labour demand with respect to the wage rate in French, German and U.S. manufacturing In this paper, we are mainly concerned with the validity of the neoclassical employment theory. The approach relies heavily on methods developed by Chamberlain

(1984) for estimating vector regression models from panel data. The wage elasticity of labour demand is also considered. The measurement of the wage rate has been one of the majour problems in disaggregated employment analysis. Our data set contains information also on work hours and average hourly wages, which enables us to complement earlier micro-level analyses of the wage-employment relationship.

2 THE NEOCLASSICAL DEMAND FOR LABOUR FUNCTION

Consider the demand for labour of a single firm. The standard neoclassical model assumes perfect competion in the labour market so that the firm takes the wage rate as exogenous. The amount of employment offered is determined by the familiar conditions so that in equilibrium, the revenue product of marginal employee is equal to the wage rate. Other things being equal, a lower wage rate means more employment and less productivity. There exists a stable negative relationship between wages and employment and, at the level of an individual firm, the direction of causation runs from wages to employment.

The demand theory outlined above is empty of any empirical content without some notion of exogeneity. The one adopted in this paper builds on timing evidence, leading to the exclusion of wage leads from the demand for labour function. This is very much in accord with the mainstream of employment studies, although leads are usually rejected on common sense grounds only.

Let l_t and w_t denote the demand for labour and the wage rate, respectively, at time t. Omitting other exogenous variables, a Sims (1972) definition for the exogeneity of wages can be written as

$$E^*(l_t \mid \ldots, w_{t-1}, w_t, w_{t+1}, \ldots) = E^*(l_t \mid \ldots, w_{t-1}, w_t)$$

where $E^*(l_t|Z)$ denotes the (minimum mean-square error) linear predictor of l_t conditional on a information set Z. The knowledge of future wages does not improve the fit of the labour demand equation because future wages - or more precisely, their "innovations" - do not belong to the firm's information set at the time of the employment decision, and because wages are independent of the employment decision.[2]

The definition of exogeneity adopted here does not exclude the purely contemporaneous relation between the two variables. A static relationship between the two variables

$$E^*(l_t \mid \ldots, w_t, \ldots) = E^*(l_t \mid w_t),$$

does not allow any inferences about the direction of causation on the basis of timing evidence only.

For each t, the exogeneity definition implies a demand for labour equation. Assuming stationarity, these can be written as

$$(E_t^*) \qquad l_t = c_0 + b_0 w_t + b_1 w_{t-1} + b_2 w_{t-2} + \ldots + u_t$$

for t = ..., 0,... In these equations, c_0, b_0, b_1,... are constants and u_t denotes an error term.

A more parsimonious presentation for the underlying dynamic employment process is usually obtained by including also lagged values of the endogenous variable in the set of explanatory variables. In the model (E_t^*) lags tend to be longer and even the restriction to finite order can be suspected on general grounds. However, this specification helps to bypass some of the econometric difficulties which arise using panel data.

Data on wages and employment are available for a limited number of periods only. Suppose we have data for periods 1,...,T. An operational counterpart for the set of equations (E_t^*) is as follows:

$$(E_1') \qquad l_1 = a_0 + b_0 w_1 + u_1$$

$$\vdots$$

$$(E_t') \qquad l_t = a_0 + b_{t-1} w_1 + \ldots + b_0 w_t + u_t$$

$$\vdots$$

$$(E_T') \qquad l_T = a_0 + b_{T-1} w_1 + \ldots + b_0 w_T + u_T$$

However, a formulation with time-variant coefficients is preferable, especially if the data cover only a few periods.

$$
\begin{array}{lll}
(E_1) & l_1 = a_{1,0} + b_{1,0}w_1 + u_1 & \\
\vdots & \vdots & \\
(E_t) & l_t = a_{t,0} + b_{t,t-1}w_1 + \dots + b_{t,0}w_t + u_t & \\
\vdots & \vdots & \\
(E_T) & l_T = a_{T,0} + b_{T,T-1}w_1 + \dots & + b_{T,0}w_T + u_T
\end{array}
$$

One reason for time-variant coefficients is the lag truncation problem. Even if the relationship described by (E_t^*)'s remain constant as t changes, time-varying parameters can be excluded only if the wage variables $\dots, w_{-1}, w_0, w_1, \dots$ are assumed to be orthogonal, which is very restrictive. In addition, the coefficients in (E_t^*) tend to change, because of the existence of various misspecification errors. Inappropriately excluded variables show up in unstable parameters.

The model (E_1) - (E_T) with time-variant negative coefficients can be regarded as an adequate presentation of the competitive neoclassical demand for labour function, at least if no information is available on output and input prices (apart from wages), demand conditions and fixed inputs. A complicated lag structure can turn some of the individual coefficients positive, and hence, the coefficients in $(E_1$ - (E_T) have to be negative only on the average. The main testable implication of the neoclassical theory is the exogeneity of wages.

Instead of profit maximization only cost minimization can be assumed. Then the model has to be supplemented with an exogenous output variable, with the same unrestricted lag structure as wages.[3]

The Cobb-Douglas production function with three inputs and constant returns to scale provides a concrete example of the neoclassical demand for labour function (E). Assume that labour (input 1) and input 2 are variable or quasi-fixed and have (time-invariant) exponents α_1 and α_2 in the production function. If variables are measured in logarithmic units, the row sum of wage coefficients gives the "long run" wage elasticity of labour demand. We expect that at least approximately,

$$\sum_{j=1}^{T} b_{T,T-j} \to - \frac{1}{1 - \alpha_1} \quad \text{as } T \to \infty$$

if the output market is competitive. With cost minimization the limiting wage elasticity is given by $- \frac{\alpha_2}{\alpha_1 + \alpha_2}$, which is equal to the share of non-wage costs out of total variable costs.[4]

Alternatively we can evaluate long run effects by comparing steady states. If these are identical except for wages, a static cross section regression of employment against wages will yield an estimate of the long-run wage elasticity in competitive conditions.

3 EXOGENEITY IN PANEL DATA MODELS

Panel data are useful in estimating models like (E_1) - (E_T), and in testing exogeneity assumptions. However, model specification requires some care and usually, one has to make some allowance for differences between firms. There are firm specific variables which affect the employment decision but nevertheless remain unobserved or unmeasured.

We assume that the coefficients of wage and output variables are equal across firms. Thus, latent variables enter into the model additively as firm specific intercepts and can be dealt with by the specification of the error term in (E_1) - (E_T). The firm subscript i is now kept explicitly in sight and so the error term is written as u_{it}.

The usual assumption in panel data models is

$$u_{it} = v_i + e_{it}$$

where v_i is the firm-specific latent variable capturing unobserved "individual effects" and e_{it} is the error term proper, assumed to be independent of the explanatory variables as well as of the v_i's.

In the random effects model v_i's are treated as a random sample from some given distribution. In a model with time-invariant coefficients this assumption leads to the use of quasi-mean deviations like $w_{it} - c \cdot w_{i.}$ with c a constant to be estimated and $w_{i.}$ the average of the wage variable for the i'th firm.[5]

Here, we adopt a somewhat more general random effects specification put forward by Chamberlain. In the profit maximization case, for example, it is assumed that

$$E^*(v_i \mid w_{i1},\ldots, w_{iT}) = v + f_1 w_{i1} + \ldots + f_T w_{iT} \quad (2)$$

with v, $f_1, \ldots,$ and f_T constants. This is a generalization of the standard random effects model, where the coefficients f_i are restricted to be zero.

Adopting the specification (2) for the random latent variable v_i, consider the linear regression of l_{it} on $w_{i1}, \ldots, w_{iT}$. The expected value of each l_{it}, i.e., $E^*(l_{it} | w_{i1}, \ldots, w_{iT})$, is a linear combination of the w_{it}'s, and hence we obtain for t = 1,...,T

$$
\begin{aligned}
l_{i1} &= \alpha_1 + \beta_{11}w_{i1} + \ldots + \beta_{1T}w_{iT} + e_{i1} \\
&\vdots \\
l_{it} &= \alpha_t + \beta_{t1}w_{i1} + \ldots + \beta_{tT}w_{iT} + e_{it} \qquad (3) \\
&\vdots \\
l_{iT} &= \alpha_T + \beta_{T1}w_{i1} + \ldots + \beta_{TT}w_{iT} + e_{iT},
\end{aligned}
$$

with constants α and β. The matrix of β-coefficients is not lower triangular even if wages are in fact exogenous. The coefficients above the diagonal capture the effects of the latent variable and tell nothing about the direction of causation.

Taking the random latent variable into account, the exogeneity restrictions on β-coefficients become

$$
(4) \qquad (\beta_{ij}) = \begin{matrix}
\beta_{11} & f_2 & f_3 & f_4 & \cdots & f_T \\
\beta_{21} & \beta_{22} & f_3 & f_4 & \cdots & f_T \\
\beta_{31} & \beta_{32} & \beta_{33} & f_4 & \cdots & f_T \\
\vdots & & & & & \vdots \\
 & & & & & f_T \\
\beta_{T1} & \beta_{T2} & \beta_{T3} & \beta_{T4} & \cdots & \beta_{TT}
\end{matrix}
$$

provided that T > 4. This notion is called exogeneity conditional on a random latent variable by Chamberlain.

If wages are exogenous, and we estimate the coefficients of the wage variables using panel data without any restrictions on leads and lags, the elements of the estimated β-matrix should be approximately equal to each other in each column above the diagonal. Formally, exogeneity can be tested by imposing the restrictions in (4) and comparing the results of restricted and unrestricted estimations.

Some of the coefficients of (E_1) - (E_T) can be evaluated from the restricted estimates. Equations (E_1) - (E_T) and (2) imply

$$b_{2,0} = \beta_{22} - f_2$$

$$b_{3,0} = \beta_{33} - f_3, \quad b_{31} = \beta_{32} - f_2$$

$$\vdots$$

$$b_{T,2} = \beta_{T2} - f_2, \ldots \qquad , \quad b_{T,0} = \beta_{TT} - f_T.$$

The first column of the matrix b - the coefficients b_{10}, $b_{21}, \ldots, b_{T,T-1}$ - cannot be identified from the estimates.

4 EMPIRICAL RESULTS

Our data are drawn from a survey conducted by Teollistamisrahasto (see Myllyniemi and Solttila (1984) for details on the construction of the original sample and on the definitions and measurement of the variables). The sample consisted of 69 small and medium sized. The data covered years 1975 - 82 and for each year, we had information on value added, debts, interest payments, work hours, number of employees, wage costs and investment. The data for 1975 were rather scanty, with many missing observations, and therefore only years 1976 - 82 were included in the analysis. Other missing observations were replaced by linear predictions on firm- and year-dummies.[6]

The wage rate variable was obtained by dividing wage costs by work hours. The number of employees was used as the employment variable and value added as the output variable. Wage and output variables were deflated by the price of industrial output before estimation. In the regressions below, all variables appear in logarithmic units.

In Table 1, we present some simple cross-section estimates from regressing employment against output and wages. In each regression, employment, output and wage variables all come from the same cross-section and thus in these equations all leads and lags are excluded. The results presented in Table 1 were obtained by seven ordinary least square regressions, one for each year. Lines E_{76},... and E_{82} give the results for cross-section regressions 1976, ... and 1982, respectively.

Table 1 provides evidence of a stable positive relationship between wages and productivity. The coefficient of the output variable is equal to 1 in every cross-section whereas the coefficient of the wage variable is about -.4. There are very plausible long-run parameter values for a (long-run) value added Cobb-Douglas production function with labour and capital both treated as variable factors.

Incidentally, the well-determined parameter estimates for the wage coefficient imply some degree of heterogeneity in the labour market. We could not distinguish between the wage variable and the constant term in a cross-section analysis if there were no differences in wage rates between firms.

Although the results of Table 1 are consistent with the neoclassical theory, they tell nothing about the direction of causation and hence do not help to discriminate between neoclassical and alternative explanations for a positive wage-productivity relationship. The alternatives assert either that even at the micro level causation runs in reverse direction, from output to wages, or that the observed correlation between the two variables is spurious.[7]

We first conside the exogeneity of wages. Table 2 contains results for unrestricted cross-section estimates, corresponding to the set of equations (3) with a maximal lead and lag structure. Employment in 1978, for example, is regressed on output and wages not only in 1978 but also in preceding years 1976 - 77 and in subsequent years 1977 - 82.

Above, we discussed the empirical implications of time invariant firm characteristics. These defy causal interpretation but turn out in regressions as spurious leads. If all leads are due to a latent variable, we expect that in Table 2 the coefficients above the two diagonals should be equal to each other in every column. The coefficients of the wage variable are w_{78}, -.53 and -.53; in column w_{79}, they are .20, .29 and .27; etc. The differences between coefficients appear as negligible, at least compared with the standard errors. These results clearly suggest that a model with a time-invariant latent variable and wages exogenous is consistent with the data.

In order to test exogeneity assumption we imposed restrictions (4) for wages and estimated the equations (E_{76}) - (E_{82}) with minimum distance procedures. The usual distance norm was used instead of the optimal Chamberlain norm, and hence, the estimates presented here are not necessarily fully efficient.

The information required for likelihood ratio test is provided on the first line of Table 8. The number of the degrees of freedom, 15, is given by the number of independent linear restrictions on coefficients. The hypothesis that wages are exogenous is very easily accepted by the data. Results lend also strong support to the exogeneity of output, although the evidence is not as strong as with wages. The conclusion is that employment innovations do not explain output and hence, we can assume cost minimization instead of profit maximization. Of course, an exogenous output variable greatly enhances the explanatory power of the employment equation.

With output and wage taken as exogenous, we can consider neoclassical models with or without further restrictions on the lag structure or exclude wages altogether from the model. The estimation results for the unrestricted model with wages and output exogenous are presented in Table 3, together with the implied elasticities in Table 4. At first sight the results are encouraging from the point of view of the neoclassical model. The response to output changes is rather slow but the long run output elasticity .74 is reasonable. The long run wage elasticity -.40 is in accord with Cobb-Douglas technology assumptions.

However, a closer inspection of the estimation results raises doubts and one may even wonder whether the wage variable is significant at all. Thus, we test whether the wage variable can be omitted from the employment function altogether except as a proxy for non-causal latent variables. The test information provided in Table 8 implies that the restriction to a latent relation only is firmly rejected. In view of our data, wages cannot be excluded from the demand for labour function. On the other hand, a static relationship between wages and employment appears to be acceptable and hence we conclude that lagged wages do not cause employment in our data. The implied static wage elasticities are presented in

Table 5. From the neoclassical point of view they are very disappointing. The estimated "elasticity" takes both negative and positive values in different years. The average value is negative, but only -.05. The output elasticities reported in Table 6 are rather reasonable. An increase of one per cent in output increases employment during the same year by about .2 per cent. The total employment acceleration effect is about .9.

Mairesse and Dormont obtained used year-differenced variables to eliminate firm specific latent variables. In all data sets, the long-run elasticity of labour demand esdtimates were about -.8 with respect to the wage rate and about .3 - .5 with respect to output. For comparison we estimated the unrestricted model with exogenous wage and output variables using year differences (Table 7). The estimation results were much like those obtained by Mairesse and Dortmont with respect to output, but wage elasticity was only about -.2.

One explanation for the differences in estimation results is different measurement errors in wage variables. Mairesse and Dortmont commented their wage elasticity estimates, as follows: "The (direct) labor cost elasticities in the labor equation seem too good to be true. Their magnitude is much larger than expected (-0.8 as against -0.3 if the elasticity of substitution of capital and labor is about 1). One plausible explanation is the existence of measurement errors in our employment measure DL, which by construction would be (negatively) transmitted to our [wage] measure DW. Since the variance of DW is much smaller than that of DL (by a factor of the order of 4), even relatively small errors in DL would lead to relatively large ones in DW. Thus if random errors were responsible for about 20 percent of the observed variance of DL, they could also be responsible for as much as 80 percent of the observed variance of DW. Such a situation could account for our estimated elasticities of -0.8, even though the 'true' coefficient would be zero."

The results in this paper give some support to the quoted explanation. The wage variable employed by Mairesse and Dormont was the labour cost per employee. Our wage variable is not directly related to the dependent variable, and hence we expect that measurement errors have less serious effects on estimates. Empirical results provide some support to this expectation. In this paper, elasticity estimates are consistently nearer to zero than those obtained by Mairesse and Dormont.

5 CONCLUSIONS

Using a sample of small and medium sized firms, we investigated the relationship between wages and employment. Our data revealed a stable cross-section correlation between wages and productivity, consistent with the neoclassical demand for labour theory in general and the Cobb-Douglas assumptions in particular. These results do not indicate anything about the direction of causation. A positive correlation between wages and productivity can arise from capital-labour substitution as wages change but other explanations are also plausible. Intervening variables are for example a particular concern in the analysis of panel data.

In this paper, we adopt the generalized random effects framework put forward by Chamberlain. A series of exogeneity tests gives some support to the neoclassical notion that at the micro level, wages affect employment and productivity but not vice versa. The evidence presented in this paper is rather weak, however, and our data do not reject a restriction to a purely static relationship. In this specification, parameter estimates are clearly non-neoclassical.

The wage-elasticity estimates obtained from the neoclassical model are of order 0.2 - 0.4, which is quite reasonable. These estimates are clearly lower than those obtained by Mairesse and Dortmont. Mairesse and Dortmont argued that measurement errors biased their elasticity estimates towards 1. Our results give support to this interpretation.

FOOTNOTES

1 Thus far, Finland has largely escaped the European debate about real wage resistance together with its sometimes disheartening overtones. Is is not difficult to explain the difference in public interest. Although our unemployment rate has been high by post-war standards throughout the 1980s, it remains well below the West-European levels. Even more remarkable is the growth of employment. Since 1978, employment has increased by some 250 000 persons, or more than 10 per cent whereas in the rest of the OECD Europe, it has been on the average stagnant or declined. Relatively favourable as this development has been for us in general terms, it has excerted a depressing effect on labour market studies.

The Finnish economy faces now a phase of relatively slow growth. We expect that a Finnish version of the real wage debate will come together with the worsening employment situation. Eriksson (1985) and Santamäki (1986) provide examples of recent labour market studies in Finland.

2 As is well known, Sims exogeneity is in practice equivalent to Granger non-causality, defined as

$$E^*(w_{t+1} \mid \ldots, w_{t-1}, w_t \text{ and } \ldots, l_{t-1}, l_t) = E^*(w_{t+1} \mid \ldots, w_{t-1}, w_t)$$

3 The aim of the proposed specification is to capture in a rough way the idea of prices governing resource allocation, not to exhaust the implications of the price theory. A more careful formulation would, for example, embed the labour demand equation in a system of interrelatedness input demand equations and take into account the standard homogeneity and summetry restrictions.

The delayed response assumed throughout this paper is motivated usually by sluggish expectations or by various adjustment costs.

Implicitly, $(E_1) - (E_T)$ assume that wages are forecast from their own lagged values. Sargent (1978) and Altonji and Ashenfelter (1980) provide some evidence which shows that the assumption is not completely unreasonable. Typically, wages follow an autoregressive process of very low order and thus, a very simple hypothesis like static expectations corrected for a trend may be enough for practical purposes.

4 These calculations assume static expectations and neglect the existence of adjustment costs.

5 The random effects estimator provides, in a sense, a compromise between ordinary least square estimates in levels and fixed effect estimates. They approach the level estimates corresponding to assumption (2) if the variance σ_v^2 of the firm specific random variable approaches zero, and the fixed effects estimates corresponding to (3) if $\sigma_v^2 \to \infty$. In the intermediate cases $0 < \sigma_v^2 < \infty$ the random effects estimator is efficient, provided that the v_i's are uncorrelated with the explanatory variables.

6 In the analyses, no attempt was made in order to correct for the degrees of freedom lost in replacing missing observations.

7 For example, if work is monotoneus and boring in capital-intensive branches, some remuneration is required in order to prevent labour shortages. An alternative explanation for the observed correlation is that wages tend to follow productivity, for example because productive individuals are well paid. Wages follow productivity also if the employees regard themselves as entitled to the profits of the firm and are able to defend their income share.

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TABLE 1.

SOME DESCRIPTIVE REGRESSION RESULTS.
STANDARD ERRORS IN PARENTHESIS

	q_{76}	q_{77}	q_{78}	q_{79}	q_{80}	q_{81}	q_{82}	w_{76}	w_{77}	w_{78}	w_{79}	w_{80}	w_{81}	w_{82}	C
E_{76}	1.02 (.04)							-.47 (.12)							-3.07 (.39)
E_{77}		.93 (.04)							-.28 (.19)						2.80 (.47)
E_{78}			1.00 (.05)							-.39 (.12)					-3.17 (.48)
E_{79}				1.00 (.04)							-.31 (.11)				3.45 (.43)
E_{80}					1.02 (.03)							-.46 (.08)			-3.08 (.34)
E_{81}						.99 (.04)							-.35 (.09)		-3.18 (.37)
E_{82}							.95 (.05)							-.35 (.13)	-2.75 (.48)

TABLE 2.

ESTIMATION RESULTS; UNRESTRICTED MODEL.
MINIMUM DISTANCE ASYMPTOTIC STANDARD ERRORS IN PARENTHESES

	q_{76}	q_{77}	q_{78}	q_{79}	q_{80}	q_{81}	q_{82}	w_{76}	w_{77}	w_{78}	w_{79}	w_{80}	w_{81}	w_{82}	C
E_{76}	1.02	-.16	-.59	.03	.61	.21	.01	-.10	-.02	-.53	.20	-.15	-.27	.16	-3.21
	(.16)	(.15)	(.21)	(.22)	(.25)	(.23)	(.14)	(.36)	(.33)	(.33)	(.44)	(.29)	(.39)	(.38)	(.48
E_{77}	.70	-.01	-.27	.00	.57	.19	.07	-.12	.07	-.53	.29	-.13	-.31	.07	-3.06
	(.14)	(.14)	(.19)	(.20)	(.23)	(.21)	(.13)	(.34)	(.30)	(.30)	(.41)	(.27)	(.36)	(.35)	(.44
E_{78}	.53	.06	-.27	-.01	.42	.16	.15	.29	-.08	-.68	.27	-.01	-.36	.00	-2.92
	(.14)	(.14)	(.19)	(.20)	(.23)	(.21)	(.13)	(.33)	(.30)	(.30)	(.40)	(.26)	(.35)	(.34)	(.43
E_{79}	.34	.01	-.39	.27	.56	.14	.09	.36	-.11	-.54	.25	-.04	-.45	.03	-2.87
	(.13)	(.13)	(.18)	(.18)	(.22)	(.20)	(.12)	(.32)	(.29)	(.28)	(.38)	(.25)	(.34)	(.33)	(.38
E_{80}	.25	.06	-.44	.11	.61	.35	.06	.38	-.34	-.51	.18	-.12	-.26	-.14	-2.83
	(.12)	(.12)	(.16)	(.17)	(.20)	(.18)	(.11)	(.29)	(.26)	(.26)	(.35)	(.23)	(.31)	(.30)	(.40
E_{81}	.09	.19	-.39	.09	.33	.51	.14	.54	-.17	-.41	.06	.26	.26	-.30	-2.90
	(.13)	(.13)	(.17)	(.18)	(.21)	(.19)	(.12)	(.30)	(.27)	(.27)	(.36)	(.36)	(.24)	(.32)	(.44)
E_{82}	.02	.15	-.27	.13	.31	.47	.27	.75	-.16	-.44	.02	.14	-.38	.24	-2.90
	(.14)	(.14)	(.19)	(.20)	(.23)	(.21)	(.13)	(.33)	(.30)	(.40)	(.26)	(.36)	(.36)	(.44)	(.44)

TABLE 3.

ESTIMATION RESULTS; OUTPUT AND WAGES EXOGENOUS.
MINIMUM DISTANCE ASYMPTOTIC STANDARD ERRORS IN PARENTHESES

	q_{76}	q_{77}	q_{78}	q_{79}	q_{80}	q_{81}	q_{82}	w_{76}	w_{77}	w_{78}	w_{79}	w_{80}	w_{81}	w_{82}	C
E_{76}	.96	-.17	-.42	-.06	.36	.38	.08	-.11	.02	-.52	.19	.07	-.23	-.21	3.13
	(.14)	(.14)	(.17)	(.17)	(.19)	(.16)	(.10)	(.32)	(.29)	(.27)	(.35)	(.22)	(.27)	(.26)	(.41
E_{77}	.73	.01						-.09	.08						2.93
	(.13)	(.13)						(.31)	(.28)						(.39
E_{78}	.59	.06	-.36					.31	-.07	-.67					2.82
	(.13)	(.12)	(.17)					(.30)	(.26)	(.27)					(.39
E_{79}	.40	.05	-.48	.24				.42	-.16	-.57	.10				2.75
	(.12)	(.12)	(.16)	(.17)				(.29)	(.29)	(.26)	(.33)				(.37
E_{80}	.25	.06	-.43	.10	.56			.39	-.04	-.51	.17	-.08			2.65
	(.11)	(.11)	(.14)	(.15)	(.17)			(.26)	(.23)	(.23)	(.23)	(.20)			(.33
E_{81}	.11	.19	-.43	.09	.29	.64		.67	-.16	-.39	-.01	.06	-.30		2.82
	(.12)	(.11)	(.15)	(.16)	(.18)	(.16)		(.27)	(.24)	(.24)	(.36)	(.21)	(.28)		(.35)
E_{82}	.04	.15	-.31	.01	.27	.59	.22	.76	-.15	-.42	-.06	.17	-.38	-.24	2.90
	(.13)	(.12)	(.17)	(.18)	(.20)	(.18)	(.11)	(.30)	(.27)	(.27)	(.35)	(.23)	(.31)	(.29)	(.38)

TABLE 4.

OUTPUT AND WAGE ELASTICITY ESTIMATES FROM TABLE 2.

	q_{77}	q_{78}	q_{79}	q_{80}	q_{81}	q_{82}	Row sum	w_{77}	w_{78}	w_{79}	w_{80}	w_{81}	w_{82}	Row sum
E_{77}	.18						.18	.06						.06
E_{78}	.23	.06					.29	-.09	.15					.06
E_{79}	.22	-.06	.30				.46	-.18	-.05	-.09				-.32
E_{80}	.23	-.01	.16	.20			.58	-.06	.01	-.02	-.15			-.22
E_{81}	.36	-.01	.15	-.07	.26		.69	-.18	.13	-.20	-.01	-.07		-.33
E_{82}	.33	.09	.07	-.09	.21	.14	.74	-.17	.10	-.25	-.07	-.15	-.03	-.40

TABLE 5.

ESTIMATION RESULTS
OUTPUT EXOGENOUS, STATIC WAGE - EMPLOYMENT RELATIONSHIP.
MINIMUM DISTANCE ASYMPTOTIC STANDARD ERRORS IN PARENTHESES

	q_{76}	q_{77}	q_{78}	q_{79}	q_{80}	q_{81}	q_{82}	w_{76}	w_{77}	w_{78}	w_{79}	w_{80}	w_{81}	w_{82}	C
E_{76}	.94	-.11	-.52	-.02	.37	.37	.08	.30	-.10	-.45	.15	-.11	-.26	-.14	-3.30
	(.14)	(.14)	(.17)	(.17)	(.19)	(.16)	(.10)	(.25)	(.22)	(.22)	(.30)	(.20)	(.27)	(.26)	(.41)
E_{77}	.70	.09						.47	-.20						-3.04
	(.14)	(.13)						(.25)	(.20)						(.39)
E_{78}	.57	.07	-.40							-.53					-2.92
	(.13)	(.12)	(.17)							(.23)					(.38)
E_{79}	.39	.04	-.49	.27							.08				-2.82
	(.12)	(.12)	(.16)	(.17)							(.30)				(.37)
E_{80}	.24	.07	-.45	.11	.58							-.15			-2.69
	(.11)	(.11)	(.14)	(.15)	(.17)							(.20)			(.33)
E_{81}	.12	.15	-.40	.04	.40	.58							-.20		-2.87
	(.12)	(.11)	(.15)	(.16)	(.18)	(.16)							(.27)		(.35)
E_{82}	.06	.08	-.26	-.05	.45	.50	.23							-.06	-3.06
	(.13)	(.12)	(.17)	(.18)	(.20)	(.18)	(.11)							(.27)	(.39)

Note: The estimate of f_{76} is given on line E_{77}.

TABLE 6.

OUTPUT AND WAGE ELASTICITY ESTIMATES FROM TABLE 5.

	q_{77}	q_{78}	q_{79}	q_{80}	q_{81}	q_{82}	Row Sum	w_{77}	w_{78}	w_{79}	w_{80}	w_{81}	w_{82}
E_{77}	.20						.20	-.10					
E_{78}	.18	.12					.30		-.08				
E_{79}	.15	.3	.29				.47			-.07			
E_{80}	.18	.7	.13	.21			.59				-.04		
E_{81}	.24	.12	.6	.3	.21		.66					.06	
E_{82}	.19	.26	-.3	.10	.13	.23	.88						.08

TABLE 7.

ESTIMATION RESULTS; DIFFERENCE MODEL, OUTPUT AND WAGES EXOGENOUS. MINIMUM DISTANCE ASUMPTOTIC STANDARD ERRORS IN PARENTHESES

	q_{77}	q_{78}	q_{79}	q_{80}	q_{81}	q_{82}	Row sum	w_{77}	w_{78}	w_{79}	w_{80}	w_{81}	w_{82}	Row sum	C
E_{77}	.18						.18	.06						.06	.20
	(.04)							(.08)							(.11)
E_{78}	.10	.06					.16	-.30	-.14					-.44	.12
	(.05)	(.04)						(.10)	(.08)						(.13)
E_{79}	.17	.18	.29				.64	-.07	-.01	-.09				-.16	.07
	(.05)	(.05)	(.06)					(.11)	(.11)	(.11)					(.14)
E_{80}	.12	.11	.06	.20			.49	.09	-.03	-.08	-.15			-.17	.10
	(.05)	(.05)	(.06)	(.06)				(.11)	(.11)	(.11)	(.07)				(.14)
E_{81}	.11	-.02	-.02	-.01	.26		.32	-.12	.00	-.12	.06	-.07		-.25	-.17
	(.05)	(.05)	(.06)	(.06)	(.05)			(.11)	(.11)	(.12)	(.10)	(.09)			(.14)
E_{82}	.07	.11	-.01	.07	.09	.14	.47	-.06	-.07	-.04	.01	-.01	-.03	-.20	-.09
	(.04)	(.04)	(.05)	(.05)	(.04)	(.03)		(.08)	(.08)	(.09)	(.08)	(.07)	(.08)		(.10)

TABLE 8.

Log-likelihood ratio tests (L) of exogeneity of output and wages at 5 per cent significance level

S_1 vs. S_2 : L = 4.5 < $\chi^2_{(15)}$ = 25.0

S_2 vs. S_3 : L = 15.4 < $\chi^2_{(15)}$ = 25.0

S_3 vs. S_4 : L = 15.3 < $\chi^2_{(20)}$ = 31.4

S_4 vs. S_5 : L = 23.8 > $\chi^2_{(7)}$ = 14.1

S_1 = both endogenous
S_2 = output endogenous, wages exogenous
S_3 = both exogenous
S_4 = output exogenous, static relationship between wages and employment
S_5 = output exogenous, wages excluded

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Luettelossa mainittuja keskustelualoitteita on rajoitetusti saatavissa kansantalouden osastolta. Kokoelma sisältää tutkimusprojekteja ja selvityksiä, joista osa on tarkoitettu myöhemmin julkaistavaksi sellaisenaan tai edelleen muokattuna. Keskustelualoitteina taltioidaan myös vanhempaa julkaisematonta aineistoa.
- Koska keskustelualoitteet joissakin tapauksissa ovat raportteja keskeneräisestä tutkimustyöstä tai ovat tarkoitetut lähinnä sisäiseen käyttöön, mahdollisiin tekstilainauksiin tai -viittauksiin olisi varmistettava kirjoittajan suostumus.

Tiedustelut: Seija Määttä, puh. 183 2519