
Timo Tyrväinen

**Wage Determination,
Taxes, and
Employment:
Evidence from Finland**

SUOMEN PANKKI
Bank of Finland



BANK OF FINLAND STUDIES E:3

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To my late father, Veikko

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Preface

This study has long roots. In 1975, after finishing my Master's thesis *Price Inflation and Related Research in Finland 1849–1974*, I joined the Economics Department of the Bank of Finland, where I was responsible for analysis and forecasting of a wide spectrum of issues related to price and wage inflation. There I was in an excellent position to gain a comprehensive view of the behaviour of the Finnish economy, its labour market and its institutions. I think that this background was my greatest relative advantage when the present research project started.

Over the past ten years or so, I have been lucky to come into contact with many distinguished economists. Whilst working on my Licentiate thesis *Determination of Wages and Employment in an Unionized Economy*, I received a great deal of encouragement and much wise advice from Steve Nickell, Richard Jackman and Andrew Oswald. They were all members of the staff of the Centre for Labour Economics (London School of Economics) at the time of my stay there in 1989. Some of the main ideas in the studies below date back to these discussions.

The research presented in this volume was carried out in 1991–92, during my stay at the Research Department of the Bank of Finland. In this period, the support and supervision of Erkki Koskela were indispensable. The requirements he set, especially as regards Chapters 2 and 5, took many hours of work to satisfy. I am highly grateful for his tough, demanding and patient position. I think that Erkki possesses the rare ability to make the researchers under his supervision feel that all new requirements imposed on them have the simple goal of improving the quality of their work. In this kind of atmosphere it was inspiring and always easy to reconsider and challenge all aspects of my earlier work.

After much of the empirical research in this volume had already been completed, I learned about the 'Johansen method', which seemed to be ideal for analysis of exactly the kind of questions I had posed. Unfortunately, this method only came to public knowledge at that time. This is why it is only applied in Chapter 4. Fortunately, however, I got to know not only the method but also its 'father' and 'mother', Søren Johansen and Katarina Juselius. Without doubt, this was one of the happy coincidences of my life. Afterwards nothing in my thinking as regards econometrics was the same as before. As far as the symbiotic development of theory and practice is concerned, I have followed with great admiration the cooperation of the Johansen–Juselius team in developing new ways to solve the actual problems raised by the applicants of the procedure. At numerous meetings of the *Nordic Workshop on Multivariate Cointegration*, organized by Katarina and Søren, I have learned a great many things which influence the evaluation throughout the entire volume. This also concerns several discussions with David Hendry.

After having finalized the research reported in the chapters below, I joined the Task Force of the OECD Jobs Study in 1993–94. My main contribution was the report *Real Wage Resistance and Unemployment*, results of which have been widely cited in the final report of the project, *The OECD Jobs Study: Evidence and Explanations*. On the one hand, my work at the OECD was a continuation of the work presented in this volume. On the other hand, the new multi-country study raised new questions. I am particularly grateful to Sven Blondal and Jorgen Elmeskov for their challenging suggestions. When the final text in this volume was edited, these discussions had a major impact.

Many other people have greatly influenced the present thesis, either directly or indirectly. This is to mention but a few of them. At the Economics Department, Seppo Kostiainen has always supported me in my career as a researcher. I have had many highly useful discussions with Antti Ripatti about econometrics. Labour market issues have been on the agenda in talks with Tor Eriksson and Jaakko Pehkonen. The latter also acted as the official examiner of this thesis, together with Vesa Kanniainen.

The brilliant staff of the Bank of Finland has made my life so much easier. The Library of the Bank could hardly be better. At different stages, Anneli Majava and Ulla Sjöblom have provided their statistical assistance. Päivi Lindqvist had the main responsibility for the word processing of the first full version of the thesis. Aila Raekoski then took it over. Malcolm Waters checked the English. And even more, he helped greatly to improve the clarity of expression. Marja Hirvensalo-Niini organized the printing work.

And finally we come to family matters.

Those who are familiar with the vivacity of my wife, Anja, and my two daughters, Taija and Tuulevi, may find it difficult to believe in the endless understanding which I received from them while I was doing this work. Given the zest for living of these three ladies, I also find it surprising – when I think back on it. This is, however, the truth, the whole truth and nothing but the truth. Thank you folks!

This thesis is dedicated to my late father, Veikko. He was a great artist who appreciated scientists very highly – perhaps even too highly, I think. He repeatedly encouraged me to continue with research. Veikko lived to see the beginning of the present research process. Luckily, he had the strange gift of being able to perceive the form things would finally take even before they were properly under way. Therefore, I think that he foresaw the final outcome of this research process as well. My dear mother, Leena, who has always supported me (and my thoughts), surely shares this conviction with me.

Helsinki, Meilahti, June 1995

Timo Tyrväinen

Chapter 1

An Introductory Survey with Summaries of the Other Chapters

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Abstract

The purpose of this chapter is threefold. First, we discuss the recent advances in economics, statistics and econometrics that have been essential for the research presented in this volume. In particular, we consider analysis of trade union behaviour and bargaining models, as well as cointegration and error correction. Second, we present a selective survey of the literature on wage determination, with emphasis on studies applying bargaining models. Third, we briefly summarize Chapters 2–5.

1 Introduction

Interest in the role and behaviour of trade unions has a long tradition (see eg Dunlop, 1944, Leontief, 1946). Broadly speaking, the early literature already concluded that unions could be thought of as bodies which maximize the utility of their members.¹ This presumption carries over to the present research. The exact nature of the welfare function is, however, still a disputed matter in spite of numerous investigations.

Developments in game theory during the 1970s and early 1980s introduced a theoretically well-defined way to link the analysis of union behaviour and the analysis of wage setting. Following the seminal paper by McDonald & Solow (1981), it has been popular to consider bargaining between unions and employers as a game the outcome of which can be described by the classical Nash maximand (Nash, 1953). Binmore et al. (1986) introduced new interpretations of bargaining models which supported this procedure. An empirical contribution which has had a remarkable influence is Nickell & Andrews (1983). Their ideas have been followed in numerous subsequent applications, including part of the research in the present volume.

Bargaining models indicate how an equilibrium between contradicting interests can be defined. The equilibrium concerned is a state from which no party has an incentive to depart once this state has been achieved. However, it was only in the latter half of the 1980s that econometricians and statisticians found ways to distinguish time-invariant equilibrium relations from dynamic short-run variation.

The seminal contributions are Engle & Granger (1987) and Johansen (1988, 1991). The Granger–Engle two-step method considers long-run relations and short-run dynamics separately. This method is applied in Chapter 3 below and in a less standard manner in Chapter 5. In the set-up proposed by Søren Johansen, long-run relations and related dynamic error-correction equations are estimated simultaneously. This procedure is applied in Chapter 4. A more thorough

I would like to thank Katarina Juselius, Vesa Kanninen and Jaakko Pehkonen for helpful comments. Suggestions by Tor Eriksson, Erkki Koskela and Antti Ripatti are also gratefully acknowledged. The usual disclaimer applies.

¹ Part of the early analysis stressed the political nature of trade unions. Accordingly, eg Ross (1948) strongly opposed the idea that unions might be thought of as agents which maximize a well-defined objective function (for a discussion, see Farber, 1986).

introduction to these concepts and procedures will be given in the next section.

The aim of this thesis is to provide a better understanding of the determination of wages and employment in Finland.

Throughout the volume, economic theory related to bargaining models serves as a background. In recent decades, collective wage bargaining has played such a vital role in Finland that this choice is quite natural.

In the empirical contributions, recent methods proposed for estimation of cointegrating relations will be applied. We attempt, as carefully as we can, to distinguish the long-lasting effects from those of only a transitory nature.

In many countries the role of the unions has been steadily declining over the past 10–15 years (see Layard et al., 1991). The Nordic countries are an exception. In Finland, Sweden, Norway and Denmark the unionization rate continued to rise in the 1980s as well. Despite tendencies reducing centralization of wage setting, unions and collective bargaining do not appear to be in the process of disappearing in these countries.

The extent to which union membership has grown in Finland can be seen in Table 1. In the mid-1960s, the unionization rate was 33 per cent. Ten years later it was almost 80 per cent and has risen further

Table 1. Membership of central unions and the unionization rate in Finland in 1965–1990, thousands

	1965	1970	1975	1980	1985	1990
1 SAK*	353	650	920	1032	1055	1071
2 TVK**	152	211	294	325	375	388
3 Akava ***	–	42	130	162	214	278
4 STTK***	–	27	87	115	130	155
5 Total (1+2+3+4)	505	930	1431	1634	1774	1892
6 Number of wage earners	1526	1626	1846	1930	2077	2108
7 Unionization rate (5/6)	33 %	57 %	78 %	85 %	86 %	90 %

* Mainly blue-collar workers; the number for 1965 includes 105 000 members of the former SAJ (Suomen Ammattijärjestö)

** White-collar workers

*** White-collar workers, mainly persons with higher education.

Source: Statistical Yearbook of Finland, various issues.

since. Therefore, it is hardly surprising that the influence² of unions is at the centre of interest throughout the study.

'Real wage resistance' occurs if real labour costs respond to higher taxes and other elements which form the 'wedge', ie the difference between the real labour cost paid by the firm and the real take-home pay which is of importance for the union. If there is such a response, higher taxes reduce employment.

The reason for the special interest in real wage resistance is obvious (see Figure 1). In Finland, the increase in the wedge has been so large that, if real wage resistance occurs, its impact on (un)employment must be of major order.³

According to the empirical results, real wage resistance has been in operation in Finland. Therefore, the most important message for economic policy is that taxation should not be considered in isolation from the labour market. Taxes influence both wages and employment. Because higher taxes are not fully absorbed by changes in nominal wages, lower employment results. This outcome represents an increase in the equilibrium unemployment rate.⁴

Since the early 1980s, higher taxes seem to have led to an increase in the real labour cost amounting to almost 10 per cent⁵ in Finland. Given this estimate and the relevant elasticities of demand for labour presented in Chapters 3 and 4, the resulting reduction in private sector employment is 2–3 per cent⁶.

² In standard bargaining models, unions raise wages. Cross-section analysis of the union-non-union mark-up indicates that it is 15 per cent on average in the USA (Lewis, 1986) and somewhat smaller in the UK (Stewart, 1983 and Blanchflower & Oswald, 1988). In countries like Finland, union wage rates are also applied in non-unionized firms. So, 'union coverage' is effectively close to 100 per cent.

³ If the change in the wedge and the degree of real wage resistance are large enough, in certain estimations this could even generate an upward sloping long-run Phillips curve. This is the result reported for the UK in Bank of England (1992).

⁴ According to the evidence in Chapter 4, the long-run effect is the same no matter whether tax revenues are collected as income taxes, indirect taxes or social security contributions. That is, wages react similarly to a cut in purchasing power which is due to an increase in income tax as to a cut which is due to an increase in value added tax.

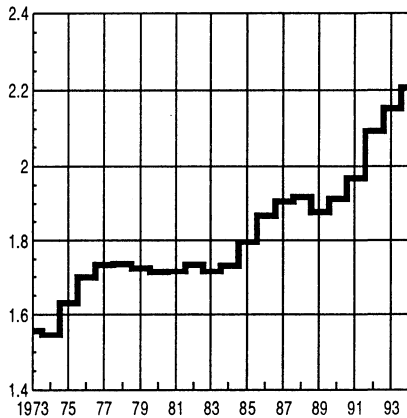
⁵ Tyrväinen (1995a,b) uses OECD estimates for the Finnish income and consumption tax rates for a period starting in the early 1980s and ending in 1991. When tax developments in 1992–94 are added, the estimate of the effect of taxes on the real labour cost is well in accordance with the one presented here.

⁶ The wage elasticity of demand for labour presented in Tyrväinen (1995a,b) exceeds that found in the present study. This is why Tyrväinen (1995a,b) indicates a negative impact of taxes on employment which is three times bigger than the one reported here.

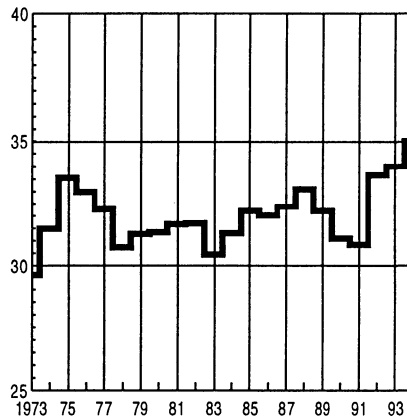
Figure 1.

The wedge and its components in Finland, 1965–1992: private sector, excl. agriculture and forestry

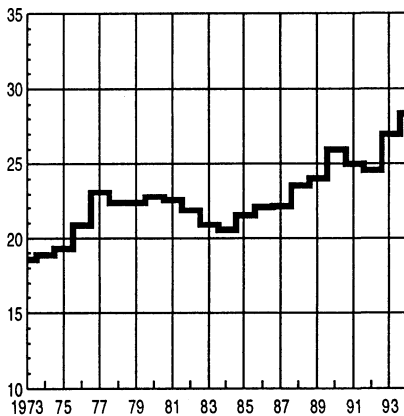
A. The wedge



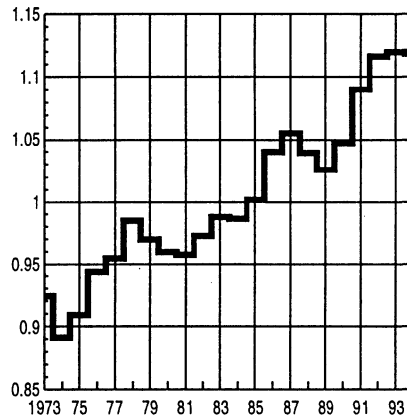
B. The income tax rate, per cent



C. Employers' social security contributions, per cent



D. Price wedge, index 1985 = 1



The aggregate wedge, A, is influenced by B) the (average) income tax rate τ_a of a representative (average) wage earner, C) the employers' social security contribution rate, s , D) the ratio of the private consumption deflator, PC , and producer prices, P , according to the formula:

$$(\text{REAL LABOUR COST})/(\text{REAL TAKE-HOME PAY}) = \text{WEDGE} = (1+s)PC/P(1-\tau_a).$$

2 Cointegration and error correction

In this volume, we are primarily interested in impacts which persist in the long run. In recent years, methods which distinguish long-run relations from short-run variation have been on the agenda of econometric research.

Long run and short run should not be considered in isolation. The latter – in the form of error-correction equations – provides important feed-back to the analysis of the former – ie cointegrating relations. Therefore, both dimensions of the data-generating process will be evaluated throughout this volume.

In this section, a short introduction to some of the relevant concepts is given. To begin, we consider the equilibrium and define properties which endow a relation with this specific and extraordinary character.

2.1 An attractor

Let us suppose that in Figure 2 there is some mechanism existing such that if point (X,Y) moves away from line A, there will be a tendency for it to return towards the line. Because of this property, line A is said to act as an attractor. Owing to the existence of uncertainties, rigidities, contracts etc., the mechanism may not immediately bring the point to the exact position of the attractor, but here will be an overall tendency towards it.

'If the economy lies on A, a shock will take it away. If there is an extended period with no exogenous shocks, the economy will definitely go to the line and remain there. Because of this property, the line A can be thought of as an "equilibrium", of the centre of gravity type' (Engle & Granger, 1991, p. 2).

The attractor is related to the concept of cointegration as follows. Let us consider the relation

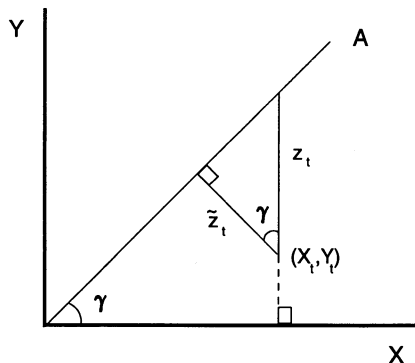
$$Y_t = AX_t + z_t, \quad (\text{ii})$$

where X is one variable or a vector of variables. If the error term z_t is stationary,⁷ $I(0)$, the system is said to be cointegrated. Under this

⁷ Stationarity is a statistical property of a series. A stationary, $I(0)$ -series has a mean m and a constant (or bounded) variance. A series is integrated of order $I(1)$ if it becomes $I(0)$ when differenced once. $I(2)$ series can be defined analogously. Engle & Granger

condition, the line $Y = AX$ corresponds to an attractor for the pair of series $(Y_t$ and $X_t)$ and z_t is the line indicated in Figure 1, which takes a negative value when the point is below the line. $\tilde{z}_t = z_t \cos \gamma$ is the orthogonal (signed) distance from the point

Figure 2. **An attractor**



(Y_t, X_t) to the line $Y = AX$. Since z_t is stationary with zero mean as in (ii) above, then so, too, is its linear transformation \tilde{z}_t (see eg Engle et al., 1991). If X_t and Y_t are each non-stationary, eg $I(1)$, then point (Y_t, X_t) will tend to move widely around the $Y-X$ plane, but as \tilde{z}_t is stationary with zero mean there will be a tendency for the points to be around the line, and thus for this line to act as an attractor. 'It is thus seen that cointegration is a sufficient condition for the existence of an attractor and this attractor can correspond to certain types of equilibrium that arise in macroeconomic theory' (Engle et al., 1991, p. 7).

It is well known that cointegrated variables can always be thought of as being generated by error-correction behaviour (see Engle & Granger, 1987). The intuition of this should be clear from the discussion of the role of attractors and disequilibrium above. In this interpretation, z_t (and \tilde{z}_t) is a measure of the extent to which the system is out of equilibrium. Accordingly, it has been called the 'equilibrium error'. If there is no disequilibrium, there is no incentive for any of the system variables to change.

(1991, p. 5) illustrate the differences in the appearances of $I(0)$ and $I(1)$ series as follows. Firstly, $I(0)$ series are generally less smooth, with more obvious fluctuations than $I(1)$ series. Secondly, an $I(0)$ series returns to the mean value often whereas an $I(1)$ series rarely returns to any particular value, including its starting value.

2.2 Cointegrating relations and error correction equations

Although the empirical analysis in Chapters 3–5 below is mainly concerned with long-run relations, dynamics will be analyzed as well. The error correction property is such a fundamental characteristic of cointegrating relations that its investigation is essential when one seeks to find out whether a certain relation acts as an attractor.

To illustrate this, let us consider a model with n variables, $n > 4$. Four of the variables are wages (W), prices (P), employment (N) and output (Q). An asterisk, $*$, indicates an 'equilibrium' or 'target' level.

In this multivariate model, there are several candidates for cointegrating relations. Four of them are

$$\begin{aligned} W_t^* &= W(P_t, N_t, Q_t, \dots) + z_{W,t}, \\ P_t^* &= P(W_t, N_t, Q_t, \dots) + z_{P,t}, \\ N_t^* &= N(W_t, P_t, Q_t, \dots) + z_{N,t}, \\ Q_t^* &= Q(W_t, P_t, N_t, \dots) + z_{Q,t}, \end{aligned} \tag{ii}$$

where $z_{i,t}$ is an error term as in (i) above with $i = W, P, N, Q, \dots$.

Whether any of the relations in (ii) act as cointegrating relations with the exceptional role of an attractor is a matter of empirical examination. For example, if an equilibrium wage relation is discovered, $z_{W,t} = W_t^* - W_t$ is an equilibrium error which generates error-correcting adjustment. Accordingly, the dynamics of the variables above can be described with error-correction equations like⁸

$$\begin{aligned} \Delta W_t &= f_W(\Delta P_t, \Delta N_t, \Delta Q_t) + \alpha_W(W_{t-1}^* - W_{t-1}) + \varepsilon_{W,t}, \\ \Delta P_t &= f_P(\Delta W_t, \Delta N_t, \Delta Q_t) + \alpha_P(P_{t-1}^* - P_{t-1}) + \varepsilon_{P,t}, \\ \Delta N_t &= f_N(\Delta W_t, \Delta P_t, \Delta Q_t) + \alpha_N(N_{t-1}^* - N_{t-1}) + \varepsilon_{N,t}, \\ \Delta Q_t &= f_Q(\Delta W_t, \Delta P_t, \Delta N_t) + \alpha_Q(Q_{t-1}^* - Q_{t-1}) + \varepsilon_{Q,t}. \end{aligned} \tag{iii}$$

When the Granger–Engle two-step method is used, the four cointegrating relations in (ii) are estimated one at a time without

⁸ We follow here the notation in Johansen & Juselius (1992). Therefore, f_i indicates a linear function of the difference terms. Δi is excluded from this equation, $i = W, P, N, Q, \dots$.

taking account of the others. This is the first step. Unfortunately, the resulting vector can also be a linear combination of various cointegrating vectors present in the system. In the second step, error-correction equations in differences, as in (iii), are estimated one by one. Accordingly, the interaction between levels and differences in one equation and also the interaction between various equations is overlooked. This may make the inference somewhat arbitrary when the Granger–Engle method is used. Of course, because of its simplicity, this procedure still serves as a useful means of 'preliminary' analysis of the data – as in Chapter 3 below.

The Johansen method is more sophisticated.⁹ The number of appropriate cointegrating relations and the presence of a linear trend is a matter of testing. Under the conclusion derived, all relations and equations are estimated simultaneously using the Full Information Maximum Likelihood (FIML) method. Problems related to linear combinations of vectors are kept under control by testing identifying restrictions and considering formal identification – as in Chapter 4.

3 Unions and wage bargaining

The discussion above has vital implications for econometric modelling. They should be borne in mind when we now turn to the economics of wage setting. We proceed by surveying a host of issues related to wage setting in a unionized labour market. We repeatedly also point to specific features which the papers making up this volume share with other contributions in this field.

The microfoundations of union models and the related empirical evidence have been surveyed in several papers. The most widely cited are Oswald (1985), Pencavel (1985) and Farber (1986). More recent contributions include 'Wages and Employment in Unionized Economies: Theory and Evidence' by Holmlund (in Holmlund et al., 1989), and 'Labour Markets under Trade Unionism' by Pencavel (1991).

'Unemployment' by Layard, Nickell and Jackman (1991, below LNJ) presents a comprehensive and highly sophisticated evaluation of the themes emphasized in earlier research. Therefore, by exploiting judgements presented therein we can skip part of the discussion on certain theories and hypotheses, which are less interesting for the present study.

⁹ For a discussion, see Ericsson (1992), p. 273 in particular.

3.1 Union objectives

Today, almost all researchers in this field seem to think that unions maximize the utility of their members. Some say that union leaders have additional interests of their own but either these interests are not dominant or they derive indirectly from members' welfare (for a discussion, see Farber, 1986, and Pencavel, 1991).

However, how the will of the members is expressed is an open question. Unfortunately, the choice in this regard also influences other aspects related to specification of the functional forms. Researchers usually assume that it is the median voter who matters (for the union leadership). According to LNJ (p. 86), 'Union democracy means that unions maximize the welfare of the median member.'

Furthermore, it is generally agreed that the wage enters the union utility function with a positive elasticity. Or more precisely, the relevant variable is the real take-home pay. In most applications, employment is the other relevant variable, it too having a positive elasticity.

Even if the presence of employment in union objectives is accepted, the way in which it enters is a disputed matter. There are two dimensions to this issue. The first concerns the magnitude of the relative weight given to employment. As compared with the weight of the wage, it may be of negligible or of considerable order. The second dimension concerns whether it enters linearly or not. These matters are connected with the hypotheses about the degree of (relative) risk aversion of unions.

The weight given to employment may be zero when the median member is not at risk of being unemployed (for a discussion, see LNJ). On the other hand, LNJ argue that related questions are not necessarily well posed. In situations where employment is likely to rise, unions are not likely to be particularly concerned, since all existing members' jobs are safe. In cases where it is likely to fall, they will be very concerned. Finally, it may be in the interest of the union leadership to have a large number of members. If the unemployed tend to quit the union or cease to pay union fees, this may increase the positive weight given to employment.

The implications of the matters discussed above for qualitative predictions will be dealt with below in Chapter 2. Empirical evidence on union objectives is scarce and not very persuasive (see Pencavel, 1991). This partly reflects the fact that discriminating empirically between competing hypotheses is difficult, as will be seen in Chapter 2.

3.2 The bargaining procedure

The Nash maximand defines how to equilibrate the interests of two optimizing agents, unions and firms, with objective functions $U(\cdot)$ and $\pi(\cdot)$, respectively. The relevant maximand is typically¹⁰ written as

$$(U(\cdot) - U_0(\cdot))^\theta (\pi(\cdot) - \pi_0(\cdot))^{1-\theta}, \quad (\text{iv})$$

where U_0 and π_0 are the so-called fall-back utilities which materialize if no agreement is achieved. θ is a factor introducing asymmetry into the bargaining and here it refers to the relative bargaining power of the union, $0 \leq \theta \leq 1$.

As already stated, the welfare of the union depends on the real purchasing power of wages and employment. Real profit is a matter of interest for the firm which produces with labour as a key input. Since the welfare of both parties depends on wages defined in real terms (W/P) and labour (N), the real wage and employment derive from model (iv) including $U(W/P, N, \dots)$ and $\pi(W/P, N, \dots)$.

The solution corresponds to an equilibrium in the sense described above: if nothing changes, none of the parties has an incentive to depart from the wage-employment combination reached. A novelty, as compared with the Phillips-curve literature, is that the equilibrium is between *levels* of wages and employment.

The next issue concerns the structure of bargaining. The union bargains with a profit-maximizing firm, but about what? The three most commonly applied hypotheses are as follows.¹¹ The first derives from Dunlop (1944) and rejects the bargaining aspect completely by assuming that the union unilaterally defines the wage level taking into account the labour demand condition. The firm then unilaterally sets employment at the profit-maximizing level. The 'monopoly union model' is probably the most widely applied set-up in the literature, at least in studies carried out by Scandinavian economists.

LNJ (p. 96) refute the monopoly union model since 'the union never gets everything it wants. It bargains. Thus we reject an excessively simple model in common usage – the model of the "monopoly union". Under this model the union chooses wages on its own, with no bargaining. Apart from being patently false, this model may give rise to the "paradox of the shrinking union": as union members leave, existing members jack up wages progressively so that

¹⁰ However, there is a strand of literature which introduces complications into this model, analysing the role of repeated games, credible threats, cheating, punishments etc.

¹¹ The model in Manning (1987) will be discussed in Section 4, where extensions to standard models are considered.

no hiring occurs. The paradox is, however, no paradox, since the premiss is false.'

The second model, which is usually associated with Leontief (1946), was elaborated by McDonald & Solow (1981). This model, advocated by many, especially North American authors (see eg Pencavel, 1991), presumes that the bargaining concerns both wages and employment. This model, known as the 'efficient contract model', has been heavily criticized by LNJ. Starting from the notion that there is no evidence on bargaining over employment, they introduce 'a number of reasons why we consider bargaining over employment in general, and "efficient bargaining" in particular, to be unimportant both in theory and in practice' (LNJ p. 193; for theoretical evaluations, see pp. 112-118).

The third model is known as the 'right-to-manage' model and was proposed by Nickell & Andrews (1983). In this set-up, the bargaining is over wages but the employer maintains his right to adjust employment¹² during the contract period. This hypothesis is applied in the empirical analyses in this volume. This is also the approach preferred by LNJ.

Judgments about the specific form of the union utility function and structure of bargaining are complicated by the fact that it is difficult to distinguish empirically between competing hypotheses. Tests tend to be joint tests by nature and the results may be conditional on the choice of the technology.¹³ The results presented in this volume also make it 'clear that any attempt to investigate bargaining structures by studying wage and employment patterns is fraught with difficulty' (LNJ, p. 195).

Potential arbitrariness of any conclusions is one of the reasons for not including testing between these hypotheses on the agenda of the present study. This issue will be thoroughly discussed in Chapter 2 below.

It is worth underlining once again the nature of the wage-employment equilibrium in union models. 'The key feature of these models is that wages are not set to clear the market' (LNJ, p. 173). Thus, the equilibrium being studied cannot be expected to be a full-employment equilibrium.

¹² For most authors it does not seem to make any difference whether employment is measured by the number of employed persons or hours worked. In contrast, Pencavel & Holmlund (1988) let both of them enter their monopoly union set-up. Empirically, differences in the determination of 'heads' and hours is also evaluated in Chapter 3 below.

¹³ LNJ consider the Cobb-Douglas production function to be the most convenient choice which also accords well with their view of the real relationship. This is also the functional form advocated by Hamermesh (1991).

3.3 Local wage setting

Early applications of the bargaining set-up focused explicitly on bargaining between a single firm and a single union. However, as Holmlund (1989) states, this set-up is also applicable to analysis of bargaining at more centralized levels, where coalitions of firms and unions are the bargaining parties.

Contrary to this view, Flanagan (1990) argues that bargaining models should only be applied where central bargaining is concerned. He contrasts contract wages (= 'central *bargaining*') with wage drift (= '*market forces*') in an analysis concerning the Nordic countries. According to many recent contributions, however, a major part of wage drift in these countries is due to local *bargaining* (see Chapter 5 below and Calmfors (ed.) 1990). So, we think that the bargaining approach is also valid for analysis of aggregate earnings, which is a view strongly opposed by Flanagan (p. 411). On this matter, we agree with Calmfors (1990) and Rödseth (1990) that the factors operating at the local level are qualitatively the same as those operating at the central level.

3.4 Centralized vs. decentralized bargaining

It is widely believed that the degree of centralization of bargaining matters. Whether the bargaining procedure should be more decentralized or more centralized is a highly topical question in Finland. Therefore, we address the matter thoroughly here.

Let us consider a case where unions bargain as a united confederation with a single, all-industry, national employers' federation. There are several ways in which this affects the bargaining.

In a centralized bargaining system, the only alternative to employment in the bargaining unit is life on unemployment benefit. However, benefits are paid out of taxes levied on all workers and all workers are in the bargain. They cannot impose the cost of benefits on other workers. In effect, the alternative income in the union's welfare function is zero.

The fall-back income during a strike can be considered analogously. As the union owns the strike fund, there is no 'external' strike pay.

For all intents and purposes, $U_0 = 0$ in (iv) when bargaining is fully centralized. As a consequence, full employment becomes a likely outcome. If there is 'somewhere else to go' full employment is less likely.

The trade-off between real wages and employment is flatter when bargaining takes place at the whole-economy level: '... under decentralized bargaining one man's wage increase is mainly another man's price increase, while under centralized bargaining one man's wage increase is the same man's price increase' (LNJ, p. 132). Looking at it from the opposite angle, a decentralized employer can pass on real wage increases as increases in the relative prices of their products. Centralized employers cannot do this. This presumably stiffens employer resistance.

When centralized bargainers choose a wage in conditions of given money demand, they know how this affects the overall price level¹⁴ and employment. Finally, in centralized bargains unions can take into account fiscal economies of scale. That is, they foresee that, if total employment expands, and with it the tax base, either the public can benefit from better public services or the tax rate can be cut. These effects, which are favourable for employment, are the stronger the weaker are unions.

Summers et al. (1992) attempt to show that the degree of corporatism has influenced the rate of taxation in various countries. The hypothesis is: if the level of labour supply is set by a small group of decision-makers, then these individuals will recognize the linkage between taxes that workers pay and the benefits that they receive. The taxes concerned are income taxes, payroll taxes and the price wedge. Empirical evidence indicates that these taxes are higher in more corporatist nations¹⁵, which is in accordance with theoretical presumptions.

Vartiainen (1992) applies a model with endogenous investment which adds a new dimension to the discussion on centralized bargaining. When labour mobility is high, workers who set wages at firm level see no advantage in wage moderation even if lower wages would lead to more investment, since they can move to other firms. A centralized trade union, on the other hand, can take into account this externality and opt for lower wages if they lead to higher capital stocks everywhere. In contrast to individual labour unions, a centralized trade union may therefore be able to sustain a policy of wage moderation which leads to higher capital accumulation. However, when labour mobility is low, centralized institutions become obsolete. The author concludes: 'If decentralization is chosen, it should be encouraged everywhere, and it should be clear that neither the workers nor the firms act in a coordinated and centralized way. If, on

¹⁴ LNJ conclude: 'Thus, it is fully legitimate to think of bargainers as in effect choosing the real wage' (p. 132).

¹⁵ Weak evidence is also found that wealth taxes and corporate income taxes tend to be lower in these countries.

the other hand, social corporatism is favoured, it should also be as encompassing as possible...' (p. 176).

Interestingly, LNJ indicate that the contrast between decentralized and centralized bargaining is less strong in an open economy. At the whole economy level, the real wage-employment trade-off becomes steeper owing to the fact that, if employment is to grow, real wages have to fall not only to reduce the marginal product of labour, but also to improve competitiveness in order to maintain the balance of trade. Thus, increased openness of an economy makes a system with centralized bargaining less likely to produce full employment. By contrast, decentralized bargaining is somewhat more likely to lead to full employment as the economy becomes more open.

LNJ restate the conclusion presented in Calmfors & Driffil (1988), known as the 'hump-shape' hypothesis. Employment is likely to be highest under fully centralized bargaining, lowest under national, single-industry bargaining and somewhere in between under completely decentralized bargaining. However, in a very open economy, industry-wide bargaining may have only a slightly more harmful effect on employment than completely decentralized bargaining. But complete centralization is better for employment than either of the other cases.

Danthine & Hunt (1992), consider the impact of economic integration and analyze how increased competition in product markets modifies the opportunity set confronting (strong) unions, their optimal strategies, and thus employment and wages. The reasoning is simple but interesting. Integrating two economies means sliding one step down the centralization scale: when two fully centralized economies integrate into one single community, unions must merge for a fully corporatist structure to be maintained. Otherwise, the economy does not enjoy a fully centralized wage-bargaining structure.

The hump flattens significantly as the world economy moves towards more integration. Bargaining at a 'wrong' level becomes less damaging as integration proceeds. In addition, the peak of the hump is moving towards the decentralized extreme. This means that being close to, but not at, the corporatist extreme becomes less costly in a highly integrated world. However, also under 'complete' integration the fully corporatist economy performs as well as the most decentralized one.

Danthine and Hunt conclude that if the process of economic integration is pushed sufficiently far, there should be no problem as regards coexistence of different national wage-setting systems in an integrated Europe. However, the case becomes more complicated if centralized unions are not able to foresee the final effects of the process concerned. Effects of economic integration on unemployment in fairly centralized economies, where unions may find it difficult to adapt long-standing practices to the new circumstances, are likely to be less favourable, at least during the transition period, than suggested by theoretical (comparative statics) analysis.

OECD (1994) summarizes the evidence related to the optimal level of bargaining. The most important evidence in favour of centralized procedures is the low level of unemployment achieved in the Nordic countries over the past decades.

If centralized systems have really supported wage moderation, then it should be primarily private employment which has reacted to the lower cost of labour. The centralized countries should therefore have performed better as regards private employment than the intermediate countries. This has not been the case, however. According to the OECD study, the favourable overall employment record in the centralized countries seems to owe more to the expansion of the public sector than to the structure of bargaining. Furthermore, in recent years unemployment in Sweden and Finland, in particular, has risen dramatically as fiscal drag has halted the growth of public sector employment.

The OECD study also discusses the relation between centralization and wage-wage spirals. While complete centralization prevents leap-frogging by definition, near-complete centralization arguably aggravates any tendencies for wage-wage spirals as rival union blocks attempt to demonstrate their relative merit in achieving wage increases. Since countries with predominantly centralized bargaining are better characterized as being near-completely rather than completely centralized, it is questionable whether their bargaining system has played a key role in preventing wage-wage competition. The OECD study also argues that in a system where bargaining takes place first at the top level and then at lower levels, inflation prones results. This is because the higher-level agreement regularly serves as a floor for the lower-level negotiation and the increases in each level add up.

According to the OECD study, accomodative policies are a precondition for wage-wage spirals: high wage increases do not result in lower employment and the resistance of employers is weakened by the fact that they can pass high wages into prices without serious losses in market shares. But vigorous competition in the product market is also necessary, or unions may be tempted to achieve mark-up over settlements elsewhere in the economy, and the resolve of employers in resisting such demands may be weakened if they can raise prices commensurately.

Calmfors (1994) also reconsiders the 'hump-shape' hypothesis proposed by Calmfors & Driffil (1988). The diversity of effects of centralization makes him hesitant to arrive at unambiguous policy conclusions. The most important of various trade-offs is, in his view, the one between real wage restraint and relative wage flexibility: centralization favours the former but reduces the latter. This suggests that its effect on macroeconomic performance depends on the type of shocks affecting the economy.

4 Extensions to the 'standard bargaining model'

A standard bargaining model' can be characterized by three features. First, it applies a Nash maximand like (iv) with unions and firms as players. Second, unions and firms are optimizing agents with well-behaved objective functions with the properties described above. Third, wages and employment are the two endogenous variables. Other variables influencing union objectives, the profit function or union power are considered as exogenous. Comparative statics defines the hypothesized effects of the exogenous variables on wages and employment.

In this section we consider five kinds of extensions to the 'standard bargaining model'. First, in the literature the Nash maximand has been modified either by replacing employers by a government or by considering the process as consisting of two phases, one defining wages and the other defining employment. The second group of extensions comprises attempts to endogenize some additional factors, eg capital stock or union membership. The third extension involves the introduction of uncertainty in the model, and the fourth is related to relaxation of the partial equilibrium nature of the analysis. The fifth attempts to apply dynamic analysis. Although research in most of these fields is still in its infancy, we briefly refer to some studies of interest.

Let us begin with studies in which the basic model has been modified by arguing that comprehensive unions bargain with a government instead of employers (Hersoug, 1985, Calmfors & Horn, 1985). In (iv), this means replacing the profit function with the objective function of the government. The latter usually refers to the goal of full employment. In the model of Calmfors & Horn, the union determines wages, and the government then responds by setting public employment in a way that makes up part of the resulting employment gap. If unions are myopic, this type of government response is supposed to actually increase unemployment.

LNJ (p. 149) contend that the reasoning above is not persuasive since it is not clear why the government would persist with an ineffective policy. On the other hand, LNJ (p. 136) point out that full employment is guaranteed only if (the absolute value of) the elasticity of substitution (= change in the wage in response to a change in employment) is smaller than a critical value derived from the

bargaining power of the government in relation to the union.¹⁶ If the union is strong – as in most cases where it negotiates with the government – full employment is not possible. In order to reach full employment the union must be weaker than the government.

Manning (1987) redefines the bargaining game by assuming that bargaining takes place in two stages. In the latter stage, employment is bargained over with the wage as given. The bargaining power of the union with respect to employment is denoted by θ_N . The first stage defines wages according to the standard procedure described above. In (iv), the counterpart of θ is θ_w . In this set-up union influence over employment is allowed to differ from that over wages. Since most observers probably agree that, if unions have influence over employment it is probably smaller than over wages, this modification of the standard Nash procedure is of great interest.

Grout (1984) considers the effect of wage bargaining on investment. When there is cooperative bargaining between the union and the firm, underinvestment emerges compared with the situation where explicit or implicit long-term wage contracts are allowed. Van der Ploeg (1987) derives similar conclusions in a non-cooperative set-up. The time inconsistency of wage announcements – announce a low wage to encourage investment, but renege and then ask for a higher wage once the investment has been installed – is a key feature of these models.

Anderson & Deveraux (1988) showed that ignoring adjustment costs removes the time-inconsistency problem. In this spirit, they modified a monopoly union model by incorporating into it an extra dimension of the firm's choice of the capital stock. Holm, Honkapohja & Koskela (1992) further extend the framework of Anderson et al. and present an empirical investigation of interaction between the firm and the trade union in the determination of employment, wages and the capital stock. From the theoretical standpoint, comparative statics does not appear to differ from standard models as far as wages are concerned. As far as employment is concerned, there may be slightly more ambiguity (Holm et al., p. 7).

Vartiainen (1992) also applies a model in which investment and wages depend on each other. One of the testable predictions is as follows. The union's bargaining power is influenced by the firm's future profit stream. Consequently, if a firm's value, as indicated by its stock exchange value, appreciates, workers can capitalize this in their wage. Hence, one expects to see a positive correlation between labour costs and the share price.

¹⁶ Formally, the precondition is that $|\partial \log W / \partial \log N| < 1/\theta - 2$. If the union is stronger than the government, ie $\theta > 1/2$, the right-hand side becomes negative and full employment is beyond reach.

There have been several attempts to model union membership, but few in a bargaining set-up, the attempts of Naylor & Raaum (1992) constituting an interesting exception. Union density is made endogenous through the possibility that a profit-maximizing firm may allocate resources to weaken support for union representation. Interestingly, there seems to be a critical level of membership necessary for the union to be able to obtain a wage mark-up. The firm *either* spends just sufficient resources to reduce the union membership to the level at which the outcome of the wage bargaining equals the competitive wage *or* accepts unionization without allocating any resources in opposition. This critical level varies with the parameters of the model such as the competitive wage and the firm's product market conditions. In particular, the standard positive relationship between the firm's product market power and the wage does not necessarily hold when management opposition is taken into account.

There are not many models where uncertainty has been introduced into bargaining models. Oswald (1982) is an early contribution in a simplistic set-up. In Chapter 5 below, we will examine empirically the impact of uncertainty on wage contracts and wage drift. Another recent contribution is Vilmunen (1992), a study on wage indexation and exchange rate policy which analyzes the effect of uncertainty on the solution of the bargaining game. A general equilibrium structure, or an approximation to it, is considered for a small open economy. Labour contracts are signed before uncertainty is resolved. By comparing the solution of this game with one corresponding to the full information Nash game, the 'mark-up' due to price risk is discovered. The solution has a simple mean-variance structure in that (random) variables correlating positively with variables affecting the union's utility tend to increase contract wage, while negative correlation tends to reduce it. An extension proposed by the author, would be to consider the degree of wage indexation as an object of bargaining.

Lockwood (1990) analyzes tax incidence in a general equilibrium monetary model with imperfect labour and product markets. The price level and real wage are simultaneously determined in a closed economy. In many respects, the results differ from the standard partial equilibrium theory. In particular, Lockwood finds overshifting of income taxes, consumption taxes and wage taxes, both in terms of the price level and real wages, and the degree of shifting tends to be increasing in elasticity of substitution (between labour and capital), rather than decreasing.

Lockwood & Manning (1989) introduce dynamics into the model through employment adjustment costs. Major questions dealt with are: a) are the long-run equilibria of dynamic models qualitatively different from those of static models?; b) how do unions affect the speed of adjustment to equilibria?; c) can tests of union behaviour based on static models be safely applied to dynamic data? The conclusions

indicate that trade unions speed up adjustment to equilibrium in the right-to-manage model but have ambiguous effects in the efficient bargain model. In contrast to the static case, the labour demand curve depends upon variables that affect union preferences, and also on union power, even in the case of the right-to-manage model. Lockwood & Manning (1987) examine dynamics derived from union membership effects.¹⁷

5 Empirical evidence

As Pencavel (1991) notes, it is not straightforward to say what we have learned about trade union objectives from analytical studies. The reason is that these objectives are themselves not directly observable. What is observed is the outcome of a bargaining process in which the union's goals are confronted with management's goals. Therefore, inference about preferences of the union is critically dependent upon auxiliary hypotheses about how these preferences are revealed through the bargaining process.

We discussed above indirect evidence on the structure of bargaining. Based on the Manning (1987) model, Alogoskoufis & Manning (1991) design a test which is supposed to discriminate between competing hypotheses. They conclude that, in the UK, the bargaining structure does not accord with the efficient bargaining model nor with a labour demand curve model. Rather, a more general model with union influence over employment is a more appropriate description of the process concerned. This is in accordance with results obtained for the manufacturing industry in Finland in Chapter 3 below. On the other hand, LNJ (p. 194) argue that the test of Alogoskoufis and Manning can discriminate between efficient and right-to-manage bargaining only in the absence of efficiency wage considerations.

¹⁷ LNJ also tackle general equilibrium analysis although not systematically. In several contexts, they show how the partial nature of analysis in influential studies reduces universal applicability of the hypotheses derived.

What can we learn about wage setting and demand for labour from applications of the bargaining models?¹⁸ The main emphasis in the majority of studies in this strand has been on wage setting. Employment has often been left in the background and inference in this respect derived from the negative wage elasticity of employment. Perhaps these choices reflect the fact that modelling demand for labour offers less scope for new findings generated by the bargaining aspect. In this respect, the distinguishing feature of union models is whether unions have an influence on employment or working hours.

One further remark on the employment issue is worth making here. Research on labour demand usually studies the 'output constant demand for labour' whereas users of bargaining models usually consider the 'capital constant demand for labour' (for a discussion see Chapter 2 below). As a consequence, comparing results surveyed by Hamermesh (1991) with those deriving from bargaining models is not straightforward.

We now consider empirical evidence on wage setting and the bargaining process. Some of the evidence derives from time series estimations and some from cross-section analysis. Since we are primarily interested in aggregate trends and dynamics, discussion on wage differentials between industries, regions and firms as also many other issues of interest will be skipped. The interested reader is referred to LNJ.

5.1 The role of firm- and industry-specific factors

Let us first consider a firm operating in a non-centralized bargaining environment. According to empirical evidence, several external forces, including comparisons with other employees in the company/industry/locality concerned and with pay increases nationwide, are considered to be important. In addition, internal considerations such as profitability and the risk of redundancy appear to be influential in determining pay settlements. Wages are a weighted sum of firm-specific or 'inside' factors and outside factors, with union power generating an additional term. LNJ argue that wage 'flexibility' in

¹⁸ It should be clear that we do not attempt to review all the research on wage setting. We consciously choose to bypass studies dealing with such strands as efficiency wage theories, implicit contract theories, staggered contract models, traditional Phillips-curve models, real-wage gap models à la Bruno & Sachs, the 'Scandinavian model' à la EFO, micro models related to determination of wage differentials etc. We are primarily interested in theories which take into account the bargaining aspect and, therefore, can serve as a background for analysis of aggregate time series in Finland.

response to firm-specific factors is not necessarily a desirable property of wage formation. It is non-competitive in the long run; for, of course, in a competitive labour market firm-specific factors have no role to play¹⁹ (for a discussion, see LNJ). This contradicts much of the reasoning characterizing the Scandinavian debate in recent years.

Importantly, the case appears to be different when bargaining is centralized. LNJ (p. 189) conclude that 'there is a considerable body of evidence that firm-specific or inside factors are important in wage determination, and that the degree to which they are important varies systematically across countries. There is weaker evidence that inside factors are less important when bargaining is centralized or when product markets are more competitive.' Holmlund & Zetterberg (1989) take a more extreme position by arguing that in all Scandinavian countries the insider weight is effectively zero.

A theoretical result confirmed by empirical evidence indicates that sectoral variations in productivity do not lead to *permanent* sectoral differences in wages. Essentially, this is because the growth in employment is accompanied by falls in the industry price, which exerts downward pressure on the industry wage (see LNJ, p. 206). So, in the long run, relative wage structure is independent of relative productivity differences.

5.2 Wage adjustment and (un)employment

The history of unemployment in industrialized countries confirms that wages are not set to clear the market.

In bargaining, wages are influenced by competing interests. The union claims a mark-up of wages over prices. The firm claims a mark-up of prices over wages. The factor which can bring these claims into equilibrium is unemployment. The specific role played by unemployment explains why it is not trended in the very long run despite its trendlike rises in most industrialized economies over the past twenty years.²⁰

Several factors affect the manner in which unemployment influences wages. As already indicated, the effect is increasing in product-market competitiveness and decreasing in the union power. Furthermore, it is decreasing in the replacement ratio (unemployment

¹⁹ Note that when the weight given to insider factors grows, the coefficient of unemployment as an equilibrating factor reduces. According to LNJ, the insider weight is increasing in union power and decreasing in the degree of product-market competition.

²⁰ According to an ADF test, unemployment has been stationary in Finland during the period examined in the chapters below.

benefit relative to the wage level). Indeed, 'the unemployment effect will be decreasing in anything that raises the generosity of the benefit system, notably the length of time for which benefits are payable (the duration of benefits)' (LNJ, p. 200). OECD (1994) also considers the unemployment benefit system as a key factor influencing unemployment.

Given the above considerations, wages are more likely to be more responsive to unemployment under centralized bargaining. Finally, wage pressure at a given level of unemployment is higher if unemployment is falling than if it is rising. The reason for this kind of 'insider hysteresis' is that insiders have become less worried about their jobs.

In countries where hysteresis forces are apparent, short-run equilibrium and long-run equilibrium can be thought to have a specific relation. That is, the short-run equilibrium level of unemployment is a weighted average of the long-run equilibrium and unemployment in the last period. If unemployment in the last period is high, unemployment can be reduced only part of the way towards the long-run equilibrium without generating inflationary pressure. It has been argued that this generates some 'speed limits' for the reduction of unemployment.

If the long-term unemployed are less active in searching for work or are less attractive to employers, then an increase in the share of the long-term unemployed will reduce competition for jobs and raise the probability of a displaced worker gaining alternative employment. LNJ demonstrate that the long-term proportion is a key determinant of the hysteresis coefficient in a wage equation across the OECD countries. Theoretical considerations indicate that hysteresis is increasing in union power and the benefit replacement ratio and decreasing in the degree of production market competition (p. 111).

OECD (1994), as too Tyrväinen (1994), stress the implications of extensions of sectoral collective contracts to third parties. Such statutory extension procedures are currently available in most European countries (see OECD, 1994, vol. II, p. 15). In Finland, collective contracts settled at industry level are automatically extended to all firms and workers in the industry concerned. These extensions tend to reduce competition both in the labour market and in the product market. By doing so, they reduce the pressure of unemployed workers on insiders – both workers and firms. Firms do not have to worry about entrants which compete with lower labour costs. When unions know that their wages will be imposed on non-union workers, an important restraint on wage demands, namely the need to avoid pricing their members out of work, is removed. So, extension procedures support insider behaviour – of both firms and workers – which tends to keep unemployment high once it has risen.

5.3 Real wage resistance

There is an important distinction between *real wage rigidity* and *real wage resistance*. The former relates to slow speed of adjustment. The latter is defined as follows: when firms' labour costs rise in response to exogenous changes which tend to reduce workers' living standards, real wage resistance is in action (LNJ, p. 209). This is the case, for example, when income taxes increase and unionized workers put in for, and obtain, higher wages as compensation.

The relevant real wage for the employer is different from the relevant real wage for the union. The difference is the 'wedge'. As was indicated in Figure 1, the wedge consists of 1) income taxes, 2) payroll taxes, and 3) the relative consumer price, ie the difference between the consumer price and the producer price, P_c/P . The relative consumer price is influenced by indirect taxes, the relative import price of consumption goods weighted with the import share and possibly by profit margins in the trade sector. Empirical analysis of real wage resistance seeks to find out whether changes in the wedge have an impact on labour costs. Whether these effects are temporary or persistent is also a matter of empirical evidence. Persistent effects lead to a shift in the level of equilibrium (un)employment.

In *The OECD Jobs Study: Evidence and Explanations* (Vol. II, p. 247), evidence on real wage resistance is reviewed. Numerous studies have revealed long-run effects of taxes on labour costs. A cross-country analysis by Symons & Robertson (1990) indicates, however, that in the long run the wedge is fully borne by labour. This is in spite of considerable 'short-run' effects which are long-lasting: on average, for 16 OECD countries, a 1 per cent rise in the wedge induces an immediate rise in labour costs of 1/2 per cent, and nearly half of this effect remains after 5 years. Given the further lags in the system this implies that a change in the wedge can have a significant impact on employment for at least a decade. LNJ (pp. 210–211) refer to these long lags found by Symons et al. and suggest that researchers who have considered the effects as 'permanent' may have had difficulties in discriminating between permanent and temporary effects.

So, the most one can say is that there is plenty of evidence that taxes have very long-lasting effects on product wages, and hence on the equilibrium of the economy, operating via real wage resistance.

On the other hand, the distinction between the long run and the short run (or equilibrium and adjustment) has been adequately

addressed in very little of the research carried out in the 1970s or 1980s.²¹

Methods which can be presumed to perform better in this respect are fairly new. The Johansen procedure applied in Chapter 4 below and Tyrväinen (1995a,b) makes it possible not only to distinguish between the long-run equilibrium and short-run dynamics but also to avoid all *a priori* structures in estimations as well as problems related to 'spurious regressions' between trended variables. We can also judge (indirectly) whether structural breaks had 'first-order' impacts on the relationships of interest.

Of course, all inference only concerns the data set and the observation periods which are available. The 'very-very long term', which is not tractable by the data, remains beyond inference. This limitation, however, concerns all empirical studies.

In accordance with Tyrväinen (1995a,b), OECD (1994) presents results of estimations for 10 OECD economies carried out using the Johansen procedure. Signs of real wage resistance were discovered in all the economies examined although it differs in degree across countries (Table 2).

As far as income taxation is concerned, the elasticities in the table incorporate the implicit assumption that marginal and average rates move conjointly. This assumption is of importance as far as Japan, Canada, Finland and Italy are concerned. In these countries a separate effect of an increase in progressivity was found. When the difference between the marginal income tax rate and the average income tax increases, it moderates wage claims. In the wage relation, the coefficient of the progressivity term is .2 in Canada, .5 in Japan and Finland, and .6 in Italy.

Chapters 3–5 provide additional evidence on real wage resistance. They indicate that increases in the wedge have led to a considerable shift in the wage-employment equilibrium in Finland, a downward shift in equilibrium employment being the consequence.

In a broader – 'general equilibrium' – view, the existence of real wage resistance in an open economy tends to lead to losses in the country's international price competitiveness. In Scandinavian countries, with exceptionally high tax rates and strong unions, this is a matter of vital importance. The danger that taxation will have an unfavourable effect on (equilibrium) employment is obvious.

²¹ When standard estimation methods are used, the evidence is heavily influenced by the short-run structure of the information set. The "long-run" is typically solved simply by shifting the lagged dependent variable to the left-hand side.

Table 2.

The long-run response of real labour costs to changes in wedge factors

	Employers' social security contributions	Consumption tax as part of the price wedge	Income tax (average)
Germany	1.0	1.0	1.0
Canada	0.8	0.8	0.8
Japan	0.5	0.5	0.5
Finland	0.5	0.5	0.5
Australia	0.5	0.5	0.5
France	0.4	0.4	0.4
Italy	0.4	0.4	0.4
Sweden	0.0	1.0	0.0
USA	0.0	0.0	1.0
UK	0.25	0.25	0.25

The numbers in the Table indicate the share of a change in the tax rate concerned which remains in the long run as an increase in real labour costs.

Source: OECD (1994) and Tyrväinen (1995a,b)

5.4 Earlier evidence on wage setting in Finland

There are several empirical studies which apply the bargaining approach in the analysis of wage setting and related matters in Finland, among which we can cite Tyrväinen (1988, 1989a,b,c, 1992), Eriksson, Suvanto & Vartia (1989), Pehkonen (1990) and Holm, Honkapohja & Koskela (1994). Finland has also been included in such multi-country studies as Newell et al. (1985), Bean et al. (1986), Alogoskoufis et al. (1988), Calmfors et al. (1990), Flanagan (1990), Layard, Nickell, Jackman (1991), OECD (1995) and Tyrväinen (1995a,b).

Pehkonen (1991) presents a survey of 26 studies on wage formation in Finland, including most of the contributions listed above. The following results were found to be robust. Productivity contributes strongly to real wage growth. If the measure is output/labour input, an elasticity close to one is usually discovered. If productivity is measured indirectly with a capital/employment ratio or an index based on the capital stock as in Chapter 3 below, elasticities are lower. Some studies report fairly long adjustment lags.

Estimations emphasizing real wages indicate that a 1 per cent increase in the unemployment rate lowers real wages by 1–2 per cent.

Estimations emphasizing nominal wages indicate that wage growth is reduced by 1 percentage point. There is no indication of that unemployment benefits have any effect on wages. This is perhaps not so surprising in the light of the discussion in LNJ about endogeneity of the benefit system in a centralized bargaining environment.

Results for real wage resistance and union effects are less clear. If one calculates an average for the studies concerned, it would seem that in the longer run approximately 30–40 per cent of an increase in income taxes will be compensated in the form of higher pre-tax wages. Some studies, however, report a zero effect (eg Eriksson et al., 1990)

Usually, the income tax system is described by one parameter only, either the average or the marginal income tax rate. Eriksson et al. (1990) is an exception as it attempts to discriminate between the implications of average and marginal income tax developments. The results are not encouraging, however.

According to most studies, employers' social security contributions (payroll taxes) do not have a big effect on labour costs. This indicates that nominal wage growth has been adjusted quite strongly. The average of the elasticities introduced in the studies surveyed implies a long-run elasticity of around 80 per cent and a short-run effect of around 60 per cent. Again, the results vary greatly. In addition, the ways in which the long-run effects are distinguished from the short-run effects are far from satisfactory. Therefore, the most one can say is that a large part of a reduction in payroll taxes is shifted backwards to higher nominal wages, *ceteris paribus*, and *vice versa*.

Results related to the price wedge, P_c/P , are even more vague and estimates more imprecise. In addition, Pehkonen notes that the choice of the left-hand-side variable appears to influence conclusions.²²

Finally, although effects of union power have been analyzed in some studies, Pehkonen hesitates to draw any far-reaching conclusions concerning the evidence.

The unclear results with respect to the wedge effects and union impact have been a major motivation for the present collection of studies.

²² When the 'real consumer wage', W/P_c , is on the left-hand side, P_c/P does not enter significantly. If the dependent variable is the 'real production wage', $W(1+s)/P$, the coefficient concerned does not differ significantly from zero either. Hence, the conclusion as to whether nominal wages have adjusted fully or not at all depends on the implicit structure of the estimating equation. This is an important issue related to the formulation of the H_0 -hypothesis. We discuss this matter more thoroughly in Chapter 4 below.

A different approach to adjustment is taken by LNJ, who emphasize wage rigidity in relation to unemployment dynamics.²³ In Finland, real wage rigidity appears to be low by international standards. This means that unemployment does not need to change much to induce adjustment. This is well in accordance with the hypothesis introduced above that, in a centralized wage bargaining system, wage setters can anticipate changes in cyclical trends. Therefore, a low degree of real wage rigidity might be a property deriving from the centralization of wage setting.

On the other hand, nominal wage rigidity in Finland is very high.²⁴ This combination – low real wage rigidity and high nominal wage rigidity – is exceptional. It accords with the fact that real labour costs have been adjusted through inflation in Finland. Repeated exchange rate realignments – ‘devaluation cycles’ – have been the consequence. Rigidity of nominal wages helps to explain why devaluations have been so deeply rooted in the Finnish economy. Of course, the behaviour discussed can only be sustainable if all agents – including the government – optimize taking future currency depreciations as a presumption for their strategies.

In Figure 3, years in which there were major exchange rate impacts have been shaded.²⁵ Obviously, there is a particular relation between the level of the unit labour cost in Finland and in competitor countries.²⁶ In the longer run, no permanent effect of exchange rate realignments on competitiveness can be discerned.

²³ In order to discuss wage rigidities, LNJ (pp. 56–60 and Chapter 9) study elasticities in real wage and real price equations and relate them to unemployment dynamics. This allows the authors to draw conclusions about the degree of real wage rigidity and nominal wage rigidity in 19 OECD economies. Low rigidity means that unemployment does not need to vary much to induce adjustment.

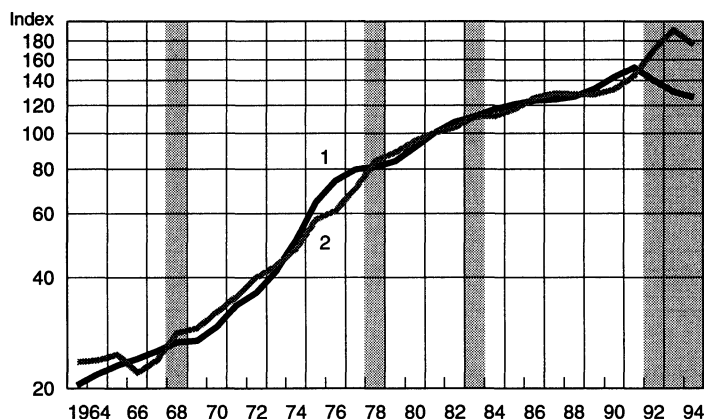
²⁴ Theoretically, the extent of nominal inertia in wage setting depends positively on duration of wage contracts or agreements and negatively on the extent of synchronization and indexation. In Finland, wage contracts are not of particularly long duration and synchronization is very high. These properties should indicate low nominal inertia, which contradicts empirical evidence from Finland. On the other hand, indexation has been prohibited by law since 1968.

²⁵ If a devaluation takes place in the final months of a particular year, the major part of the effect is evident in the annual average for the following year. Another clarification is as follows. The Markka has been floating since September 1992. Initially there was an excessive market-led depreciation. Since early 1993, however, the Markka has appreciated considerably.

²⁶ Cointegration is accepted at the 1 per cent confidence level by standard ADF and CRDW tests.

Figure 3.

**Unit labour costs in manufacturing industry
in Finland and 14 competitor countries,
1963–1992***



In common currency, 1981 = 100

* The figures for 1992 are forecasts.

- 1 Finland
- 2 Competitor countries

The unemployment rate in Finland has tended to be below the average rate in competitor countries. Whenever it has been higher, unit labour costs in Finland have responded. This was the case at the end of the 1960s, at the end of the 1970s and during the recession in the early 1990s. A widely held notion is, however, that lost competitiveness has, in the past, always been restored through a reduction in the foreign currency value of Finnish labour costs, ie through an exchange rate realignment. This constitutes the core of the particular combination of low real wage rigidity and high nominal wage rigidity typical of the Finnish economy.²⁷

²⁷ LNJ (1991) present results of a multi-country study which comes to the same conclusion.

6 Summaries of the chapters

The remaining four chapters of this volume consist of separate papers written at various times over the past few years. Therefore, it is only natural that certain issues have been reconsidered during the research process when more advanced procedures have been found to solve problems of interest.

Since the intention is that it should be possible to read each chapter independently, some overlapping is inevitable.

In the literature, there are two prevailing ways of selecting estimating relations. One makes explicit assumptions concerning utility functions of unions, production functions etc. and seeks to estimate various structural parameters. This is the method applied by eg Pencavel (1985) and Pencavel & Holmlund (1988). A competing method seeks merely to specify the relevant variables and to search for functional forms more or less on an *ad hoc* basis. The latter approach is followed by, *inter alia*, Nickell & Andrews (1983), Bean, Layard & Nickell (1986) and Calmfors & Forslund (1990).

In the empirical analyses below, we usually follow the latter approach, which appears to be by far the most popular, especially among British economists. However, in Chapter 2, we evaluate whether hypotheses with special interest for the empirical applications are sensitive to the choice of model.

6.1 Tax incidence in union models (Chapter 2)

Above we discussed the real wage resistance which occurs when increases in taxes lead to increases in real labour costs. Evaluation of this phenomenon in the context of Finland is on the agenda of the empirical studies included in this volume. To obtain a better background, Chapter 2 considers theoretically the role of taxes in differently specified bargaining models.

In Chapter 2, we examine several aspects related to tax effects, paying particular attention to whether the qualitative hypotheses proposed are model-specific, ie whether they are sensitive to specification of various functional forms. With this end in view, we consider three union models with alternative specifications of union preferences and examine the effects of four tax parameters on both wages and employment.

In the majority of the literature – both theoretical and empirical – applying union models, it is assumed that the union acts as a

monopolist. Because serious doubts have been cast on this model,²⁸ it is of special importance to find out whether the conclusions derived in this set-up also hold in other union models.

Summarizing the comparative statics concerning the wage effect of taxes, the signs are mostly ambiguous without restrictions on some elasticities. This is in accordance with results for competitive markets. In the present context, the distinguishing feature appears to some extent to be whether the variable enters via the preference function of the union or of the firm.

The effect of the payroll tax, which enters via the profit function, cannot be signed without specific assumptions concerning technology, the union's preference function and the bargaining structure.

Steeper progressivity in income taxation reduces the equilibrium wage in all models²⁹. The effects of the other two relevant tax factors depend on the properties of the union preference functions. Under the most plausible hypotheses concerning the strategic elasticities, the hypotheses are not particularly sensitive to the set-up chosen. In this respect, the Stone-Geary function is an exception.

The decisive elasticities are the weight given to employment and/or the concavity of the preference function with respect to employment. In general, the parameter values which we consider to be the most plausible indicate that a higher proportional income tax probably leads to higher wages³⁰ and higher indirect taxes have the same effect. However, with the Stone-Geary utility function the proportional income tax and the indirect tax cannot be signed.

If unions are insider-dominated, the results usually remain unchanged.

With most preference functions, changes in payroll taxes have no wage effect in the monopoly union model. In the right-to-manage and efficient bargaining models, the results indicate ambiguity in general.

In general, the models seem to indicate partial incidence. This is in accordance with empirical findings indicating the existence of real wage resistance. A closer look at various formulas reveals that the hypothesis of the irrelevance of *de jure* incidence does not hold in union models.

The analysis also indicates that empirical discrimination between hypotheses concerning the structure of bargaining is not easy. Evidence on union preferences derived from wage equations would not be easy to interpret either. So, we are not likely to learn much

²⁸ See the discussion above due to LNJ.

²⁹ This result is in accordance with Koskela & Vilmunen (1994). The specification in Creedy & McDonald (1991) leaves this effect ambiguous.

³⁰ The conclusion in Creedy & McDonald (1991) is exactly the same.

about union objectives by estimating wage equations. Employment equations might offer some hope.³¹ On the other hand, the results are generally so similar that, even though our knowledge of union preferences is not completely accurate, this does not inevitably reduce the relevance of empirical applications derived from union models. This is especially true as far as wage equations are concerned.

The monopoly union model and the right-to-manage model share the property that firms operate on the downward sloping labour demand curve. Hence, tax changes which lead to higher labour costs tend to reduce employment.

In the efficient contract model things are different and the rule-of-thumb of opposite wage and employment effects does not necessarily hold. Technically, this is because the profit-maximizing condition has been relaxed and replaced by the pareto optimality condition. These two conditions do not generally coincide, although special cases can be found where they do.

As far as the tax effect on employment is concerned, it is opposite to the wage effect when the contract curve is downward sloping. Since in this case the contract curve has a similar shape to the labour demand curve (although the former is located to the right of the latter), the comparative statics is qualitatively identical. When the contract curve is upward sloping, the tax effect on the wage and on employment has the same sign. There is no effect on employment if the contract curve is vertical. Both the specification of union preferences as also specific parameter values in these functions influences the slope of the contract curve.

The analysis in Chapter 2 is partial. In a broader context, a tax shift which induces the union to push up wages weakens the competitive position of the country concerned. Losses in market shares reduce exports and, thereby, growth of output. In most models, this leads to lower employment and – sooner or later – to downward adjustment in real wages. In a general equilibrium set-up, this may well neutralize the original wage effect. Owing to nominal rigidities and union resistance, the process concerned may be prolonged. It may involve devaluations and become painful because of substantial fluctuation in unemployment and interest rates. For an understanding of the nature of the processes that tend to be generated by shifts in tax rates, we consider the analysis presented in Chapter 2 has a role of its own to play.

³¹ We discussed above the test proposed by Alogoskoufis & Manning (1991) for discriminating between hypotheses concerning bargaining structure. The test exploits employment equations rather than wage equations. In Chapter 4 below, we make use of some of this model's ideas.

6.2 Unions, wages and employment (Chapter 3)

Chapter 2 was concerned with a theoretical evaluation of the role of taxes in different model specifications. In the Chapter 3, we proceed to the empirics.

In this Chapter, we specify a set-up to be applied – with slight modifications here and there – in the rest of the volume. It is assumed that unions and firms maximize well-behaved welfare functions. Firms are identical and produce with a three-factor technology: labour, raw materials and capital are the inputs. The capital stock is treated as predetermined. Imperfect competition is assumed to prevail in product markets. Bargaining between firms and unions is defined according to the right-to-manage hypotheses. Two endogenous variables derive from the model: wages and employment.

Reduced-form wage and employment equations are estimated using the two-step method proposed by Engle and Granger (1987). These are the first attempts to identify cointegrating relations acting as attractors and having the characteristics of wage setting and demand for labour schedules. The results are highly encouraging. Standard cointegration tests, properties of residuals and the apparent error correction property are the evidence.

According to the results, wages and employment are influenced by variables which determine profits, on the one hand, and the utility of the union, on the other hand. In addition, bargaining power appears to matter. This is all as expected.

To be more precise, union strength is found to have a positive effect on wages both in the aggregate private sector and in the manufacturing industry. In the latter, the positive effect is on both wages and employment. Because this contradicts *a priori* expectations due to the right-to-manage hypothesis, this hypothesis is rejected as far as the manufacturing industry is concerned.³² As the union density rate – used as the proxy for union power – is a key right-hand-side variable, we can draw a further conclusion. We can reject the monopoly union model, where union power in wage determination is by definition (constantly) one. If there were no variation in union power, it would be captured wholly by the intercept of the equation.

³² In fact, we are inclined to conclude that the bargaining procedure concerned lies between the efficient bargaining and the right-to-manage models, which is in accordance with the conclusion of Alogoskoufis & Manning (1991) for the UK. In a test where the 'general bargain model' of Manning (1987) nests the 'efficient bargain model' which, in turn, nests the 'labour demand curve model', the latter two specifications were clearly rejected. In addition, the method applied does not allow us to test formally the strict validity of the result concerning the union power effect on employment.

This is especially so in Finland where union wages are also applied to non-unionized workers.

The hypothesis of monopolistic competition in product markets gains support, since the demand shift factor – no matter how it is proxied – is a key explanatory variable. Real wage resistance is apparent. Higher income taxes add to wage pressures although not with a one-to-one impact. A rise in employers' social security contributions is only partly shifted backwards to lower wages. Part of an increase in the price wedge (P_c/P) is compensated in real wages, and hence higher labour costs result. Because of real wage resistance, weaker competitiveness and lower employment result. Higher import prices of raw materials and energy reduce both real wages and employment.

Short-run adjustment is evaluated by means of dynamic simulation. Step response functions indicate that adjustment is not particularly slow in general. This is in accordance with studies referred to above which indicate that real wages in Finland are fairly flexible. Importantly, flexibility also applies to employment. Hence, if the actual real wage-employment combination is considered inappropriate, it is not primarily due to 'too slow' adjustment. Rather, it implies that the equilibrium is inappropriate. This is a message which ought to have a profound impact on economic policy.

6.3 Wage Setting, Taxes and Demand for Labour (Chapter 4)

Chapter 3 provided the preliminary analysis of the cointegrating relations. In the Chapter 4, we attempt to identify more adequately the relations of interest. This also concerns the point estimates of the relevant elasticities. Real wage resistance and union effects are again of special interest.

A 10-dimensional vector space is defined as the outcome of a modelling exercise. In general accordance with earlier evaluations, the variables entering the unrestricted VAR model are: 1) nominal wages, 2) producer prices, 3) employment, 4) output volume, which enters as a proxy for the demand shift factor, 5) the average income tax rate, 6) the marginal income tax rate, 7) the rate of employers' social security contributions, 8) the price wedge, ie the consumer price relative to the producer price, 9) import prices of raw materials (incl. energy) and 10) the unionization rate, which acts as a proxy for the

bargaining power of the unions.³³ As the system is overparametrized as such, the number of estimated parameters is reduced by means of conditioning. In contrast with the Engle & Granger method, no *a priori* restrictions are imposed concerning the endogeneity or (weak) exogeneity of any variable.

Structural restrictions identifying the long-run relations of interest are specified and tested. Tests are performed for wage and employment relations, first partially, for one relation at a time, and then, after this preliminary analysis, the two relations are estimated jointly with all identifying restrictions imposed and tested.

Generally, restrictions satisfying the condition for formal identification pass tests at a fairly high significance level. The plausibility of the resulting cointegrating relations applies not only to the signs but to the magnitudes of the coefficients as well.

The relationships show up almost identically in partial and full analysis. They do not appear to be sensitive to the choice of four or three cointegrating relations in the system. Finally, the relations are hardly influenced at all by alternative assumptions concerning endogeneity of tax rates. Therefore, we consider these long-run relations to be robust.

According to the results, in the private sector in Finland neither of the bargaining parties – employers or employees – has gained complete dominance in the wage-setting process. However, coefficient estimates indicate that adjustment in the long run may have reflected union goals somewhat more closely.

Evidence on real wage resistance is clear. An equiproportional increase in average and marginal income tax rates is shifted to a higher pre-tax wage level with an elasticity of around two-thirds, which is also the magnitude of the effect on the real labour cost. The effect of the payroll tax and the indirect tax on the labour cost is exactly the same. Stronger unions have pushed up the wage level. The significant role of the union density variable is in accordance with bargaining models. Higher real raw material prices reduce wages. The driving force of real wage growth is productivity growth.

As far as demand for labour is concerned, it is only influenced by factors which enter the profit function and the negative impact of real labour cost is clear-cut. The equilibrium employment level appears to be on the labour demand curve. Since income taxes and indirect taxes, which enter our set-up via the union utility function are insignificant,

³³ The unemployment rate is one of the variables excluded because of the restrictions related to the dimensions of the model. Since the unemployment rate is stationary in the estimation period, its presence would probably not influence the cointegrating vectors. Therefore, omitting the unemployment variable does not affect the inference.

potential evidence against the efficient bargaining model is discovered.³⁴ This result concerning the aggregate private sector is in broad accordance with the inference in Chapter 3.

6.4 Wage drift and error correction (Chapter 5)

This final chapter examines the process which generates wage increments in excess of those agreed upon centrally, ie wage drift. In particular, we seek to show that wage drift can be analyzed and understood in a framework emphasizing equilibrium and adjustment, ie in a set-up familiar from the previous chapters.

A synthesis of explanations common in the literature is first sketched. This attempt is strongly motivated by the notion that the time series properties of the wage series we are interested in differ significantly from each other.

The time series properties of aggregate nominal wages are similar to those of contract wages. Both series are non-stationary. The properties of wage drift are different. Because wage drift is stationary over the observation period, it cannot be considered to be an independent factor contributing to the long-run trend growth in wages. Instead, it has a specific role in the adjustment process.

Wage drift acts as an error-correcting factor but the adjustment is not towards the competitive wage. The equilibrium is defined by the bargaining process. Since adjustment is not instantaneous, present wage drift is also influenced by 'equilibrium errors' stemming from the past. Additionally, a robust inverse correlation between contract wages and wage drift is detected.

If the dispersion of financial prospects faced by firms – measured by the standard deviation of the stock of orders – is large, wage drift tends to be larger than otherwise, *ceteris paribus*. In addition, wage drift is closely related to excess demand for labour. Finally, the size of wage drift appears to vary in accordance with the magnitude of expectational errors concerning the inflation rate.

Wage drift has consistently been positive. This is as one might expect since uncertainty about the state of the world during the contract period is permanently larger *ex ante*, ie at the time the contract wage is settled.

A vital policy implication concerns the role of the government as a partner aiming to pave the way for moderate wage contracts. In Finland, unions are typically first requested to approve a moderate wage contract. The government then backs the pact with accomodative

³⁴ Note the discussion on the validity of this procedure in Section 4 above.

policy measures (eg tax cuts). During the contract period, an increase in wage drift starts to undermine the desired wage moderation. In the light of the analysis above, this is as expected since government action increased the equilibrium error which is the driving force of wage drift.

In one sense, the institutions – centralized bargaining – do not appear to add much to the determination of wages. For example, Jackman (1990) points to rather similar wage paths in countries with centralized and decentralized bargaining. In another respect, however, institutions may matter a lot. This is especially so when the economy has moved off course or serious imbalances are on the point of emerging. In these circumstances, synchronized contracts and centralized wage setting offer an opportunity for discrete adjustment. This indicates less delay in adjustment of actual (real) wages towards equilibrium.

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Chapter 2

Tax Incidence in Union Models

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Abstract

In this chapter we examine several aspects related to tax effects paying special attention to whether the qualitative hypotheses put forward are model-specific, ie whether they are sensitive to specification of various functional forms. With this end in view, we consider three union models with alternative specifications of union preferences and examine the effects of four tax parameters on both wages and employment.

The main results are as follows. The hypothesis of the irrelevance of *de jure* incidence does not appear to hold in union models. Most of comparative statics is *a priori* ambiguous without restrictions on either the union's objective function or technology. However, given the most plausible assumptions about the decisive elasticities, the results are fairly similar across the models. Steeper progressivity in income taxation unambiguously moderates wage claims. In the models applied, the effect of a higher proportional income tax, as well as that of a sales tax, is ambiguous without the imposition of restrictions the on union's objective function but the parameter values which can be considered to be the most plausible indicate that there is a positive impact on the pre-tax wage in most cases. Generally, payroll tax has an *a priori* ambiguous effect on wages. Under plausible assumptions about technology, a rise in the payroll tax rate has no impact on wages in the monopoly union model. In the right-to-manage model and in the efficient bargaining model the impact is ambiguous.

1 Introduction

Kotlikoff & Summers (1987) survey the literature on tax incidence in a competitive economy with clearing markets. Given the choice of the model and the issue concerned, the results are generally ambiguous without additional restrictions on the precise nature of preferences and technology. The sensitivity of judgements to a large number of elasticities is stressed. One of the few widely accepted conclusions concerns the irrelevance of *de jure* incidence, ie that the incidence does not depend on which side of the market the tax is levied. The burden is borne by the side which cannot easily adjust. According to Kotlikoff & Summers, these principles carry over to much more general contexts and underly the general equilibrium results as well.

In this chapter, the focus is on a unionized labour market. Two topics are of special interest. First, do the two characteristics of competitive models (the irrelevance of *de jure* incidence and the sensitivity to various elasticities) hold in the union framework? Second, are the hypotheses concerning tax incidence sensitive to the specification of 1) the structure of the bargaining and 2) union preferences? Up till now, a thorough analysis of these issues has been lacking.¹ As there is no accurate empirical evidence on either the structure of bargaining or the proper description of union preferences, researchers have usually chosen one of the specifications on the basis of personal preferences.² To see whether this is essential for the hypotheses concerning tax incidence, the comparative statics for the commonly used models is derived.³ Earlier contributions in which tax

This chapter has benefited from useful discussions with Erkki Koskela and comments by Vesa Kanninen. Suggestions by Bertil Holmlund and Jaakko Kiander are also gratefully acknowledged. Needless to say, the usual disclaimer applies.

¹ According to Farber (1986, p. 1068), 'an interesting and important agenda for future research is a careful exploration of exactly how much *a priori* structure has to be put on objectives and/or the bargaining process in order to learn something useful from bargaining outcomes about both union objectives and the bargaining process'.

² According to Pencavel (1985, p. 223) the 'agreements in model building have not arisen because of persuasive evidence of the empirical relevance of these modelling assumptions, but because of the theoretical convenience of certain simplifying assumptions and because of their conformity with analogous assumptions in other areas of economics... In view of this, it would seem ill-advised to place much reliance on these models for the purpose of macroeconomic policy evaluation and prescription'.

³ Of course, not all possible models are covered by our exercise. In particular, we do not consider models in which unions optimize knowing that part of the tax revenues will be returned to union members as transfers. A complication of this kind would, however, hardly influence the comparative statics.

incidence is analyzed in the context of union models include Hersoug (1983), Holmlund (1989), Creedy & McDonald (1991), Andersen & Rasmussen (1992) and Lockwood & Manning (1993).

In this chapter, we consider a partial equilibrium.⁴ As in the vast majority of the literature on union models, the analysis is static by nature. According to Kotlikoff & Summers (1987, p. 1050), 'static models can provide considerable insight into the incidence of taxation in the short run, ie before capital stocks have adjusted to changes in after-tax prices. In addition, many of the conclusions of static tax analysis can be directly applied to the case of the long-run dynamic incidence'.⁵

2 The model

As the discussion above indicates, we wish to distinguish the 'union-side' from the discussion concerning technology, price setting, endogenous capital formation etc., which are issues common to all literature analyzing tax incidence. In order to keep the 'firm side' of the model simple, we consider a small open economy where (identical) firms take the producer price, P , as given by the world market.⁶ Furthermore, we normalize this price variable to unity, $P = 1$. Profits are defined as the difference between sales revenues and production costs:

$$\pi = F(N) - W(1+s)N \quad (2.1)$$

⁴ The general equilibrium case has been analyzed by Lockwood (1990).

⁵ After the first draft of this chapter was completed, we discovered that Creedy & McDonald (1991) had examined similar issues. The aspects covered in the two studies are, however, somewhat different.

⁶ Of course, the assumption that firms are price takers also holds in models with competitive product markets. In Chapter 3, we examine a bargaining model with endogenous producer prices. The first consequence is the introduction of a proxy for the demand shift factor. In addition, the extent to which the parties bear the tax is influenced by the shape of the demand curve (see Stiglitz, 1988, pp. 423–425).

where W = the nominal wage per worker, N = employment⁷ and s = the payroll tax. $F(N)$ summarizes the technology, $F' > 0$, $F'' < 0$.

The key elements in the union utility function are the real take-home pay, \hat{W} , employment and the alternative income, eg unemployment benefit in real terms, B :

$$U = U(\hat{W}, N, B), \quad \text{where } \hat{W} = \frac{W(1-\hat{\tau})}{(1+v)} \quad (2.2)$$

and $U_W > 0$, $U_N > 0$, $U_{WW} < 0$, $U_{NN} < 0$. $\hat{\tau}$ refers to the income tax rate⁸ and the consumer price has been written in terms of the indirect tax, v (eg value-added tax): $P_c = P(1+v) = (1+v)$, because we assumed above that $P = 1$.

We consider four alternative specifications of union preferences. The first and the second have been widely applied in the bargaining literature. The third and the fourth are more common in other areas of economics.

The *utilitarian utility function* is

$$U(\hat{W}, N, B) = N \cdot u(\hat{W}) + (M-N) \cdot u(B), \quad (2.3)$$

where M = union membership, which is given exogenously, and we assume $M \geq N$, as usual. It is noteworthy that $U_N > 0$ only holds when $u(\hat{W}) > u(B)$, which also requires that $\hat{W} > B$, which we assume to hold throughout the chapter.

The *Stone-Geary utility function* is

$$U(\hat{W}, N, B) = (\hat{W}-B)^{1-b} N^b, \quad (2.4)$$

where b indicates the relative weight given to employment, $0 \leq b \leq 1$. Again, $U_N > 0$ implies that $\hat{W}-B > 0$.

The *iso-elastic, additively separable utility function* is the third specification

⁷ In the present context we assume that the number of hours worked per worker is constant. So, it makes no difference if employment is measured in terms of heads or hours.

⁸ We consider two kinds of $\hat{\tau}$'s below. One refers to a proportional income tax system and the other to progressivity in a progressive system.

$$\begin{aligned}
U(\hat{W}, N, B) &= u_0(\hat{W}-B) + u_1(N) \\
&= \frac{(\hat{W}-B)^{1-\delta_0}}{1-\delta_0} + b_1 \frac{N^{1-\delta_1}}{1-\delta_1},
\end{aligned} \tag{2.5}$$

where $b_1 \geq 0$ indicates the weight given to employment and $u_0' > 0$, $u_1' > 0$, $u_0'' < 0$, $u_1'' < 0$. It is noteworthy that

$$\delta_0 = -\frac{u_0''(\hat{W}-B)}{u_0'} \quad \text{and} \quad \delta_1 = -\frac{u_1''N}{u_1'} \tag{2.6}$$

have their counterparts in Arrow-Pratt measures of relative risk aversion with regard to (net) wages ($\delta_0 = R_w^c$) and employment ($\delta_1 = R_N^c$). Of course, this characterization – although commonly applied – is somewhat loose since there is no risk in our analysis.

Obviously, (2.5) is not defined when $\delta_0 = 1$ and/or $\delta_1 = 1$. However, it can be shown that when δ_0 and δ_1 approach unity, we discover, as a special case, the *logarithmic utility function*

$$U(\hat{W}, N, B) = \log(\hat{W}-B) + b_1 \log N. \tag{2.7}$$

The outcome of the bargaining game between the firm and the union is commonly specified as the Nash solution where the parties maximize the product of utility increment over the fall-back utilities U_0 and π_0 which refer to a situation where the bargaining breaks down. We assume⁹ that $U_0 = \pi_0 = 0$.¹⁰

The standard hypotheses concerning the structure of the bargaining are as follows. In the *efficient contract model* the problem is

⁹ In Finland, which is a highly strike-prone economy by international standards, a strike is the relevant alternative to a contract. During a strike, union members usually receive strike allowances which are funded union fees and, hence, endogenous by nature. On the other hand, during a strike the union can be considered to be a bargaining party which has no income (= union fees).

¹⁰ Lockwood & Manning (1993) arrive at this by assuming that, in the event of a disagreement over wages, no union members are employed and therefore $U_0 = 0$. As these union members cannot profitably be replaced by outsiders, then $\pi_0 = 0$ as well.

$$\max_{W,N} \Lambda = U^\theta \cdot \pi^{1-\theta}, \quad (2.8)$$

where θ is a measure of the bargaining power of the union, $0 \leq \theta \leq 1$. By imposing the profit-maximization condition on (2.8), we have the *right-to-manage model*

$$\max_W \Omega = U^\theta \cdot \pi^{1-\theta} \quad \text{s.t. } N(\cdot) = \arg \max_N \pi. \quad (2.9)$$

By setting $\theta = 1$ in (2.9), we obtain the *monopoly union model*, in which the union sets the wage unilaterally:

$$\max_W U \quad \text{s.t. } N(\cdot) = \arg \max_N \pi. \quad (2.10)$$

In this model, the union acts as a Stackelberg-leader with respect to the firm. The firm is a follower in the sense that it takes the strategy chosen by the union as given (Nash assumption).

In the monopoly union model the union power is constantly unity. The two other models will be analyzed under the assumption that the bargaining power of the parties is equal. This allows us to simplify notation by dropping the θ 's in the rest of the chapter.¹¹

In the monopoly union model, as too in the right-to-manage model, the firm permanently operates on the labour demand curve. Therefore these models are often called Labour Demand Curve models (LDC models).

Issues related to insider-dominated unions can be analyzed as special cases, implying that unions are indifferent as regards employment. This implies $b = 0$ in the Stone-Geary function (2.4) and $b_1 = 0$ in the logarithmic function (2.7) and the iso-elastic function (2.5). In the utilitarian function (2.3) the role of employment is not dependent on specific parameter values.

Finally, we are interested in the following four tax parameters

- 1) Payroll tax rate (s).
- 2) Indirect tax rate (v).

¹¹ This has no effect on the relevant comparative statics. This can be seen by rescaling θ so that $0 \leq \theta \leq 2$. Equal bargaining power now implies $\theta = 2 - \theta = 1$. This issue is considered in a more explicit context in the Appendix.

- 3) Income tax¹²/Progressive (τ_p). In this system the tax paid depends on the wage level and an exogenous shift parameter η in the tax function, ie $\tau = \tau(W, \eta)$. Shifts in the rate of progressivity of income tax schedules will be analyzed in terms of discrete changes in the parameter η .
- 4) Income tax/Proportional (τ_a). In this system the (average) tax rate is permanently τ_a and does not depend on the wage level or on a shift parameter like η above.

Since we are dealing with wage and employment effects of four tax factors within three union models with four different preference functions and, additionally, with the special case of insider-dominated unions, there are in all 168 cases to cover.

In order to improve the readability of the paper, we economize in the reporting. For instance, in all the functional forms analyzed in this chapter, τ_a and v enter the analysis in a manner which allows us to write the partial derivatives¹³ as

$$\hat{W}_v = \hat{W}_{\tau_a} \frac{(1-\tau_a)}{(1+v)} \quad (2.11)$$

and, hence, having derived¹⁴ $W_{\tau_a}^*$, we know that $\text{sgn}(W_v^*) = \text{sgn}(W_{\tau_a}^*)$. So, it is not necessary to analyze v separately. Therefore, we do not lose anything by assuming below that $v = 0$.

Finally, a clarifying note about the reporting is in order. As will be seen below, signs of certain effects remain ambiguous unless specific assumptions are made about either the parameter values in the union's preference function or about the product function. In so far as the most plausible hypotheses concerning these functional forms allow us to sign an elasticity of interest, the sign is reported in parentheses in Tables 3–6. A question mark indicates that standard hypotheses are not sufficient to generate unambiguity.

¹² In Finland, the tax levied on wages is a combination of a progressive central government income tax and a proportional local government tax.

¹³ It should be noted that we systematically use the following notation for partial derivatives. When there are several arguments in a function, eg such as $U(W,N,B)$, we write $U_w = \partial U / \partial W$ whereas, if there is only one argument (see eg the right-hand side of (2.5)), we simply write the partial derivative as $u_1(\cdot)$.

¹⁴ An asterisk here refers to the 'equilibrium' or 'target' level of the variable concerned.

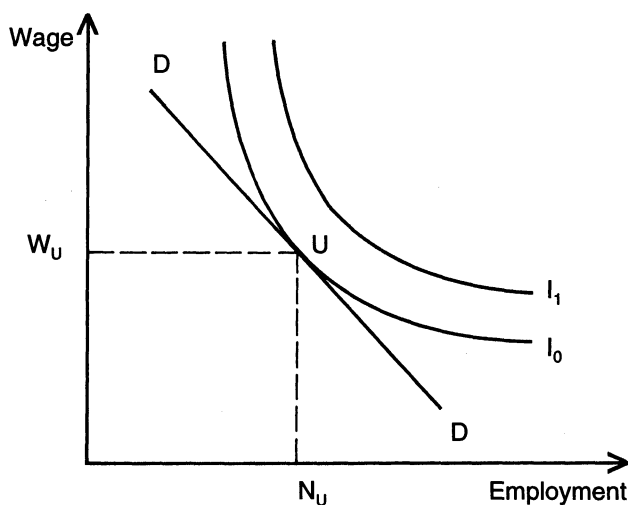
3 Labour demand curve models

In this section we derive the comparative statics concerning wage and employment effects of various taxes in the context of the two union models known as labour demand curve models, ie the monopoly union model and the right-to-manage model.

3.1 Monopoly union model

When the union acts as a monopoly, it chooses the wage level unilaterally. When doing so, it knows the demand for labour curve of the firm. It is standard to describe the outcome as in Figure 4 (see eg McDonald & Solow, 1981). The point U at which the union's indifference curve, I, is tangential to the labour demand curve, DD, defines the resulting combination of wage and employment levels, (W_U, N_U) .

Figure 4. **Monopoly union model**



In the monopoly union model, the first-order condition for optimum (FOC) is $\partial U(W, N(W), B) / \partial W \equiv U_W = 0$. The second-order condition $U_{WW} < 0$ is assumed to hold. It can be shown¹⁵ that for W_ϕ^* , with $\phi = s, \tau_a, \tau_p, v$, it holds that

$$\text{sgn } W_\phi^* = \text{sgn } U_{W\phi}. \quad (3.1)$$

Below, we give different specifications for U and derive the comparative statics implied.

3.1.1 Utilitarian union

If the union has the utility function (2.3),¹⁶ after some manipulation the FOC becomes

$$U_W = N \{ (1 - \tau_a) u'(W(1 - \tau_a)) - \frac{\varepsilon}{W} \cdot [u(W(1 - \tau_a)) - u(B)] \} = 0, \quad (3.2)$$

where ε is the wage elasticity of the demand for labour,

$$\varepsilon = - \frac{N_W}{N} W = - \frac{F''^{-1}}{(F')^{-1}} W > 0. \quad (3.3)$$

In the present context, a clear distinction should be drawn between 'capital constant' elasticity and 'output constant' elasticity. The former refers to the wage elasticity of demand for labour examined under the assumption of constant capital stock whereas the latter refers to the wage elasticity examined under the assumption of constant output. In union models, the relevant concept is typically the former whereas in some other strands of the literature it is the latter¹⁷.

Given the FOC in (3.2), the relevant partial derivative with respect to the payroll tax, s , is

¹⁵ An example is given in footnote 18.

¹⁶ In some countries unemployment benefits are taxed whereas in other countries they are not. In the present paper, we assume that they are not treated as taxable income.

¹⁷ Hamermesh (1991) surveys the evidence on the 'output constant' wage elasticity of demand for labour.

$$U_{W_s} = \frac{\varepsilon_s}{W} [u(\hat{W}) - u(B)], \quad (3.4)$$

where ε_s is the elasticity of ε with respect to s . Since $u(\hat{W}) > u(B)$, the sign of U_{W_s} depends on the sign of ε_s . This, in turn, depends on the technology and, hence,¹⁸ W_s^* is generally ambiguous. If we assume that the wage elasticity of demand for labour is independent of the payroll tax, then $U_{W_s} = 0$. This independency holds if the technology is eg Cobb-Douglas or logarithmic.

As far as the proportional income tax τ_a is concerned, the crucial partial derivative is¹⁹

$$U_{W\tau_a} = -u' \left[1 - (\varepsilon + R_w^c) \right]. \quad (3.5)$$

So, the sufficient condition for $W_{\tau_a}^* > 0$ is $\varepsilon + R_w^c > 1$, ie that the sum of the relative risk aversion and of the wage elasticity of labour demand exceeds unity (see also eg Andersen & Rasmussen, 1992). This always holds when $R_w^c \geq 1$ but may hold with considerably lower values as well. As the case with $R_w^c > 1$ appears to be the most plausible in the light of the discussion in eg Farber (1986), we expect that $W_{\tau_a}^* > 0$.

By allowing the income tax rate to depend on the wage level, $\tau(W, \eta)$, the problem is

$$\max_W U = N \cdot u(W(1 - \tau(W, \eta))) + (M - N) \cdot u(B), \quad \text{s.t. } \pi_N = 0.$$

Now the FOC becomes

$$U_W = N u' \cdot (1 - \tau(W, \eta) - \tau_W W) + N_W [u(W(1 - \tau(W, \eta))) - u(B)] = 0.$$

¹⁸ Having derived U_{W_s} , the effect of the payroll tax on wages, W_s^* , can be solved from $U_{Ww}dW + U_{Ws}ds = 0$ as $dW/ds = -(U_{Ws}/U_{Ww})$. As $U_{Ww} < 0$ by the second-order condition, obviously $\text{sgn } W_s^* = \text{sgn } U_{Ws}$. In the present case, $U_{Ws} = 0$ implies $W_s^* = 0$. On the other hand, $U_{Ws} < 0$ would imply $W_s^* < 0$. An analogous procedure is applied throughout the chapter.

¹⁹ As defined on page 58, R_w^c can – albeit somewhat loosely – be considered the counterpart of the Arrow-Pratt measure of relative risk aversion with regard to (net) wages.

As assumed above, the average tax rate does not depend on η and, therefore, $\tau_\eta = 0$. If we then choose η such that $\partial\tau_w/\partial\eta = \tau_{w\eta} = 1$ always holds, the relevant partial derivative with regard to progressivity becomes

$$U_{w\eta} = -Nu' \cdot W < 0 \text{ and consequently } W_\eta^* = W_{\tau_p}^* < 0.$$

3.1.2 Stone-Geary utility function

If the union has the utility function (2.4), the FOC $U_w = 0$ holds when

$$(1-b)(1-\tau)W + (W(1-\tau) - B)b\varepsilon = 0.$$

Given the FOC, the relevant partial derivative with respect to the payroll tax, s , is $U_{w_s} = (\hat{W} - B)b\varepsilon_s = 0$ under the assumption that $\varepsilon_s = 0$. So, $W_s^* = 0$ as well.

As far as the proportional income tax, τ_a , is concerned

$$U_{w\tau_a} = [-1 + b(1 - \varepsilon)]W. \quad (3.6)$$

The term in the square brackets is definitely negative because $0 \leq b \leq 1$ and $\varepsilon > 0$. This implies that $U_{w\tau_a} < 0$, which also holds when the union is insider-dominated ($b = 0$).

Having reformulated the utility function by allowing the income tax to depend on the wage, $\tau(W, \eta)$, and assuming that $\tau_{w\eta} = 1$, the relevant partial derivative of the FOC becomes

$$U_{w_\eta} = -(1-b) \cdot U \cdot W^{-1} < 0. \text{ Hence, generally, } W_{\tau_p}^* < 0. \quad (3.7)$$

It is noteworthy that, in the present context, none of the results is influenced by the assumption of insider domination.

3.1.3 Iso-elastic utility function

If the union has the additively separable utility function (2.5), the FOC $U_w = 0$ holds when

$$\hat{W}(W(1-\tau_a) - B)^{-\delta_0} - b_1 N^{1-\delta_1} \varepsilon = 0. \quad (3.8)$$

The relevant term when s is considered is

$$U_{W_s} = -b_1(1 - \delta_1)N^{-\delta_1} \varepsilon N_s. \quad (3.9)$$

Therefore $U_{W_s} \gtrless 0$ as $\delta_1 \lesseqgtr 1$.

Obviously, $W_s^* = 0$ if the union is insider-dominated and does not care about employment, ie when $b_1 = 0$. Otherwise, the sufficient condition for $U_{W_s} < 0$, is that $R_N^c = \delta_1 > 1$, ie that the union is sufficiently 'risk averse' with respect to employment. Finally, if $R_N^c = \delta_1 = 1$, $U_{W_s} = 0$, implying that $W_s^* = 0$ when the utility function is logarithmic.

Let us now turn to the analysis of the proportional income tax, τ_a . Given the FOC, the relevant partial derivative can be written as

$$U_{W_{\tau_a}} = -W(\hat{W} - B)^{\delta_0} [1 - \delta_0 \hat{W}/(\hat{W} - B)]. \quad (3.10)$$

Obviously, a sufficient condition for $W_{\tau_a}^* >$ is $R_w^c = \delta_0 \geq 1$. The case where $R_w^c = \delta_0 = 1$ is the logarithmic function. As the case where $R_w^c > 1$ appears to be the most plausible assumption, we expect that $W_{\tau_a}^* > 0$.

With a progressive income tax, the FOC is

$$U_W = (\partial u_o / \partial W) [W(1 - \tau(\cdot))(-\tau_w(W, \eta))] + b_1 \cdot \frac{N^{1-\delta_1}}{W} \varepsilon = 0 \quad (3.11)$$

and the relevant partial derivative with respect to η is

$$U_{W\eta} = -(\partial u_o / \partial W) \tau_{w\eta} \hat{W} \quad (3.12)$$

and, because $\tau_{w\eta} = 1$, $W_{\tau_p}^* < 0$. This result also holds in the special cases of logarithmic utility and insider-dominated unions.

3.1.4 Summary of the wage effects in the monopoly union model

The results of this section are summarized in Table 3. In most cases, the comparative statics is quite similar across the models.

As far as the proportional income tax (and analogously the consumption tax) is concerned, an increase in it tends to push up wages in most models. The Stone-Geary specification, however, seems to generate a different (= negative) wage response.

In all models, steeper progressivity tends unambiguously to reduce wages.

The intuition behind the results above is as follows. The union faces a trade-off between wage gains and employment losses. Steeper progressivity reduces the after-tax gain of a wage increment but leaves the employment loss unchanged. Consequently, the union increases its utility by reducing the wage. If the proportional tax rises and if the 'income effect' dominates, it is profitable for the union to aim for a higher (pre-tax) wage. This hypothesis holds in all other specifications except the Stone-Geary and remains unchanged if the union is dominated by insiders.

In most models, a change in the level of the payroll tax rate levied on firms has no influence on the wage preferred by a monopoly union. A hypothesis indicating this contradicts most empirical evidence. The iso-elastic specification leaves the relationship concerning ambiguous.

Table 3. Wage effects in the monopoly union model

	Type of utility function				Insider-dominated union as a special case of		
	Utilitarian (U)	Stone-Geary (SG)	Iso-elastic (I)	Logarithmic (L)	(SG)	(I)	(L)
$W_{\tau_p}^*$	-	-	-	-	-	-	-
$W_{\tau_a}^*$	(+)	-	(+)	+	-	+	+
W_v^*	(+)	-	(+)	+	-	+	+
W_s^*	(0)	(0)	?	(0)	(0)	(0)	(0)

The parentheses indicate that the sign of the coefficient is conditional on some parameter values of the union's utility function. The most plausible results are shown in the table. The symbols are: s = payroll tax; v = indirect tax; τ_a = income tax, proportional; τ_p = income tax, progressivity.

3.2 Right-to-manage model

In the monopoly union model, the profit-maximization condition only influences the outcome indirectly through its impact on employment, which enters the utility function of the union. In the right-to-manage model, a direct effect is allowed as well. In this section, we consider how this influences the comparative statics.

The FOC for the problem defined in (2.9) is

$$\Omega_w = \pi U_w + U \pi_w = \pi U_w - U(1+s)N = 0, \quad (3.13)$$

where U_w is the FOC of the monopoly union model.

The second-order condition $\Omega_{ww} = \pi_w U_w + \pi U_{ww} < 0$ clearly holds as $\pi > 0$, $U_{ww} < 0$ and, by the profit-maximization condition, $\pi_w = 0$. As before, it can be shown that

$$\text{sgn } W_\phi^* = \text{sgn } \Omega_{w\phi}.$$

3.2.1 Utilitarian union

Given the FOC in (3.13), the relevant partial derivative with respect to the payroll tax is

$$\Omega_{ws} = \pi U_{ws} - U_w WN - UN(1 - \epsilon). \quad (3.14)$$

The analysis of the monopoly union model in section 3.1.1 showed that – under the chosen assumption on technology – U_{ws} is nil. In the right-to-manage set-up in (3.14), the second term is negative but the third is either positive or negative depending on whether $\epsilon \geq 1$. With a Cobb-Douglas function with one production factor (= N), $\epsilon > 1$ holds and W_s^* is ambiguous.²⁰

The relevant partial derivative with respect to τ_a is

$$\Omega_{w\tau_a} = \pi U_{w\tau_a} - (1+s)NU_{\tau_a}. \quad (3.15)$$

²⁰ $\epsilon > 1$ also holds if the Cobb-Douglas technology includes two factors, N and K (= capital stock), if capital is considered as exogenous.

As $U_{\tau_a} < 0$ and from section 3.1.1 we know that $U_{W\tau_a^*} > 0$ under plausible conditions, we see that $\Omega_{W\tau_a} > 0$ and, hence, $W_{\tau_a^*} > 0$.

Since $U_{\eta} = 0$ because $\tau_{\eta} = 0$, the relevant partial derivative with respect to τ_p reduces to

$$\Omega_{W\tau_p} = \pi U_{W\tau_p} < 0 \quad (3.16)$$

because the analysis above indicates that $U_{W\tau_p} < 0$. Hence, $W_{\tau_p^*} < 0$.

3.2.2 Stone-Geary utility function

The relevant partial derivative with respect to s is (3.14) above. Its sign depends on the magnitude of ε . In general, Ω_{W_s} is ambiguous.

As far as a proportional income tax is concerned, we know from section 3.1.2 that $U_{W\tau_a} < 0$ in the Stone-Geary specification. Because $U_{\tau_a} < 0$, the partial derivative in (3.15) is ambiguous, and so too is $W_{\tau_a^*} > 0$.

As far as τ_p is concerned, the relevant partial derivative defined in (3.16) is negative since we know from section 3.1.2 that $U_{W\tau_p} < 0$. Hence, $W_{\tau_p^*} < 0$.

3.2.3 Iso-elastic utility function

Given the FOC, the relevant partial derivative with respect to the payroll tax, s , is

$$\Omega_{W_s} = \pi U_{W_s} - U_W WN - N \left[\frac{(1-\varepsilon)}{(1-\delta_0)} (W(1-\tau_a))^{1-\delta_0} + \frac{(1-\delta_1\varepsilon)}{(1-\delta_1)} b_1 N^{1-\delta_1} \right] \quad (3.17)$$

From section 3.1.3, we know that U_{W_s} is ambiguous when the utility function is iso-elastic. However, if the union is insider-dominated, U_{W_s} is zero. In the right-to-manage context in (3.17), the second term is definitely negative and the term in square brackets is negative when simultaneously $\delta_0 > 1$, $\varepsilon > 1$ and $\delta_1 > 1$. Although we expect these conditions to be met in real life, Ω_{W_s} is generally ambiguous. Only if the union is insider-dominated ($b_1 = 0$), is W_s^* unambiguous and

definitely negative. With logarithmic preferences implying $\delta_0 = \delta_1 = 1$, the sign of W_s^* is ambiguous.

The relevant partial derivative with respect to τ_a is as in (3.15). In the present context $U_{\tau_a} = -W^{1-\delta_0}(1-\tau_a)^{-\delta_0} < 0$. From the analysis involving the monopoly union model, we know that $U_{W\tau_a} > 0$ when $\delta_0 = R_W^c \geq 1$. Under the same condition, $\Omega_{W\tau_a} > 0$. The same result holds when preferences are logarithmic.

Again, to analyze the progressive tax, τ_p , we redefined U by letting the income tax rate depend on the wage, $\tau(W, \eta)$. As above, the relevant partial derivative reduces to $\Omega_{W\tau_p} = \pi U_{W\tau_p}$.

From (3.12) we know that $U_{W\tau_p} < 0$. So, $\Omega_{W\tau_p} < 0$ and consequently $W_{\tau_p}^* < 0$. The same result holds in the logarithmic case and with insider domination in unions.

3.2.4 Summary of the wage effects in the right-to-manage model

In the right-to-manage model, the tax parameters affect via a) the union's objective function, b) the demand for labour schedule and c) the employer's profit function. Compared with the monopoly union model, the novelty is that in the right-to-manage model the profit function exerts influence as a separate factor in the Nash product. As can be seen from Table 4, the comparative statics changes somewhat, but not much, as a result of the extension. Again, there seems to be a difference between the payroll tax, which enters via the profit function, and the rest of the tax parameters, which enter via the union preference function.

The wage effect of the payroll tax is in general ambiguous. Other results depend on certain elasticities in union preferences but the probability of them being met in reality has increased as compared with the monopoly model. However, under the most plausible hypotheses on the elasticities concerned, the results are strikingly similar across models, the Stone-Geary function being the exception as far as proportional income taxes (and analogously consumption taxes) are concerned. As in the monopoly union model, the results are seldom sensitive to the assumption of insider domination.

Table 4. Wage effects in the right-to-manage model

	Type of utility function				Insider-dominated union as a special case of		
	Utilitarian (U)	Stone-Geary (SG)	Iso-elastic (I)	Logarithmic (L)	(SG)	(I)	(L)
$W_{\tau_p}^*$	-	-	-	-	-	-	-
$W_{\tau_a}^*$	(+)	?	(+)	+	?	(+)	+
W_v^*	(+)	?	(+)	+	?	(+)	+
W_s^*	?	?	?	?	?	-	?

The parentheses indicate that the sign of the coefficient is conditional on some parameter values of the union's utility function. The most plausible results are shown in the table. The symbols are: s = payroll tax; v = indirect tax; τ_a = income tax, proportional; τ_p = income tax, progressivity.

3.3 Employment effects in labour demand curve models

The monopoly union model and the right-to-manage model share the property that the firm operates on the downward sloping labour demand curve. For the tax parameters which enter the model via the union's preference function, ie τ_a , τ_p , v , obviously

$$\text{sgn}(N_\phi^*) = -\text{sgn}(W_\phi^*). \quad (3.18)$$

The relevant employment effects can be directly derived from Tables 3 and 4. As already noted in other contexts above, the payroll tax, which enters via the profit function, makes a difference. If $W_s^* = 0$, the real labour cost increases by the full amount of the labour tax. The real labour cost also increases when $0 > W_s^* > -1$. The effect on the real labour cost is zero if wages adjust by the full amount of the tax increment, ie when $W_s^* = -1$. This implies

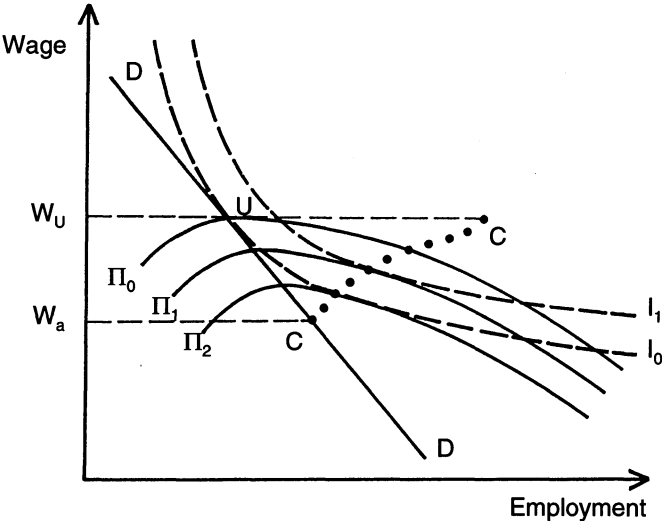
$$N_s^* \begin{matrix} \geq \\ < \end{matrix} 0 \quad \text{when} \quad (W_s^* + 1) \begin{matrix} \leq \\ \geq \end{matrix} 0. \quad (3.19)$$

Because we could not in most cases sign W_s^* above, N_s^* is in general ambiguous. In addition, as can be seen from (3.19), unambiguity of W_s^* would not necessarily generate unambiguity of N_s^* . The crucial assumption here derives from $W_s^* \leq -1$ and not from $W_s^* \leq 0$.

4 Efficient contract model

A contract is efficient if there is no contract which gives higher utility to one of the parties without any reduction in the utility of the other party. Pareto efficient contracts are on the contract curve, which consists of points of tangency between an isoprofit curve, π_i , and the indifference curve of the union, I_i , in (W,N) space (see Figure 5).

Figure 5. **Efficient contract model**



The relevant part of this curve is above the alternative wage, W_a , and below the monopoly union wage, W_U . Because the contract curve is above the labour demand curve where $\pi_N < 0$, it implies that $F' < W(1+s)$. So, in contrast to the right-to-manage model, we relax the profit-maximization condition $\pi_N = 0$. As a result, there is no uniform demand for labour condition to substitute into the Nash solution. In this sense, the efficient contract model is much less restricted than the models discussed so far.

4.1 Wage effects

To analyze the tax incidence in the efficient contract model, we maximize the Lagrangian function

$$\mathcal{L} = U - \lambda[\underline{\pi} - \pi],$$

where $\underline{\pi}$ defines the minimum profit level.

The first-order conditions are

$$\mathcal{L}_W = 0 = U_W + \lambda\pi_W$$

$$\mathcal{L}_N = 0 = U_N + \lambda\pi_N$$

$$\mathcal{L}_\lambda = 0 = \pi - \underline{\pi}$$

The second-order condition for maximum is satisfied under non-restricting conditions, as can be easily verified.

4.1.1 Payroll tax, s

According to Cramer's rule, the sign of the wage effect of the payroll tax is

$$\text{sgn}(W_s^*) = \text{sgn}\left[-\mathcal{L}_{WN}\pi_N\pi_s - \mathcal{L}_{Ns}\pi_N\pi_W + \mathcal{L}_{NN}\pi_W\pi_s + \mathcal{L}_{Ws}\pi_N^2\right].$$

First, note that $\mathcal{L}_{NN} = U_{NN} + \lambda\pi_{NN} < 0$, and $\mathcal{L}_{WN} = U_{WN} + \lambda\pi_{WN} = -\lambda(1+s) < 0$. As the terms deriving from the profit function are

identical in all cases,²¹ we proceed by evaluating $\mathcal{L}_{W_s} = U_{W_s} + \lambda\pi_{W_s}$ and $\mathcal{L}_{N_s} = U_{N_s} + \lambda\pi_{N_s}$.

A major consequence of relaxing the profit-maximization condition is that the partial derivatives U_{W_s} and U_{N_s} are zeros for all the functional forms considered. This is because the payroll tax does not enter any of the utility functions directly. So, the analysis of W_s^* is identical for all preference specifications.

Substituting $\pi_{W_s} = -N < 0$ and $\pi_{N_s} = -W < 0$ and rearranging gives

$$\text{sgn}(W_s^*) = -\text{sgn}\left[\lambda W(1+s)\left(1 - \frac{\pi_{NN}N}{\pi_N}\right) - W(1+s)U_{NN}N - \lambda N\pi_N F'\right].$$

The second term is positive as, too, is the third. The sign of the first term depends on the concavity of the profit function. So, without a more specific structure being imposed on technology, W_s^* appears to be ambiguous in the efficient contract model. The more concave the production function is with respect to labour, the less we can expect the last two terms to dominate and to generate a negative wage effect.

On the other hand, the absolute value of $\pi_N < 0$ indicates the magnitude of deviation from the profit-maximizing employment. The deviation is presumably larger for an upward sloping contract curve than for a downward sloping one. This counterintuitive result states that W_s^* is more likely to be negative when the contract curve is upward sloping. In section 4.2.1, it will be shown that the slope is also influenced by the elasticities in the preference functions. The Stone-Geary function implies that W_s^* is more likely to be negative when the weight given to employment, b , is very large. With the iso-elastic objective function, this requires a) that either $R_N^c > 1$ or that the union is insider-dominated and b) that R_W^c is small. With the logarithmic function the relative weight given to employment, b_1 , must be large compared with the weight given to wages.

4.1.2 Proportional income tax, τ_a

As $\pi_{\tau_a} = \pi_{W\tau_a} = \pi_{N\tau_a} = 0$, we know that

²¹ That is, $\pi_W = -(1+s)N < 0$, $\pi_s = \pi_W W(1+s)^{-1} = -WN < 0$, $\pi_N = F'(N) - W(1+s) < 0$.

$$\text{sgn } W_{\tau_a}^* = \text{sgn} \left[-U_{N\tau_a} \pi_w \pi_N + U_{W\tau_a} \pi_N^2 \right].$$

So, we proceed by examining $U_{N\tau_a}$ and $U_{W\tau_a}$ in the context of the relevant preference functions.

For a utilitarian union $U_{W\tau_a} > 0$ and $U_{N\tau_a} < 0$, implying $W_{\tau_a}^* > 0$. In the latter case, if the union is insider-dominated, $U_{W\tau_a} = U_{N\tau_a} = W_{\tau_a}^* = 0$. With the Stone-Geary function, $U_{W\tau_a} < 0$, which implies that $W_{\tau_a}^*$ is ambiguous.

With the iso-elastic function, $U_{N\tau_a} = 0$ and $U_{W\tau_a} > 0$, whenever $R_W^c = \delta_0 > 1$. So, $W_{\tau_a}^* > 0$. The same holds in the case of the logarithmic utility function.

4.1.3 Progressive income tax, τ_p

As before

$$\text{sgn } (W_{\tau_p}^*) = \text{sgn} \left[-U_{N\tau_p} \pi_N \pi_w + U_{W\tau_p} \pi_N^2 \right].$$

Since $U_{N\tau} = 0$ for all the relevant utility functions, the signs are according to $U_{W\tau_p}$, which is negative in all cases as we saw in section 3.1. So, all the utility functions imply that $W_{\tau_p}^* < 0$. The assumption of insider-domination has no influence on the results.

4.1.4 Summary of the wage effects in the efficient contract model

In the efficient bargaining model the profit-maximization condition specifying the determination of employment is relaxed. Hence, the profit function enters the analysis only as a term in the Nash product instead of via the two channels discussed in the context of the right-to-manage model. The comparative statics derived in this section can be seen in Table 5. The ambiguity of the wage effect of the payroll tax once again confirms that this effect cannot be signed without a specific structure being assumed for technology. The rest of the results show that assumptions about the wage effects of direct and indirect taxes are very similar in most cases. As before, the Stone-Geary function is the exception. Finally, the assumption of insider domination does not seem to matter much.

Table 5. **The wage effects
in the efficient contract model**

	Type of utility function				Insider-dominated union a special case of		
	Utilitarian (U)	Stone-Geary (SG)	Iso-elastic (I)	Logarithmic (L)	(I)	(SG)	(L)
$W_{\tau_p}^*$	-	-	-	-	-	-	-
$W_{\tau_a}^*$	+	?	+	+	+	?	+
W_v^*	+	?	+	+	+	?	+
W_s^*	?	?	?	?	?	?	?

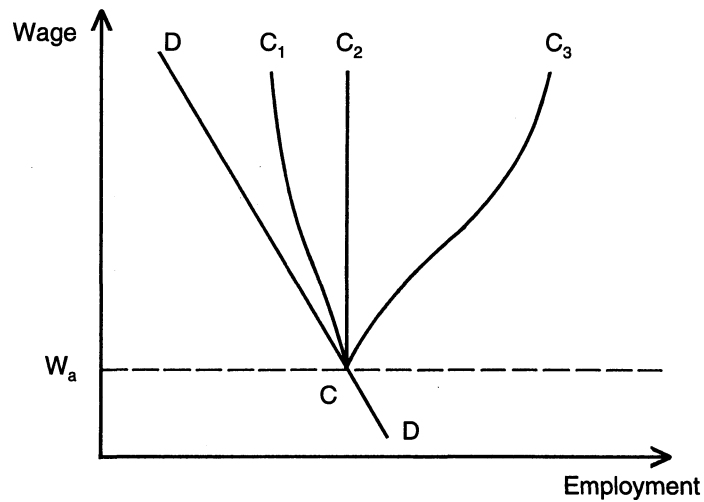
A question mark indicates that the coefficient depends on special technology assumptions. The symbols are: s = payroll tax; v = indirect tax; τ_a = income tax, proportional; τ_p = income tax, progressivity.

4.2 Employment effects in the efficient contract model

In the efficient contract model, the employment effect depends on the slope of the contract curve, C . In Figure 6, three different contract curves are illustrated. They are all located to the right of the labour demand curve.

It is shown below that the contract curve is upward sloping in the (W, N) space if the utility function of the union is convex enough with regard to wages or the union otherwise pays more attention to employment than to wages. The presumption that higher labour cost (which results from higher taxes) leads to lower employment is consistent only with a downward sloping contract curve. If the contract curve is vertical there is no effect on employment. Below, we examine how various specifications influence assumptions about the slope of the contract curve. As will be seen, the results seem to challenge the general accuracy of the statement by Brown & Ashenfelter (1986, p. 51) that 'efficient contracts lead, if anything, to negligible (or positive) correlations between price and quantity across bargaining pairs...'

Figure 6. **Some contract curves**



4.2.1 The slope of the contract curve

The contract curve is defined by the condition that the slope of the isoprofit curve equals the slope of the indifference curve, that is

$$\frac{\pi_N}{\pi_W} = \frac{U_N}{U_W}. \quad (4.3)$$

Substituting π_N and π_W , the slope can be derived from

$$(F' - W(1+s))U_W = -(1+s)NU_N \quad (4.4)$$

by taking the total differential with respect to W and N . If dW/dN is negative, the contract curve is downward sloping and vice versa.

The employment effect of a tax can be expressed in terms of the contract curve, on the one hand, and the wage effect, W_ϕ^* , on the other hand:

$$\text{sgn } N_{\phi}^* = \begin{cases} \text{sgn} \left(\frac{dW}{dN} \right) \cdot \text{sgn } W_{\phi}, & \text{for } \phi = v, \tau_a, \tau_p \\ \text{sgn} \left(\frac{dW}{dN} \right) (W_{\phi} + 1), & \text{for } \phi = s \end{cases}$$

We proceed by analyzing dW/dN in the context of alternative preference functions.

4.2.1.1 Utilitarian union

The slope of the contract curve is

$$\frac{dW}{dN} = \frac{F''(1+s)^{-1}}{\frac{u''(\hat{W})}{u'(\hat{W})} \left[\frac{u(\hat{W}) - u(B)}{u'(\hat{W})} \right]} > 0,$$

which indicates an upward sloping contract curve whenever the union is risk averse ($u''/u' < 0$), which we expect to hold. Under this condition, $N_{\tau_a}^*$, $N_v^* > 0$ and $N_{\tau_p}^* < 0$. N_s^* is ambiguous because W_s^* is ambiguous but $N_s^* > 0$ whenever $W_s^* + 1 > 0$.

4.2.1.2 Stone-Geary utility function

In this case (4.4) becomes

$$W - F'(1+s)^{-1} = b(1-b)^{-1}(\hat{W}-B)(1-\tau_a)^{-1},$$

where $0 < b < 1$. Total differentiation gives us the slope (which is not defined when $b = 1/2$),

$$\frac{dW}{dN} = \frac{F''(1+s)^{-1}}{\left(2 - \frac{1}{1-b}\right)} \leq 0 \quad \text{if } 1-b \geq \frac{1}{2}.$$

In accordance with argumentation above, we consider the case with $1-b > \frac{1}{2}$ to be the more plausible. This implies a downward sloping contract curve, indicating $N_{\tau_p}^* > 0$. The rest of the elasticities are ambiguous. The contract curve is unambiguously downward sloping when the union is insider-dominated, ie when $b = 0$.

4.2.1.3 Iso-elastic utility function

Now the slope is defined by

$$\frac{dW}{dN} = \frac{\left(F''(1+s)^{-1} + b_1(1-\delta_1)N^{-\delta_1}W^{\delta_0}(1-\tau_a)^{\delta_0-1}\right)}{\left(1 - \delta_0\hat{W}^{\delta_0-1}N^{1-\delta_1}\right)}. \quad (4.5)$$

The numerator is negative if $\delta_1 \geq 1$ or $b_1 = 0$ but otherwise ambiguous. Below, we assume that the precondition for unambiguity is met. If $\delta_0 = \delta_1 = \delta > 1$, the denominator in (4.5) is

$$1 - \delta \left(\frac{N}{\hat{W}}\right)^{1-\delta} = 1 - \delta \left(\frac{U_N}{U_W}\right) \frac{N}{W}. \quad (4.6)$$

Since the definition of the contract curve implies that

$$\frac{U_N}{U_W} = \frac{W(1+s) - F'}{(1+s)N},$$

(4.6) can be written as

$$1 - \delta \left(\frac{W(1+s) - F'}{(1+s)N}\right) \frac{N}{W} = 1 - \delta \left(1 - \frac{F'}{W(1+s)}\right). \quad (4.6')$$

It should be noted that $F'/W(1+s) = X$ is a kind of measure for the deviation from the profit-maximization condition, $\pi_N = 0$, which if holds implies that $X = 1$. In general, on the contract curve

$F' < W(1+s)$ and, hence, $0 < X < 1$. Note that this implies $(1-X)^{-1} > 1$.

Obviously, when $\delta > 1$, then

$$\frac{dW}{dN} \gtrless 0 \text{ when } \delta \gtrless (1-X)^{-1}. \text{ When } \delta < 1, \text{ the slope is ambiguous.}$$

In addition, it can be seen from (4.6) that the larger is U_N and the smaller is U_W , the more likely it is that the contract curve is upward sloping. This generates a larger deviation from the profit-maximizing level of employment.

Let us now assume that $\delta_0 \neq \delta_1$. The denominator in (4.5) becomes

$$1 - \delta_0 \frac{(\hat{W})^{\delta_0-1}}{N^{\delta_1-1}} = 1 - \delta_0 \left(\frac{U_N}{U_W} \right) \frac{N}{W}. \quad (4.7)$$

Analogous to the previous case, it can be shown that (4.7) is unambiguously positive when $\delta_0 < (1-X)^{-1}$. On the condition that $\delta_1 \geq 1$,

$$\frac{dW}{dN} \gtrless \text{ when } \delta_0 \gtrless (1-X)^{-1}.$$

The intuition of this result is as follows. The unambiguity of any conclusion requires that the concavity of the preference function with respect to employment exceeds the value indicated by $R_N^c = \delta_1 = 1$. Interestingly, this condition can be replaced by the insider domination assumption. If in addition to one of the conditions above, the concavity of preferences with respect to wages exceeds a certain threshold above unity, then the contract curve is upward sloping. We do not expect the condition concerning the magnitude of δ_1 to be met in real life. Thus, because the evidence in favour of a downward sloping contract curve is weak in the present context, we report this result in double parentheses in Table 6. With iso-elastic preferences, the conclusions are not sensitive to the insider domination assumption.

Because the contract curve (4.5) is not defined when $\delta_0 = \delta_1 = 1$, the logarithmic utility specification is analyzed separately. The slope is then

$$\frac{dW}{dN} = \frac{F''}{(1-b_1)(1+s)},$$

which is negative when $0 < b_1 < 1$ and positive if $b_1 > 1$. If $b_1 = 1$, the contract curve is not defined. Again, we expect that $0 < b_1 < 1$, which indicates a downward sloping contract curve, implying that $N_{\tau_p}^* > 0$ because $W_{\tau_a}^* < 0$. Since $W_{\tau_a}^* = W_v^* > 0$ with logarithmic preferences, $N_{\tau_a}^* = N_v^* < 0$. N_s^* is ambiguous but if $W_s^* + 1 > 0$, then $N_s^* < 0$. Under the insider domination assumption, ($b_1 = 0$), the contract curve is unambiguously downward sloping.

4.2.2 Summary of the employment effects in the efficient contract model

In the analysis above, we have examined the slope of the contract curve. As far as the tax effect on employment is concerned, it is opposite to the wage effect when the contract curve is downward sloping. When the contract curve is upward sloping, the wage effect and the employment effect have the same sign. There is no effect on employment if the contract curve is vertical.

The specification of union preferences and specific parameter values in these functions influence the slope of the contract curve. The utilitarian preference function gives an upward sloping contract curve as the only alternative (whenever the union is risk averse). The other preference specifications are more likely to generate a downward sloping contract curve. If unions are assumed to be insider-dominated, both the Stone-Geary and logarithmic preference specifications unambiguously generate a downward sloping contract curve. The implications of the most likely outcomes are shown in Table 6. The payroll tax effect is ambiguous because of the ambiguity of W_s^* .

The first column in Table 6 introduces the effects on employment in the context of an upward sloping contract curve generated by the utilitarian preference specification. This set-up indicates, for instance, that employment falls as a result of a cut in the (proportional) income tax, which reduces the wage and, hence, leads to lower labour cost.

Table 6. **Employment effects in the efficient contract model given the wage effects in Table 3**

	Type of the utility function				Insider-dominated union as a special case of		
	Utilitarian (U)	Stone-Geary (SG)	Iso-elastic (I)	Logarithmic (L)	(I)	(SG)	(L)
$N_{\tau_p}^*$	-	(+)	((+))	(+)	((+))	+	+
$N_{\tau_a}^*$	+	?	((-))	((-))	((-))	?	-
N_v^*	+	?	((-))	((-))	((-))	?	-
N_s^*	?	?	?	?	?	?	?

The parentheses indicate that the sign of the coefficient is conditional on some parameter values of the union's utility function. The most plausible results are shown in the table. The symbols are: s = payroll tax; v = indirect tax; τ_a = income tax, proportional; τ_p = income tax, progressivity.

5 Conclusions

In most of the literature – both theoretical and empirical – applying union models, it is assumed that the union acts as a monopolist. As serious doubts can be cast on this model²², it is of special importance to investigate whether the conclusions derived are model-specific.

Summarizing the comparative statics concerning the wage effect of taxes, the signs are mostly ambiguous without the imposition of restrictions on some elasticities. This is in accordance with results for competitive markets. In the present context, the distinguishing feature appears to some extent to be whether the variable enters via the preference function of the union or of the firm.

The effect of the payroll tax, which enters via the profit function, cannot be signed without specific assumptions concerning technology, the union's preference function and the bargaining structure.

²² See the discussion by Layard, Nickell & Jackman (1991) referred to in Chapter 1 above.

Steeper progressivity in income taxation reduces the equilibrium wage in all models²³. The effects of the other two relevant tax factors depend on the properties of the union preference functions. Under the most plausible hypotheses concerning the strategic elasticities, the hypotheses are not particularly sensitive to the set-up chosen. In this respect, the Stone-Geary function is an exception.

The decisive elasticities are the weight given to employment and/or the concavity of the preference function with respect to employment. The parameter values which we consider to be the most plausible indicate that a higher proportional income tax probably leads to higher wages.²⁴ Since higher indirect taxes have the same effect, we expect an increase in sales tax to push up wages. An 'outlier' results with the Stone-Geary utility function. Here, the proportional income tax (and consequently, the indirect tax) cannot be signed.

If unions are insider-dominated, the results usually remain unchanged.

With most preference functions, changes in payroll taxes have no wage effect in the monopoly union model. In the right-to-manage and efficient bargaining models, the results indicate ambiguity in general.

In general, the models seem to indicate partial incidence. This appears to be in accordance with common empirical findings indicating real wage resistance. A closer look at the various formulas reveals that the hypothesis of the irrelevance of *de jure* incidence does not hold in union models.

Our analysis indicates that empirical discrimination between hypotheses concerning the structure of bargaining is not easy. Evidence on union preferences derived from wage equations would not be easy to interpret either. So, we are not likely to learn much about union objectives by estimating wage equations. Employment equations might offer some hope.²⁵ On the other hand, the results are generally so similar that, even though our knowledge of union preferences is not completely accurate, this does not necessarily reduce the relevance of empirical applications derived from union models. This is especially true as far as wage equations are concerned.

²³ The specification in Creedy & McDonald (1991) leaves this effect ambiguous.

²⁴ The conclusion in Creedy & McDonald (1991) is the same. Since they define the post-tax wage, y , as $y = w - (w-a)t$, analysis of the proportional tax collapses to analysis of the threshold factor a and the analysis of progressivity collapses to analysis of t .

²⁵ Accordingly, the test in Alogoskoufis & Manning (1991), which was designed to discriminate between hypotheses concerning the bargaining structure, relies on employment equations rather than wage equations.

The monopoly union model and the right-to-manage model share the property that firms operate on a downward sloping labour demand curve. Hence, tax changes which lead to higher labour costs tend to reduce employment.

In the efficient contract model things are different and the rule-of-thumb of opposite wage and employment effects does not necessarily hold. Technically, this is because the profit-maximizing condition has been relaxed and replaced by the pareto optimality condition. These two conditions do not generally coincide, although special cases have been discussed in the literature where they do.

As far as the tax effect on employment is concerned, it is opposite to the wage effect when the contract curve is downward sloping. Since in this case the contract curve has a similar shape to the labour demand curve (although the former is located to the right of the latter), the comparative statics is qualitatively identical. When the contract curve is upward sloping, the tax effect on the wage and on employment has the same sign. There is no effect on employment if the contract curve is vertical. Both the specification of union preferences as, too, specific parameter values in these functions influence the slope of the contract curve. The most plausible assumptions on the decisive elasticities indicating how the union values employment tend, however, to generate a contract curve which is downward sloping in the (W,N) space. In this respect, the utilitarian union is an exception, which generates an unambiguously upward sloping contract curve whenever the union's utility function is concave enough.²⁶ The upward sloping contract curve generates hypotheses concerning tax effects which contradict intuition. For instance, it implies a reduction in employment as a response to a cut in the proportional income tax, which leads to a lower wage (and to lower labour cost).

The final issue discussed concerns our limitation to partial analysis. In a broader context, a tax shift which induces the union to push up wages weakens the competitive position of the country concerned. Losses in market shares reduce exports and, thereby, growth of output. In most models, this leads to lower employment and – sooner or later – to downward adjustment in real wages. In a general equilibrium set-up, this could well neutralize the original wage effect.²⁷ Owing to nominal rigidities and union resistance, the process concerned may be prolonged. It may involve devaluations and become

²⁶ As indicated in Section 2 above, a more concave utility function is often considered – albeit somewhat loosely – to be a sign of bigger relative risk aversion of the union.

²⁷ See also the discussion in Chapter 1 above.

painful because of substantial variation in unemployment and interest rates. For an understanding of the nature of the processes that tend to be generated by shifts in the tax rates, we consider the kind of analysis presented in this chapter to have a role of its own.

The remaining chapters analyze empirically models incorporating the features discussed here.

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Appendix to Chapter 2

A note on asymmetry in the Nash solution

The role of asymmetry in the bargaining game has not been considered formally in the paper. Here, we wish to show that this is not a major deficiency.

Asymmetry, as measured by θ , plays a role in the right-to-manage model (2.9) and the efficient contract model (2.8). In the former, the level of employment implied by the predetermined wage level is on the labour demand curve (LDC). In the latter, wage and employment can be found from the contract curve (CC) (see Section 4.2). By reconsidering the Nash solutions (2.9) or (2.8), it is easy to see that asymmetry in bargaining does not influence the amount of utility available for the players but it may influence the shares of the parties. As can be seen, θ enters the maximization problem as a third separate element in addition to U and π . So, it has an independent influence on the location of the equilibrium on the labour demand curve or the contract curve.

For a given value of θ , $0 < \theta < 1$, the comparative statics related to the factors which determine U or π is not influenced. Two examples are given below for the asymmetric right-to-manage model. As far as the payroll tax is concerned in the context of the iso-elastic utility function, the relevant partial derivative is

$$\begin{aligned} \Omega_{W_s} = & \theta\pi U_{W_s} - \theta U_w WN \\ & - (1-\theta)N \left[\frac{(1-\varepsilon)}{(1-\delta_0)} (W(1-\tau_a))^{1-\delta_0} + \frac{(1-\delta_1\varepsilon)}{(1-\delta_1)} b_1 N^{1-\delta_1} \right]. \end{aligned} \quad (3.17')$$

The only difference as compared with (3.17) is that each term has been multiplied by a positive constant, either by $0 < \theta < 1$ or $0 < 1-\theta < 1$.

Since (2.11) implied a uniform relation between $W_{\tau_a}^*$ and W_v^* , we can examine both of them by considering (3.15) in the context of asymmetric bargaining. With the same functional forms as above, the relevant partial derivative is

$$\Omega_{W\tau_a} = \theta\pi U_{W\tau_a} - (1-\theta)(1+s)NU_{\tau_a}. \quad (3.15')$$

Again, (3.15') is a weighted average of the two terms in (3.15). As $U_{W\tau_a}$ is positive and U_{τ_a} is negative, $\Omega_{W\tau_a}$ does not vanish when θ approaches unity or zero. So, $W_{\tau_a}^* > 0$ and analogously $W_v^* > 0$ for all possible values of θ . This also covers the monopoly union model ($\theta = 1$).

How about the effect of changes in θ ? It is straightforward to expect increasing union power to push up the wage. As the LDC is generally downward sloping, employment decreases in the right-to-manage model, ie $\text{sgn}(N_\theta) = -\text{sgn}(W_\theta)$. As far as efficient contracts are concerned, the slope of the CC is decisive. The contract curve can be either upward sloping, downward sloping or vertical and $\text{sgn}(N_\theta) = \pm \text{sgn}(W_\theta)$ or $N_\theta = 0$, respectively.

Chapter 3

Unions, Wages and Employment

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Abstract

This chapter begins with a brief description of the labour market institutions in Finland. We then introduce a theoretical set-up and its operationalization, which will be applied in the rest of the papers with minor modifications.

The two-step method proposed by Engle and Granger (1987) is used to estimate reduced-form wage and employment relations. In this exercise, we are particularly interested in finding out whether one can define empirically cointegrating relations with the relevant interpretation and error correction properties characterizing attractors.

According to the evidence, cointegrating wage and employment relations can be found. Furthermore, the variables of interest are influenced by variables which determine profits, on the one hand, and the utility of the union, on the other hand. In addition, bargaining power appears to matter. This all accords with the bargaining model.

Union strength is discovered to have a positive effect on both wages and employment in the manufacturing industry. Importantly, taxes have an effect which indicates that real wage resistance exists not only in the short run but in the long run as well.

When a shock occurs, the system is pushed out of the equilibrium. The resulting adjustment of wages and employment is analyzed by means of dynamic simulation. Step response functions indicate that adjustment is not particularly slow in general. This appears to be true for wages but especially for employment. Hence, if the actual real wage-employment combination is considered inappropriate, it is not primarily due to 'too slow' adjustment. Rather, it implies that the equilibrium is inappropriate.

1 Introduction

Let us begin with a brief note on the institutional features of the labour market, bargaining environment and union influence in Finland (see also Tyrväinen, 1989a, and Eriksson et al., 1990). In the middle of the 1960s, only one in every three Finnish workers was a union member. In the latter half of the 1960s, the unionization rate started to rise rapidly and it exceeded 80 per cent at the end of the 1970s. In the 1980s, union density continued to climb steadily, in contrast with the experience in most other industrialized countries. At the beginning of the 1990s, the degree of unionization was around 90 per cent and union membership has been growing since then too.¹ Sweden and perhaps also Iceland seem to be the only countries with a higher unionization rate.

Finland has one large central confederation of unions, consisting primarily of manufacturing workers. In addition, there are three confederations of unions representing mainly white-collar workers. The position of the white-collar workers' organizations has strengthened over the past 20 years. The most influential trade unions have consistently been headed by the Social Democrats, although the Communists traditionally occupied a strong position within the manual workers' Central Organization of Finnish Labour Unions (SAK). Particularly in certain industrial unions, the balance between the two labour parties remained relatively even until as recently as the early 1980s.

Comprehensive wage settlements in Finland in the 1960s – that is before the so-called stabilization policy phase in 1968–1970 –

This chapter is an extended and updated version of a paper published in Applied Economics, 1992, 24. It is also part of a research project 'Nordic Labour Markets in the 1990s' organized by the NAUT. I would like to thank Steve Nickell, Richard Jackman, Andrew Oswald and Erkki Koskela for helpful comments. Suggestions by George Alogoskoufis, Palle Schelde Andersen, Heikki Koskenkylä and Matti Virén are also gratefully acknowledged. Needless to say, the usual disclaimer applies.

¹ At present, it is not easy to give a plausible figure for the effective unionization rate in Finland. The standard way to measure union density is to calculate the share of workers who are unionized. Operationally, this is the relation of union members to the number of employed workers. Kauppinen et al. (1991) include unemployed workers (4 per cent of union members in 1989) in the denominator and come up with a unionization rate of 87 per cent for Finland in 1989. Since 1989, however, unemployment in Finland has increased dramatically. At the same time, the number of union members has also been growing. This is because union members receive better benefits if they become unemployed. Finally, according to Kauppinen et al., a fairly large share of union members (17 per cent of all members) did not pay normal fees in 1989. Most of these members were pensioners, students etc.

generally covered a period longer than one year. This was followed by several one-year contracts until two-year agreements became the norm again. These contracts frequently incorporated other incomes policy elements besides wages, the actual extent of which has varied from time to time. They have covered a broad range of issues related to income tax adjustments, reductions in regular annual working time through legislative changes, unemployment insurance, rent control, social welfare policy etc. In the 1980s, the tendency was towards less comprehensive agreements even when they were concluded at the nation-wide level. In recent years, settlements have typically covered only wages and issues directly related to terms of employment (working conditions, flexibility of organization of work etc.)

As late as the early 1960s, bitter political rivalry between the Social Democrats and the Communists reduced the attraction of union membership for non-politically active workers. In the latter half of the 1960s, the prerequisites for unionization changed in several respects, however. In the 1966 general elections, the labour parties won a majority in parliament. They formed a coalition government with parties of the political centre as a minority. As a by-product of the political cooperation between the two labour parties (which lasted until 1971), the two central confederations of manufacturing workers – one led by the Social Democrats (SAJ) and the other by the Communists (SAK) – united in 1969. This appears to have reduced the political obstacles to joining a union.

As part of the stabilization pact reached in 1968, employers started to withhold union fees directly from the salaries of union members, remitting them to the union concerned. In the same context, the system of wage payment was reformed and, instead of the old system of cash payment, wages were paid directly into employees' bank accounts. Together, these measures may have reduced some of the technical and psychological obstacles to joining a union. In addition, deductibility of membership fees in income taxation was introduced as part of the pact.

The size of the fee varies from union to union. It has usually been between 0.5 per cent and 1.5 per cent of the salary. It appears to be higher in blue-collar unions, where the unemployment insurance system plays a larger role.

Since 1944, that is starting with the first comprehensive settlements, the employer organizations have agreed on the prevailing working conditions for a specific industry with the 'representative' unions. Hence, the ability of a union to become a wage-setting partner partly depends on its size. On the other hand, non-unionized workers have been covered by collective agreements since 1971. This implies

that non-organized employers must also implement the comprehensive settlements. One might think that this would create an incentive for individual workers to stay outside the unions, thereby avoiding the payment of membership fees. Interestingly enough, the result seems to have been exactly the opposite. This is due to the fact that the knowledge of the settlements lies with the unions. Hence, particularly in small firms, union membership gives workers an opportunity to make sure that the comprehensive settlements are being applied properly. In this case the fee is clearly a kind of monitoring cost.

The Central Organization of Finnish Labour Unions (SAK) has no authority to conclude agreements that are binding on member unions. Agreements settled at the central level only reveal their actual nature when applied at the industry level. Here, the terms of the comprehensive settlements have at times been clearly exceeded. Strikes are legal until the industry-level contracts are signed.

General pay rises have often been specified in a 'mixed form' (for example, X markka, but at least Z per cent). As far as the egalitarian effects of the agreements are concerned, the significance of low-pay components has generally been relatively modest and they have been applied quite freely at the industry level. Thus, 'solidaristic' features in wage policy have been less pronounced than for example in Sweden.² They have mainly been present in the markka-weighting of negotiated pay increases in the 1970s.

In Finland, wage indexation was effective for most of the 1960s. It was abolished by law in 1968.

Hence, the wage settlement procedure is highly centralized and synchronized. The period 1964–1994 saw only six years when no central³ agreement was reached. In these years, settlements were concluded at industry level. Although one or more industrial unions have frequently deviated from the central agreements because of branch-specific issues, it is natural to analyze the Finnish labour market within a bargaining framework.⁴

² Pissarides & Moghadam (1989) appear to confirm that the difference between the two countries can also be seen in the actual data. The authors conclude that the exceptional rigidity of relative wages between different sectors in Sweden should be proof of success in achieving egalitarian objectives in wage setting. In Finland, relative wages have fluctuated much more, the order of magnitude, in fact, being about the same as in the United Kingdom and in the United States.

³ In fact, two of the central contracts cover only the manufacturing sector. For more details about the contracts, see Tyrväinen (1989a) or Eriksson et al. (1990).

⁴ The role of wage drift will be examined in Chapter 5.

2 The model

In the literature, there are two prevailing ways of selecting empirical equations. One makes explicit assumptions concerning the utility functions of unions, production functions etc. and estimates various structural parameters. This is the method applied by Pencavel (1985) and Pencavel and Holmlund (1988), among others. A competing method seeks merely to specify the relevant variables and to search for functional forms more or less on an *ad hoc* basis. The latter approach is followed by Bean, Layard & Nickell (1986) and Calmfors & Forslund (1990), among others, and is also followed here.

An example of the derivation of wage and employment equations under strictly specified assumptions is given in Appendix 1. Hence, only a brief description of the model and its underlying characteristics is given here. There are n identical firms, which have constant returns to scale (Cobb-Douglas) production functions, $F(N, m, K)$, with three inputs, labour (N), raw materials (m) and capital (K). Capital stock is taken as predetermined. Any investment undertaken during the period only influences the capital stock for the next period. Imperfect competition prevails in the product market. The firm maximizes profits, which are defined as the difference between sales revenue and production costs:

$$\pi = \hat{P}[\tilde{Z}F(N, m, K)]F(N, m, K) - W(1+s)N - P_m m, \quad (i)$$

where $\hat{Q} = \hat{P}^{-1}(P)\tilde{Z}^{-1} \equiv D(P)Z$ is a downward sloping demand curve of the separable form introduced by Nickell (1978, p. 21). $Z = \tilde{Z}^{-1}$ is a parameter describing the position of the demand curve faced by the firm, \hat{P} represents the producer price of the firm, P competitors' producer prices, W nominal wages, s payroll taxes, P_m prices of raw materials (incl. energy) and \hat{Q} the output of the firm, which is considered endogenous. According to the marginal product condition, optimal use of inputs is determined by their relative prices. In so far as the firm uses raw materials optimally, we can derive the following standard aggregate labour demand function:⁵

⁵ All signs in this section are according to the model in Appendix 1. Those which do not necessarily carry over to more general models are in parentheses.

$$N^d = N^d \left(\frac{W(1+s)}{P}, \frac{P_m}{P}, \underline{K}, Z \right). \quad (\text{ii})$$

- (-) ? +

In an organized labour market the firm bargains with a union. The welfare of a utilitarian union depends on the after-tax real wage of its employed members and the unemployment benefit received by the unemployed members. Hence, its utility function is $U = U(W(1-\tau)/P_c, N, B)$, where P_c represents consumer prices, τ income taxes and B the replacement ratio (unemployment benefit in real terms).

There exist several widely used union models. They differ as regards the factors which are assumed to be bargained over. In the 'right-to-manage' model, wages are bargained over and the profit-maximizing firm sets employment unilaterally. The game is specified as a standard Nash solution of a cooperative game after Binmore et al. (1986):

$$\begin{aligned} \max_w (U - U_0)^\theta (\pi - \pi_0)^{1-\theta} \\ \text{s.t.} \quad N(\cdot) = \arg \max_N \pi, \end{aligned} \quad (\text{iii})$$

where θ refers to the bargaining power of unions. U_0 is the fall-back utility of the union in the event an agreement is not reached. In Finland, the relevant alternative for an agreement is a strike, not only in economy-wide negotiations but at the local level as well. So, U_0 is assumed to depend on strike allowances, $U_0 = U(A)$. π_0 is the fall-back profit, which reflects fixed costs during a production stoppage. When π_0 is deducted from π in (iii), fixed costs cancel out. For simplicity, fixed costs were already omitted from (i) above. Equation (iii) gives the monopoly union model and efficient bargaining model as special cases.

As a marked reduction in normal annual working time has occurred in Finland during our observation period, we feel that this matter should not be disregarded. Generally, the effect of shorter working time on wages and employment is theoretically not clear. Holmlund (1989) stresses the sensitivity of the results to assumptions about how working time is initially determined. So, the question of how wages and employment are affected by shorter regular working time is ultimately empirical. Our model does not offer any guidance in this respect.

The model below for equilibrium (real) wages consists of variables influencing profits, on the one hand, and the utility of the union, on the other hand. In addition, a role is played by determinants of the fall-back utilities of the parties. Finally, the relative bargaining power matters. In its most general form, the model is

$$W^* = W(P_c, s, \tau, \frac{P_c}{P}, \theta, \frac{P_m}{P}, Z, H_N, B, A, K, t), \quad (iv)$$

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where H_N is the number of normal working hours and t is technical progress. Indirect taxes are part of the price wedge, P_c/P .

In modelling the determination of real wages and employment, we follow the tradition of Nickell & Andrews (1983) and Layard & Nickell (1986), despite obvious differences in specifications. The employment relation is commonly estimated in the structural form (ii) above, with the real wage on the right-hand side. We prefer, however, to work with reduced forms as in Carruth, Oswald & Findlay (1986). This is mainly in order to avoid simultaneity. For this reason, we replaced W in (ii) with (iv). The resulting equation consists of the same variables as the wage relation (iv) above.^{6,7}

⁶ The unemployment variable could have been introduced as a factor influencing the bargaining power of unions, for example. It was, however, considered inconvenient to have an unemployment variable such as $((N^s - N^d)/N^s)$ in an equation explaining employment, N^d . In so far as there are rigidities in labour supply, N^s , artificial explanatory power could have resulted. As we preferred to work with identical reduced-forms for both wages and employment, unemployment was omitted not only from the employment equation but also from the wage equation. In addition, since the unemployment rate was stationary during the observation period, its introduction would presumably have no significant effect on the cointegrating relation.

⁷ Pencavel & Holmlund (1988) let employment depend on (lagged) actual hours. We use normal hours instead. If *ceteris paribus* higher activity leads to higher employment as well as to more overtime work, a positive relation between hours and employment emerges. If hours are adjusted more flexibly than heads, the probability of this relation increases. If, however, *ceteris paribus* regular working time is reduced (by legislation), the share of overtime increases, implying higher average unit labour costs. This may make it profitable for the firm to hire more workers each of whom works less hours. In that case a negative relation between employment and hours can be detected. As Tyrväinen (1988) shows, actual hours and normal hours have developed very differently from each other in Finland. This is why we are sceptical about any results obtained in regressing employment on actual hours, at least in the context of Finland. It is interesting to note that, in different regressions, Pencavel & Holmlund find first a negative and then a positive coefficient in Sweden.

$$N^* = N(s, \tau, \frac{P_c}{P}, \theta, \frac{P_m}{P}, Z, H_N, B, A, K, t). \quad (v)$$

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Our aim is not to question the existence of a labour demand curve. When the employment relation was estimated in the structural form (ii), with the real wage on the right-hand side instrumented with variables indicated by (iv), wages were found to have a negative effect on the use of labour. In this article we wish, however, to evaluate whether the data provides support for the assertion that in the longer run both wages and employment – and basically the combination of the two – adjust towards an equilibrium determined by the exogenous factors of the bargaining model.⁸

Discrimination between bargaining models and other models is not straightforward. For instance, market-clearing models can be specified so that they produce relations which are very much like those above.⁹ The role of bargaining power is, however, the distinguishing feature of bargaining models. In the right-to-manage model, the impact of union power on employment is negative. The same is true for the monopoly union model. In time-series estimations, discrimination of the monopoly union model is problematic as union power is by definition constant (equal to unity) over time. Of course, even when a union acts as a monopolist, the unionization rate may vary when membership and employment do not change equiproportionally. Specifications with a positive union effect on employment are also common in the literature (see eg Manning, 1987, and Moene, 1988).

When the model is solved under the assumption of perfect competition in the product market, the demand shift variable drops out (see Tyrväinen, 1988). Hence, the significant presence of a variable describing aggregate economic activity would give support to the hypothesis of monopolistic competition. It is this channel that distinguishes this model from the competitive special case, and consequently the search for the significant presence for aggregate

⁸ In more general systems most of the variables of the model can, of course, be considered as endogenous. Granger-causality will be discussed below.

⁹ In bargaining models, labour supply is not usually considered separately. The union objectives define the terms for labour supply. However, as shown in the modelling exercise in Tyrväinen (1988), in standard models individual labour supply depends on variables which are similar to the factors which define union's welfare. If this is the case, the resulting relations look very much the same.

demand variables is an important aspect of their empirical implementation' (Andrews, 1988, p. 29).

3 Estimating long-run relations and error correction equations

Relations (iv) and (v) are assumed to determine the equilibrium levels related to the error correction models. The two-stage procedure presented by Engle & Granger (1987) is applied. The estimation period is 1965Q1–1989Q4. Mainly series derived from the Bank of Finland Quarterly Model of the Finnish Economy, BOF4, were used for the two sectors: 1) private sector, excl. agriculture and forestry, and 2) manufacturing industry.¹⁰ All definitions and sources can be found in Appendix 2.

As wage settlements are concluded more or less simultaneously in Finland, there are peaks in the differenced wage series in the contract quarters. This institutional feature is taken into account by means of a multiplicative dummy, DCONT.

We are now ready to write the estimating wage relations and error correction equations. Employment can be considered analogously. All variables are in logarithmic form.

Stage one/cointegrating wage relation (in log levels):

$$W_t = \beta_1 P_{c,t} + \beta_2 \left(\frac{P_c}{P} \right)_t + \beta_3 \left(\frac{P_m}{P} \right)_t + \beta_4 Z_t + \beta_5 (1+s_t) + \beta_6 (1-\tau_t) + \beta_7 \theta_t + \beta_8 B_t + \beta_9 A_t + \beta_{10} H_{N,t} + \beta_{11} (K\&TIME)_t + \text{constant} + z_{w,t},$$

where $z_{w,t}$ is the residual of the equation and $\beta_1 = 1$, in so far as the long-run price homogeneity holds, which is a restriction commonly imposed but seldom tested (see the discussion below). The capital stock and the time trend have been combined in one variable $K\&TIME$ which measures the contribution of these factors to productivity growth (see Appendix 2).

¹⁰ In the mid-1980s, manufacturing accounted for 50 per cent of production in the aggregate private sector and for 34 per cent of total employment.

Stage two/error correction equation for wages (in log differences):

$$\begin{aligned} \alpha_0(L)\Delta W_t = & \alpha_1(L)\Delta P_{c,t} + \alpha_2(L)\Delta \left(\frac{P_c}{P} \right)_t + \alpha_3(L)\Delta \left(\frac{P_m}{P} \right)_t + \\ & \alpha_4(L)\Delta Z_t + \alpha_5(L)\Delta(1+s_t) + \alpha_6(L)\Delta(1-\tau_t) + \\ & \alpha_7(L)\Delta\theta_t + \alpha_8(L)\Delta B_t + \alpha_9(L)\Delta A_t + \alpha_{10}(L)\Delta H_{N,t} + \\ & \alpha_{11}(L)\Delta(K\&TIME)_{t-1} + \alpha_{12}DCONT + \alpha_{13}z_{w,t-1}, \end{aligned}$$

where $z_{w,t-1}$ is the lagged residual (fitted minus actual) of the level equation and $\alpha_{13} > 0$.

The dynamics in error correction equations is determined freely. Four lags of all variables are included and $\alpha_i(L)$ summarizes the relevant lag polynomials. The dummy, DCONT, which is related to discrete changes in wage contracts (see Appendix 2), only enters the difference equation. In the cointegrating relation between levels, this stationary variable is not needed.

4 Estimations

Having assumed monopolistic competition in the product market, a variable (Z) is required which determines the location of the downward sloping demand curve. Pencavel & Holmlund (1988) use household disposable income for this purpose. However, income is by and large a product of wages, on the one hand, and employment, on the other. Moreover, its third key component, the tax rate, is one of the right-hand-side variables in our model. Theoretically, if instantaneous adjustment is assumed to take place in the product market, variations in inventories can be abstracted away and aggregate output (Q) is a suitable proxy for aggregate demand. On the other hand, it is straightforward to assume that output corresponds to demand in the long-run equilibrium, which prevails when all adjustment has taken place.

Generally speaking, there are many unresolved questions concerning the appropriate choice of the demand shift variable (see Holmlund, 1989). This is why we report alternative regressions. First, output is used. Second, the real disposable income of households is used as in Pencavel & Holmlund (1988). Finally, instrumental variable

techniques are applied. In addition to the exogenous variables of the model, we instrument output with imports of the countries important for Finnish exports and government real expenditure. For the manufacturing industry we also include export prices of goods. The observed output is tracked well by the instruments chosen.

In conditions of imperfect competition, the endogenous pricing decisions of a firm are influenced by the (exogenous) prices of competitors. In aggregation over identical firms, the counterpart of competitors' producer prices is the aggregate producer price of the industry concerned. The results of a test of the Granger-causality (see Tyrväinen, 1988) do not indicate that models where producer prices and output are considered as (weakly) exogenous with respect to wages and employment should be rejected.¹¹

The proxy chosen for union power is the unionization rate, UNION. In Finland, the picture given by the unionization rate closely corresponds to the qualitative conception of changes in union strength, although the former is undoubtedly only a rough measure of the latter.¹² The size of strike allowances is determined on a case-by-case basis in Finland. Hence, it is not possible to construct a uniform time series for it.

Short-term post-sample forecasts simulated with equations similar to those in this paper were introduced in Tyrväinen (1988). The actual outcome was tracked well with one exception. The actual number of persons employed in 1985 was 20 000 (around 1 per cent) less than predicted by the model. A survey (Borg, 1988) suggests that firms reacted strongly by reducing recruitment when a law improving employees' security against dismissal came into effect on 1 September 1984. It was indicated that as many as 20 000–30 000 jobs were involved. So, the results of our early forecasting exercise and the survey accord with each other. In this paper we include a dummy, DISD, in the employment equation to evaluate the matter more thoroughly.

¹¹ A complete set of results is available from the author upon request. Similar conclusions as ours have been reported for Sweden in Pencavel & Holmlund (1988) and for Denmark in Andersen & Risager (1990).

¹² According to Layard et al. (1991, p. 96) 'the union's power depends on the right to organize and strike'. Clearly, a union which covers most of the employees in an industry is more credible as far as its ability to organize industrial action is concerned. It should also be noted that strike allowances are funded by union fees. Obviously, if the union covers all the strikers ($M = N_s$), it is in a better position as regards the size of the strike funds (= funded fees of M members) in relation to outlays (= allowances paid to M strikers instead of $N_s > M$). Reference to alternative specifications of union power is made in Tyrväinen (1988) and Chapter 5 below.

The two-stage procedure of Granger & Engle makes use of the notion that a set of time series can form a stationary system as a linear combination, although separately the time series are not stationary. How about the time series of this study? Can they be made stationary, and if so, how many times must each series be differentiated in order to achieve stationarity? An ADF test indicates that we have a mixture of I(1) and I(2) variables in our regressions (see Tyrväinen, 1991). This will be reconsidered when the results are evaluated.

4.1 Cointegrating relations

The first stage of the Granger & Engle procedure, level-form relations, is reported in Tables 7 and 8. The estimation period is generally 1965Q1–1989Q4. In choosing the preferred regressions – marked with an asterisk, * – the size of the standard error has not been the only criterion. More general features of the equations have been evaluated as well.

The CRDW and ADF test statistics of all the relevant regressions exceed the critical levels known at the 1 per cent significance level (see Hall, 1986, Engle & Yoo, 1987 and Blangiewicz et al., 1990). The cointegration hypothesis can be accepted without problems.

Tyrväinen (1988) reports regressions which are similar to those reported in this paper with an observation period which was 5 years (20 observations) shorter than here. The qualitative results are not affected by the change of the estimation period. In addition, the cointegration regressions below were also carried out so that the more recent observations were given more weight than those located in the more distant past. When all the series were multiplied by the unionization rate, the results differed only slightly from those reported in Tables 7–8. The same was true for a shorter estimation period (Tyrväinen, 1988). As the unionization rate rose from 33 per cent in 1965 to more than 85 per cent in the middle of 1980s, these results also provide evidence for the stability of the relations.

Table 7. Cointegrating relations: wages

Estimation period: 1965Q1—1989Q4, except 1971Q1—1989Q4 in equation (10)
 Estimation method: OLS, except TSLS in regressions (3), and (8)

Independent variables	Dependent variable: log (W/CPI)									
	Private sector				Manufacturing industry					
	(1) *	(2)	(3) inst.	(4)	(5) *	(6)	(7)	(8) inst.	(9)	(10) *
log(CPI/P)	-.284	-.271	-.374	-.237	-.255	-.187	-.092	-.153	-.154	-.191
log(P _h /CPI)	.032	.045	.061	-	-	.049	.040	-	-	.043
log(1+s)	-.314	-.317	-.685	-.719	-.400	-.217	-.137	-.133	-.324	-.903
log(1-τ)	-.476	-.458	-.466	-.308	-.344	-.401	-.433	-.438	-.361	-.302
log(P _m /P)	-.130	-.127	-.156	-	-.223	-.172	-.140	-.210	-	-.186
log(TOT)	-	-	-	.263	-	-	-	-	.164	-
log(Q)	.226	-	.077	-	.085	.073	-	.239	-	-
log(YD)	-	.312	-	.285	-	-	.338	-	.354	.151
log(UNION)	.105	.113	.218	.093	.275	.267	.228	.226	.173	.487
log(K&TIME)	.486	.444	.555	.565	.434	.385	.219	.268	.281	.303
log(B)	.086	.061	-	.108	-	-	-	-	.048	-
DSTAB	-.029	-.026	-.043	-.237	-.048	-.048	-.041	-.046	-.039	-
Constant	7.365	-6.293	-5.630	-6.695	-4.195	-4.122	-4.526	-5.181	-4.937	-3.551
R ²	.995	.995	.995	.996	.984	.984	.985	.984	.984	.943
R ² C	.995	.995	-	.996	.983	.983	.984	-	.983	.936
ADF	6.14	6.70	6.17	6.86	6.38	7.31	7.05	7.22	7.01	6.57
CRDW	1.463	1.501	1.401	1.525	1.418	1.422	1.486	1.427	1.426	1.967
SE	.0207	.0201	.0217	.0188	.0350	.0350	.0340	.0356	.0350	.0336

CPI = consumer price index, P = producer prices, P_m = import prices of raw materials and semifinished products (incl. energy), TOT = terms of trade = P_x/P_m where P_x = export prices of goods and services (export prices of goods only for the manufacturing industry), P_h = prices of dwellings, s = employers' social security contribution rate, τ = marginal rate of income taxes, Q = output, YD = households' real disposable income, UNION = M/N = unionization rate, K = capital stock, K&TIME measures the contribution to the productivity of capital stock and technical progress is (K**0.4088)*EXP(0.00582*TIME) in the private sector. In manufacturing it is (K**0.3658)*EXP(0.00811*TIME). B = unemployment benefit in real terms, DSTAB is a stabilization policy dummy which receives the value of one in 1968Q2—1970Q4, and is zero elsewhere.

In regressions (3) and (8) output (Q) has been instrumented. Other independent variables of the relation have been used as instruments. Additional instruments are government real expenditure and imports of countries important for Finnish exports. In the manufacturing industry the instruments also include export prices of goods.

Wages

In the level-form regressions of wages, the signs of the coefficients of all key variables correspond to our *a priori* expectations. They are also highly significant by the usual criteria. Higher income taxes add to wage pressures although not with a one-to-one impact. A rise in employers' social security contributions is partly shifted backwards to lower wages.¹³ Indirect taxes contribute to the divergence in deflators relevant for employees and employers.

An increase in the price wedge (P_c/P) only partly lowers consumption real wages, and hence higher labour costs result. The data reject the wedge restriction, which would imply that the coefficients of factors contributing to the total wedge ($(1+s)$, $(1-\tau)$, (P_c/P)) are equal in absolute value.

The impact of relative import prices of raw materials is small, which could be expected because of their small import share.

The proxy for union power, the unionization rate, is of special interest for us. Its coefficient is positive in all wage equations, being in the range 0.1–0.3, and highly significant by the usual criteria. An inverse effect of normal working hours on the wage level, implying that total earnings do not fall hand in hand with hours worked, was found in all regressions. As the coefficient was quite imprecisely defined, however, it was omitted from the final regressions. The positive wage effect of unemployment benefits implied by the bargaining model is clear-cut in the private aggregate sector.

As already noted, three alternative ways of introducing the effect of the product demand were experimented with. As the table shows, the results are not sensitive to the method chosen. The relations are also virtually unchanged when the unionization rate is instrumented with its past values and other exogenous variables of the model.

One of the most interesting findings of this study concerns the operationalization of the price deflator, P_c , relevant to the union. Tyrväinen (1989b) estimated wage relations for 1971Q1–1984Q4 and used the deflator of private consumption derived from the National Accounts. When the estimation period was extended this measure appeared to be inappropriate. When the deflator was replaced by the

¹³ Ingberg (1984) estimates that social security contributions influence wages with a weight of about one quarter. Ingberg applies the approach of Holmlund (1983), who obtains a result for Sweden according to which about half of an increase in social security contributions is transmitted to wages within a year's time. This is the short-run effect. Holmlund points out that in the longer term employees will probably bear the burden in full (op. cit. p. 13). Ingberg's results should also be interpreted as short-run effects. A long-run coefficient of -0.7 can be solved from his various equations.

consumer price index (CPI), the results of the earlier study were restored. This deserves some comments. Although the deflator is the more comprehensive measure, this quarterly series is published with a considerable time lag. As the CPI, which is a monthly series, is published with a lag of only one month, its use appears to be more straightforward for wage setters.

In addition, there are substantial differences in the way of calculating the deflator and the CPI. For the present discussion, the most important point refers to how the cost of housing is measured. When the new CPI (1985=100) was introduced in 1988, the most significant revision concerned the measurement of housing costs. Half of housing expenses is now considered to arise from capital costs, of which depreciation accounts for two-thirds. The weight of the latter in the CPI is 4.8 percentage points. The 'cost' of depreciation is calculated by multiplying the replacement value of the dwelling by a constant depreciation coefficient. The replacement value follows movements in house prices. As prices of dwellings rose by more than 60 per cent between 1987Q3 and 1989Q1, a sizeable gap emerged between the two price measures, which also generated additional wage claims on the union side.

In regressions (1)–(3), (6), (7) and (10), however, the real prices of dwellings play an independent role. This could indicate that unions give an even larger weight to house prices than the CPI. This conclusion is, however, complicated by the fact the Finnish economy was heavily overheated in 1988–1989. There were two reasons for this: the liberalization of the financial markets led to a credit boom while, at the same time, the terms of trade improved substantially. The first of these factors is difficult to measure whereas the latter is more straightforward.

Above we proxied the strength of demand with the output variable. But, because of capacity constraints, excessive demand largely boosted imports, resulting in a deterioration in the current account. So, output obviously underestimates product demand in 1988–1989. It may well be that housing prices capture this effect. To investigate this we replaced the relative price term P_m/P by the ratio of export prices to import prices, P_x/P_m (= the terms of trade) in relations (4) and (9). Consumer goods were excluded from import prices as before. In addition, export prices of services were excluded where the manufacturing sector was concerned. The real housing price lost its explanatory power in the resulting regressions. This appears to indicate that this term at least partly captures the demand effects discussed above.

Bargaining models imply an equilibrium relation between employment and real wages. Accordingly, price homogeneity holds in our wage equations in 1971–1989. However, the devaluation of the Finnish markka by more than 30 per cent in 1967 and the stabilization policies in 1968–1970 had such a major influence on the price-wage relation that homogeneity is rejected as far as the second half of the 1960s is concerned.

Employment

Employment can be measured by two different concepts: the number of employed persons and the number of hours worked. If hours per head change, these two series may differ from each other. Changes may be due not only to cyclical variation in economic activity but also to legislation and agreements concerning normal working hours. Employment measured in time units (hours) appears to be closer to the concept relevant for the production function, the profit function and household income. From the point of view of economic policy, the number of employed persons is the key variable. Regressions have been estimated for both heads (N) and hours (H).¹⁴

As the results are presented in the table, we comment on them only briefly here. Employers' social security contributions were found to have a negative effect on employment in the aggregate private sector. This is in accordance with the wage relations, according to which an increase in the payroll tax is only partly shifted backwards to lower real wages in the sector concerned. An increase in the price wedge, CPI/P, which includes the effect of indirect taxes, reduces employment. This influence appears to be larger in the manufacturing industry than in the aggregate private sector.

The coefficient of normal working hours was negative in all regressions. This implies that shorter normal working time may have induced an increase – albeit modest – in the number of employed persons.¹⁵ The effect is, however, small and the coefficient varied considerably from one regression to another. We have therefore omitted normal hours from the reported relations.

¹⁴ An interesting topic for further research is whether the determination of heads and hours actually follows different mechanisms. Pencavel & Holmlund (1988) discovered some differences whereas our results give no indication of this.

¹⁵ Wadhvani (1987) finds a similar although somewhat stronger effect for the UK.

Table 8. Cointegrating relations: employment

Estimation period: 1965Q1–1989Q4

Estimation method: OLS, except TSLS in regressions (12), (15), (18) and (21)

Independent variables	Dependent variable:											
	N = number of employed persons						H = hours worked					
	Private sector			Manufacturing industry			Private sector			Manufacturing industry		
	(11) *	(12) inst.	(13)	(14) *	(15) inst.	(16)	(17) *	(18) inst.	(19)	(20) *	(21) inst.	(22)
log(CPI/P)	-.279	-.289	-.261	-.551	-.523	-.472	-.276	-.283	-.255	-.512	-.513	-.499
log(P _h /CPI)	-	-.011	-	-.162	-.201	-.136	-	-	-	-.163	-.162	-.133
log(1+s)	-.279	-.297	-.282	-	-	-	-	-	-	-	-	-
log(1-τ)	-	-	-	-	-	-	-	-	-	-	-	.189
log(P _m /P)	-.017	-.022	-.001	-.077	-.112	-	-.006	-.007	-.013	-.067	-.067	-
log(Q)	.369	.326	-	.394	.577	-	.459	.441	-	.549	.545	-
log(YD)	-	-	.300	-	-	.541	-	-	.474	-	-	.640
log(UNION)	.035	.033	.023	.124	.093	.140	-.072	-.071	-.091	.014	.015	.063
log(K&TIME)	-.215	-.153	-.074	-.264	-.382	-.353	-.382	-.365	-.308	-.505	-.502	-.466
DISD	-.014	-.014	-.008	-.024	-.029	-.010	-	-	-	-	-	-
D _N	.009	.017	.029	-	-	-	-	-	-	-	-	-
Constant	4.342	4.528	6.007	4.065	2.839	5.403	3.381	3.486	5.431	2.722	2.748	4.650
R ²	.968	.968	.952	.959	.951	.948	.637	.636	.540	.818	.818	.770
R ² C	.965	-	.948	.956	-	.944	.617	-	.516	.806	-	.755
ADF	5.60	5.62	6.25	4.72	5.29	5.14	8.50	6.49	2.76	7.00	7.00	7.42
CRDW	.994	.957	1.101	.670	.818	.902	1.972	1.970	1.877	1.521	1.521	1.499
SE	.0086	.0087	.0105	.0181	.0198	.0203	.0178	.0178	.0199	.0305	.0305	.0343

CPI = consumer price index, P = producer prices, P_m = import prices of raw materials and semifinished products (incl. energy), P_h = prices of dwellings, s = employers' social security contribution rate, τ = marginal rate of income taxes, Q = output, YD = households' real disposable income, UNION = unionization rate, K = capital stock, K&TIME measures the contribution to the productivity of capital stock and technical progress is (K**0.4088)*EXP(0.00582*TIME) in the private sector. In manufacturing it is (K**0.3658)*EXP(0.00811*TIME). D_N is a dummy referring to a change in statistics and is 1 in 1965Q1—1975Q4, and 0 elsewhere. DISD is a dummy referring to an act improving workers' security against dismissals. It is 1 from 1984Q4 onwards and is 0 elsewhere.

In regressions (12), (15), (18) and (21) output (Q) has been instrumented. Other independent variables of the relation have been used as instruments. Additional instruments are government real expenditure and imports of countries important for Finnish exports. In the manufacturing industry the instruments also include export prices of goods.

In general, the relations are not sensitive to the choice of the demand shift variable. The output elasticity of employment is, however, fairly low in comparison with conventional results. This is because we are dealing with reduced-form relations, where employment is not explained by wages. If an exogenous increase in product demand raises wages, the adjustment required for employment is smaller than in the conventional structural forms. Finally, technical progress has reduced the amount of labour needed to produce a given level of output.

It was stated above that indirect evidence indicates that the law improving employees' security against dismissal has reduced the number of recruitments since 1984. A dummy taking account of this is a key right-hand-side variable in all employment relations. The negative impact would have involved around 1.5 per cent of private sector employees or approximately 20 000–25 000 persons. In the manufacturing industry the relative effect appears to be even larger. This is in accordance with earlier evidence.

Stronger unions appear to have increased employment in the manufacturing industry.^{16,17} When reviewing the entire private sector, union power obtained a (positive) coefficient close to zero. One, though not necessarily the only, way to interpret this is to argue that outside the manufacturing industries the union effect on employment has been negative, as the right-to-manage model implies.

The positive employment effect found for Finnish manufacturing contradicts the right-to-manage hypothesis.¹⁸ In the literature, there are several sources for evaluations concerning this result. The generalized model in Manning (1987) analyzes bargaining as a sequential process where the union's influence on wages and employment may be different. In our context, the change in union influence on employment may have outweighed that on wages. As there are no signs of bargaining over employment at the aggregate level, this is a more attempting interpretation than the one implied by the efficient bargaining model. On the other hand, in a slightly different set-up than ours, Moene (1988) shows that an increase in the bargaining power of the union leads to higher employment whenever

¹⁶ Alogoskoufis & Manning (1991) find a similar effect for the UK. In their structural form employment equation the coefficient of union density was +0.12 with a t-value of 2.70.

¹⁷ This appears to indicate lower productivity as employment for a given output is higher.

¹⁸ This does not imply that our empirical model should necessarily be redesigned. In Chapter 2, we showed that the comparative statics concerning the key variables is not sensitive to the choice of the specification of the bargaining structure.

work stoppages are used as threats in the Nash solution (iii) above. As noted above, this argument could be relevant in Finland. Finally, if one wishes to verify the favourable effects of increasing 'corporatism' (see Calmfors & Driffill, 1988) in an empirical context, Finland would be an obvious candidate. There is hardly any other industrialized economy where the characteristics of the labour market have changed so much since the middle of the 1960s.

The explanatory power of the equations for hours worked remains notably weaker than that of the wage and employment equations. This is due to strong quarterly variation, which occurs even though the series have been seasonally adjusted. The coefficients are in general close to those obtained for employment. The union effect on hours is negative in the aggregate private sector and zero in manufacturing.

4.2 Error correction equations

In the second stage of the Granger & Engle procedure, an error correction equation is regressed where the lagged residual of the level-form relation determines the long-run properties of the system. No restrictions are imposed on dynamics. The initially overparametrized error correction model (ECM) is simplified and reparametrized step by step until a parsimonious presentation of the data generating process is achieved (see eg Hendry, 1986). The resulting equations are shown in Table 10 in Appendix 3.

According to Granger (1986, p. 217) 'Data generated by an error correction model ... must be cointegrated'. Accordingly, the error correction term is highly significant in all equations. Its magnitude should not, however, be considered as the sole indicator of the speed of adjustment. The dynamics is generated through various channels. In addition to the lagged residual, the contemporary and lagged coefficients of the shock variable matter as do also the lags of the dependent variable. To analyze the properties of the error correction equations, simulation of step response functions is required.¹⁹ The

¹⁹ It is surprising that in the literature there does not appear to be an earlier example of a study applying the two-step method which evaluates the properties of the results by means of dynamic simulations. On the other hand, in so far as the two-stage procedure is concerned, dynamic simulation is not primarily a method of stability analysis. The error correction model has been built in a way which ensures convergence towards the long-run solutions implied by the cointegrating regressions, provided that the error correction terms receive correct signs as in our case.

convergence is obtained as the difference between the shock solution and the control solution.

Dynamic simulations produced fairly well-behaving paths, as can be seen in Figure 7. As far as real wages are concerned, the speed of adjustment varies. In some cases the adjustment has, by and large, taken place within 1 1/2 years whereas in some cases the process is still going on in the third or even fourth year. However, most of the adjustment has generally taken place during the first two years. It is especially noteworthy that speeding up inflation only appears to lead to a short-lived and minor reduction in real wages.

Employment appears to adjust slightly faster than real wages.²⁰ The effects of shocks are largely transmitted within one year and the adjustment has fully taken place within two years.

Figure 8 shows the level-form wage relation (1), its error term and the fit of the corresponding error correction equation. It is particularly worth noting the excellent explanatory power of the error correction equation. The high significance level of the error correction term additionally confirms that the error correction hypothesis is well adapted to Finnish wage dynamics.

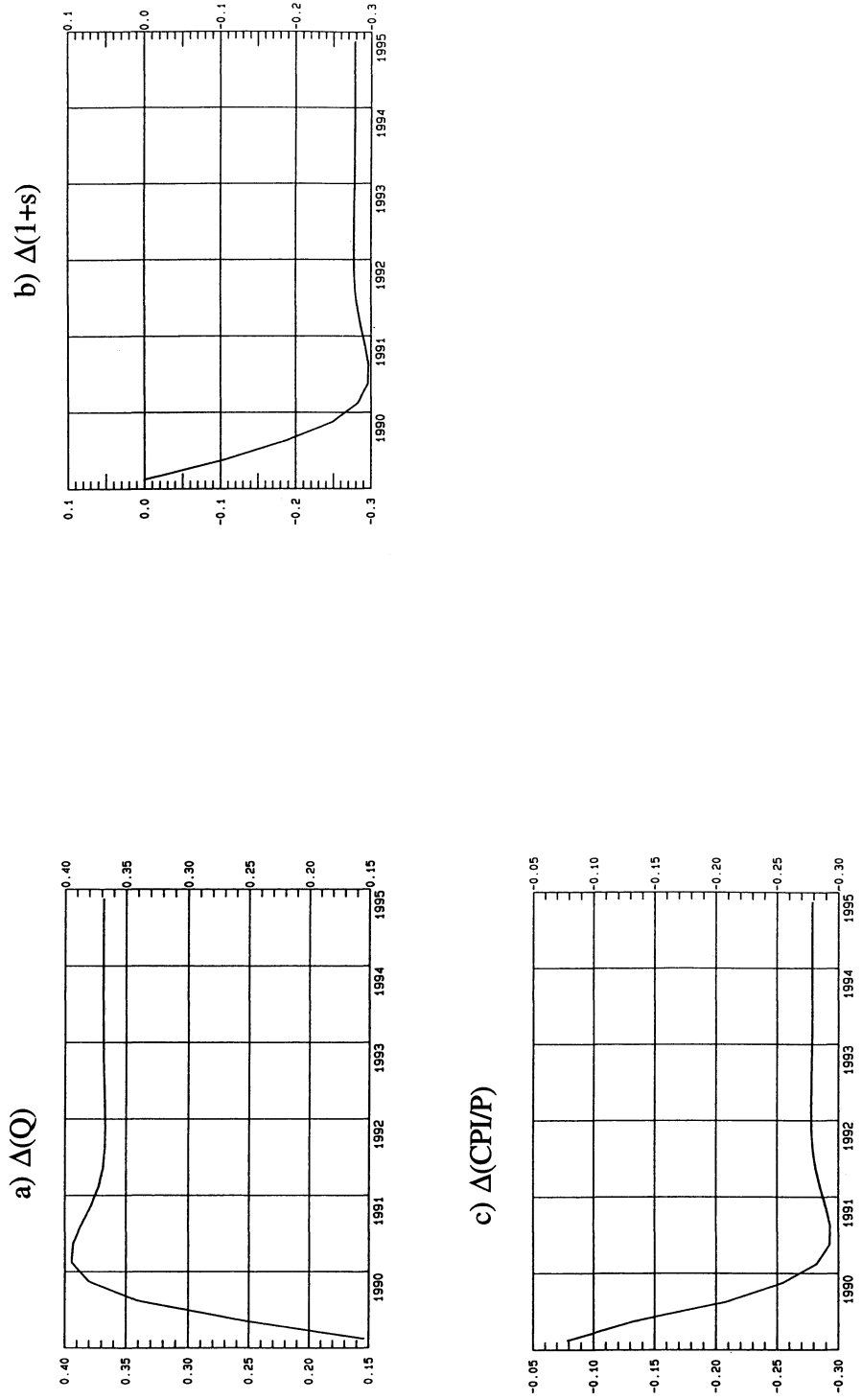
Figure 9 introduces the fit of the level-form regression (11) for employment as measured by heads. The residual and the ECM equation are shown below. The residual confirms the casual evidence of labour hoarding in 1976. Subsequently, a reaction set in after economic policy had been tightened sharply. Equilibrium was restored only in 1980. Otherwise, the level-form regression tracks actual employment well, and the standard error is small. Also, the error correction equation works quite nicely.

It is sometimes claimed that the use of the two-stage estimation procedure is dubious. In an early simulation study, Banerjee et al. (1986) argue that the superconsistency property of the coefficients in the first-stage cointegration regression shows up only poorly in small samples. Based on more recent Monte-Carlo simulations, Phillips & Hansen (1990) state that 'the reverse is true' (p. 120). Asymptotics are not only relevant but also seem to provide good approximations even for samples as small as 50.

²⁰ This appears to be in accordance with the results of Pehkonen (1990) and Pencavel & Holmlund (1988), which argue that the weight of wages in unions' utility functions is substantially larger than the weight of employment. This kind of model generates larger fluctuations in employment than in real wages.

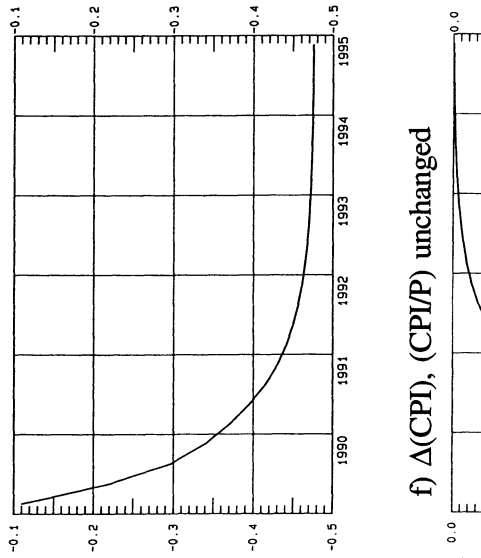
Figure 7. Step response functions simulated for real wages and employment

Employment

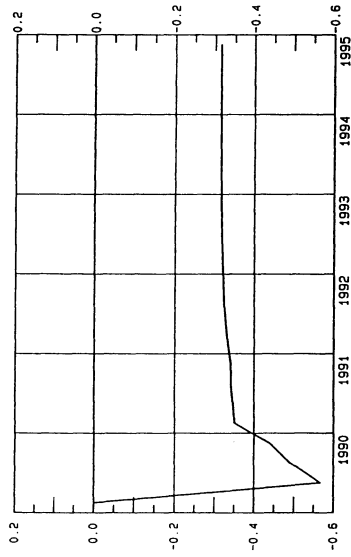


Wages

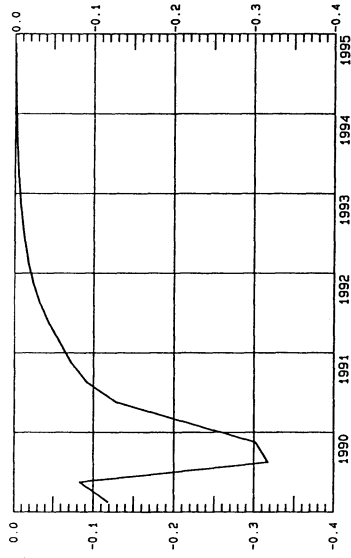
d) $\Delta(1-\tau_2)$



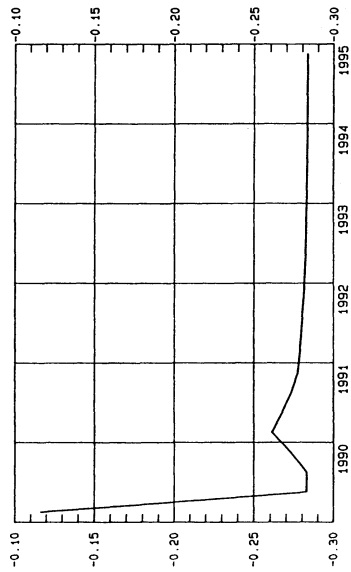
e) $\Delta(1+s)$



f) $\Delta(\text{CPI})$, (CPI/P) unchanged



g) $\Delta(\text{CPI}/P)$



The figures show the adjustment paths obtained by means of dynamic simulation after a shock has been fed into the system. The shock was induced as a permanent shift of 10 per cent in the level of an explanatory variable in 1990Q1. The simulations concerning the private sector apply cointegrating relations (1) and (11) in combination with the corresponding error correction equations (see Figures 8 and 9).

Doubts have been cast on the cointegration tests as well (see *Oxford Bulletin of Economics and Statistics*, Vol. 48, No. 3, special issue on cointegrated variables). However, Blangiewicz and Charemza (1990) shed new light on the small-sample properties of the ADF test in a multivariate case. Here, the critical values related to the ADF cointegration test do not differ much from the earlier estimates. As far as our test results are concerned, none of them is affected.

A final comment related to the robustness of the results concerns the fact that the regressions include both I(1) and I(2) variables (see Table 9 in Appendix 3). Thus, it could be thought that some of the I(2) variables on the right-hand side form a linear combination which is I(1). It may be reasonable to argue that Q is I(2) because K is I(2) via the production function. Whether these kind of relations will work their way through appropriately in estimations deserves special attention when the coefficient estimates are evaluated.

As it happens, the results are generally 1) in accordance with theoretical considerations, 2) do not contradict earlier evidence from Finland, 3) do make common sense, and finally 4) fit the data well.²¹ Hence, the potential problems discussed above do not appear to emerge in the present context.

The two-stage method is particularly useful when the equations examined are complicated. Especially when it is desired to determine the lag structure freely, the degrees of freedom are often too small for reliable unrestricted estimation of the coefficients of all variables – both in level and difference form – in a single ECM regression. When there are many multicollinear variables both in levels and in differences in a regression, the results are very sensitive even to small changes in the data matrix: not only the magnitudes but even the signs of coefficient estimates are fragile.²² Hence, the conventional procedure whereby a two-stage estimation is checked by regressing an ECM in the traditional fashion in one stage may in some cases lead to false conclusions.

²¹ In addition, a test carried out within the maximum likelihood framework proposed by Johansen (1991) confirms that the data accepts the existence of cointegrating vectors such as (1) and (11) above.

²² The error correction models applied in the simulations were also estimated using the traditional estimation technique in one stage. The initial forms of the new equations contained all the relevant variables in level form as well as the difference terms with four lags. The parsimonious equations differed from those obtained with the two-stage method. In many cases the signs of the coefficients differed from those implied by theory, or their magnitude was implausible.

Figure 8a. **Wage relation in real levels (1), private sector**
1 = Actual, 2 = Fitted; 1965 = 100

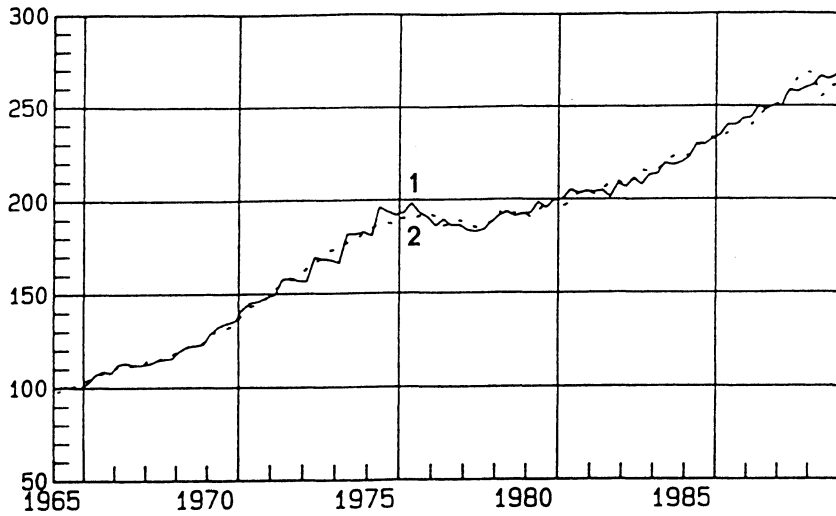


Figure 8b. **Residual of the regression above**

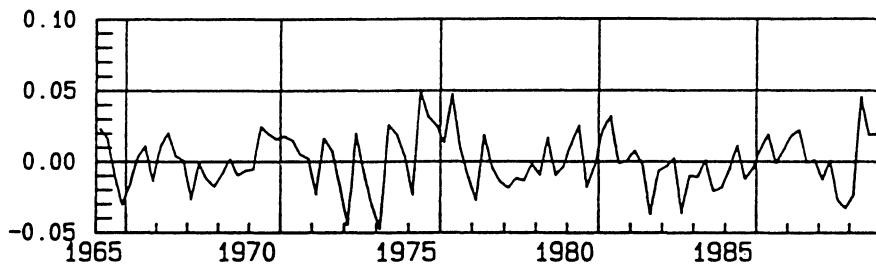


Figure 8c. **Error correction equation for the change in (nominal) wages**
From the previous quarter, per cent

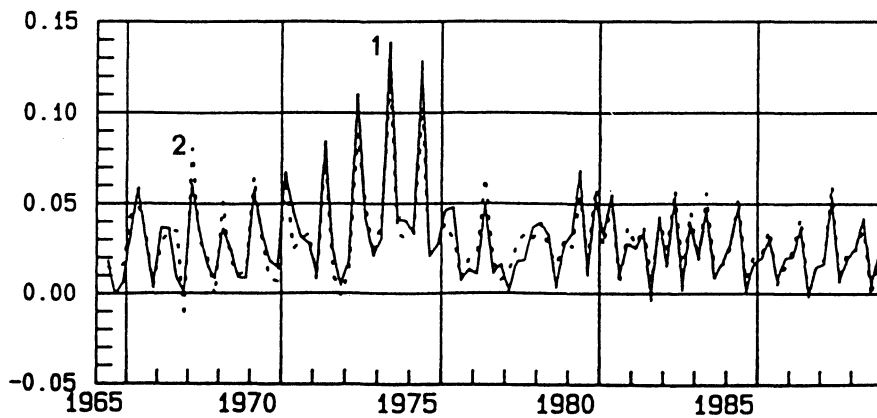


Figure 9a. **Employment relation in levels (11), private sector**
 1 = Actual, 2 = Fitted; thousands of employees

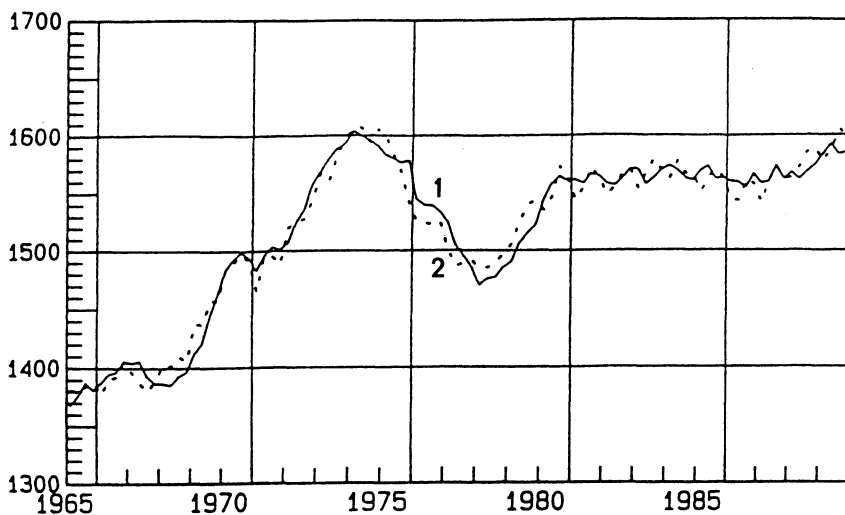


Figure 9b. **Residual of the regression above**

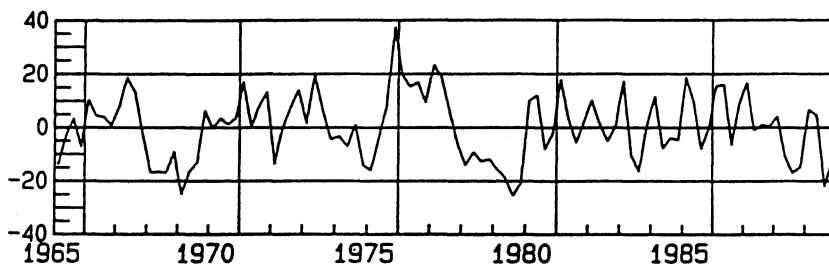
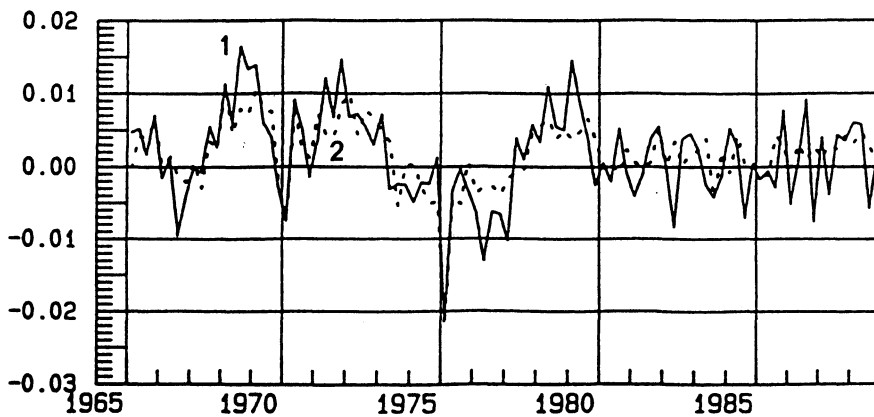


Figure 9c. **Error correction equation for the change in employment**
 From the previous quarter, per cent



5 Conclusions

This paper presents preliminary analysis of the Finnish data on wages and employment applying the two-stage estimation method proposed by Engle & Granger (1987). The results are highly encouraging. Cointegration is apparent and the model applied in this paper works well with one exception. Against our *a priori* expectations, in the manufacturing industry stronger unions appear to have a positive effect not only on wages but on employment as well. Hence, the right-to-manage hypothesis is rejected as far as the manufacturing industry is concerned.²³ As the union density rate – used as the proxy for union power – is a key right-hand-side variable, we can draw a further conclusion. The result also rejects the monopoly union model, where union power in wage determination is by definition (constantly) one. If there were no variation in union power, it would be captured wholly by the intercept of the regression. This is especially so in Finland, as union wages are also applied to non-unionized workers.

The hypothesis of monopolistic competition in product markets gains support, since the demand shift factor – no matter how it is proxied – is a key explanatory variable. Higher income taxes add to wage pressures although not with a one-to-one impact. A rise in employers' social security contributions is partly shifted backwards to lower wages. Indirect taxes contribute to the divergence in deflators relevant for employees and employers. An increase in the price wedge (P_c/P) only partly lowers consumption real wages, and hence higher labour costs result. As increases in taxes are not fully absorbed by wages, real wage resistance is in action and lower employment results. The data appear to reject the wedge restriction,²⁴ which would have implied that the coefficients of factors contributing to the wedge are equal in absolute value. Higher import prices of raw materials and energy reduce both real wages and employment.

²³ Having analyzed the matter in the light of recent research, we conclude that the bargaining procedure concerned lies between the efficient-bargaining and the right-to-manage models, which is in accordance with the conclusion of Alogoskoufis & Manning (1991) for the UK. In a test where the 'general bargain model' of Manning (1987) nests the efficient bargain model' which, in turn, nests the 'labour demand curve model', the latter two specifications were clearly rejected.

²⁴ There is an extended discussion on different ways to define the wedge in the literature in Chapter 4.

According to dynamic simulations, adjustment lags are generally not particularly long. This implies that developments in actual employment – in so far as they are considered unfavourable – cannot be attributable primarily to 'too slow' adjustment.²⁵ Rather, it is the equilibrium – the attractor – which is inappropriate. Admittedly, more accurate inference of cointegrating relations requires use of more sophisticated estimation methods. The next chapter proceeds in this direction.

²⁵ This result is in accordance with studies indicating low real wage rigidity in Finland. For a discussion see Chapter 1.

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Appendix 1 to Chapter 3

Modelling the equilibrium wage and employment

By way of an example, the derivation of the wage and employment equations with explicitly defined functional forms is reported below. In addition to the signs of the parameters, several parameter restrictions are obtained. In the empirical work these restrictions are, however, not tested. Because the underlying specification includes a complicated set of joint hypotheses, the parameter restrictions for the regression equations become intractable in practice.

A three factor Cobb-Douglas technology $F(N,m,K)$ relates output to inputs of labour, capital and raw materials. Gross output or the supply of products can be written as

$$Q = Y^a m^{1-a}, \quad \text{where } 0 < a < 1, \quad (\text{vi})$$

and Y is value-added, which is

$$Y = AN^\alpha, \quad \text{where } 0 < \alpha < 1 \quad (\text{vii})$$

and $A = Ge^{(\lambda t)} K^{(1-\alpha)}$. Technical progress is embodied in parameter t . The explicit formula for gross output is obtained by substituting A and (vii) to (vi). That is

$$Q = G^a e^{\gamma a t} N^{a\alpha} K^{a(1-\alpha)} m^{(1-a)}. \quad (\text{viii})$$

The technology concerned implies constant returns to scale as $\alpha a + a(1-\alpha) + (1-a) = 1$. The coefficient capturing the role of technical progress is $\gamma = \lambda a$.

The price of gross output, the producer price (P), can also be written as a weighted combination of the value-added deflator (P_Y) and the prices of raw materials (P_m):

$$P = P_Y^a P_m^{1-a}, \quad (\text{ix})$$

and accordingly the value-added deflator is equal to

$$P_Y = P^{\frac{1}{a}} P_m^{-\frac{1-a}{a}}$$

The profit of the firm is defined as the difference between its sales revenues and its production costs:

$$\pi = PQ - \hat{W}N - P_m m - C \quad (x)$$

\hat{W} includes payroll taxes. By substituting the value-added identity, $P_Y Y = PQ - P_m m$, into (x), we obtain an alternative expression for profits

$$\pi = P_Y Y - \hat{W}N - C. \quad (x')$$

The firm stays in business only if its profit exceeds an exogenously given minimum level π_0 . For an active firm $\pi \geq \pi_0$. Let us assume that the threat point in the Nash solution refers to a situation where the firm gives up because this minimum profit condition has been violated. Here, the profit (= loss) equals constant production costs, $\underline{\pi} = -C$.

In Finland, a strike is the relevant alternative to an agreement. When the uncertainty aspect of a bargaining process is the risk of a breakdown in negotiations, a von Neumann-Morgenstern specification is a utility function consistent with the game in question (see Binmore et al., 1986). The union maximizes a utilitarian welfare function. Its welfare depends on its members' after-tax real wage \tilde{w} and employment. Membership M is taken as exogenous. The utility function is

$$U = U(\tilde{w}, N) = N \cdot u(\tilde{w}) + (M - N) \cdot u(\tilde{w}_a), \quad (xi)$$

where \tilde{w}_a is the alternative wage of the members with no union job. For simplicity, we assume that at the moment the bargaining breaks down, all the union members receive this alternative income and $\underline{U} = M \cdot u(\tilde{w}_a)$. So, for the union the excess payoff over the threat payoff is

$$U - \underline{U} = N \cdot (u(\tilde{w}) - u(\tilde{w}_a)). \quad (xii)$$

Labour and raw materials are used up to the levels where their relative marginal products equal their relative prices, that is

$$\frac{F_N}{F_m} = \frac{\hat{W}}{P_m}. \quad (\text{xiii})$$

According to (xiii), the optimal use of raw materials can be solved as

$$m^* = \frac{1-a}{\alpha a} \cdot N \cdot \frac{\hat{W}}{P_m}. \quad (\text{xiv})$$

The firm sells its products in imperfectly competitive markets. It optimizes with regard to the price of its own product, \hat{P} , facing a well-behaved log-linear downward sloping demand curve, which is defined as:

$$\hat{Q}^d = f(\hat{P})X^{-1} = \gamma_0 \hat{P}^\gamma X^{-1}, \quad (\text{xv})$$

where $X = P^\gamma Z^{-\gamma_1}$, $\gamma_1 > 0$.

Z is the shift parameter and P is the price of competitors. It is often assumed that the absolute value of the price elasticity of demand is greater than one, $\gamma < -1$. However, if the demand curve is kinked, it may be that $-1 < \gamma < 0$. A similar result may occur as a result of aggregation, even when the firm is competitive. Hence, the elasticity of demand in relation to prices can be anything between zero and (minus) infinity (See Layard and Walters, 1978).

The demand curve (9') gives us the following pricing rule:

$$\hat{P} = \gamma_0^{-\frac{1}{\gamma}} \hat{Q}^{\frac{1}{\gamma}} X^{\frac{1}{\gamma}}. \quad (\text{xvi})$$

As the technology is identical in all firms, the value-added deflator is thus

$$\hat{P}_Y = \mu_0 \hat{Q}^\mu X^\mu P_m^{-\frac{(1-a)}{a}} = \mu_0 A^{a\mu} N^{\alpha a \mu} m^{(1-a)\mu} X^\mu P_m^{-\frac{1-a}{a}} \quad (\text{xvii})$$

where $\mu_0 = \gamma_0^{-\frac{1}{a\gamma}}$ and $\mu = \frac{1}{a\gamma}$, and $-1 < \mu < 0$, if $\gamma < -1$.

Equation (xiv), which implies optimal use of raw-material inputs, is substituted into the price equation (xvii). The production function and the pricing rule can be used to write the formula for profit (x')

$$\pi = e_1 A^{1+a\mu} N^{(1-a+\alpha a)\mu + \alpha} \hat{W}^{(1-a)\mu} P_m^{-\frac{(1-a)(1+a\mu)}{a}} X^\mu - \hat{W}N - C,$$

where $e_1 = \mu_0 \frac{(1-a)^{(1-a)\mu}}{\alpha a}$. From this we can solve the formula for the marginal product of labour, π_L . In equilibrium, the firm operates on the labour demand curve, where $\pi_N = 0$.

For the sake of notational simplicity, we consider below a symmetric bargaining game. The parameter θ (see equation (iii) in the main text) measuring asymmetry in bargaining is discussed at length in Tyrväinen (1988), where the implications of its introduction are analyzed (see also Manning, 1987). The optimization exercise is carried out in terms of value-added (see Andrews, 1988). According to the Nash cooperative solution, the problem is as follows:

$$\max_W (U(\tilde{w}, N) - \underline{U})(\pi(\hat{w}, N) - \underline{\pi}) = (N \cdot (u(\tilde{w}) - u(\tilde{w}_a))) (\hat{P}_Y Y - \hat{W}N)$$

s.t.

$$N = e_2 A^{-\frac{1+a\mu}{(1-a+\alpha a)\mu + \alpha - 1}} \hat{W}^{\frac{1-(1-a)\mu}{(1-a+\alpha a)\mu + \alpha - 1}} P_m^{\frac{(1-a)(1+\alpha\mu)}{a[(1-a+\alpha a)\mu + \alpha - 1]}} X^{\frac{\mu}{(1-a+\alpha a)\mu + \alpha - 1}},$$

$$\text{where } e_2 = (e_1(1-a+\alpha a)\mu + \alpha)^{-\frac{1}{(1-a+\alpha a)\mu + \alpha - 1}}.$$

The optimization condition incorporates the right-to-manage hypothesis, according to which firms use labour optimally. Having solved the target wage, optimal employment is found by substituting W^* into the equilibrium condition above. In logarithmic form, the equations for equilibrium employment and wages are:

$$\log(N^*) = b_0 - b_1 \log(1 + \tau_1) + b_1 \log(1 - \tau_2) - b_1 \log(1 + \tau_3) + \\ b_2 \log(\tilde{w}_a) + b_3 \log(P_m) + b_4 \log(P) + b_5 \log(Z) + b_6 \log(A)$$

and

$$\log(\hat{W}^*) = b_{10} - b_{11} \log(1 + \tau_1) + b_{11} \log(1 - \tau_2) - b_{11} \log(1 + \tau_3) + \\ b_{12} \log(\tilde{w}_a) + b_{13} \log(P_m) + b_{14} \log(P) + b_{15} \log(Z) + b_{16} \log(A)$$

The signs are $b_1 > 0$, $b_2 < 0$, $b_3 < 0$, $b_4 > 0$, $b_5 > 0$, $b_{11} < 0$, $b_{12} > 0$, $b_{13} < 0$, $b_{14} > 0$, $b_{15} > 0$, $b_{16} > 0$. b_6 cannot be generally signed. $b_6 > 0$, when the price elasticity of the product demand $\gamma < -1$. Earlier in this section we concluded that γ can also obtain values between $(0, -1)$. In that case $b_6 < 0$.

The wage equation above has been written so that the product wage (ie labour cost) is on the left-hand side. In the main text, the wage equation is written for the nominal wage. Account of this purely technical transformation has been taken as far as the signs are concerned.

Appendix 2 to Chapter 3

Definitions and sources of series

The source is the database of the quarterly model of the Bank of Finland (BOF4) unless otherwise indicated.

- 1) s = rate of employer's social security contribution
= $\frac{\text{social security contributions}}{\text{wage sum}}$
- 2) τ = marginal income tax rate of the 'representative tax payer'
- 3) W = nominal average (consumption) wage
= $\frac{\text{wage sum}}{\text{hours worked}}$
- 4) P = producer price
= deflator of gross production in the respective sector
- 5) P_c = consumer prices
- 6) P_h = prices of dwellings
- 7) P_m = input price of raw materials and semifinished products (incl. energy), proxied by the import price of raw materials and semifinished products
- 8) m = raw material input (incl. energy)
- 9) M = number of union members
- 10) N = number of persons employed
- 11) UNION =
unionization rate = $\frac{M}{N}$
- 12) H = hours worked

- 13) B = unemployment benefits in real terms
Source: Eriksson et al. (1990)
- 14) Q = gross output
- 15) YD = real disposable income of households
- 16) K = capital stock
- 17) TIME = time trend
- 18) K & TIME = contribution of capital stock and technical progress to productivity growth
= $(K^h) * (e^{\xi * TIME})$, where
h is the income share of capital;
 ξ is the rate of increase in overall productivity

h is calculated from the National Accounts as an average over the sample period s.t.

$$h_i = 1 - \frac{(\text{Wage sum} + \text{social security contributions})_i}{\text{value of GDP}_i}$$

where i refers to the respective sector.
 ξ is the average over the sample period

$$\Delta \log Q_i - h_i \Delta \log(K_i) - (1 - h_i) \Delta \log(H_i).$$

- 19) DCONT = 'institutional' dummy which captures the differences in the quarterly timing of wage settlements in different years. The sum of the quarterly dummies is one in each year. If the only rise in the year becomes effective at the beginning of March, the contract raises wages in the first quarter with a weight of 1/3 while 2/3 of the effect is observed in the wage index only in the second quarter. Our contract dummy (DCONT) obtains the value 0.333 in the first quarter and 0.666 in the second (see also Tyrväinen, 1988).

- 20) DSTAB = dummy for stabilization policy. It is 1 in 1968Q2–1970Q4 and nil otherwise.
- 21) DN = dummy for a change in private sector employment statistics. It is 1 before the change took place, that is 1965Q1–1975Q4, and nil otherwise.
- 22) DISD = dummy referring to an Act improving workers' security against dismissals. It is 1 from 1984Q4 onwards and nil otherwise.

Appendix 3 to Chapter 3

Estimation results

Table 9. **Tests for the order of integration: results of an Augmented Dickey-Fuller (ADF) test**

W	private sector manufacturing	I(2) I(2)
W/CPI	private sector manufacturing	I(2) I(1)
N	private sector manufacturing	I(1) I(1)
H	private sector manufacturing	I(1) I(1)
CPI		I(2)
P_m		I(1)
P	private sector manufacturing	I(2) I(2)
P_h/CPI		I(1)
CPI/P	private sector manufacturing	I(1) I(1)
P_x		I(1)
P_x/P_m		I(1)
P_m/P	private sector manufacturing	I(2) I(2)
$1+\tau_1$	private sector manufacturing	I(1) I(1)
$1-\tau_2$		I(1)
Q	private sector manufacturing	I(2) I(2)
YD		I(2)
B		I(2)
B/CPI		I(2)
K	private sector manufacturing	I(2) I(2)
K&TIME	private sector manufacturing	I(2) I(2)
M		I(2)

Table 10.

**The second stage of the Granger & Engle
two-step estimation procedure:
the parsimonious error correction equations**

Estimation method: OLS

Estimation period: 1965Q2-1989Q4, except 1971Q2-1989Q4 in equation (27)

Explanatory variables		Cointegrating relation with which the ECM concerned is connected						
		(1)	(5)	(10)	(11)	(15)	(18)	(21)
		Dependent variables						
Lag	ΔW priv. (25)	ΔW manuf. (26)	ΔN manuf. (27)	ΔN priv. (28)	ΔN manuf. (29)	ΔH priv. (30)	ΔH manuf. (31)	
Lagged dependent	1	-	.381 (2.69)	.272 (2.45)	.161 (2.27)	-	-.186 (1.93)	.172 (1.35)
	2	-	.221 (2.09)	-	.161 (2.09)	.167 (2.02)	-.398 (5.20)	-
	3	-.091 (2.17)	-	-	-	.302 (3.42)	-.521 (7.40)	-
$\Delta \log(\text{CPI})$	0	.883 (5.99)	-	-	-	-	-	-
	2	-.261 (1.89)	-	-	-	-	-	-
$\Delta \log(\text{CPI}/P)$	0	-.119 (1.82)	.446 (1.78)	-	-.076 (2.84)	-.276 (3.65)	-.141 (1.74)	-.661 (2.37)
	1	-.114 (1.54)	-	-	.034 (1.29)	-	-	-
	3	-	-	-	-	-	-	.388 (2.15)
$\Delta \log(P_v/\text{CPI})$	0	-	-	.667 (2.05)	-	-	-	-
	2	-.138 (3.56)	-	-	-	-.094 (2.15)	-	-
	3	-	-	-.698 (3.15)	-	-	-	-
$\Delta \log(P_m/P)$	0	-	-	-	-	-.034 (1.52)	-	-.118 (1.26)
	2	-	.120 (1.47)	.178 (2.24)	-.024 (3.11)	-	-	-
	3	-	-	-	-.012 (1.55)	-	-	.152 (1.78)
$\Delta \log(1+\tau_1)$	1	-.461 (1.17)	-	-	-	-	-	
$\Delta \log(1-\tau_2)$	0	-.115 (2.02)	-	-	-	-	-	
	1	-	-	-.338 (2.88)	-	-	-	
$\Delta \log(B/\text{CPI})$	2	.214 (1.93)	-	-	-	-	-	
	3	-.173 (1.67)	-	-	-	-	-	
$\Delta \log(\text{UNION})$	0	-	-	-	-	-	-.235 (4.02)	
	1	-	.498 (2.36)	-	-	-	-	
	2	-	-.550 (2.41)	-2.126 (2.02)	-	-	.102 (2.05)	
	3	-	-	2.118 (2.47)	-	-	-	
$\Delta \log(Q)$	0	-.203 (2.39)	-	-	.154 (6.00)	.179 (5.08)	.278 (4.16)	.389 (2.91)
	1	-.206 (2.31)	-	-	-	-	.285 (3.13)	-
	2	-	-	-	-	-	.323 (3.34)	-
	3	-	-	-	-	-.113 (2.66)	-	-
$\Delta \log(K\&TIME)$	1	6.840 (5.26)	-	-	-	-	-.725 (3.37)	-6.405 (2.12)
	2	-	-	-	-	-1.555 (1.96)	-	6.026 (1.90)
	4	-5.707 (4.14)	-	-	-	1.634 (2.12)	-	-
DCONT	.0575 (9.32)	.049 (5.65)	.077 (7.44)	-	-	-	-	
$\Delta(\text{DSTAB})$	-	-.057 (4.63)	-	-	-	-	-	
$\Delta(\text{DISD})$	-	-	-	-.008 (8.35)	.006 (2.78)	-	-	
$\Delta(\text{DN})$	-	-	-	.016 (10.25)	-	-	-	
TARGET ERROR	1	.305 (3.89)	.926 (4.50)	.752 (3.76)	.373 (6.24)	.310 (5.90)	.867 (6.23)	.909 (5.51)
R ²		.863	.569	.645	.653	.524	.809	.550
R ² c		.838	.530	.602	.617	.468	.786	.508
DW		1.959	1.916	2.050	1.946	2.017	1.795	2.138
SE		.010	.027	.028	.004	.010	.012	.028

White's heteroscedasticity adjusted t-ratios are shown below the parameter estimates. The degrees of freedom correction has been made according to McKinnon and White (1985).

Chapter 4

Wage Setting, Taxes and Demand for Labour: Multivariate Analysis of Cointegrating Relations

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Abstract

In two respects, this paper proceeds from the point where the previous chapter left off. Firstly and more importantly, the estimation method applied is 'better', ie the FIML procedure proposed by Johansen (1988). Secondly, taxes are treated in a slightly more elaborate manner than in Chapter 3.

A 10-dimensional vector space is defined as an outcome of modelling wage setting and demand for labour in a bargaining framework. This overparametrized vector autoregressive (VAR) system is reduced by means of conditioning. Structural restrictions identifying the long-run relations of interest are specified. The restrictions characterizing wage setting and labour demand schedules are imposed and tested first separately and then jointly.

Generally, restrictions satisfying the condition for *formal identification* pass the tests at a fairly high significance level. The plausibility of the resulting cointegrating relations applies not only to the signs but also to the magnitudes of the coefficients. This concerns *economic identification*. Preliminary evidence indicates that the preferred relations satisfy conditions for *empirical identification* as well.

The relations show up almost identically in partial and joint analysis. They do not appear to be sensitive to the choice between four or three cointegrating relations in the system. Finally, the relations are hardly influenced at all by alternative assumptions concerning the endogeneity of various tax rates.

According to the results, an equiproportional increase in average and marginal income tax rates is shifted to a higher pre-tax wage level with an elasticity of around two-thirds, which is also the effect on labour costs. The impact of higher employers' social security contributions on real labour costs is identical to the income tax effect. Interestingly, the adjustment coefficient associated with indirect taxes appears to be the same as well. Stronger unions push up the wage level. Higher real prices of raw materials reduce wages. The driving force of real wage growth is productivity growth. As far as demand for labour is concerned, the negative impact of real labour costs is clear-cut. Employment appears to be determined by the labour demand curve, which contradicts the efficient bargaining hypothesis.

1 Introduction

The introduction of the concept of cointegration has provided an interesting avenue for investigation of the long-run relations between non-stationary variables. For estimation, Engle & Granger (1987) proposed a two-step method, which has been applied in Chapters 3 and 5. More recently, Søren Johansen (1991b) has proposed a maximum likelihood procedure for estimation of multivariate systems. As the two-step method only selects one of the potential candidates for the relevant long-run relations with no consideration of the other vectors, the Johansen method marks a considerable step forward as it allows us to examine the vector space in a more thorough manner. Furthermore, testing of hypotheses and discussion of identification is more straightforward in this framework (see Johansen & Juselius, 1992a,b).

In the present paper, wage setting and demand for labour in Finland are investigated applying the Johansen procedure. Furthermore, we place special emphasis on issues related to identification of the relations of interest in the three contexts relevant in econometric work (see Johansen & Juselius, 1992b). That is, we are interested in 1) *formal identification*, which is related to the statistical model, 2) *empirical identification*, which is related to the actual estimated parameter values, and last but not least, 3) *economic identification*, which is related to the economic interpretability of the estimated coefficients of a formally and empirically identified model.

The chapter is organized as follows. Section 2 introduces the economic model. Section 3 discusses the statistical model applied. In Section 4, an unrestricted vector autoregressive (VAR) model derived from the theoretical considerations is specified. The final operational model is arrived at by reducing this overparametrized model by conditioning. In Section 5, the identifying conditions of the structural hypotheses are specified. In Section 6, these restrictions are tested in terms of the partial model. Section 7 discusses the results concerning tax effects on wages in the light of earlier evidence. Section 8 summarizes the paper.

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2 The economic model

There are n identical firms which have a production function $Q = F(N, m, K, t)$ with three inputs, labour (N), raw materials (m) and capital (K), which is assumed to be predetermined. (Steady) technical progress is embodied in t . Imperfect competition is assumed to prevail in the product market. The firm maximizes profits which are defined as the difference between sales revenues and production costs:

$$\pi = \hat{P}[\tilde{Z}F(N, m, \underline{K})]F(N, m, \underline{K}) - W(1+s)N - P_m m, \quad (i)$$

where $\hat{Q}^d = \hat{P}^{-1}(P)\tilde{Z}^{-1} \equiv D(P)Z$ is a downward sloping demand curve of the separable form introduced by Nickell (1978). Here, $Z = \tilde{Z}^{-1}$ is a parameter describing the position of the demand curve faced by the firm and \hat{P} is the (endogenous) producer price of the firm, P the competitors' producer price, W the nominal wage, s the payroll tax and P_m the price of raw materials (incl. energy). The output of the firm, \hat{Q} , is assumed to be endogenous. According to the marginal product condition, optimal use of an input is determined by the relative price. If the firm uses raw materials optimally, the demand for labour schedule has the following standard form

$$N^d = N^d \left(\begin{array}{c} \frac{W(1+s)}{P}, Z, \frac{P_m}{P}, \underline{K}, t \\ - \quad + \quad (-) \quad ? \quad ? \end{array} \right). \quad (ii)$$

All functions and related signs presented in this chapter are as in Chapters 2 and 3 above. The signs which do not necessarily hold generally are shown in parentheses.

The firm bargains with a union. The welfare of the union depends on the after-tax real wage of its employed members and the (real) unemployment benefit received by the unemployed members, $U = U(W(1-\tau)/P_c, N, B)$, where P_c is consumer prices, τ income taxes and B the replacement ratio or unemployment benefit in real terms. As far as the partial derivatives are concerned, we assume that $U_1, U_2, U_3 > 0$ and $U_1'', U_2'', U_3'' < 0$, respectively. This general specification covers most of the common preference functions.

The widely used union models differ as regards the factors assumed to be bargained over. In the 'right-to-manage' model applied

here, wages are bargained over and the profit-maximizing firm sets employment unilaterally. The game is specified as a standard Nash solution of a cooperative game after Binmore et al. (1986):

$$\max_w (U - U_0)^\theta (\pi - \pi_0)^{1-\theta} \quad \text{s.t.} \quad N(\cdot) = \arg \max_N \pi, \quad (\text{iii})$$

where θ refers to the bargaining power of unions, $0 < \theta < 1$. U_0 is the fall-back utility of the union in the event an agreement is not reached. In Finland, the relevant alternative for a contract is a strike, not only in economy-wide negotiations but at the local level as well. Although strike allowances are only paid in non-local strikes, there is hardly a better choice than to assume that U_0 depends on strike allowances, $U_0 = U_0(A)$. π_0 is the fall-back profit, which reflects fixed costs during a production stoppage. When π_0 is deducted from the 'under-contract' profits, fixed costs cancel out. For simplicity, fixed costs were already dropped from (i) above. The model defined in (iii) gives the monopoly union model and the efficient bargaining model as special cases. Of course, the latter implies relaxation of the profit-maximization condition.

The model for the equilibrium (real) wage consists of variables influencing profits, on the one hand, and the utility of the union, on the other hand. In addition, a role is played by the determinants of the fall-back utilities of the parties. Finally, relative bargaining power matters. In its most general form, the wage-setting schedule is

$$W^* = W(P, s, \tau, \frac{P_c}{P}, \theta, P_m, Z, B, A, \underline{K}, t). \quad (\text{iv})$$

+ - + + + (-) + + + + +

Indirect tax, v (eg value-added tax) exerts influence as part of the price wedge, P_c/P .

Discrimination between bargaining models and other models is not straightforward. For instance, market-clearing models can be specified so that they produce wage and employment schedules which are very much like those above. The role of bargaining power is, however, the distinguishing feature of bargaining models.

3 The statistical model

The statistical analysis is carried out in terms of an n-dimensional vector autoregressive model

$$\Delta X_t = \Gamma \Delta X_{t-1} + \Pi X_{t-1} + \psi D_t + \mu + \varepsilon_t, \quad (v)$$

where the X is a vector of stochastic variables, D is a vector of deterministic or non-normal variables (dummies),² μ contains constant terms and ε the Gaussian residuals. For simplicity, the lag length is assumed to be 2.

A case of particular interest is when Π is neither of rank zero nor full rank, $0 < r < n$. Now, the hypothesis of cointegration indicates that we can write

$$\Pi = \alpha \beta',$$

where α (the adjustment coefficients) and β (the cointegration relations) are $n \times r$ matrices, and

$$\alpha'_\perp (I - \Gamma) \beta_\perp = \rho \zeta',$$

where α'_\perp is orthogonal to α , β'_\perp is orthogonal to β ($\alpha'_\perp \alpha = 0$, $\beta'_\perp \beta = 0$) and ρ and ζ are $(n-r) \times c_1$ matrices. If $c_1 = n-r$, we have an I(1) model; c_1 indicates the number of I(1) common trends. If, however, $c_1 < n-r$ the model is I(2); $c_2 = n-r-c_1$ indicates the number of I(2) trends.

If (v) is I(1), the constant term can be partitioned into

$$\mu = \alpha \beta_0 + \alpha_\perp \gamma_0,$$

where β_0 (which is $r \times 1$) represents the intercept in the cointegration relations and γ_0 (which is $(n-r) \times 1$) is a vector of linear trend slopes in the data. If $\alpha_\perp \gamma_0$ is zero, the data contain no linear trends (see Johansen, 1991b). This is a testable hypothesis. Since technical progress can be approximated by a linear trend, we expect the data to contain linear trends.

In empirical work, it is often advantageous to partition X_t into

² To account for various extraordinary effects one almost always has to condition on dummies.

$$X_t = \begin{bmatrix} \hat{X}_t \\ \bar{X}_t \end{bmatrix},$$

where the \hat{X} 's are the variables to be modelled in the system of equations and the \bar{X} 's are the potentially weakly exogenous variables (see Engle, Hendry & Richard, 1983).

Let the parameters of interest be β (= the long-run parameters). We can partition the likelihood function into the conditional distribution and marginal distribution

$$\begin{aligned} f(X_t; \psi | D_t) &= f(X_t | X_{t-1}, D_t; \psi) \\ &= f(\hat{X}_t | \bar{X}_t, X_{t-1}, D_t; \psi_1) \cdot f(\bar{X}_t | X_{t-1}, D_t; \psi_2), \end{aligned} \tag{vi}$$

where ψ_1 and ψ_2 are functions of ψ . If β only depends on the parameters of the conditional model, $\beta = f(\psi_1)$ and ψ_1 and ψ_2 are variation free, then the inference is fully efficient about β from the conditional model. Johansen (1992b) shows that a sufficient and necessary condition is that $\alpha_{\bar{X}} = 0$ (here $\alpha_{\bar{X}}$ contains adjustment coefficients related to variables in \bar{X}), ie that the variables in \bar{X} are weakly exogenous. This is a testable hypothesis and – if satisfied – it ensures that we do not lose any information concerning the long-run relations if part of the data is assumed to be weakly exogenous.

4 The empirical vector autoregressive model

4.1 The full model

In order to obtain a reasonably operationalized empirical model, it is worth making a further note on tax matters. Most of the empirical literature characterizes the income tax system – summarized above by τ – with one parameter only, either the average tax rate, τ_a , or the marginal tax rate, τ_m . However, the analysis in Chapter 2, as also in Lockwood & Manning (1993), shows that this may be insufficient. Since both matter and have a separate role to play, they should both be included. In addition, we expect that $W_{\tau_a}^* > 0$ and $W_{\tau_m}^* < 0$.

These considerations leave us with too many variables to deal with. Because a VAR model becomes vulnerable when the number of variables grows, the dimension of the system must not be 'too large'. When this problem is considered, the choice is guided by our special interest in studying real wage resistance, ie the impact of taxes on wage setting and demand for labour. Accordingly, such variables of key interest as capital stock and the related user cost, unemployment benefits and strike allowances are reluctantly left out.³ Earlier evidence indicates that this is not a major deficiency. For example, in Chapter 5, we will see that the wage relations for Finland remain by and large intact when the capital-labour ratio (K/N) is replaced by a productivity measure (Q/N). Output, Q , enters our system as a proxy for the demand shift factor Z (for a discussion, see Chapter 3) and N is also included in the model.

The coherence of the resulting set-up will be scrutinized using common misspecification tests. As it stands, our system appears to be the largest analyzed applying this estimation procedure.

To sum up, our 10-dimensional VAR model contains the following variables:

- 1) nominal wages, W ,
- 2) producer prices, P ,
- 3) employment, N ,
- 4) output volume, Q , which enters as a proxy for the demand shift factor, Z (for a discussion, see Chapter 3),
- 5) the income tax rate, average, $1-\tau_a$,
- 6) the income tax rate, marginal, $1-\tau_m$,
- 7) the rate of employers' social security contributions, $1+s$,
- 8) the price wedge, ie the consumer price relative to the producer price, CPI/P , which also proxies the effect of the indirect tax, v ,
- 9) the (import) price of raw materials (incl. energy), P_m ,
- 10) the unionization rate, $UNION$, which is a proxy for the bargaining power of the unions.

The observation period is 1970Q1–1990Q4 and most of the (seasonally adjusted) series are derived from the database of the quarterly model of the Bank of Finland (BOF4). Some of the data are

³ The unemployment rate could have been introduced in the theoretical model via several channels. For instance, one could argue that the bargaining power of the union with a given unionization rate is smaller if the unemployment rate is higher. This is the argumentation applied in Andersen et al. (1990) and in Chapter 5 below. However, since unemployment appeared to be stationary during the observation period, it was left out. This presumably has no significant effects on the long-run relation.

only available for the aggregate economy, ie variables 5), 6), 9), and 10) above. In view of this, the analysis of the economy as a whole would be a straightforward choice. Earlier analysis indicates, however, that there is a profound difference in the behaviour of the wage and employment series of the public sector as compared with the rest of the economy. Consequently, we exclude the public sector and focus on analysis of the private sector.

According to tests⁴, none of the variables is non-relevant and can, hence, be excluded (exclusion test).

4.2 The preliminary analysis of the model

The estimations are carried out using the maximum likelihood procedure proposed by Johansen (1991b).⁵ To start, we test jointly the cointegration rank, r , and for the existence of a linear trend. The rank defines the number of linearly independent stationary relations between the levels of the variables. The cointegrating relations are estimated as the eigenvectors corresponding to the r largest eigenvalues in the system with n variables. The magnitude of an eigenvalue, λ_i , indicates how strongly the cointegrating relation is correlated with the stationary part of the process. The test for a specific value of r involves testing the hypothesis that $\lambda_{r+1} = \dots = \lambda_n = 0$, whereas $\lambda_1, \dots, \lambda_r > 0$ (see Johansen, 1992a).⁶ As our earlier studies indicate that there may be I(2) series in our data, this must be taken into account. This is especially so as a closer look at the residuals of the cointegrating relations also confirms the presence of I(2)-ness.

The 10-dimensional model is estimated and the results of the Trace test are given in Table 14 in the Appendix. The hypothesis that $r = \underline{r}$ is rejected if $H_0, \dots, H_{\underline{r}-1}$ are rejected and further,

⁴ For the test procedure, see Juselius & Hargreaves (1992).

⁵ Katarina Juselius has kindly supplied me with the program for Cointegration Analysis of Time Series (CATS) in RATS.

⁶ The likelihood ratio (LR) test statistic of the hypothesis of r cointegrating vectors in an n -dimensional system is given by the so-called trace statistic, $Q_r = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i)$, where T is the number of observations. The distribution of the test statistic, which is a non-standard Dickey-Fuller type (involving a multivariate Brownian motion), has been tabulated for the asymptotic case in Johansen & Juselius (1990). The distribution depends on which assumption concerning the existence of the linear trend (yes or no) is maintained. The distribution has broader tails if the trend is absent.

$$Q_r^* > CV_{95\%}^* \text{ and } Q_r > CV_{95\%}$$

where the superscript, *, derives from a system with no linear trend (ie $\alpha_{\perp}\gamma_0 = 0$ above). In Table 14, H_0^*, \dots, H_3^* and H_0, \dots, H_3 are rejected, as also is H_4^* . However, $Q_4 < CV_{95\%}^*$. So, the hypothesis of no linear trend is rejected. There appear to be four long-run relations ($r = 4$) and six common trends ($c = n - r = 6$). According to the test statistics in Table 16, we conclude that the process is I(2) in one direction ($c_2 = c - c_1 = 1$), indicating that there is one common I(2) trend which drives the system. Hence, the four-dimensional cointegration space is found to be stationary in three directions and non-stationary in one direction such that the differenced I(2) variable is needed to obtain stationarity. This is an example of multicointegration.

Investigation of the so-called β_{\perp}^2 -vector resulting from the system above (see Johansen, 1992a) reveals that I(2)-ness is mainly to be found in W, P and P_m . In addition, the coefficients of the first two in β_{\perp}^2 are approximately equal in absolute value. Hence, it is likely that the common I(2) trend could be eliminated by specifying the system in real terms.

An experiment with a 9-dimensional system comprising W/P and P_m/P indicates that r is reduced from 4 to 3 and, in addition, that no I(2) common trend remains. A major deficiency of the 'real model' is that price homogeneity is imposed to hold not only in the long run but in the short run as well. To allow for temporary short-run deviation, we prefer to work with the nominal model. The issue of I(2)-ness will be reconsidered below.

The residual analysis indicates that some of the series do not seem to satisfy the Gaussian assumptions (see Table 17A).

4.3 The partial model

Compared with the sample size, the number of variables, n , is such that it creates the risk of the model being overparametrized. Since the parameters are unrestricted in the model, the total number of estimated parameters increases rapidly with increasing values of n and k where the latter refers to the lag length. Particularly in small samples, overparametrization often leads to undesirable statistical properties. Fortunately, as far as k is considered, residual misspecification tests

indicate that we do not lose anything by restricting the lag length to $k = 2$.⁷

Since the parameters we are interested in are the long-run parameters, β , we proceed by considering weak exogeneity, ie whether some of the variables do not react to a disequilibrium in the long-run relations. There are several ways of investigating this matter. First, weak exogeneity can be tested in terms of the full model, although the deviations from the Gaussian assumptions obviously reduce the credibility of the test.⁸ Second, we can consider qualitatively whether some of the variables are exogenously determined by nature (eg tax rates). Third, the time series properties may provide an indication of whether the data result from an endogenous data-generating process.

Having indicated that there are probably four cointegrating vectors in our VAR model, we cannot reduce the set of system variables to a smaller number. Wages, prices and employment are without doubt among the endogenous variables. Import prices of raw materials (incl. energy) will be treated as exogenous.⁹ The quarterly time disaggregation of union membership is maintained by technical routines from annual observations. Hence, we do not wish to place too much emphasis on this quarter-to-quarter path.

The discussion on taxes is less straightforward, although there is a great deal of arbitrariness in the quarterly time paths here as well. To begin, since payroll tax rates are flat rates which are announced in

⁷ This indicates that there is one lagged difference term in each equation.

⁸ The hypothesis is that for selected equations, the α_i 's are zeros. The test statistic is similar to that described in footnote 17 below. It has been shown recently that if there is I(2)-ness in the model, the results of exogeneity tests included in CATS must be considered cautiously (see Paruolo & Rahbek, 1995). This is because an extra term related to the I(2)-ness enters the test statistic. If the test rejects weak exogeneity, this term does not influence the inference. If the hypothesis of weak exogeneity is accepted, the extra term may or may not influence the inference. So far, appropriate test producers to take account of this have not been available.

⁹ There are substantial discrete shifts in import prices of raw materials (incl. energy), P_m , which have been generated by two factors: oil price shocks and devaluations of the Finnish markka. The first set of events is exogenous whereas strictly speaking the other is not necessarily so. However, if we were to treat P_m as endogenous, serious problems would arise for estimation. First, the residual analysis reported in Table 17A indicates that in order to estimate a proper equation for ΔP_m the least one would need is a (probably large) set of dummy variables to take account of the extraordinary shifts due to oil shocks and numerous devaluations. Secondly, if we were to attempt to take account of exchange rate adjustments, we would have to extend the models by introducing variables related to trading partners' cost developments. Since both aspects lead to an expansion in the number of estimated parameters, we prefer to treat import prices of raw materials (incl. energy) as weakly exogenous. We do not believe that this is a serious deficiency but a more thorough evaluation of this matter will be left for future research.

advance, it is natural to consider them weakly exogenous. The price wedge contains both an endogenous and a weakly exogenous element. The latter is in the form of the sales tax, which is a stable rate with a few stepwise shifts within the observation period. We expect the latter to dominate and start by treating the term as weakly exogenous. As far as income taxes are concerned, the assumption of weak exogeneity is even more vague. One could argue that the union optimizes by taking the marginal income tax rate as given and seeks to obtain the optimal combination between the after-tax wage and employment. In this case, the marginal tax would be (weakly) exogenous and the average tax endogenous. Again, however, there is such a large amount of arbitrariness in the quarterly time path of income tax series that we prefer to treat them as weakly exogenous at the outset. This issue will, however, be reconsidered at the end of the chapter. For the moment, we prefer to consider output as the fourth system variable. This is so despite the fact that the tests in the present context, as also those discussed in Chapter 3, indicate that it could be considered weakly exogenous as well.

Hence, we proceed by examining a model with four system variables,

W, P, N, Q,

and six weakly exogenous variables¹⁰

$1 - \tau_a, 1 - \tau_m, 1 + s, \text{CPI/P}, P_m, \text{UNION}.$

The residual analysis of the partial model does not point to any special problems (Table 17B). Importantly, the simulations in Eitrheim (1991) indicate that the parameter estimates of the long-run relation are not sensitive to misspecification in any respects other than that generating

¹⁰ The version of CATS which was available when this study was made can handle a maximum of six weakly exogenous variables. This introduces a further technical constraint on the size of the model as far as introduction of weakly exogenous variables is concerned.

autocorrelation. As can be seen in Table 17B, autocorrelation does not appear to be a serious problem in our partial model.¹¹

5 Specifying structural hypotheses

The economic model in section 2 was designed for analysis of wage setting and the demand for labour. To proceed, we need to define how to identify these relevant relations in the vector space. The problem is solved by imposing structure implied by theoretical considerations on the long-run relations. Below, these restrictions are made explicit.

First, let us define a log linear relation

$$\begin{aligned} \log W = & \beta_P \cdot \log P + \beta_N \cdot \log N + \beta_Q \cdot \log Q \\ & + \beta_{\tau_a} \cdot \log(1 - \tau_a) + \beta_{\tau_m} \cdot \log(1 - \tau_m) + \beta_s \cdot \log(1 + s) \\ & + \beta_v \cdot \log(\text{CPI}/P) + \beta_{P_m} \cdot \log(P_m) + \beta_U \cdot \log(\text{UNION}). \end{aligned} \quad (\text{vii})$$

If this relation is to be considered a wage-setting schedule (see (iv) above), the signs should be $\beta_P \geq 0$, $\beta_Q \geq 0$, $\beta_{\tau_a} \leq 0$, $\beta_{\tau_m} \geq 0$, $\beta_s \leq 0$, $\beta_v \geq 0$, (probably) $\beta_{P_m} \leq 0$ and $\beta_U \geq 0$. Setting $\beta_N = -\beta_Q \leq 0$ is the restriction which defines the productivity term (Q/N). If it is the real raw material price which matters, then the homogeneity restriction implies $\beta_P + \beta_{P_m} = 1$ in (vii). Note also that, if accepted, this restriction probably removes the I(2)-ness from the long-run relation.

One can cite two (contradicting) extreme hypotheses about wage setting. According to the first, the unions dominate the process whereas, according to the second, the opposite is true and the firms

¹¹ Discrete shifts in the data in level form may, when differenced, generate outliers which distort the estimation of the long-run parameters of interest. To avoid this, we have included 6 quarterly dummies in the short-run part of the model. These are 1) $D\tau_1$ and 2) $D\tau_2$, which are due to discrete changes in income tax schedules that became effective in 1976Q1 and 1989Q2, respectively, 3) Ds , which is due to a discrete reduction in the employers' social security contribution rate in 1990Q1, 4) DM is a dummy for the three-week strike in the metal and engineering industry in 1971Q1 and 5) $DOPECI$ refers to the first oil shock in 1973Q3. Finally, the sixth dummy captures an important institutional feature related to centralized wage setting. In Finland, wage agreements covering almost the entire economy become effective simultaneously. This generates peaks in the differenced wage data in the contract quarters. This has been taken into account by introducing a multiplicative, centred dummy, $DCONT$. In the estimations, each of the six dummies enter at least one of the short-run equations significantly.

dominate. These hypotheses also indicate how taxes and relative prices enter the wage relation.

As far as real wage resistance is concerned, one can impose a wedge-restriction like

$$-\beta_{\tau_a} = \beta_v = 1 + \beta_s \quad (\text{viii})$$

in (vii), which is a standard manner to proceed. If the unions dominate the process, these terms equal zero. If the firms dominate, these terms equal one. In the former case the taxes fall on the firm while in the latter they fall on the worker.

However, in addition to (viii), several hypotheses concerning the influence of taxes on wages have been applied in empirical applications. The fact that the choice of the dependent wage term implies a considerable amount of implicit structure in the model has seldom been stressed in the literature¹² in spite of its great importance for the testing of behavioural hypotheses. In order to consider a wedge-restriction which is seemingly identical to (viii) in an empirical context, Table 11 introduces the H_0 -hypotheses in some commonly applied estimating equations. The *a priori* structure can be analyzed by investigation of the β_i -coefficients. For instance, a closer look at equation (B) reveals that, according to the H_0 -hypothesis, tax incidence is fully borne by unions. In equation (C), tax incidence is fully borne by the firms according to H_0 . In (A) and (D), we test certain combinations of these hypotheses implying that different taxes have different effects.

Table 11. **H_0 -hypothesis about tax incidence in some wage equations**

Coefficient	Independent variables	Dependent variable			
		(A) W	(B) $\left(\frac{W(1+s)}{P}\right)$	(C) $\left(\frac{W(1-\tau)}{P(1+v)}\right)$	(D) $\left(\frac{W}{P(1+v)}\right)$
β_p	P	$H_0: \beta_p = 0$	$H_0: \beta_p = 0 \Leftrightarrow \beta_p = 1$	$H_0: \beta_p = 0 \Leftrightarrow \beta_p = 1$	$H_0: \beta_p = 0 \Leftrightarrow \beta_p = 1$
β_s	(1+s)	$H_0: \beta_s = 0$	$H_0: \beta_s = 0 \Leftrightarrow \beta_s = -1$	$H_0: \beta_s = 0 \Leftrightarrow \beta_s = 0$	$H_0: \beta_s = 0 \Leftrightarrow \beta_s = 0$
β_τ	(1- τ)	$H_0: \beta_\tau = 0$	$H_0: \beta_\tau = 0 \Leftrightarrow \beta_\tau = 0$	$H_0: \beta_\tau = 0 \Leftrightarrow \beta_\tau = -1$	$H_0: \beta_\tau = 0 \Leftrightarrow \beta_\tau = 0$
β_v	(1+v)	$H_0: \beta_v = 0$	$H_0: \beta_v = 0 \Leftrightarrow \beta_v = 0$	$H_0: \beta_v = 0 \Leftrightarrow \beta_v = 1$	$H_0: \beta_v = 0 \Leftrightarrow \beta_v = 1$

¹² Calmfors & Nymo en (1990) is one of the few exceptions.

Model (B) has been used by, for instance, Calmfors & Forslund (1990) and Calmfors & Nymoén (1990) with the *a priori* wedge restriction, $|\beta'_s| = |\beta'_\tau| = |\beta'_v|$. Model (C) has been used by, *inter alia*, Eriksson et al. (1990) and Pencavel & Holmlund (1988) with the *a priori* wedge restriction $|\beta''_s| = |\beta''_\tau| = |\beta''_v|$. Model (D) has been estimated by Rødseth & Holden (1990) with the restrictions $\beta'''_s = \beta'''_\tau = \beta'''_v = 0$ imposed. As is clearly evident from the table, although the restrictions may look similar at first sight, they have very different implications in different specifications. This is of potentially major importance, particularly if the elasticities with respect to taxes are not very precisely defined, as is often the case. The procedure applied in this paper allows testing between alternative hypotheses in a flexible manner.

Finally, the progressivity index proposed by Jackobsson (1978),

$$\tau_p = \frac{\tau_m - \tau_a}{1 - \tau_a},$$

turns out to be useful at a later stage. Taking logarithms and subtracting τ_p from unity, gives

$$\begin{aligned} \log(1 - \tau_p) &= \log\left(1 - \frac{\tau_m - \tau_a}{1 - \tau_a}\right) \\ &= \log(1 - \tau_m) - \log(1 - \tau_a). \end{aligned}$$

Hence, τ_p imposes a restriction according to which the coefficients of the two parameters describing the tax rates are of opposite sign and equal in absolute value. All the three characteristics, τ_a , τ_m and τ_p , of the income tax system can be seen in Figure 10.

The discussion on the demand for labour schedule is more straightforward. To see this, let us write

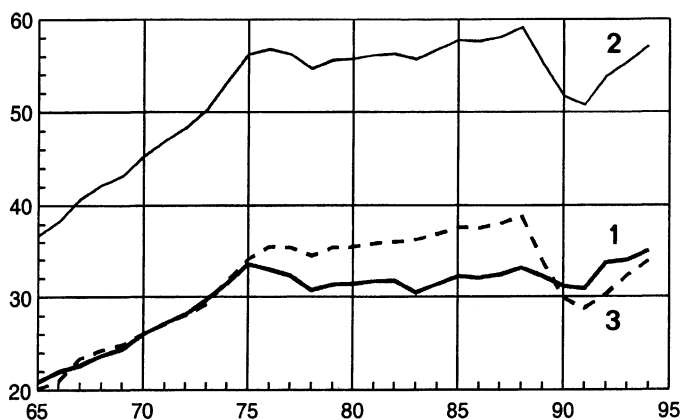
$$\begin{aligned} \log N &= \beta_w \cdot \log W + \beta_p \cdot \log P + \beta_Q \cdot \log Q \\ &\quad + \beta_{\tau_a} \cdot \log(1 - \tau_a) + \beta_{\tau_m} \cdot \log(1 - \tau_m) + \beta_s \cdot \log(1 + s) \quad (\text{ix}) \\ &\quad + \beta_v \cdot \log(\text{CPI}/P) + \beta_{P_m} \cdot \log(P_m) + \beta_U \cdot \log(\text{UNION}). \end{aligned}$$

If this relation is to be considered a labour demand schedule, we expect that $\beta_w \leq 0$, $\beta_p \geq 0$, $\beta_Q \geq 0$, $\beta_{\tau_a} = 0$, $\beta_{\tau_m} = 0$, $\beta_s \leq 0$, $\beta_v = 0$

and (probably) $\beta_p \leq 0$. The effects of the income tax, as also of the indirect tax, derive from their wage effect. If the union has a direct influence on employment (for a given wage), then $\beta_U \neq 0$. The restriction $\beta_w = -\beta_p = -\beta_Q = \beta_s > 0$ implies that it is the real labour cost for a produced unit which matters. If, again, it is the relative raw material price which matters, we write $\beta_w = -\beta_p - \beta_p = -\beta_Q = \beta_s$.

We concluded above that there are probably^m four cointegrating vectors in our data space. Two of them have been specified so far. Specification of the other two is less straightforward. The reason is as follows. As pointed by Johansen & Juselius (1992b), in macro-economic behaviour a role is often played by at least two types of agents with disparate goals (demanders versus suppliers, producers versus consumers etc.) interacting in such a way that equilibrium is restored once it has been violated. Therefore, in estimation one may also end up with vectors describing either the demand side or the supply side of the variables concerned.

Figure 10. **Income tax rates in Finland, per cent**



- 1 Average tax rate, τ_a
- 2 Marginal tax rate, τ_m
- 3 Progressivity index, $\tau_p = (\tau_m - \tau_a)/(1 - \tau_a)$

Source: The database of the quarterly model of the Bank of Finland (BOF4)

In the present context, we could for instance discover a relation describing the supply of output, ie the production function. Since the capital stock is not included in the model, no relation can, of course, be more than a poor description of the appropriate technology. On the other hand, the demand side may show up because the data set covers the largest component of household disposable income, Y , ie the after-tax real income of wage earners:

$$Y \sim \frac{W(1-\tau_a)N}{P(\text{CPI}/P)}. \quad (\text{x})$$

The model, however, lacks export demand and government demand. Therefore we can only hope to discover a misspecified demand relation suffering from problems related to omitted variables. However, if the demand for output schedule shows up, we expect that this misspecified output demand relation to produce an elasticity above unity between output, Q , and household disposable income, Y . This is because government demand has grown considerably more than household demand, ie the level of Q has risen more than Y . Strikingly, in so far as the demand effect is concerned, the wage level has a positive and the deflator a negative impact on output. Looking from the cost side, which emphasizes profitability, the effect to expect is presumably the opposite.

A simple price-setting schedule links producer prices to unit labour costs and prices of other inputs. If, in addition, we allow shifting backwards of indirect taxes, we end up with the relation

$$P = P \left(\frac{W(1+s)N}{Q}, P_m, \text{CPI}/P \right). \quad (\text{xi})$$

The first two terms capture the constant mark-up feature in the price setting. The third term indicates whether producer prices adjust when consumer prices rise as a result of an increase in eg the value-added tax. As this kind of price adjustment is a reaction to the effect of taxes on real product demand, this term captures a demand-side effect. Of course, product demand may also influence mark-ups directly, which could have a positive effect on Q instead of the negative effect apparent in (xi).

To sum up, we expect the two well-specified relations, ie a wage-setting schedule and demand for labour condition, to show up. However, as the tests indicate that there are other long-run relations in the data set, there are additional vectors to investigate. We expect them

to mimic 1) the supply of output, 2) the demand for output, 3) the constant mark-up pricing rule and 4) the price setting determined by the demand conditions in the product market. The resulting 'semirelations' may also be mixtures of two or more competing but misspecified relations. Hence, one should not put too much emphasis on the overinterpretation of the 'left over' vectors.¹³

Our strategy below is as follows. Because the number of possible joint hypotheses is very large, we start with partial analysis. As far as wage setting is concerned, we first test the two extreme structures indicating that one of the two parties – unions or employers – dominate. The purpose of this exercise is to investigate which is a better 'initial' approximation of the process concerned. We then examine whether deviations from the extreme structure are better in accordance with the data. Having found the preferred partially estimated relations, we test whether they are jointly accepted by the data. In this exercise, we take the numerical values of all the elasticities from the partially estimated vectors. These vectors are, in other words, considered as known *ex ante*. The aim is not to test whether the partially estimated vectors are identical to those which would result from a joint estimation but rather to see whether the partially discovered vectors are 'too far' from the 'appropriate' ones or not.

The final exercise is to estimate and test the relevant structure jointly for wage setting and the demand for labour. For the joint analysis, the point of departure is the preferred structure resulting from the partial analysis.

¹³ Some restrictions for these 'semirelations' can be defined. In the constant mark-up pricing model, $\beta_w = \beta_N = -\beta_Q = \beta_s > 0$ captures the unit labour cost restriction. If, additionally, homogeneity holds between unit labour costs and producer prices, we have $\beta_w = -\beta_p = \beta_N = -\beta_Q = \beta_s = 1$. The restriction $\beta_w = -\beta_p = \beta_N = -\beta_Q = \beta_\tau = -\beta_v$ generates the proxy for the household demand factor. This restriction is supposed to hold not only in the output demand relation but also in the price setting function, allowing mark-up to vary with demand. In the relation concerned, real wages have a positive output effect. In the output supply relation we expect the amount of input (= labour) to be the driving force. A Cobb-Douglas technology would imply $\beta_N = 1$. A (permanent) shift in eg the relative price of energy may additionally influence output, however. If income taxes and unions influence (cost) price setting only through wages, then $\beta_\tau = \beta_{\tau_m} = \beta_U = 0$ in the relevant vector. Because the present model only allows us to test these restrictions in the context of misspecified 'semirelations', any tests, as also the related parameter estimates, will be biased.

6 Testing structural hypotheses

6.1 Partial analysis

Table 18 in the Appendix introduces the four non-restricted cointegrating vectors. Interestingly, λ_4 is fairly small. This could indicate that the appropriate number of cointegrating vectors would be three rather than four. Therefore, we evaluate the model not only under the assumption that $r = 4$ but also under the assumption that $r = 3$. Choosing a 'too high' r implies that the tests imposed are 'too loose'. Consequently, if the correct choice is $r = 4$ but we choose $r = 3$, the tests are excessively stringent and the resulting p-values¹⁴ are definitely the low limits of the appropriate ones. Whether the fourth vector contains relevant information about the long-run relations of interest can also be evaluated by comparing the parameter estimates discovered, including and excluding the fourth vector.

The β_1 -coefficients indicate the long-run relationships embodied in the eigenvectors. For each cointegrating vector there is a corresponding vector of α 's with at least one element, α_i , different from zero. These elements are the weights with which the cointegration relation enters the equation concerned. Hence, the α_i -coefficients embody the error correcting behaviour in the system.

In Table 18, some of the desirable properties can be detected. Furthermore, the error correction property is quite clearly evident in these freely estimated vectors.¹⁵ However, the relation we are looking for can be a linear combination of the freely estimated vectors. So, mapping the processes of interest requires more discipline in the analysis. This is where the theoretical considerations and the identifying restrictions are indispensable.

We proceed by imposing restrictions describing the long-run properties which the vectors of interest are expected to fulfil. Short-term adjustment (to the changes in the process and to the long-

¹⁴ The concept of the 'p-value' refers to the significance level. Usually, a hypothesis is rejected if the p-value related to the test is smaller than .05. In statistics, the concept of p-value is related to the 'type II error' which indicates acceptance of H_0 -hypothesis when it is in fact false.

¹⁵ This can be seen by multiplying each α_i by β_i . In the wage equation the disequilibrium error of relation (3) enters with the weight $.008(-52.3) = -.40$, which indicates rapid error correcting behaviour. In the employment equation, relation (2) enters with the weight $-.20$. Finally, the first relation generates error correction in the price equation.

run steady-states) is determined freely. However, in so far as relevant cointegrating relations with behavioural interpretation are detected, we expect the error correcting property to show up even more clearly.¹⁶

A restriction on the β -coefficients is data-consistent if the resulting eigenvalues do not change significantly as compared with the unrestricted estimation. Hence, each restricted vector is always compared with the original unrestricted vector and all r eigenvalues contribute to the test statistic¹⁷, which follows the χ^2 -distribution with degrees of freedom as indicated in Table 12, which reports the results of the partial analysis.

6.1.1 Wage-setting schedule

The necessary condition for unique identification is that the minimum number of restrictions is one less than the number of cointegrating vectors, $r-1$. In the present context this is three as we start by assuming that $r=4$. First, we examine the two extreme hypotheses concerning the dominance of the bargaining parties and tax incidence augmented with the restriction ($\beta_N = -\beta_Q$), which makes productivity the driving force of real wages. Under $r = 4$, both of the contradicting hypotheses pass the test.¹⁸ The hypothesis of union dominance (with taxes borne in full by firms) generates a p-value of .34 whereas the opposite hypothesis has a p-value of .07. At face value, this could indicate that the former is better in accordance with the data. Under $r = 3$, both extremes are, however, rejected. Therefore, we expect an intermediate case to outperform the extreme hypotheses. To proceed,

¹⁶ The importance of this notion dates back to the statement of Granger (1986, p. 217) on the special relation between cointegration and error correction: 'Not only must cointegrated variables obey such a model but the reverse is also true; data generated by an error-correction model ... must be cointegrated.' Of course, this result is technical by nature, and the interpretability of the coefficients indicates the economic plausibility of the outcome.

¹⁷ The test statistic concerned is $T \sum_{i=1}^r \ln((1-\hat{\lambda}_i)/(1-\hat{\lambda}_i))$, where $\hat{\lambda}_i(\hat{\lambda}_i)$ is calculated without (with) the restrictions on β . The H_0 -hypothesis is always that the restriction imposed is accurate (for details, see Johansen & Juselius, 1990).

¹⁸ The fact that competing hypotheses pass the test may indicate that the surface of the likelihood function is so flat that it cannot distinguish between hypotheses at the standard 5 % significance level. It may also be the case that we are testing a relatively small number of restrictions as compared with the number of parameters. As it happens, we choose to adjust the significance level upwards. This is in accordance with preferring a hypothesis which generates a higher p-value.

we assume that the simple τ_p -restriction, $\beta_{\tau_a} = -\beta_{\tau_m}$, holds and that the coefficients of the payroll tax and the price wedge are equal in absolute value. These assumptions pass the test, albeit at a fairly low significance level. As the general structure of the resulting vector is implausible, we prefer to relax this restriction and, instead, to test whether the absolute value of the coefficients of $(1-\tau_m)$, $(1+s)$, (CPI/P) are equal in absolute value. The restriction is accepted but now the elasticity β_{τ_a} is above unity, which can be considered to be implausibly large. However, β_{τ_a} can adequately be restricted to take the value of unity, a result which does not appear to be sensitive to the choice between $r = 4$ or $r = 3$.

The likelihood ratio test can also be used to investigate a further issue of special importance for empirical identification. This is whether (in an acceptable structure) any of the coefficients which are close to zero are actually zeros. If in equation (2), for instance, β_U is restricted to zero, the difference between the original test statistic (6.00) and the resulting test statistic (15.7) follows $\chi^2(1)$, which gives 3.8 as the critical value at the 5 per cent significance level. This test indicates that union density can definitely not be omitted under $r = 3$. The same applies to raw material prices. Under $r = 4$, the second of these rejections applies but not the first.

Finally, columns (3) & (4) indicate that the long-run homogeneity between the real wage and productivity is rejected both under $r = 3$ and under $r = 4$ (the test is the one above). In fact, as the trend is supposed to capture the contribution of technical progress, a coefficient below unity for Q/N is what we expect to discover. Raw material prices enter in the form of the relative price, P_m/P , which – when combined with the price homogeneity – presumably removes the $I(2)$ -ness, as argued above.

6.1.2 Demand for labour

The demand for labour schedule we are looking for was defined above. The sole tax factor which enters (ii) directly is the payroll tax. Other taxes influence indirectly through wages. Hence, we expect that $\beta_{\tau_a} = \beta_{\tau_m} = \beta_v = 0$. The hypothesis that (in the long run) the firms operate on the labour demand curve forces components of real labour costs to have equal effect, ie $\beta_w = -\beta_p = \beta_s$. The restrictions above, as well as the omission of union effects on employment, are easily accepted as can be seen in columns (5) and (6). Hence, the demand for labour is determined by real labour costs and the level of activity. However, the elasticities with respect to both of these factors are

significantly below unity, which is what one would expect under simple Cobb-Douglas technology.

Columns (7) and (8) indicate that the effect of (real) raw material prices does not differ significantly from zero. The test discussed above provides the evidence despite the drop in the p-values. It is interesting to evaluate this result in the light of Hamermesh (1991). Having surveyed a wide selection of studies concerning various countries, he concludes 'labour and energy are p-(= price)substitutes, with a very small cross-price elasticity' (p. 6). So, the fact that we cannot detect an impact for raw material prices in the employment equation does not appear to contradict findings obtained elsewhere.

As a final experiment, we restricted the output elasticity to be equal to the labour cost effect. Under $r = 4$, this restriction passes the test and generates a unit labour cost elasticity of .49. However, the p-value of .19 is considerably lower than the one related to vector (7). Under $r = 3$, the restriction concerned is definitely rejected.

6.1.3 Output and price setting 'semischedules'

The various effects which may show up in the 'left over' vectors were discussed in section 4. Under $r = 4$, we discover some interesting results. First, relation (9) in Table 12 resembles a demand for output schedule. On the other hand, the hypothesis for the Cobb-Douglas technology, $\beta_Q = -\beta_N$, is also accepted. Hence, the vector concerned appears to capture both demand side and supply side elements.

As far as price setting is concerned, it appears to be driven by unit labour costs. The results indicate that β_v is not precisely defined as the data accepts two contradicting hypotheses. According to the first, producer prices do adjust fully to an increase in sales tax ($\beta_v = 1$). According to the second, there is no adjustment at all ($\beta_v = 0$). This leads us to search by iteration for that specific value of the adjustment coefficient which is most easily accepted by the data, taking the rest of the structure as given. This is analogous to adjusting upwards in a stepwise manner the standard significance level of 5 %, *ceteris paribus*. This procedure gives an elasticity in the range of $\beta_v = .6-.7$. A vector indicating this is well in accordance with the data and the p-value rises to .23. This fragile evidence indicates that around 2/3 of a higher sales tax will be shifted backwards to lower producer prices.

Table 12. Partially identified cointegrating relations, under $r = 4$ and $r = 3$

Coef.	Variables	Wage-setting schedule				Labour demand schedule				Output 'semi-schedule'				Price setting 'semi-schedule'				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(10)	(11)	(12)		
		$r = 4$	$r = 3$	$r = 4$	$r = 3$	$r = 4$	$r = 3$	$r = 4$	$r = 3$	$r = 4$	$r = 4$	$r = 4$	$r = 4$	$r = 4$	$r = 4$	$r = 4$	$r = 4$	
Long-run coefficients β_i																		
β_w	W	1.000	1.000	1.000	1.000	.237	.213	.210	.188	-1.361	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	
β_p	P	-1.115	-1.124	-1.043	-1.071	-257	-228	-210	-188	1.361	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
β_N	N	.659	.667	1.000	1.000	1.000	1.000	1.000	1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	
β_Q	Q	-.659	-.667	-1.000	-1.000	-320	-307	-294	-283	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
$\beta_{1-\tau_s}$	$1-\tau_s$	1.000	1.000	1.000	1.000	.000	.000	.000	.000	-1.361	.000	.000	.000	.000	.000	.000	.000	
$\beta_{1-\tau_m}$	$1-\tau_m$	-.209	-.271	-.368	-.548	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
β_{1+s}	$1+s$	.209	.271	.368	.548	.237	.213	.210	.188	.000	.000	.000	.000	.000	.000	.000	.000
$\beta_{CPI/P}$	CPI/P	-.791	-.729	-.632	-.452	.000	.000	.000	.000	1.361	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
β_{P_m}	P_m	.115	.124	.043	.071	.019	.015	.015	.000	.000	.000	.000	.000	.000	.000	.000	.000	
β_U	UNION	-.263	-.311	.099	-.050	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
Adjustment coefficients α_i																		
α_w	ΔW	-.548	-.491	-.403	-.115	-.410	-.601	-.367	-.569	.451	.283	.332	.305	.283	.332	.305	.305	
α_p	ΔP	.152	.152	.147	.172	.313	.279	.309	.273	-1.01	-1.43	-1.50	-1.52	-1.43	-1.50	-1.52	-1.52	
α_N	ΔN	-.024	-.011	-.044	-.045	-.253	-.227	-.261	-.231	.019	.072	.091	.081	.072	.091	.081	.081	
α_Q	ΔQ	.422	.146	.369	-.020	-.018	-.134	-.044	-.134	-2.53	-1.58	-1.12	-1.53	-1.58	-1.12	-1.53	-1.53	
Number of restrictions imposed (η)																		
Characterization of restrictions imposed	5	5	5	6	6	6	6	7	7	8	8	8	8	8	8	8	8	
	6	6	6	6	6	6	6	7	7	8	8	8	8	8	8	8	8	
	7	7	7	7	7	7	7	7	7	8	8	8	8	8	8	8	8	
	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
LR test statistic, $\chi^2((\eta-2)J_1)$																		
4.4	4.4	6.00	7.33	16.09	3.12	6.47	4.99	8.08	5.22	7.15	7.65	6.91	7.15	7.65	6.91	6.91	6.91	
Critical value, $CV_{.95}((\eta-2)J_1)$																		
5.99	5.99	7.82	7.82	9.49	7.82	9.49	9.49	11.07	11.07	11.07	11.07	11.07	11.07	11.07	11.07	11.07	11.07	
p-value																		
.80	.80	.11	.06	.00	.37	.17	.29	.15	.39	.21	.18	.23	.21	.18	.23	.23	.23	
Eigenvalues, λ_i																		
.364	.364	.367	.249	.250	.418	.432	.394	.410	.245	.246	.182	.221	.246	.182	.221	.221	.221	

All variables are in logs, and $r =$ number of cointegrating vectors, $r_1 =$ number of cointegrating vectors to be restricted and $r_2 =$ number of non-restricted cointegrating vectors = $r - r_1$.

The results above derive from tests carried out under the assumption $r = 4$. Under $r = 3$, all structures which mimic the output schedule or price-setting schedule are rejected. This indicates that for the 'semirelations', the information contained in the fourth cointegrating vector is of crucial importance.

6.1.4 Summary of the partial analysis

We now test whether the data accept the simultaneous coexistence of the partially identified vectors in Table 12. The results are highly encouraging. When the co-existence of the wage and employment relations characterized by the restrictions in relations (1)&(7) is tested under the assumption $r = 4$, the p-value is as high as .54. When we add the output schedule (9), the test is passed with a p-value .05. When we replace the output schedule with the pricing rule (12), the p-value is .04.

The coexistence of all the four vectors concerned is definitely rejected. Having indicated in Section 4 that the composition of our data set does not allow us to identify a well-specified output schedule or pricing rule, this is as could be expected. Under $r = 3$, the coexistence of the wage and employment schedules (2) and (8) is accepted with a p-value .36.

Introduction of restrictions leads to a strengthening in the α -coefficients as compared with the non-restricted estimates. In the resulting structure, the error correction property shows up very clearly. This is an indication of success in the search for the fundamental long-run processes.

Of course, one can ask whether we correctly interpret the context of the various long-run relations and, in particular, are the vectors different enough for us to be able to distinguish between the schedules suggested? The test concerning the formal identification will be discussed below. However, investigation of the weights in Table 12 also gives some insight into the matter. Relation (2), which is considered to be a wage-setting schedule, enters the equation for short-run adjustment of wages, ΔW , with a weight $\alpha_w = -.49$, indicating rapid error correction. Vector (8), which is considered to be a labour demand schedule, enters the dynamic equation, ΔN , with a high weight as well ($\alpha_N \sim -.23$). The rest of the weights, $\alpha_i \beta_i$, are all noticeably smaller. As it happens, each of the two well-specified long-run relations with a special interpretation contributes strongly to the short-run adjustment of the factor concerned. This surely does not

indicate that the interpretations suggested for these long-run relations are arbitrary.

The partial nature of the analysis above reduces the strength of the inference. Therefore, we proceed by carrying out the identification tests simultaneously for the two schedules of special interest, ie wage setting and the demand for labour.

6.2 Joint hypotheses

The final exercise is to carry out joint estimation of the relations characterized by the relevant identifying restrictions. As the wage-setting and the demand for labour schedules do not appear to be sensitive to the choice between $r = 4$ or $r = 3$ in partial analysis, we prefer to take the risk of making the test excessively stringent by choosing $r = 3$ in the joint analysis. After that, we investigate the data consistency of the resulting relations under $r = 4$.

Table 13 gives the results of the joint identification. There are four pairs of relations, the first of which has its counterparts in relation (2) combined with either (6) or (8) in Table 12. In each pair, 5 restrictions have been imposed on the wage-setting schedule and 6 or 7 restrictions on the labour demand curve. The joint hypothesis (A) with separate effect of real import prices on employment passes the test at the 9 per cent significance level. Since β_{p_m} does not, however, differ significantly from zero in the employment relation, hypothesis (B) is strictly preferable to (A) as far as empirical identification is concerned. The other two pairs, (C) and (D), are designed to investigate whether the results are sensitive to the decision to treat tax rates as weakly exogenous. As discussed above, the average income tax rate, in particular, could well be endogenously generated in a process in which the union optimizes net wages taking as given the marginal tax schedules defined by the authorities *ex ante*. In (C), the average income tax rate has been endogenized. Restrictions which are identical to those in (A) pass the test with a p-value of .15 and there is hardly any change in the coefficients. In addition, β_{p_m} does not differ significantly from zero in the demand for labour schedule. So, earlier inference concerning elasticities of interest is also valid when the average income tax rate is considered endogenous.

We also examined the sensitivity of the results to endogenization of not only the average income tax but also the marginal tax and the price wedge. In the estimations, the relevant structure remains qualitatively intact. However, we feel that one should not put too much emphasis on these results since, as compared with (B), we have

taken a major step towards our original overparametrized, full model. Consequently, we prefer the more parsimonious relations identified in (B), which have also been shown to be robust for treating τ_a as endogenously determined as in (D). As regards empirical identification, it is particularly interesting that the LR test rejects restrictions of β_{p_m} and/or β_U to zero in all wage relations.

It is noteworthy that the third ('leftover') relation does not influence wage setting or demand for labour equations. The relevant α -coefficient is close to zero ($\sim .03$) in all cases. Hence, the fact that we cannot give a plausible interpretation to the third relation hardly undermines the credibility of the identification of the two relations of interest. Under $r = 4$, the co-existence of the pairs of relations which are numerically identical to those reported as the preferred pairs (B) and (D) in Table 13 pass the test with p-values .63 and .77, respectively.

To sum up, the preferred cointegrating relations resulting from the joint identification can be written as follows:

$$\begin{aligned} \log W = & 1.00 \cdot \log P - 1.00 \cdot \log(1 - \tau_a) + .30 \cdot \log(1 - \tau_m) \\ & - .30 \cdot \log(1 + s) + .70 \cdot \log(\text{CPI}/P) + .66 \cdot \log(Q/N) \\ & - .12 \cdot \log(P_m/P) + .33 \cdot \log(\text{UNION}) \end{aligned} \quad (\text{xii})$$

$$\log N = -.18 \cdot \log\left(\frac{W(1+s)}{P}\right) + .28 \cdot \log(Q). \quad (\text{xiii})$$

These jointly identified wage and employment relations are almost identical to the partially identified relations reported in Table 12. Finally, we check the formal identification of the structure present in the preferred relations. This is consistent with testing that no linear combination of β_j 's with $i \neq j$ can produce a vector that 'looks like' β_i . The rank condition for formal identification is defined in Johansen & Juselius (1992b). In the present context it is satisfied as far as the relevant wage-setting and demand for labour schedules are concerned. The result showing that there are several overidentifying restrictions can be seen in Table 19 in the Appendix.

Table 13.

Jointly identified cointegrating relations, under $r = 3$, with weakly exogenous τ_a in (A) and (B) and endogenous τ_a in (C) and (D)

		(A)		(B)		(C)		(D)	
		Wage-setting schedule	Labour demand schedule	Wage-setting schedule	Labour demand schedule	Wage-setting schedule	Labour demand schedule	Wage-setting schedule	Labour demand schedule
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Coeff.	Variables	Long-run coefficients β_i							
β_w	W	1.000	.214	1.000	.188	1.000	.208	1.000	.176
β_p	P	-1.125	-.229	-1.119	-.188	-1.124	-.224	-1.118	-.176
β_N	N	.671	1.000	.661	1.000	.666	1.000	.655	1.000
β_Q	Q	-.671	-.307	-.661	-.285	-.666	-.301	-.655	-.272
β_{τ_a}	$1-\tau_a$	1.000	.000	1.000	.000	1.000	.000	1.000	.000
β_{τ_m}	$1-\tau_m$	-.299	.000	-.291	.000	-.290	.000	-.288	.000
β_s	$1+s$	.299	.214	.291	.188	.290	.208	.288	.176
β_v	CPI/P	-.701	.000	-.709	.000	-.710	.000	-.712	.000
β_{P_m}	P_m	.125	.015	.119	.000	.124	.016	.118	.000
β_U	UNION	-.323	.000	-.332	.000	-.317	.000	-.331	.000
		Adjustment coefficients α_i							
α_w	ΔW	-.647	.443	-.645	.432	-.709	.681	-.685	.635
α_p	ΔP	.042	.265	.072	.217	.184	.134	.208	.099
α_N	ΔN	-.124	-.384	.102	-.348	.141	-.332	.120	-.308
α_Q	ΔQ	.434	-.804	.397	-.744	.442	-.665	.407	-.616
α_{τ_a}	$\Delta \tau_a$	-	-	-	-	-.089	.177	-.079	.162
Number of restrictions imposed on relation i , (η_i)		5	6	5	7	5	6	5	7
Characterization of restrictions imposed		$\beta_w = -\beta_p - \beta_{P_m}$ $= \beta_{\tau_a}$ $\beta_N = -\beta_Q$ $\beta_{\tau_a} + \beta_{\tau_m} = 1 - \beta_s = -\beta_v$	$\beta_w = -\beta_p$ $-\beta_{P_m} = \beta_s$ $\beta_{\tau_a} = \beta_{\tau_m} = \beta_U = 0$	$\beta_w = -\beta_p - \beta_{P_m} = \beta_{\tau_a}$ $\beta_N = -\beta_Q$ $\beta_{\tau_a} + \beta_{\tau_m} = 1 - \beta_s = -\beta_v$	$\beta_w = -\beta_p = \beta_s$ $\beta_{P_m} = \beta_{\tau_a}$ $-\beta_{\tau_m} = \beta_U = 0$	$\beta_w = -\beta_p - \beta_{P_m} = \beta_{\tau_a}$ $\beta_N = -\beta_Q$ $\beta_{\tau_a} + \beta_{\tau_m} = \beta_U = 0$ $1 - \beta_s = -\beta_v$	$\beta_w = -\beta_p - \beta_{P_m} = \beta_{\tau_a}$ $\beta_N = -\beta_Q$ $\beta_{\tau_a} + \beta_{\tau_m} = \beta_U = 0$ $1 - \beta_s = -\beta_v$	$\beta_w = -\beta_p - \beta_{P_m} = \beta_s$ $\beta_{\tau_a} = \beta_{\tau_m} = \beta_U = 0$	
LR test statistic, $\chi^2(\Sigma(\eta_i - (r-1)))$		12.42		14.11		10.73		12.86	
Critical value, $CV_{5\%}(\Sigma(\eta_i - (r-1)))$		14.07		15.51		14.07		15.51	
p-value		.09		.08		.15		.12	
Eigenvalues, λ_i		.511	.411	.511	.411	.531	.490	.531	.490

All variables are in logs, and r = number of cointegrating vectors, r_1 = number of cointegrating vectors to be restricted and r_2 = number of non-restricted cointegrating vectors = $r - r_1$

As far as real wage resistance is concerned, the important results become even more obvious when (xii) is written in a slightly different form. This is because in the labour demand schedule the key cost variable is the real labour cost.¹⁹ In the literature, it is often called as the real production wage, $W_{pr} = W(1+s)/P$. To proceed we use the approximation $\log(1+X) = X$, which in the present context implies $\log(1-\tau_m) - \log(1-\tau_a) = \tau_a - \tau_m$. Recall that this is precisely the progressivity measure of Jakobsson (1978) which we discussed above. If we now manipulate (xii) so that W_{pr} is on the left-hand side, we have a wage relation

$$\begin{aligned} \log(W_{pr}) = & .70 \cdot \log \left(\frac{(CPI/P)(1+s)}{1-\tau_a} \right) + .30 \cdot (\tau_a - \tau_m) \\ & + .66 \cdot \log(Q/N) - .12 \cdot \log(P_m/P) \\ & + .33 \cdot \log(\text{UNION}). \end{aligned} \tag{xii'}$$

A tightening in income taxation taking the form of an equiproportional rise in average and marginal tax rates leads to compensating wage claims and induces an increase in the real labour cost which is around two-thirds of the relative tax rise. An increase in the employers' social security contribution rate leads to a downward adjustment in wages, but around two-thirds remains as higher labour cost. An increase in indirect taxes leads to upward adjustment of nominal wages, which induces a rise in the labour cost which is identical in magnitude with the effects of other taxes, ie two-thirds of the tax rise. So, this implies a special kind of wedge restriction $-\beta_{\tau_a} + \beta_{\tau_m} = \beta_v = 1 + \beta_s$, where the first component is different from (viii) above.

A thorough analysis of the full effects of a shock in the form of a shift in a tax rate would require simulations like those introduced in Chapter 3 and in Tyrväinen (1995). In the present context, this is, however, left for future work.

As a by-product we found some evidence against the efficient bargaining model. In the right-to-manage model (iii), employment is determined by the profit-maximization condition (ii), which only contains variables entering the profit function. It is well known that if – as in the efficient bargaining model – the profit-maximization condition is relaxed, employment is determined by the bargaining solution. In this case, all the variables entering the game play a role in

¹⁹ In (xiii), the output effect differs significantly from the wage cost effect and they both differ significantly from zero and unity.

the determination of employment. As it happens, the key determinants of profit enter the employment relation significantly whereas the others do not. This indicates that the equilibrium level of employment is on the labour demand curve. Generally, this result concerning the private sector in Finland contradicts the efficient bargaining hypothesis.

7 Wages and taxes: discussion

One of the interesting novelties in the present study concerns the opposite effects discovered for the average and marginal income tax rates. The signs are in accordance with discussion in Chapter 2. As the elasticity related to the former is unity and the opposite effect related to the latter is around .3, the net impact of an equiproportional increase in average and marginal income tax rates on wages is positive and approximately .70.

Table 14 contains the wage elasticities discovered in some other studies concerning Finland. There are three considerations of special interest. First, the parameter estimates vary a lot. In spite of this, Calmfors & Nymoen (1990) is a real outlier. Second, Eriksson et al. (1990) discover a zero effect for the average income tax and a positive effect for the marginal income tax rate. In their estimations, which suffer from a small number of observations, the effects of the two tax factors, which behave quite similarly (see Figure 10), appear to be mixed. This impression is supported by the fact that in Chapter 3, in which only the marginal rate enters, this factor captures the role of the average rate, which plays the dominant role in the present estimations. Third, the rest of the elasticities discovered in Chapter 3 above applying the Granger & Engle procedure (with OLS) are quite close to those discovered in the present chapter.

Interestingly, for the UK, Manning (1992) reports effects of +.3 and -.3 for average and marginal income tax, respectively, after having imposed them to be equal in absolute value according to the τ_p -restriction discussed above. In fact, this implies that there is no effect if a tax rise takes place as equiproportional changes in average and marginal income tax rates.

Numerically, our relation (xii') is almost identical to that found for Sweden in Padoa Schioppa (1992). The long-run solution of her regression (estimated with instrumental variable techniques) gives the following parameter estimates $W_{pr} = .73 \cdot [s+v+\tau_a] + [.42 \cdot (D61-78) + .52 \cdot (D79-87)] \cdot (\tau_a - \tau_m) + \text{other push factors including } Q/N \text{ and } P_m/P$, where v is indirect tax and D indicates a dummy.

As can be seen from Figure 10, the average income tax rate rose by almost 15 percentage points in Finland between 1965 and 1994. The marginal rate increased by about 20 percentage points. The coefficients discovered in the present study indicate that these changes in *income* tax rates would have generated a compensating increase in the pre-tax wage level – as also in the labour cost – of some 8 per cent.

Table 14. **The effects of taxes on pre-tax nominal wages derived for Finland in selected studies**

	Payroll tax	Price wedge (incl. VAT)	Income tax, average	Income tax, marginal
This study	-.3	.7	1.0	-.3
H-H-K	-.4	.6	.6	..
B-L-N	-.7	.2	.2	..
P	-.7	.9	1.0	..
E-S-V	-1	.9	0	.3
C-N	-1	0	0	..
TT	-.5	.5	1.0	-.5

The studies concerned are H-H-K: Holm, Honkapohja & Koskela (1991), E-S-V: Eriksson, Suvanto & Vartia (1990), P: Pehkonen (1990), C-N: Calmfors & Nymoén (1990), B-L-N: Bean, Layard & Nickell (1986), TT: Tyrväinen (1995).

8 Conclusions

A 10-dimensional vector space was defined as an outcome of modelling wage setting and demand for labour in a bargaining framework. Structural restrictions identifying the long-run relations of interest were specified and tested first in partial and then in joint analysis.

Generally, restrictions satisfying the condition for formal identification pass the tests at a fairly high significance level. The plausibility of the resulting cointegrating relations applies not only to the signs but also to the magnitudes of the coefficients. This concerns economic identification. Testing empirical identification is not straightforward as yet. However, the preliminary results applying the likelihood ratio (LR) test indicate that the preferred relations also satisfy this condition. All these considerations play a role in ensuring that the structure applied does not suffer from the potential lack of

identification of wage-setting relations addressed by Bean (1992) and Manning (1992).

The relations of interest show up almost identically in partial and joint analysis. They do not appear to be sensitive to the choice between $r = 4$ or $r = 3$, which is the factor defining the number of cointegrating relations in the system. Finally, the relations are hardly influenced at all by alternative assumptions concerning the endogeneity of various tax rates. Therefore, we consider these long-run relations to be robust.

According to the results, an equiproportional increase in average and marginal income tax rates is shifted to a higher pre-tax wage level with an elasticity of around two-thirds, which is also the effect on labour costs. The impact of higher employers' social security contributions on real labour costs is identical to the income tax effect. Interestingly, the adjustment coefficient related to indirect taxes is the same as well.

Stronger unions have succeeded in pushing up the wage level. The significant role of the union density variable is in accordance with bargaining models. Higher real prices of raw materials have reduced wages. The driving force behind real wage growth is productivity growth.

As far as demand for labour is concerned, the negative impact of real labour costs is clear-cut. The lack of a separate (negative) effect of higher raw material prices on employment indicates that the influence concerned operates primarily through wages.

Finally, equilibrium employment appears to be on the labour demand curve. This evidence concerning the aggregate private sector in Finland tends to contradict the efficient bargaining hypothesis.²⁰

²⁰ It should be noted that, in accordance with Layard et al. (1991), we argued in Chapter 1 that this conclusion is fully valid only in the absence of efficiency wage considerations.

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Appendix to Chapter 4

Estimation results

Table 15. **A joint Trace test for the cointegration rank, r , and the existence of a linear trend, H_r^* versus H_r**

r	No linear trend, H_r^*			Linear trend, H_r		
	Eigen-value, λ_r	Test statistic, Q_r^*	Critical value, $CV_{95\%}$	Eigen-value, λ_r	Test statistic, Q_r	Critical value, $CV_{95\%}$
0	.686	397	244	.628	351	233
1	.555	302	203	.555	270	193
2	.536	236	166	.526	203	156
3	.444	174	132	.443	142	124
4	.399	126	102	.316	93	94
5	.316	84	76	.285	63	68
6	.285	53	53	.188	35	47
7	.174	25	35	.174	18	30
8	.108	10	20	.028	3	15
9	.003	.2	9	.003	.2	4

The critical values are from Johansen & Juselius (1990, Tables A1 and A3) and Osterwald-Lenum (1990).

Table 16. **A Trace test for I(2) common trends**

Number of		Test statistic, Q_{4,c_1}	Critical value, $CV_{95\%}$
I(1) common trends, c_1	I(2) common trends, $c_2 = c - c_1$		
0	6	426	102
1	5	248	76
2	4	162	53
3	3	92	35
4	2	30	20
5	1	8	9

In a 10-dimensional system with $r = 4$, the number of common trends is $c = 10 - 4 = 6$.

Table 17.

Residual analysis**A. The full model**

Equation	B-P.Q(20)/18 (1)	ARCH(2) (2)	SKEW. (3)	EX.KURT. (4)	J-B.NORM. (5)
ΔW	1.030	1.783	-.367	-.112	1.887
ΔP	1.666	1.185	.112	.458	.889
ΔQ	.919	.034	-.248	.466	1.579
ΔN	1.117	4.703	.015	.012	.004
$\Delta(1-\tau_a)$	1.642	9.508**	.189	2.104	15.612**
$\Delta(1-\tau_m)$	1.517	18.161**	-.129	6.191	131.188**
$\Delta(1+s)$	1.083	.638	.783	5.061	95.887**
$\Delta(\text{CPI}/P)$	1.603	.943	-.142	.155	.357
ΔP_m	.707	.167	1.217	4.999	105.616**
ΔUNION	1.330	4.701	-.317	.621	2.690

B. The partial model

Equation	B-P.Q(20)/18 (1)	ARCH(2) (2)	SKEW. (3)	EX.KURT. (4)	J-B.NORM. (5)
ΔW	1.252	3.997	-.338	-.132	1.621
ΔP	1.036	1.848	.306	.117	1.327
ΔN	.826	4.610	.048	-.446	.709
ΔQ	.919	1.516	.080	-.095	.119

* indicates significance at the 5 per cent and ** at the 1 per cent level.

All variables are in logs. The first column shows a scaled Box-Pierce autocorrelation test statistic. The second column is the test statistic for conditional heteroscedasticity which follows the χ^2 -distribution with degrees of freedom indicated in parentheses. Third column measures skewness and the fourth measures excess kurtosis-3 (these two statistics are zeros with the normal distribution). Finally, the fifth column shows a Jarque & Bera test statistic for normality of the residuals (derived from columns three and four) which is distributed $\chi^2(2)$.

Table 18. **Unrestricted cointegrating relations in the partial model**

		(1)	(2)	(3)	(4)
Coeff.	Variables	Long-run coefficients β_i			
β_W	W	40.340	-20.704	-52.284	16.496
β_P	P	-66.575	-9.973	61.414	-19.257
β_N	N	68.195	-99.963	24.934	-41.835
β_Q	Q	-8.002	59.477	19.693	-8.841
β_{τ_a}	$1-\tau_a$	91.366	-11.813	-170.146	-149.500
β_{τ_m}	$1-\tau_m$	-32.449	-10.599	48.410	47.316
β_s	$1+s$	73.878	-56.979	-4.876	-139.612
β_v	CPI/P	-42.120	4.973	50.275	-1.709
β_{P_m}	P_m	10.951	10.598	-5.005	5.893
β_{U^m}	UNION	-6.729	20.070	11.995	11.168
		Adjustment coefficients α_i			
α_W	ΔW	-.001	.004	.008	-.004
α_P	ΔP	.004	.000	.001	.000
α_N	ΔN	.000	.002	-.001	.000
α_Q	ΔQ	.000	.001	-.005	-.002
Eigenvalues, λ_i		.511	.411	.335	.133

All variables are in logs.

Table 19. **Verification of the rank condition for formal identification in alternative long-run structures (A)–(D) imposed in Table 13¹**

Structures (A) and (C) ²				Structures (B) and (D) ²			
H_{ij}		$H_{i,jk}$		H_{ij}		$H_{i,jk}$	
1.2:	2	1.23:	5	1.2:	2	1.23:	5
1.3:	5			1.3:	5		
2.1:	4	2.13:	6	2.1:	4	2.13:	6
2.3:	7			2.3:	7		

¹ For the method, see Johansen & Juselius (1992b). Formal identification requires that the value of each H_{ij} is greater than 1 and each $H_{i,jk}$ exceeds 2. The statistics reported have been kindly calculated by Katarina Juselius.

² The two structures concerned are identical.

Chapter 5

Wage Drift and Error Correction

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Abstract

In Finland, local bargaining plays an important role in wage setting. In the present chapter, we examine processes which generate wage increments in excess of those agreed upon centrally, ie wage drift.

A synthesis of explanations commonly found in the literature is sketched. This attempt is strongly motivated by the notion that the time series properties of the relevant wage series differ significantly from each other. The resulting hypothesis is that wage drift – which is a stationary series – is to be considered a factor related to adjustment towards an equilibrium level.

Empirical results are in accordance with the error correction hypothesis. There is a robust inverse correlation between the contract wage and wage drift. Adjustment is quite rapid but not instantaneous. Wage drift tends to be larger when the dispersion of economic prospects foreseen by firms – as measured by the standard deviation of the stock of orders – is large. Wage drift is positively correlated with changes in demand for labour. Finally, variation in wage drift appears to be correlated with errors in (inflation) expectations.

1 Introduction

In all economies with collective wage bargaining, a certain proportion of pay increases is due to wage drift, ie wage increments over and above the wage rates agreed upon collectively. This proportion is particularly high in the Nordic countries, where bargaining is highly centralized (see Flanagan, 1990). Figure 11 shows contract wages,¹ wage drift and labour market slack in Finland

During this period, wage determination is characterized by a three-step process as described in detail in Appendix 1. First, the central confederations reach a settlement, which sets the general guidelines for wage developments over the next year or two. However, central agreements become effective only after they have been approved at the industry level. The contract wage index accumulates the approximated relative changes in the prevailing wage level due to these industry-specific contracts.²

Both country-wide and industry-level bargaining represent centralized bargaining. So, in accordance with Hibbs & Locking (1991), we refer to this tri-level bargaining system as the 'centralized' institutional regime. At each level – including the local level – workers negotiate with employers. At each level, a relevant union body is involved.³ The evidence in Appendix 1 indicates that the major part of wage drift results from local bargaining and local settlements. Consequently, the boundary between the contract wage and wage drift refers more to the 'local versus central bargaining' aspect than to the 'bargaining versus competitive' aspect.

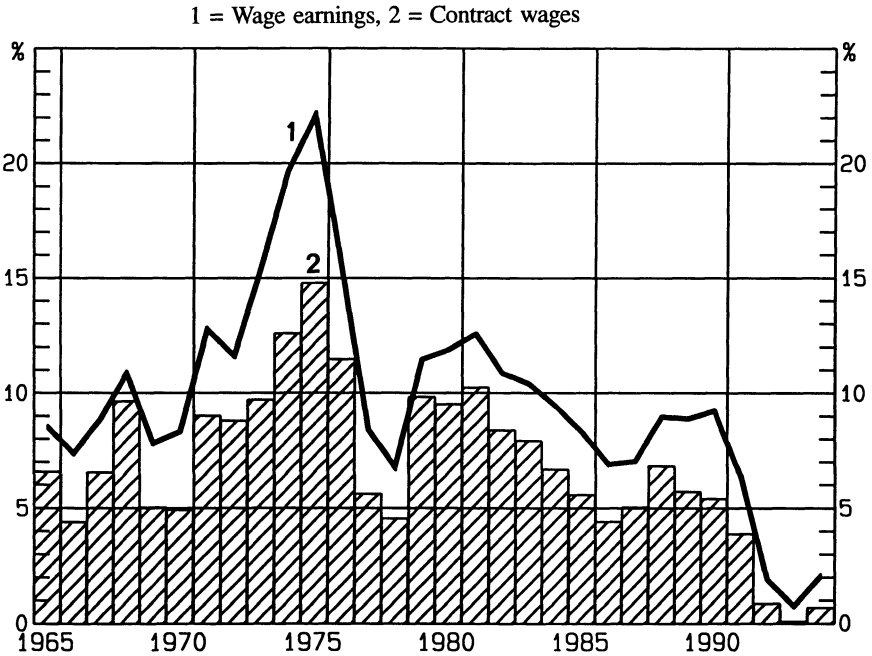
This chapter has benefited from many suggestions by Erkki Koskela. Useful comments by Tor Eriksson, Steinar Holden, Richard Jackman, Heikki Koskenkylä, Jaakko Pehkonen and Matti Virén are also acknowledged. The research is part of the research project 'Nordic Labour Markets in the 1990s' organized by the NAUT. Financial support from Jenny and Antti Wihuri Foundation is gratefully acknowledged. The usual disclaimer applies.

¹ In Finland, there was not a single year in the period 1964–1994 when there was no collective agreement. In addition, there were only six years when settlements were concluded at industry level with no economy-wide agreement.

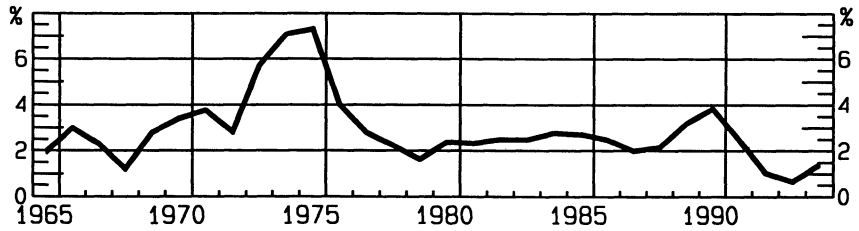
² In Finland, wage bargaining has been influenced by government intervention in several wage rounds. These effects are difficult to quantify. In addition, because of the method of calculating the contract wage index, there is a continuously growing gap in relation to the prevailing wage and price levels (see Tyrväinen, 1991). Consequently, we are sceptical about attempts to estimate separate equations for contract wages in Finland.

³ Although often overlooked, as in eg Flanagan (1990), this finding is by no means new. Lerner & Marquand (1962) note that in British engineering 'the greatest part of the wage drift ... in the 45 firms examined arose out of workshop bargaining between shop stewards and management'.

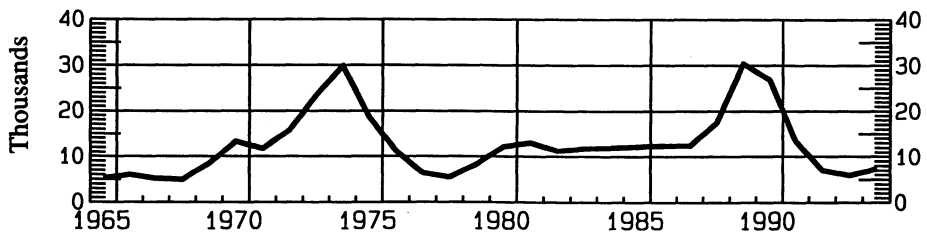
Figure 11. **Wages and labour market slack in Finland, 1965–1994**



Wage drift



Number of vacancies *



* There is a discontinuity in the series for vacancies in 1988 when a new Employment Act made it obligatory for employers to publish all vacancies. This appears to have increased the number of vacancies by as much as one-third.

In Calmfors (1990) and Rödseth (1990), the factors exerting influence at the local and central levels are qualitatively the same. In broad terms, this accords with the argumentation in the present study. So, if we partition the growth of total wages, ΔW_t , into two components⁴

$$\Delta W_t = \Delta W_{c,t} + W_{d,t}, \quad (i)$$

where W_c is the contract wage and W_d is wage drift, both components can be analyzed in terms of a bargaining model. Hence, it is an adequate description of the aggregate relation as well.

Most of the early empirical work on wage drift relied on a Phillips-curve type of framework, often augmented in an *ad hoc* fashion with auxiliary variables.⁵ Only recently has wage drift been considered the outcome of local bargaining about the implementation of central contracts; see eg Holden (1988) and Holmlund & Skedinger (1990). This accords with the above description of the Finnish institutions. The potential role of expectational errors in the process has been stressed by eg Holmlund (1985) and Pencavel (1985).⁶

This paper intends to produce a kind of synthesis of the arguments outlined above. The intuition is as follows. Empirical evidence confirms that wage drift is boosted by excess demand for labour. According to almost any theory, excess demand for labour signals that the prevailing wage level is below the equilibrium. This introduces the error correction mechanism as a potential means of modelling wage drift. Equilibrium errors are presumably influenced contributed by expectational errors because contracts are made in advance for a period of one to two years. In order to evaluate this causal chain, we derive and estimate wage drift equations in terms of

- 1) an excess demand for labour model,
- 2) an error correction model,
- 3) a model emphasizing expectational errors.

Although the error correction model constitutes the core of this paper, we also attempt to show that the three approaches above should not be

⁴ All variables are in log form throughout the chapter.

⁵ For example, Isachsen (1977) and Söderström & Udden-Jondal (1982) include output prices and Hansen & Rehn (1956) and Schager (1981) stress the role of profitability.

⁶ Attempts have also been made to examine wage drift in terms of efficiency wage models (Lucifora, 1991 and Lever, 1991). Hibbs & Locking (1991) consider the effect of wage compression due to central contracts on wage drift.

considered mutually exclusive in the sense that acceptance of one would reject the others.

Modern econometrics indicates that an empirical structure is plausible only if certain conditions related to the time-series properties of the contributing series are met. Otherwise the relation may be nonsense and any correlation discovered spurious. These aspects, which also provide a statistical method for discrimination between empirical models, have not usually been considered in the context of wage drift analysis.

The paper is organized as follows. Section 2 introduces conceptual tools used when wage drift equations are specified. Implications of uncertainty are also considered. Section 3 introduces an empirical application of the error correction model as well as of the other two models. Section 4 summarizes the paper and proposes some policy conclusions.

2 Wage drift as adjustment towards the equilibrium

A synthesis of three different ways to consider wage drift is sketched in this section. For this purpose, we first discuss some useful concepts.

2.1 Attractors, equilibrium and adjustment

Let us consider the relation

$$Y_t = AX_t + z_t, \quad (\text{ii})$$

where X is one variable or a vector of variables. Let us suppose that there is some mechanism existing such that if point (X, Y) moves away from line A , there will be a tendency to move back close to it. On account of this property, line A is said to act as an attractor. Because of uncertainties, rigidities, contracts etc., the mechanism may not immediately bring the points exactly to the attractor. However, there will be an overall tendency towards it. If the economy lies on A , a shock will take it away. If there is an extended period with no exogenous shocks, the economy will definitely go to the line and remain there. Because of this property, the line A can be thought of as

an "equilibrium", of the centre of gravity type' (Engle & Granger, 1991, p. 2).

The attractor is related to cointegration as follows. If the error term z_t in (ii) is stationary, $I(0)$, the system is said to be cointegrated. This is the statistical condition under which the line $Y = AX$ corresponds to an attractor for the pair of series $(Y_t \text{ and } X_t)$. '... cointegration is a sufficient condition for the existence of an attractor and this attractor can correspond to certain types of equilibrium that arise in macroeconomic theory' (Engle et al., 1991, p. 7).

It is well known that cointegrated variables can always be thought of as being generated by error correction behaviour. According to this interpretation, z_t is a measure of the extent to which the system is out of equilibrium. Accordingly, it has been called the 'equilibrium error'. If there is no disequilibrium, there is no incentive for any of the system variables to change.

2.2 Wage drift and the attractor

In order to consider the equilibrium as far as wage setting is concerned, we define a Nash bargaining solution according to the 'right-to-manage' hypothesis:

$$\max_w (U - U_0)^\theta (\pi - \pi_0)^{1-\theta} \quad \text{s.t. } N(.) = \arg \max_N \pi, \quad (\text{iii})$$

where U is a well-behaved utility function of the union and π is the profit function (see Appendix 2). U_0 and π_0 are the fall-back levels of utility and profit which materialize if no contract is settled. θ is a measure of the union's bargaining power. Obviously, (iii) defines the levels of two endogenous variables, wages and employment.

For wages, we can solve a relation like

$$W = W(N,P,X), \quad (\text{iv})$$

where the wage level depends on employment, prices and a set of exogenous variables X consisting of variables entering the union's utility function, the profit function and a proxy for union power. We call (iv) a *structural* wage relation.

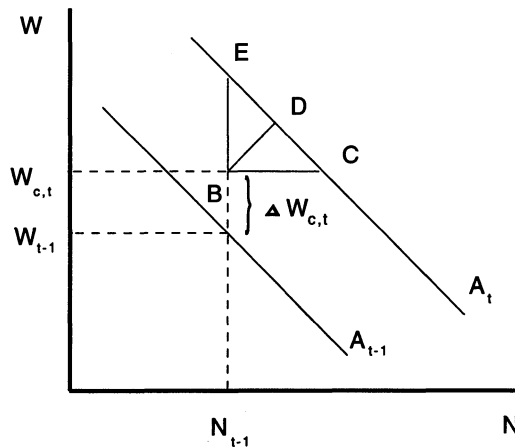
Since it is straightforward to think that it is the real wage which defines both the union welfare and the marginal cost related to labour demand, the model *de facto* defines an equilibrium relation between

the real wage and employment given the economic environment described by X. Prices can be endogenously determined as in Appendix 2, but for our present purpose we do not lose anything by thinking of prices as exogenous and by normalizing them to unity.

The structural relation is shown in Figure 12. Obviously, it resembles the downward sloping labour demand curve because it captures the inverse relation between wages and employment. For simplicity, let X consist of one factor only, the output or product market demand for example. Let us assume that in the previous period (W_{t-1}, N_{t-1}) was on the attractor A_{t-1} . A shock, eg higher demand for products, leads to an upward shift in the attractor. The new position is at A_t . Since the old equilibrium is no more valid, an incentive for adjustment emerges.

Let the wage setters react by setting the level of the contract wage which prevails at the beginning of period t at $W_{c,t}$. If $(W_{c,t}, N_{t-1})$ is below the attractor A_t as in Figure 12, a negative equilibrium error emerges. The disequilibrium can be defined in three ways. It is B-C with respect to employment and B-E with respect to the wage. Finally, the counterpart of \bar{z}_t defined in Chapter 1, Section 2, is B-D. If we presume that both wages and employment adjust, then $\Delta N_t > 0$ and $\Delta W_t > 0$. As a result, (W, N) drifts towards the new attractor A_t . Since the contract wage is fixed, the condition $\Delta W_t > 0$ *de facto* implies $W_{d,t} > 0$.

Figure 12. **The structural wage-employment relation as an attractor**



Let us assume that the factors influencing the profit function are not perfectly known by the union but that it can collect the relevant information indirectly. For example, if it is profitable for the firm to hire additional workers, the union can presume that the marginal wage is below the marginal product. This gives grounds for wage claims. If sudden changes in hirings – during the contract period t – are used as a screening device by the unions, the number of vacancies probably rises first and wage adjustment (through wage drift) follows. The relation is

$$W_{d,t} = f(\Delta N_t), \quad f' > 0. \quad (v)$$

In the literature wage drift has repeatedly been regressed on the excess demand for labour and the correlation discovered is usually high. Still, it is more a description of the adjustment of two interrelated variables to shocks in third factors than a causal relationship. Of course, the time structure of the adjustment – which may be influenced by asymmetries in information – can look like causality in econometric exercises.

At best, the relation between wage drift and employment is one characterized as Granger-causality. That is, information about changes in the demand for labour helps to predict wage drift. This is because changes in the former may precede the latter. However, this does not constitute causality in a deep sense.

In the wage relation (iv) above, employment is derived from the profit function. It depends on real wages and some exogenous variables, ie $N = N(W/P, X_1)$, where X_1 is a subset of X and contains variables in the profit function.

By substituting $N = N(\cdot)$ into the structural wage relation, we obtain a *reduced* form expression for wages

$$W = W(P, X)$$

which applies when all adjustment of employment has taken place. Under the right-to-manage condition, X consists of the same variables as in the structural relation. Under other bargaining structures, this does not necessarily hold. By normalizing prices to unity, the reduced form becomes seemingly identical to the attractor (ii), ie $W = AX$.

Figure 13 introduces the attractor defined in terms of the reduced form. Since many of the contributing variables grow in a trendwise fashion, we have drawn the attractor as an upward sloping line in time. In real life the attractor is, of course, seldom linear and it is

rising only if a dominant part of the components of X is rising. For expository reasons, however, we assume the form expressed above and by so doing we do not lose anything as far as insight is concerned.

In Figure 13, let us assume that at the end of period $t-1$ all parties see that W_{t-1} is no longer the equilibrium for period t . This is because of an expected change in the economic situation. Or put more explicitly, $X_t^e > X_{t-1}$. Since the future is not perfectly foreseen, the contract wage set at the level $W_{c,t} = W_{t-1} + \Delta W_{c,t}$ turns out to be below the attractor. This is because $X_t^* > X_t^e$. Pressure for adjustment emerges, which could take place in a smooth manner as indicated by the arrow. This is because, in real life, adjustment is usually partial.

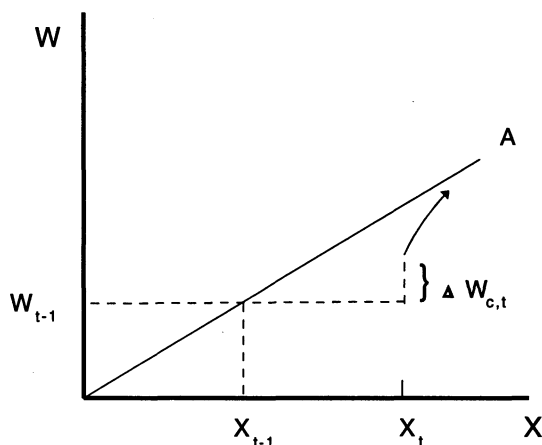
The driving equilibrium error, $z_t = W_t^* - W_{c,t}$, can be partitioned as $z_t = \Delta z_t + z_{t-1}$, where $\Delta z_t = \Delta W_t^* - \Delta W_{c,t}$. The error correction model for wage drift – in accordance with Engle & Granger (1987) – becomes

$$W_{d,t} = \rho \cdot z_t \tag{vi}$$

$$= \rho_1 \Delta W_t^* - \rho_2 \Delta W_{c,t} + \rho_3 z_{t-1},$$

where z_{t-1} measures the need for adjustment stemming from the past and $\rho_i > 0$. Of course, to allow ρ_i 's to differ from each other is somewhat *ad hoc*. Still, it is interesting first to see whether the estimates differ much when they are allowed to be determined freely and only then proceed to test whether the coefficients can be restricted to be identical.

Figure 13. The reduced form wage relation as an attractor



The statistical preconditions for (vi) to be a plausible specification are as follows. First, a cointegrating wage relation which defines W^* and generates a stationary error term, $z_t \sim I(0)$, must be found. If $W_{d,t} = \rho \cdot z_t$ is expected to hold, wage drift should be stationary as well. Secondly, the two difference terms in the lower row of (vi) must be integrated of the same order. Otherwise they cannot cointegrate in a fashion which brings the full system down to stationarity. Since earlier evidence indicates that $W \sim I(2)$, then W_c should be $I(2)$ as well. If this holds, these two series will be $I(1)$ when differenced and cointegration becomes possible.

Empirical results show that the preconditions set out above are met. Thus, the time series properties of wage drift and the contract wage differ fundamentally.

In equation (vi), hypotheses about the relation between the contract wage and wage drift can be characterized as follows (see also Calmfors, 1990, and Flanagan 1990⁷):

- (A) The wage setters predict wage drift and take it into account when setting the contract wage. According to the strong version, (A1), they succeed perfectly and, hence, central negotiations *de facto* determine the final wage. This implies $\rho_1 = \rho_2 = 1$. Under these conditions, $\rho_3 = 0$ by definition. According to the weak version, (A2), central negotiators make predictions but fail to reach the desired wage outcome because of expectational errors.⁸ If it turns out that $\Delta W_t^* \neq \Delta W_t^{*e}$ and $W_{d,t} \neq W_{d,t}^e$, then it may be that $\rho_3 \neq 0$.
- (B) According to the error correction hypothesis, there is an inverse relation between wage drift and the contract wage. In an extreme version, (B1), the adjustment is instantaneous and, hence, permanently $\rho_1 = \rho_2 = 1$, implying $\rho_3 = 0$ by definition.

⁷ Flanagan (1990) suggests the following test. The negotiated wage change is determined by a vector of variables, V_1 , as well as by the response of negotiators to wage drift (with coefficient α_4). Wage drift is determined by a vector of variables, V_2 , as well as by the influence of central negotiations on decentralized pay decisions (with coefficient α_5). The vectors V_1 and V_2 may share some common variables. The test concerns whether $\alpha_4 = \alpha_5 = 1$ or $\alpha_4 = \alpha_5 = 0$ or $0 < \alpha_{4,j} < 1$. The discussion above, however, indicates that the procedure is valid only if instantaneous adjustment is presupposed. An additional caveat is that in Flanagan's test vectors V_1 and V_2 are imposed not to be identical. As the natural starting point would be the contrary, the procedure is prone to problems related to omitted variables (see Rødseth, 1990, and Holmlund, 1990).

⁸ Of course, in centralized wage negotiations it is difficult to take account of the fact that the growth of productivity differs between industries.

In the weak version, (B2), the adjustment may be gradual. If $\rho_1 \neq 1$ and $\rho_2 \neq 1$ and, thus, equilibrium errors emerge, $\rho_3 \neq 0$. If $\rho_1 = \rho_2 = \rho_3 = \rho > 0$, then the r-h-s in (vi) collapses to $\rho \cdot z_t$ which we call the strong version of the error correction hypothesis (B3).

(C) Wage drift is independent of the wage contracts if $\rho_2 = 0$.

Closer investigation reveals that one cannot distinguish between (A1) and (B1) or (A2) and (B2) or (B3) when *ex post* statistics are used. (A) is a special case of (B) emphasizing whether the process has been foreseen. Therefore, when estimating equation (vi) with *ex post* statistics, we wish to distinguish between hypotheses (B1), (B2), (B3) and (C). Hypothesis (A) needs to be examined differently, as will be seen in later sections.

2.3 Wage bargaining and uncertainty

Bargaining models have been typically analyzed under the (implicit) assumption of certainty. This is clearly unsatisfactory where the relation between the contract wage and wage drift is concerned.⁹ The former is settled discretely *ex ante* for a predefined period. The latter represents the continuous adjustment of actual wages during the contract period. Obviously, the information sets driving these two elements differ considerably.

In the present context, we illustrate the matter in a very simple set-up. Let the technology be $F(N)$, $F' > 0$, $F'' < 0$. Under certainty (abstracting away payroll taxes and normalizing exogenous prices to unity), the profit function is $\pi = F(N) - WN$ and the optimal demand for labour derives as $N^* = N(W)$. The union preferences are as in Appendix 2.

The agents decide on the contract wage at a time when they do not know the state of the world which is going to prevail during the contract period. Since we are primarily interested in wages, it is useful to make an *ad hoc* assumption that the uncertainty concerns the optimal level of labour input, \tilde{N}^* , which is a (subjectively) random variable with a density function $d(\tilde{N}^*)$ and expected value $E[\tilde{N}^*]$. So,

⁹ As far as the characteristics of the equilibrium wage are concerned, Oswald (1982) indicates that introduction of uncertainty into his model of the trade union leaves the model's qualitative predictions unaltered. However, changes in the magnitude of uncertainty may matter.

we rewrite the demand for labour condition as $\tilde{N}^* = N(W) + \tilde{e}$, where \tilde{e} is a stochastic term which contains the information defining the state of the world.

A definition of the risk which can be applied in studying this matter involves 'stretching' the probability distribution around a constant mean. Higher uncertainty is defined as greater variance of \tilde{e} , $\delta_{\tilde{e}}^2$, which leaves the mean, $E[\tilde{N}^*]$, unchanged. Analogous to Sandmo (1971), we now examine the optimal (contract) wage under uncertainty as compared with the situation where N^* is known to be equal to the expected value of the original distribution. This will be analyzed in terms of the Nash solution with expectations included:

$$\begin{aligned} \max_W \Omega &= E[u(W) + v(N(W) + \tilde{e})] \cdot E[F(N(W) + \tilde{e}) - W(N(W) + \tilde{e})] \\ &= \Lambda \cdot \Psi \end{aligned} \quad (\text{vii})$$

The FOC of the problem which defines the optimum wage, W^* , is

$$\Omega_{-W} = \Psi \Lambda_{-W} + \Lambda \Psi_{-W} = 0.$$

From Rothschild & Stiglitz (1971), it follows, that for the wage effect of uncertainty defined above in terms of $\delta_{\tilde{e}}^2$, it holds that

$$W_{\delta_{\tilde{e}}^2}^* \begin{cases} \geq 0, \\ < 0, \end{cases} \quad \text{when } \Omega_{W\tilde{e}\tilde{e}} \begin{cases} \geq 0. \\ < 0. \end{cases} \quad (\text{viii})$$

The decisive partial derivative is as follows:

$$\begin{aligned} \Omega_{W\tilde{e}\tilde{e}} &= \Psi \Lambda_{W\tilde{e}\tilde{e}} + \Lambda \Psi_{W\tilde{e}\tilde{e}} + 2\Psi_{\tilde{e}} \Lambda_{W\tilde{e}} \\ &\quad + \Lambda_{-W} \Psi_{\tilde{e}\tilde{e}} + \Lambda_{\tilde{e}\tilde{e}} \Psi_{-W} + 2\Lambda_{\tilde{e}} \Psi_{W\tilde{e}}. \end{aligned} \quad (\text{ix})$$

It is easy to verify¹⁰ that in economically meaningful circumstances $W_{\delta_{\tilde{e}}^2}^* < 0$.¹¹ This indicates that higher uncertainty about labour demand tends to reduce the wage chosen. This serves as an insurance device against the possibility of low labour demand. Since the uncertainty concerning the contract period (measured by $\delta_{\tilde{e}}^2$) is always less during

¹⁰ A full set of derivations is available from the author upon request.

¹¹ This holds unambiguously in the monopoly union model defined according to the present set-up. Oswald (1982) considers an increase in the riskiness of product demand in a slightly different set-up and finds a generally ambiguous wage effect. Under specific technology restrictions, however, the effect appears to be well specified.

the period than beforehand, the rationale for permanently positive wage drift has been discovered.¹²

It is difficult to measure uncertainty. However, we can think of it as being related to the dispersion of economic prospects faced by firms that are covered by the union contract. Surprisingly, this issue has hardly been considered at all in the literature on wage drift.¹³ If the dispersion is large, the number of unfavourable realizations may be large if the contract wage is collectively set 'too high'. In addition, it is widely known that wage drift will quickly compensate for a considerable part of any 'excessive' wage moderation if the state of the world turns out to be favourable. Accordingly, in times of great uncertainty (consistent with large δ_ε^2), wage drift is expected to be higher. Therefore, (vi) will be augmented to include a term describing the dispersion with an expected positive coefficient.

The magnitude of the equilibrium error z_t is presumably correlated positively with shocks due to unexpected changes in the determinants incorporated in the vector X of exogenous variables. Likewise, expectational errors are presumably positively correlated with unexpected shocks. So, there should be a positive relation between wage drift and expectational errors concerning the key determinants of $W^*(.)$, ie

$$W_d = g(W^*(.) - E[W^*(.)]), \quad g' > 0. \quad (x)$$

3 Empirical results

Above we have considered three different ways to model wage drift. The structural wage-employment relation indicates a Phillips-curve type of correlation, which is the most widely applied model in the literature. The causality in (v) is not pure, however. The reduced form wage relation generates the error correction equation (vi). Finally, relation (x), which emphasizes unexpected shocks and expectational

¹² 'An $I(0)$ will have a mean m and can be considered to have a constant (or bounded) variance' (Engle & Granger, 1991, p. 5). The discussion above on the implications of uncertainty indicates that in the present context $m > 0$ systematically.

¹³ Hibbs & Locking (1991) is an exception — though in a different context. The authors demonstrate that efforts to compress wage dispersion in Sweden in the 1970s had considerable effects on both contract wages and wage drift.

errors, provides an explanation for the variation of equilibrium errors and – consequently – of wage drift as well. Of course, since expectations are also influenced by factors outside our model, the third equation is presumably the most tentative as far as empirical implementation is concerned.

3.1 The error correction equation and the relationship between the contract wage and wage drift

The error correction equation (vi) is constructed so that the outcome of the central bargaining is given (or predetermined). The wage drift equation applies to the local stage of the sequential bargaining process. A closer look at the other models reveals that the error correction model is the only one which postulates a well-defined relation between the contract wage and wage drift. This relation is definitely inverse.

In the literature, the relationship between contract wages and wage drift has for long been an unresolved issue and Phelps Brown (1962) has already documented the contradictory evidence. First, it has been argued that large increases in contract wages tend to be accompanied by high wage drift. For instance, in a theoretical paper by Holden (1988, p. 96) 'a higher tariff wage *increases* wage drift'. This argument is supported by the fact that high contract wage increments and high wage drift often occur simultaneously (see Figure 11). Secondly, an inverse relation between the contract wage and wage drift has been discovered by Holmlund & Skedinger (1990)¹⁴ with microdata on the Swedish wood industry and by Lucifora (1991) with Italian microdata. Finally, Calmfors & Forslund (1990) do not find conclusive evidence for any specific relation between the contract wage and wage drift in time series regressions for Swedish manual workers. Holden (1989), using Norwegian time series for the manufacturing industry, ends up with the same result. Flanagan (1990) argues that contracts and drift have no interaction in the Nordic countries, with Finland as a possible exception. So, the evidence is mixed.

¹⁴ Calmfors (1990) argues that when the feed-back effect between industry and central agreements is accounted for, the net effect of a change in the central agreement on wage drift may even be zero in Holmlund & Skedinger (1990).

The error correction structure implies that the wage outcome incorporating wage drift converges towards the long-run equilibrium, which is defined theoretically in Appendix 2 and identified empirically as a cointegrating relation in Appendix 3.¹⁵ As temporary disequilibrium is allowed, eg the price homogeneity is not imposed to hold permanently.

Since the process converges towards the long-run equilibrium, wage drift contributes primarily to the dynamic path of the adjustment.

The observation period is 1965–1989 and the data for the aggregate private sector and the manufacturing industry are mostly derived from the database of the quarterly model of the Bank of Finland, BOF4.¹⁶

It has been argued that there do not exist good grounds for quarterly analysis where economies with annual wage rounds are concerned (see eg Eriksson et al., 1990). However, the basic reason why we prefer to work with annual data despite the loss in degrees of freedom is that the contract wage series and the level of earnings series are constructed very differently (see Tyrväinen, 1991). The contract effects show up differently in the two series, especially when contracts become effective retroactively, which is by no means exceptional in Finland. This creates artificial volatility in the quarterly path of wage drift. In annual analysis this problem can be overlooked.

In order to find an appropriate empirical specification, there is one more complication to consider. The equilibrium wage is defined and estimated in terms of National Accounts. In this context, the (annual) average hourly labour cost, W , tends to increase as a result of a reduction in normal working hours. This is because shorter hours hardly ever involve a one-to-one cut in wage earnings. Wage drift

¹⁵ Holmlund & Skedinger (1990) translate a level equation (comparable to (xii) in Appendix 2) into a wage drift equation simply by decomposing the wage level $W_t = W_{t-1}(1 + \Delta W_{c,t})(1 + W_{d,t})$. This is how they define a wage drift equation with terms both in levels and differences, which is characteristic of error correction models. However, the error correction structure is not 'complete' because the difference terms are due to the disaggregation above and cover only the two wage components. Closer examination of the equation of Holmlund & Skedinger (1990) in comparison with ours reveals that a model in which the disagreement point refers to the contract wage appears to imply a smaller negative coefficient for the contract wage than a model in which the disagreement is a strike. Consequently, if strikes are rare in local bargaining, wage drift is less sensitive to changes in contract wages. In a slightly different set-up, Moene (1988) shows that when the typical form of industrial action is a go-slow, a higher wage results than if the threat is a strike. These aspects may explain part of the differences between the empirical results concerning Finland, on the one hand, and Norway and Sweden, on the other.

¹⁶ In Finland, the manufacturing industry accounts for about one-third of the aggregate private sector. Unfortunately, useful data for micro analysis are not available.

derives from the level of earnings index, W_1 , which measures the wage for normal working time. Here, a reduction in normal hours plays no role. This difference must be controlled when the equilibrium error from the cointegrating relation is plugged into the wage drift equation. So, the latter is allowed to include the term $\Delta(W/W_1)$.

An ADF test indicates that, for the error terms of the cointegrating relations, $z_t \sim I(0)$ holds definitely (see Appendix 3). Wage drift is $I(0)$ with a constant different from zero as the mean. Our earlier discussion on the implications of uncertainty related to the sequential process implies that this is what one would expect to discover. Total wages and contract wages are both $I(2)$ and, hence, the differences are $I(1)$. This indicates that the structure of (vi) is plausible *prima facie* and the regressions will show whether the $I(1)$ terms cointegrate in a manner generating well-behaved error correction equations.

The error correction equations are reported in Table 20 below and Table 25 in Appendix 3. At the head of each table, we indicate the cointegrating relation from which the estimate of the equilibrium error derives. There are four variants of each specification. The fourth is the most parsimonious equation according to (vi) above. The other three have been reported to indicate how strongly the relation according to the main hypothesis of this study shows up in the present data set. In the first set of equations, the effects of all 12–13 variables entering the target wage relation (xii) in Appendix 2 are estimated freely (see Table 25). In these overparametrized equations the coefficients are generally of expected sign. Their magnitudes are plausible and well in accordance with those discovered in the level regressions. The role of the past target error z_{t-1} is clear-cut. The inverse relationship between wage drift and contract wages is apparent.

The second variant was designed to overcome the overparametrization problem with ΔW^* as predicted by a connected cointegrating relation reported in Table 24. Again, the lagged equilibrium error enters significantly and the inverse relationship between contract wages and wage drift is straightforward (see Table 20).

The next restrictions $\rho_1 = \rho_2$ pass the test without exception. The coefficient concerned takes a value of around three-quarters.

Table 20. Wage drift

Estimation period: 1966–1989, except 1969–1989 in equation (19) and 1972–1989 in equations (20)–(22)
 Estimation method: OLS

Independent variables	Dependent variable: $W_d = \text{wage drift}$																							
	Private sector												Manufacturing industry											
	The cointegrating wage relation in Table 24 from which the lagged equilibrium error z_{t-1} derives																							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	
$\Delta \log(W^*) - \Delta \log(W_d) + z_{t-1}$	.606 (4.50)	.714 (5.05)	.757 (6.08)	.746 (6.23)	.774 (4.82)	.912 (10.28)	.874 (6.77)	.541 (3.94)	.606 (4.50)	.707 (5.01)	.648 (6.11)	.688 (5.27)	.778 (4.88)	.716 (6.38)	.821 (2.75)	.874 (6.77)	.468 (4.37)	.005 (.005)	.002 (.002)	.002 (.002)	.006 (.006)	.005 (.005)	.005 (.005)	.005 (.005)
$\Delta \log(W^*) - \Delta \log(W_d)$	-.431 (2.14)	-.483 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.483 (2.81)	-.483 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)	-.486 (2.81)
$\Delta \log(W^*)$	.728 (3.31)	.763 (2.91)	.965 (4.62)	.965 (4.62)	.923 (3.45)	.987 (4.05)	.825 (3.00)	.821 (2.75)	.825 (3.00)	.923 (3.45)	.987 (4.05)	.966 (4.46)	.965 (4.62)	.923 (3.45)	.987 (4.05)	.825 (3.00)	.821 (2.75)	.825 (3.00)	.825 (3.00)	.821 (2.75)	.825 (3.00)	.821 (2.75)	.825 (3.00)	.821 (2.75)
z_{t-1}	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)	.004 (0.22)
D89	.001 (0.22)	.010 (2.03)	.009 (1.88)	.009 (1.88)	.008 (1.43)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)	.003 (0.32)
Constant	.630 (5.99)	.574 (5.99)	.700 (5.37)	.700 (5.37)	.620 (5.33)	.849 (1.22)	.737 (1.87)	.390 (1.41)	.790 (2.16)	.620 (2.20)	.849 (1.22)	.737 (1.87)	.390 (1.41)	.790 (2.16)	.620 (2.20)	.849 (1.22)	.737 (1.87)	.390 (1.41)	.790 (2.16)	.620 (2.20)	.849 (1.22)	.737 (1.87)	.390 (1.41)	.790 (2.16)
R^2	.698	.629	.726	.739	.662	.864	.782	.446	.839	.670	.864	.782	.446	.839	.670	.864	.782	.446	.839	.670	.864	.782	.446	.839
R^2C	.634	.593	.700	.700	.630	.849	.753	.393	.790	.620	.849	.753	.393	.790	.620	.849	.753	.393	.790	.620	.849	.753	.393	.790
DW	1.630	1.474	1.982	1.715	1.976	2.253	1.711	1.744	1.467	1.873	2.253	1.711	1.744	1.467	1.873	2.253	1.711	1.744	1.467	1.873	2.253	1.711	1.744	1.467
SE	.0093	.0099	.0084	.0076	.0111	.0067	.0090	.0140	.0080	.0111	.0067	.0090	.0140	.0080	.0111	.0067	.0090	.0140	.0080	.0111	.0067	.0090	.0140	.0080

D89 is a dummy which receives the value one in 1989.

Below the parameter estimates are shown White's heteroscedasticity adjusted t-ratios. The degrees of freedom correction has been made according to McKinnon & White (1985).

The final restriction, which implies $\rho_1 = \rho_2 = \rho_3 = \rho$, generally passes the test.¹⁷ The resulting equations consist of only one independent $I(0)$ variable, the equilibrium error z_t . The restriction concerned in most cases generates a favourable effect on the adjusted R^2 . The estimate of the ρ -coefficient indicates that around three-quarters of an equilibrium error is corrected through the drift within a year.¹⁸

The significant role played by a dummy (D89) confirms that wage drift in 1989 exceeded historical relationships. At the time, the Finnish economy was heavily overheated, as already noted in Chapter 3.

Investigation of the role of the dispersion of the economic conditions of firms compels us to use data which differ considerably from the rest of the data. Six alternative measures of dispersion, all calculated from the Business Survey of the Confederation of Finnish Industries, were experimented with (see Appendix 4). The most successful regressions utilize information on current order books, which have a straightforward interpretation as a proxy for short-run production expectations. A positive, significant coefficient was found when the equations in Table 20 were augmented to include the measure concerned. As can be seen in Table 21, the resulting equations have the same basic structure as the original ones. Still, they outperform those in Table 20 without exception. This indicates that a larger *ex ante* dispersion in financial prospects faced by firms tends to increase wage drift discovered *ex post* (*ceteris paribus*). The reason for discretion is due to the difference of the data on dispersion from the rest of the data.

To conclude, the results so far have the following implications:

¹⁷ There is one exception, however. The restriction is rejected at the 5 per cent significance level (but not at the 1 per cent level) when imposed on equation (11) to get to (12).

¹⁸ Tyrväinen (1991) indicates that observed changes in contract wages are measured with error. As Holmlund & Skedinger (1990) show, measurement errors influence the estimate of the coefficient of the contract wage in the wage drift equation. The larger the proportion of the variance in the observed contractual wage that is due to error, the closer the coefficient of the contract wage is to unity. In Finland, the change in contract wages is systematically underestimated for statistical reasons (see Tyrväinen, 1991). As wage drift is consequently overestimated, we expect our coefficient of -0.7 – -0.8 to be the upper limit of the 'correct' parameter value, although some other studies applying different approaches and considering different countries have produced almost identical elasticities as the ones above. These studies are Honkapohja & Koskela (1990), which estimates the equation of Holmlund & Skedinger (1990) for Finland, Hibbs & Locking (1991) for Sweden and Lever (1991) for the Netherlands.

- 1) There is a robust inverse correlation between contract wages and wage drift. The latter acts as an error correcting factor which brings the wage outcome in line with its underlying determinants.
- 2) The adjustment is not instantaneous. Therefore, present wage drift is also influenced by the 'equilibrium error' deriving from the past.
- 3) Larger dispersion in the firms' stock of orders leads to higher wage drift *ceteris paribus*.

When z_{-1} is omitted, the other elasticities remain intact. This is as expected since experience in other contexts, eg Davidson, Hendry, Srba & Yeo (1978), suggests that 'error correction terms' are likely to be only weakly correlated with the other regressors, so that omission is unlikely to bias the coefficients on these other variables unduly. In the present context, the explanatory power of the regression is, however, substantially reduced (see equations (23) and (24) in Table 20 and (46) in Table 25).

Since the results above derive from specifications of cointegrating relations which may be controversial, four modified regressions were run. (The full set of results is in Tyrväinen, 1991). First, wedge restrictions¹⁹ were imposed which imply $\beta_1 = \beta_2 = -\beta_3$ both in the cointegrating relation and in the corresponding error correction equation. Secondly, we disqualified the unionization rate as a measure of union power. Thirdly, since the simultaneous inclusion of Q and K/N can be challenged, we estimated a relation with the growth of productivity as the driving force of real wages. This specification was estimated both including and excluding a proxy for union power.

The earlier results carry over to the new regressions. The new cointegrating relations are much like the earlier ones despite the decrease in their explanatory power. In particular, the exclusion of the unionization rate has a profound unfavourable effect. Modifications tend to increase autocorrelation in wage drift equations. Because of this, the lagged dependent variable was included when necessary. Otherwise, the results do not differ much from the earlier ones.

¹⁹ An extended discussion of various ways to define the wedge in the literature can be found Chapter 4 above.

Table 21. **Wage drift and the dispersion in the stock of orders among individual firms**

Estimation period: 1966–1989, except 1972–1989 in equations (31)–(32)
 Estimation method: OLS

Independent variables	Dependent variable: $W_d =$ wage drift							
	Private sector				Manufacturing industry			
	Wage drift equation in Table 20 with which the wage drift equation concerned is connected							
	(11)	(12)	(14)	(15)	(17)	(18)	(21)	(22)
	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
$\Delta \log(W^*) - \Delta \log(W_c) + z_{-1}$	–	.685 (7.19)	–	.728 (7.67)	–	.734 (7.08)	–	.822 (8.97)
$\Delta \log(W^*) - \Delta \log(W_c)$	.684 (7.45)	–	.721 (8.37)	–	.736 (7.28)	–	.825 (8.59)	–
z_{-1}	.700 (3.17)	–	.907 (5.07)	–	.788 (3.86)	–	.728 (2.73)	–
Dispersion	1.100 (2.13)	1.106 (2.16)	.860 (2.17)	.915 (2.27)	1.860 (2.72)	1.895 (2.79)	1.111 (2.53)	1.088 (2.48)
D89	.003 (3.46)	.003 (6.31)	.001 (1.23)	.002 (4.97)	.003 (2.52)	.003 (4.78)	.002 (1.70)	.001 (3.06)
Constant	–.012 (1.03)	–.013 (1.04)	–.008 (.947)	–.010 (1.13)	–.030 (2.02)	–.031 (2.08)	–.017 (1.51)	–.016 (1.49)
R^2	.674	.674	.766	.756	.758	.758	.822	.820
R^2C	.605	.625	.717	.720	.708	.721	.767	.781
DW	1.430	1.452	1.676	1.924	1.807	1.862	1.780	1.728
SE	.0096	.0094	.0081	.0081	.0097	.0095	.0084	.0082

D89 is a dummy which receives the value one in 1989.

Below the parameter estimates are shown White's heteroscedasticity adjusted t-ratios.
 The degrees of freedom correction has been made according to McKinnon & White (1985).

Let us now consider the behavioural hypotheses specified in section 2.2. First, the past target error plays a significant role, thus falsifying hypotheses (A1) and (B1), which indicate instantaneous adjustment. Second, the contract wage enters the wage drift equation significantly, which falsifies hypothesis (C), according to which central bargaining and wage drift are independent processes. The weak form of the error correction hypothesis (B2), which indicates gradual adjustment and inverse correlation between contracts and drift, is in accordance with the empirical results. Furthermore, since the data do not reject the restrictions $\rho_1 = \rho_2 = \rho_3$, the strong hypothesis of error correction (B3) receives support. Hypothesis (A2) will be discussed in the next section when the role of expectational errors is examined.

The discussion above makes it easy to understand the existence of opposite empirical results in the literature. If any of the key elements is missing, regressions become arbitrary. Two examples of inappropriate modelling are as follows: when wage drift is regressed on the change in contract wages only we discover a significant positive (!) elasticity in Finland. Because in this nonsense regression an I(0) variable is explained by an I(1) variable, any correlation is spurious. Augmenting this simplistic regression with the current price inflation – which is an I(1) variable – removes the positive effect of the contract wage on wage drift and a zero (!) elasticity results in this regression, which suffers severely from a bias related to omitted variables.

3.2 Expectational errors and vacancies

Relation (x) in section 2.3 specifies a relation between wage drift and expectational errors. In order to structure the investigation of this hypothesis let us examine the contributing factors.

It is highly likely that some determinants of the target wage can be predicted with smaller forecast errors than others. Tax schedules which are announced in advance probably belong to the former group. The factors which contribute most to the expectational errors could be as follows.

Pencavel (1985) and Holmlund (1985) stress the uncertainty concerning future prices. The level of activity is another straightforward candidate whereas inclusion of other variables entering (xii) in Appendix 2 would require quite arbitrary operationalization of expectations.

Thus, we approximate the driving expectational errors with $\Delta W^* - \Delta W^{*e} \approx [\Delta Z - \Delta Z^e] + [\Delta P - \Delta P^e]$. Above we proxied the demand shift factor Z with the output variable and do the same here.

Within the estimation period, the annual wage bargaining rounds usually start in the autumn after the publication of the government's economic forecast as incorporated in the budget proposal. Since this forecast appears to serve as a guideline for the discussion about the room for wage increases at the time when the unions set their wage claims, we take it as the point of reference. A prediction of GDP in volume terms is available whereas there are no explicit forecast of either producer prices or of the GDP deflator. We therefore approximate domestic inflation with consumer prices. To the extent that export and import prices move hand in hand, the size of the pie to be bargained over is not affected. If these prices do not move

conjointly, the size of the pie changes. Therefore, foreign trade prices are taken into account by including the terms of trade, P_x/P_m .

So, we approximate the expectational errors about the equilibrium wage with²⁰

$$\Delta W^* - \Delta W^{*e} \approx [\Delta Q - \Delta Q^e] + [\Delta P_c - \Delta P_c^e] + \omega * [P_x/P_m - P_x^e/P_m^e] \quad (\text{ix})$$

First, errors in expectations about output growth, consumer prices and terms of trade were included separately. The output variable was never significant. In addition to the deviation from the government forecast, static expectations and the second difference of GDP were experimented with. For consumer prices and the terms of trade, the government forecast appeared to be an adequate choice. Finally, we combined errors in price expectations into one variable, $P - P^e$, in accordance with footnote 20, which produces an approximation of output prices. As equations (33) and (36) in Table 22 show errors in price expectations have a clear-cut influence on the magnitude of wage drift. Although this is in accordance with the (weak) behavioural hypothesis (A2) introduced in Section 2, one must be cautious. Because the proxies for expectations are rough, more sophisticated models are clearly needed to confirm conclusions on this issue.

Interestingly, for the whole observation period the hypothesis of stationarity of the $P - P^e$ variable is rejected at the 1 per cent level although not at the 5 per cent level (see Blangiewicz et al., 1990). This result appears to be influenced by the fact that the government – partly deliberately – underestimated inflation for a number of years in a row in the early 1970s. This led to a systematically positive error of exceptional magnitude in inflation forecasts in 1971–1975. Before and after this period, forecast errors fluctuated around a zero mean more nicely. If the test starts from the middle of the decade, stationarity of the error in price forecasts is definitely accepted at the 1 per cent level as well.

²⁰ The National Accounts identities imply that $\Delta P_Q \approx \Delta P_D + \omega \cdot \Delta(P_x/P_m)$, where P_Q is the GDP deflator, P_D is the deflator of domestic demand and ω is the share of foreign trade in GDP.

Table 22. Wage drift, expectational errors and vacancies

Estimation period: 1969–1989^{a)}

Estimation method: OLS

Independent variables	Dependent variable: Wage drift					
	Private sector ^{b)}			Manufacturing industry		
	(33)	(34)	(35)	(36)	(37)	(38)
P – P ^c	.335 (4.68)	–	–	.319 (3.83)	–	–
Number of vacancies (in thousands)	–	.002 (4.54)	–	–	.004 (9.44)	–
Average duration of vacancies (weeks)	–	–	.017 (6.52)	–	–	.010 (8.04)
D80 ^{c)}	–	–	–.026 (6.58)	–	–	–.010 (4.28)
D88/D89 ^{c)}	–	–.022 (2.21)	–.012 (1.85)	–	–.012 (2.22)	–.011 (2.33)
Lagged dependent	.379 (3.21)	.440 (3.79)	–	.513 (4.17)	.563 (8.73)	.399 (4.64)
Constant	.019 (4.45)	.001 (0.18)	.010 (1.64)	.015 (3.07)	.001 (0.20)	–.001 (0.19)
R ²	.777	.780	.782	.744	.926	.909
R ² C	.752	.741	.743	.715	.913	.885
DW	1.282	1.998	2.181	2.240	2.153	2.462
SE	.007	.008	.008	.009	.005	.006

a) In equation (38) the estimation period is 1970–1989 because of the lack of data for 1969. Below parameter estimates are shown the t-ratios.

b) Disaggregation of vacancies between the public and private sectors is not available. Data for the whole economy are used in the equations for the private sector. For the manufacturing industry, the appropriate sector-specific data are used.

c) There is a discontinuity in the series for vacancies in 1988 when a new Employment Act made it obligatory for employers to publish all vacancies. This appears to have increased the number of vacancies by as much as one-third. To take account of this, we include a dummy D88 in equations (34) and (37). D88 receives the value one in 1988–1989 and is zero elsewhere. Two statistical changes in the Labour Force Survey influence the series for the average duration of vacancies. The first took place at the beginning of the 1980s and the second in 1989. To take account of this we include two dummies – D80 and D89 – in equations (35) and (38).

Holden (1989) assumes that losses of the firm due to a go-slow are smaller when inventories are large.²¹ His regressions indicate a significant negative correlation between the size of inventories and wage drift. If inventories become excessively large when product demand drops unexpectedly and *vice versa*, ie if there is a negative correlation between the size of inventories and the unexpected variation in product demand, Holden's results are well in accordance with our discussion on the role of expectational errors.

Model (vi) above relates wage drift to (changes in) the excess demand for labour. Variation in the number of vacancies is a good measure of this. So, we define the empirical model as a relation between vacancies (or, analogously, the duration of the unfilled vacancies; see the discussion in Schager, 1981) and wage drift:²²

$$W_d = f(V), \quad f' > 0. \quad (v')$$

Table 22 introduces the regressions, which explain 80–90 per cent of the variation in wage drift in 1969–1989 (equations (34)–(35) and (37)–(38)). Importantly, both vacancies and average duration of vacancies appear to be I(0) variables. As far as the latter is concerned the conclusion is slightly tentative for the aggregate private sector.

²¹ In Holden's model, employment is affected by the division of the actual wage into the contract wage and wage drift. This is because the threat point is defined in a similar fashion as in Holmlund & Skedinger 1990, ie if the bargaining breaks down, production goes on and the centrally negotiated wage contract defines the prevailing wage. In Holden's model, employment is decided before the local bargaining and, consequently, unions can buy more employment by being moderate in the central negotiations and then striving for higher wages in the local negotiations. 'The central union may comfortably concentrate on the employment level in central negotiations, while knowing that higher wages will be achieved through local wage bargaining' (Holden, 1988, p. 99). A similar conclusion is reached in a theoretical paper by Holmlund (1985). If the wage drift is flexible, ie it reacts quickly to realized excess demand, 'the union will lower the contractual wage in order to increase expected employment' (p. 231). These properties appear to contradict the profit-maximization assumption supposed to hold in both papers.

²² Hansen (1970) examines the matter in a neoclassical framework. Some of the submarkets are in the mode of excess demand for labour and some in the mode of excess supply of labour. Thus, both vacancies and unemployment enter – in the form of an U/V-curve – Hansen's macro equation for wage drift. However, unemployment figures have ceased to serve as good indicators for a number of well-known reasons. Therefore, we prefer to use vacancies as the sole indicator of labour market slack for two reasons. First, Schager (1981) indicates that the stocks of vacancies contain the same information on the labour market as stocks of job applicants. Second, since the centrally settled contract wage acts as a floor in local negotiations, we expect an asymmetry to prevail between the submarkets with excess supply and excess demand such that the former is not crucial for the analysis of aggregate wage drift.

In accordance with our presumptions, expectational errors and vacancies appear to be substitutes for each other rather than complements as explanatory variables. When they enter simultaneously, they both lose their significance in estimations for the private sector whereas in the manufacturing industry vacancies enter significantly but expectational errors non-significantly with an implausible negative sign. When the equations concerned were augmented with the change in the contract wage, no significant relation between the contract wage and wage drift was discernible. Finally, when 1) the number of vacancies and 2) $(P-P^e)$ were added to the error correction equations in Table 20, the related coefficients did not differ significantly from zero. Although these results are fully in accordance with the synthesis sketched above, which considers the three models to be descriptions of different phases of the causal chain rather than contradictory or complementary explanations of wage drift, we have to admit that the chain of evidence is not fully conclusive.

As a final attempt to verify whether any of the three models dominates, the J-test suggested by Davidson & McKinnon (1981) was performed. For this purpose, the predictions of equations (13), (33) and (34) were saved. The first is an ECM model, the second models the role of expectational errors and the third is a vacancy model. Then each model was re-estimated with the prediction of another model included as an auxiliary explanatory variable. If the prediction from another model enters significantly, the models cannot be discriminated according to the test. The t-ratios in Table 23 indicate that this is what happens in the present case. This is the final evidence confirming that each of the models contains relevant information. Of course, the differences in marginal p-values vaguely indicate that the ECM model (13) could be the 'strongest' and the expectation model (33) the 'weakest' of the three.²³

²³ Pehkonen & Viskari (1992) investigate 1) the model presented in this paper, 2) the model of Holmlund & Skedinger (1990), and 3) a Phillips-curve model augmented in a fashion commonly applied in the earlier literature. They estimate these models using data for the Finnish metal and engineering industry (with an observation period which is different from ours) and perform constancy tests as well as a selection of encompassing tests (Cox's test, Ericsson's IV test, Sargan's reduced-form test, the Joint model test). They conclude is that 'The performance of Tyrväinen's model was quite respectable: the model explained the data with remarkable precision, its post-sample properties were satisfactory and it variance-encompassed both the rival models. As far as the question of the relative performance of ... models is concerned, our answer is tentative but not inconclusive: as a whole the results lend support to the view that the superiority of wage bargaining models is not only theoretical but also empirical.'

Table 23.

The J-test

The prediction stemming from:	The maintained model:		
	ECM model (13)	Exp. err. model (33)	Vacancy model (34)
ECM model (13)	–	6.00 (0.00 %)	5.86 (0.00 %)
Exp. error model (33)	3.71 (0.08 %)	–	2.94 (0.42 %)
Vacancy model (34)	6.14 (0.00 %)	4.00 (0.04 %)	–

The table reports the t-values of the prediction of each model when added to a competing model as an auxiliary explanatory variable. Marginal p-values are in parentheses below the t-values.

4 Conclusions

The results can be summarized as follows:

- 1) In Finland, the time-series properties of the relevant wage series differ fundamentally. The properties of total nominal wages are similar to those of contract wages and different from those of wage drift. Since the last-mentioned has been stationary during the observation period, it cannot be an independent factor contributing to the long-run trend growth in wages.
- 2) Wage drift has a specific role in the adjustment process. It acts as an error correcting factor. The adjustment is not towards the competitive wage, however. The equilibrium is defined by the bargaining process and it is influenced by the existence of real wage resistance. Since the adjustment is not instantaneous, current wage drift is also influenced by 'equilibrium errors' stemming from the past. Additionally, a robust inverse correlation between contract wages and wage drift was detected.
- 3) Wage drift is closely related to the excess demand for labour.

- 4) If the dispersion of economic prospects faced by firms – measured by the standard deviation of the stock of orders – is large, wage drift tends to be larger than otherwise *ceteris paribus*.
- 5) The magnitude of wage drift appears to vary in accordance with the magnitude of expectational errors concerning the inflation rate.
- 6) The fact that wage drift has consistently been positive is as expected, since uncertainty about the state of the world which will prevail during the contract period is always larger *ex ante*, ie at the time the contract wage is settled.

A vital policy implication concerns the role of the government as a partner seeking to pave the way for moderate wage contracts. In Finland, the procedure has typically been as follows. Trade unions are requested to approve a moderate wage contract (with the result: $W_c \downarrow$). The government then backs the pact with expansive policy measures (with the result: $W^* \uparrow$). Finally, an increase in wage drift starts to undo the desired wage moderation. In the light of the analysis above, this is as expected since government intervention has actually increased the gap $W^* - W_c$, which is the driving force of wage drift.

In one respect, institutions – centralized bargaining – do not appear to add much to the determination of wages. For example, Jackman (1990) points to rather similar wage paths in countries with centralized and decentralized bargaining. But in another respect institutions may matter a lot. This is especially so where the economy has moved off course or serious imbalances are about to emerge. In our model, this refers to a sudden drop in W^* . In these circumstances, synchronized contracts and centralized wage setting offer an opportunity for a discrete adjustment of the aggregate wage level.

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Appendix 1 to Chapter 5

Wage formation in Finland: The case of the paper industry

This section describes how a central agreement is implemented and how actual wages are generated in the paper industry in Finland. As will be seen, bargaining influences wages at all levels of the process. Arguments according to which wage drift primarily represents the competitive part of wage determination are not fully in accordance with actual processes.

The industry and the institutions

In Finland, the paper industry employs some 40 000 people, which is one-fifth less than in the middle of the 1970s. The share of the paper industry in the total manufacturing workforce has been quite stable at just under 10 per cent. Its share of the aggregate output of the economy has been around 15 per cent, with cyclical variation larger than in most other industries. The paper industry accounted for half of the country's total exports in the middle of the 1960s. By the early 1980s, this share had dropped to less than 30 per cent, at which level it has remained in most years since then.

Roughly 80 per cent of all employees in the paper industry are blue-collar workers. In practice, the industry is fully unionized. The branch serves as a kind of wage leader and the Central Union of Paper Workers has been the first to settle in several wage rounds. The average earnings of male workers in the paper industry are the highest among manual workers, some 10–15 per cent above the average wage level. The gap increased considerably in the 1980s.

The annual average change in contract wages in the paper industry was 6.2 per cent in 1975–1986. This is almost identical with the figure for the aggregate manufacturing industry. However, average wage drift of 5.0 per cent per annum is more than half percentage point above the average figure for manufacturing. Wage drift fluctuated slightly less than in the manufacturing industry on average (Pehkonen, 1990).

In wage negotiations, firms are represented by the Confederation of Paper and Pulp Industry Employers (Metsäteollisuuden työnantaja-liitto). The Central Union of Paper Workers has 50 employees, half of

whom permanently travel around the country visiting local unions. There are 74 local unions, each of which has its own chief shop steward, who is elected by union members. All the chief shop stewards in the paper industry receive remuneration but less than half of them work full-time. In addition, there are a large number of part-time shop stewards and deputy shop stewards.

The chief shop steward represents the local union in bargaining with the firm. He is informed about wages in other firms in the industry. The chief shop stewards and chairmen of the local unions hold regular national conferences. Close contacts exist both between the local bodies and between the central union and local unions.

The central agreement

In Finland, wage bargaining is centralized and synchronized. In the period 1965–1994, there were only six years when no agreement was reached between the central organizations. In these wage rounds, however, collective agreements were reached at the industry level. The central agreement applied in the paper industry is between the Central Organization of Labour Unions (SAK) and the Central Confederation of Employers (STK).

The central agreement defines changes in wages either in markka terms or in percentages or as a combination of the two: eg X markkas per hour, but at least Z per cent. Some settlements have included an index clause or an earnings development guarantee. The latter ensures compensation for those branches where wage drift is (systematically) below that in other branches. In addition, a certain proportion of the wage sum, Y per cent, is often allocated to branch-specific arrangements.

Central agreements are short documents of just a few pages written in general terms. Hence, they only reveal their actual nature when applied at the industry level. The agreement of the central organizations is not binding on anybody before it has been approved at the industry level. The SAK has no authority to conclude agreements which are binding on member unions. Strikes are legal until the industry-specific contract has been signed.

The agreement for the industry

The collective agreement for the paper industry is reached between the industry-specific confederations of unions and employers. Where a central agreement exists, the negotiations concern its application. Even where there is no central agreement or the industry has deviated from it, industry-specific negotiations are usually a continuation of those held at central level. Hence, they are influenced by earlier negotiations at central level.

At the industry level, a large number of issues is bargained over. Even those which do not directly concern wages, almost without exception entail costs for the employer. Sector-specific agreements are difficult to appraise for those who are not specialist in of the field. For example, the collective agreement for the paper industry in 1986–1988 comprised 117 pages, which is by no means unusual as compared with other branches. In addition, the appendix includes several agreements determining the status and working conditions of shop stewards, sick pay etc.

Changes in the text of the contract often conceal pay rises which exceed the effect of the central agreement. Such arrangements are especially common when economic conditions are favourable. An example follows.

The paper industry generally has continuous three-shift work. Some years ago the parties agreed on a 'sauna bonus'. Under this arrangement, between Saturday 6 a.m. and Sunday 6 a.m., each worker received an extra payment for each hour work called a 'sauna-bonus' (!) which was 20 per cent (!) of the average hourly earnings in the paper industry. Extra payments of this kind have increasingly been defined in terms of percentages and, hence, their effect is permanent.

Bonuses and pay increases arising from changes in the text of the agreement are a major reason for the fact that the *ex post* statistics on contract wages and the *ax ante* approximations differ considerably. The outcome systematically exceeds the *ex ante* evaluations.

After the collective agreement for the paper industry has been signed, strikes are illegal.

The local level: the firm Myllykoski Oy²⁴

Myllykoski Oy is a highly specialized, advanced paper mill which exports 96–98 per cent of its output. It has 1 250 employees, 1 000 of whom are blue-collar workers. The size of the staff has decreased by one-third since the end of the 1970s.

Even when the collective agreement is in effect, negotiations on local issues go on almost continuously. In Myllykoski Oy there are some 100 (!) firm-specific bonuses. They concern special working conditions, production records, piecework pay etc. and most of them are settled annually. For each paper machine there are ten different categories of bonuses. If the wage contract implies an increase of 1 markka in the wage of the machineman, after local bonuses the increase exceeds 1.50 markkas. For lower-paid jobs the effect of local bonuses is approximately 20 per cent. The average effect appears to be around 33 per cent. This all comes on top of the bonuses implied by the collective agreement for the industry discussed above. In Myllykoski, the effect of local bonuses exceeds that of bonuses specified in the collective agreement.

Assessment of productivity gains has created problems in local negotiations. At the firm level, wage compensation is claimed for the full amount of productivity growth in the firm even though average productivity growth has already been accounted for in both the central and the industry-specific agreements. The union in Myllykoski Oy claimed more wages even when the number of employees was reduced: 'Part of the gains arising from the reduction in the wage costs must be shared with the workers'.

According to paragraph 11 of the collective agreement for the paper industry, 'if there are fundamental changes in the conditions on the basis of which wages have been agreed upon, new wages will be negotiated locally. The aim is to reach agreement on adjustment of wages and other conditions before a new working arrangement is introduced. The negotiations are to be started without unnecessary delay and if no agreement is reached locally, the issue will be settled by the industry confederations, if possible already before the new working arrangement takes effect. If the confederations in the paper industry do not reach unanimity, the case will be referred to the central confederations'. It is not surprising that this expression has led

²⁴ This information was obtained during a visit to Myllykoski Oy from 7 to 9 November 1990. The visit was arranged by the Confederation of the Finnish Industries. I am grateful for having the opportunity to talk with the head of personnel, the chief shop steward of the mill and the chairman of the local union.

to wage claims on miscellaneous grounds. For example, in the spring of 1990, the whole Myllykoski paper mill was at a standstill for five days because one group of workers required more pay when, at the request of foreign customers, stronger core board was introduced in paper rolls. The employer contends that more wages are claimed even when new equipment makes the work easier: 'Where it now suffices to push a button where before a knob had to be turned, they demand higher pay'. According to an anecdote, a union representative has defined a fundamental change in working conditions as a change which can be noticed.

The expression 'the aim is to reach agreement...' has also led to confusion as far as the legality of strikes is concerned. In Myllykoski, for instance, a modernized paper machine was at a standstill for several weeks because of a dispute concerning the introduction of a new cutting machine. Unions consider that they have right to prevent the introduction of an investment if the relevant wage arrangements have not been settled. Employers argue the opposite. There is no prejudgement by the labour court. Despite several disputes the employer confederation has not taken any cases to court.

In Myllykoski Oy, both the employer and the union confirm that the employer does not have any wage policy that is not covered by the bargaining process. There are no personal incentive bonuses. Behaviour according to the efficiency wage hypothesis does not therefore appear to be observed in this particular Finnish enterprise.

All in all, the local union agrees on the local pay rise with the employer as an outcome of local bargaining. The initiative usually comes from one group (department) and the shop steward of the department presents the claim to the head of the department. In the next stage, the chief shop steward negotiates with the firm's head of personnel. If the issue is not settled, it is then passed over to the industry confederations. The final stage is that between the central confederations, the SAK and STK. For example, in 1989, 60 cases in the paper industry were passed from local level to the industry confederations. Seven (!) of these concerned Myllykoski Oy. Not a single case was passed over to the central level.

Appendix 2 to Chapter 5

Modelling the equilibrium wage

In the derivation of the target wage, W^* , – where an asterisk, *, refers to the 'equilibrium' or 'target' level – the 'right-to-manage' model is applied, which indicates that the wage is determined according to a Nash bargaining solution

$$\max_W (U - U_0)^\theta (\Pi - \Pi_0)^{1-\theta} \quad \text{s.t. } \Pi_N = 0, \quad (\text{xi})$$

where $U(\cdot)$ is the union's welfare and $\Pi(\cdot)$ is the firm's profit when an agreement is reached. The union's fall-back utility, U_0 , is identified as the utility available to union members when no agreement is reached (see Binmore et al., 1986). Correspondingly, the firm's fall-back utility, Π_0 , represents profits when no agreement is reached. We specify Π_0 as the constant cost of production, $C = rK$. The parameter θ is a measure of the union's bargaining power.

The union maximizes an iso-elastic utility function

$$U = u(W(1-\tau)/P_c) + v(N),$$

where P_c = consumer prices, τ = income taxes, N = employment and $u' > 0$, $u'' < 0$, $u''' > 0$, $v' > 0$, $v'' < 0$, $v''' > 0$.

There are n identical firms with a constant returns to scale production function, $F(N, m, \underline{K})$, with three inputs, labour (N), raw materials (m) and capital (\underline{K}), which is considered predetermined. The firm maximizes profits, which are defined as the difference between sales revenues and production costs:

$$\Pi = \hat{P}[ZF(N, m, \underline{K})]F(N, m, \underline{K}) - W(1+s)N - P_m m - C,$$

where $\hat{Q} = \hat{P}^{-1}(P)Z^{-1} \equiv D(P)Z$ is a downward sloping demand curve of the separable form introduced by Nickell (1978, p. 21). Z is a parameter describing the position of the demand curve faced by the firm and \hat{P} is the endogenous producer price of the firm, P represents competitors' producer prices, s is the payroll tax, P_m is the price of

raw materials (incl. energy) and \hat{Q} is the endogenous output of the firm.

In Finland, strikes are illegal once an agreement for an industry has been approved. However, the fines payable have been negligible and strikes have been common in connection with local negotiations. As far as the number of wildcat strikes is concerned, Finland is among the top countries whereas go-slows are rare.²⁵ Hence, the appropriate specification of the disagreement point refers to a strike in connection with both central and local bargaining. So, U_0 depends on (real) strike allowances.

Union power can be proxied by union density (UNION), as in Chapters 3 and 4. Union militancy may also be affected by the prevailing rate of unemployment (UR) as in Andersen & Risager (1991), because the expected utility of the union during a labour dispute may partly depend on the possibility of its members to find a job in another firm. So, we assume that $\theta = \theta(\text{UNION}, \text{UR})$, $\theta_1 > 0$, $\theta_2 < 0$. After recognising that there is no coherent series for strike allowances (see Tyrväinen, 1989), the log linear equation for the level of the equilibrium wage becomes:

$$\begin{aligned} \log W_t^* = & \log P_{c,t} + \beta_1 \log(1+s)_t + \beta_2 \log(1-\tau)_t + \beta_3 \log(P_c/P)_t \\ & + \beta_4 \log(P_m/P)_t + \beta_5 \log Z_t + \beta_6 \log(K/N)_t \\ & + \beta_7 \log(\text{UNION}_t) + \beta_8 \log(\text{UR}_t) + \text{constant} + \varepsilon_{w,t}, \end{aligned} \quad (\text{xii})$$

where $\varepsilon_{w,t} = W_t - W_t^*$ is the residual of the equation and $\beta_1 < 0$, $\beta_2 < 0$, $\beta_3 > 0$, (probably) $\beta_4 < 0$, $\beta_5 > 0$, $\beta_6 > 0$, $\beta_7 > 0$, $\beta_8 < 0$.

If the empirical counterpart of equation (xii) produces a stationary error term, the set of series concerned is cointegrated.²⁶ In that case, OLS is an appropriate estimation method for the cointegrating regression, which is run in levels with no lags in any of the variables.

Having assumed monopolistic competition in the product market, a variable (Z) is required which determines the location of the downward sloping demand curve. Pencavel & Holmlund (1988) use household disposable income for this purpose. However, income is by

²⁵ In 1975–1989, 90 per cent of all labour disputes were strikes. The share of go-slows and overtime bans was about 1 per cent each.

²⁶ An ADF test indicates that there are both series which are I(1) and I(2). For a discussion on this issue, see Chapters 3 and 4.

and large a product of wages, on the one hand, and employment, on the other. Moreover, its third key component, the income tax rate, is one of the right-hand-side variables. In contrast, in so far as instantaneous adjustment is assumed to take place in the product market, inventories are abstracted away and aggregate output (Q) could be a suitable proxy for aggregate demand. In the long run, it is straightforward to expect that output and demand grow hand in hand. So, we prefer to work with the output variable, though Chapter 3 above indicates that the results are not sensitive to how the demand shift variable is proxied or instrumented.

In conditions of imperfect competition, the endogenous pricing decision of the firm is influenced by competitors' prices. At the aggregate level, the counterpart of competitors' prices is the aggregate producer price of the industry concerned. A test of the Granger-causality does not reject models which assume producer prices and output as exogenous with respect to wages.²⁷

The cointegrating regressions²⁸ are shown in Table 24 in Appendix 3. As there is no dynamics in the cointegrating regressions, autocorrelation problems can be expected (see Hendry, 1986). Hence, in the literature the potentially biased t-statistics have simply been left out. This is not considered a problem as the parameter estimates are 'superconsistent' and converge towards the 'real values' 'quickly' (Engle & Granger, 1987). This property has been confirmed more recently by Phillips & Hansen (1990). Since, however, autocorrelation does not appear to be particularly severe in our cointegrating regressions, we choose to include the t-statistics as they give an indication of how precisely the coefficients are defined.

In 1967, the Finnish markka was devalued by almost 30 per cent. Earlier evidence (see eg Chapter 3 above) indicates that this led to disturbances in economic processes which are not easy to capture by econometric methods. This concerns especially the export sector, ie manufacturing industry. To see whether the coefficient estimates are sensitive to the exclusion or inclusion of the years following the devaluation, different sample periods were experimented with. This reasoning carries over to the analysis of wage drift equations for the manufacturing industry.

²⁷ Similar results have been reported for Sweden in Pencavel & Holmlund (1988) and for Denmark in Andersen & Risager (1990).

²⁸ For the specific reasons discussed in Chapter 3, we prefer to use the Consumer Price Index rather than the private consumption deflator as a measure of consumer prices.

The commonly applied tests confirm the cointegration property of the relevant relations. The signs of all coefficients are as expected. Parameter estimates are of plausible magnitude and in accordance with other studies. In addition, they are close to those reported in Tyrväinen (1988), in which the specifications were slightly different and the estimations were carried out on quarterly data over an observation period which was five years shorter.²⁹ The similarity to the relations estimated with the Johansen method and reported in Chapter 4 are also clear-cut.

²⁹ The set of right-hand-side variables in Table 24 is large. Chapter 3 above reports similar equations estimated on quarterly basis. The number of independent variables is the same (8–10) but the number of observations is 100 rather than 25 as in the annual regressions here. There are no major differences in results. So, we are quite confident about the robustness of our cointegrating equations.

Appendix 3 to Chapter 5

Estimation results

Table 24. **Cointegrating relations: the equilibrium wage**

Estimation period: 1965–1989, except 1968–1989 in relations (6)–(7) and 1971–1989 in relations (8)–(9)

Estimation method: OLS

Independent variables	Dependent variable: log (W/CPI)								
	Private sector		Manufacturing industry						
	*	*	*				*	*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
log(CPI/P)	-.400 (2.63)	-.219 (1.38)	-.323 (3.17)	-.196 (1.54)	-.513 (2.83)	-.379 (3.96)	-.177 (2.29)	-.454 (5.45)	-.206 (1.61)
log(1- τ)	-.516 (3.96)	-.560 (4.74)	-4.70 (3.95)	-.533 (4.41)	-.291 (1.35)	-.346 (2.93)	-.421 (5.40)	-.328 (3.34)	-.407 (4.55)
log(1+s)	-.840 (1.80)	-.717 (1.70)	-.191 (0.50)	-.016 (0.04)	-1.009 (1.49)	-.627 (1.35)	-.301 (0.98)	-.682 (1.67)	-.386 (1.05)
log(P _m /P)	-.183 (6.87)	-.148 (5.17)	-.177 (5.55)	-.129 (2.99)	-.124 (2.17)	-.203 (5.66)	-.112 (3.60)	-.147 (3.81)	-.116 (3.32)
log(Q)	.469 (7.98)	.369 (5.36)	.328 (6.53)	.273 (4.58)	- (-)	.304 (6.47)	.198 (5.11)	.235 (5.09)	.198 (4.74)
log(UNION)	.148 (3.59)	.174 (4.49)	.201 (3.63)	.214 (3.98)	.407 (4.80)	.397 (2.71)	.422 (4.45)	.246 (1.65)	.419 (2.87)
log(K/N)	.311 (2.41)	.394 (3.25)	.302 (3.78)	.311 (4.05)	.667 (6.30)	2.92 (3.55)	.332 (6.16)	.475 (4.79)	.346 (3.46)
log(UR)	- (-)	-.034 (2.22)	- (-)	-.025 (1.56)	- (-)	- (-)	-.048 (4.38)	- (-)	-.044 (2.34)
DSTAB	-.034 (2.75)	-.032 (2.92)	-.042 (2.75)	-.039 (2.71)	-.063 (2.30)	-.025 (1.31)	-.022 (1.78)	- (-)	- (-)
Constant	-8.448 (21.48)	-7.746 (16.39)	-6.456 (16.27)	-6.055 (11.87)	-4.503 (9.29)	-5.921 (10.28)	-5.025 (11.85)	-6.151 (12.05)	-5.087 (8.12)
R ²	.999	.999	.998	.998	.993	.998	.999	.997	.998
R ² C	.998	.998	.997	.997	.990	.996	.998	.995	.996
ADF	5.10	6.59	6.73	7.65	4.22	5.15	6.31	4.73	5.49
CRDW	2.063	2.345	2.327	2.482	1.754	2.004	2.518	1.981	2.430
SE	.0136	.0122	.0145	0.0139	.0270	.0131	.0084	.0108	.0091

CPI = consumer price index, P = producer prices, P_m = import prices of raw materials and semifinished products (incl. energy), s = employers' social security contribution rate, τ = marginal rate of income taxes, Q = output, K = capital stock, N = number of persons employed, UNION = M/N = unionization rate, where M = the number of union members, UR = unemployment rate, DSTAB is an annual stabilization policy dummy, which has been constructed from quarterly dummies which receive the value one in 1968Q2–1970Q4 and are 0 elsewhere.

Below the parameter estimates are shown the t-ratios. Preferred regressions have been marked with an asterisk, *.

Table 25. **Wage drift**

Estimation period: 1966–1989, except 1969–1989 in equation (44) and 1972–1989 in equation (45)
 Estimation method: OLS

Independent variables	Dependent variable: W_d = wage drift					
	Private sector		Manufacturing industry			
	The cointegrating wage relation in Table 24 with which the wage drift equation concerned is connected					Lagged error term omitted
	(1)	(4)	(3)	(7)	(8)	
	(41)	(42)	(43)	(44)	(45)	(46)
$\Delta \log(W_c)$	-.545 (4.69)	-.403 (2.56)	-.705 (3.99)	-.622 (4.10)	-.599 (3.40)	-.663 (4.21)
z_{-1}	.634 (5.53)	.496 (3.78)	.583 (2.51)	.829 (2.59)	.735 (3.32)	xxx
$\Delta \log(W/W_P)$	-.204 (1.41)	-.230 (1.37)	-.246 (1.75)	-.500 (2.87)	-.386 (2.28)	-
$\Delta \log(P_c)$	.649 (8.95)	.514 (4.46)	.819 (7.54)	.818 (6.25)	.841 (6.30)	.710 (7.60)
$\Delta \log(P_m/P)$	-.078 (5.17)	-.052 (2.73)	-.097 (3.85)	-.089 (3.41)	-.106 (4.22)	-.053 (2.39)
$\Delta \log(CPI/P)$	-.021 (0.40)	-.051 (0.79)	-	-.017 (0.35)	-.126 (2.59)	-
$\Delta \log(1-\tau)$	-.309 (3.61)	-.289 (3.88)	-.512 (6.31)	-.348 (4.77)	-.372 (5.06)	-.483 (6.79)
$\Delta \log(1+s)$	-.177 (1.34)	-.108 (0.61)	-	-	-.287 (1.11)	-
$\Delta \log(Q)$	.464 (6.98)	.291 (2.74)	.322 (4.61)	.222 (2.30)	.317 (3.45)	.273 (4.54)
$\Delta \log(UNION)$	.054 (3.27)	.033 (1.40)	.086 (2.31)	.203 (3.23)	.048 (0.98)	.013 (0.46)
$\Delta \log(K/N)$	.397 (5.83)	.445 (5.28)	.174 (2.62)	.335 (4.69)	.400 (4.72)	.155 (2.01)
$\Delta \log(DSTAB)$	-.030 (9.12)	-.019 (3.94)	-.034 (4.47)	-.014 (1.65)	-	-.023 (3.60)
$\Delta \log(UR)$	-	-.016 (1.78)	-	-.043 (3.38)	-	-
D89	.003 (1.52)	.003 (1.09)	.010 (4.53)	.001 (0.27)	.006 (3.75)	.012 (6.69)
Constant	-.013 (2.70)	-.005 (0.91)	-.009 (1.32)	-.011 (1.26)	-.020 (2.55)	-.001 (0.08)
R^2	.938	.916	.906	.940	.941	.881
R^2C	.857	.785	.819	.830	.801	.804
DW	1.851	2.061	2.092	1.987	1.838	2.255
SE	.0058	.0071	.0077	.0071	.0078	.0080

W = average wages, W_c = contract wages, W_1 = level of earnings index, z_{-1} is the target error stemming from the previous period, P_c = consumer prices, P = producer prices, P_m = import prices of raw materials and semifinished products (incl. energy), s = employers' social security contribution rate, τ = marginal rate of income taxes, Q = output, $UNION$ = unionization rate, K = capital stock, N = number of employed persons, UR = unemployment rate, $DSTAB$ is an annual stabilization policy dummy, which has been constructed from quarterly dummies which receive the value one in 1968Q2–1970Q4 and are 0 elsewhere, $D89$ is a dummy which receives the value of one in 1989.

Below the parameter estimates are shown White's heteroscedasticity adjusted t-ratios.

Table 26.

Cointegrating relations: the equilibrium wage, private sector

Estimation period: 1965–1989

Estimation method: OLS

Independent variables	Dependent variable: log (W/CPI)			
	(39)	(40)	(41)	(42)
log(WEDGE)	-.411 (6.75)	-.602 (11.78)	-.247 (2.91)	-.133 (1.88)
log(P _m /P)	-.167 (5.97)	-.167 (5.32)	-.071 (1.52)	-.125 (3.27)
log(Q)	.410 (6.16)	.518 (9.24)	-	-
log(UNION)	.154 (4.10)	-	-	.176 (4.01)
log(K/N)	.399 (4.60)	.374 (5.79)	-	-
log(Q/H)	-	-	.872 (28.73)	.749 (19.43)
log(UR)	-.022 (1.51)	-	-	-
DSTAB	-.027 (2.37)	-	-	-
Constant	-8.212 (18.99)	-9.514 (28.54)	-10.952 (36.19)	-9.474 (21.77)
R ²	.999	.997	.993	.996
R ² C	.999	.996	.992	.995
DW	1.982	1.634	1.267	2.079
SE	.0130	.0172	.0257	.0196

P = producer prices, P_m = import prices of raw materials and semifinished products (incl. energy), Q = output, H = hours worked, K = capital stock, N = number of persons employed, UNION = unionization rate, UR = unemployment rate, DSTAB is an annual stabilization policy dummy which has been constructed from quarterly dummies which receive the value one in 1968Q2–1970Q4 and are 0 elsewhere.

Below the parameter estimates are shown the t-ratios.

Table 27. Wage drift: private sector

Estimation period: 1966–1989

Estimation method: OLS

Independent variables	Dependent variable: W_t = wage drift											
	The equilibrium wage relation in Table 26 with which the wage drift equation concerned is connected											
	(39)				(40)				(42)			
	(43)	(44)	(45)	(46)	(47)	(48)	(49)	(50)	(51)	(52)	(53)	(54)
$\Delta \log(W^*) - \Delta \log(W_c) + z_{-1}$	-	-	-	.518 (7.58)	-	-	-	.367 (3.18)	-	-	-	.245 (2.12)
$\Delta \log(W^*) - \Delta \log(W_c)$	-	-	.473 (6.61)	-	-	-	.363 (2.88)	-	-	-	.242 (2.27)	-
$\Delta \log(W^*)$	-	.471 (6.02)	-	-	-	.356 (2.81)	-	-	-	.228 (1.96)	-	-
$\Delta \log(W_c)$	-.283 (1.95)	-.467 (3.59)	-	-	-.230 (1.20)	-.294 (1.56)	-	-	-.381 (2.40)	-.171 (0.80)	-	-
z_{-1}	.460 (4.14)	.726 (6.37)	.727 (6.66)	-	.371 (3.72)	.398 (3.95)	.391 (3.61)	-	.324 (2.99)	.329 (2.21)	.326 (2.19)	-
$\Delta \log(W/W_t)$	-.217 (1.35)	-	-	-	-.098 (0.53)	-	-	-	-.136 (0.81)	-	-	-
$\Delta \log(\text{CPI})$	.421 (4.56)	-	-	-	.375 (2.22)	-	-	-	.238 (2.35)	-	-	-
$\Delta \log(P_m/P)$	-.063 (3.22)	-	-	-	-.066 (2.19)	-	-	-	-	-	-	-
$\Delta \log(\text{WEDGE})$	-.149 (5.55)	-	-	-	-.148 (2.69)	-	-	-	-.120 (1.98)	-	-	-
$\Delta \log(Q)$	.296 (3.59)	-	-	-	.412 (3.74)	-	-	-	-	-	-	-
$\Delta \log(\text{UNION})$	.017 (0.74)	-	-	-	-	-	-	-	-	-	-	-
$\Delta \log(K/N)$	.575 (7.70)	-	-	-	.389 (3.06)	-	-	-	-	-	-	-
$\Delta \log(Q/H)$	-	-	-	-	-	-	-	-	.244 (4.71)	-	-	-
$\Delta \log(\text{DSTAB})$	-.017 (4.27)	-	-	-	-	-	-	-	-	-	-	-
$\Delta \log(\text{UR})$	-.012 (1.63)	-	-	-	-	-	-	-	-	-	-	-
$W_{d,-1}$	-	.441 (5.18)	.445 (6.87)	.406 (5.64)	.362 (2.10)	.481 (4.11)	.535 (5.21)	.530 (5.47)	.582 (4.31)	.457 (2.38)	.501 (2.37)	.493 (2.26)
Constant	-.007 (1.65)	.004 (1.12)	.004 (1.26)	.003 (1.01)	-.017 (3.24)	.002 (0.74)	.004 (1.10)	.004 (1.08)	.014 (2.67)	.008 (1.14)	.010 (1.88)	.010 (1.95)
R^2	.918	.837	.837	.805	.819	.722	.715	.715	.801	.607	.602	.592
R^2C	.843	.802	.812	.786	.703	.663	.673	.687	.713	.524	.542	.553
DW	1.769	1.609	1.603	2.004	2.426	1.675	1.615	1.673	1.964	1.643	1.623	1.714
SE	.0061	.0068	.0066	.0071	.0083	.0089	.0088	.0086	.0082	.0106	.0104	.0102

W = average wages, W_c = contract wages, W_t = level of earnings index, CPI = consumer prices, P = producer prices, P_m = import prices of raw materials and semifinished products (incl. energy), Q = output, UNION = unionization rate, K = capital stock, N = number of employed persons, UR = unemployment rate, DSTAB is an annual stabilization policy dummy, which has been constructed from quarterly dummies which receive the value one in 1968Q2–1970Q4 and are 0 elsewhere, D89 is a dummy which receives the value one in 1989.

Below the parameter estimates are shown White's heteroscedasticity adjusted t-ratios.

Appendix 4 to Chapter 5

Dispersion and Wage Drift

This section reports the methods applied in evaluating the impact of dispersion of the economic conditions prevailing in the firm sector. Six alternative measures, all calculated from the Business Survey of the Confederation of Finnish Industries, were experimented with. The dispersion was measured in terms of standard deviation in accordance with Jalas (1981). As the normal distribution is assumed in this procedure, dummies for double-peaked annual observations were added where necessary. The annual series for the manufacturing industry (excluding construction) were generated from quarterly data on answers (three alternatives) to the following questions:

I	As compared with the previous year, the volume of output of the firm is	larger <input type="checkbox"/>	the same <input type="checkbox"/>	smaller <input type="checkbox"/>
II	As compared with the previous year, the inventories of the firm are	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
III	As compared with the previous year, the number of employees is	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IV	Do you consider the current stock of orders of the firm to be	large <input type="checkbox"/>	normal <input type="checkbox"/>	small <input type="checkbox"/>
V	Do you expect the cyclical position of the firm in the near future to	improve <input type="checkbox"/>	remain unchanged <input type="checkbox"/>	worsen <input type="checkbox"/>
VI	Do you expect the number of employees in the next quarter to be	larger <input type="checkbox"/>	the same <input type="checkbox"/>	smaller <input type="checkbox"/>

Questions I–III are backward looking. Question IV refers to the current situation although it has a clear-cut interpretation as a proxy for short-run production expectations. Questions V–VI are forward looking by nature. Here, however, problems arise because annual data have been generated by taking the annual average of expectations concerning one quarter ahead. So, estimations with series based on V and VI must be treated with special caution.

Among the backward-looking questions (I–III), the share of double-peaked annual observations is 10–25 per cent. In addition, the annual share of the answer 'the same' is permanently below 50 per

cent (in I and III below 40 per cent). In the other three cases, there are no double-peaked observations. In the forward- looking cases V and VI, the share of the answers 'the same/unchanged' is always above 50 per cent. So, expectations are centred on the neutral alternative.

With backward-looking measures (I–III), no significant role for dispersion was generally found in wage drift equations. There is, however, one exception. When the estimation period is shorter (1972–1989), as in equations (20)–(21) in Table 20, alternative III – employment compared with the previous year – appeared to play a role in the manufacturing industry. A positive coefficient of the standard deviation is significantly different from zero at the 5 per cent risk level. The positive coefficient of the dummy for double-peaked annual observations does not quite reach the 5 per cent significance level but is very close.

The most successful attempts to assess the role of dispersion use responses concerning order books. A positive and significant coefficient was found in all cases when the equations in Table 20 were augmented to include a measure of the relevant standard deviation (see Table 21). In addition, the statistical properties of the equations were better and only minor changes occurred in other coefficients. This appears to indicate that variation in dispersion explains part of the variation which was unexplained by our basic model.

As noted above, calculation of annual expectations based on series V–VI was somewhat arbitrary. In this light it is not worrying that a significant role was not found in general. However, when the wage drift equation (20) for the manufacturing industry in Table 20 was augmented to include a dispersion measure referring to employment expectations (VI), a highly significant positive coefficient was discovered.

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