

WORKING PAPERS IN ECONOMICS

A TARGET-WAGE DILEMMA:

SOME CONSEQUENCES OF INCOMPLETE INFORMATION

by

Flora Gill

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CONTENTS

A TARGET-WAGE DILEMMA:
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	PAGE
I. INTRODUCTION	1
II. MODELING THE UNION AS A 'WAGE-SETTER'	
(a) Whose objective function	4
(b) Imperfectly known demand constraint	7
III. FORMAL ANALYSIS	10
(a) Choice under certainty	11
(b) Choice under uncertainty	12
(c) Choice under uncertainty with a normally distributed error	18
IV. DISCUSSION	25
V. CONCLUSION	28
REFERENCES	31
APPENDIX AND FIGURES	33
ADDENDUM	

I. Introduction

It has been observed recently that "despite numerous attempts at modelling, there is no universally accepted model of union goals or behaviour" (Hirsch and Addison, 1986, p.10). Nevertheless, as the same authors point out, there appears to be a core of assumptions which is rather widely shared amongst labour economists. These assumptions are: (a) that union objectives may be represented by an objective function which involves strictly convex indifference curves between wage and employment levels over the entire choice set, and (b) that the union seeks to maximize this objective function subject to a downward sloping demand curve for labour (*ibid.* p.10).

These core assumptions are also present in a number of influential studies published recently (e.g. Farber, 1978; Pencavel & Dertouzos, 1981) which share the conclusion that wage and employment bargaining-outcomes are "on the demand curve". If, as is done in some of these models, the union is deemed a wage-setter operating under conditions of perfect information, the conclusion follows that any resulting employment is knowingly chosen by the union which is only too happy to generate unemployment amongst its members provided the wage is high enough.

However, when the analysis treats the boundary of the opportunity set as something which is only known imperfectly, then some, or even all, of the wage-related employment loss incurred by the wage-setting

union may be an *ex-post* phenomenon diverging from its *ex-ante* chosen level to an extent depending on the error involved in 'estimating' the demand curve.

The model developed in the present paper is guided by a specific methodological objective. It seeks to highlight the identification problem faced when we try to infer a union's objective function from empirical data relating wage changes to *ex-post* changes in employment levels. This identification problem is exacerbated by the fact that the analysis deals with the outcomes of choices which are made under conditions of incomplete information. Empirical observation of a negative correlations between changes in wage and employment levels are often interpreted as reflecting preference ordering under *conditions of certainty*. Such negative correlations, the present paper argues, do not necessarily reflect the existence of convex indifference curves which permit trade-offs between wages and employment under certainty. The inevitable lack of complete knowledge on the boundary of the opportunity set introduces a new perspective into the question of the admissibility of trade-offs between changes in wage and employment levels. Whereas the latter may be ruled out as a matter of free choice under certainty, this may no longer be viable under incomplete information. The bargaining unit which under conditions of certainty will seek wage increases only when they can be attained without reduction in the number of its fully employed members may nevertheless accept the risk of triggering employment loss as a cost which must be incurred when information is incomplete. Since there may always be a finite chance that any price increase will subsequently be regrettable, refusal to undertake such costs may doom the unit to a stalemate. Furthermore, a bargaining unit which translates its preference for employment maintenance under complete information into a refusal to undertake any risk of employment loss under conditions of incomplete information will be an easy prey for its adversary. Strategic considerations are, therefore, likely to preclude such an extreme form of risk aversion.

The formal analysis explores the consequences of incomple-

information for wage targets selected by a 'monopoly union'¹ with local lexicographic ordering of preferences in the sense that it prohibits the trading off of employment reductions (from the current level) for wage increases when choice is made under certainty. Accepting risk of triggering employment loss under conditions of uncertainty, it adopts maximization of expected utility as its decision rule. In the first instance, attention is focused on a union which seeks to appropriate all improvements in demand conditions in the form of higher wages for the 'insiders' (whilst, as discussed above, it is reluctant to knowingly inflict loss of employment on these 'insiders'). The analysis is subsequently relaxed to permit a more conventional description of preference ordering over the subset of the choice-set containing wage and employment levels which are both above the prevailing levels.

These are explored for two specifications of the random error faced by the wage-setter when 'estimating' the demand constraint: (i) a random error with symmetric probability density function, and (ii) more specifically a normally distributed error. Attention is focused on two specific issues: (a) will the wage target selected by the union be on, below or above the estimated boundary of its opportunity set, and (b) how do changes in the perceived level of uncertainty impinge on the level of this wage.

The formal analysis yields the following propositions. First, when employers have discretionary power over employment levels, the selected wage is not likely to be on the estimated boundary of the

1. An increasing number of models have followed McDonald and Solow (1981) in modelling the situation where collective bargaining contracts bind both wages and employment levels. These so called 'efficient-bargains' models build on Leontief's (1946) analytical observation that contracts which fix both wages and employment permit the exhaustion of 'gains from trade'. These gains are not brought to their maximal level in an industrial environment which retains managerial discretion power over employment levels. The issue, however, remains contentious, with many (though not all) labor economists maintaining that management still maintains a significant degree of discretionary power over employment levels (e.g. Rees, 1977; Hayes, 1974; Bean, 1975).

opportunity-set.² Under most conceivable circumstances it will be an interior point, but the possibility of its being outside the estimated frontier cannot be excluded.

Second, the analytical results suggest that the relationship between the lack of confidence in the precision of the estimate and the value of the wage target is not monotonic - as confidence in the estimate decreases the selected wage, other things remaining equal, declines, but only up to a point. Beyond that critical threshold the wage target increases with further increases in uncertainty about the true location of the boundary of the opportunity set.

Finally, the paper yields the proposition that a discontinuity of ~~changes~~ in response to an (estimated) change in demand conditions

II. Modeling the Union as a 'Wage-setter'

(a) Whose objective function?

A widespread convention in the economic literature on trade union behaviour has been the treatment of the trade union as a collective entity. More recently there have been a number of studies which postulate strictly individualistic micro underpinnings for this objective function. The present paper refrains from following the latter path.

2. The argument, though, is different from that followed in McDonald and Solow's (1981) bargaining model.

These recent models of union behaviour involve either aggregation over self-centered individuals who share identical utility functions and uniform chances of being laid off (e.g. Farber, 1978), or the median voter approach with individuals who are homogenous with respect to preferences but heterogenous in terms of the probability of job loss (Oswald, 1984, 1985). These simplifications are necessary, because of the hurdles posed by the aggregation problem when seeking to explicitly build on microfoundations, but they are problematic. Farber's specification raises a problem which was addressed by Oswald's (1984) analysis. In reality formal (and informal) seniority clauses in industrial contracts generate different lay off probabilities for different workers within a given establishment. Moreover, for any given wage rate (with perfectly known aggregate demand as assumed by Farber) the group of workers can often be partitioned into two subsets, one involving workers with a probability of lay off of 1, the second with zero lay off probability. Consequently, if group behaviour is guided by strictly selfish individual utility functions then the selected wage should depend on the political strength of each of these two groups. Opting for the median voter rule, Oswald effectively suggests that the political balance is determined by an institutional commitment to a majority vote where each individual seeks to enforce the maximal wage which leaves his conditional lay off probability set at zero. Thus, the most senior 51 per cent of a group of workers vote to raise wages to the point where the remaining 49 per cent lose their jobs. The model is dynamically unstable, and this exposes the fact that the median voter model is poorly suited for the issue at hand. No collective institution except the most myopic will settle for the median voter rule when it is just a matter of time before everybody is on the loser's side.

We really know very little about the details of the processes by which unions select specific goals and strategies. Neither can we assume that all workers in all unions are always narrowly focused on their own individual welfare.

As Johnson reminds us, when describing the spectrum of trade unions in the US, there is a variety of types of unions ranging from

"gangster unions ... [to] uplift unions which pursue policies which promote the general welfare of the working class as opposed to the narrow interest of their members." - Johnson, 1985, p.196.

Different objective functions are needed to describe the preferences of such different types of unions; some of these at least will need to be founded on a conceptual framework that limits egocentricity and admits a more collective ethical disposition.

Social 'uplift' unions may be a great deal more employment-oriented (because of a concern for fellow men), whereas the 'gangster-unions' may be primarily wage-oriented unions striving to appropriate improved demand conditions for a small parochial group while disregarding the welfare of those outside the group.

These attitudes may also depend on whether the change in opportunities involves a rise or contraction of demand. For example, a bargaining unit may be employment-oriented when demand increases but wage oriented when demand contracts, or vice versa.

The 'orientation' may also depend on the size of the bargaining unit. A peak union at the national level is likely to place a high premium on employment expansion in the upswing of the trade cycle and employment maintenance on the downswing. In contrast, a very parochial bargaining unit is more likely to display a strong wage orientation on the upswing, regardless of the actual level of national (or even local) unemployment, and yet it may have a strong employment orientation on the downswing.

The general level of employment in the economy also matters. The lower the general level of unemployment the higher the probability that all bargaining units, parochial or national, will gravitate towards a 'wage-oriented' policy (see Figure 1). Finally, as Johnston's above-mentioned observation suggests, ideology also matters, and this may entail a collective objective to which purely individual concerns play a rather secondary role.

The spectrum of orientations may span from the strictly parochial, but internally cohesive bargaining unit which is strictly wage-oriented when demand expands, and strictly employment oriented when demand contracts, to the strong national union with a strong employment-oriented policy which permits reversion to a strict wage orientation only when full employment is reached.³

(b) Imperfectly known demand constraint

The present model focuses attention on a non-myopic union which is less than perfectly informed about the long run employment consequences of its wage target. The lack of complete information, in the present model, stems strictly from asymmetry of information rather than from the shared uncertainty which stochastic market demand may inflict equally on both sides.

Thus, the present paper, like Hart (1983), is concerned with a union which is incompletely informed about the true demand conditions it faces, whereas the firm is fully informed.⁴ As in Hart's analysis, the consequence may be *ex-post* unemployment which is not knowingly chosen *ex-ante* and which could have been avoided were it not for the

3. Centrifugal forces, however, are likely to exert their power, and this would tend to rule out strictly vertical indifference curves in the preference ordering of the peak organization. Furthermore, the larger the centrifugal force which is brought to bear by powerful affiliates of the peak organization, the flatter the indifference curve (of the peak organization). With a strong ethos of real wage resistance maintained even in the face of large national unemployment, horizontal indifference curves will occupy the lower left quadrangle.

4. Hart's (1983) analysis emphasises that although a union may choose to gamble, accepting unemployment when specific ('bad') states of nature eventuate following the making of the contract, it will in effect incur higher unemployment than knowingly chosen for that state because of its inability to accurately identify the state even when actually occurring.

asymmetry of information and mistrust between the parties concerned (Hart, 1983, p.24).

Hayes (1984) proposed that when the firm's choice set in a Hart's type model is redefined so that it consists of wage-employment-strike triads (rather than wage-employment pairs), incentive compatibility constraints ensure that the union has no subsequent cause for regret. This result depends on a number of specific assumptions. In particular, a crucial role is played by the assumption that the parties are locked in an exclusive relationship - workers have only firm-specific skills and they form the only supply of labour available to the firm; this relationship extends to an indefinite time horizon. In addition, the asymmetry of information represents a fully informed firm which knows both its own profitability structure and the union's preferences, while the union is imperfectly informed about its opportunity set.⁵

The present paper is concerned with a somewhat different description of asymmetric information. The firm's choice set is partitioned into two subsets, only one of which is available in the short run. Only during this first period is the firm's productive capacity tied up with its existing workforce. In the long run the firm has alternative options (such as movement offshore or the introduction of labour displacing technology on a large scale). The firm will then tolerate a strike which is long enough to bring the demanded wage (or wage-employment combination) to the long-run viable wage only if it perceives that this still dominates the alternative long run 'separation' option. If the separation option dominates, the firm may still capitulate to the union immediately and grant a wage which is too high to dominate the separation option in the long run⁶ but is low enough to permit a profit margin over variable costs in the

5. Also, note that a major insight offered by the literature on asymmetric information is the proposition that asymmetry of information is a real phenomenon, and it will persist unless the party with the relevant information has an incentive to reveal it truthfully, and the opponent has a compelling reason to accept it fully.

6. Yanis Varoufakis drew my attention to the fact that this is very similar to the strategy followed by Rupert Murdoch in setting up his Wapping operation in London in 1985.

present productive environment.⁷ The non-myopic rational union thus faces an uncertain future where it runs the risk of achieving Pyrrhic victories because of imperfect information.⁸

This conclusion, that a non-myopic unions may face an unavoidable finite risk of incurring regrettable (and irrevocable) employment losses which are caused by its own unfortunate selection of wage target in an earlier period, forms the starting point of the formal analysis in the present paper. As mentioned above, it is likely that even the union which abhors trading off employment reduction for wage increases under conditions of certainty may not refrain from the risk of triggering employment reduction in an economic environment where information is incomplete and asymmetric. Indeed, it cannot refrain from assuming such a risk. Analytically, this can be described as a situation where the union must take up a lottery, and where the only question is which one. The wage-setting union can exercise a degree of control on the level of risk it assumes, because the latter is positively correlated with the level of the selected wage. Each wage level then represents a different lottery. The choice of the optimal wage target is tantamount to choosing the most preferred lottery. The choice of an optimal wage target (i.e. the optimal 'lottery') then consists of judiciously balancing the losses inflicted by overshooting the unknown best target (i.e. the optimal wage under certainty) against the rewards bestowed by wage increases *per se*. The focal point of the formal analysis is the exploration of the consequences of this overshooting-risk for the choice of a wage target.

7. Since collective bargaining contracts are typically drawn up for a limited period, even a formal legally binding commitment to maintain a given employment level does not secure the union against Pyrrhic achievements where wage targets are overshot.

8. It must not only try to estimate the true boundary of the opportunity set in order to minimize the costs of any strike (as implied by Hayes' model), but it must also pay heed to other, more critical, repercussions of wrongly estimated demand conditions - employment loss which may involve all the members of the negotiating unit in the wake of plant closure.

III. Formal Analysis

The formal analysis is focused on the *parochial* negotiating unit whose preferences under certainty prohibit a trade off of employment reduction for wage rise. In the first instance, the analysis assumes that the preference ordering is described by an indifference map which involves a horizontal indifference curve to the east of the initial employment level (e_0) (see Figure 1). To allow numerical results to be generated, we shall postulate that to the left of e_0 the value of the objective function drops to zero. However, since the analysis which follows focuses on wage-setting in the situation where the wage-setter believes that there is a finite probability that the boundary of the opportunity set has moved outward, the configuration of the preference ordering left of e_0 (the initial employment level) is significant for the analysis in only one way - it affects the penalty associated with overshooting the true target. Thus setting a rather extreme penalty for overshooting should provide a lower bound for the selected wage target.

The assumptions of the model are subsequently relaxed to admit a more conventional form of preference ordering with strictly convex indifference curves over the subset of the choice set involving all wage employment combinations with employment above its current level; the assumption that the value of the objective function to the left of e_0 drops to zero is maintained throughout the analysis.

The aim of the analysis is to explore the consequences of the uncertainty regarding the boundary of the opportunity set for wage setting. As mentioned above, the analysis begins with a rather generalized form of random error, and is then repeated with the assumption that the random errors are normally distributed.

(a) Choice under certainty

Let

$$U(w, e) = u(w) \cdot g(e) \quad (1)$$

be the objective function of the 'parochial' wage-setter where

$$u(0) = 0, u' > 0, u'' < 0$$

$$g(e) = \begin{cases} 1 & \text{if } e > e_0 \\ 0 & \text{otherwise,} \end{cases}$$

e = employment level,

w = wage level and

e_0 = current (or initial) level of employment.

Consequently,

$$U(.) = \begin{cases} u(w) & \text{if } e > e_0 \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

and the optimization problem consists of:

$$\begin{aligned} \text{Max}_w U(.) &= \begin{cases} u(w) & \text{if } e > e_0 \\ 0 & \text{otherwise} \end{cases} \\ \text{s.t.} & \\ e &= f(w) \end{aligned} \quad (3)$$

where f is monotonically decreasing in w . The solution is simply:

set $w = w^*$, where w^* is defined by $e_0 = f(w^*)$.

The goal, in other words, simply consists of attaining the highest possible wage which permits $e = e_0$. Thus, all shifts in the boundary of the opportunity set, "parallel" or otherwise, have the same expansion path, extending from e_0 parallel to the w axis.

(b) Choice under uncertainty

The objective function remains the same as in (1), but the constraint incorporates a postulate about imperfect information which gives rise to uncertainty about the precise location of the boundary of the opportunity set. The union selects a given wage, but consequent future employment is a random variable whose expected value depends on the set wage. Consequently, the future level of the objective function becomes a random variable. As the formal analysis below shows, given the specification of the objective function under certainty, effectively the union faces a lottery which offers two possible outcomes: (i) 'good' when the set wage (w^T) permits employment to be maintained (in the long run) and the value of the objective function is given by $u(w^T)$, and (ii) 'bad' due to overshooting of the true (but unknown) target, with the value of the objective function dropping to zero.

The demand conditions can be now described probabilistically:

$$e = f(w, v) \quad (4)$$

where

$$v = \text{a random error term with } E[v] = 0.^9$$

Thus, for a given w there is a distribution around the true boundary which describes the corresponding value of e . Let w^* denote the optimal wage which would have been chosen under certainty, as above. Then the probability that employment does not fall short of the initial level e_0 for a given targeted wage w^T is simply equal to the probability that w^T does not exceed (the unknown) w^* :

$$P(e \geq e_0) = P(w^T \leq w^*).$$

Let \hat{w}^* be a point on the estimated demand curve which would have been treated as the optimal wage had the uncertainty been altogether ignored. (Henceforth \hat{w}^* shall be referred to as the risk-neutral

9. That is, the estimation is perceived as involving unbiased estimators.

optimum.) \hat{w}^* is treated as a random variable with some (subjective) probability density function $k(\hat{w}^*)$, with $E[\hat{w}^*] = w^*$.¹⁰

The question then is: would the non-myopic union actually choose the estimated value of (\hat{w}^*) as its new wage target (w^T), would they, alternatively, select a lower wage target, or would they perhaps choose a target which actually exceeds \hat{w}^* ? Are all of these possible outcomes, and if so what are the conditions which determine which of these three strategies will produce the optimal result? The answer hinges on some properties of $k(\hat{w}^*)$ and on the magnitude of \hat{w}^* relative to w_0 .

Maximization of (2) subject to (4) implies that ex-post $U(w, e)$ has only two possible values: $u(w^T)$ and 0. Ex-ante the union which sets $w^T > w_0$ involves itself in the following lottery:

$$U(w, e) = \begin{cases} u(w^T) & \text{with probability } 1 - K(w^T) \\ 0 & \text{with probability } K(w^T), \end{cases} \quad (5)$$

where

$$K(w^T) = \int_{w^T}^{\hat{w}^*} k(\hat{w}^*) d\hat{w}^*. \quad (6)$$

The expected utility of this lottery is simply given by:

$$EU(.) = u(w^T)[1 - K(w^T)]. \quad (7)$$

Clearly, an increase in w^T has two opposing effects on $EU(.)$: a negative effect through the risk of overshooting w^* [the risk being given by $K(w^T)$ which is a monotonically increasing function of w^T] and a positive effect through $u(w^T)$. The alternative is to leave the wage level unchanged at w_0 which, it is postulated, yields $U(.) = u(w_0)$. The rationale for this postulate is supported by the following argument.

10. This follows from $E\hat{w}^* = w^*$.

Human beings typically treat the uncertainty associated with the status quo in terms which are quite distinct from those applied to the uncertainty associated with change. The current wage level w_0 itself might involve a risk of reduced employment the long-term, but this issue is not reopened. In contrast, the contemplation of an increase in the wage is treated as an altogether different matter, with a considerable caution. This asymmetry of treatment is especially likely in the case of the union which contemplates a new wage target. Furthermore, given the lack of information and the inherent conflict between labour and capital, it is hard to conceive a voluntary offer of a wage cut by the union, unless the non-optimality of the prevailing wage is beyond doubt. Finally, it should also be recalled that in the present paper we are dealing with the special case of the union which has some reason to believe that demand conditions have improved, but it is not at all certain that this is indeed the case.

Returning to the formal model, optimization implies that the agent sets $w^T > w_0$ if there exists values of $w > w_0$ for which $EU(w) > U(w_0)$. Within this set of w , a specific value of w , w^T , is chosen which maximizes the value of $G(w^T)$, the expected gain from the wage increase:

$$G(w^T) = EU(w^T) - u(w_0).$$

Thus, the optimization problem is given by:

$$\text{Max}_{w^T} G(w^T) = [1 - K(w^T)]u(w^T) - u(w_0) \quad (8)$$

s. t.

$$(1) \quad G(w^T) > 0 \quad (9)$$

It is easily seen that (9) yields the condition:

$$[1 - K(w^T)] > u(w_0)/u(w^T). \quad (10)$$

For the agent with a linear $u(w)$ and with $u(0) = 0$ (i.e. risk neutral in w) the condition (10) reduces to

$$[1 - K(w^T)] > w_0/w^T \quad (11)$$

For agents with a concave $u(w)$ the condition becomes

$$[1 - K(w^T)] > w_0/w^T + m \quad (m > 0). \quad (12)$$

Equations (11) and (12) yield the following proposition:

Proposition A:

For all linear $u(w)$ an (estimated) outward shift in the boundary of the opportunity set will be followed by a new wage target ($w^T > w_0$) only if $[1 - K(w^T)] > w_0/w^T$, that is only if the probability of not overshooting the target exceeds the ratio between the existing wage and the target wage. For all $u(w)$ concave in w , $w^T > w_0$ only if $[1 - K(w^T)] > w_0/w^T + m$, where $m > 0$.

Let us now examine a somewhat less restrictive form of $U(\cdot)$. Suppose we consider a partition of the preference set at the point (w_0, e_0) where the value of the objective function west of E_0 is zero, as before, but in the north-east quadrangle preferences are described by a very generalized well behaved objective function $U(w, e)$ which belongs to the family of the homothetic functions with homogeneity degree 1 (in e and w).

Thus, expansion paths which are formed by parallel shifts in the boundary of the opportunity set form straight lines extending from (w_0, e_0) in the north-east direction. The opportunity set, however, must be convex with a linear boundary. Alternatively, the boundary can be curvilinear, but with shifts which form a sequence which defines a homothetic map.¹¹

¹¹. Although this is an utterly well behaved description in keeping with convention, I personally happen to believe that in reality the

U(.) now takes the form

$$U(w, e) = \begin{cases} u(w, e) & \text{with probability } 1 - K(w^T) \\ 0 & \text{with probability } K(w^T), \text{ and} \end{cases} \quad (13)$$

G(.) now takes the form:

$$G(w^T, e) = [1 - K(w^T)]u(w^T, e) - u(w_0, e_0) \quad (14)$$

This, as before, is optimized subject to the constraint given by equation (9).

The condition given by Equation (10) implies

$$[1 - K(w^T)] > u(w_0, e_0) / u(w^T, e^T) \quad (15)$$

and by homotheticity cum homogeneity degree 1 we know that

$$u(w_0, e_0) / u(w^T, e) = e_0 / e^T = w_0 / w^T \quad (16)$$

and therefore (15) reduces to:

$$[1 - K(w^T)] > w_0 / w^T \quad (17)$$

When $u(w, e)$ is concave in e and w then (15) is reduced to:

$$[1 - K(w^T)] > w_0 / w^T + m, \quad (m > 0) \quad (18)$$

These results are identical to those obtained for the more restricted case of the 'parochial' wage setter [(17) is identical with (11) and (18) is identical with (12)]. It thus transpires that the crucial role is played by $U(.) = 0$ for $e < e_0$ rather than $U(.) = u(w)$ for $e > e_0$. The following proposition summarizes these results:

opportunity-set faced by the parochial wage setter will fairly often be non-convex (Gill, 1984).

Proposition B:

For all homothetic functions $u(w, e)$ degree 1 and linear in e and w a (estimated) parallel shift in the boundary of the opportunity set will be followed by a new wage target ($w^T > w_0$) only if $[1 - K(w^T)] > w_0 / w^T$. For all homothetic $u(w, e)$ degree 1 and concave in w and e , $w^T > w_0$ only if $[1 - K(w^T)] > w_0 / w^T + m$, where $m > 0$.

More specific results can be obtained only if the P.D.F. $k(w^*)$ is specified more explicitly.

Let us consider the case where $k(.)$ is symmetric. It is easily seen that when the target wage exceeds the risk-neutral optimum (\hat{w}^*) the probability of overshooting the true target exceeds 0.5. For a positive gain we need

$$w_0 / w^T < [1 - K(w^T)] - m \quad (m > 0). \quad (19)$$

Consider the case where

$$w^T > \hat{w}^*$$

then we must have

$$[1 - K(w^T)] < 0.5. \quad (20)$$

Combining (19) and (20) gives

$$w_0 / w^T < 0.5$$

i.e. $w^T > 2w_0$

which is unrealistic. It is politically inconceivable that a union attempt to double its wage rate. Thus the condition needed for $G(w^T) > 0$ cannot be met realistically if $w^T > \hat{w}^*$. Hence \hat{w}^* is an upper bound w^T .

w_0 is clearly a lower bound on w^T , since $G(w^T) < 0$ for $w^T < w_0$ (regardless of the form of $k(.)$).

Proposition C:

If $k(\hat{w}^*)$ is symmetric then w^T will, in all practically conceivable cases, be in the range $w_0 < w^T < \hat{w}^*$.

When $k(\hat{w}^*)$ is approximated by the normal distribution [and focusing on the reference case where $u(w)$ is linear in w with $u(0) = 0$] it is possible to highlight the role of the (perceived) "standard deviation" of the estimate in determining the value of w^T and its relationship to the estimated value \hat{w}^* .

(c) Choice under uncertainty with a normally distributed error

Let

$$\hat{w}^* \sim N(w^*, \sigma^2) \quad (21)$$

$$\text{and } z = (w^T - \hat{w}^*)/\sigma \quad (22)$$

then (8) can be rewritten as

$$G(z) = [1 - F(z)]u(\hat{w}^* + \sigma z) - u(w_0), \quad (23)$$

where $F(z)$ is the the distribution function of the truncated standard normal variable z (and $\hat{w}^* + \sigma z$ is substituted for w^T). The optimization problem then consists of selecting a value of z which maximizes $G(\cdot)$ (from the set of values of z satisfying $G(\cdot) > 0$). $G(\cdot) > 0$ simply requires a restriction of the admissible z to the the set of z satisfying the condition:

$$[1 - F(z)] > w_0/w^T. \quad (24)$$

The optimization problem (substituted $w^* + \sigma z$ for w^T) then is:

$$\text{Max}_z G(z) = [1 - F(z)]u(\hat{w}^* + \sigma z) - u(w_0), \quad (25)$$

s. t.

$$G(z) > 0.$$

Assuming

$$u'(w) = \gamma \text{ and } u(0) = 0 \quad (\text{i.e. } u(w) = \gamma w)$$

then

$$\begin{aligned} G'(z) &= [1 - F(z)]u'(\hat{w}^* + \sigma z)\sigma - f(z)u(\hat{w}^* + \sigma z) \\ &= [1 - F(z)](\gamma\sigma) - u(\hat{w}^* + \sigma z)f(z), \end{aligned} \quad (26)$$

where $f(z) = F'(z)$.

Therefore, given $f(z) \neq 0$

$$G'(z) = 0 \Leftrightarrow u(\hat{w}^* + \sigma z) = \frac{1 - F(z)}{f(z)} \gamma\sigma, \quad \text{or}$$

$$\frac{1 - F(z)}{f(z)} = \frac{\gamma\hat{w}^* + \gamma\sigma z}{\gamma\sigma} = \frac{\hat{w}^*}{\sigma} + z$$

That is, the first order condition requires that

$$z + \hat{w}^*/\sigma = \frac{1 - F(z)}{f(z)}. \quad (27)$$

The second order condition involves the sign of $G''(z)$:

$$\begin{aligned} G''(z) &= -2f(z)\gamma\sigma + zf(z)(\hat{w}^* + \sigma z)\gamma, \\ &\quad [\text{since } f'(z) = -zf(z)] \\ G''(z) &= \gamma\sigma f(z)[z^2 + (\hat{w}^*/\sigma)z - 2]. \end{aligned} \quad (28)$$

Since γ , σ and $f(z)$ are always positive, the sign of $G''(z)$ is determined by $[z^2 + (\hat{w}^*/\sigma)z - 2]$. It can be shown that the second

order condition, $G''(z) < 0$, is satisfied for all $z < 0$ provided the first order condition is satisfied (see Appendix).

Let us check whether the solution to $G'(z) = 0$ allows for a negative value of z and if so whether there are additional constraints. (In addition, recall that the first constraint which requires $G(\cdot) > 0$ itself restricts z to $z < 0$, in virtually all practically conceivable cases.)

First, since

$$0 < F(z) < 1.0$$

and $f(z) > 0$

the right-hand side of equation (27) is positive implying that the optimum value of z must have a lower bound given by

$$z > -\hat{w}^*/\sigma.$$

Secondly, solving the first order condition (equation (24))

for $z = 0$ yields $\hat{w}^*/\sigma = 1.25$. For an optimum with $z < 0$ we therefore require $\hat{w}^*/\sigma > 1.25$.

Finally, since $\hat{w}^*/\sigma > 0$, and $[1 - F(z)] / f(z)$ is monotonically decreasing in z , the first order condition also implies an upper bound on the optimal value for z given by solving $z = [1 - f(z)]/f(z)$, which yields $z < 0.60$ approximately. This is only relevant if we admit the possibility of positive values of z (i.e. of $w^T > 2w_0$, see the discussion above).

Proposition D:

- (1) When estimation errors are normally distributed, and whenever \hat{w}^*/σ is larger than 1.25 the target wage falls below the estimated value of \hat{w}^* , however small the standard deviation. In the range $1.25 < \hat{w}^*/\sigma < 3.69$, smaller standard deviation leads to values of w^T which are closer

to \hat{w}^* . The smaller the standard error the larger the gap between w^T and \hat{w}^* .

- (ii) Very large standard deviation, $\hat{w}^*/\sigma < 1.25$, favour $w^T > \hat{w}^*$. But note that this would be optimal only if $w^T > 2w_0$.

Numerical simulation of $[1 - F(z)]/f(z)$ establishes that it is a monotonic decreasing function of z in the range $-3 < z < 3$.

At $z = 0$ we obtain

$$[1 - F(z)]/f(z) = 1.25, \quad (29)$$

hence if $\hat{w}^*/\sigma > 1.25$ (a condition which is likely to be satisfied in most practically conceivable cases) the first order condition (equation (27)) dictates $z < 0$ (see Figure 3). However, $w^T > w_0$ only if, in addition (to the first order condition), the condition (equation (24))

$$1 - F(z) > w_0/w^T \quad (30)$$

is satisfied (otherwise $G(\cdot)$ is negative even at the maximum).

In all likelihood at $z = 0$ (i.e. $w^T = \hat{w}^*$) the ratio w_0/w^T will exceed 0.5. If σ is very large then w_0/w^T forms a steep curve (curve (1) in Figure 4) as z decreases, and it remains above $[1 - F(z)]$, so the optimal strategy is to keep $w^T = w_0$. As σ decreases (i.e. the estimate is deemed more accurate) w_0/w^T charts a flatter curve (curve (2) in Figure 4), and with a sufficiently small σ (and sufficiently large \hat{w}^*) w_0/w^T crosses $[1 - F(z)]$ at $z > (w_0 - \hat{w}^*)/\sigma$, permitting $w^T > w_0$ (curve (3) in Figure 4).

Whereas the condition $G(\cdot) > 0$ dictates an intuitively plausible relationship between σ and w^T (as σ decreases the chance of setting $w^T > w_0$ increases), the first order condition can generate

counter-intuitive results. This is explained in the following section.

Implications of the first order condition for the relationship between the target wage w^T and the standard deviation of \hat{w}^* , σ

$$\text{Let } Y(z) = \frac{1 - F(z)}{f(z)}. \quad (31)$$

Then the target wage w^T is given by the intersection of this curve with $z + \hat{w}^*/\sigma$ (Figure 3). Note that w^T is easily obtained from the value of $Y(z)$ at this point:

$$Y(z) = z + \hat{w}^*/\sigma = w^T/\sigma \quad (32)$$

$$\therefore w^T = \sigma Y(z).$$

Intuitively, we might expect that the target wage w^T would increase as the confidence in the estimate of \hat{w}^* increases (i.e. as σ decreases), but this is not always the case.

To find the effect on w^T of a small change $\Delta\sigma$ in the standard deviation, we must first find the corresponding changes in Y .

$$\begin{aligned} \Delta w^T &= \Delta[\sigma Y(z)] \\ &= Y(z)\Delta\sigma + \sigma \frac{dY(z)}{dz} \Delta z \end{aligned} \quad (33)$$

Differentiating (32) gives

$$\frac{dY(z)}{dz} \Delta z = \Delta z - \frac{\hat{w}^* \Delta\sigma}{\sigma^2} \quad (34)$$

$$\begin{aligned} \therefore \Delta z &= \frac{\frac{\hat{w}^*}{\sigma^2} \Delta\sigma}{1 - \frac{dY(z)}{dz}} \\ &= \frac{Y(z) - z}{\sigma \left[1 - \frac{dY(z)}{dz}\right]} \Delta\sigma \end{aligned} \quad (35)$$

Substituting (35) in (33) gives

$$\begin{aligned} \Delta w^T &= Y(z)\Delta\sigma + \sigma \frac{dY(z)}{dz} \frac{[Y(z) - z]}{\sigma \left[1 - \frac{dY(z)}{dz}\right]} \Delta\sigma \\ &= \frac{Y(z) - z}{1 - \frac{dY(z)}{dz}} \Delta\sigma \end{aligned} \quad (36)$$

Now note that $[dY(z)/dz] < 0$ in the region of interest ($-3 < z < 3$), and so the denominator is positive. Then Δw^T is positive for a negative value of $\Delta\sigma$ (i.e. w^T increases when the confidence in the estimate increases) and vice versa if

$$Y(z) - z \frac{dY(z)}{dz} < 0.$$

$$\text{i.e. } Y(z) < z \frac{dY(z)}{dz}.$$

Graphically, this is true if the tangent to the curve $Y(z)$ intersects the vertical axis below the origin. Numerical solution of this equation yields (see Figure 5)

$$\frac{\Delta w^T}{\Delta\sigma} < 0 \text{ for } z < -0.84.$$

$$\text{i.e. } \frac{w^T}{\sigma} > 2.85 \text{ or } \frac{\hat{w}^*}{\sigma} > 3.69.$$

A graphical presentation of the relationship between \hat{w}^*/σ and w^T/\hat{w}^* is provided in Figure 6 in terms of the inverse of \hat{w}^*/σ , σ/\hat{w}^* which is the well-known measure of dispersion, the coefficient of variation. The relationship, as should be clear by now, is not monotonic. Figure 6 plots the results of the numerical analysis which is described briefly below.

Let us first consider the region where the solution yields $w^T < \hat{w}^*$. The first order condition (equation (27)) implies that when $\hat{w}^*/\sigma = 1.25$ then $w^T/\hat{w}^* = 1$ (this is an admissible solution only if $\hat{w}^* > 2w_0$). As σ declines so does w^T until \hat{w}^*/σ reaches the value 3.69. w^T/\hat{w}^* then stands at 0.77. Thereafter σ and w^T are positively related as σ decreases further. Thus, 0.77 sets a lower bound for the ratio between the risk-neutral optimum (\hat{w}^*) and the target wage.

The reason underlying the counter-intuitive result in the range $3.69 > \hat{w}^*/\sigma > 1.25$ is quite straightforward. Within this range the gain from bringing about a decrease in the probability of overshooting $F(z)$, (or $K(w^T)$) as a result of lowering the target wage outweighs the gain from enjoying a higher wage.

Finally when σ is sufficiently large that $\hat{w}^*/\sigma < 1.25$, w^T increases as σ increases. This too is counter-intuitive, but the explanation again hinges on the trade-offs between the probability of overshooting and the direct benefits of a higher wage. Here the union 'goes for broke' - there is very little scope for reduction in the risk of overshooting, so the only profitable course is to increase w^T . However, note that only for $w^T > 2w_0 + n$ (with n being relatively large) is there a possibility that the condition $G(\cdot) > 0$ can be satisfied for $w^T > \hat{w}^*$. These results are summarized by the following proposition.

Proposition E:

The question of whether a rise in the agent's confidence in his estimate will lead to a rise in the target wage depends

on the magnitude of \hat{w}^/σ , the inverse of the coefficient of variation. If \hat{w}^*/σ exceeds 1.25 the target wage w^T will decline as σ decreases until \hat{w}^*/σ reaches the value 3.69. Thenceforth, further decreases in σ will bring about a rise in the target wage. The value of the target wage will not fall below 0.77 times the estimate \hat{w}^* , unless the condition $[1 - K(w^T)] > w_0/w^T$ entails a corner solution. When σ is sufficiently large relative to \hat{w}^* that \hat{w}^*/σ is below 1.25, the union will increase w^T as σ increases. This, however, will be a feasible solution only if $w^T > w_0 + n$ where n is sufficiently large.*

IV. Discussion

The preference orderings which guide the actions of a given individual organization elude direct empirical observation and therefore remain a subject for conjecture. Whereas some may assiduously maintain confidence in the ability of the preferences to reveal themselves unequivocally, others have pointed to examples where manifest behaviour fails to reveal the true ordering of preferences (e.g. Sen, 1973). The consensus pointed out by Hirsch and Addison, that all unions have preferences which follow a strictly convex indifference curves between wage and employment levels over the entire choice set, reflects the strong grip of analytical conventions. The present paper argues in favour of welcoming a measure of scepticism because it may prove more fruitful than the tranquility of consensus in the long run.

In addition to the benefits which follow methodological pluralism there is an even more compelling reason for abandoning the search for what Hirsch and Addison describe as a "... universally accepted model of unions goals or behaviour" (as cited above). Unions are far from being monolithic entities which could justifiably be represented by

one universal model, an argument recently made by George Johnson and cited above (1985), who in turn echoes Collard's observation that

"The standard assumption of self-interest is simply a special case, though a highly important special case. It ignores those non-selfish elements in his behaviour of which man has always been conscious..." [emphasis is mine.]
-Collard (1978) p.16.¹²

The description of preferences (under certainty) adopted in the present paper, incorporating as it does a measure of altruism, cannot possibly apply to all unions at all times.¹³ It must be emphasised, however, that the introduction of initial conditions means that the abhorrence for trading off employment reductions for wage increases applies only locally. Attention is focused on the neighbourhood of the point representing the initial wage and employment levels. The exclusion of trade offs, the analysis has shown, can in fact be confined to a subset of this neighborhood (by permitting trade offs between magnitudes of change when wage and employment levels can both be increased) with little loss in the generality of the derived analytical propositions.¹⁴

The development of the model has primarily been motivated by the desire to highlight two issues. First, the analysis seeks to emphasise the identification problem inherent in any attempt to

12. Collard's seminal monograph goes further in establishing a case for paying serious attention to non-selfish behaviour with altruism as a principle of conduct which represents something beyond sophisticated self-interest. Individuals hold different views on human nature, and so it is not surprising to find disagreement on the extent of the applicability of the selfishness assumption. However, the extent of exclusion of non-selfish motives also reflects the grip of unquestioning conventionalism.

13. The implementation of non-selfish, altruistic principles is also predicated on the availability of political processes and institutional structures which are capable of accommodating and given effect to altruistic motives. Collard's (1978) monograph aptly makes this point.

14. Once the effect of very large shifts in the boundary of the opportunity set are contemplated, the assumption underlying choice theory, that preferences and the opportunity set are orthogonal, may indeed no longer be valid. Under the shock of radical changes in opportunities, agents often re-evaluate their priorities; this is likely to imply a revision of the structure of preferences.

uncover preference orderings under certainty when agents operate in an uncertain environment. The question of the realism of the descriptive content of the model is of little consequence for this particular issue, since the latter concerns a proposition which can legitimately employ hypothetical situations as examples to illustrate a methodological problem.

The second aim is to illustrate some of the consequences of incomplete information for the wage targets selected by unions. Here, specific assumptions about the functional form naturally place limitations on the applicability of the results. The results, though can be treated as providing a rough estimate of a lower boundary on the value of selected wage targets under different degrees of uncertainty. Specifically, if the specification of the penalty for overshooting the target (the level of the objective function dropping to zero) is deemed excessively large, then the condition $w^T/\hat{w}^* > 0.77$ may be treated as a lower bound. More generally, the conclusion that w^T/\hat{w}^* is not monotonically related to uncertainty (where the latter is represented by the coefficient of variation) does not appear to be confined to the specifics of the present model.

Finally, the formal analysis is confined to the so called 'monopoly union' which sets wages whilst the employment level remains entirely the prerogative of the firm. In reality, unions are often limited in their ability to set a given wage, not only because of employment repercussions (which the monopoly model recognizes), but also because of the loss of earnings during a strike, the ability of the firm to muster political support (against wage increases) and because of limitations on the ability of the union to ensure the compliance of its own members.

In like manner, strong unions can place limits on managerial prerogatives regarding employment levels. This consideration has generated interest in the 'efficient-bargains' model (following the lead of McDonald and Solow, 1981) which builds on Leontief's observation that a firm may attain higher profit levels if it agrees to limit its discretionary power on employment levels. However, as mentioned above, labour economists remain divided on the extent to which the efficient-bargain model is applicable in a real world

setting.¹⁵ Both institutional constraints and factors which affect optimization solutions but remain unaccounted for within the formal analysis may leave significant latitude for managerial discretionary power on employment level.

In any event, the analytical insights of the model presented in this paper are not confined to the subset of situations which approximate the situation described by the 'monopoly union' model. The threat point of the union in an efficient bargain model should, *inter alia*, depend on the risks of overshooting its true (but unknown) long term wage target. The position of the contract curve in the efficient bargain model should therefore be affected by the extent of this risk. As argued above, for the non-myopic union, incomplete information generates such risks in the typical bargaining situation, and they will be absent only in contracts which bind employment levels for the entire time horizon of the bargaining unit.¹⁶

V. CONCLUSION

This paper focuses on the following question. Suppose demand conditions seem to have improved, but there is a finite chance that this impression is erroneous; what should a tight-knit group of workers do under such circumstances, if under conditions of certainty they would refrain from any wage rise unless their employment level would remain intact? This question provides the starting point of the formal analysis. Arguing that under conditions of incomplete information an absolute refusal to undertake a risk of triggering undesirable employment changes is not a tenable option, the paper proceeds to explore the consequences for the level of the set wage of the uncertainty engendered by incomplete information.

15. See footnote 1.

16. See Section II (c).

The paper argues that unless the firm and workers are locked in a mutually exclusive relationship (extending to an infinite time horizon) where the workers possess only firm-specific skills and provide the only supply of workforce the union runs a finite risk of achieving Pyrrhic victories.¹⁷ The firm could concede work conditions in the short run which are unsustainable in the long run, but in circumstances where this is revealed unequivocally only after the damage is irrevocable any wage rise involves a finite chance of providing the trigger for a Pyrrhic victory.

Since the focus of the analysis is on uncertainty stemming from information asymmetry (and not from the stochastic nature of future demand) the risk of overshooting the true, but unknown, target is defined strictly by the degree of confidence the wage setter has in his estimate of the boundary of the opportunity set.

Intuitive reasoning suggests that the larger the estimated shift in this boundary, and the higher the confidence in the estimate, the larger the chance that a new (higher) wage will be sought. If the shift is deemed small and the lack of confidence large, the prevailing wages will remain unaltered. The formal analysis confirms this intuitive proposition.

However, we obtain a counter-intuitive result when we explore the relationship between uncertainty (i.e. the degree of lack of confidence in the estimate) and the actual level of the new set wage (when the setting of a new wage dominates the *status-quo* option) - the relationship between the optimal level of the set wage (the 'wage target') and the uncertainty about the estimate are not monotonically related. As the uncertainty about the estimate increases the set wage will decline, as intuition would suggest, but beyond a critical threshold level the relationship reverses - a further increase in uncertainty is positively associated with the optimal wage!

17. The 'optimal contract' literature is focused on the case where workers and firms are locked into such mutually exclusive relationship.

The paper provides an explanation for this lack of monotonicity.¹⁸ It is also shown that under most (but not all) conceivable circumstances, the set wage is likely to be below the estimated boundary.

In summary, the formal analysis yields three main results: (i) the wage setting union will not follow every outward shift in the (estimated) demand curve with a wage rise, (ii) set wages will tend to be below the estimated boundary, but with sufficiently large outward shifts in the demand curve the set wage may be above it, and (iii) beyond a certain point increases in uncertainty about the magnitude of the change in demand may be associated with higher rather than lower levels of set wages.

18. The lack of monotonicity does depend on the assumption that estimation involves a normally distributed error term. Specifically, this non-monotonicity stems from the non-linearity of the cumulative distribution function of the normal random variable.

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APPENDIX A

Establishing that the condition $G''(z) < 0$ is satisfied for all $z < 0$.

$$G''(z) = -2f(z) \cdot \gamma \sigma + zf(z)(\hat{w}^* + \sigma z) \cdot \gamma,$$

[since $f'(z) = -z \cdot f(z)$]

$$G''(z) = \gamma \sigma f(z) [z^2 + (\hat{w}^*/\sigma)z - 2].$$

$$= \gamma \sigma f(z) [(\hat{w}^T/\sigma)z - 2]$$

Since γ , σ and $f(z)$ are always positive, $G''(z)$ is negative if $(\hat{w}^T/\sigma)z < 2$. Since we require $\hat{w}^T > 0$, this is clearly satisfied for $z < 0$. In fact numerical analysis shows it to be true for all values z in the range of interest.

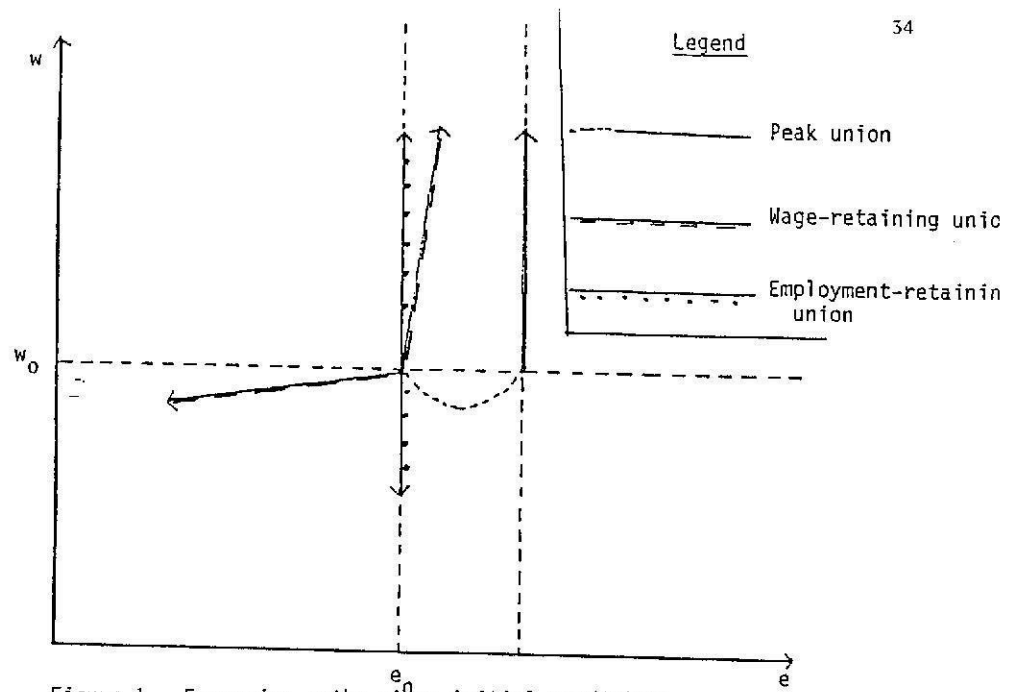


Figure 1. Expansion paths given initial conditions

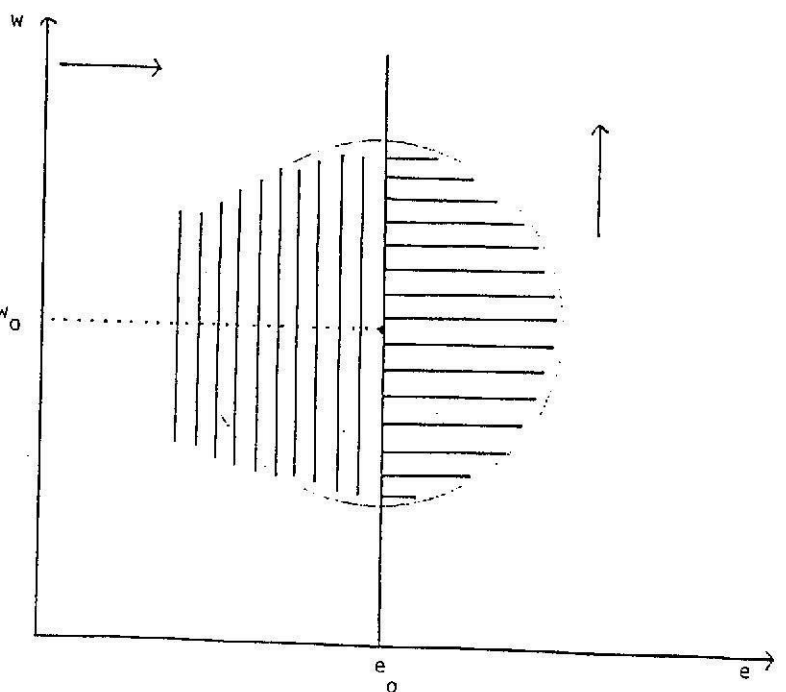


Figure 2. Iso-quant map of the parochial employment-retaining bargaining unit

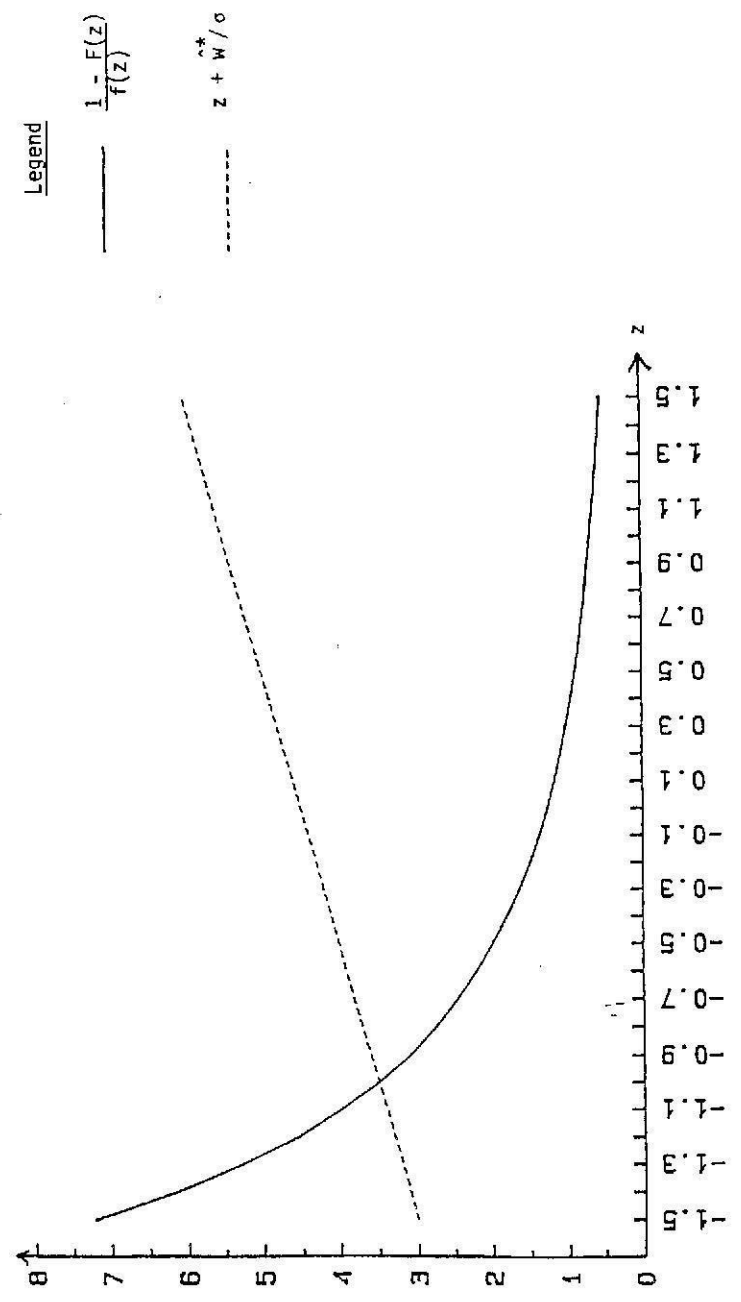


Figure 3. The first order condition for the choice of the target wage

Legend

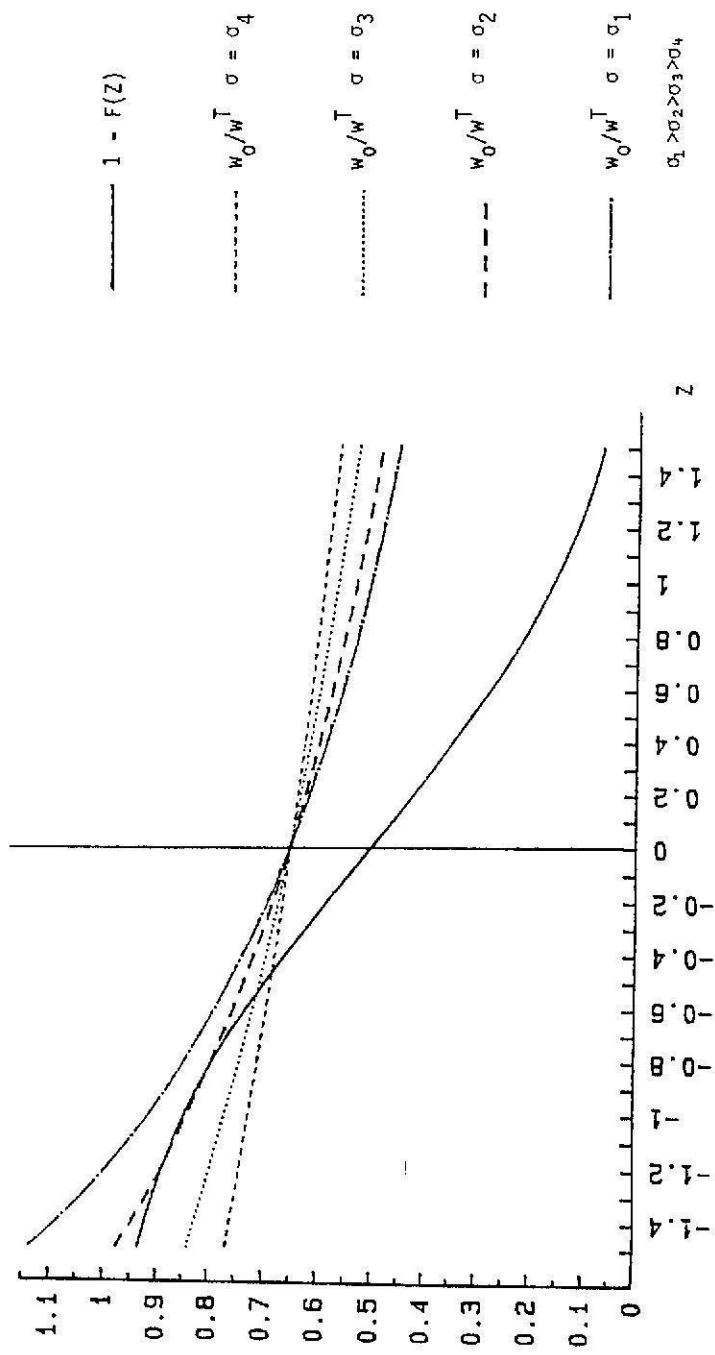


Figure 4. Conditions for a positive gain. A positive gain occurs only if $1 - F(z) > w_0/w^T$

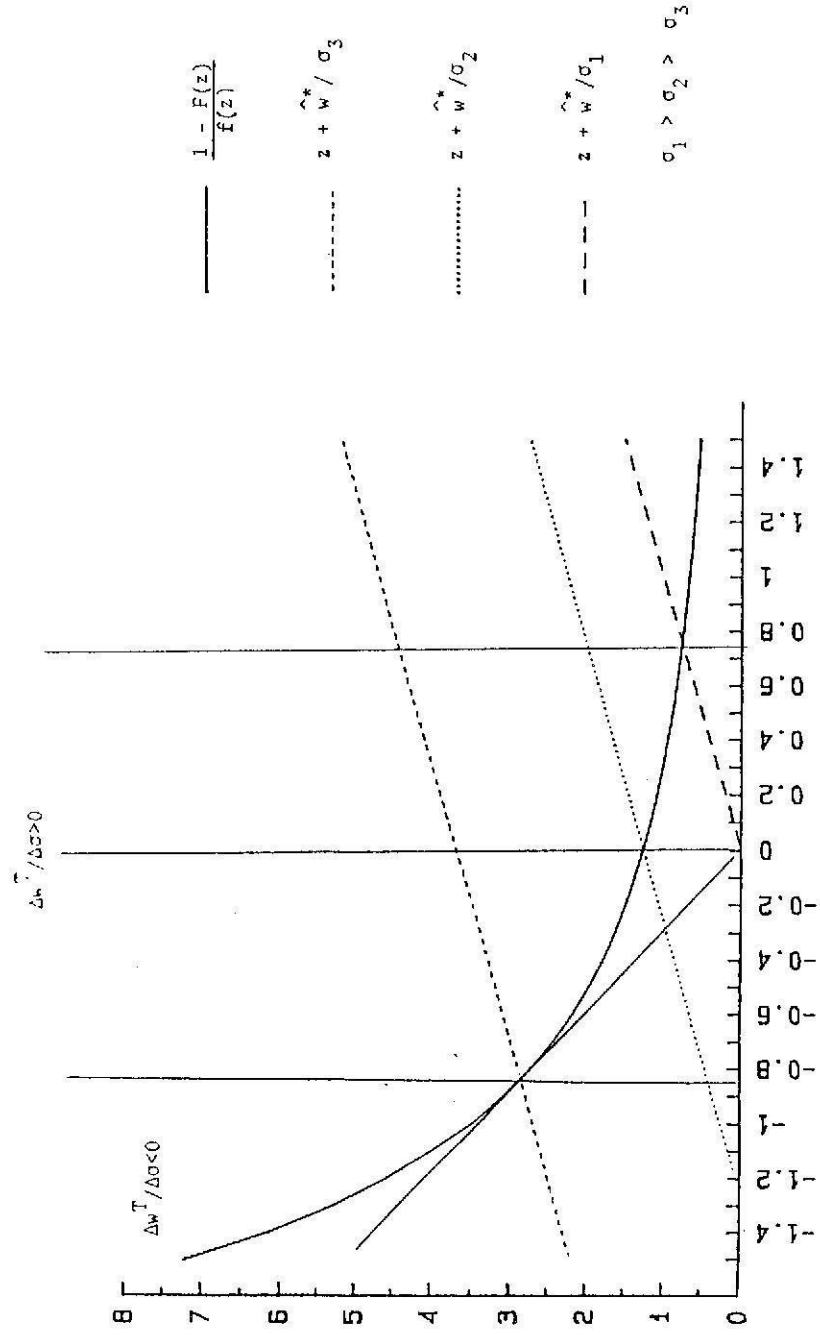


Figure 5. The relationship between the magnitude of the target wage (w^T) and the error of the estimate (σ)

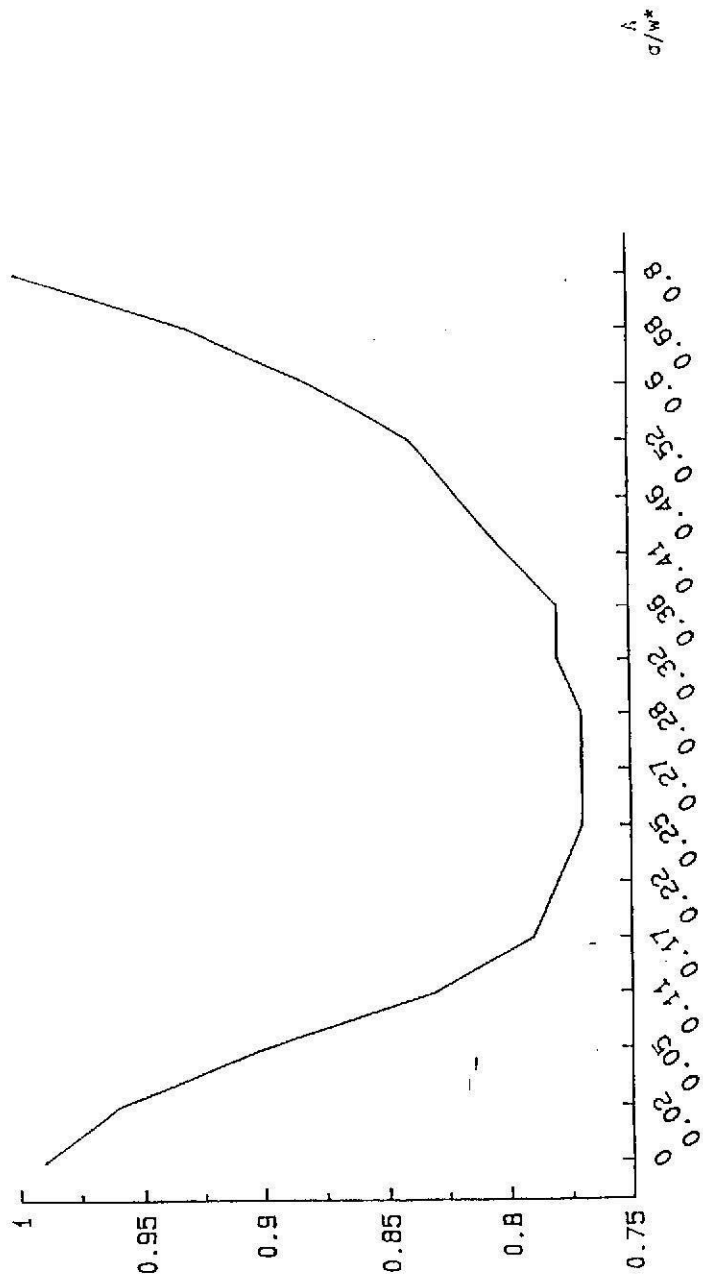


Figure 6. The relationships between the target wage (w^T) and the coefficient-of-variation (σ/w^A) of the estimated 'risk-free' optimum wage (w^*)

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