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TAX THREATS AND WAGE FORMATION

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ABSTRACT: The government, concerned about unemployment and inflation, can threaten the trade unions: if wages exceed a certain limit, income taxes will be increased. We analyze these kinds of threats as an inverted Stackelberg game between the government and many trade unions. The credibility of the threat is a key issue. If the threat is credible, it leads to lower wages and thus to higher employment.

The success of a tax threat policy requires that the threat be tailored to fit certain unions. Tailoring need not be explicit; the names of these unions need not be mentioned. But each union must know, after some iterative reasoning, which unions will be restricted by the wage limit. Thus tax threats seem to differ entirely from taxes as policy instruments, because it is usually thought that taxes cannot and must not be tailored differently to different groups of workers and unions. What really is tailored is, however, the exact conditions under which the threatened measures will be implemented.

The use of threats is likely to be restricted to temporary policy packages. But if one union's wages affect the utilities of other unions, e.g. via consumer prices, and if the unions are unable to cooperate among themselves, there is room for permanent tax threat policies. The threat then forces the unions to make agreements that are Pareto superior to the noncooperative equilibrium.

KEY WORDS: tax threats, wage formation with many trade unions, credibility

Contents

1 Introduction

Tax threats have been both a research subject and a practical policy tool in the Nordic countries. The idea of using tax threats to make trade unions accept lower wage levels was first presented by Hansen (1958)[1]. The idea was later developed using game theoretic methods in Johansen (1977). In practise the idea was tried in Norway in the mid-70's and in Finland in 1989. There have also been other more informal attempts to affect wages through tax threats and promises. The anglo-saxon counterpart is 'TIP' (tax-based incomes policies), where the idea is to influence employers instead of trade unions (see e.g. Jackman and Layard, 1990).

The Finnish case was the starting point of this study. The centralized wage negotiation process that took off in autumn 1989 led to the so-called Kallio agreement. A tax threat was a part of the process— if a vast majority of unions did not accept Kallio's proposal, income taxes would have been increased. Credibility of the threat was increased by printing the extra tax percentages into personal income tax withholding cards in advance. Some unions forsook the proposal. A majority accepted, however, and the tax threat was not executed.

Game theory methods have not been applied to tax-wage interdependencies in a multi-union context. One reason may be that in a multi-union setting taxation has been regarded as a poor policy instrument. Calmfors (1989, p. 101) claims that unions look not only at the incomes of their own members but also at the incomes of members of other unions. As tax reductions cannot be tailored differently for different unions, tax threats may be ignored because of the 'keeping up with the Jones' effect, even though this leads to lower net income development. Tailoring is a key word in this study— the main result is that although taxes cannot or must not be tailored, the tax threat can and must be tailored with some specific unions in mind.

There are two or more trade unions in this study. They cannot make binding contracts between themselves— the game is non-cooperative. It is also a one-shot game, which means either that it is not repeated or that the possible repetition does not affect the present decisions. Employers have been abstracted away by using monopoly union assumption. Unions do not

[1] Appeared in Swedish in 1955

care about relative wages, only about the real net income and employment of their own members. Effects of wage increases on consumer prices are taken into account.

The success of the tax threat depends on sufficient and accurate information available to participants. We assume that information here is sufficient for all players to make the necessary calculations and deductions. There is no uncertainty whatsoever. The credibility of the tax threat is also a key issue. Here credibility is partially masked by introducing costs of making threats and costs of cheating. The reason is to make credibility depend on the size of the threatened tax increase, and not to belittle the problem itself. By limiting the size of the threat the distributional effects of the policy and the necessity to tailor the threat becomes more apparent.

Section 2 contains some basic considerations about the nature of threat policies in general and tax threats in particular. It paves the way to the government preference function introduced in section 3, after the wage formation and wage-price equilibrium of the economy in normal times, without threat policy measures, are described. Section 4 then describes the tax threat game and its effects in detail. Some alternatives are considered in Section 5. The conclusions are drawn in section 6.

2 Tax threats as a policy instrument

2.1 The basic idea and the basic problem

Hansen (1958, p. 358) expressed clearly the basic idea in using taxes to influence wages. He suggested a method where 'the State makes a declaration of its plans concerning future fiscal and monetary policy for the realization of full employment and a stable value of money with alternative future money wage rates. This declaration will include a promise that fiscal and monetary policy will be constructed in such a way that at one certain money wage rate, namely the one that the State considers suitable, wage earners will achieve the highest real disposable income, whereas at both higher and lower money wage rates their real disposable incomes will be lower'.

Hansen also wondered whether the State should give a detailed description of the policy measures that will be taken in various situations, or whether the State should merely announce the real disposable income levels that will

result from alternative money wage rates, but leave open the exact measures by which these income levels will be achieved. Hansen concludes that from the point of view of the government, the latter way is better because it gives the government free hands to take whatever measures appear necessary to fulfil the declared intentions. A counter-argument is that this freedom may itself endanger the credibility of the proposal, because afterwards it might be difficult to identify whether the government really tried to fulfil its intentions but failed because of some unexpected events, or whether the government did not try to do that. If the unions anticipate this difficulty, they are liable to dismiss the proposal.

Johansen (1977, pp 96- 97) discussed Hansen's proposal in a game-theoretic setting[2]. He mentions 'the serious problem of credibility' as the reason why a 'policy using conditional statements is therefore not an easy and simple policy, but often something of a gamble'. The policy is succesful only if the other players believe the government's declarations.

The threat game played in this article is a reversed Stackelberg game. The solution, as Pohjola (1985) notes, is subgame perfect only under precommitment or credibility. Pohjola points out that reputation building through repetitions of the game is a possible way to obtain credibility. Here we opt for another formulation, to be described later. But the credibility problem itself is in no way 'solved' by the choice we make — it remains perhaps the biggest obstacle to practical applications of threat policies.

2.2 A permanent or temporary instrument?

Tax threats are very rarely used. This seems to indicate that threats are considered by those presenting them to be suitable in temporary policy packages, but not in permanent policy instruments.

[2]Although Hansen did not put forth his proposal in a game setting, he pondered about credibility, and his views seem to precede the reputation building approach: 'The first condition for the success of a policy of this kind is obviously that the State announces its plans openly and then behaves in full accordance with them, neither concealing its intentions nor hesitating to carry out its declarations concerning the real incomes of the workers, even if the trade unions do not choose the money wage desired by the State. Obviously this requires a tough and a consistent policy by the State, but this is nothing new in the field of wage-determination. Consistency in economic policy is indeed always necessary if the desired ends are to be realized' (p.360).

In principle, threats may give the leadership to the government, as Pohjola (1985) remarks. So we need an explanation why the government does not use threats more often.

Let us consider three different situations.

1. There is a genuine and permanent difference between the unions' and the government's preferences. Unions want more money and less employment than the government thinks optimal. This is the setting in many studies about the interplay of the government and the trade union. Tax threats were explicit in Johansen (1977), but the case is similar with wages and public expenditure and wages and the exchange rate, see e.g. Gylfason and Lindbeck (1986, 1987) and Horn and Persson (1985).

2. The occurrence of some external shock. Consider, e.g. a major rise, expected to be temporary, in the prices of imported consumer goods. Trade unions may want to raise nominal wages and take less employment, to offset the fall in real consumption wages. The government may want to prevent this with a threat. As in the first case, there is a conflict of interests, but now temporary.

3. The unions cannot act cooperatively. Non-cooperative decisions may lead to a Nash equilibrium that are not Pareto-optimal. If there is a Pareto optimum, where wage levels are lower and employment levels higher than in the non-cooperative equilibrium, it is advantageous also for the government to force unions toward the optimum by using a tax threat. The result may not be optimal for the government, but it is better than the alternative.

Tax threats are a poor instrument in the first case, for various reasons. If threats are used systematically, from one period to another, they may create counter-threats. After all, succesful policy leaves trade unions worse off than they would otherwise have been. The situation can be compared to a devaluation policy. Hersoug (1985) e.g. says that a systematic devaluation policy would be anticipated by the union, and the union may hedge against it by demanding formal wage indexation.

A repeated threat policy would also make the government unpopular; we return to this below.

The second case is the prime focus of our analysis. We argue that a tax threat may be a good instrument. In a many-union setting, however, it has

effects on the wage distribution between unions, and this may be considered harmful.

The possibility of the third case will also appear in our analysis. In the model we will use there is room for such a policy. Tax threats are a good instrument in this situation, in principle.

Notice that if the unions could act cooperatively, this might serve as a starting point for the first case above. Despite the basic conflict of interests, there is an area where cooperation between the government and the unions is useful.

But our main emphasis is on tax threats as a temporary instrument. We analyze the policy as a one-shot game. The imminent credibility problem might warrant the reputation building approach in repeated games. A more realistic and much more difficult way would be to consider reputation in a series of games where the actors are the same but the game situations differ. One period the game could be about wages and exchange rates and the next period about wages and public expenditure. To further cite Johansen (p. 97): '... the game in which economic planning and policy take place does not usually fall into a pre-determined class of games with a reasonably transparent structure. Precisely the influencing of the nature of the game is one of the important aspects of economic planning and policy'. Tax threats would have such a minor role in these repetitions that we stick to a one-shot game.

2.3 Making threats is costly

Whether a threat is credible or not, depends on the utility function of the maker of the threat, here the government. Johansen did not include anything directly connected with making threats in the government's utility function. Later authors have not considered this, either. Yet there are reasons why threat-making should directly affect the government's utility.

The word 'threat' itself has strong negative connotations. Anyone who makes a threat without a justifiable reason, is considered to be a trouble maker. A government who in normal times systematically threatens a group in the society is seldom very popular, unless the motives of the government are generally thought important. In this respect, the case of preventing pollution is much stronger than the case of lowering wage inflation. It is important here to stress the word 'normal': in some situations a threat for

preventing wage increases may be generally accepted as a good thing. But not if used continuously, without some specific reason.

So, making a threat has some direct cost attached to it. For the government, it costs popularity points. Even if a threat is totally credible after it is presented, this does not mean that it is a good instrument. Its presentation costs may be such that it is advantageous only on rare occasions.

But in some cases the cost may be negative: if the economic situation is bad or worsening rapidly, the government is expected to do something, expected to show character. A threat policy may be cheered by the public. In normal times, however, it will be received with appallment. This, I think, is essentially what the government thinks when it considers making a threat. The possible lack of credibility may not be the only reason, or even the main reason, for not using the threat.

2.4 Cheating is costly

After a threat is made, and the possible popularity cost is paid, there may be another kind of cost. If the threat has not had the desired effect, the government has to decide whether to execute the threat or not. This is the credibility problem Johansen (1977) and Pohjola (1985, 1986) have stressed. The government clearly has a strong incentive to cheat. In the model we shall use, the tax increase would trigger more wage increases and make the situation much worse than it would have been without the threat intervention.

But there is also an opposing factor. A cheater gets a bad reputation. In many areas of business it is essential that a person's word can be trusted. 'My word is my bond', as the saying goes. In politics things appear to be different. Promises seem to be given lightly and also broken lightly. But this appearance may be deceptive, because it usually concerns large abstract subjects, such as 'the line of overall economic policy'. They are neither clearly defined nor exactly measurable, and debates about cheating and breaking of promises have a different character. An explicit tax threat, however, can be compactly and exactly defined and measured. It is possible to follow whether one breaks one's word.

If the cheater gets a bad reputation, then cheating has direct costs. And they should be included in the utility calculation of the government. This is the line we follow here.

Including cheating costs in the utility function has a side effect that to me seems realistic. It makes small threats more credible than big threats. Threats are executed if the cheating costs are greater than the costs from worsening inflation and unemployment. Doubling the tax rate would probably drive the economy into chaos, and such a threat would hardly ever be believed to be executed. A small increase in taxes, on the other hand, would not collapse the economy. Such a threat might be considered credible if the government is thought to value its own word. In the Norwegian and Finnish experiences the threated measures have been rather small.

2.5 The symmetry of tax threats and tax promises

A tax increase that is not put into force is similar to a tax relief that is put into force. So likewise a tax threat is symmetric to a tax relief promise. [3] Assume that at the start of period one the government announces the tax rate t_0, and threatens that with wages above a certain level $\bar{W}$ the tax rate will be increased to t_1. This is exactly the same that in the beginning of the period the government announces the tax rate t_1, and promises that with wages below a certain level $\bar{W}$ the tax rate will be lowered to t_0. This symmetry is consistent with the 'cost of making a threat and cost of cheating' formulation presented above. Rational agents notice that t_1 is artificially high, and deduct popularity points from the government. If the proposal is turned down by the unions and the government still lowers the tax rate, it has broken its word and is deemed 'wet'.

3 Wage formation, prices and government behavior

3.1 Monopoly union wage setting

There are several ways to model the effects of one union's decisions on the well-being of other unions. The effects may come via the demand for labor and depend on whether the unions are in industries whose products are

[3] The Norwegian experience was presented in relief form (Johansen, 1977, p. 96): 'The State Budget (was) formulated with a rather high tax level with room for later reductions in case of a wage settlement which conforms with the Government's intentions'.

complements or substitutes (see e.g. Wallerstein, 1990). The effects may also come in the form of varying alternative wages if labor can move easily between industries. A third alternative, via consumer prices, is chosen here. This choice is not crucial for the main results concerning the nature of tax threat policies.

We apply the so-called monopoly union model to the case of many trade unions. Each union is assumed to maximize its members' utility, which consists of the real net consumption wage and employment. The utility function of union i is

$$U_i = U_i(1-t)W_i/P, L_i), \quad U_{i1}, U_{i2} > 0 \tag{1}$$

W_i and L_i are the wage rate and employment of union i, t is the proportional income tax rate and P denotes consumer prices. U_{i1} and U_{i2} are partial derivatives.

As we will compare the utility levels of different wage - consumer price combinations, it is useful to make an additional assumption of the behavior of the unions: if a union is indifferent between two wage-price combinations, it will choose the one with lower price level. This assumption is similar to the 'epsilon truthfulness' assumption in Rasmusen (1990, p. 161) and it makes the preferences lexicographic. Because lower price level may be thought to be advantageous to other unions, we might call this assumption 'epsilon solidarity'.

Employment is determided by the demand for labor, and is a decreasing function of the wage rate:

$$L_i = L_i(W_i) \ , \ L_i' < 0 \tag{2}$$

The union maximizes (1) with respect to W_i, subject to (2). The condition for an inner solution is

$$U_{i1}(1-t)/P + U_{i2}L_i' = 0 \tag{3}$$

The optimal wage rate can be expressed as a function of the income tax rate and consumer price level. The second-order condition for maximum ensures that both partial derivatives are positive:

$$W_i = \tilde{W}_i(t, P) \tag{4}$$

We assume that there is a positive minimum wage below which the unions will not go. This rules out wage and price levels equal to zero in further parts of this analysis.

Inserting the optimal wage into the utility function we get the optimal utility function of union i:

$$V_i(t,P) = U_i((1-t)\tilde{W}_i/P, L_i(\tilde{W}_i)) \tag{5}$$

By direct calculation, using condition (3), it could be shown that the optimal utility is decreasing both in taxes and in consumer prices.

3.2 Wage and price equilibrium

Although unions above did not take into account the effect of their own wages on consumer prices when setting the optimal wage, they are aware that a following connection between wages and prices exist.

$$P = P(W) \tag{6}$$

where

$$W = W(W_1, ..., W_n) \tag{7}$$

The unions are assumed to act non-cooperatively, each according to equation (4). The equilibrium of the economy is found when the average wage level (7) and the consumer price level (6) are consistent with unions' wage levels. These equilibrium values can be straightforwardly solved.

The average wage level, resulting from unions' optimal wage levels, is derived by inserting (4) to (7):

$$\tilde{W}(t,P) = W(\tilde{W}_1(t,P), ..., \tilde{W}_n(t,P)) \tag{8}$$

The equilibrium level of consumer prices can now be solved from (8) and (6) and expressed as a function of the tax rate t.

$$\tilde{P}(t) = P(\tilde{W}(t,P)) \tag{9}$$

$\tilde{P}$ is an increasing function of t.

In most of what follows, we use the non-cooperative Nash equilibrium that is described by the equations above. But the wage set by each union has spillover effects to other unions through consumer prices. Thus it would

be possible to find cooperative equilibria, where all unions would be better off. Such equilibria could be found by maximizing some objective function that depends positively on the utilities of all the unions. We return to this in section 5.2.

3.3 The government's preferences

We formulate the government's utility function so that it contains only one economic variable, the consumer price level as defined in equation (6). Indirectly it may be thought of as the determinant of aggregate employment, through labor demand as in equation (2). The weighting would be different for employment, but nothing would be gained by introducing another weighting system.

Two other variables are the cost of making a threat, M, and the cost of cheating, C. These are both private costs: they do not affect the social welfare, only the popularity of the government. The cost of making a threat is assumed to vary with the overall economic situation (see section 2.3). It gets a value of 0 if a threat is not made, and a value of $\bar{M}_s$ if a threat is made in period s. The cost of cheating is thought to be a constant $\bar{C}$ if the threat is not executed although the unions have rejected the government's offer (see section 2.4). If the threat is carried out, or if no threat was made in the first place, the variable gets the value 0.

The government's utility function is thus:

$$U_G = -P(W) - M - C \tag{10}$$

Let us further assume that if the government is indifferent between two alternatives, it chooses the one with no cheating. If cheating is not involved, it chooses the one with the lower average wage level, which in this model also means a lower price level. In what follows, we assume that all unions know the government's preferences.

4 The tax threat game

4.1 The order of play

There is a specific order of play in a tax threat game. It consists of four phases.

1. Information about all the parameter values and exogenous variables is gathered. The government calculates the wage level outcome that is to come if no intervention is made. The government also calculates the optimal threat, in a way to be shown later, and decides whether or not to use the threat.

2. The unions make their wage decisions, taking the possible threat into account. If no threat was made, the game ends.

3. If a threat was made, the government audits the outcome. If the conditions of the proposal are met, taxes are not increased and the wage decisions of the unions are realized, and the game ends. If the conditions are not met, the threatened tax increase is put to force.

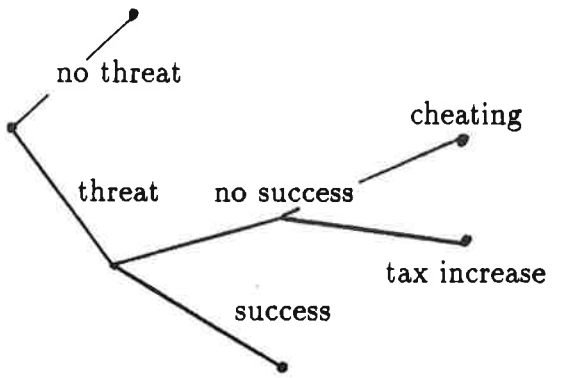
4. If the tax increase is executed, all the unions make new wage decisions, taking the increased tax rate into account.

The steps determine the information that the government has about the unions' choices, and vice versa. The sensitivity of the results of these types of games to the exact structure of information is demonstrated by Pohjola (1985). Here it is essential that although the government presents the threat first (step 1), it acts after the unions have made their choices and knows the choices (step 3)[4]. Step 4 is important because it hedges the unions against the otherwise worst possible choice: a union accepting the government's proposal would be stuck with a low wage, but because of other unions' rejections the tax rate would still be increased. Here this situation is ruled out. In the Finnish 1989 experiment there was a similar clause.

All players are assumed to have certain, symmetric and complete information (see Rasmusen, 1990, p. 51). Information is not perfect, though: in step 2 the unions do not know the decisions of other unions.

[4]This is why the game is called an inverted Stackelberg game; in an ordinary Stackelberg game the leader (the government) would move first.

Table 1:



Outcome:	Utilities:
$\tilde{P}(t_0)$	$-\tilde{P}(t_0)$
t_0	$V_i(t_0, \tilde{P}(t_0))$
$\tilde{P}(t_0)$	$-\tilde{P}(t_0) - \bar{M}_s - \bar{C}$
t_0	$V_i(t_0, \tilde{P}(t_0))$
$\tilde{P}(t_1)$	$-\tilde{P}(t_1) - \bar{M}_s$
t_1	$V_i(t_1, \tilde{P}(t_1))$
$< \tilde{P}(t_0)$	$> -\tilde{P}(t_0)$
t_0	see Section 4.5 -

Table 1 summarizes the various outcome and utility possibilities. For each outcome, the utility of the government is indicated above and the utility of union i is below in the far right column.

4.2 Desired properties of a tax threat

The tax threat is a triplet $(t_1, \bar{W}, F)$, where t_1 is the tax rate that will be put into force if a bigger share than F of the trade unions forsake the proposed ceiling $\bar{W}$ to wage levels. $\bar{W}$ is a single number, common to all unions. The share F means the number of employees belonging to unions that forsake the proposal, compared to the total labor force. The threat is made whenever the gain from the threat, through lower price level, is greater than the cost of making the threat.

We will call a threat an optimal tax threat if it satisfies the following three conditions.

1. The threat is credible,

2. at most the share F of rational unions will reject it, and

3. from the threats satisfying the two conditions above, it leads to the highest value of the government's utility, that is, to the lowest average price level. 'Optimality' is thus defined from the government's point of view.

Next we show how the government can find proper values for the triplet $(t_1, \bar{W}, F)$ so that the result is optimal. First we show that the credibility depends on t_1 but not on $\bar{W}$ and F.

4.3 Credible tax threats

The threat is credible whenever the cost of cheating is greater than the loss from executing the threat, which results in unions setting even higher wages than they originally would have done.

Using the government's utility (10) and the expression (9) for P, we find t_1 so that

$$\tilde{P}(t_1) - \tilde{P}(t_0) \leq \bar{C} \tag{11}$$

It is clear that the t_1 to be chosen is the one that satisfies (11) as an equality when we search for an optimal threat.

We note that the credibility of a threat does not depend on the proposed wage level or on the allowed rejection share. This is not surprising, because credibility is a question of what happens if the proposal is rejected, and then $\bar{W}$ and F play no role any more.

Formulating credibility to depend on the size of the threat has important effects on the outcome of the game. If credibility is taken as given, as in e.g. Salman and Cruz (1981), the government can set the threat so high that it achieves its target completely. In this model it could press the wage levels arbitrarily low. In our formulation this is not possible.

4.4 How to set the wage limit

After the threatened tax increase is determined from the credibility constraint (11), the government has to set a common wage limit for all unions and a statement of how many unions or how large a share of the unionized labor

force is allowed to reject the proposal without triggering the tax increase [5].

We need to show that all necessary calculations can be made by all participants in the game. But since they have the same information we have, it is enough to show how the optimal threat is found.

We classify the unions into three groups. Group R consists of those unions who reject a certain proposal (threat). Group A is the set of unions who accept the offer and are restricted by the wage limit. Group B consists of unions who accept the offer but are not restricted by the wage limit, because their optimal wage is below the limit.

The task now is to find a solution to a slightly different non-cooperative game than the wage-setting game described in equations (1) - (9). The difference is that some unions' wages are not set optimally but instead set equal to a fixed value. Thus equations (8) and (9) are not valid.

The government must do some calculations for all possible divisions of unions into groups A and other groups. During these calculations, the division of unions not in A into R and B will be made. From n unions the group A can be formed in 2^n different ways.

For a given A, the government's problem can be expressed as a mathematical programming problem:

$$\min_{\bar{W}} P = P(W) \tag{12}$$

subject to

$$W_i = \bar{W} \ , \ \ \forall i \in A. \tag{13}$$

$$V_i(t_1, \tilde{P}(t_1)) \leq U_i(\bar{W}, t_0, P(W), L_i(\bar{W})) \ , \ \ \forall i \in A. \tag{14}$$

$$W_i = \tilde{W}_i(t_0, P(W)) \ , \ \ \forall i \notin A. \tag{15}$$

$$W = W(W_1, ..., W_n) \tag{16}$$

The government maximizes its utility by minimizing (12) with respect to $\bar{W}$, subject to the conditions (13) - (16). Condition (13) tells that the wages of unions in A are set to $\bar{W}$. Condition (14) expresses the fact that

[5] It is impossible to defend the choice of a common limit in this model, because union-wise limits are manifestly better. The reason why common limit (for wage increases, not levels) policies are used in practise is probably the lack of sufficient information concerning the situation and preferences of different unions. That makes both kinds of policies a gamble, but the chances of success are probably better with the common limit.

the utility of any union in group A must be at least as high as it would be if the threatened tax increase were put into effect. Otherwise the union would reject the proposal and thus belong to group R. Condition (15) gives the wage setting of unions that are not in A, and equation (16) gives the connection between unions' wages and the average wage level.

There are points that satisfy conditions (13) - (16), the no-threat equilibrium being one of them. The free minimum of (12), driving wages to minus infinity, is not possible as it violates (14). The solution therefore must be on the boundary. At least one union must be restricted exactly to the alternative utility level, otherwise the threat would not be optimal because a lower limit could be set without triggering any more rejections of the proposal. So, for some union $k \in A$, it must be that

$$V_k(t_1, \tilde{P}(t_1)) = U_k(\bar{W}, t_0, P(W), L_k(\bar{W})) \tag{17}$$

The government solves the above programming problem for all possible divisions of unions into A and other groups, and chooses the solution that gives the lowest price level[6]. The optimal wage limit $\bar{W}^*$ is thus found in this manner.

Next the optimal wages for unions not in group A are calculated. If the wage for such a union is above $\bar{W}^*$, the union is classified into group R. Otherwise the union belongs to group B. The accepted share of rejections F^* is simply the total size of unions in R in the optimal solution. F cannot be set to a lower value, because all the unions in group R would reject the proposal anyway, and then the whole proposal would be deemed rejected. Setting a higher value for F could, on the other hand, create a possibility for free-riding for unions in group A; the incentive clearly exists.

4.5 Distributional effects of tax threat policies

Provided that the parameters of the threat are set properly, the government achieves a lower price level and higher employment than without the threat. These aggregate effects are clearly favourable. But the policies affect also the

[6]For a given A, the solution may have the drawback that the optimal wage for some union in A might be below $\bar{W}$. That cannot, however, be true in the solution that gives the lowest price level.

wage distribution between the unions. These effects can be deducted from the properties of solutions to mathematical programming problems.

Some unions, the group R, reject the offer and resort to their optimal wage setting. Because some other unions lower their wage levels, prices will be lower, and also optimal wages will be lower. That means higher labor demand and greater utility for unions in R.

Then there are unions in the group A who accept the proposal and whose wage levels are restricted. Whether their utility is lowered or increased is not clear, because for some unions the increase in employment might offset the decrease in the real net wage. But if the government's policy is optimal, then there is at least one union k whose utility falls to the acceptance limit $V_k(t_1, \check{P}(t_1))$.

The last group of unions is B: they accept the proposal but set their wages optimally, because the result is below the proposed wage ceiling. These unions benefit from the policy by the same reasoning as group R.

We can make one statement concerning the division of unions into these groups in the optimal policies. There is at least one union in group A. Groups R and B may be empty. All depends on the preferences of the unions and other parameters of the model.

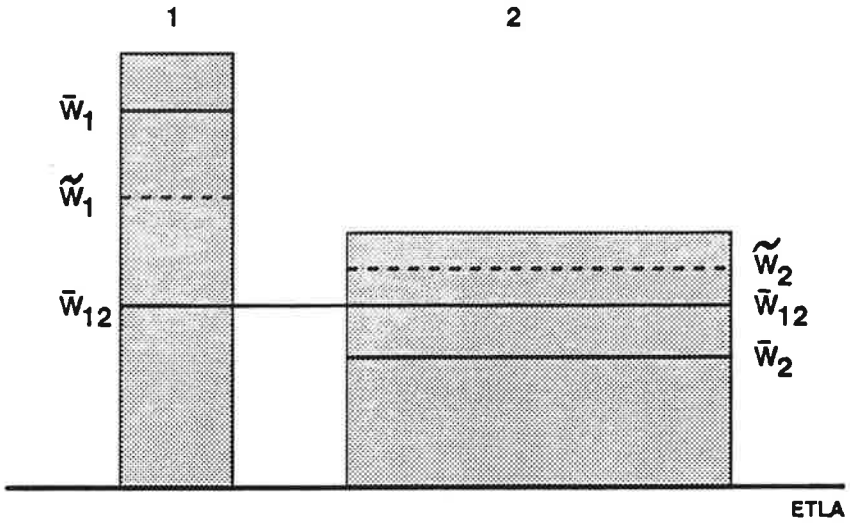
Other things being equal, unions that have higher effect on the consumer price level are more likely to be in the group A than unions whose wages have smaller effects on consumer prices. So large unions and/or unions in the sheltered sectors of the economy are more likely to belong to group A. Restricting their wages have greater effect on other unions' wages (through consumer prices) than vice versa.

4.6 An illustration

Let us consider an economy with two trade unions. Their wage setting is illustrated in Figure 1. The height of the bars denote the wage levels that would have been set in the absence of tax threats. The width of the bars denote the sizes of the unions.

The government decides to make a threat. The threatened tax increase is found from the credibility constraint (11). The proposed wage level is calculated according to the procedure of the previous subsection. With two unions, there are four possibilities for group A. It may consist of union 1,

Figure 1: A two-union example



union 2, both unions, or be empty. The last alternative does not require consideration.

With the threat to increase taxes from t_0 to t_1, the government can achieve the wage level $\bar{W}_1$ for union 1, if it restricts only that union. Union 2 would then set its wage optimally to $\tilde{W}_2$; it is below the wage level that would have been set without the threat, because the wage of union 1 is lower, and thus also the price level is lower. If the government restricts only union 2, the resulting wage levels would be $\bar{W}_2$ for union 2 and $\tilde{W}_1$ for union 1. If both unions are restricted the outcome would be $\bar{W}_{12}$ for both unions. Which of these is chosen?

Since the price level is an increasing function of the average wage level, it is sufficient to calculate the average wage level in each alternative. Let us denote the share of union 1 of the total employment by α. The wage levels are $\alpha\bar{W}_1 + (1-\alpha)\tilde{W}_2$ if union 1 is restricted, $\bar{W}_{12}$ if both unions are restricted, and $\alpha\tilde{W}_1 + (1-\alpha)\bar{W}_2$ if union 2 is restricted. If we assume that the last is the lowest, then $\bar{W}$ is set equal to $\bar{W}_2$ and F is set equal to α. When the government makes this threat, union 2 realizes that union 1 will

reject the proposal, and that if union 2 would also reject it taxes would rise. Union 2 consults its preferences, behaves rationally and accepts the proposed wage level. It thus belongs to group A, and suffers from the policy. Union 1 belongs to group R, and benefits from the policy. Group B is empty.

5 Remarks on other types of tax threats

5.1 Threats with union-wise wage limits

If the government can set union-wise limits $\bar{W}_i$, it achieves a lower price level than when it sets a common wage limit to all unions. We show how to find such limits with $F = 0$, so that no union is allowed to reject the proposal.

When the government is trying to find a value for the wage limit for union i, it searches from the points where utility of union i is equal to what it would get if taxes were increased to t_1. The other requirement is that the aggregated wage limits must form the consumer price level that is used in calculating the utilities.

Equating the utilities gives

$$U_i(\bar{W}_i, t_0, P, L_i(\bar{W}_i)) = V_i(t_1, \tilde{P}(t_1)) \tag{18}$$

and the aggregating condition for the wage limits gives

$$P = P(\bar{W}) = P(W(\bar{W}_1, ..., \bar{W}_n)) \tag{19}$$

There are n equations of type (18), plus one (19), and there are $n + 1$ unknowns $\bar{W}_i$ and P together. There may be many solutions to this system of equations, but at least one can be assumed. From the solutions the government then chooses the one with highest government utility, that is, with the lowest average wage level. The optimality of the obtained threat is self-evident.

There is not much to be said about the properties of the found threats, except that under the assumptions made, rational unions will set their wages lower than they otherwise would have done. An optimal policy leaves all unions with lower utilities, lower real net wages and higher employment.

Let us also note that the government need not use the limits $\bar{W}_i$ when presenting the threat. If the chosen solution gives a unique minimum for

W among the set of solutions, then the government merely announces that unless the average wage level is at most the minimum for W, the tax rate will be increased to t_1. The unions, the perfect logicians as they are, then calculate the limits themselves.

5.2 Threats with Pareto superior outcomes

As we noted earlier, there is room for the use of tax threats to achieve outcomes Pareto superior to the Nash equilibrium that would result without any threats. There is a multitude of such solutions. We concentrate on cases where the government chooses the best outcomes from its own point of view, with the restriction that no union is worse off than it would be at the Nash equilibrium with no tax threats.

We will call a threat an optimal restricted tax threat if it satisfies conditions 1, 2 and 3 in section 4.2 with the added restriction that no union is worse off than it would have been without threats[7].

For the optimal restricted threat, any threatened tax increase would be sufficient; we use t_1 also in this case.

Let us first consider the case of setting a common wage limit to all unions. The procedure for finding the optimal restricted threat is otherwise similar than in section 4.4 except that condition (14) is replaced by (20):

$$V_i(t_0, \tilde{P}(t_0)) \leq U_i(\bar{W}, t_0, P(W), L_i(\bar{W})) \ , \quad \forall i \in A. \tag{20}$$

Again the no-threat Nash equilibrium satisfies the constraint. It is evident that other possible solutions also exist. Consider, e.g., what happens if, starting from the Nash equilibrium, one union would lower its wage. To a first degree approximation, the utility loss from the wage would be exactly offset by the increase in employment. As other unions would also lower their wages because of a fall in the price level, all unions would be better off. Reducing the wage further, however, would eventually lead to a point where the utility from increased employment is small and wage reduction diminishes utility. This would certainly happen when the economy approaches full employment. So, there is a point where the utility would be the same as in the original equilibrium. Similar possibilities arise if several unions start to lower their

[7]Optimal restricted tax threat brings the game very close to a team model. See Rasmusen (1990, p. 170).

wages together. This kind of behavior is not optimal for the unions, if there are no threats, and thus cannot lead to an equilibrium. But it may become optimal if the government sets the threat properly.

If the government adheres to the optimal restricted policy with a common limit, then by definition no union ends up with lower utility. There is at least one union in group A that has the same utility level than without the policy. All unions in group A have lower real net wages, but the increase in employment compensates this. Unions in groups R and B have higher employment and higher utility than they would have had without the threat. Their nominal wages have fallen; the directions of change of their real net wages is not known.

If the government sets union-wise wage limits, the procedure for finding the optimal restricted tax threat is otherwise the same as in section 5.1 but equations (18) are replaced by (21):

$$U_i(\bar{W}_i, t_0, P, L_i(\bar{W}_i)) = V_i(t_0, \tilde{P}(t_0)) \tag{21}$$

The no-threat Nash equilibrium is one solution to this group of equations. Whether other solutions exist is not clear. A reasoning similar to that with the common limit restricted threats would, however, indicate that it is possible.

An optimal restricted policy gives the unions exactly the same utility levels but lower real net wages and higher employment than they would have got if the threat had not been presented.

6 Concluding remarks

We have analyzed tax threats as an inverted Stackelberg game between the government and many trade unions. The credibility problem was formulated to depend on the size of the threatened tax increase. Thus there was an upper limit to the conditional tax increase, and we sought optimal values of the proposed wage limits and of the share of rejections that is allowed without triggering taxes to be raised to that limit. With rational union behavior, the policies work. Employment is higher and the price level lower than they would have been without the threat. The threatened tax increase will not be put into force.

Tailoring is the essence of a succesful tax threat policy. Earlier we cited Calmfors (1989) as saying that tax relief is perhaps are not a good instrument in a many-union economy, because tax cuts cannot be tailored differently for different unions (in practise). But here we saw that tax threats are entirely different in this respect. Although the threat was expressed as an increase in taxation that is the same for all unions, the setting of the threat was explicitly done by tailoring it to those unions who, when accepting the proposal, would lower their wage demands so that the effects were maximal. As we remarked earlier, there is an exact correspondence between tax threats and tax relief promises. A conditional tax reduction executed is similar to a conditional tax increase not executed, so if a threat can be tailored, so can the reduction.

The key word, of course, is 'conditional'. What really was tailored was the conditions under which the threat might be executed, not the tax rate that would then result. Nothing in our analysis suggests that Calmfors was wrong in saying that tax reliefs cannot in practise be tailored. But that must not be interpreted as denying the power of conditional tax reliefs in a multi-union economy.

Perhaps it is useful to reconsider how the tailoring was done. It was not done by saying that 'if Union ABC exceeds a wage level $\bar{W}$, then taxes will be increased'. The names of individual unions were not mentioned. But they were still present there. Some unions were mentioned in F, the accepted share of rejection. Although F was expressed as a share, each threat was made so that all unions could calculate which unions would reject the proposal. It was necessary for the succession of the proposal that each union would know this. Some other unions were mentioned in the sense that they would accept the threat but still could set their wages according to the original optimal rule, because that would lead to lower wage levels than the proposed ceiling. Again, all unions could calculate which unions belonged in this group. The rest of the unions were then those who had to accept the proposal and whom it really restricted. And, for each threat, the identity of these unions was known to all, although they were never mentioned.

This tailoring feature may in fact be one reason why tax threats are so rarely used. Any threat of the common limit type we have considered can be interpreted as a threat tailored towards some unions, irrespective of whether that was the aim of the government or not. This may arouse aggression among those unions, and when agitated, behavior is not always rational.

Tailoring has also different effects on different unions, both regarding

wages, employment and utilities.

The use of threats is likely to be restricted to temporary policy packages. But if one union's wages affect the consumer prices and thus the utilities of other unions, and if the unions are unable to cooperate between themselves, there is room for recurrent tax threat policies. The threat then forces the unions to make agreements that are Pareto superior to the noncooperative equilibrium.

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