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**Working Paper — Digitized Version**

## Endogenous tariff formation in a political market for protection

Kiel Working Paper, No. 224

**Provided in Cooperation with:**

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*Suggested Citation:* Klepper, Gernot (1984) : Endogenous tariff formation in a political market for protection, Kiel Working Paper, No. 224, Kiel Institute of World Economics (IfW), Kiel

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# Kieler Arbeitspapiere

# Kiel Working Papers

Working Paper No. 224

Endogenous Tariff Formation  
in a Political Market for Protection

by  
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December 1984

Institut für Weltwirtschaft an der Universität Kiel

ISSN 0342-0787

Kiel Institute of World Economics  
Düsternbrooker Weg 120, 2300 Kiel

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Ag 536 / 85  
Weltweit  
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\*The author would like to thank F.D. Weiss for helpful comments and for being a patient audience during the development of this paper. Funding by the Krupp-Stiftung is gratefully acknowledged.

## Introduction

"The proposition that freedom of trade is on the whole economically more beneficial than protection is one of the most fundamental propositions economic theory has to offer for the guidance of economic policy."<sup>1</sup> Based on this proposition JOHNSON wrote his classical paper on the cost of protection as a critique on a myriad of counterarguments for protection. Today, not many of the cases for protection have survived in scientific discourse. Yet, tariffs or other trade barriers are a prevalent feature of world trade and it seems that the pressure to promote free trade leads merely to a substitution from - easily observable - tariffs to disguised non-tariff barriers.

In this paper a partial equilibrium model explaining the existence of protective measures a tariffs or non-tariff barriers (NTB's) is formulated. Through a model with endogenous determination of protection the factors influencing the level of protection can be determined. The social cost of protection then consists of the well-known welfare triangles and the cost of lobbying. Since these results can not be computed directly, a comparative static analysis will indicate the behavior of the relevant variables in equilibrium.

Of course, this analysis rests on a history of research on international trade and political economy of protection. Three main research areas should be mentioned; the literature on the social cost of protection, the theory of endogenous tariff formation, and the new political economy.

The classical analysis for the determination of social costs of protection is JOHNSON's (1960) "The Cost of Protection and the Scientific Tariff"<sup>2</sup>. Protection can be represented by the difference between the domestic and the world market

price for a commodity ( $\bar{p} - p_w$ ). Given such a price differential, the cost of protection is measured as the sum of the areas  $L_1$  and  $L_2$ .<sup>3</sup>

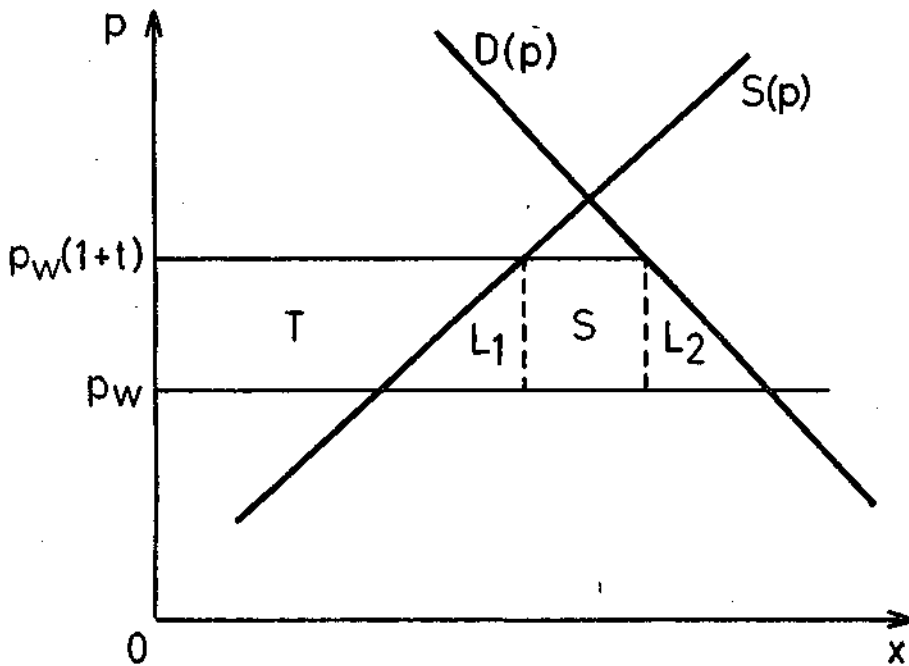


Figure 1

Depending on the system of protection the area  $S$  is partly or completely social cost. In the case of a tariff it represents tariff revenues, i.e. it is no cost, provided tariff collection is costless. For voluntary export restriction, e.g.,  $S$  is a social cost.

The area  $T$  is, according to JOHNSON, a transfer from consumers to producers but no social cost. This has been questioned by TULLOCK (1967) based on the premise, that governments will not impose tariffs of their own, since they are welfare reducing. Rather, they have to be pressured to do so by special interest groups.

"One would anticipate that the domestic producers would invest resources in lobbying for the tariff until the marginal return on the last dollar so spent was equal to its likely return producing the transfer. There might also be other interests trying to prevent the transfer and putting resources into influencing the government in the other direction. These expenditures, which may simply offset each other to some extent, are purely wasteful from the standpoint of society as a whole; they are spent not in increasing wealth, but in attempts to transfer or resist transfer of wealth. I can suggest no way of measuring these expenditures, but the potential returns are large, and it would be quite surprising if the investment was not also sizable."<sup>4</sup>

The same view, although in a slightly different context, has been taken by KRUEGER (1974).

"... rent seeking is one part of an economic activity, such a distribution or production, and part of the firm's resources are devoted to the activity."<sup>5</sup>

Since KRUEGER only analyses the distribution of existing rents, the social cost of creating rents have to be added to Krueger's cost of rent-seeking. McCULLOCH (1979), therefore, sees competitive efforts from different interest groups to influence governments for protective measures.

"The net effect is to turn economic activity away from the production of goods and services available to the final consumer and toward attempts to influence the legislative and administrative process ... The loss thus incurred is probably far greater than any of the present estimates of the cost of protection; for every applicant, many others who have made similar investments have been turned away."<sup>6</sup>

All these authors have two things in common. They emphasize the need to treat lobbying just like any other economic activity, and they are rather nebulous when it comes to estimating the probable social cost of these activities. This paper is an attempt to clarify the proper measurement of social costs under the premise employed by these authors. But at the same time it ignores many aspects which have been investigated in the literature of the so called "New Political Economy".

Lobbying and endogenous tariff formation in the spirit of the "New Political Economy" have been investigated by BROCK/MAGEE (1978, 1980) and by FINDLAY/WELLISZ (1980). Both approaches use general equilibrium models, but with different emphasis on certain aspects of the politico-economic process.

BROCK and MAGEE construct a political equilibrium with two politicians, who maximize their respective probability of becoming reelected. The probability of being reelected is an increasing function of the own campaign contributions and the promised protection of the other politician. It is inversely related to his own level of promised protection and the other politician's campaign contributions, which are assumed to be financed from lobbying expenditures. There are two lobbies; an anti-protectionist consumer lobby and a protectionist producer lobby. Consumers can not organize themselves effectively so that they can influence the politicians through their votes only. Those producers, however, who are able to form an effective lobby, will obtain protection through campaign contributions.





the result of political decisions is a tariff rate which is an increasing function of the resources spent by the protection seeking group and a decreasing function of the protection opposing group. In a specific factors general equilibrium model the owners of these factors constitute opposing interest groups lobbying for, or against, a tariff. The resulting non-cooperative Nash-equilibrium uniquely determines a tariff level and the deadweight loss measured through resources spent for lobbying. Since the equilibrium tariff can be between zero and a prohibitive level depending on the relative strength of the interest groups, it clearly follows that the social cost due to lobbying are, in general, not an increasing function of the tariff level.

The more empirically oriented studies of the "New Political Economy" do not have very much in common with the abstract conceptual models above but the idea of a political market for protection. This research<sup>7</sup> tests different variables for their potential in explaining the level and/or the pattern of protection.

Most authors work - implicitly or explicitly - with a political market for protection with import-competing producers as demanders and a government as the supplier of protection [ANDERSON/BALDWIN (1981), pg. 2-3; GLISMANN/WEISS (1980), pg. 1]. Demand for protection becomes effective through industry lobbies which "will select the level of lobbying expenditures which yields the degree of protection that maximizes the difference between its producer surplus gains and the costs of lobbying." [ANDERSON/BALDWIN (1981), Pg. 4]. The supply of protection is determined by a DOWNSian politician [DOWNS (1957)], who maximizes his probability of reelection by financing his campaign with funds from lobbies.

With this general framework in mind, proxies are sought which are supposed to capture determinants of the pattern of protection. ANDERSON and BALDWIN (1981) have collected several country studies following this approach. Instead of discussing the appropriateness of the choice of variables and the estimation, we will make some conceptional remarks which have influenced the formulation of the model developed in this paper.

If one accepts the existence of a political market for protection, then it is natural to model the demand as well as the supply side as a maximization process. The resulting equilibria represent the simultaneous outcomes of this maximization. Before demand for protection appears on the political market industries must form a lobby to promote their protectionist interests. This formation requires industry specific organization costs. OLSON (1965) has provided valuable insight in this aspect. Given the process of lobby formation, costs and benefits of protection to an industry have to be determined. On the political market, then, several lobbies compete for protection thus determining external costs of protection. On the supply side a model of the political decision process should be formulated of which the political market for protection is a part. It goes without saying, that such an ideal approach can not be realized. The empirical studies in the spirit of the "new political economy" have chosen to focus of the outcomes without exact examination of the comparative static or dynamic properties of the processes determining these outcomes.

It is our suspicion, however, that some of the hypotheses entering the estimation for the determination of patterns of protection are not investigated deeply enough with respect to their internal rationality and with respect to their

compatibility. This paper is an attempt to analyse some of the issue mentioned above. Before we outline the subsequent sections, a summary of topics excluded from the analysis is in order.

The internal formation of lobbies as well as their costs of organizing, communicating, policing and distributing are ignored. With this assumption it is possible to view an industry and its lobby as identical units with a well-defined objective function. Then the demand side of the political market can be formulated in a straightforward manner. The level of abstraction is even higher on the supply side. Due to the lack of an economic theory of political decision processes the form of the supply function of protection will be determined on plausibility arguments instead of a model of the political process. We feel, however, that results would not change significantly, if the model would be supplemented by a complete optimization problem of politicians.<sup>8</sup>

In such a restricted model the determination of protection, measured as the price difference between world market and domestic prices, is our main concern. When possible, we indicate the welfare effects of the endogenously determined level of protection, i.e. the social cost of protection. Two questions will be answered in the subsequent models. Given some, parametrically determined, political situation, what is the relation between the commodity production decision and the lobbying expenditures of an industry<sup>9</sup>, and what are the effects of parameter changes? The parameters considered are the world market price level, the political situation as far as protection is concerned, and the technology of commodity production. The second question addresses the determinants of the pattern of protection and its comparative static properties.

In the next section a simple model of a simultaneous lobbying and production decision of one industry is formulated. The political situation is condensed in a "lobby cost function" which represents the lobbying expenditures necessary to obtain a specific tariff rate. The optimal tariff rate - from the view of the industry - is derived through profit maximization. In a quadratic example the situation is illustrated graphically, making the interdependency between commodity and lobbying decisions transparent. The subsequent comparative static analysis shows some surprising results. In a purely economic argumentation the optimal tariff rate increases with rising world market prices and improved technology. Or, if it is put the other way around, higher protection with falling world market prices or relatively declining technologies cannot be explained by purely monetary arguments.

A duality approach is used to explain the pattern of protection. Two industries compete on the political market for protection. In a Nash-equilibrium framework optimal tariff rates are determined. It is assumed that lobbies invest only in the protection of their own industry, but not against protection of other industries.<sup>10</sup> The comparative static analysis shows, that the reaction functions of both industries are negatively sloped. Hence, parameter changes have reciprocal results on the two industries. That is, a parameter change in industry *i* will have the effect on that industry as described in the one-industry model; the effect on the other industry is just the opposite.

### THE ONE-INDUSTRY CASE

We first investigate the determination of protection simultaneously with the production decision in a partial-equilibrium framework with one industry. The small country assumption is valid so that the supply of the rest of the world is perfectly elastic and the world market price  $p_w$  is given. The industry produces one good  $x$  and invests in lobbying to obtain a tariff rate

$$t = \frac{\bar{p} - p_w}{p_w}$$

where  $\bar{p}$  denotes the domestic price of good  $x$ .

The supply of protection, measured through  $t$ , is determined by a government or politicians. The decision makers in the government have, besides some private ethical and monetary interests, one major objective, namely to stay in power by winning the next election. Therefore, one can describe their objective as maximizing the probability of getting a majority of votes. Voters, on the other side, are influenced in their voting decision by the relative size of the campaigns of politicians and by their own perception of their well-being as far as it is related to governmental policy. Both factors go in the same direction; raising campaign funds lead to a more effective presentation of the success of the government, and - positively correlated with it - higher perceived well-being leads to more votes for the incumbents.

Since most voters are consumers, the well-being of a voter can be approximated by the sum of consumers surplus in his different consumption activities which depends on his income and domestic prices. But domestic prices themselves are

partly determined by the protection granted by the government. Therefore, any protection of a commodity granted by the government will have a slight effect on the consumer-price-level and leads, *ceteris paribus*, to a loss of votes. Such losses, however, can be compensated by more than proportionate increases in campaign expenditures [ANDERSON/BALDWIN (1981), pg. 10.]<sup>11</sup>

Since campaigns are to some extent - this differs from country to country - financed by contributions, e.g. from industry lobbies, the supply function for protection can be derived from the politician's objective to win the next election. In order to receive a majority of votes, an incumbent politician needs high utility levels of voters, that is, among other things, low tariff rates or higher tariff rates with even higher campaign funds. Hence, the supply function for protection

$$t = \tau(m), \quad m = \text{contributions}$$

will be concave.

From the view of an industry, the supply function for protection of the government looks like a cost function. We construct this cost function  $s(t)$  simply by inverting the supply function  $\tau(m)$ , i.e.

$$s(t) = \tau^{-1}(t).$$

Therefore, it becomes increasingly costly for any lobby to obtain additional protection. Hence  $s(t)$  is convex and - in addition - assumed to be at least twice differentiable, i.e.

$$\frac{\partial s}{\partial t} = s'(t) > 0; \quad \frac{\partial^2 s}{\partial t^2} = s''(t) > 0.$$

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For simplicity reasons it is assumed, that there are no fixed costs, i.e.  $s(0)=0$ . This is no severe restriction, since fixed costs  $s(0)>0$  could be considered as an ex ante reduction of the transfer  $T$ <sup>12</sup>.

In order to avoid unnecessary complications it is convenient to investigate only circumstances which do not result in eliminating all imports. Again, this is not a severe assumption, since, in terms of the industries lobbying decisions, the inclusion of prohibitive protection would only result in an upper bound on lobbying once imports have ceased to exist. In terms of the production decision, however, things might become more complicated under prohibitive protective measures. The industry could now act as a monopolist, if it consists of just one firm, or as a cartel or cooperative oligopoly in case of a relatively small number of firms in the industry. This would involve additional social costs which are not subject of this study.

The commodity production technology can be described by a convex, at least twice differentiable cost function  $c(x)$ , i.e.

$$\frac{\partial c}{\partial x} = c'(x) > 0; \quad \frac{\partial^2 c}{\partial x^2} = c''(x) > 0.$$

The profit maximization problem of the industry can be formulated as

$$(1) \quad \max_{x,t} p(1+t)x - c(x) - s(t).$$

The necessary conditions for a maximum are

$$(2) \quad p(1+t^*) - c'(x^*) = 0$$

$$(3) \quad px^* - s'(t^*) = 0,$$

where  $(x^*, t^*)$  are the optimal output and protection levels.  
For sufficiency the following conditions must hold:

$$(4) \quad c''(x^*) > 0$$

$$(5) \quad c''(x^*) s''(t^*) - p^2 > 0.$$

(4) follows from the assumptions and (5) requires the slope of the marginal cost curves to be sufficiently large.

From (2) the supply of  $x$  as a function of the domestic price can be derived as the inverse of

$$(6) \quad \bar{p} = c'(x).$$

The determination of  $x^*$  as a function of the world market price  $p$  follows from equations (2) and (3) simultaneously. Since the two equations can not be solved explicitly for  $x^*(p)$  and  $t^*(p)$ , the results are illustrated by an example.

#### A QUADRATIC EXAMPLE

Let the cost functions be of the form

$$c(x) = \frac{1}{2} ax^2$$

$$s(t) = \frac{1}{2} bt^2$$

with  $a > 0$ ,  $b > 0$ .

The industry will maximize profits, i.e.

$$\pi(x, t) = p(1+t)x - \frac{1}{2} ax^2 - \frac{1}{2} bt^2.$$



The necessary and sufficient conditions for a maximum are

$$(7) \quad p(1+t^*) - ax^* = 0$$

$$(8) \quad px^* - bt^* = 0$$

$$(9) \quad ab - p^2 > 0.$$

With  $a > 0$ ,  $b > 0$  all conditions for a maximum are met and the optimal values  $x^*$  and  $t^*$  can be computed. From (7) and (8) we get

$$(10) \quad x^*(p) = \frac{bp}{ab-p^2}$$

and

$$(11) \quad t^*(p) = \frac{p^2}{ab-p^2}$$

The supply function as a function of the domestic price  $\bar{p}=p(1+t^*)$ , i.e. given the optimal lobbying  $t^*$ , is

$$(12) \quad x_o(\bar{p}) = \frac{1}{a} \bar{p}.$$

In order to determine  $x^*$  and  $t^*$  graphically, we need equations (10) and (12).

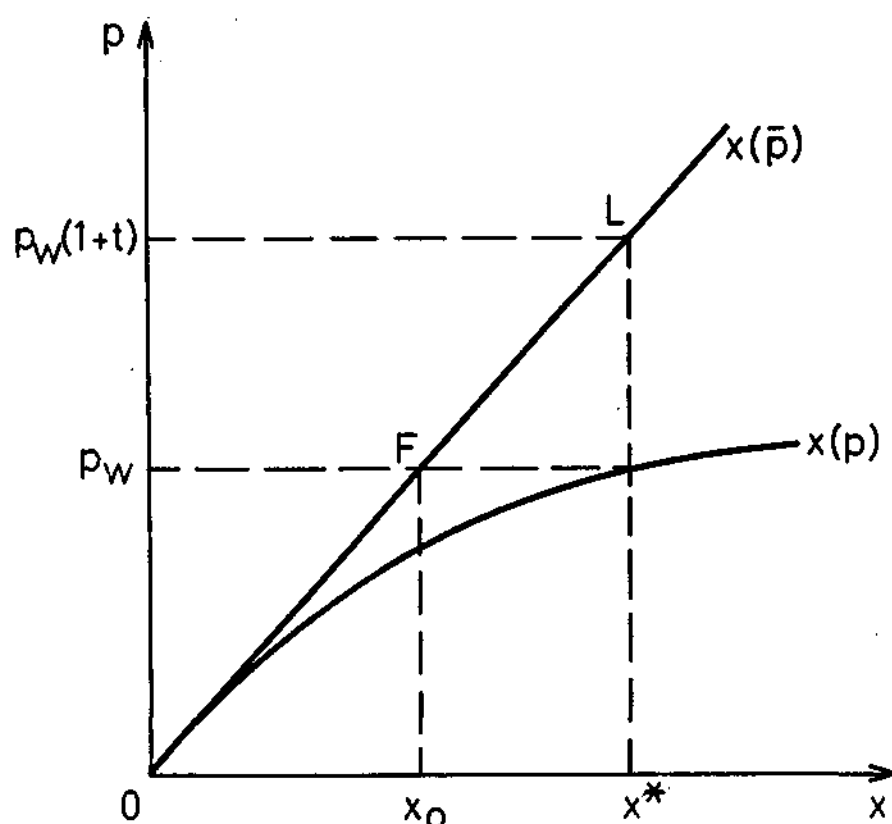


Figure 2

In Figure 2 the optimal supply  $x^*$  for a given world market price  $p_w$  is determined by  $x(p_w)$ . The domestic price  $\bar{p} = p_w(1+t^*)$  is given by the intersection of  $x^*$  with the marginal cost curve  $x(\bar{p})$ . Without lobbying the supply of the domestic producers would be  $x_0 < x^*$  at the world market price  $p_w$ . This also holds for the general case of equations (1) through (5). The details are shown in the appendix (Lemma 1).

In the quadratic example it is easy to show, how much of the redistribution from consumers to domestic producers is lost because of lobbying activities. The area  $T = p_w \bar{p} L F$  is the consumer surplus lost - due to protection - which goes to the domestic producer. The producer, however, has lobbying cost of  $s(t^*)$ . Then the proportion of the area  $T$  which is lost is equal to  $s(t^*)/T(p)$ .

From the definition of  $s(t)$  we have the optimal lobby cost

$$(13) \quad s(t^*) = \frac{1}{2}bt^*(p)^2 = \frac{bp^4}{2(ab-p^2)^2}$$

The area  $T$  is determined as

$$(14) \quad T(p) = \bar{p}x^*(p) - p_w x_0(p) - \int_{x_0}^{x^*} \frac{\partial c(x)}{\partial x} dx$$

Since the marginal cost curve goes through the origin and is linear and together with

$$(15) \quad x_0 = \frac{p}{a}$$

equation (14) reduces to

$$(16) \quad T(p) = \frac{1}{2} [p(1+t^*(p))x^*(p) - \frac{p^2}{a}].$$

After substituting equations (10) and (11) into (13) and (14) and rearranging terms  $\frac{s(t^*)}{T}(p)$  becomes

$$(17) \quad \frac{s^*}{T}(p) = \frac{ab}{2ab-p^2}.$$

From (17) and the second order condition (9) one can immediately see, that

$$\frac{1}{2} \leq \frac{s^*}{T}(p) < 1.$$

For the quadratic example we can summarize, that at least half of the are  $T$  - the redistribution from consumers to domestic producers - is used up for lobbying purposes. With increasing world market prices lobby costs  $s(t^*)$  rise relatively faster than the gain from lobbying  $T$ .

The net gain  $T(p) - s[t^*(p)]$ , however, is still an increasing function in  $p$ , i.e.

$$\frac{d(T-s^*)}{dp} > 0.$$

(For the derivation see LEMMA 2)

Therefore producers will always increase their lobbying efforts, when there is a rise in the world market price.

It is interesting to investigate in this example the relation between the technology in the production of  $x$  and the social cost incurred through lobbying. Changes in production technology can be represented by a variation of the parameter  $a$  in the cost function  $c(x) = \frac{1}{2}ax^2$ . If  $da < 0$ , there has been technical progress in the production of  $x$ .

From equations (10) and (11) the effect of technological change on the optimal output and protection level  $x^*$  and  $t^*$  can be determined as

$$(19) \quad \frac{\partial x^*(p, a, b)}{\partial a} = \frac{-b^2 p}{(ab - p^2)^2} < 0$$

and

$$(20) \quad \frac{\partial t^*(p, a, b)}{\partial a} = \frac{-ap^2}{(ab - p^2)^2} < 0.$$

The increase in output  $x^*$  through an improvement in technology,  $-da$ , at constant world market prices can be decomposed in two effects. First, there is, what may be called the pure production effect. The decrease in  $a$  lowers the marginal cost curve, i.e. moves the supply curve to the right. As one can see in Figure 3, output of the industry will increase from  $\bar{x}^*$  to  $\hat{x}^*$ , if there is no change in the protection  $\hat{t}$ , i.e. the domestic price remains constant.

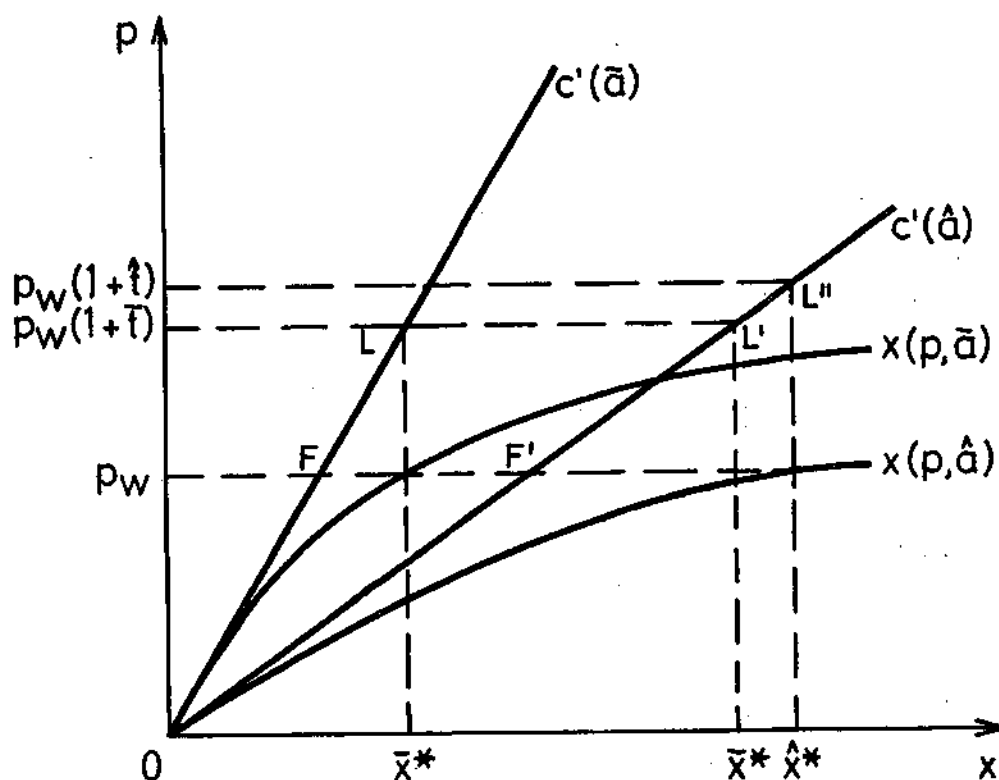


Figure 3

The second effect on  $x^*$  is due to a change in the optimal protection  $t^*$ . Although the lobby cost function remains the same, i.e. there is a constant technology, the change in the technology of producing the commodity  $x$  will affect the lobby decision as follows. Through the shift of the marginal cost curves of  $x$  from  $c'(\tilde{a})$  to  $c'(\hat{a})$  the rent of the industry through its lobby activity has increased from  $p_w F L p_w(1+\tilde{t})$  to  $p_w F' L' p_w(1+\tilde{t})$ . Hence the marginal revenue of

lobbying has become larger than its marginal costs and in order to have equality the lobby activity has to be expanded. The new optimal protection is represented by  $\hat{t}$ . The intersection of the world market price  $p_w$  with the curve  $x(p, \hat{a})$  determines the new commodity output  $\hat{x}^*$  which, in turn, determines through  $\hat{c}'$  the domestic price  $p_w(1+\hat{t})$  and the optimal protection  $\hat{t}$ .

Figure 3 shows immediately that with a technological improvement the redistribution from consumers to the industry has increased from  $p_w F L p_w(1+\hat{t})$  to  $p_w F' L' p_w(1+\hat{t})$ . The cost of lobbying  $s(t^*)$  has increased also, but at a faster rate, since the cost function was assumed to be convex. In order to determine the change in the ratio of lobby costs to the gain of producers the derivative of  $\frac{s}{T}$  with respect to  $a$  is taken.

$$(21) \quad \frac{\partial \left( \frac{s}{T}(p, a, b) \right)}{\partial a} = \frac{-2bp^2}{(2ab-p^2)^2} < 0.$$

By equation (21) an improvement in the technology of producing  $x$  will lead to an increase in the ratio of costs to gain. Graphically this can be represented by an upward shift of  $\frac{s}{T}(p)$  in Figure 4.

The net gain  $T-s(t^*)$ , however, is increasing with technological advances.

$$(22) \quad \frac{\partial [T(p, a, b) - s(t(p, a, b))]}{\partial a} = \frac{-p^2(2ab-p^2)}{2a^2(ab-p^2)^2} < 0$$

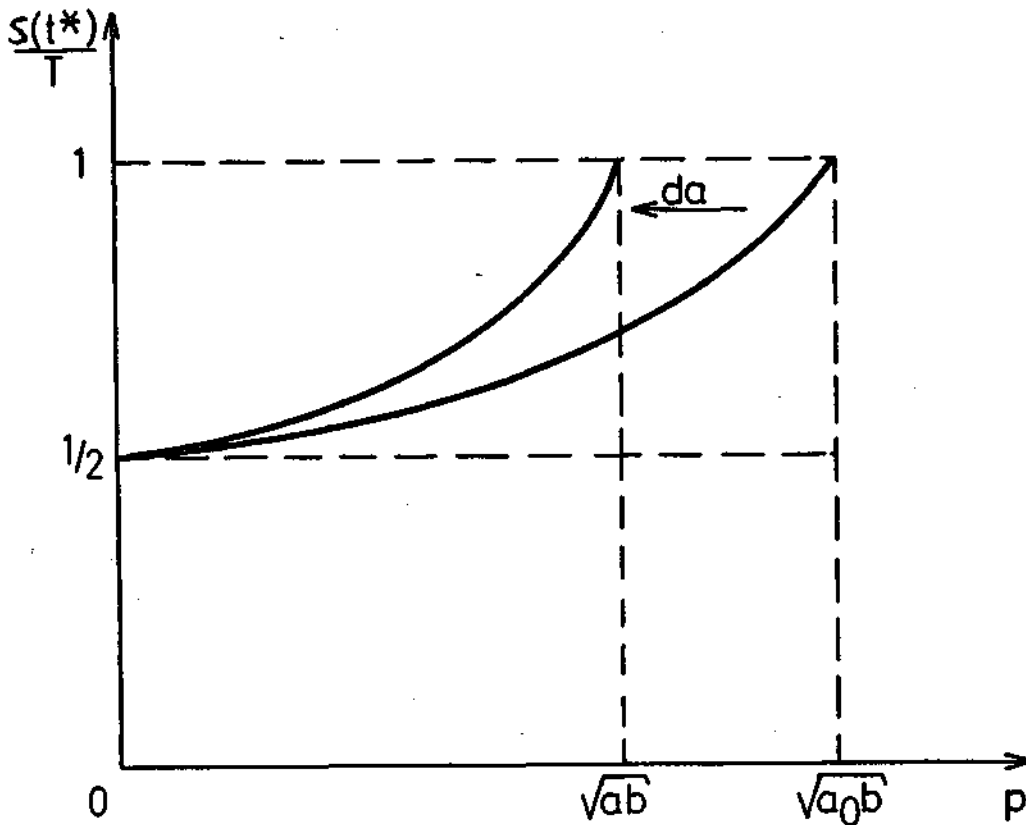


Figure 4

The same analysis can be applied to changes in the "technology of creating protection". They describe exogenous changes in the government or the electorate. Better information of voters about the costs of protection, e.g., will probably decrease the governments willingness to grant protection. From the viewpoint of the lobby this means that the protection obtained at some level of lobbying activity has decreased or, in other words, the technology of creating production has deteriorated. Conversely, the election of a new government which is more benevolent towards the interests of a specific industry can be viewed as an improved technology of lobbying from the standpoint of this industry. Without interpreting too much into this, by a variation in  $b$  we try to capture the effect of exogenous changes on the side of supply protection.

The sign of the change in the optimal commodity output  $x^*$  and the optimal protection  $t^*$  due to changes in  $b$  can be computed from equations (10) and (11).

$$(23) \quad \frac{\partial x^*(p, a, b,)}{\partial b} = \frac{-p^3}{(ab-p^2)^2} < 0$$

$$(24) \quad \frac{\partial t^*(p, a, b,)}{\partial b} = \frac{-ap^2}{(ab-p^2)^2} < 0$$

If a government becomes reluctant to grant protection the optimal values of  $x^*$  and  $t^*$  will both decrease. As this is not surprising, it is worthwhile to compare the working of a change in  $b$  with a change in  $a$  graphically. Whereas Figure 3 shows, that a change in  $a$  shifts the curve  $x(p)$  as well as the marginal cost curve  $c'$ , a change in  $b$  does not affect the marginal cost of production. In Figure 5 the optimal values for  $db < 0$  are determined through a shift in  $x^*(p, b)$  alone. The optimal output  $x^*$  increases from  $\tilde{x}^*$  to  $\hat{x}^*$  and the protection increases from  $\tilde{t}^*$  to  $\hat{t}^*$ . Correspondingly the lobby costs  $s(t^*)$  have increased also.

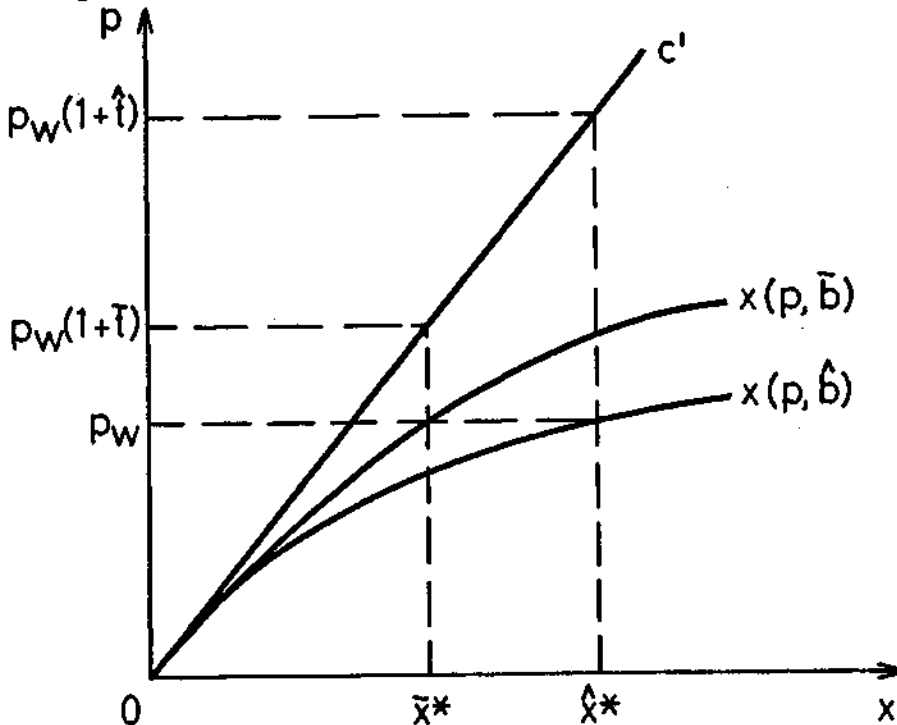


Figure 5



The ratio of lobby costs to the gain of lobbying when there is a change in  $b$  can be computed in the same manner as in the case of a change in  $a$ .

$$(25) \quad \frac{\partial \frac{S}{T}(p, a, b)}{\partial b} = \frac{-2ap^2}{(2ab - p^2)^2} < 0$$

$$(26) \quad \frac{\partial [T(p, a, b) - s(t(p, a, b))] }{\partial b} = \frac{-p^4}{(ab - p^2)^2} < 0$$

Again, changes in the lobbying technology have the same sign with respect to  $\frac{s(t^*)}{T}$ , and  $T - s(t^*)$  as changes in the production technology.

Any reduction in the willingness to grant protection of government or a bureaucracy will reduce the cost of redistribution measured through  $s(t^*)$ . This cost reduction is smaller than the decrease in the amount  $T$  redistributed so that the net gain to producers  $T - s(t^*)$  falls.

### The General Results

Most results of the quadratic example carry over to the general case. PROPOSITION 1 and LEMMA 1 in the appendix confirm the graphical representation in Figure 2, i.e. the supply function  $x(\bar{p})$  always lies above  $x(p)$ . Also the net surplus  $T - s(t^*)$  is strictly positive (PROPOSITION 2).

The sign of effect of changes in the world market price is the same as in the quadratic case (see PROPOSITION 3). Commodity supply  $x^*$  together with the tariff rate  $t^*$  increase. Also net surplus from lobbying  $T - s(t^*)$  increases. For the

measurement of the social cost of protection, we do not know which proportion of the area T in Figure 1 has to be regarded as social cost when prices change. It seems to depend on the relative steepness of the cost functions in commodity production versus lobbying.

For the analysis of changes in the technology of production as well as lobbying we define the cost functions as

$$\begin{aligned}c(x) &= hx^{\alpha} \\s(t) &= gt^{\beta}.\end{aligned}$$

Technological changes can be represented by parameter variation of h and g. Again the quadratic results are confirmed with the exception of the change in  $s^*/T$ . I.e., technical progress in commodity production - or, equivalently falling input prices - yield higher optimal commodity supply, higher lobbying, higher tariff rates, and a higher net surplus. The results of a shift in the lobby cost function are not surprising, since an increase in the parameter g can, e.g., be interpreted as higher reluctance of politicians to grant protection.

Since, in general, one can not empirically observe lobby costs, the estimation of social costs of protection through observation of the price difference between domestic and world market prices beyond the welfare triangles is not facilitated through the above results. Potentially observable parameter variations do not give clear indication as to the treatment of the area T traditionally considered as redistribution. At least we know, that a good part of T is a social cost and that this social cost becomes larger, if fixed costs of lobbying are added.

### THE SEVERAL INDUSTRY CASE

In the previous section it was shown that an economic analysis of lobbying decisions for protection can not be separated from the simultaneous commodity production decision, since costs and benefits from lobbying are functions of the production decision. This has to be taken into account, when the pattern of protection is analysed. Such an interdependency on the production side requires a specification of the relation of industries on the commodity as well as the political market. Unfortunately, all the different possibilities can not be subsumed under one model.

In the following, we will present three typical situations which are equal with respect to the political decision maker, but differ with respect to the relation between industries. Then the implications of two of the models will be analysed; the third will be investigated in a subsequent paper.

The first and easiest generalization might be called the "independent industry" case. There are several industries with their lobbies. Each industry produces a different commodity  $x_k$ , ( $k=1, \dots, u$ ), with a convex production technology. The industries are independent by the assumption that their products are sold on different markets and that there are no substitution effects. With this restriction the focus is solely on the interrelation of industry through their lobbying activities. The political decision maker has increasing political cost of overall protection. That is, lobby  $i$ 's protection is a concave, nondecreasing, function of its lobbying expenditures  $m_i$ . On the other hand,  $t_i$  is a nonincreasing function of the expenditures of another lobby  $j$ . Such a constellation forms a typical noncooperative game.

The second model is more realistic in that the assumption of independence of industries in the commodity sphere is dropped. It is convenient to circumvent a modeling of the demand side with consumers by assuming that the interdependence on the commodity side is established through factor demands of one industry for the output of another industry. That is, both industries lobby for protection of their respective outputs, but the one industry which uses another protected industry's output as an input will be hurt by the production of that industry. This is a simple case of effective protection, where the industry tries to compensate its negative effective protection through lobbying for protection of its own products. The additional interdependence through the commodity market will not alter the results of model in a significant way.

One important implicit assumption is the exclusion of the possibility for an industry to lobby against protection of - as in our case - inputs which it uses in its production. One reason lies in the empirical evidence supporting the hypothesis that there is no interindustry lobbying against each other. On the consumer side, i.e. of those who eventually are hurt by protection, explicit lobbying against protection can rarely be observed. Rather, there is the indirect pressure of a loss of votes of disappointed consumers which has been subsumed under the increasing political cost of protection assumption. Recently, some evidence indicating the formation of anti-protectionist forces, however, suggests to investigate the consequences of competition for and against protection which is the purpose of the third model.

This third possible basic interaction between economic units with respect to protection can best be modeled by having two groups with antagonist interests. In a different context BECKER (1983) had two pressure groups competing for redis-

tribution. Similarly, we can take two industries competing for and against protection. Let, e.g., there be an industry  $i$  producing inputs for industry  $j$ . These inputs are protected so that cost for industry  $j$  rise. Contrary to the model above, industry  $j$  now is assumed to lobby against protection of industry  $i$ . Of course, the anti-protectionist lobby could be composed of consumers as well without altering the structure of the models. Since such a model leads to rather complicated issues of multiple noncooperative equilibria and stability, it will be discussed in a subsequent paper.

The above mentioned models represent the three possible cases of interaction between economic units in a politico-economic situation. Instead of working with a large number of industries, we only investigate the Nash-equilibrium properties in a two industry framework. This simplification seems justified, since in the comparative-static analysis the effects of exogenous changes in one industry on the rest of the economy can be determined by viewing the other industries as one "composite" group. Also indirect effects of parameter changes in one industry through the reaction of the other industries can be reduced to such a framework. Therefore, in the following we analyse two industries  $i, j$  with their production and lobby activities.

Whereas in the one lobby case the analysis was more intuitive when presented in terms of cost functions, here it seems to be more convenient to formulate the model in terms of production functions and their dual profit function. Of course, the structure of the decision problem of an industry and its lobby, remains identical.

Both industries are assumed to have convex technologies of production, i.e. concave production functions, denoted by

$$x_k = f_k(z_k) \quad k = i, j$$

where  $z$  is a vector of inputs and  $x_k$  the commodity produced by industry  $k$ .

Lobbying is determined like a production activity. Protection, measured through  $t$  with  $\tilde{p} = p(1+t)$ , is produced with inputs which, for convenience, we call money. I.e., each industry spends money,  $m_i$  and  $m_j$ , in order to produce  $t_i$  and  $t_j$ . Again, the government is assumed to face increasing political cost of protection for industry  $i$  as well as industry  $j$ . It therefore seems natural to make the following assumptions.

- (1) Protection  $t_k$  of industry  $k$  ( $k=i, j$ ) is a concave function of its money payments  $m_k$ .
- (2) Protection  $t_i$  of industry  $i$  is a nonincreasing function of the money payments  $m_j$  of industry  $j$  and vice versa.

(1) is the same assumption as the convex cost function in the one lobby case. (2) is a straightforward formalization of increasing political cost of overall protection. If the protection of one industry  $k$  increases, the increased political cost of this protection result in a nonincreasing protection of the other industry.

Formally we have

$$\frac{\partial \tau_k(m_i, m_j)}{\partial m_k} > 0 \quad \frac{\partial^2 \tau_k(m_i, m_j)}{\partial m_k^2} < 0 \quad k = i, j$$

and

$$\frac{\partial \tau_i(m_i, m_j)}{\partial m_j} \leq 0 \quad \frac{\partial \tau_j(m_i, m_j)}{\partial m_i} \leq 0$$

For  $\partial \tau_i / \partial m_j = 0$  and  $\partial \tau_j / \partial m_i = 0$  we are back to the original model, since there is no interaction between lobbies.

For the subsequent derivations the sign of the cross-partial

$$\frac{\partial^2 \tau_k}{\partial m_i \partial m_j}$$

has to be determined also. It can be interpreted as the effect of one additional dollar spent in industry  $j$  on the marginal product of lobbying in industry  $i$ . Since there are increasing political costs of protection it is plausible to assume a negative sign for the cross-partial.

The profit functions for industry  $i$ , resp.  $j$ , in the "independent industry" case can now be written as

$$\pi_i(z_i, m_i, m_j) = p_i[1 + \tau_i(m_i, m_j)]f_i(z_i) - vz_i - m_i$$

$$\pi_j(z_j, m_i, m_j) = p_j[1 + \tau_j(m_i, m_j)]f_j(z_j) - vz_j - m_j$$

where  $v$  = input price.

The profit maximization problem for the two industries becomes

$$\max_{z_i, m_i} \pi_i(z_i, m_i, m_j)$$

and

$$\max_{z_j, m_j} \pi_j(z_j, m_i, m_j)$$

The subsequent analysis becomes considerably simplified, if the production and lobby decisions are separated. Let

$$\bar{\pi}_k(p_k(1+t_k)) = \max_{z_k} p_k(1+t_k) f_k(z_k) - v z_k - m_k$$

$k = i, j$

$\bar{\pi}_k(p_k(1+t_k))$  can be interpreted as the profit function with exogenous tariff  $t_k = t_k(m_i, m_j)$ . Having thus eliminated the commodity decision, we can focus exclusively on the lobby decisions of the two industries.

It is well-known that  $\bar{\pi}_k(p_k(1+t_k))$  is continuous for  $p_k > 0$ ,  $v > 0$ , linear-homogenous and convex in  $p_k(1+t_k)$  (see, e.g., McFADDEN (1978)). In addition we have by HOTELLINGS's LEMMA

$$\frac{\partial \bar{\pi}_k(p_k(1+t_k))}{\partial p_k(1+t_k)} = x_k^*, \quad k = i, j,$$

where  $x_k^*$  denotes the profit maximizing supply of commodity  $k$ .

The lobby decisions of the two industries can now be formulated as

$$\max_{m_k} \bar{\pi}_k[p_k(1+t_k)] - m_k$$

$$\text{with } t_k = \tau_k(m_i, m_j), \quad k = i, j.$$



The necessary conditions for a profit maximum are

$$(28) \quad \frac{\partial \bar{\pi}_k}{\partial p_k (1+t_k)} p_k \frac{\partial \tau_k}{\partial m_k} - 1 = 0 \quad k=i, j.$$

Sufficiency requires

$$\Delta_k = \frac{\partial^2 \bar{\pi}_k}{\partial [p_k (1+t_k)]^2} p^2 \left( \frac{\partial \tau_k}{\partial m_k} \right)^2 + \frac{\partial \bar{\pi}_k}{\partial p_k (1+t_k)} p \frac{\partial^2 \tau_k}{\partial m_k^2} < 0$$

Equation (28) can be written as

$$(29) \quad x_i^* p_i \frac{\partial \tau_i(m_i, m_j)}{\partial m_i} - 1 = 0$$

$$(30) \quad x_j^* p_j \frac{\partial \tau_j(m_i, m_j)}{\partial m_j} - 1 = 0$$

These two equations are the implicit reaction functions of the two industries.

The solution concept employed for this noncooperative game of lobbying is a Nash-equilibrium.  $(m_i^*, m_j^*)$  is a Nash-equilibrium, if the following equations hold:

$$(31) \quad x_i^* p_i \frac{\partial \tau_i(m_i^*, m_j^*)}{\partial m_i} - 1 = 0$$

$$(31) \quad x_j^* p_j \frac{\partial \tau_j(m_i^*, m_j^*)}{\partial m_j} - 1 = 0$$

Before the solution can be shown graphically, two more computations are necessary. The slope of the reaction functions of industry i and j are negative. To see this, let  $R_i(m_i, m_j)$  and  $R_j(m_i, m_j)$  denote the implicit reaction functions of (29) and (30). Then<sup>13</sup>

$$\frac{\partial R_i(m_i, m_j)}{\partial m_j} < 0 \quad \text{and} \quad \frac{\partial R_j(m_i, m_j)}{\partial m_i} < 0$$

For a Nash-equilibrium with both industries lobbying, i.e.  $m_i^* > 0$ ,  $m_j^* > 0$ ,  $(m_i^*, m_j^*)$  must be a stable equilibrium. Stability requires the absolute value of the slopes of the graph of  $R_j$  in Figure 8 to be larger than that of  $R_i$  which is equivalent to the requirement, that the Hessian of the equations (29) and (30),  $\Delta$ , has a positive sign.<sup>14</sup>

The above results are summarized in Figure 6.

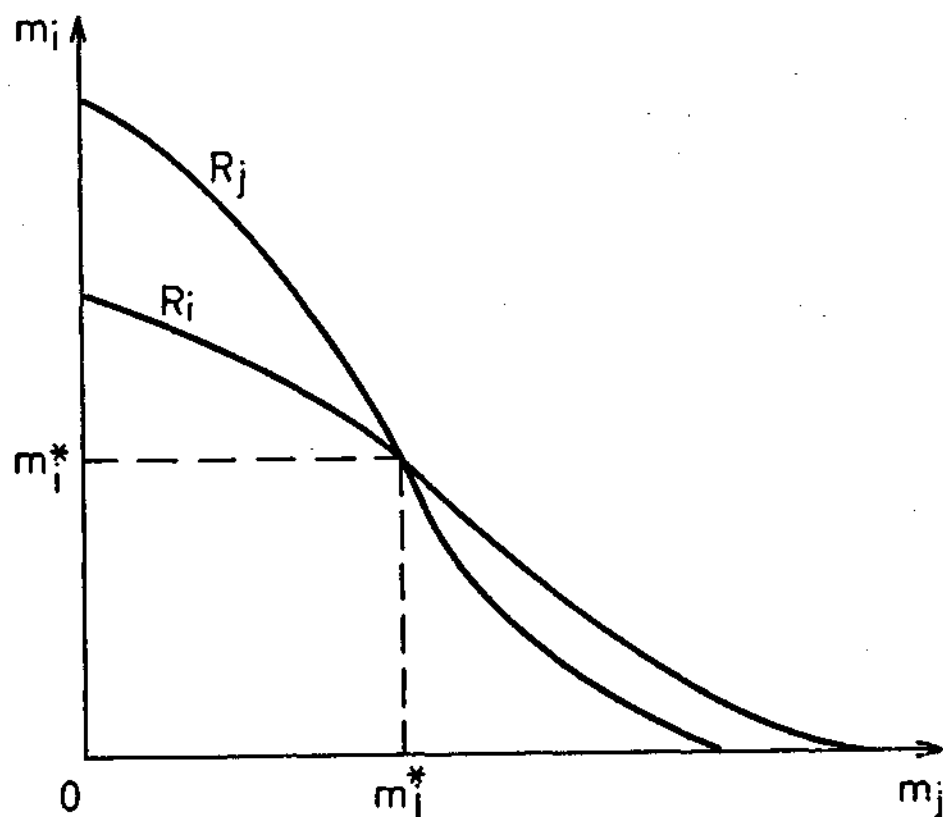


Figure 6

One can immediately see, that the level of lobbying expenditures in each industry is lower than in a situation with one lobby only. In that case optimal lobbying expenditure is determined by the intercept of  $R_i$  with the vertical axis or  $R_j$  with the horizontal axis. Figure 8 also shows that lobbying is a dominant strategy compared to the strategy of not lobbying. In other words, tariff-seeking is not a Prisoner's Dilemma problem.

We now turn to the comparative-static analysis of parameter changes on the Nash-equilibrium levels of protection. Changes in world market prices, in production technology of an industry, and changes in the political arena will be considered.

First, an increase (decrease) in  $p_i$  will shift the reaction function  $R_i(m_i, m_j)$  upward (downward). This is obvious from differentiation of (29).

$$\frac{dm_i}{dp_i} = \frac{- [p_i(1+t_i) \frac{\partial x_i^*}{\partial p_i(1+t_i)} \frac{\partial \tau_i}{\partial m_i} + x_i^* \frac{\partial \tau_i}{\partial m_i}]}{\Delta_i} > 0,$$

since  $\Delta_i < 0$  by the second-order condition for a profit maximum of industry  $i$ . The reaction function  $R_j(m_i, m_j)$  will remain unaffected, since in this model independence on the commodity market was assumed.

The equilibrium changes  $dm_i^*/dp_i$  and  $dm_j^*/dp_i$  can be computed using Cramer's Rule through differentiation of equations (29) and (30). For a stable equilibrium the optimal lobbying expenditures of industry  $i$ ,  $m_i^*$ , will increase with  $p_i$  and those of industry  $j$ ,  $m_j^*$ , will decrease, i.e.  $dm_i^*/dp_i > 0$  and

$dm_j^*/dp_i < 0$  (for the computation see PROPOSITION 7 in the appendix). From the definition of the tariff functions  $\tau_i(m_i, m_j)$  and  $\tau_j(m_i, m_j)$  it follows immediately that  $\partial t_i^*/\partial p_i > 0$  and  $\partial t_i^*/\partial p_j < 0$ .

The seemingly paradoxical result of the one-industry case of tariffs rising (falling) with increasing (decreasing) world market prices carries over to the several-industry model. In addition the industry whose world market price remained constant will reduce its lobbying and receive a lower tariff rate.

For the analysis of unequal technical progress in the two industries a simple representation of technology is chosen. The production functions are defined as

$$x_k = \alpha_k f_k(z_k) \quad k=i, j, \quad \alpha_k > 0.$$

The net revenue function of industry  $k$  becomes

$$\pi_k(m_i, m_j, z_k) = p_k(1+t_k)\alpha_k f_k(z_k) - vz_k - m_k.$$

Maximization over  $z_k$  yields the profit function<sup>15</sup>

$$\pi_k(m_i, m_j, p_k) = \alpha_k \bar{\pi}_k[p_k(1+t_k), \frac{v}{\alpha_k}] - m_k.$$

The reaction functions have the same characteristics as before and are of the form

$$R_k(m_i, m_j) = \alpha_k p_k \frac{\partial \bar{\pi}_k}{\partial p_k(1+t_k)} \frac{\partial \tau_k}{\partial m_k} - 1 = 0, \quad k=i, j$$

Technical progress in industry  $k$ , i.e.  $d\alpha_k > 0$ , will shift the reaction function to the right. Total differentiation of  $R_k$  w.r.t.  $m_k$  and  $\alpha_k$  yields the desired result

$$\frac{dm_k}{d\alpha_k} = \frac{-p_k \frac{\partial \tau_k}{\partial m_k}}{\Delta_k} \left( \frac{\partial \bar{\pi}_k}{\partial p_k (1+t_k)} - \frac{v}{\alpha_k} \frac{\partial^2 \bar{\pi}_k}{\partial p_k (1+t_k) \partial \frac{v}{\alpha_k}} \right) > 0$$

since  $\Delta_k > 0$  and

$$\frac{\partial^2 \bar{\pi}_k}{\partial p_k (1+t_k) \partial \frac{v}{\alpha_k}} = \frac{\partial x_k^*}{\delta \frac{v}{\alpha_k}} < 0.$$

On the other hand, a change in the technology of one industry will have no effect on the reaction of the other industry. Differentiation of  $R_i$  w.r.t.  $m_i$  and  $\alpha_j$  and  $R_j$  w.r.t.  $m_j$  and  $\alpha_i$  shows this.

The equilibrium changes of  $m_i^*$  and  $m_j^*$  follow directly from the shifts of these reaction functions, i.e.

$$\frac{dm_k^*}{d\alpha_k} > 0 \quad \text{and}$$

$$\frac{dm_k^*}{d\alpha_n} < 0 \quad k, n = i, j; n \neq k. \quad 16$$

The results are illustrated graphically in Figure 7 for the case of  $d\alpha_i > 0$ . The graph of  $R_i(m_i, m_j)$  is shifted to the right, while  $R_j(m_i, m_j)$  remains unchanged.

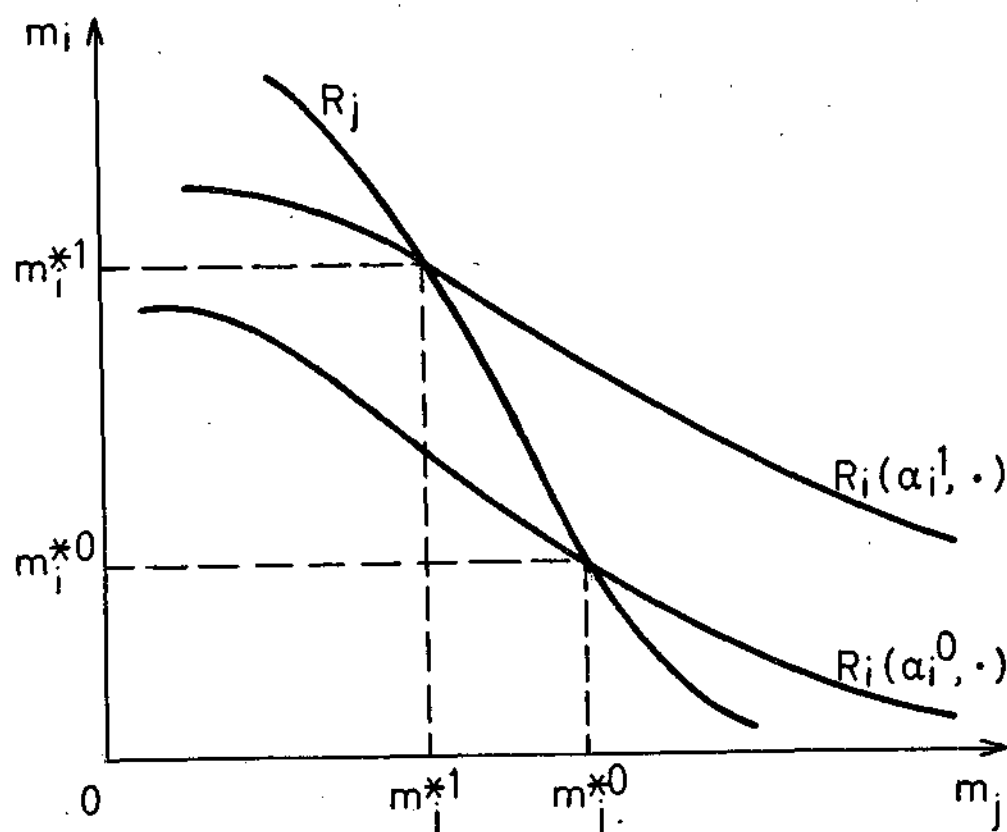


Figure 7

The optimal lobbying expenditures of industry  $j$  falls from  $m_j^0$  to  $m_j^*$  and those of industry  $i$  rise from  $m_i^0$  to  $m_i^1$ . Correspondingly the tariff rate  $t_i$  will rise, while  $t_j$  falls. On the commodity side the results coincide with those of the one industry case. The supply of commodity  $x_i^*$  increase and  $x_j^*$  decreases as one can see from the reaction functions  $R_i(m_i, m_j)$  and  $R_j(m_i, m_j)$ .

We now turn to the analysis of political changes. Again, one can choose from a myriad of different ways to model such changes, each reflecting different aspects of the political decision process with respect to protection. Three configurations are more or less arbitrarily picked which show the effects of exogenous political changes on optimal lobbying, protection, etc. All modifications amount to reformulations of the protection functions  $\tau_k(\cdot)$ .

The first modification is concerned with the "overall political climate" towards protection in the society. Contrary to theoretical results showing the Pareto-superiority of free trade in most cases one can observe in some countries or over some periods widespread agreement with protectionistic policies. Whatever the reasons for such a climate - be it "national pride" or lack of information about the social cost of protection -, exogenous changes - e.g. induced by new information provided to the general public - will affect the optimal lobbying and the protection levels. In our two industry model this can be included by writing the protection functions as

$$t_k = \mu \tau_k(m_i, m_j) \quad k=i, j, \quad \mu > 0.$$

$\mu$  is simply a scaling factor, equal in both protection functions. The larger  $\mu$  the easier, i.e. the cheaper, it is to obtain protection. Suppose, e.g., the general public has become informed about the considerable costs of protection through the media. This will raise political costs of protection to the politicians. In our model it would amount to a reduction of  $\mu$ .

The second case is concerned with the political preference towards protecting certain sectors of the economy. In most political discussions on protection, protecting jobs has been a major issue and a successful strategy for obtaining protection. Obviously, this is possible since a job saved has a high political value despite its social netbenefits - which may well be negative. Hence, industries which are threatened, or at least appear to be threatened, with a considerable loss of jobs will obtain protection easier than other industries.

Such differences can be modeled with industry specific parameters. The protection functions will be

$$t_k = \kappa_k \tau_k(m_i, m_j) \quad k=i, j; \kappa_k > 0.$$

The last variant emphasizes the efficiency of an industry's lobbying. The relative efficiency of money spent in lobbying by an industry will be determined by a scaling factor

$$\kappa = \frac{\kappa_i}{\kappa_j} \quad \text{with } \kappa_j = 1 \text{ w.l.o.g., such that}$$

$$t_k = \tau_k(\kappa m_i, m_j) \quad k=i, j; \kappa > 0.$$

An increase in  $\kappa$  will then represent rising efficiency of industry  $i$  or - equivalently - falling efficiency of industry  $j$  and vice versa for a decrease in  $\kappa$ .

We will begin the derivation of the comparative static results with the last case. The first order conditions for a profit maximum and implicit reaction functions are

$$\frac{\partial \bar{\pi}_i}{\partial p_i (1+t_i)} p_i \frac{\partial \tau_i}{\partial m_i} \kappa - 1 = 0.$$

$$\frac{\partial \bar{\pi}_j}{\partial p_j (1+t_j)} p_j \frac{\partial \tau_j}{\partial m_j} - 1 = 0.$$



A marginal increase in  $\kappa$  will shift the reaction function of industry  $j$   $R_j(m_i, m_j, \kappa)$  to the left, since

$$\frac{dm_j}{d\kappa} = \frac{-1}{\Delta_j} \left[ \frac{\partial \bar{\pi}_j}{\partial p_j(1+t_j)} p_j \frac{\partial^2 \tau_j}{\partial m_j \partial \kappa m_i} m_i + \frac{\partial^2 \bar{\pi}_j}{\partial [p_j(1+t_j)]^2} \frac{\partial \tau_j}{\partial m_j} \frac{\partial \tau_j}{\partial \kappa m_i} m_i \right] < 0$$

The shift of  $R_i(m_i, m_j, \kappa)$ , however, is indeterminate.

$$\frac{dm_i}{d\kappa} = \frac{-1}{\Delta_i} \left[ \frac{\partial \bar{\pi}_i}{\partial p_i(1+t_i)} p_i \frac{\partial \tau_i}{\partial \kappa m_i} + \frac{m_i}{\kappa} \Delta_i \right] \gtrless 0, \dots$$

since  $\Delta_i < 0$ .

The changes in the Nash-equilibrium levels of lobbying,  $dm_i^*/d\kappa$  and  $dm_j^*/d\kappa$ , are easily determined, if  $R_i$  is shifted to the right, i.e.  $dm_i/d\kappa > 0$ .

Then

$$\frac{dm_i^*}{d\kappa} > 0 \quad \text{and} \quad \frac{dm_j^*}{d\kappa} < 0^{17}.$$

If, however, the reaction function  $R_i$  is shifted downward the sign of the equilibrium changes of lobbying expenditures is indeterminate. We will show graphically the possible configurations.<sup>18</sup> In Figure 8  $E_0$  represents the initial equilibrium. If  $R_i$  is shifted upward to  $R_i^1$  we get the result mentioned above with  $m_i^0 < m_i^1$  and  $m_j^0 > m_j^1$ . The new equilibrium  $E_1$  lies to the north-west of  $E_0$  as long as  $R_i$  does not fall so far such that the intersection with  $R_j^1$  falls below the line  $m_i^0 E_0$ . If the intersection of  $R_i$  with  $R_j^1$  lies below  $m_i^0 E_0$  and to the left of  $E_0 m_j^0$  both  $m_i^*$  and  $m_j^*$  fall. Finally, if the intersection is to the right of  $E_0 m_j^0$ , like  $E_2$ , then  $m_i^*$  falls and  $m_j^*$  rises as a consequence of increased relative efficiency of lobby  $i$ .

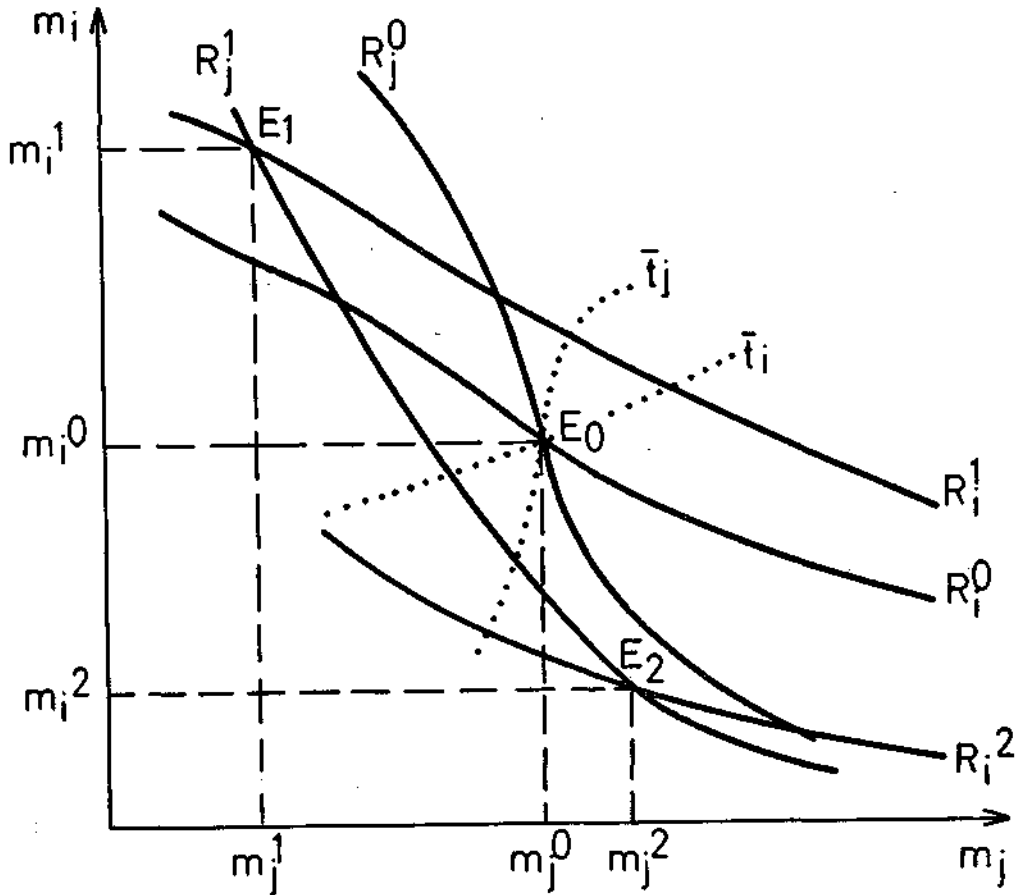


Figure 8

The changes in the optimal level of lobbying expenditures do not show directly the resulting effects on the tariff rate. In Figure 8 the dotted lines  $\bar{t}_i$  and  $\bar{t}_j$  represent the combinations of  $(m_i, m_j)$  resulting in a specific tariff rate  $\bar{t}$  - one may call them "iso-tariff lines". If the new equilibrium lies above (below)  $\bar{t}_i$ , the tariff rate of industry  $i$  will rise (fall). For industry  $j$  the case is just opposite; for an equilibrium below (above)  $\bar{t}_j$  the tariff rate  $t_j$  will rise (fall).

The reason for such counterintuitive results can be found in the possibility of a decline in the marginal product of lobbying. This will lead to a reduction of lobbying. But it also has repercussions on the commodity decisions, since it

depends on the domestic price. A reduction in lobbying and a decline of the tariff rate happens, if the reduction in lobby costs is larger than the resulting loss of commodity revenues, i.e. profits still rise.

We now turn to the second case, changes in the political preferences towards specific sectors. This model is symmetric with respect to the protection functions of the two industries, so that we can analyse w.l.o.g. a change in  $\kappa_i$  only. The shifts in the reaction function of industry  $i$  is determined as

$$\frac{dm_i}{d\kappa_i} = \frac{-p_i \frac{\partial \tau_i}{\partial m_i}}{\Delta_i} \left[ \frac{\partial \bar{\pi}_i}{\partial p_i (1+t_i)} + \frac{\partial^2 \bar{\pi}_i}{\partial [p_i (1+t_i)]^2} p_i t_i \right] > 0,$$

i.e.  $R_i$  is shifted upward. Since the reaction functions of industry  $j$   $R_j(m_i, m_j, \kappa_j)$  is not a function of  $\kappa_i$ , it will not be affected by a change in  $\kappa_i$ . The Nash-equilibrium changes follow then easily from a graphical representation of the shifts. A rise in  $\kappa_i$  will increase the optimal lobbying of industry  $i$ ,  $m_i^*$ , and decrease that of industry  $j$ ,  $m_j^*$ . The tariff rates go in the same direction, i.e.  $dt_i^*/d\kappa_i > 0$ ,  $dt_j^*/d\kappa_i < 0$ . The graphical representation is the same as for changes in the commodity production technology in Figure 8.

The last case to be investigated represents changes in the overall political climate towards protection. I.e. increases in  $\mu$  are equivalent to a shift towards a more protectionist position of the society. Again, we skip the optimization and state immediately the effects of a change in  $\mu$  on the reaction function  $R_i$  and  $R_j$ .

$$\frac{dm_k}{d\mu} = \frac{-p_k \frac{\partial \tau_k}{\partial m_k}}{\Delta_k} \left[ \frac{\partial \bar{\pi}_k}{\partial p_k (1+t_k)} + \frac{\partial^2 \bar{\pi}_k}{\partial [p_k (1+t_k)]^2} p_k t_k \right] > 0,$$

Both reaction functions are shifted upward. The new equilibrium has either increased lobbying expenditures for both industries or increased lobbying in one and reduced lobbying in the other industry. The change in the optimal tariff rates  $(t_i^*, t_j^*)$  can not be determined without further specifications of the model.

The qualitative results of the independent industry case also hold for the second case where industry  $j$  uses protected inputs of industry  $i$  and only lobbies for protection of its output  $x_j$  but not against protection of  $x_i$ . To see this let the profit maximization problems be

$$\max_{z_i, m_i} p_i [1 + \tau_i(m_i, m_j)] f(z_i) - v z_i - m_i$$

$$\max_{x_i, m_i} p_j [1 + \tau_j(m_i, m_j)] f(x_i) - p_i [1 + \tau_i(m_i, m_j)] x_i - m_j$$

$$\text{with } x_i = f(z_i).$$

Whereas the situation for industry  $i$  remains the same, one can see that, compared to the previous model, changes in  $m_i$  or  $m_j$  have exaggerated effects for industry  $j$ . Take for example an increase in  $m_i$ . Protection  $t_i$  will rise and  $t_j$  will fall; in addition, input prices for industry  $j$  will rise as well, leading to a further reduction of profits. The opposite affect have increases in  $m_j$ . These considerations already show, that the qualitative results of the "independent-industry" model remain the same. Derivation of the comparative static effects along the same lines as in the previous model confirm these results as well.

## SUMMARY AND CONCLUSIONS

The determination of protection has widely been viewed as a market process. On a political market for protection politicians, government, or bureaucrats supply tariff or non-tariff barriers against foreign competitors in exchange for monetary and nonmonetary contributions. On the other side companies in an industry form lobbies, who express the demand for protection and buy it on that market. In this paper the supply side has not been modeled explicitly, but was given by a tariff supply function, i.e. the cost curve for tariffs or the tariff production function which had incorporated the features assumed about the decision of politicians or governments.

In the first model the relation between commodity production and lobbying decisions was investigated. Since the lobby decision was assumed to follow the objective of profit maximization, there must be a close relationship between the commodity and the political side through the domestic commodity price. By making the lobby decision endogenous this interrelation can be examined in a comparative static analysis.

The comparative statics show, that the optimal lobbying decision depends on the profitability of the commodity side. Contrary to the widely held belief that industries, whose comparative advantage vis-a-vis the rest of the world has deteriorated, choose between efforts to regain their comparative advantage internally and lobbying for protection, it is shown that falling world market prices will induce less lobbying and - other things as the political situation being equal - a lower tariff rate. This happens, although the ratio of imports to domestic consumption rises even at a constant tariff rate. In the same direction go changes in

the production technology. At a given world market price with improving technology production costs will fall, hence production will increase, thus reducing imports and increasing profits. At the same time the surplus from lobbying has increased also violating the equality of marginal costs and marginal surplus of lobbying. Consequently lobbying is increased until equality is restored.

The situation, when there are several lobbies, is considerably complicated through the need to model the interdependence of lobbies on the political market as well as that of industries on the commodity markets. As long as industries are only lobbying for but not against protection of some commodity, the reaction functions of lobbying have negative slopes for both industries, i.e. lobbying expenditures of industries are inversely related. Also the Nash-equilibrium lobbying will react inversely. Any exogenous function of one industry will increase the optimal lobbying expenditures of that industry and reduce those of the other industries. Therefore the comparative static results of the first model hold for most of the direct effects of the many industry case. The cross-effects have the opposite sign, since any improvement in the comparative advantage of an industry on the political market will deteriorate the position of the other industry.

Only for exogenous changes affecting the tariff functions  $\tau_i$  and  $\tau_j$  the results are not all clear-cut. Changes in the sectoral bias toward protection of politicians are as expected from the one-industry model. A change in the protective bias towards industry  $i$  will increase lobbying as well as tariff rates of that industry, whereas tariff rates and optimal lobbying of industry  $j$  will be reduced, and vice versa. When, for some reason, the overall political climate with respect to granting protection deteriorates, it is very

likely, but not necessary, that both industries reduce their lobbying expenditures. They will not increase them, since both reaction functions are shifted downwards.

It can not be determined, how the tariff rates react to the reduction in lobbying. Both rates could go either way. The analysis of changes in the relative efficiency of lobbying expenditures on the tariff rate will very likely lead to higher tariff rates of the industry experiencing higher efficiency. The sign of the changes of lobbying expenditures is not predictable on this level of abstraction.

What does the several-industry case tell with respect to the cost of protection? Since most comparative static effects have opposite signs on the two industries, we know from the one-industry model, that the social costs of protection in one industry will rise while they will fall in the other industry. Such diverging effects indicate some insensitivity of changes in the social costs of protection with respect to parameter changes outside the political market, i.e. world market prices or production technology. Only for some changes in political parameters one can expect unidirectional effects on social costs.

The results obtained in this paper are surprising in that they contradict widely held beliefs about the determinants of protection. These beliefs may be based on the notion that industries react to exogenous changes in their environment either through internal adjustments such as improving productivity or through external means such as obtaining protection from competitors. They could be explained by the use of an insufficient analysis of the metaphors used to explain the existence of protection. The "political market for protection" is one such metaphor<sup>19</sup> employed to organize and interpret an otherwise too complex reality. McCLOSKEY (1983) has investigated advantages and disadvantages of the

metaphorical character of economics<sup>20</sup>. "An important metaphor in economics has the quality admired in a successful scientific theory, a capacity to astonish us with implications yet unseen" [McCLOSKEY (1983), 503-4]. The verdict on the metaphor of a political market for protection will and can not be brought by us, but by empirical tests and scientific discourse.

Prior empirical work using a political market for protection such as ANDERSON/BALDWIN's (1981) collection of studies do not explicitly incorporate the features of our model. However, for some variables they predict signs which would not be supported by our model. Fortunately for us, the empirical estimations do not show conclusive signs. Only an explicit test of the model presented here will shed more light on its validity.



# APPENDIX

## PROPOSITION 1:

The supply functions  $x(p)$  and  $x_0(\bar{p})$  for the maximization problem

$$\max_{x,t} \quad p(1+t)x - c(x) - s(t)$$

with  $c(x)$  and  $s(t)$  convex and at least twice differentiable are increasing in  $p$  resp.  $\bar{p}$ .

## Proof:

$x^*(p)$  is the solution of the system (2) and (3)

$$(2) \quad p(1+t^*) - c'(x^*) = 0$$

$$(3) \quad px^* - s'(t^*) = 0.$$

Since the objective function is strictly concave,  $(x^*, t^*)$  is an interior, global maximum.

$$(a) \quad \frac{dx^*}{dp} = \frac{\begin{vmatrix} -(t^*+1) & p \\ -x^* & -s''(t^*) \end{vmatrix}}{\Delta},$$

where

$$\Delta = \begin{vmatrix} -c''(x^*) & p \\ p & -s''(t^*) \end{vmatrix} = c''(x^*)s''(t^*) - p^2 > 0.$$

Hence

$$(a') \quad \frac{dx^*}{dp} = \frac{(1+t^*)s''(t^*)+px^*}{c''(x^*)s''(t^*)-p^2} > 0.$$

The slope of the supply function  $x_0(\bar{p})$  with  $\bar{p}=p(1+t^*)$  is determined from

$$(b) \quad \bar{p} = c'(x^*)$$

as

$$\frac{dx^*}{d\bar{p}} = \frac{1}{c''(x^*)} > 0.$$

#### LEMMA 1:

For all  $p > 0$

$$x^*(p) > x_0(p) \text{ and } p(1+t^*) > p.$$

#### Proof:

By the concavity of the objective function  $\pi(x,t)$   $(x^*,t^*)$  is an interior solution for  $p>0$  and therefore for  $t^* >0$ . Hence  $p(1+t^*)>p$ .

$$x_0(p) = \{x \mid p = c'(x)\}$$

$$x^*(p) = \{x \mid p = \frac{c'(x)}{1+t^*}, t^* = \operatorname{argmax} \pi(x,t)\}.$$

Since  $t^*>0$  and since  $c'(x)$  is increasing in  $x$  by convexity of  $c(x)$  we get

$$x^*(p) > x_0(p) \text{ for all } p>0. ||$$

PROPOSITION 2:

Given the maximization problem

$$\max_{x,t} \pi(x,t) = \max_{x,t} p(1+t)x - c(x) - s(t)$$

where  $c(x)$  and  $s(t)$  are convex and at least twice differentiable functions. Suppose a unique maximum exists, then

$$T - s(t^*) > 0,$$

$$\text{where } T = p(1+t^*)x^* - px_0 - c(x^*) + c(x_0)$$

and

$$(x^*, t^*) = \operatorname{argmax} \pi(x, t),$$

$$x_0 = \operatorname{argmax} \pi(x) = \operatorname{argmax} px - c(x)$$

Proof:

$$\begin{aligned} T - s(t^*) &= p(1+t^*)x^* - px_0 - c(x^*) + c(x^*) + c(x_0) - s(t^*) \\ &= \pi(x^*, t^*) - \pi(x_0). \end{aligned}$$

If  $\pi(x^*, t^*) < \pi(x_0)$ , then  $t^* = 0$  and  $\pi(x^*, 0) = \pi(x_0)$ , a contradiction. Therefore  $\pi(x^*, t^*) \geq \pi(x_0)$  and  $T - s(t^*) > 0$ . ||

LEMMA 2:

$$\frac{d[T(p) - s(t^*)]}{dp} > 0.$$

Proof:

$$\begin{aligned} T(p) - s[t^*(p)] &= p[1 + t^*(p)]x^*(p) - px_0(p) - c[x^*(p)] \\ &\quad + c[x_0(p)] - s[t^*(p)] \end{aligned}$$

After differentiation with respect to  $p$  and rearranging terms we get

$$\begin{aligned} \frac{d[T(p) - s[t^*(p)]]}{dp} &= [1 + t^*(p)]x^*(p) - x_0(p) \\ &\quad + \frac{\partial x^*(p)}{\partial p} \{p[1 + t^*(p)] - \frac{\partial c(x^*)}{\partial x}\} \\ &\quad + \frac{\partial t^*(p)}{\partial p} \{px^*(p) - \frac{\partial s(t^*)}{\partial t}\} \\ &\quad - \frac{\partial x_0(p)}{\partial p} \{p - \frac{\partial c(x_0)}{\partial x}\} \\ &= [1 + t^*(p)]x^*(p) - x_0(p) \\ &> 0, \end{aligned}$$

by using the first order conditions and LEMMA 1. ||

PROPOSITION 3:

Given the maximization problem

$$\max_{x,t} \pi(x,t) = \max_{x,t} p(1+t)x - c(x) - s(t)$$

where  $c(x)$  and  $l(t)$  are convex and at least twice differentiable functions, and given  $\max_{x,t} \pi(x,t)$  exists, then the following holds:

a)  $\frac{dx^*}{dp} > 0$

b)  $\frac{dt^*}{dp} > 0$

c)  $\frac{dT}{dp} > 0$

d)  $\frac{ds(t^*)}{dp} > 0$

e)  $\frac{d(T-s(t^*))}{dp} > 0$

Proof:

a.) Using Cramer's Rule we get

$$\frac{dx^*}{dp} = \frac{(1+t^*)s'' + px^*}{\Delta},$$

where  $\Delta = c''s'' - p^2$  and  $x^*$  and  $t^*$  denote the optimal values of  $\max_{x,t} \pi(x,t)$ .

$\Delta > 0$  by the existence of a maximum.  $s'' > 0$  by convexity of  $s(t)$ . Hence  $\frac{dx^*}{dp} > 0$ .

b.) By the same arguments one gets

$$\frac{dt^*}{dp} = \frac{c''x'' + p(t^*+1)}{\Delta} > 0$$

c.) T was defined as

$$T = p(1+t^*)x^* - px_0 - c(x^*) + c(x_0).$$

then

$$\begin{aligned} \frac{dT}{dp} &= (1+t^*)x^* + p(1+t) \frac{\delta x^*}{\delta p} + px^* \frac{\delta t^*}{\delta p} - x_0 - p \frac{\partial x_0}{\partial p} \\ &\quad - c' \frac{\partial x^*}{\partial p} + c' \frac{\delta x_0}{\delta p} \end{aligned}$$

Using the first-order conditions this reduces to

$$\frac{dT}{dp} = (1+t^*)x^* + px^* \frac{\partial t^*}{\partial p} - x_0 > 0,$$

since  $\frac{\partial t}{\partial p} > 0$  by b.) and  $x^* > x_0$  by LEMMA 1.

$$d.) \quad \frac{ds(t^*)}{dp} = \frac{\partial s(t^*)}{\partial t} \frac{\partial t^*}{\partial p} > 0$$

by b.) and the convexity of  $s(t)$ .

e.) See LEMMA 2. ||

PROPOSITION 4:

Given the maximization problem

$$\max_{x,t} p(1+t)x - hx^{\alpha} - gt^{\beta}$$

with  $\alpha > 1$ ,  $\beta > 1$ ,  $h > 0$ , and  $g > 0$ , the following holds:

$$a) \quad \frac{dx^*}{dh} < 0$$

$$b) \quad \frac{dt^*}{dh} < 0$$

$$c) \quad \frac{dT}{dh} < 0$$

$$d) \quad \frac{ds(t^*)}{dh} < 0$$

$$e) \quad \frac{d(T-s(t^*))}{dh} < 0$$

Proof:

a.) By Cramer's Rule

$$\frac{dx^*}{dh} = \frac{1}{\Delta} \cdot \begin{vmatrix} -\frac{c'}{h} & p \\ 0 & -s'' \end{vmatrix} = \frac{-s''c'}{h\Delta} < 0.$$

where  $\Delta = c''s'' - p^2 > 0$  and

$$\frac{\partial c'}{\partial h} = \frac{\partial \alpha h x^{\alpha-1}}{\partial h} = \alpha x^{\alpha-1} = \frac{c'}{h}.$$

Since all terms are positive, we get the desired sign.

b) Equivalently

$$\frac{dt^*}{dh} = \frac{1}{\Delta} \cdot \begin{vmatrix} -c'' & \frac{c'}{h} \\ p & 0 \end{vmatrix} = \frac{-c'p}{h\Delta} < 0.$$

$$\begin{aligned} \text{c) } \frac{dT}{dh} &= [p(1+t^*) - c'(x^*)] \frac{dx^*}{dh} - [p - c'(x_0)] \frac{dx_0}{dh} \\ &\quad + px^* \frac{dt^*}{dh} - \frac{\partial c(x^*, h)}{\partial h} + \frac{\partial c(x_0, h)}{\partial h} \\ &= px^* \frac{dt^*}{dh} - \frac{1}{h} [c(x^*) - c(x_0)] \\ &= \frac{-c'px^*}{h\Delta} - \frac{1}{h} [c(x^*) - c(x_0)] \\ &< 0. \end{aligned}$$

The second equation follows from the first-order conditions and since

$$\frac{\partial c(x, h)}{\partial h} = \frac{\partial hx^\alpha}{\partial h} = x^\beta = \frac{c(x, h)}{h}.$$

$\frac{dt^*}{h}$  is negative.  $x^* > x_0$  together with the assumption, that  $c(x)$  is increasing in  $x$ , yields  $c(x^*) - c(x_0) > 0$ . Therefore  $T$  is decreasing in  $a$ .

$$\text{d.) } \frac{ds(t^*)}{dh} = \frac{\partial s(t^*)}{\partial t} \frac{\partial t^*}{\partial h} = \frac{-s'c'}{h\Delta} < 0$$

$$\begin{aligned} \text{e.) } \frac{d(T-s(t^*))}{dh} &= \frac{-s'c'}{h\Delta} - \frac{1}{h} [c(x^*) - c(x_0)] + \frac{s'c'}{h\Delta} \\ &= -\frac{1}{h} [c(x^*) - c(x_0)] \end{aligned}$$

$$< 0. ||$$



PROPOSITION 5:

Given the maximization problem

$$\max_{x,t} p(1+t)x - hx^\alpha - gt^\beta$$

with  $\alpha > 1$ ,  $\beta > 1$ ,  $h > 0$ , and  $g > 0$ , the the following holds:

$$a) \quad \frac{dx^*}{dg} = - \frac{ps'}{g\Delta} < 0$$

$$b) \quad \frac{dt^*}{dg} = - \frac{c''s'}{g\Delta} < 0$$

$$c) \quad \frac{dT}{dg} = px^* \frac{dt}{dg} = - \frac{px^*c''l'}{g\Delta} < 0$$

$$d) \quad \frac{ds(t^*)}{dg} = \frac{\partial s(g, \cdot)}{\partial g} + \frac{\partial s(t^*, \cdot)}{\partial t} \frac{\partial t^*}{\partial g}$$

$$= t^\beta - \frac{s'c''s'}{g\Delta}$$

$$= t^\beta \left(1 - \frac{\beta}{\beta-1} \frac{c''s''}{\Delta}\right) < 0$$

$$e) \quad \frac{d(T-s(t^*))}{dg} = - \frac{pxc''s'}{g\Delta} + \frac{s'c''s'}{g\Delta} - t^\beta$$

$$= -t^\beta$$

$$< 0.$$

Proof:

Since the computation of a.)-e.) follows the same procedures as in PROPOSITION 4, it is omitted. ||

PROPOSITION 6:

Let the reaction function of industry  $i$  and  $j$  be

$$R_k(m_i, m_j) = \frac{\partial \bar{\pi}_k}{\partial p_k(1+t_k)} p_k \frac{\partial t_k}{\partial m_k} - 1 = 0, \quad k=i, j.$$

Then  $R_i(m_i, m_j)$  and  $R_j(m_i, m_j)$  have negative slope.

Proof:

Total Differentiation of  $R_i$  yields

$$\frac{dm_i}{dm_j} = \frac{p_i \left( \frac{\partial^2 \bar{\pi}_i}{\partial [p_i(1+t_i)]^2} p_i \frac{\partial t_i}{\partial m_i} \frac{\partial t_i}{\partial m_j} + \frac{\partial \bar{\pi}_i}{\partial p_i(1+t_i)} \frac{\partial^2 t_i}{\partial m_i \partial m_j} \right)}{-\Delta_i}$$

and for  $R_j$  one gets

$$\frac{dm_j}{dm_i} = \frac{p_j \left( \frac{\partial^2 \bar{\pi}_j}{\partial [p_j(1+t_j)]^2} p_j \frac{\partial t_j}{\partial m_j} \frac{\partial t_j}{\partial m_i} + \frac{\partial \bar{\pi}_j}{\partial p_j(1+t_j)} \frac{\partial^2 t_j}{\partial m_i \partial m_j} \right)}{-\Delta_j}$$

Both,  $\Delta_i$  and  $\Delta_j$  are negative by the second-order condition for a profit maximum. For the numerators we have ( $k=i, j$ )

$$\frac{\partial \bar{\pi}_k}{\partial p_k(1+t_k)} > 0, \quad \frac{\partial^2 \bar{\pi}_k}{\partial [p_k(1+t_k)]^2} > 0$$

by the convexity of  $\bar{\pi}_k[p_k(1+t_k)]$ ;

$$\frac{\partial t_k}{\partial m_k} > 0, \quad \frac{\partial t_k}{\partial m_1} < 0, \quad \frac{\partial^2 t_k}{\partial m_i \partial m_j} < 0, \quad i \neq k,$$

by the assumption of a Downsian politician or government. ||

PROPOSITION 7:

Given the reaction functions  $R_i(m_i, m_j)$  and  $R_j(m_i, m_j)$ , then the following holds

$$\frac{dm_i^*}{dp_i} > 0$$

$$\frac{dm_j^*}{dp_i} < 0$$

Proof:

Let  $\bar{p}_k = p_k(1+t_k)$ ,  $k=i, j$ . The Hessian of  $R_i$  and  $R_j$  is given by

$$\Delta = \begin{vmatrix} \Delta_i & \frac{\partial x_i^*}{\partial \bar{p}_i} p_i^2 \frac{\partial t_i}{\partial m_i} \frac{\partial t_i}{\partial m_j} + x_i^* p_i \frac{\partial^2 t_i}{\partial m_i \partial m_j} \\ \frac{\partial x_j^*}{\partial \bar{p}_j} p_j^2 \frac{\partial t_j}{\partial m_i} \frac{\partial t_j}{\partial m_j} + x_j^* p_j \frac{\partial^2 t_j}{\partial m_i \partial m_j} & \Delta_j \end{vmatrix}$$

In a stabil equilibrium  $\Delta > 0$ . Now by Cramer's Rule

$$\frac{dm_i^*}{dp_i} = \frac{-\Delta_j}{\Delta} \left[ \frac{\partial x_i^*}{\partial \bar{p}_i} p_i (1+t_i^*) \frac{\partial t_i^*}{\partial m_i} + x_i^* \frac{\partial t_i^*}{\partial m_i} \right]$$

since  $\Delta > 0$ , and  $\Delta_j < 0$  by the second-order condition for a maximum of industry  $j$ .  $\delta x_i / \delta \bar{p}_i > 0$  by the convexity of  $\bar{\pi}_i(\bar{p}_i)$  and  $\partial t_i / \partial m_i \geq 0$  by assumption.

$$\frac{dm_i^*}{dp_i} = \frac{1}{\Delta} \left[ \frac{\partial x_i^*}{\partial \bar{p}_i} p_i (1+t_i^*) \frac{\partial t_i}{\partial m_i} + x_i^* \frac{\partial t_i}{\partial m_i} \right].$$

$$\left[ \frac{\partial x_j^*}{\partial \bar{p}_j} p_j^2 \frac{\delta t_j}{\delta m_i} \frac{\delta t_j}{\delta m_j} + x_j^* \frac{\delta^2 t_j}{\delta m_i \delta m_j} \right]$$

$< 0$ ,

since the terms in the first bracket are all positive and both terms in the second bracket have one negative partial. ||

#### PROPOSITION 8:

Let the reaction function  $R_k(\alpha_k, m_i, m_j)$ ,  $k=i, j$ , be defined as

$$R_k(\alpha_k, m_i, m_j) = \alpha_k p_k \frac{\partial \bar{\pi}_k}{\partial p_k (1+t_k)} \frac{\partial t_k}{\partial m_k} - 1 = 0.$$

Then the following holds for  $n, k=i, j$  and  $n \neq k$

$$\frac{dm_k^*}{d\alpha_k} > 0$$

$$\frac{dm_k^*}{d\alpha_n} < 0$$

Proof:

By CRAMER's Rule

$$\frac{dm_k^*}{d\alpha_k} = \frac{1}{\Delta} \cdot \begin{vmatrix} -\frac{\partial R_k}{\partial \alpha_k} & \frac{\partial R_k}{\partial m_k} \\ 0 & \Delta_n \end{vmatrix}$$

$$= \frac{-\Delta_n}{\Delta} \left[ p_k \frac{\partial t_k}{\partial m_k} \left( \frac{\partial \bar{\pi}_k}{\partial p_k (1+t_k)} - \frac{v}{\alpha_k} \frac{\partial^2 \bar{\pi}_k}{\partial p_k (1+t_k) \partial \alpha_k} \right) \right]$$

$$> 0$$

since  $\Delta_n < 0$ , by sufficiency,  $\Delta > 0$  by stability of the equilibrium. The bracket is positive, since all terms are positive except for the last term.

Again by CRAMER's Rule

$$\frac{dm_k^*}{d\alpha_n} = \frac{1}{\Delta} \cdot \begin{vmatrix} 0 & \frac{\partial R_k}{\partial m_n} \\ -\frac{\partial R_n}{\partial \alpha_n} & \Delta_n \end{vmatrix}$$

$$= \frac{1}{\Delta} \left[ p_n \frac{\partial t_n}{\partial m_n} \left( \frac{\partial \bar{\pi}_n}{\partial p_n (1+t_n)} - \frac{v}{\alpha_n} \frac{\partial^2 \bar{\pi}_n}{\partial p_n (1+t_n) \partial \alpha_n} \right) \right]$$

$$\left[ \frac{\partial x_k^*}{\partial p_k (1+t_k)} p_k^2 \frac{\partial t_k}{\partial m_k} \frac{\partial t_n}{\partial m_n} + x_k^* p_k \frac{\partial^2 t_k}{\partial m_k \partial m_n} \right]$$

$$< 0$$

since the last bracket is negative, whereas the first bracket is positive as well as  $\Delta > 0$ . ||

LEMMA 3:

$$\begin{aligned} \frac{dm^*_i}{d\kappa} &> 0 && \text{if } \frac{\delta R_i}{\delta \kappa} > 0 \\ \frac{dm^*_i}{d\kappa} &\leq 0 && \text{if } \frac{\delta R_i}{\delta m_j} \frac{\delta R_j}{\delta \kappa} - \frac{\delta R_i}{\partial \kappa} \Delta_j \leq 0 \end{aligned}$$

$$\begin{aligned} \frac{dm^*_j}{d\kappa} &< 0 && \text{if } \frac{\delta R_i}{\delta \kappa} > 0 \\ \frac{dm^*_j}{d\kappa} &\geq 0 && \text{if } \frac{\delta R_j}{\delta m_i} \frac{\delta R_i}{\delta \kappa} - \frac{\delta R_j}{\partial \kappa} \Delta_i \geq 0 \end{aligned}$$

Proof:

Let

$$R_i(m_i, m_j, \kappa) = \frac{\partial \bar{\pi}_i}{\partial p_i(1+t_i)} p_i \kappa \frac{\delta \tau_i}{\partial \kappa m_i} - 1 = 0$$

$$R_j(m_i, m_j, \kappa) = \frac{\partial \bar{\pi}_j}{\partial p_j(1+t_j)} p_j \kappa \frac{\delta \tau_j}{\partial \kappa m_j} - 1 = 0.$$

Then

$$\frac{\delta R_i}{\delta m_i} = \Delta_i,$$

$$\frac{\delta R_j}{\delta m_j} = \Delta_j,$$

$$\frac{\delta R_i}{\delta m_j} = \frac{\partial \bar{\pi}_i}{\partial p_i(1+t_i)} p_i \kappa \frac{\delta^2 \tau_i}{\partial \kappa m_i \delta m_j} + \frac{\delta^2 \bar{\pi}_i}{\partial [p_i(1+t_i)]^2} p_i^2 \kappa \frac{\delta \tau_i}{\partial \kappa m_i} \frac{\delta \tau_i}{\delta m_j} < 0$$

$$\frac{\delta R_j}{\delta m_i} = \frac{\partial \bar{\pi}_j}{\partial p_j (1+t_j)} p_j^\kappa \frac{\delta^2 \tau_j}{\partial \kappa m_j \delta m_i} + \frac{\delta^2 \bar{\pi}_j}{\partial [p_j (1+t_j)]^2} p_j^{2\kappa} \frac{\delta \tau_j}{\partial \kappa m_j} \frac{\delta \tau_j}{\delta m_i} < 0$$

$$\frac{\delta R_j}{\delta \kappa} = \frac{\partial \bar{\pi}_j}{\partial p_j (1+t_j)} p_j \frac{\delta^2 \tau_j}{\partial \kappa m_j \delta m_i} m_i + \frac{\delta^2 \bar{\pi}_j}{\partial [p_j (1+t_j)]^2} \frac{\delta \tau_j}{\partial \kappa m_j} \frac{\delta \tau_j}{\delta m_i} m_i < 0$$

$$\frac{\delta R_i}{\delta \kappa} = \frac{\partial \bar{\pi}_i}{\partial p_i (1+t_i)} p_i \frac{\delta \tau_j}{\partial \kappa m_i} + \frac{\delta \bar{\pi}_i}{\partial p_i (1+t_i)} p_i^{\kappa m} \frac{\delta^2 \tau_i}{\delta (\kappa m)^2}$$

$$+ \frac{\delta^2 \bar{\pi}_i}{\partial [p_i (1+t_i)]^2} p_i^{\kappa m_i} \left( \frac{\delta \tau_i}{\partial \kappa m_i} \right)^2$$

$$= \frac{\delta \bar{\pi}_i}{\partial p_i (1+t_i)} p_i \frac{\delta \tau_i}{\partial \kappa m_i} + \frac{m_i}{\kappa} \Delta_i > 0.$$

For the first part of the Lemma we get

$$\frac{dm_i^*}{d\kappa} = \frac{1}{\Delta} \left[ \frac{\delta R_i}{\delta m_j} \frac{\delta R_j}{\delta \kappa} - \frac{\delta R_i}{\delta \kappa} \Delta_j \right],$$

where  $\Delta$  is the Hessian Determinant with  $\Delta > 0$  by the stability condition. Since the first element of the difference in the bracket is positive and  $\Delta_j < 0$ , the desired result follows immediately. The second part of the Lemma follows equivalently:

$$\frac{dm_j^*}{d\kappa} = \frac{1}{\Delta} \left[ \frac{\delta R_j}{\delta m_i} \frac{\delta R_i}{\delta \kappa} - \frac{\delta R_j}{\delta \kappa} \Delta_i \right]. ||$$

FOOTNOTES

- <sup>1</sup> Harry G. Johnson (1960), "The Cost of Protection and the Scientific Tariff", in: The Journal of Political Economy, Vol. 68, No. 4, 327.
- <sup>2</sup> Op. cit., 327-345.
- <sup>3</sup> Op. cit., 331-332.
- <sup>4</sup> Gordon Tullock (1967), "The Welfare Costs of Tariffs, Monopolies, and Theft", in: Western Economic Journal, Vol. V, No. 3, 228.
- <sup>5</sup> Anne O. Krueger (1974), "The Political Economy of the Rent-Seeking Society", in: American Economic Review, Vol. 64, No. 6, 293.
- <sup>6</sup> Rachel McCulloch (1979), "Trade and Direct Investment: Recent Policy Trends", in: Rüdiger Dornbush and Jacob A. Frenkel (eds.), "International Economic Policy - Theory and Evidence", The Johns Hopkins University Press, Baltimore, 83.
- <sup>7</sup> See, e.g., ANDERSON/BALDWIN (1981), CAVES (1976), GLISMANN/WEISS (1980).
- <sup>8</sup> Without doubt, a convex cost-function of lobbying would come out of the model. One could obtain better information as to the political parameters determining the functional form of such a cost-function.
- <sup>9</sup> In the terminology of Anderson/Baldwin (1981) the question would be: How are marginal lobbying costs and marginal producer surplus equated?



- 10 This assumption seems to be supported by casual observation of the media, where such conflicts - at least until recently - have not been observed.
- 11 Compensation may become impossible for a dramatic increase in the consumer price level. But this is not empirically relevant for the last decades in industrialised countries.
- 12 Of course, with positive fixed costs one has to take care of possible discontinuities at low lobbying levels.
- 13 The proof is in the appendix, PROPOSITION 6.
- 14 See e.g. MOULIN (1981).
- 15 For a proof see Theorem II-3 in LAU (1978), pg. 154.
- 16 For the exact derivation see PROPOSITION 8 in the appendix.
- 17 See LEMMA 3 in the appendix.
- 18 The formal conditions are given in LEMMA 3.
- 19 If one considers recent reports on the intermingling interests of politicians and industry, one could become doubtful as to whether the metaphor has turned into reality.
- 20 And all other sciences, of course.

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