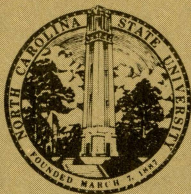# FACULTY

WORKING PAPERS

**Content Requirements with
Bilateral Monopoly**

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Content Requirements with Bilateral Monopoly*

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Comments and quotations welcome.

Abstract This paper models physical content policies in a bilateral monopoly
setting, using a cooperative game approach. For just binding or nonbinding
content requirements, the policy does not induce any dead-weight loss but
alters the profit distribution in favor of the domestic supplier. This result
holds as long as the inputs concerned by the policy are good substitutes in
production, and when the disagreement point corresponds to low content
requirements and low marginal cost for the domestic input.

Keywords: domestic content, bilateral monopoly, efficient contract

JEL Classification: 411

Content Requirements with Bilateral Monopoly

1. Introduction

Content requirement policies allow a domestic manufacturer to receive a tariff rebate on an imported input in exchange for using a required content of domestic substitute input into its output. This paper was motivated by the case of domestic content requirements in the Australian tobacco sector. Australian leaf tobacco farmers produce solely for the domestic manufacturing industry and face strong competition from foreign tobacco producers. Australian tobacco producers are organized as a government-sponsored cartel that controls output levels with production and marketing quotas. The oligopolistic cigarette manufacturing industry composed of three firms buys domestic leaf, high quality tobacco from the United States and low quality tobacco from less developed countries. On the domestic market, Australian cigarettes compete with imported U.S. cigarettes. The Australian government provides a minimum domestic content requirement of 50 percent for cigarettes. The government also sponsors and mediates at annual price and quantity negotiating sessions between the growers' cartel and cigarette manufacturers' association (IAC, 1987). Historically, manufacturers have agreed voluntarily to use 57 percent and to negotiate the price and quantity yearly.

This paper analyzes the economic implications of physical content requirements in a bilateral monopoly situation, using a cooperative game framework.[1] Both the domestic input supplier and manufacturer behave strategically and negotiate an enforceable marketing contract.

We analyze two bargaining situations. First, we investigate the implications of a minimum domestic content requirement set at the free trade input proportion. The input supplier and final good manufacturer bargain over the

price and quantity of the input. Then we consider a minimum domestic content requirement that is below its free trade level and let the two agents negotiate price, quantity, as well as the actual content proportion above the policy requirement. The latter situation is consistent with the Australian tobacco content policy. Both cases are used to analyze the impacts of shocks in the demand for the final good and changes in the content requirement on resource allocations, input price and profit.

Whenever the requirement is not strictly binding, the policy leads to an efficient outcome (no deadweight loss). But it alters the rent distribution in favor of the domestic input supplier by increasing his leverage in negotiations. Further, under plausible assumptions about input substitution and bargaining ability of the two agents, a higher minimum domestic content requirement leads to higher producer price and profit for the domestic input supplier to the cost of the final good manufacturer. These intuitive results are very similar to those of efficient employment contracts in which labor and management maximize the "size of pie" of the firm and then allocate profit shares through the negotiated wage (Brown and Ashenfelter). Hence, in the bilateral monopoly case, moderate (below free trade level) minimum content policies can redistribute income with no direct efficiency effect. The paper suggests that nonbinding quantitative trade barriers are strategically valuable to some domestic producers because they help them reach a better outcome in their marketing negotiations. Hence, we provide a deterministic explanation for the persistence of nonbinding quantitative restrictions which departs from the view that these restrictions are options against some states of nature in an uncertain environment (Anderson).

In this context, the rent-seeking activities are likely to focus on influencing the minimum content level, presumably the manufacturer attempting to lower the requirement and the input supplier doing the opposite; casual evidence suggests these stereotypical behaviors hold in the case of the Australian cigarette industry.[2] However, if the two competing inputs concerned by the content policy exhibit little substitution, higher content requirements eventually will benefit the manufacturer. We characterize these results precisely in the paper.

Finally, the results also have important implications for industries facing declining demand such as cigarette manufacturing confronting smoking restrictions and excise taxes. Exogenous inward shifts in the derived demand for the input under a given domestic content requirement would eventually cause under-production of the domestic input and foregone surplus opportunities if the minimum requirement is non-negotiable.

2. The Literature

Corden and Grossman analyze the effects of such protection schemes in a competitive environment. Content requirements slightly above free trade levels induce higher use of domestic input. Grossman also establishes the perverse effect of content requirement for monopolistic input markets. Content restriction allows the domestic input supplier to use monopoly power created by the policy and restrict his output for monopoly pricing. Mussa, and Findlay and Wellisz question the conventional wisdom of the inferiority of quantitative restrictions compared to tariffs. They show that content requirements induce smaller deadweight loss than a protection-equivalent tariff because the input cost is lower under content requirements. In a related paper Vousden compares the welfare cost of protectionism under different policies

(content requirement and several tariff schemes, protection and cost equivalents). The social cost ranking of these policies depends critically on the market structure and the price responsiveness of the derived demand for the input.

Hollander considers the impact on production, profit, and welfare of different content schemes for a vertically integrated transnational firm that is a monopolist in the final sector. Although all schemes increase cost of production, some can increase production of the final good as well as domestic welfare. More recently, Krishna and Itoh analyze the implications of strategic behavior by the domestic input supplier and its foreign rival. In such an oligopolistic setting the effect of content requirement is determined by the elasticity of substitution between the two inputs. Such policy increases (decreases) profit when the inputs are substitutes (complements) in demand, whereas its price implications are ambiguous. The latter authors offer an interesting decomposition of various effects of content protection into C effects (the policy is effective when strictly binding), M effects (nonbinding restrictions influence the equilibrium by changing demand or supply conditions), and I effects (strategic interaction among agents brings additional impacts).

This study complements the existing literature by considering content requirements in the context an enforceable marketing agreement. Relative to Krishna and Itoh this paper identifies a fourth effect - call it R - of content policies that influences the rent distribution between a monopolistic input supplier and a monopsonistic manufacturer. A small content requirement (smaller than the content equivalent to free trade) has no production effect but increases the profits of the domestic input supplier at the expense of the

manufacturer of the final good.

3. The Model

The model is a companion model to Grossman's. Assume the final output requires three inputs. The two inputs of particular interest include one domestic and one import. For simplicity's sake we present the model and major results assuming perfect substitution between the imported input and the domestic counterpart. At the end of the paper we show the implication of relaxing that assumption. The third input is an aggregate "other input" with infinitely elastic supply to the industry. Denote the first two inputs by M and M* (the asterisk indicates the foreign origin of the factor) and the third input by L. For simplicity, the manufacturer is a price-taker in the output market, in the L-input market, and in the world market for M^* but has monopsony power in the domestic M-input market.

The domestic supplier of M has monopoly power domestically; the foreign substitute, M*, is the only source of competition. We assume that the supply elasticity of M^* is infinite to the domestic industry. Each agent is a profit-maximizer. The profit of the manufacturer, Π_O, is

(1) $\Pi_O = PF(L, M + M^*) - WL - (P_M M + P_M^* M^*)$

where P, W, P_M and P_M^* are the prices of output, L, M, and M^* respectively and F is the production function for the final good, assumed twice differentiable and strictly concave in inputs. The price of the final output, P, is assumed predetermined by the world price (for our tobacco example the price of U.S. cigarettes determines the price of Australian cigarettes).

Define K as the domestic proportion of the total use of M-input, or K = M/(M + M^*). Then the profit of the manufacturer can be expressed as a function of M and K rather than M and M^*. The profit of the input supplier, Π_I, is

$$(2) \quad \Pi_I = P_M M - C(M),$$

where $C(M)$ is the cost function of the input supplier; also assumed twice differentiable, with $C' > 0$ and $C'' > 0$. Because of the minimum domestic requirement $K^r \leq M/(M + M^*)$, the prices of M and M^* do not have to be identical even though the two inputs are perfect substitutes in production. The requirement affects the profit distribution and transforms the market equilibrium into a bargaining problem between the two agents. In a first bargaining problem the agents, the domestic input supplier and manufacturer, negotiate on the price and quantity of the domestic input to be marketed, given a minimum content proportion set at the free trade level. The analysis with K^r set at the free trade level is a benchmark setting used in many studies (e.g., Grossman) and is useful for comparison purposes. In a second bargaining problem, the same two agents bargain over price, quantity, and content of the domestic input, given a minimum content set by the policymaker below the free trade level. This bargaining situation is consistent with the stylized facts of the Australian tobacco and cigarette industries.

We use a cooperative bargaining framework which is appropriate to describe a negotiation outcome with some enforcement mechanism. We assume that the government sanctions and enforces the marketing agreement between the two parties (again this corresponds to the Australian case). A payoff set describes the feasible profit opportunities for the two players. It contains the disagreement point which is attained if no agreement is reached. Many cooperative bargaining solution concepts exist. We use a generalized Nash bargaining game developed by Roth. This framework is simple but provides a good static approximation of more elaborate sequential games (Binmore et al.). This approach allows for a wide range of equilibrium solution points on the

payoff frontier by varying the relative bargaining strength of the players.

We assume that the payoff functions of the players are their profits. If they cannot reach an agreement on the pair (P_M, M), they will behave non-cooperatively. In that case, the input supplier charges the maximum feasible price and the manufacturer reduces its purchase of domestic input M to account for the higher price and forgoes some profit opportunity. This noncooperative behavior assumes that the domestic input supplier's profit is still increasing in P_M at P_M^d. The input supplier would charge even more if it was feasible. This assumption is convenient to determine the impact of the minimum requirement proportion, K^r, on the disagreement point and hence on the marketing contract between the two agents. Other disagreement behaviors are conceivable.[3]

The maximum feasible price for M makes the manufacturer indifferent between satisfying the content requirement to benefit from a tariff rebate and purchasing only the imported substitute at the full import cost including the tariff for violations of the minimum content (Grossman). That is, $K^r P_M^d + (1 - K^r)P_M^* = P_M^* + t$. So the maximum price, P_M^d, is

(3) $P_M^d = P_M^* + t/K^r$,

with t being the specific tariff imposed on the imported inputs; P_M^* represents the after-rebate price of the foreign input and the superscript d denotes the disagreement strategy throughout the paper.

In case of conflict, the manufacturer takes this price as given and adjusts its derived demand to equate the value of marginal product to the new average price of the input, or

(4) $PF_M(L^d, M^d + M^{*d}) = (1 - K^r)P_M^* + K^r P_M^d = P_M^* + t$, with $F_M = \partial F/\partial M$.

Similarly, L^d is chosen by equating the value of marginal product of L to the factor unit cost. Given L^d, M^d, P_M^d we can define the profit of the two negotiating parties reached in case of conflict:

$$(5.1) \qquad \Pi_O^d = PF(L^d, M^d + M^{*d}) - (P_M^d + \frac{(1-K^r)P_M^*}{K^r})M^d - WL^d \quad , \text{ and}$$

$$(5.2) \qquad \Pi_I^d = P_M^d M^d - C(M^d) \quad .$$

The solution to the bargaining process between the manufacturer and input supplier maximizes the Nash product of the payoff gains from reaching an agreement or

$$(6) \quad \max(\Pi_O - \Pi_O^d)^{\gamma O}(\Pi_I - \Pi_I^d)^{\gamma I} \qquad ,$$

where γ^O and γ^I are the "exogenous bargaining power" coefficients reflecting the relative bargaining ability of the players (Roth). The players also derive bargaining strength from the relative magnitude of the conflict payoffs. Other things equal, the higher the conflict payoff, the larger is the profit of a player at equilibrium (Thomson). The maximization of (6) is under the constraints of the technology F, the cost function C, prices P, P_M^*, W, the tariff t, and the content policy.

The parameters γ^O and γ^I are assumed given for the rest of the paper because they are not central to the analysis. But the conflict profits are influenced by changes in the content requirement and changes in manufacturing price. We incorporate these effects into the analysis.

4.   First Game with Non-Negotiable Content

In this first bargaining problem the actual domestic content proportion K is set equal to the minimum requirement K^r, which is also the competitive proportion. The two players jointly choose an optimum price and quantity of domestic M-input to maximize (6). The manufacturer also chooses an optimum

level of L given the optimum level of M, the output price and the input price W. The first order conditions are:

$$(7.1) \qquad \frac{(\Pi_O - \Pi_O^d)}{\gamma^O} \frac{\partial \Pi_I}{\partial P_M} = \frac{-(\Pi_I - \Pi_I^d)}{\gamma^I} \frac{\partial \Pi_O}{\partial P_M} \quad ,$$

$$(7.2) \qquad \frac{(\Pi_O - \Pi_O^d)}{\gamma^O} \frac{\partial \Pi_I}{\partial M} = \frac{-(\Pi_I - \Pi_I^d)}{\gamma^I} \frac{\partial \Pi_O}{\partial M} \quad , \text{ and}$$

$$(7.3) \qquad \frac{\partial \Pi_O}{\partial L} = 0 \quad .$$

They yield

$$(8.1) \qquad PF_L \ (L, \ M/K \ ) = W \quad ,$$

$$(8.2) \qquad PF_M \ (L, \ M/K \ ) = KC'(M) + (1 - K)P_M^* \ , \text{ and}$$

$$(8.3) \qquad \frac{(\Pi_O - \Pi_O^d)}{\gamma^O} = \frac{(\Pi_I - \Pi_I^d)}{\gamma^I} \quad ;$$

where F_L is $\partial F/\partial L$. Equations (8.1) and (8.2) determine the optimum level of inputs, and equation (8.3) determines the price at which M is marketed. Note that M is determined by a weighted average of marginal factor costs and not by the price P_M, very much as in efficient labor contracts (Brown and Ashenfelter). This behavior is illustrated in Figure 1. The segment FA represents the total demand for the input, $M + M^*$, and is labeled PF_M. The demand for the domestic input, labeled KPF_M, along segment FC is shown for a domestic proportional content equal to the free trade proportion (BC/BA). The domestic input use at the disagreement point, M^d, corresponds to the intersection of the average factor cost, $P_M^* + t$, and the domestic input demand schedule, KPF_M, at point G. The related price, P_M^d which is shown at point E, makes the manufacturers indifferent between buying enough domestic input to avoid the tariff and using only the imported input at the nonconcessional price ($P_M^* + t$). Therefore the segment EC shows the willingness to pay for the domestic input with the corresponding value of marginal product along
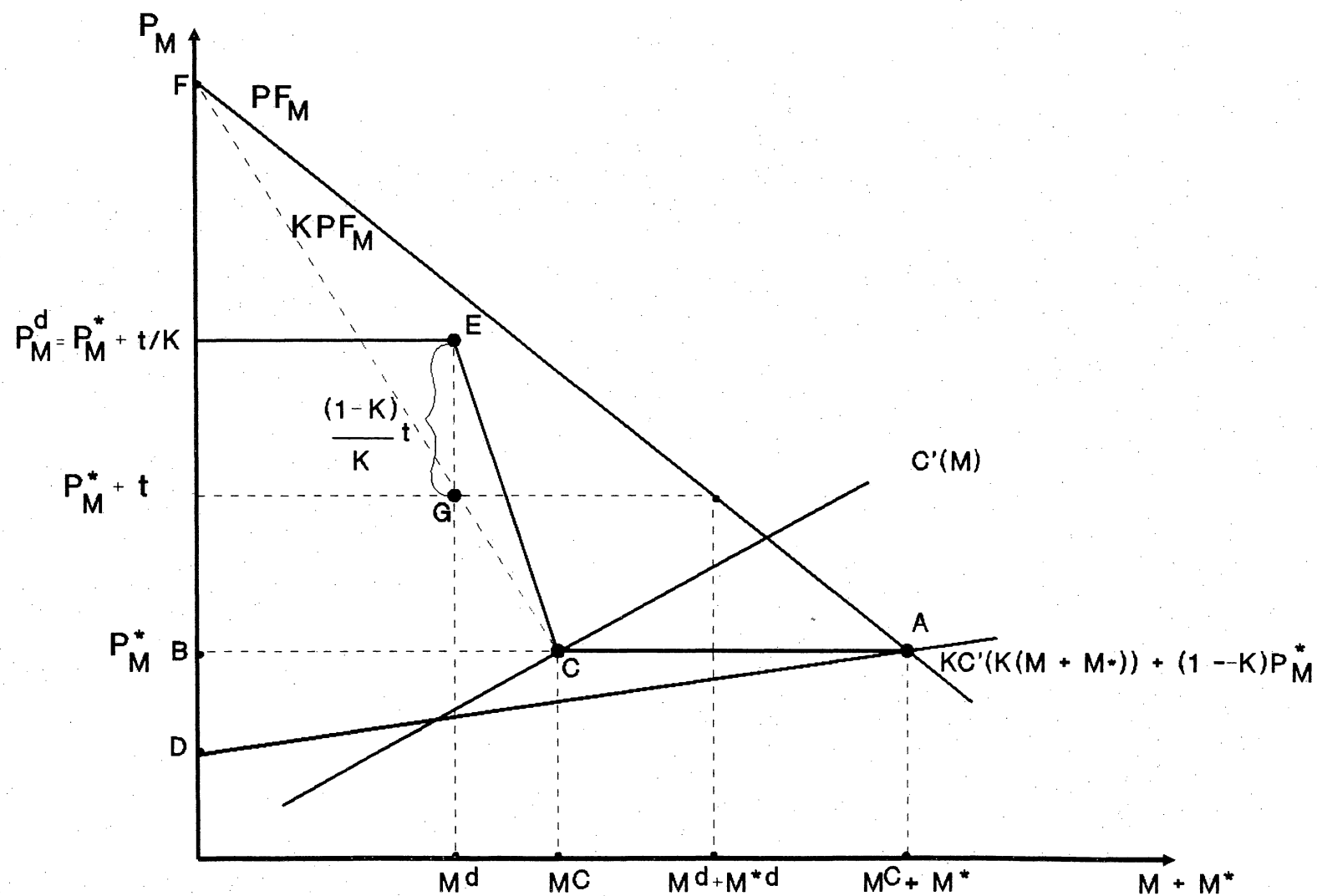
Figure 1: The Derived Demand for Domestic and Foreign Inputs

the segment GC. The weighted marginal factor cost, along DA, is the weighted average of the marginal cost of the domestic input, $C'(K(M + M^*))$, and the world price, P_M^*. At the cooperative equilibrium, the domestic input, M^C, shown at point C, is associated with total input use, $M^C + M^*$, at point A; and the associated marginal factor cost is equal to $KC'(M^C) + (1 - K)P_M^*$, since $K(M + M^*) = M^C$.

We have the following result:

Result 1. <u>In a bilateral monopoly, a physical minimum content requirement equal to the free trade content</u> (i) <u>has no impact on either the equilibrium output or input use of the manufacturer</u>; (ii) <u>increases the price received by and profit of the supplier of the domestic input</u>; (iii) <u>decreases the profit of the manufacturer</u>.

(Proof in Appendix 1)

In a bilateral monopoly the market power of the two bargaining agents does not induce inefficiency. Agents set the level of input to maximize surplus possibilities, that is, their aggregate profit; then they bargain over the price of the input which will determine the distribution of profits. Hence, if the content proportion is set at its free trade value, it will not induce any welfare loss or reduction in imported input use. It will, however, trigger a transfer from the manufacturer to the input supplier.

The agents maximize the surplus by setting the "weighted average" marginal factor cost of the input equal to its value of marginal product and equal to the world price of the input. In figure 1, the total surplus is the area defined by the triangles ABD and BAF.

A corollary to the first result is that a small increase in the content requirement proportion above its free trade level increases the use of the domestic input M. But such an increase reduces the manufacturer's profit and the aggregate welfare possibilities of the two agents (i.e., there is a

deadweight loss). In this case, imports are restricted because of this higher

content requirement. The profit of the input supplier is ambiguously affected,

depending on how fast its marginal cost curve rises and how large $K = K^r$ is.

The comparative statics are shown in appendix 2.

This set of results is in contrast with the results of the pure

monopolistic case where the use of the domestic input always decreases with

larger domestic proportional content requirements (Grossman's Proposition 6).

In figure 1 a larger content requirement would shift the demand for M outward

and make the weighted average marginal factor cost curve pivot counter-

clockwise, decreasing the overall usage of $(M + M^*)$. The marginal cost

schedule, $C'(M)$, represents the limit case of $K = 1$.

Since content requirement policies often occur in vulnerable mature or

infant industries, it is interesting to look at the comparative statics of

shocks in the derived demand for the input $(M + M^*)$[4]. We model these exogenous

shifts by changing the output price, P (e.g., a change in excise tax on

cigarettes). The impact of a lower manufacturing price on the domestic input

M is ambiguous. It is negative if the two inputs L, and $(M + M^*)$ are such that

$F_{ML} = \partial^2 F / \partial M \partial L > 0$. Similar conclusions hold for the comparative statics

(dL/dP); F_{ML} positive is sufficient to insure $dL/dP > 0$. Both agents decrease

their disagreement profits with lower output price. At the cooperative

equilibrium, the input supplier reaches a lower profit, but the manufacturer's

profit is ambiguously influenced by the lower price depending on the relative

strength of the two players (γ^0/γ^I) and on how the change in conflict profits

has affected the bargaining environment. If the decrease in conflict profit is

much bigger for the input supplier than for the manufacturer, the latter will

eventually gain from the decrease in manufacturing price, although its output

is now smaller. Appendix 3 contains derivation of the impacts of changes in P.

5. **Second Game with Negotiable Content**

In this second problem, the two agents renegotiate the actual domestic content proportion above the nonbinding (below free trade level) minimum content requirement set by the policymaker. An additional first order condition reflects the introduction of this new strategy; the Nash product is differentiated with respect to K. It yields

$$(9) \quad \frac{(\Pi_O - \Pi_O^d)}{\gamma^O} \cdot \frac{\partial \Pi_I}{\partial K} = \frac{-(\Pi_I - \Pi_I^d)}{\gamma^I} \cdot \frac{\partial \Pi_O}{\partial K} \quad .$$

We combine (9) with system (8) to derive new conditions:

$$(10.1) \quad PF_M = KC'(M) + (1 - K)P_M^* \quad ,$$

$$(10.2) \quad PF_M = P_M^* \quad \text{if} \quad K \geq K^r \quad ,$$

$$(10.3) \quad PF_L = W \quad , \quad \text{and}$$

$$(10.4) \quad \frac{\Pi_O - \Pi_O^d}{\gamma^O} = \frac{\Pi_I - \Pi_I^d}{\gamma^I} \quad ;$$

where K and K^r are the optimum negotiated and policy-set minimum content requirements, respectively. System (10) implies that as long as the negotiated content proportion is higher than the legal minimum, the domestic input supply is determined by equating the marginal cost $C'(M)$ to the world price P_M^*. Hence, inefficient production is avoided as long as the minimum content proportion is not binding. However, the nonbinding legal minimum content influences the disagreement profit of the two agents and therefore the final profit distribution. If the legal minimum content proportion is fixed over time and if the derived demand for the input decreases due to a decline in the demand for the manufacturing good, eventually the fixed legal minimum becomes nonbinding. (This seems to have been the case for the Australian tobacco and

cigarette industries.) To avoid inefficiency, the input supplier and the manufacturer will negotiate the actual content proportion above the legal minimum content. This will also increase the quantity of the domestic input M. We summarize this last set of remarks as follows:

Result 2. <u>A "small" minimum content requirement policy for which the input</u> <u>supplier and the manufacturer negotiate price, quantity, and content (above</u> <u>policy requirement) of the domestic input</u> (i) <u>is efficient, i.e., inputs are</u> <u>used at their free trade level</u>; (ii) <u>increases the profit of the input</u> <u>supplier and decreases the manufacturer's profit by increasing the domestic</u> <u>input price P_M above the world price P_M^*.</u>   (Proof in Appendix 4).

This result states the R-effect that was mentioned in the second section.

Corollary results relate to the impact of small increases in the nonbinding legal content requirement and changes in manufacturing prices. Increases in the minimum legal content accentuates result 2 (ii). The larger the content, the higher the domestic price, P_M, and the input supplier's profit, and the lower is the manufacturer's profit. Although it does not increase input use, a larger minimum legal content is instrumental in obtaining larger profit for the input supplier.

The deterministic model of this analysis rationalizes the existence of nonbinding quantitative restrictions because of their strategic value in contrast to risk reasons proposed by Anderson. In the latter, quantitative restrictions on trade are options against some possible future states of nature. In expected terms, quota licenses are valuable, even though the quota may not be binding in the present state of nature because it may become binding later. In this model the restriction is never expected to be binding but affects prices and profits by influencing bargaining power.

The next comparative-static experiment deals with the final good price. A

lower manufacturing price decreases the disagreement profit of the manufacturer and leaves the domestic input use unchanged as long as K^r remains nonbinding. If the two inputs L and $(M + M^*)$ are complements in production $(F_{ML} > 0)$, the lower price for the manufactured good induces higher negotiated content proportion, a smaller use of the aggregate input L, and smaller disagreement profit and price received by the input supplier. The negotiated profits of each party are ambiguously influenced by the changing manufacturing price although aggregate profit decreases. Under the complementarity assumptions between L and M, the profit of the input supplier decreases whereas the direction of the change for the manufacturer's profit depends on the relative bargaining power (γ^0/γ^I) and the relative change in disagreement profits for the two players. (See Appendix 5.)

6.   **Relaxing Perfect Substitution**

We now consider the implications of relaxing the assumption of perfect substitution between the two inputs, M and M*. To introduce imperfect substitution between the domestic and imported inputs, we assume weak separability between the two inputs concerned by the policy, M and M*, and the other input L. For illustration, the two competing inputs form a composite input with constant elasticity of substitution. The composite input, M_c, is

(11) $M_c = \delta(\alpha M^{-\mu} + (1 - \alpha)M^{*-\mu})^{-1/\mu}$, where

δ is the scaling parameter; μ is the substitution parameter with the elasticity of substitution, $\sigma = 1/(1 + \mu)$; and α is the share parameter.

Assuming a nonbinding minimum legal content proportion, the two agents negotiate the actual content proportion, price and quantity of the domestic input. The first order conditions to maximize the Nash product (6) are similar to system (10) except (10.1) and (10.2) which become

$$(12.1) \quad PF_M = C'(M)$$

$$(12.2) \quad PF_{M^*} = P_M^* ,$$

or in terms of the composite input $PF_{Mc} = KC'(M) + (1-K)P_M^*$ with $K \geq K^r$. Hence, the chief result of efficient contracts remains unaltered.

The comparative statics of increasing the minimum content reveal the importance of considering heterogeneous inputs. Only if M and M^* are sufficiently substitutable does an increase in the minimum content requirement increase the price P_M and the profit of the input supplier. When the elasticity of substitution is small, an increase in the minimum content leads to a lower price P_M and benefits the final good producer. The intuition resides in the change in relative profits at the conflict point. The maximum conflict price, P_M^d, is very high when the inputs are poor substitutes; any increase in the minimum content dramatically decreases this maximum willingness to pay for the protected input to avoid the tariff penalty and thus increases the profit of the manufacturer in case of conflict. The input supplier benefits to a lesser extent from the increase in the minimum content (lower price is more than offset by the larger quantity sold) in absence of agreement. Hence a higher minimum content will increase the conflict profit of the manufacturer to a greater extent than the input supplier's profit. The relative change in conflict payoffs is disadvantageous for the input supplier $(d\Pi_I/dK^r < 0)$ because it weakens its bargaining position in the negotiations. As the inputs become better substitutes, the impact of higher content requirement is less pronounced on the maximum price, P_M^d, but is still substantial on the quantity sold in case of conflict, M^d. Eventually, increases in the minimum content help the input supplier strategically to obtain higher profit both in case of conflict and agreement. The last appendix

establishes these results.

7.   **Conclusion**

The chief results of the paper concern the efficiency and income distribution effects of the physical minimum domestic content proportion in a bilateral monopoly setting. We have identified a R-effect showing the strategic value of a nonbinding content requirement for the distribution of profit between the input supplier and the final good producer. In this context, a nonbinding or just binding minimum content requirement is efficient (i.e., it does not induce any deadweight loss), although it increases the profit of the domestic input supplier compared to its free trade level. Another direct consequence of this efficiency result is that a minimum content requirement does not restrict trade because the import decision leads to free trade import levels.

These conclusions extend to the case of less than perfectly substitutable inputs. Under a wide range of values for the elasticity of substitution between the two inputs, an increase in the nonbinding content requirement benefits the input supplier.

This paper could be extended to other content schemes, e.g., domestic content expressed in percent of value added or sales. Krishna and Itoh, and Hollander have shown in their analysis that effects of content policy depend considerably on the form of the scheme (physical, value added...). Hence, it would be interesting to know if these scheme-specific effects exist for the bilateral monopoly case. Another obvious extension concerns the tariff on imported input and its strategic value in the negotiations. We could derive the comparative statics of changes in tariffs.

It is also of interest to investigate empirically the implications of

content policies for prices and quantities of domestic inputs and imported
substitutes. The Pareto-efficient contract implies that the domestic input use
should vary with fluctuations of the world price of the competing foreign
substitute but should not depend on changes in the contract price. This
implication leads to testable hypotheses. Such an empirical investigation
could contribute to the general debate on efficiency of cooperative bargaining
outcomes common to labor contracts (Brown and Ashenfelter), marketing
agreements such as in this paper, social contracts among pressure groups
(Beghin and Karp), and vertical contracts with franchise fee (Tirole).

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Endnotes

1. The content policy is defined in proportional physical terms, i.e., the domestic input cannot fall below a given fraction of the total input use.

2. The Industrial Assistance Industry report notes that Philip Morris insures the policy- maker it would comply with the agreement (using 57%) in case of phasing out of the content policy, whereas the Australian tobacco grower association has been pushing to increase the minimum requirement from 50 percent to 57 percent.

3. An alternative is that when bargaining breaks down, no domestic input is exchanged at any price. Throughout the paper we assume that the tariff, t, is never prohibitive such that the manufacturer is not driven out of business because of zero profit at the conflict point. If eventually the tariff were high enough to stop manufacturing production, then the maximum price P_M^d will make the manufacturer indifferent between producing and satisfying the domestic content requirement and exiting the industry. The conflict profits would then be equal to zero.

4. In 1982, the U.S. car industry lobbied vigorously for a domestic content bill, which was defeated (Hillman). Australian Tobacco industries have been under strong competitive pressures from foreign producers and face increasing smoking restrictions and excise yaxes on cigarettes (the Industry Assistance Commission). Brazil has a domestic content policy for its car industry (Munk).

Appendix 1.   <u>Proof of Result 1</u>

In this appendix we have $K = K^r$, since the content policy is set at its free trade value. At the free trade equilibrium, the two agents behave competitively because the world price determines domestic price ($P_M^* = P_M$). The optimum input levels L_{ft}, M_{ft}, and M_{ft}^* satisfy

(A.1) $PF_L(L_{ft}, M_{ft} + M_{ft}^*) = W$, and

(A.2) $PF_M(L_{ft}, M_{ft} + M_{ft}^*) = P_M^* = C'(M) = P_M$.

Define $K = M_{ft}/(M_{ft} + M_{ft}^*)$ and define the function $G(L, M) = PF(L, M/K) - C(M) - LW - ((1 - K)/K)P_M^*M$, which is strictly concave because F and (-C) are strictly concave. Therefore, G has a unique maximum satisfying

(A.3) $PF_L - W = 0$

(A.4) $PF_M - \dfrac{C'(M)K - (1 - K)P_M^*}{K} = 0$

The free trade input combination also satisfies (A.3) and (A.4). Hence, the value of L and M satisfying (A.3) and (A.4) must be equal to L_{ft}, M_{ft} and the output F corresponding to the maximum of G is $F(L_{ft}, M_{ft}/K)$.

By condition (8.3) we have $\dfrac{(\Pi_I - \Pi_I^d)}{\gamma^I} = \dfrac{(\Pi_O - \Pi_O^d)}{\gamma^O}$.

By the axioms of rationality, we have $\Pi_I \geq \Pi_I^*$ with $\Pi_I^* = P_M^*M_{ft} - C(M_{ft})$. This inequality implies $P_M \geq P_M^*$. Equation (8.3) is differentiated with respect to γ_I, which yields $dP_M/d\gamma_I > 0$. P_M^* is the lower bound on P_M. As the parameter γ^I increases, the price received by the input supplier increases; because of (A.4) we have $P_MM_{ft} - C(M_{ft}) > P_M^*M_{ft} - C(M_{ft})$ and $PF(L_{ft}, M_{ft}/K) - WL_{ft} - (P_M + ((1 - K)/K)P_M^*)M_{ft} < PF(L_{ft}, M_{ft}/K) - WL_{ft} - P^*M_{ft}$.

Appendix 2.   <u>The comparative-statics of a change in K^r around its free trade value</u>

We differentiate the first order conditions (8) for small exogenous

changes in the content ratio around its free trade value. This gives

$$(A.6) \quad \frac{dM}{dK^r} = \frac{(M + M^*)((F_{MM} - F_{LM}^2/F_{LL})}{(P(F_{MM} - F_{ML}^2/F_{LL}) - K^2 C'')}$$

Strict concavity of the production function insures that $(F_{MM} - F_{LM}^2/F_{LL}) < 0$ and that the marginal cost is increasing, $C'' > 0$. These two intermediate results insure that $dM/dK^r > 0$ for small increases above K_{ft}.

Next we obtain the change in domestic price P_M. Evaluated at $K^r = K$, it is

$$(A.7) \quad \frac{dP_M}{dK^r} = \frac{[-(PF_{LM}^2/KF_{LL}) + (1 + \rho)(C' - P_M)][PF_{MM} - (PF_{ML}^2/F_{LL})]}{(1 + \rho) K[PF_{MM} - (PF_{ML}^2/F_{LL}) - C''K^2]}$$

$$+ [\rho(M^d/M)(P_M^* - C'(M^d)) + (PF_{LM}^2/KF_{LL})]/[K(1 + \rho)] \quad ,$$

where $\rho = (\gamma^0/\gamma^I)$. The denominator $(C'(M) - P_M)$ is negative $(P_M^* - C'(M^d))$ is positive, ρ is positive. Hence, the sign of (dP_M/dK^r) is ambiguous.

Similarly, the impact of a small increase of K above its free trade level has an ambiguous impact on the profit of the input supplier. We have

$$(A.8) \quad \frac{d\Pi_I}{dK^r} = \frac{M}{(1 + \rho)K} \, w \frac{a'(PF_{MM} - (PF_{ML}^2/F_{LL}))(-PF_{LM}^2/KF_{LL})}{(PF_{MM} - (PF_{ML}^2/F_{LL}) - C''K^2)}$$

$$+ (\rho M^d/M)(P_M^* - C'(M^d)) + (PF_{LM}^2/KF_{LL})) \overset{p}{\underset{q}{w}} .$$

The quantity effect (dM/dK^r) is positive, whereas the price effect (dPM/dK^r) is ambiguous. For small values of $(C''K^2)$ and large differences $(P_M^* - C'(M^d))$ and large ρ, the profit of the input supplier increases with K. These conditions correspond to small values of K_{ft} and slowly rising marginal cost.

Next we derive the negative impact of the same increase of K on the profit of the manufacturer.

$$\text{(A.9)} \quad \frac{d\Pi_0}{dK} = \frac{M}{K(1+\rho)}\left\{ w\frac{(PF_{MM} - (PF_{ML}^2/F_{LL}))(-PF_{LM}^2/F_{LL}K)p}{a \quad (PF_{MM} - (PF_{ML}^2/F_{LL}) - KC'') \quad q}w \right.$$

$$\left. + (PF_{LM}^2/KF_{LL}) - (M^d/M)(P_M^* - c'(M^d)) \right\} \qquad < 0 \ .$$

Finally, the multipliers $(d(M + M^*)/dK^r)$ and (dL/dK^r) will determine the impact of a larger content on manufacturing output. We have

$$\frac{d(PF_M(M + M^*, L))}{dK^r} = KC'' \frac{dM}{dK^r} > 0 \qquad ;$$

implying a lower total use of input $(M + M^*)$ or $(d(M + M^*)/dK) < 0$.

The impact on L-input use is ambiguous depending on the substitution between M and L. We have

$$\text{(A.10)} \quad \frac{dL}{dK^r} = \frac{M}{KP(F_{LL} - F_{ML})}\left\{ w\frac{dM}{adK^r}\frac{1}{M} - \frac{1}{Kqa}wwPF_{MM} - PF_{ML}w\frac{pdM}{qdK^r}\frac{1}{M} - K^2C'' \right\}$$

which cannot be signed before determining the sign and magnitude of F_{ML}. Hence the impact of a larger K on manufacturing output cannot be signed without further assumptions.

Appendix 3.   The Comparative Statics of a Change in P

The comparative statics of a change in manufacturing price, P, are relatively simple because of the envelope theorem. We first derive the impact on M and L of changes in P by differentiating (8.1) and (8.2). They are

$$\text{(A.11)} \quad \frac{dM}{dP} = \frac{K(F_L F_{ML} - F_M F_{LL})}{((F_{MM}F_{LL} - F_{LM}^2)P - C''KF_{LL})} \qquad , \text{ and}$$

$$\text{(A.12)} \quad \frac{dL}{dP} = \frac{-(F_L F_{MM} - F_M F_{LM})P + F_L C''K}{(P(F_{LL}F_{MM} - F_{LM}^2) - C''KF_{LL})}$$

Complementarity between L and M ($F_{LM} > 0$) is sufficient to insure a positive impact of P on L and M and therefore on $(M + M^*)$. From (A.11) and (A.12) it is

clear that dF/dP is positive.

Next we derive the impact multiplier for the domestic price P_M. It is obtained by differentiating (8.3) for changes in P:

$$(A.13) \quad \frac{dP_M}{dP} = \frac{1}{(1 + \rho)M} \left\{ wF + (C'(M) - P_M)\frac{(1 + \rho)K(F_M F_{LL} - F_L F_{ML})\,P}{(P(F_{ML}^2 - F_{LL}F_{MM}) + C''KF_{LL}q}w + \right.$$

$$\frac{(F_M(L^d, M^d/K^r)F_{LL}(L^d, M^d/K^r) - F_L(L^d, M^d/K^r) \cdot F_{ML}(L^d, M^d/K^r))}{P(F_{LM}^2(L^d, M^d/K^r) - F_{LL}(L^d, M^d/K^r)F_{MM}(L^d, M^d/K^r)}$$

$$\left. + \rho(P_M^d - C'(M^d) - F(L^d, M^d/K^r) \right\} \quad .$$

The multiplier dP_M/dP is decomposed into three components: a direct output effect (FdP) which is positive; a negative input demand effect $((C' - P_M)dM)$; and a combined change in the disagreement profits $[(-d\Pi_O^d/dP < 0)$ and $(\rho d\Pi_I^d/dP > 0)$ if L and M are complements]. The aggregate effect of these three influences is difficult to sign a priori.

The change in manufacturing price has an impact on the distribution of profit. We derive the multipliers $(d\Pi_O/dP)$ and $(d\Pi_I/dP)$ by differentiating Π_O and Π_I and substituting (A.11) to (A.13) into the results. This yields

$$(A.14) \quad \frac{d\Pi_O}{dP} = wF\rho + \frac{d\Pi_O^d}{dP} - \rho \frac{d\Pi_I^d}{dP}w\frac{P}{q(1 + \rho)} \quad , \text{ and}$$

$$(A.15) \quad \frac{d\Pi_I}{dP} = \frac{1}{(1 + \rho)a}wF + \rho \frac{d\Pi_I^d}{dP} - \frac{d\Pi_O^d}{dP}\frac{P}{q}w \quad ;$$

where $\dfrac{d\Pi_I^d}{dP}$ and $\dfrac{d\Pi_O^d}{dP}$ are the changes in conflict profits for the input supplier and manufacturer. They are

$$(A.16) \quad \frac{d\Pi_I^d}{dP} = \frac{(P_M^d - C'(M^d))F_M(L^d, M^d/K^r)F_{LL}(L^d, M^d/K^r)K^r}{P(F_{LM}^2(L^d, M^d/K^r) - F_{MM}(L^d, M^d/K^r)F_{LL}(L^d, M^d/K^r))} \quad , \text{ and}$$

(A.17)
$$\frac{d\Pi_O^d}{dP} = F(L^d, M^d/K^r) \quad .$$

Both conflict profits increase with a higher manufacturing price. The input supplier increases its equilibrium profit ($d\Pi_I/dP > 0$), but the manufacturer's profit is ambiguously changed depending on the relative bargaining power (γ^O/γ^I) and the relative size of ($\rho F - F(L^d, M^d/K^r)$) and ($d\Pi_I^d/dP$).

Appendix 4. **Proof of Result 2**

Equations (10.1) and (10.3) are equivalent to the free trade first order conditions. Hence, $M = M_{ft}$ and $L = L_{ft}$ and $K = K_{ft}$.

Part (ii). The argument is quite similar to the first result's. Assume that the input supplier has no bargaining power. His lowest profit will be such that $\Pi_I - \Pi_I^* \geq 0$, with $\Pi_I^* = P_M^* M_{ft} - C(M_{ft})$. It implies $P_M \geq P_M^*$. As soon as γ^I increases, P_M will be larger than its lower bound since $dP_M/d\gamma_I > 0$. As in the case of Result 1, the profit of the input supplier increases with P_M, whereas the manufacturer's profit decreases.

Appendix 5. **Comparative-statics of changes in K^r and P for the second game**

Changes in K^r

Differentiation of system (10) with respect to K^r yields

(A.18)
$$dM = 0 = dL = dM^* = dF \quad ,$$

(A.19)
$$\frac{dP_M}{dK^r} = \rho \frac{(P_M^* - C'(M^d))}{(1 + \rho)M} \frac{M^d}{K} > 0 \quad , \text{ for small } K^r, \text{ i.e., } (C'(M^d) < P_M^*)$$

(A.20)
$$\frac{d\Pi_O}{dK^r} = \frac{-\rho(P_M^* - C'(M^d))}{(1 + \rho)} \frac{M^d}{K} < 0 \text{ (for small } K^r) \quad , \text{ and}$$

(A.21)
$$\frac{d\Pi_I}{dK^r} = \rho \frac{(P_M^* - C'(M^d))}{(1 + \rho)} \frac{M^d}{K} > 0 \text{ (for small } K^r) \quad ;$$

where K^r refers to the legal content, assumed lower than K_{ft}.

Changes in P

We differentiate system (10) with respect to P. We obtain

(A.22) $$\frac{dK}{dP} = \frac{[F_L F_{ML} - F_M F_{LL}]K^2}{P\,[-M][F_{MM}F_{LL} - F_{LM}^2]} \quad,$$

(A.23) $$\frac{dM}{dP} = 0 \quad,$$

(A.24) $$\frac{dL}{dP} = \frac{(F_M F_{LM} - F_L F_{MM})}{P[F_{MM}F_{LL} - F_{LM}^2]} \quad,$$

(A.25) $$\frac{dP_M}{dP} = w(F - F(L^d, M^d/K^r)) + \rho\frac{d\Pi_I^d}{dP}\frac{P}{qM(1 + \rho)}\frac{1}{w} \quad, \text{ where}$$

(A.26) $$\frac{d\Pi_I^d}{dP} = [P_M - C'(M^d)]\frac{K}{P} - \frac{[F_L(L^d, M^d/K^r) - F_M(L^d, M^d/K^r)F_{LL}(L^d, M^d/K^r)]}{[F_{MM}(L^d, M^d/K^r)F_{LL}(L^d, M^d/K^r) - F_{ML}^2(L^d, M^d/K^r)]} \quad,$$

(A.27) $$\frac{d\Pi_O}{dP} = \frac{wF\rho}{a} + F(L^d, M^d/K^r) - \rho\frac{d\Pi_I^d}{dP}\frac{P}{q}\frac{1}{1 + \rho}\frac{1}{w} \quad, \text{ and}$$

$$\frac{d\Pi_O^d}{dP} = F(L^d, M^d/K^r) > 0$$

When L and M are complement, (dK/dP) is negative and (dL/dP) and $(d\Pi_I^d/dP)$ are positive. From (A.22) and (A.24) it is obvious that F decreases with a lower P independently of the sign of F_{LM}.

Appendix 6 Changes in K^* with imperfect substitution

The composite input is $M_C = \delta(\alpha M^{-\mu} + (1 - \alpha)M^{*-\mu})^{-1/\mu}$. In case of conflict, the maximum willingness to pay for the domestic input makes the manufacturer indifferent between the cost of M_C under the content policy without tariff and the unconstrained cost with tariff. The unit price of M_C, P_C, is equal under the two alternatives

$$(A.28) \qquad P_C^d = 1/\delta(P_M + BP_M^*)(\alpha + (1 - \alpha)B^{-\mu})^{1/\mu} = 1/\delta(\alpha^\sigma P_M^{\sigma\mu} + (1 - \alpha)^\sigma$$

$$(P_M^* + t)^{\sigma\mu})^{1/\sigma\mu} \qquad , \qquad \text{where } B = (1-K^r)/K^r.$$

This identity is differentiated to yield the multipliers dP_M^d/dK^r, dP_C^d/dK^r. They are

$$(A.29.1) \qquad \frac{dP_M^d}{dK^r} = - \frac{1}{K^{r2}} B^{-1}P_M^d(1 - A^{1/\sigma})/(1 - A) \leq 0 , \qquad \text{and}$$

$$(A.29.2) \qquad \frac{dP_C^d}{dK^r} = - \frac{1}{K^{r2}} B^{-1}P_C^{d\sigma} \delta^\sigma \alpha^\sigma P_M^{d\mu\sigma}(1 - A^{1/\sigma})/(1 - A) \leq 0 \qquad , \text{ where}$$

$$A = (P_C\delta\alpha/P_M)^\sigma(\alpha + B^{-\mu}(1 - \alpha))^{-1/\mu} .$$

Next we differentiate the first order conditions to maximize the manufacturer's profit at the conflict point for changes in K^r. Combining this intermediate result with (A.29) yields the multipliers

$$dM_C^d/dK^r \qquad , \qquad dM^d/dK^r \qquad , \qquad d\Pi_0^d/dK^r \qquad , \qquad \text{and } d\Pi_1^d/dK^r.$$

They are

$$(A.30.1) \qquad \frac{dM_C^d}{dK^r} = \frac{F_{LL}}{P} \frac{1}{(F_{M_CM_C}F_{LL} - F_{M_CL}^2)}(dP_C^d/dK^r) \geq 0 \qquad ,$$

with F_{ij} evaluated at the conflict point;

$$(A.30.2) \qquad \frac{dM^d}{dK^r} = (\frac{dM_C^d}{dK^r})(\alpha + (1 - \alpha)B^{-\mu})^{1/\mu} + \frac{M^d}{K^2}B^{-1/\sigma}(1 - \alpha)$$

$$(\alpha + B^{-\mu}(1 - \alpha))^{-1} \geq 0,$$

$$\text{(A.30.3)} \quad \frac{d\Pi_0^d}{dK^r} = -M_C^d(dP_C^d/dK) \geq 0$$

$$\text{(A.30.4)} \quad \frac{d\Pi_0^d}{dK^r} = \frac{M^d}{K^{r2}} B_a^{-1}{}_w(-P_M^d + (P_M^d - C'(M^d))A\eta)\frac{(1 - A^{1/\sigma})}{(1 - A)} + (1 - \alpha(\alpha + B^{-\mu}$$

$$(1 - \alpha))^{-1}(P_M^d - C'(M^d))_w{}^p{}_q$$

where η $(\eta = -\dfrac{dM^d}{dP_M^d}\dfrac{P_M^d}{M^d} > 0)$ is the elasticity of demand for the domestic

input under the content requirement at the conflict point. Since we assume

the input supplier's conflict strategy is to charge the most possible under the

content policy, it is implied that $d\Pi_I^d/dP_M^d > 0$ at the maximum price, P_M^d (i.e.,

the supplier should charge even more to satisfy the first order condition).

Hence the demand elasticity, η, has an upper bound $\eta \leq P_M^d/(P_M^d - C'(M^d))$. The

multiplier, $d\Pi_I^d/dK^r$, is positive when the two inputs M and M^* are good

substitutes (σ high), when the marginal cost $C'(M^d)$ is low, K^r is small and η

large. The term $A = (P_C^d\delta\alpha/P_M^d)^\sigma \cdot (\alpha + (1 - \alpha)B^{-\mu})^{-1/\mu}$ goes to zero very quickly

for large sigma. For example, if $\sigma = 10$, $\alpha = .5$, $K^r = .20$, $P_M^* = 1$, $t = 1$, the

value of A is .0000351.

Next we derive the impact on the cooperative equilibrium of changing K.

By the envelope theorem we have $dM = dM^* = dL = dF = 0$, and P_M is the only

changing variable:

$$\frac{dP_M}{dK^r} = \frac{M}{(1 + \rho)}(\rho\frac{d\Pi_I^d}{dK^r} - \frac{d\Pi_0^d}{dK^r})$$

$$\text{(A.31)} \quad = \frac{M}{(1 + \rho)}\rho M^d\frac{B^{-1}}{K^2}\left\{[-(A/\rho)P_M^d - C'(M^d))A\eta - P_M^d]\frac{(1 - A^{1/\sigma})}{1 - A} + \right.$$

$$\left. (1 - \alpha(\alpha + B^{-\mu}(1 - \alpha))^{-1})(P_M^d - C'(M^d))\right\} > 0 \quad ,$$

for ρ and σ large, small α and K, low $C'(M^d)$, and large η. Hence we have the

final result

$$(A.32) \qquad \frac{d\Pi_I}{dK^r} = M \frac{dP_M}{dK^r} > 0 \qquad , \qquad \text{and}$$

$$(A.33) \qquad \frac{d\Pi_O}{dK^r} = -M \frac{dP_M}{dK^r} < 0 \qquad , \text{ under the same conditions.}$$

When σ, ρ, and η become smaller and K and α larger, the signs of (A.31) to

(A.33) are eventually reversed.