A GAME-THEORETIC ANALYSIS OF THE AUSTRALIAN TOBACCO DOMESTIC CONTENT POLICY

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1. Introduction

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, and tobacco from the United States and 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). 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. The competitive and monopoly cases were originally analyzed by Grossman. Following Grossman, 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. Other papers by Mussa, Findlay and Wellisz, Vousden, Hollander and Krishna and Itoh analyze related issues (see Beghin and Sumner). Elaborating on Grossman's model, we analyze two bargaining situations where both the domestic input supplier and manufacturer behave strategically and negotiate an enforceable marketing contract. 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.

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).

The paper also 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). Lastly, the paper suggests testable hypotheses on the production, trade and efficiency effects of these policies for the Australian tobacco industry.

2. 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 which are assumed perfect substitutes. 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

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

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 M-input use, 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. 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.

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

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

with t being the specific tariff imposed on the imported input; 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

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

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:

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

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

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

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

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 in to the analysis.

3. 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:

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

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

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

They yield

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

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

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

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).

We have the following result:

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

(Proof in Beghin and Sumner)

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.

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.

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).

4. 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 (6) 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:

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

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

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

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

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

This result states the distributional effect mentioned in the introduction.

Corollary results relate to the impact of small increases in the nonbinding legal content requirement. 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.

5. 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 incorporated Grossman's model into a cooperative game framework, to analyze the strategic value of a nonbinding content requirement to transfer profit from the final good producer to the input supplier. In this context, a nonbinding or just binding minimum content requirement is efficient (no production effect), 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 (below its free trade level) 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.

It is of interest to investigate empirically the implications of content policies for prices and quantities of domestic inputs and imported substitutes in the Australian cigarette industry. The tobacco demand system of the Australian cigarette industry should be determined by world prices of tobacco, the marginal cost of providing the domestic tobacco, but not by the negotiated domestic price.

Hence, 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. Another implication of our model is the independence of the optimum tobacco mix or derived demand from the domestic content policy. Neither the minimum nor the actual content should influence the tobacco derived demand. These hypotheses can easily be tested as restrictions imposed on the tobacco demand system. 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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