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**Trade and Efficiency Effects
of Domestic Content Protection
The Australian Tobacco and Cigarette Industries**

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DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS
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Trade and Efficiency Effects
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(DARE: 91-03/April 1991)

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ABSTRACT

This paper provides an empirical investigation of the international trade and domestic market efficiency effects of physical domestic content requirement in the Australian tobacco leaf growing and cigarette manufacturing industries. Our empirical evidence suggests that the content requirement has distorted trade by restricting leaf imports. Nevertheless, the data are also consistent with the efficient contract hypothesis. The mix of domestic to imported leaf used in cigarette manufacturing depends on domestic leaf production costs and on world leaf prices but not on the negotiated domestic leaf price.

TRADE AND EFFICIENCY EFFECTS OF DOMESTIC CONTENT PROTECTION

The Australian Tobacco and Cigarette Industries

1. Introduction

In this paper we analyze the international trade and domestic market efficiency implications of domestic content protection in the Australian tobacco leaf growing and cigarette manufacturing industries. Because of the way these two industries are organized, we are able to use a single body of data to test a pair of related hypotheses. The first is whether the domestic content requirement has distorted international trade in tobacco leaf. The second is whether, in this protected and potentially distorted environment, the marketing agreement reached between the leaf growing and tobacco manufacturing industries is efficient. The two hypotheses are related in the sense that one might expect leaf growers to parlay the distortionary effects of domestic content protection into higher leaf prices than would exist in efficient domestic marketing contracts.

The two industries are structured as a bilateral monopoly. Domestic leaf growers get their monopoly power from the domestic content scheme, while tobacco manufacturers get their monopsony power because they constitute the sole domestic (and virtually the sole international) market for domestic leaf. They negotiate price and quantity of domestic tobacco leaf and reach an annual marketing contract which is administered by the Australian Tobacco Board, which comprises representatives of the government,

tobacco growers and cigarette manufacturers. Participation is mandatory. Each year the Australian Agricultural Council determines minimum leaf prices based on tobacco grades and on an aggregate national production quota based on recommendations of the ATB. Once the AAC has set prices and quotas, the national quota is allocated to states and then to individual growers based on historical production. Prices are enforced unless the grade quality is contested. A dispute procedure arbitrated by the ATB resolves contested sales.

International trade in tobacco leaf is also managed. Cigarette manufacturers must meet a domestic content requirement on their leaf use that has increased progressively over time. The requirement is expressed as the ratio of domestic to total leaf usage, and is defined physically, by weight. It increased from 28.5% in 1960 to 50% in 1966, where it has remained ever since. However manufacturers "voluntarily" agreed to a 55% requirement in 1967 and to a 57% requirement in 1977, and the higher share is used by the Australian Customs Service when they monitor compliance. Compliance is encouraged by a penalty tariff, which also has increased progressively over time, and which must be paid on all imported leaf by manufacturers who violate the domestic content requirement. The penalty tariff has increased from A\$0.33 per kilogram during 1960-1971 to A\$0.95 per kilogram during 1978-1988.¹

We use a cooperative game framework to analyze the marketing contract in the presence of the domestic content requirement.

Two testable hypotheses emerge from the model, one concerning the trade and production effects of the requirement and the other concerning the efficiency of the marketing contract reached in the presence of the requirement. The two issues are related through their common trade implications. An inefficient contract would create further distortions in trade flows in addition to any distorting effects of the content requirement. We first show that the domestic content requirement has neither trade nor domestic production effects as long as it is not binding; the marketing contract stipulates domestic and imported leaf use at free trade levels. However even a nonbinding domestic content requirement influences the profit distribution between domestic growers and manufacturers. The second implication of the model concerns the nature of the marketing contract. The contract is Pareto efficient if growers and manufacturers cooperate to maximize joint surplus, in which case we show that domestic leaf use depends on domestic leaf production cost and the world price of the competing imported leaf, but is independent of the marketing contract price. If growers and manufacturers do not cooperate, domestic leaf use is determined by manufacturers in response to a monopoly price set by domestic growers, and the contract is not Pareto efficient. This bargaining model is largely an adaptation to a new institutional setting of the efficient employment contract model developed by Brown and Ashenfelter (1986). In their model labor and management choose employment so as to maximize joint surplus. In an efficient

employment contract the negotiated wage does not influence the bargained level of employment.

These hypotheses lead to a sequence of empirical tests. We first test to see if the domestic content requirement has been binding, by testing the hypothesis that domestic and imported leaf uses are independent of the requirement. We then test the efficiency of the marketing contract, first by testing the hypothesis that leaf uses are independent of the contract price, and then by testing the hypothesis that leaf uses are independent of domestic leaf production costs and world leaf prices. If domestic leaf use is influenced by domestic leaf cost and world leaf prices, but not by the contract price, then the tests provide evidence that the contract maximizes joint surplus in the given policy environment. However this test of the efficient contract hypothesis is really a conditional test, conditioned on the presence of a related institutional constraint, a domestic content requirement that may or may not be binding.

The hypotheses are tested econometrically using 1960-1988 annual time series data. Our results suggest that the mix of domestic to imported tobacco leaf has been raised by the domestic content requirement, measured both by the seemingly nonbinding legal minimum and by the actual higher effective requirement. Hence trade has been distorted, restricting import flows. The domestic content requirement has proved to be an effective device for altering the mix of domestic to imported leaf in the cigarette industry, thereby providing protection to domestic leaf growers.

In this distorted environment, however, our empirical evidence is consistent with the efficient contract hypothesis: world leaf prices and domestic leaf costs strongly influence the mix of domestic and imported leaf use, but negotiated domestic leaf prices do not. Thus the marketing arrangement does not induce further trade distortion. These two findings are quite robust to specification changes and variable definition changes.

The remainder of the paper proceeds as follows. In Section 2 we lay out the cooperative game bargaining model in an environment that is descriptive of the protected environment in which Australian tobacco leaf growers and cigarette manufacturers bargain under the auspices of the Australian Tobacco Board. This model extends the protected bilateral monopoly model of Beghin and Sumner (1990), which in turn builds on the content protection model of Grossman (1981). The trade distortion and contract efficiency hypotheses emanating from the model developed in Section 2 are tested empirically in Section 3. In Section 4 the results are summarized and their implications are discussed.

2. The Model

The model characterizes the behavior of two domestic agents, a final output producer and an input supplier. The producer uses three imperfectly substitutable inputs in the production of the final output: the input of the domestic supplier, a competing imported input, and an aggregate other input. The producer is assumed to be a price-taker in the final output market, in the

aggregate other input market, and in the world market for the competing imported input. The producer is assumed to have monopsony power in the domestic input market, and the domestic input supplier is assumed to have monopoly power in the same market. Both agents are assumed to seek maximum profit.

The profit of the producer is

$$(1) \quad \pi_0 = pF(L, D, I) - wL - (p_D D + p_I I),$$

where p , w , p_D and p_I are the prices received for the final output and paid for the aggregate other input L , the domestically supplied input D , and the competing import I , respectively. The production function for the final output, $F(\cdot)$, is assumed to be sufficiently well behaved to serve our analytical needs. The profit of the supplier is

$$(2) \quad \pi_D = p_D D - C(D; r),$$

where $C(\cdot)$ is a similarly well behaved cost function and r is a vector of resource prices. The two agents are linked not only by their joint activity in the D market, but also by a domestic content requirement scheme of the form

$$(3) \quad p_I = \begin{cases} \bar{p}_I & \text{if } D/(D+I) \geq \kappa \\ (\bar{p}_I + \tau) & \text{if } D/(D+I) < \kappa, \end{cases}$$

where $\bar{p}_I$ is the world market price for the competing import, inclusive of concessionary tariff, τ is a penalty tariff to be paid if the producer fails to meet the statutory content requirement κ , and $0 < \kappa \leq 1$. Substitution of (3) into (1) suffices to show that the content requirement scheme affects the profit distribution, and transforms the market equilibrium determination process into a bargaining problem between the two agents. The supplier and the producer negotiate the price and quantity of the domestic input, in the presence of the content requirement scheme.

We use a cooperative bargaining framework, which is appropriate to describe a negotiation outcome with some enforcement mechanism. Consistent with the Australian context, we assume that the government sanctions and enforces the marketing agreement between the two agents. A payoff set describes the feasible profit opportunities for the two agents. 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 (1979). This framework is simple but provides a good static approximation of more elaborate sequential games (Binmore et al. (1986)). This approach allows for a wide range of equilibrium solution points on the payoff frontier by varying

the relative bargaining strength of the agents.

We assume that the payoff functions of the agents are their profits. If they cannot reach an agreement on the pair (P_D, D) they behave noncooperatively. In that case the supplier behaves like a monopolist and sets price at the monopoly level, p_D^M . The producer adjusts its purchase of the domestic supplier's input D accordingly and pays the full price for the imported substitute, inclusive of the penalty tariff.²

Hence in the event of conflict, the producer takes p_D^M as given and adjusts its derived demands to equate the value of marginal product of inputs to their prices, and we have

$$(4.1) \quad p_{F_D}(L^d, D^d, I^d) = p_D^M,$$

$$(4.2) \quad p_{F_I}(L^d, D^d, I^d) = \bar{p}_I + \tau,$$

$$(4.3) \quad p_{F_L}(L^d, D^d, I^d) = w,$$

where the superscript "d" denotes disagreement or conflict values of the inputs, and a subscript on $F(\cdot)$ indicates a partial derivative. The profits of the two agents reached in case of conflict are thus

$$\pi_0^d = pF(L^d, D^d, I^d) - wL^d - p_D^M D^d - (\bar{p}_I + \tau)I^d, \quad (5)$$

$$\pi_D^d = p_D^M D^d - C(D^d; r).$$

Suppose now that the two agents reach an agreement. The solution to the bargaining process between the producer and the supplier maximizes the Nash product of the payoff gains from reaching an agreement. The problem can be expressed as

$$(6) \quad \max (\pi_0 - \pi_0^d)^{\gamma_0} (\pi_D - \pi_D^d)^{\gamma_D},$$

where γ_0 and γ_D are exogenous bargaining power parameters reflecting the relative bargaining abilities of the two agents. The two agents also derive bargaining strength from the relative magnitudes of the conflict payoffs π_0^d and π_D^d . Other things equal, the higher the conflict payoff, the larger is the profit of an agent in equilibrium (Thompson (1987)).

Problem (6) is solved under the constraints of final output production technology $F(\cdot)$, domestic input supplier technology as represented by $C(\cdot)$, prices p , $\bar{p}_I$, w , the penalty tariff τ , and the content requirement parameter κ . The producer and the supplier jointly choose an optimum domestic input price and quantity to maximize (6). The producer also simultaneously chooses an optimal amount of the aggregate other input. With the content requirement just binding, the first order conditions for

problem (6) are

$$\begin{aligned}
 (7) \quad & \frac{(\pi_0 - \pi_0^d)}{\gamma_0} \frac{\partial \pi_D}{\partial p_D} = \frac{-(\pi_D - \pi_D^d)}{\gamma_D} \frac{\partial \pi_0}{\partial p_D}, \\
 & \frac{(\pi_0 - \pi_0^d)}{\gamma_0} \frac{\partial \pi_D}{\partial D} = \frac{-(\pi_D - \pi_D^d)}{\gamma_D} \frac{\partial \pi_0}{\partial D}, \\
 & \frac{\partial \pi_0}{\partial L} = 0.
 \end{aligned}$$

They can be manipulated to yield

$$(8.1) \quad p[F_D(L, D, I) + \left(\frac{1-\kappa}{\kappa}\right) F_I(L, D, I)] = C_D(D; r) + \left(\frac{1-\kappa}{\kappa}\right) \bar{p}_I,$$

$$(8.2) \quad pF_L(L, D, I) = w,$$

$$(8.3) \quad \frac{(\pi_0 - \pi_0^d)}{\gamma_0} = \frac{(\pi_D - \pi_D^d)}{\gamma_D},$$

where a subscript on $C(\cdot)$ indicates a partial derivative.³

Equation (8.1) expresses the equality between the value of the marginal product and the marginal cost of the restricted joint tobacco leaf input. Equation (8.2) does likewise for the aggregate other input. Together equations (8.1) and (8.2), in conjunction with the content requirement (3), determine the optimum employment levels of the three inputs to maximize joint

surplus, while (8.3) determines the price at which domestic leaf is marketed such that the two players receive profit according to their bargaining abilities. Note that D and I are determined by p , $\bar{p}_I$, $C_D(D; r)$, w , and the content requirement parameter κ , but not by the negotiated price p_D .

If the content requirement is not binding, (8.1) becomes

$$(8.1') \quad pF_D(L, D, I) = C_D(D; r) \quad \text{and} \quad pF_I(L, D, I) = \bar{p}_I.$$

In this event equations (8.1') and (8.2) express necessary conditions for the maximization of joint surplus with respect to the three unconstrained inputs D , I and L . Thus when the content requirement is not binding, input use is distorted only by the concessionary tariff included in $\bar{p}_I$ in (8.1').

We now have two motives for conducting an empirical investigation. The first is to inquire whether the content requirement distorts trade by affecting usage of the domestic input and its competing import, or merely influences the distribution of profits between domestic final output producers and input suppliers. The second is to inquire whether the domestic input market achieves a Pareto efficient contract, in which usage of the domestic input is independent of the negotiated price of that input.

3. Australian Tobacco and Cigarettes

The model developed in Section 2 describes quite well the context within which the Australian Tobacco Board supervises the operations of the domestic tobacco leaf market. Three cigarette manufacturers use domestic and imported leaf, together with other inputs, to produce cigarettes. They comprise the only source of demand for domestic leaf. Domestic leaf suppliers compete with imports from several countries, principally high quality leaf from the U.S., but gain market power from the content requirement scheme. Thus the market is structured as a supervised bilateral monopoly.

The system of equations (8.1)-(8.3) describes the simultaneous determination of domestic input use, imported input use, and domestic price. The solution may be written as

$$(9.1) \quad D = D(p_D, \bar{p}_I, w, r, \kappa),$$

$$(9.2) \quad I = I(p_D, \bar{p}_I, w, r, \kappa),$$

$$(9.3) \quad p_D = p_D(\bar{p}_I, w, r, \kappa, \tau).$$

The hypothesis that the content requirement does not distort trade is expressed as $\partial D(\cdot)/\partial \kappa = \partial I(\cdot)/\partial \kappa = 0$. The efficient contract hypothesis is expressed as $\partial D(\cdot)/\partial p_D = \partial I(\cdot)/\partial p_D = 0$, $\partial D(\cdot)/\partial \bar{p}_I \neq 0$, $\partial I(\cdot)/\partial \bar{p}_I \neq 0$ and $\partial D(\cdot)/\partial r \neq 0$, $\partial I(\cdot)/\partial r \neq 0$.

The trade distortion and efficient contract hypotheses as formulated above involve separate impacts on domestic and imported leaf. However the content protection scheme described in equation (3) targets only the ratio of domestic to imported leaf, and it is obviously possible for the content requirement to influence (D/I) without changing both D and I . This suggests an alternative model in which the solution to the system of equations (8.1) - (8.3) is expressed as

$$(10.1) \quad D/I = D/I(p_D, \bar{p}_I, w, r, \kappa),$$

$$(10.2) \quad p_D = p_D(\bar{p}_I, w, r, \kappa, \tau).$$

The hypothesis that the content requirement does not distort trade is now expressed as $\partial[(D/I)(\cdot)]/\partial\kappa = 0$. The efficient contract hypothesis is now expressed as $\partial[(D/I)(\cdot)]/\partial p_D = 0$, $\partial[(D/I)(\cdot)]/\partial \bar{p}_I \neq 0$ and $\partial[(D/I)(\cdot)]/\partial r \neq 0$.

In Figure 1 the impact of declining demand for cigarettes is more than offset by a binding content requirement. As a consequence, demand for domestic leaf increases slightly, and the impact on the leaf mix is transmitted primarily through a reduction in imported leaf.

We now turn to a specification of the variables used in the empirical analysis. All variables are annual values observed over the 29 year period 1960-1988. D and I refer to the quantity of domestic and U.S. import leaf per cigarette, respectively.

Figure 1. The Impact of Content Requirement on Import Mix

Other significant imports occur annually, primarily from Malawi, Korea and Brazil, but U.S. imports are used because disaggregated quantity data are not available for the entire period under observation. The share of the high quality U.S. leaf in total imports is roughly 50 per cent by weight, although this share has been declining throughout the period. We do have disaggregated import price data, however, and so $\bar{p}_l$ is captured by the prices paid for U.S. ($\bar{p}_{US}$), Malawi ($\bar{p}_{MA}$), Korean ($\bar{p}_{KO}$), and Brazilian ($\bar{p}_{BR}$) leaf, all inclusive of the concessionary tariff. We account for shifts in the marginal cost of producing domestic leaf with an index of prices paid by farmers, r . Shifts in the marginal cost of producing cigarettes, and hence shifts in the demand for domestic and imported leaf, are captured by three factors: the manufacturing wage (w_w), the manufacturing capital deflator (w_r), and the excise tax levied per cigarette (w_t). The domestic content requirement κ appears in all three equations in system (9) and in both equations in system (10), and the penalty tariff τ appears in the domestic price equation in both systems. All variables are fully described in the Appendix.

Linear specifications of systems (9) and (10) were estimated by two stage least squares. Coefficient estimates, and hypothesis test results, appear in Tables 1 and 2 for system (9) and in Tables 3 and 4 for system (10). In Table 3 only the leaf mix equation results are reported because the price equation results are the same as those appearing in Table 1. In Tables 1 and 3 all estimated equations have very good fits for such a

TABLE 1. ESTIMATION OF SYSTEM (9) BY TWO STAGE LEAST SQUARES

<u>Equation (9.1)</u>		<u>Domestic Leaf Demand</u>		$R^2 = 0.7785$
<u>Variable</u>	<u>Coefficient</u>	<u>Standard Error</u>	<u>t-ratio</u>	
P_D	0.7966E-04	0.2504E-03	0.3182	
$\bar{P}_{US}$	0.4141E-03	0.2562E-03	1.6161	
$\bar{P}_{MA}$	-0.4341E-03	0.2625E-03	-1.6537	
$\bar{P}_{KO}$	0.4194E-03	0.2383E-03	1.7596	
$\bar{P}_{BR}$	-0.3433E-03	0.2592E-03	-1.3243	
r	-0.8681E-02	0.2640E-02	-3.2886	
w_w	0.2026E-03	0.5638E-01	0.0036	
w_r	0.1411E-02	0.5370E-02	0.2627	
w_t	-0.3896E-01	0.1274	-0.3058	
κ	0.2106E-02	0.1830E-02	1.1506	
constant	0.7793	0.4507	1.7293	
<u>Equation (9.2)</u>		<u>U.S. Import Leaf Demand</u>		$R^2 = 0.9003$
<u>Variable</u>	<u>Coefficient</u>	<u>Standard Error</u>	<u>t-ratio</u>	
P_D	-0.2250E-04	0.2716E-03	-0.0829	
$\bar{P}_{US}$	-0.5584E-03	0.2780E-03	-2.0084	
$\bar{P}_{MA}$	0.7299E-03	0.2848E-03	2.5630	
$\bar{P}_{KO}$	0.1882E-03	0.2586E-03	0.7278	
$\bar{P}_{BR}$	-0.2674E-03	0.2812E-03	-0.9509	
r	0.3767E-02	0.2864E-02	1.3153	
w_w	0.3513E-01	0.6118E-01	0.5743	
w_r	-0.1399E-01	0.5827E-02	-2.4017	
w_t	0.6195E-01	0.1382	0.4481	
κ	-0.1160E-01	0.1986E-02	-5.8414	

Table 1 (continued)

constant	1.8507	0.4890	3.7849
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Equation (9.3) Domestic Leaf Price $R^2 = 0.9590$

<u>Variable</u>	<u>Coefficient</u>	<u>Standard Error</u>	<u>t-ratio</u>
- PUS	0.1630	0.2898	0.5624
- PMA	0.4714E-01	0.3659	0.1288
- PKO	-0.4484E-01	0.2876	-0.1559
- PBR	-0.3554	0.2745	-1.2946
r	-2.3172	2.8626	-0.8095
W _w	154.36	92.58	1.6673
W _r	3.0130	5.9941	0.5027
W _t	-211.98	123.07	-1.7224
K	0.1232	2.1042	0.0585
τ	10880.0	5347.5	2.0346
constant	-346.61	549.89	-0.6303

TABLE 2. WALD TEST STATISTICS FOR HYPOTHESIS TESTS FROM SYSTEM (9)

<u>Hypothesis</u>	<u>Test Statistic</u>	<u>Degrees of Freedom</u>	<u>Significance</u>
$\partial D/\partial \kappa =$	35.45	2	0.99
$\partial I/\partial \kappa = 0$			
$\partial D/\partial p_D =$	0.11	2	
$\partial I/\partial p_D = 0$			
$\partial D/\partial \bar{p}_{US} =$	6.65	2	0.95
$\partial I/\partial \bar{p}_{US} = 0$			
$\partial D/\partial \bar{p}_{MA} =$	9.30	2	0.99
$\partial I/\partial \bar{p}_{MA} = 0$			
$\partial D/\partial \bar{p}_{KO} =$	3.63	2	
$\partial I/\partial \bar{p}_{KO} = 0$			
$\partial D/\partial \bar{p}_{BR} =$	2.66	2	
$\partial I/\partial \bar{p}_{BR} = 0$			
$\partial D/\partial \bar{p}_{US} = \partial D/\partial \bar{p}_{MA}$ $= \partial D/\partial \bar{p}_{KO} = \partial D/\partial \bar{p}_{BR} = 0$	10.22	4	0.95
$\partial D/\partial \bar{p}_{US} = \partial I/\partial \bar{p}_{US}$ $= \partial D/\partial \bar{p}_{MA} = \partial I/\partial \bar{p}_{MA}$ $= \partial D/\partial \bar{p}_{KO} = \partial I/\partial \bar{p}_{KO}$ $= \partial D/\partial \bar{p}_{BR} = \partial I/\partial \bar{p}_{BR} = 0$	21.26	8	0.99
$\partial D/\partial r = \partial I/\partial r = 0$	13.86	2	0.99

TABLE 3. ESTIMATION OF SYSTEM (10) BY TWO STAGE LEAST SQUARES

<u>Equation (10.1)</u>	<u>Domestic/Import Leaf Demand</u>	<u>R² = 0.8229</u>	
<u>Variable</u>	<u>Coefficient</u>	<u>Standard Error</u>	<u>t-ratio</u>
P _D	-0.2824E-02	0.2370E-02	-1.1915
-			
P _{US}	0.5794E-02	0.2426E-02	2.3889
-			
P _{MA}	-0.4001E-02	0.2485E-02	-1.6105
-			
P _{KO}	-0.2583E-04	0.2256E-02	-0.0115
-			
P _{BR}	-0.7046E-03	0.2454E-02	-0.2872
r	-0.7805E-01	0.2499E-01	-3.1239
w _w	-0.3880	0.5337	-0.7271
w _r	0.1560	0.0508	3.0694
w _t	-0.9772	1.2060	-0.8103
κ	0.6066E-01	0.1732E-01	3.5018
constant	-8.3521	4.2659	-1.9579

TABLE 4. WALD TEST STATISTICS FOR HYPOTHESIS TESTS FROM SYSTEM (10)

<u>Hypothesis</u>	<u>Test Statistic</u>	<u>Degrees of Freedom</u>	<u>Significance</u>
$\partial (D/I) / \partial \kappa = 0$	12.26	1	0.99
$\partial (D/I) / \partial p_D = 0$	1.42	1	
$\partial (D/I) / \partial \bar{p}_{US} = 0$	5.71	1	0.975
$\partial (D/I) / \partial \bar{p}_{MA} = 0$	2.59	1	
$\partial (D/I) / \partial \bar{p}_{KO} = 0$	0.00 ⁺	1	
$\partial (D/I) / \partial \bar{p}_{BR} = 0$	0.08	1	
$\partial (D/I) / \partial \bar{p}_{US} =$ $\partial (D/I) / \partial \bar{p}_{MA} =$ $\partial (D/I) / \partial \bar{p}_{KO} =$ $\partial (D/I) / \partial \bar{p}_{BR} = 0$	10.37	4	0.95
$\partial (D/I) / \partial r = 0$	9.76	1	0.99

small sample, and several coefficient estimates are statistically significant.

Consider first Tables 1 and 2. From Table 1 it is clear that increases in the content requirement parameter k over time have led to a statistically insignificant increase in use of domestic leaf, and to a statistically significant reduction in use of U.S. imported leaf. The corresponding elasticities, calculated at variable means, are 0.22 and -2.32, respectively, suggesting that imports of high quality U.S. leaf are very sensitive to increases in the content requirement. The null hypothesis that the content requirement has had no effect on D and I is rejected by the Wald test statistic reported in the first row of Table 2. We conclude that physical content protection has done more than simply redistribute domestic profits; it has distorted international trade in tobacco leaf by inducing domestic cigarette manufacturers to use more domestic leaf and less U.S. imported leaf per cigarette than they would have used in the absence of the protection.

We next consider the efficient contract hypothesis. In Table 1 the negotiated domestic price has no statistically significant effect on the use of either domestic or imported U.S. leaf. The corresponding price elasticities are 0.10 and -0.05, respectively. The null hypothesis that the domestic price has no effect on leaf usage is not rejected by the Wald test statistic reported in the second row of Table 2. The second part of the hypothesis is that world leaf prices and domestic leaf production

costs do influence use of domestic and imported leaf. None of the four world price coefficients in the domestic leaf demand equation is statistically significant, and two of four world price coefficients in the U.S. import leaf demand equation are statistically significant. The Wald test statistics show U.S. and Malawi prices to significantly effect leaf usage, and Korean and Brazilian prices to have no significant effect on leaf usage. However the hypothesis that the set of four world prices has no impact on leaf usage is decisively rejected. So is the hypothesis that the set of four world prices has no impact on the demand for domestic leaf. Finally, the hypothesis that domestic leaf production cost has no impact on leaf usage is also decisively rejected; the corresponding elasticities are -1.73 and 1.41 respectively. We conclude that the efficient contract hypothesis is strongly supported by the data when equation system (9) is used to characterize the determination of leaf usage. The use of domestic leaf and imported U.S. leaf in cigarette manufacturing is influenced by world leaf prices and domestic leaf production costs, but not by the negotiated domestic leaf price. Conditional on the trade-distorted environment in which it takes place, bargaining between growers and manufacturers generates a Pareto efficient outcome which maximizes joint surplus.

Both of these conclusions are supported by the results of equation system (10), reported in Tables 3 and 4. The mix of domestic to imported U.S. leaf is positively and significantly

related to the content requirement parameter, with an elasticity of 1.32. Trade has been distorted. But the domestic contract is efficient. The mix of domestic to imported U.S. leaf is not significantly affected by the negotiated domestic leaf price, and is significantly influenced by world leaf prices and domestic leaf production costs.

These findings are robust to changes in variable definition and model specification. For example, the results just discussed are based on a content requirement parameter fixed at 50% since 1966. When this series is replaced with the semi-formally agreed upon series in which the parameter increases to 55% in 1967 and to 57% in 1977 virtually nothing is changed. Parameter estimates and t-ratios and elasticities change only marginally, and no Wald test result is modified. For another example, when four separate world leaf prices are replaced with a single index of world leaf prices, results are similar. Regardless of which content requirement parameter series is used, and regardless of how world leaf prices are specified, domestic content protection distorts trade. In this environment, domestic growers and manufacturers reach an efficient contract.⁴

4. Summary and Conclusions

That domestic content protection can distort trade is well known but not widely documented. That negotiation in bilateral monopoly markets can generate Pareto efficient contracts is well known in the labor literature, but not well documented there or

in other types of market. The institutional organization of the Australian tobacco leaf growing and cigarette manufacturing industries provides an ideal framework within which to test both hypotheses, simultaneously and with a single body of data. We have adapted a bargaining model to the protected environment in which domestic leaf contracts are negotiated. Several variants of the bargaining model lead to the same strong conclusions. Domestic content requirements have afforded considerable protection to Australian tobacco leaf growers. But they have been unable to translate that protection into inefficient monopoly contracts with domestic cigarette manufacturers. Domestic contracts, negotiated under the auspices of the Australian Tobacco Board, have been Pareto efficient.

Two policy implications emerge from our empirical analysis. First, the content requirement should be reduced to a nonbinding level so that international trade in tobacco leaf will not be impeded by the requirement. Second, the institutional arrangement used to market Australian tobacco seems efficient and should be left as is since it does not induce trade or domestic distortions.

FOOTNOTES

1. Detailed information on the Australian leaf growing and cigarette manufacturing industries can be found in Industries Assistance Commission (1982, 1987).
2. We assume here that p_D^M is sufficiently high to induce the producer to violate the content requirement κ and pay $(\bar{p}_I + r)$ for all imported substitutes. This assumption also appears in the analytical model of the Industries Assistance Commission (1987; Appendix 7), and in Mussa (1984). It is of course possible that the producer satisfies κ under p_M^D and pays no penalty tariff. The only effect this would have on our model would be to eliminate the penalty tariff from equation (4.2), and hence also from the domestic price equations (9.3) and (10.2) below.
3. We assume here that the producer does not violate the content requirement κ and so does not pay the penalty tariff. It is possible that a sufficiently large content requirement, coupled with a sufficiently small penalty tariff, might induce the producer to violate the requirement and pay the penalty, even under cooperation. This does not appear to be sound

commercial policy, but it can be incorporated into our model.

4. Results of these and many other model reformulations are available from the authors.

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Appendix

1. Variable Definitions

P_D	=	Domestic price of leaf
P_{US}	=	U.S. import price inclusive of shipping cost and tariff
P_{MA}	=	Malaysian import price inclusive of shipping cost and tariff
P_{KO}	=	Korean import price inclusive of shipping cost and tariff
P_{BR}	=	Brazilian import price inclusive of shipping cost and tariff
r	=	Index of input prices paid by farmers (fuel, machinery, fertilizer) (1980 = 100)
w_w	=	Manufacturing wage index (1965 = 100)
w_r	=	Capital deflator index (1979 = 100)
w_t	=	Excise tax levied on cigarette (state and local) in cents per 1000 cigarettes
τ	=	Penalty tariff (difference between nonconcessionary and concessionary tariffs)
k	=	Domestic content requirement proportion (minimum and actual)
Q	=	Cigarette output in million cigarettes
D	=	Domestic leaf use in metric tons
I	=	Imports of U.S. tobacco leafs in metric tons
CPI	=	Consumer price index

2. Variable Transformations

All tobacco prices are in dry weight equivalent. The data refers to Australian fiscal years. All prices are deflated using the Australian CPI. All prices and tariffs are in Australian cents per Kg of tobacco. The exchange rate is the average period rate of the International Financial Statistics. All import tobacco prices are multiplied by 1.12 to reflect shipping cost; then the concessionary tariff is added to this CIF price to give the import unit cost.

Although complete data was available for both the manufacturing wage and capital deflator, they were obtained from 2 different series. We regressed overlapping data points for the two series (for both the wage and the capital deflator) to minimize the base change problem. Then we predicted a complete series using the regression results and the existing value of the other series which was used as right-hand side variable in the regression. To account for drying and aging of the domestic tobacco leafs we matched domestic tobacco produced and marketed in year $t/t+1$ with imported tobacco of year $t+1$. This gives an aging period of 6 to 12 months which is a standard assumption in modelling tobacco processing (IAC). From 1976 to 1988 the data on tobacco imports refers to fiscal years. The data from 1960 to 1975 was originally given for calendar year. We took the average

calendar year ($\frac{t + (t+1)}{2}$) to approximate fiscal year t for the years 1960 to 1975.

We have two measures of the domestic content requirement. One is the official minimum content proportion. The second one is the actual content proportion that the cigarette industry agreed to respect. The latter is higher than the minimum proportion. Table A1 presents the data for the variables listed above; foreign prices include shipping cost and tariff; all prices and taxes are nominal. Tobacco quantities are in dry-weight equivalents.

3. Data Sources

For the domestic tobacco price: The Annual Report of the Australian Tobacco board for 1965-1988. For 1959-1965 "Tobacco in Australia", Report M 26 of USDA FAS March 1972.

For the price of US tobacco: "Industry Assistance Inquiry into Tobacco Growing and Manufacturing Industries" The Tobacco Grower Council, Australia, for 1970 to 1985. For 1960 to 1970, Report M 26 of USDA-FAS op cit.; for 1986 to 1988, "World Tobacco Situation" of USDA-FAS several issues.

For the price of Malawian Tobacco: "International Financial Statistics" of IMF, series 76m. The 1970 FOB price of Malawian tobacco comes from "Industry Assistance Inquiry into Tobacco Growing and Manufacturing Industries" op cit.

For the price of Korean Tobacco: similar sources as for U.S. tobacco for 1970 to 1988. For 1960 to 1970, "World Tobacco Situation" of USDA-FAS November 1988, Table 13, provides the series of price received by Korean burley producers (1959-1987). That series is adjusted to account for Wholesale markup.

For the Brazilian tobacco price: Similar sources as for the Korean price.

For the index of price paid by farmers: "Quarterly Review of the Rural Economy", Australian Bureau of Agricultural and Resource Economics. Similar data is published by the FAO in its "production Yearbook".

For the manufacturing wage: "OECD Economic Surveys", OECD, and the IMF's "International Financial Statistics".

For the manufacturing capital deflator: "OECD Economic Surveys", op cit.

For the cigarette excise taxes: "Annual Report" of the Australian Tobacco Board op cit. for 1965 to 1988. For 1960 to 1965, personal communication of the Australian Bureau of Agricultural and Resource Economics.

For the content requirement proportions: "Annual Report" of the Australian Tobacco Board.

For the difference between the nonconcessionary and concessionary tariffs: "World Tobacco Situation. Import Requirement and Restrictions for Tobacco and Tobacco Products in Foreign Markets", USDA-FAS, various issues.

For the CPI index: "OECD Economic Surveys", OECD, or International Financial Statistics of IMF.

For the conversion ratio green leaf into dry weight of tobacco: "World Tobacco Situation" of USDA-FAS, various issues.

For domestic tobacco use: Similar sources as for the domestic price of tobacco.

For the cigarette output: Similar sources as for the domestic tobacco price.

For U.S. tobacco imports: Similar sources as for domestic tobacco use.

Table A1
Presents the data for the variables listed above.

YEAR	P _D	P _{US}	P _{MA}	P _{KO}	P _{BR}	r	w _w	w _r
1960	214.65	339.00	240.30	210.00	215.30	24.00	89	27.62
1961	264.06	343.00	240.30	220.00	213.36	24.30	90	27.75
1962	260.00	351.00	235.97	222.00	214.38	25.70	91	27.98
1963	235.34	353.00	244.63	224.00	210.58	25.70	93	28.51
1964	231.35	352.00	238.13	224.00	199.98	26.40	98	29.49
1965	261.00	352.00	255.46	223.00	203.99	27.70	100	30.81
1966	254.20	354.00	256.26	222.00	200.75	29.00	106	31.34
1967	255.37	350.00	260.10	221.00	201.32	30.00	112	32.39
1968	260.91	353.00	263.82	223.00	204.06	30.50	119	33.37
1969	263.42	365.10	265.67	224.00	208.94	30.80	125	34.66
1970	276.92	384.24	255.44	254.32	230.48	31.30	134	37.32
1971	274.87	376.40	257.71	248.72	254.67	33.00	150	39.70
1972	269.30	348.47	205.45	198.39	187.33	36.00	164	42.40
1973	325.51	329.43	216.48	201.75	183.38	39.60	194	48.00
1974	383.34	389.91	235.63	247.67	211.60	52.00	251	59.80
1975	366.55	417.91	254.05	266.71	240.36	60.00	286	69.20
1976	391.47	491.83	271.75	339.51	277.65	67.00	325	77.30
1977	378.45	559.03	279.21	401.11	326.55	74.00	354	84.30
1978	385.92	526.36	227.24	320.28	291.39	79.00	378	90.70
1979	421.07	549.88	234.23	409.88	287.78	88.00	413	100.00
1980	455.51	557.72	255.79	405.40	346.07	100.00	458	111.30
1981	476.79	637.24	316.44	456.92	348.98	111.00	513	122.90
1982	490.74	804.12	354.25	473.72	501.03	123.00	560	136.40
1983	529.04	890.36	363.36	561.08	510.68	134.00	607	145.70
1984	541.28	1009.1	441.05	605.88	483.19	141.00	651	155.70
1985	556.38	974.36	411.95	643.96	576.35	153.00	693	171.90
1986	565.96	930.68	383.88	486.04	478.79	165.00	738	188.90
1987	594.26	869.08	356.68	491.64	405.61	172.00	783	205.20
1988	610.96	882.52	386.51	533.08	414.24	182.00	837	224.87

Table A1, continued

YEAR	w_t	r	Minimum κ	Actual κ	Cigarette Output	D	I	CPI
1960	74.15	33.00	28.50	28.50	18513	7988.889	8966	28.14
1961	73.67	33.00	35.00	35.00	18573	10741.00	8700	28.44
1962	72.24	33.00	40.50	40.50	19657	8714.667	7780	28.48
1963	82.67	33.00	41.50	41.50	20002	11289.75	6071	28.89
1964	80.68	33.00	41.88	41.88	21768	13357.72	8921	29.80
1965	95.96	33.00	48.00	48.00	21333	10100.38	7477	30.84
1966	88.76	33.00	50.00	50.00	22585	11026.11	6043	31.79
1967	91.70	33.00	50.00	55.00	23334	11051.40	8942	32.72
1968	89.18	33.00	50.00	55.00	25188	10760.84	9751	33.63
1969	85.09	33.00	50.00	55.00	27061	13628.04	6500	34.77
1970	94.27	33.00	50.00	55.00	27931	14780.51	4922	36.52
1971	108.49	33.00	50.00	55.00	27548	14644.45	6727	38.70
1972	109.55	24.25	50.00	55.00	28423	14431.07	6303	41.69
1973	129.75	24.25	50.00	55.00	30072	14390.27	8476	46.86
1974	144.92	24.25	50.00	55.00	31664	13538.87	7691	53.93
1975	168.11	24.25	50.00	55.00	31971	13360.86	4645	61.61
1976	173.86	24.25	50.00	55.00	31052	13905.60	6453	69.54
1977	165.62	24.25	50.00	57.00	32626	12960.55	6084	76.48
1978	204.26	95.00	50.00	57.00	32359	13537.73	4717	83.00
1979	207.21	95.00	50.00	57.00	32883	14577.38	6254	90.99
1980	201.14	95.00	50.00	57.00	34137	13781.06	6298	100.00
1981	201.85	95.00	50.00	57.00	35005	13457.76	4901	110.45
1982	232.99	95.00	50.00	57.00	34465	12740.45	4475	122.17
1983	260.78	95.00	50.00	57.00	32425	13589.70	4797	130.57
1984	269.81	95.00	50.00	57.00	32153	12710.02	4023	137.59
1985	286.13	95.00	50.00	57.00	32903	11740.07	4087	148.53
1986	285.80	95.00	50.00	57.00	34722	11620.31	4527	161.31
1987	316.39	95.00	50.00	57.00	34106	12560.73	4263	174.04
1988	327.80	95.00	50.00	57.00	34629	12535.21	3222	186.83