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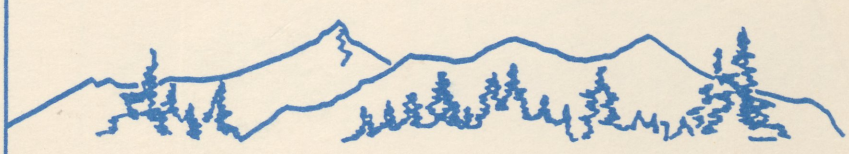

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TESTING TRADE AND EFFICIENCY EFFECTS OF DOMESTIC CONTENT IN THE AUSTRALIAN TOBACCO AND CIGARETTE INDUSTRIES

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ABSTRACT: This paper provides an empirical investigation of trade and domestic market efficiency effects of physical domestic content requirement in the Australian tobacco leaf growing and cigarette manufacturing industries. Results suggest that the content requirement has restricted imports of U.S. leaf. However, the data are consistent with the efficient contract hypothesis.

We analyze the trade and efficiency implications of physical domestic content protection in the Australian tobacco growing and manufacturing industries. The two industries, structured as a bilateral monopoly, negotiate price and quantity of domestic tobacco leaf and reach an annual marketing contract which is administered by the Australian Tobacco Board. Under the domestic content scheme cigarette manufacturers receive a tariff rebate on imported tobacco leaf if they agree to source a share of their total leaf requirement from domestic growers. The share is defined physically, by weight, and has increased over time. It has been 50% since 1966, although manufacturers have "voluntarily" agreed to a 57% requirement since 1977, and the higher share is used by the Australian Customs Service.

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 because of their trade implications. An inefficient contract would imply further distortions of trade flows in addition to the potential distorting effects of the content policy. We first show that the domestic content requirement has neither trade nor 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 a monopoly price set by domestic growers, and the contract is not Pareto efficient. This 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 use are independent of the requirement. We then test the efficiency of the marketing contract, by testing the hypothesis that leaf uses are independent of the world leaf prices and the cost of production of domestic leaf, and independent of the contract price. If domestic leaf use is influenced by the world leaf price and domestic leaf cost but not by the contract price, then the tests provide evidence that the contract maximizes joint surplus in the given policy environment. Note that this test of the efficient contract

hypothesis is really a conditional test, conditioned on 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 imports flows. In this distorted environment, our empirical evidence is consistent with the efficient contract hypothesis: world leaf prices and domestic leaf cost changes strongly influence leaf input demands, but negotiated domestic leaf prices do not. Hence, the marketing arrangement does not induce further trade distortion.

The Model

The 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 approach 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

$$(1)\quad \pi_0 = pF(L, D, I) - wL - (p_D D + \bar{p}_I I),$$

where p, w, p_D and $\bar{p}_I$ 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, $F(\bullet)$, is assumed to be well behaved to serve our analytical needs. The profit of the supplier is

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

where $C(\bullet)$ 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, and τ is a penalty tariff to be paid if the producer fails to meet the statutory content requirement κ. κ is non-negative and smaller than one. Substitution of (3) into (2) 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 on 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 consistently with our Australian case. 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)).

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 will behave noncooperatively. In that case, we assume that 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.

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

$$(4.1)\quad pF_D(L^d, D^d, I^d) = p_D^M,$$
$$(4.2)\quad pF_I(L^d, D^d, I^d) = p_I + \tau,$$
$$(4.3)\quad pF_L(L^d, D^d, I^d) = w,$$

where the superscript "d" denotes disagreement or conflict values of the inputs and the subscript of F refers to first derivatives. The profits of the two agents reached in case of conflict are thus

$$(5)\quad \begin{cases} \pi_0^d = pF(L^d, D^d, I^d) - wL^d - p_D^M D^d - (p_I + \tau)I^d, \\ \pi_D^d = p_D^M D^d - C(D^d; r). \end{cases}$$

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 or

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

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(•), domestic input supplier technology as represented by C(•), prices p, 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 κ just binding the first order conditions for the maximization of (6) are

$$(7.1)\quad p[F_D(L, D, I) + \frac{(1-\kappa)}{\kappa} F_I(L, D, I)] = C_D(D; r) = \frac{(1-\kappa)}{\kappa} p_I$$
$$(7.2)\quad pF_L(L, D, I) = w,$$
$$(7.3)\quad \frac{(\pi_0 - \pi_0^d)}{\gamma_0} = \frac{(\pi_D - \pi_D^d)}{\gamma_D},$$

Equations (7.1) and (7.2) determine the optimum employment levels of the inputs to maximize joint surplus, and (7.3) determines the price at which the domestic input is marketed such that players receive profit according to this bargaining ability. Note that D and I are determined by 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 (7.1) becomes

(7.1′) $pF_D(L, D, I) = C_D(D; r)$ and $pF_I(L, D, I) = p_I$. Hence

(7.1′) with (7.2) expresses necessary conditions to maximize joint surplus with respect to the three unconstrained inputs. Thus when the content requirement is not binding, trade is only distorted by the presumably low concessionary tariff included in $\bar{p}_I$.

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.

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. 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 imports 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 (7.1)-(7.3) describes the simultaneous determination of domestic input use, imported input use, and domestic price. The solution may be written as

$$(8.1)\quad D = D(p_D, p_I, w, r, \kappa, Q)$$
$$(8.2)\quad I = I(p_D, p_I, w, r, \kappa, Q)$$
$$(8.3)\quad p_D = p_D(p_I, w, r, \kappa, \tau, Q)$$

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

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. 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. We do have disaggregated import price data, however, and so p_I is captured by the prices paid for U.S. (p_{US}), Malawi (p_{MA}), Korean (p_{KO}), and Brazilian (p_{BR}) 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, and the penalty tariff τ appears in the domestic price equation. All variables are fully described in the Appendix available from the authors.

The system actually estimated, by two stage least squares, is a linear specification of system (8). Empirical results appear in Table 1. The three equations have very good fits and several significant estimated coefficients. Primary interest focuses on the estimated coefficients on the variables κ, p_D, r and (p_{US}, p_{MA}, p_{KO}, p_{BR}).

Increases in the content requirement parameter κ 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 null hypothesis that the content requirement has had no effect on D and I is resoundingly rejected by the Wald test statistic reported in 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. The negotiated domestic price has no discernible effect on use of domestic leaf, and a statistically insignificant effect on the use of U.S. imported leaf. The null hypothesis that the domestic price has no effect on D and I is not rejected. The second part of the hypothesis is that world prices and cost of production of domestic leaf do influence use of domestic and imported leaf. One of the four relevant coefficients in the domestic leaf demand equation is statistically significant, and two of 4 relevant coefficients in the U.S. import leaf demand equation are statistically significant. The Wald test statistics show U.S. and Malawi prices to affect leaf usage, and Korean and Brazilian prices to have no effect on leaf usage. The hypothesis that the set of four world prices has no impact on domestic and U.S. imported leaf usage is decisively rejected. The hypothesis that the change in the cost of production does not influence leaf uses is also rejected. We conclude that the efficient contract hypothesis is confirmed. The use of domestic leaf and imported U.S. leaf in cigarette manufacturing is influenced by world leaf prices, and cost of domestic leaf production but not by the negotiated domestic leaf price. Bargaining between growers and manufacturers generates a Pareto efficient outcome which maximizes joint surplus given the domestic content requirement.

Two policy implications emerge from our empirical analysis. First, the content requirement should be decreased to a nonbinding level such that trade will not be impeded by the requirement. Second, the institutional arrangement used to market Australian tobacco seems efficient and should be left as such since it does not induce welfare losses.

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TABLE 1. ESTIMATION OF SYSTEM (8) BY TWO STAGE LEAST SQUARES

Equation (8.1)	Domestic Leaf Demand		$R^2 = 0.7636$
Variable	Coefficient	Standard Error	t-ratio
p_D	0.1088E-04	0.3622E-03	0.0300
p_{US}	0.3092E-03	0.2532E-03	1.2215
p_{MA}	-0.3043E-03	0.4460E-03	-0.6824
p_{KO}	0.4559E-03	0.2452E-03	1.8592
p_{BR}	-0.3890E-03	0.2717E-03	-1.4316
r 0.1015E-01	0.2926E-02	-3.4703	
w_w	0.1466E-01	0.6759E-01	0.2169
w_r	0.2294E-02	0.5911E-02	0.3880
w_t	-0.5055E-01	0.1325	-0.3814
κ 0.1242E-02	0.1793E-02	0.6930	
constant	0.8036	0.4778	1.6819

Equation (8.2)	U.S. Import Leaf Demand		$R^2 = 0.8798$
Variable	Coefficient	Standard Error	t-ratio
p_D	-0.4463E-03	0.4178E-03	-1.0682
p_{US}	-0.5825E-03	0.2120E-03	-1.9948
p_{MA}	0.1450E-02	0.5144E-03	2.8181
p_{KO}	0.1190E-03	0.2829E-03	0.4205
p_{BR}	-0.3113E-03	0.3134E-03	-0.9933
r 0.9070E-02	0.3375E-02	2.6877	
w_w	0.1135	0.7796E-01	1.4561
w_r	-0.2114E-01	0.6817E-02	3.1002
w_t	0.6789E-01	0.1529	0.4441
κ 0.1120E-01	0.2068E-02	-5.4177	
constant	2.0892	0.5511	3.7913

Equation (8.3)	Domestic Leaf Price		$R^2 = 0.9632$
Variable	Coefficient	Standard Error	t-ratio
p_{US}	-0.3323E-02	0.2621	-0.0127
p_{MA}	0.8394	0.4594	1.8270
p_{KO}	0.4708E-01	0.2666	0.1766
p_{BR}	-0.2850	0.2629	-1.0839
r 0.5306	3.0842	0.1720	
w_w	106.46	88.34	1.2052
w_r	-0.8474	6.0589	-0.1399
w_t	-194.22	116.65	-1.6650
κ 0.5920	1.8375	-0.3222	
265 0.1	5818.8	0.4554	
constant	137.32	554.74	0.2475

TABLE 2. WALD TEST STATISTICS FOR HYPOTHESIS TESTS

HYPOTHESIS	$\partial D/\partial\kappa = \partial I/\partial\kappa = 0$	$\partial D/\partial p_D = \partial I/\partial p_D = 0$	$\partial d/\partial \bar{P}_{US} = \partial I/\partial \bar{P}_{US} = 0$	$\partial D/\partial \bar{P}_{MA} = \partial I/\partial \bar{P}_{MA} = 0$	$\partial D/\partial r = \partial I/\partial r = 0$	$\partial D/\partial \bar{P}_{KO} = \partial I/\partial \bar{P}_{KO} = 0$	$\partial D/\partial \bar{P}_{BR} = \partial I/\partial \bar{P}_{BR} = 0$	$\partial D/\partial \bar{P}_{US} = \partial I/\partial \bar{P}_{US} = \partial D/\partial \bar{P}_{MA} = \partial I/\partial \bar{P}_{MA} = \partial D/\partial \bar{P}_{KO} = \partial I/\partial \bar{P}_{KO} = \partial D/\partial \bar{P}_{BR} = \partial I/\partial \bar{P}_{BR} = 0$
TEST STATISTIC	29.83*	1.14	5.47***	8.41**	19.27*	3.04	3.63	20.94*
DEGREES OF FREEDOM	2	2	2	2	2	2	2	8

* Significant at 1%.
** Significant at 5%.
*** Significant at 10%.