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Impact of domestic content requirement on the US tobacco and cigarette industries

John C. Beghin, A. Blake Brown, M. Hasyim Zaini

North Carolina State University, Department of Agriculture and Resource Economics, Box 7509, Raleigh, NC, NC 27695-8109, USA

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Abstract

Using a log-linear equilibrium displacement model we quantify the impact of the recent domestic tobacco content requirement on US cigarette manufacturing. We investigate effects on US growers and manufacturers, and competing tobacco imports. The policy increased domestic use of US-grown tobacco, but induced a small negative output effect. Tobacco imports decreased substantially. The paper also discusses the political–economic incentives for US manufacturers to comply with such policies. The political cooperation between US growers and manufacturers decreases the opposition of the latter to protectionist policies championed by the former.

1. Introduction

Domestic content requirement regulations abound under various formulations in many industries and countries (e.g. on car parts in value terms in automobile assembly in China and Brazil, on tobacco in physical terms (weight), in food processing and other manufacturing, and in rules of origin in custom unions and trade arrangements such as NAFTA; see the Economist Intelligence Unit [1] for detailed examples). Broadly, a domestic content scheme is a hybrid trade restriction combining quantitative restrictions and tariff penalties for noncompliance. The scheme usually requires a manufacturer to source inputs locally for a specified portion of total input use in physical or value terms. Concessionary tariffs are offered on imports of competing inputs if the content requirement is satisfied. Conversely, tariff penalties are raised if the content requirement is violated. The widespread presence of domestic content requirements is consistent with the rise of nontariff and less transparent nontariff barriers (NTBs) that has accompanied the general decrease in tariffs around the world achieved by successive rounds of the GATT (see Hillman, 1996, for a recent review of agricultural NTBs).

The economics of domestic content requirement have been elucidated over the last 15 years focusing on welfare and trade effects (Grossman, 1981 in a seminal paper; Mussa, 1984; Vousden, 1987) and on the incidence of industrial organization and strategic behavior on these fundamental results (Grossman, 1981; Hollander, 1987; Vousden, 1987; Krishna and Itoh, 1988; Beghin and Sumner, 1992). Surprisingly, the empirical literature on the actual effects of domestic content policies is scarce and limited in scope to a few industries and countries. Munk (1969) provides an early investigation of these policies in Latin American car manufacturing; Takacs (1994) investigates the same industry in the Phillipines;

[1] *Investing, licensing and trading conditions abroad*, various issues. The Economist Intelligence Unit, London.

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Beghin and Knox Lovell (1993) look at the case of the Australian cigarette industry.

Our paper contributes to this limited applied literature with an analysis of the likely impact of the 1994–1995 domestic tobacco content regulation on US cigarette manufacturing. The policy stipulated that 75% of total tobacco use (in weight) in US domestic cigarette manufacturing has to be of domestic origin. Penalties for not complying were punitive.

We investigate the effect of the content regulation on US growers, US manufacturers and competing tobacco imports used in US cigarette manufacturing. We found that, other things being equal, the policy yielded a substantial increase in domestic use of US-grown tobacco, but induces a small negative output effect. Export demand for US tobacco decreases due to higher tobacco price induced by the content. Foreign tobacco imports are the most negatively affected by the policy which explained the controversy stirred by this policy.

The US market is a vital export market for many foreign tobacco growers (e.g. Brazil, Mexico and Zimbabwe). Indeed, several countries had asked the GATT to investigate the consistency of the new policy with GATT rules (GATT, 1993a). Given its quantitative nature the policy was inconsistent with GATT's articles III.5 and XI which condemn quantitative restrictions (Dam, 1970; GATT, 1993b). As expected, GATT ruled that the policy is inconsistent with its principles (GATT, 1994). In September 1995, the US changed the content protection into a two-tier tariff rate quota (TRQ), which imposes 350% tariff on imports when they exceed a predetermined level. While more consistent with the GATT/WTO principles, the modified policy is still a quantitative restriction in disguise, given the prohibitive tariff level, which provides similar protective effects for US tobacco growers. It is too early to know if the new TRQ policy will be binding for many tobacco exporters to the US, but we predict that the policy will stir another GATT/WTO controversy if it is indeed binding.

Although the US domestic content policy has recently been changed, our analysis is of general interest and a useful contribution because it delineates the welfare and trade effects of a type of distortion neglected in applied economics. A second motivation is the fact that the US policy mutated rather than disappeared, and that the TRQ is likely to have effects similar to those of the content requirement. Both policies raise cigarette production costs, and benefit growers and quota holders through a stronger domestic tobacco demand. Finally, the political economy of this US policy episode remains unchanged and is unique to the US cigarette and tobacco "alliance" against the anti-smoking pressure groups. The cigarette industry is willingly taxed on some of its inputs to secure cooperation with a large political base of domestic growers. The paper also discusses this political economy.

The paper is organized as follows. We first present important stylized facts on the US tobacco industry which motivate the establishment of the US domestic tobacco content requirement. The content scheme policy is then described. Next, we present the displacement model. Then we discuss parameter estimates used to quantify our models as well as the simulation scenarios considered in our study. Results are then presented. We follow with a brief discussion of political–economic incentives faced by cigarette manufacturers to accept the cost increase. The paper ends with remarks and conjectures about the long-term consequences of the US tobacco protectionism through production capacity relocation.

2. The US tobacco growing and manufacturing industries

In the last three decades the quantity share of US-grown tobacco used in US cigarette production has continuously declined as the use of imported tobacco has risen sharply. Continuing increases in tobacco imports have been major concerns among US tobacco growers. Greater use of foreign tobacco in US manufacturing, driven by its cheaper price relative to domestic tobacco, is depressing the demand for US-grown tobacco.

Greater use of imported tobacco has resulted from an increasing differential between world and US tobacco prices and quality improvement of foreign tobacco, and from the expansion of market shares of some types of cigarettes, which contain more imported tobacco. Relative price and nicotine content changes have a significant role in explaining the

change in input use (Chang, 1988). Low-tar and -nicotine cigarettes contain more imported tobacco relative to regular cigarettes. Health concerns may have led to greater popularity of low-tar and -nicotine cigarettes among smokers. Since the mid-1980s generic cigarettes, which are cheaper than premium cigarettes and contain more imported tobacco, have become more popular among price-conscious smokers. Generic cigarettes now retain more than one-third of the domestic market share.

Cigarette consumption in the US had been on an upward trend until 1981 when total cigarette consumption reached about 640 billion. Since that year total cigarette consumption has fallen by about 2 to 3% per year. Smoking restrictions, high excise taxes, health concerns, and anti-smoking campaigns explain the decline in cigarette consumption (Ipolito and Ipolito, 1984; Sumner and Wohlgenant, 1985; Brown, 1995). Along with the patterns of cigarette consumption, US cigarette production has steadily grown until the early 1980s. The recent fall in US cigarette consumption has been more than offset by increases in cigarette exports.

Although cigarette production has increased during the last three decades, total tobacco use did not change. Cigarette manufacturers have reduced the amount of tobacco per unit of cigarette (Sumner and Alston, 1987). As a result, domestic use of both US flue-cured and burley declined. Quantity share of US flue-cured in the cigarette industry has fallen from about 55% in the early 1960s to about 32% in 1992. In the same period the quantity share of burley also has declined, at slower rates, from 36% to 26%. This continuous decline in the domestic use has forced US tobacco growers to be more export-oriented and also to look for protectionist policies. However, high US prices, partly induced by the tobacco program, along with greater foreign competition for maturing cigarette markets, and foreign market distortions are some of the major challenges to the competitiveness of US tobacco in the world market (Beghin and Hu, 1995).

The US tobacco program was designed to support and stabilize tobacco prices through production control and price support. A national quota for flue-cured and burley tobacco is set every year by a predetermined formula (Toussaint, 1991). Usually, the market price of this tobacco is slightly above the prescribed support price. If the market price is less than one cent above the support price, grower-owned and financed cooperatives purchase the tobacco at the support price. The national quotas for flue-cured and burley tobacco are determined by three factors: purchase intentions by cigarette manufacturers, three-year average tobacco exports, and stock adjustment to maintain a specified reserve stock level. The tobacco program, which fixes aggregate tobacco supply, has increased US tobacco prices above competitive prices and has created rents (Johnson and Norton, 1983). In the long run the program has induced substitution away from US tobacco and has fostered the emergence of foreign tobacco production.

3. The US domestic tobacco content requirement

In January 1994, a new US law required that the tobacco content of US manufactured cigarettes, expressed in weight, be at least 75% US tobacco (Grise, 1993). Support for this new regulation was mixed. Two concerns were voiced. First, the policy could induce retaliation by other countries, and second, cigarette manufacturers could decide to reduce their demand for US tobacco by shifting their plants abroad to avoid the content requirement. Demand for US tobacco could also be reduced by declines in cigarette demand due to higher cigarette price if the content requirement is much larger than what would prevail under free trade, because the substitution effect is outweighed by the negative output effect of the domestic content (Grossman, 1981).

The domestic content policy required every US cigarette manufacturer to certify annually to the Secretary of Agriculture that US-grown tobacco made up at least 75% of the total volume of tobacco used by the manufacturer in manufacturing cigarettes in the US. This requirement applied to all cigarettes produced in the US. A manufacturer failing to fulfill this requirement was subject to a series of punitive taxes payable to the US government (see Zaini, 1994, for details on these penalties).

We can summarize the recent US content policy as follows. The physical domestic content scheme is a combination of a required physical content ratio and a tariff penalty. The content ratio, k, stipulates the share of the domestic input, D, in total input use

(imported plus domestic), expressed in weight. If the domestic input use falls short of that ratio an import tariff penalty is imposed on the imported competing input, I. Let P_I and β be the border price of I and the tariff penalty, respectively. The imported input price is

$$P_I = \begin{cases} P_I & \text{if } I \leq (1-k)(D+I), \\ P_I + \beta & \text{otherwise} \end{cases}$$

The penalty per unit of imported input, β, was so extensive that compliance with the policy was insured. In the following section we assume that the manufacturers always satisfy the US tobacco content requirement.

In fall 1995, a GATT/WTO panel ruled against the US policy. The domestic content policy was subsequently changed into a tariff-rate quota, which imposes a prohibitive tariff of 350% on tobacco imports exceeding a specified amount to be determined annually.

4. A model of the impact of the domestic content policy

To analyze the impact of the domestic content policy on US cigarette and tobacco industries, we use a log-linear equilibrium displacement model similar to those of Sumner and Wohlgenant (1985) and Beghin and Chang (1992). We assume that US cigarette manufacturers comply with the domestic content requirement. We model the impact of a small increase in the content requirement, k, from a previous just-binding level (the pre-regulated level). Two key assumptions of the model are, first, that constant returns to scale exist in cigarette manufacturing, and second, that tobacco enters cigarette manufacturing as a CES composite made of domestic and foreign tobacco. These two assumptions are convenient without being restrictive. Foreign and domestic tobacco involved in the content requirement have been repeatedly shown to be substitutes (e.g. Sumner and Alston, 1987; Beghin and Chang, 1992). The two assumptions allow us to model proportional changes in marginal costs of cigarette production as a sum of weighted changes in input prices and in the content requirement.

Although the US cigarette industry consists of only six manufacturers, the empirical evidence of monopoly power in the US cigarette market is mixed and not unanimous (e.g. Rezitis et al., 1996; Sumner, 1981; Sullivan, 1985; Tremblay and Tremblay, 1995). To accommodate competing assumptions on the level of market power we assume that the industry has a monopoly markup in its output market. The markup changes with the elasticity of cigarette demand.

In contrast, US cigarette producers are price-takers in their input markets. This is an assumption consistent with stylized facts of the US tobacco market, which is global and in which leaf dealers and manufacturers compete from all over the world. Hence, the presence of any buyer with some monopsony power is improbable in this market. The supply of domestic tobacco is regulated and determined through the tobacco program. Prices of imported tobacco and other inputs are assumed exogenous to the domestic content policy because shares of US imports in the world tobacco market are small, and US cigarette manufacturers use only a small proportion of the market supply of other inputs. The tobacco and cigarette markets are assumed to be in equilibrium. The model abstracts from the change in stock levels in response to the domestic content policy. We also abstract from possibilities of foreign policy retaliation and of off-shore shift of US domestic cigarette manufacturing capacity. In Appendix A we discuss how these two considerations could be incorporated in the model.

All share and elasticity parameters are assumed constant in the comparative statics. Variables that are not affected by the policy do not appear in the system of log differential equations. We use the "E" operator ($\mathrm{E}x = d\log x = dx/x$ for any variable x). Definitions of endogenous variables are summarized in Table 1.

We start the model description with cigarette production. We assume a CES composite tobacco input, with imperfect substitution between the two tobacco types. We parameterize the composite tobacco input, $G(\mathrm{D,I})$, with a CES production function:

$$G(\mathrm{D,I}) = \left[aD^{-\rho} + (1-a)I^{-\rho}\right]^{-1/\rho}$$

where ρ is the parameter determining the elasticity of substitution between domestic and imported com-

Table 1
Endogenous variables

Symbol	Definition
Q_{cd}	Quantity of US cigarettes sold in the domestic market
Q_{ce}	Quantity of US cigarettes exported by US manufacturers
Q_c	Total quantity of cigarettes produced by US manufacturers
P_{cd}	Domestic wholesale price of cigarettes
P_{ce}	Export wholesale price of US cigarettes
D_d	Quantity of US tobacco used by cigarette manufacturers
D_e	Quantity of US tobacco exported
D_T	Total quantity of US grown tobacco
P_D	Average price of US tobacco – quantity share weighted average of flue-cured and burley tobacco prices
P_I	Average price of imported tobacco
L_D	Market lease rate for tobacco quota
R_D	Total quota revenue

peting inputs. The elasticity σ is equal to $1/(\rho+1)$ and a is the CES share parameter showing the contribution of each tobacco to the composite input. With the tobacco mix constraint by the domestic content ratio $(D/I = k/(1-k))$, the composite input G becomes:

$$G(\mathrm{D,I}) = (D/k)\left[ak^{-\rho} + (1-a)(1-k)^{-\rho}\right]^{-1/\rho}$$

Under the CES assumption, the price of the constrained composite tobacco is

$$P_G = \left[P_D k + P_I(1-k)\right] \times \left[ak^{-\rho} + (1-a)(1-k)^{-\rho}\right]^{1/\rho}$$

From necessary conditions for cost minimization we express D_d, the derived demand for domestic tobacco used in domestic manufacturing, as $D_d = D_d(Q_c, P_D, k$,prices of competing inputs). Since only P_D, k and Q_c change, we express the relative change in D_d as

$$\mathrm{E}D_d = \eta_{ddd}\mathrm{E}P_D + \mathrm{E}Q_c + \gamma \mathrm{E}k, \qquad (1)$$

with $\gamma = (1-a)(1-k)^{-\rho-1}/[ak^{-\rho} + (1-a)(1-k)^{-\rho}]$, and with η_{ddd} denoting the output-constant own-price elasticity of D_d. The expression for γ is derived by differentiating $D_d = Gk[ak^{-\rho} + (1-a)(1-k)^{-\rho}]^{1/\rho}$, holding scale and price constant (i.e. $dG = 0 = dP_D$), in order to obtain the effect of changes in the content ratio k on D_d, *ceteris paribus*. Constant return to scale implies that the scale elasticities, $d\ln G/d\ln Q_c$ and $d\ln D_d/d\ln G$, are equal to 1, hence $\mathrm{E}d_d/\mathrm{E}Q_c = 1$. Eq. (1) is useful to motivate the forces at work with a content requirement: a direct positive substitution effect from k, an indirect negative scale effect due to higher cost of production and lower cigarette market equilibrium quantity, and a negative own-price effect induced by the tobacco program which constrains the supply of US tobacco.

The quantity ratio of imported tobacco (I) to domestic tobacco (D) used in cigarette manufacturing is equal to $(1-k)/k$. In proportional change this relationship implies:

$$\mathrm{E}I = \mathrm{E}D_d - [1/(1-k)]\mathrm{E}k \qquad (2)$$

US-produced cigarettes are sold domestically and exported. We assume that cigarette imports are equal to zero because they are negligible. The domestic and export demand functions for US cigarettes (Q_{cd} and Q_{ce}), expressed in proportional changes, are influenced by changes in the US cigarette price in each market (P_{cd} and P_{ce}):

$$\mathrm{E}Q_{cd} = \eta_{cd}\mathrm{E}P_{cd} \text{ and } \mathrm{E}Q_{ce} = \eta_{ce}\mathrm{E}P_{ce}, \qquad (3)$$

with η_{ci} denoting the respective own-price elasticities in market i. Total cigarette demand (Q_c) is the sum of both domestic and export markets. Its proportional change is represented by the share-weighted sum:

$$\mathrm{E}Q_c = \alpha_{cd}\mathrm{E}Q_{cd} + (1-\alpha_{cd})\mathrm{E}Q_{ce}, \qquad (4)$$

with α_{cd} being the share of domestic cigarette demand in total demand.

With the fixed monopoly markup implied by the constant elasticities η_{ci} and with the assumption of constant return to scale in cigarette manufacturing, we know that the proportional change in the cigarette price equals the proportional change in unit cost of production. This is due to the fact that cost of production can be written as the product $[Q_c * f(P_D,k)]$, implying that average cost = marginal cost = $f(P_D,k)$ and that $P_{cd} = P_{cd}(p_D,k)$ = [markup * $f(P_D,k)$].

To derive this change in the cigarette price, we first derive the change in the composite tobacco price. Proportional changes in the tobacco composite input induce proportional changes in the marginal cost and in the price of cigarettes, that is, $\mathrm{E}P_{cd} = \beta_G \mathrm{E}P_G$, with β_G being the cost share of the composite tobacco in cigarette production, and P_G as

defined above. The proportional change in the price of the composite tobacco is obtained by differentiating the definition of P_G for changes in k, and P_D. Hence,

$$\begin{aligned} EP_G = {} & (kP_D/P_a)EP_D \\ & + \Big\{k(P_D - P_I)/P_a + k\big[-ak^{-\rho-1} \\ & + (1-a)(1-k)^{-\rho-1}\big] \\ & /\big[ak^{-\rho} + (1-a)(1-k)^{-\rho}\big]\Big\}Ek, \end{aligned}$$

or

$$EP_G = \beta_D EP_D + \beta_k Ek,$$

with

$$\beta_D = \big(kP_D/(kP_D + (1-k)P_I)\big),$$

and with

$$\begin{aligned} \beta_k = {} & k(P_D - P_I)/(kP_D + (1-k)P_I) \\ & + k\big[-ak^{-\rho-1} + (1-a)(1-k)^{-\rho-1}\big] \\ & /\big[ak^{-\rho} + (1-a)(1-k)^{-\rho}\big] \end{aligned}$$

The change in the composite tobacco price, EP_G, is substituted into the change of the domestic cigarette price EP_{cd} to yield

$$EP_{cd} = \beta_G(\beta_D EP_D + \beta_k Ek) \tag{5}$$

As shown in Eq. (5), two factors cause the change in production cost and the cigarette price: the content requirement and an induced increase in the US tobacco price reflecting the feedback effect of the changing demand for US tobacco on its price via the tobacco program.

The price of exported cigarettes is equal to the domestic wholesale price of cigarettes net of excise tax ($P_{ce} = P_{cd} - T$). Because the excise tax and tariff rates do not change, the relative change in exported cigarette price is

$$EP_{ce} = \big[1/(1-\beta_T)\big]EP_{cd}, \tag{6}$$

with β_T being the tax share of the domestic wholesale price of cigarettes.

The proportional change in the export demand for US-grown tobacco is represented by

$$ED_e = \eta_{dde} EP_D, \tag{7}$$

with η_{dde} denoting the own-price elasticity of export demand. Total demand for US tobacco is the sum of both domestic use and export, i.e.

$$ED = \alpha_{dd} ED_d + (1-\alpha_{dd})ED_e, \tag{8}$$

with α_{dd} denoting the share domestic use in total disappearance of US tobacco.

The tobacco program regulates the production of US tobacco. Changes in the supply of US-grown tobacco, S, can be written as

$$ES = \epsilon EP_D, \tag{9}$$

with parameter ϵ being the output response elasticity of domestic tobacco, which is determined by the tobacco program. At equilibrium supply equals demand, $S = D$. If the program fixes the level of quota, then the price is allowed to adjust or $\epsilon = 0$. Conversely, to maintain the current support price levels, a change in US tobacco demand is accommodated by quota adjustment, i.e. $\epsilon = \infty$.

Following Sumner and Wohlgenant (1985), the impact of the domestic content policy to quota owners is represented by changes in the lease rate for quota, which is the difference between tobacco price and its marginal cost, i.e. $L_D = P_D - MC_D$. The relationship between the marginal cost and output can be represented by $EMC_D = \mu ED$, with μ being the elasticity of marginal cost with respect to output. Proportional changes in quota lease rates can be written as

$$EL_D = (1/\beta_L)EP_D - \big[(1-\beta_L)/\beta_L\big]\mu ED, \tag{10}$$

where β_L is the average cost share of the lease rate. Proportional changes in the total quota rents are determined by changes in the quantity of tobacco and changes in the lease rates, i.e.

$$ER_D = E(D.L_D) = ED + EL_D \tag{11}$$

The change in producers' rent, PS_D, in dollar terms, is derived by summing up the rectangle and triangle induced by the increase in production and comprised between the marginal cost schedule and the old and new producer prices net of the rental rate ($P_D - R_D$). Denote the change in producer price by the change in marginal cost, dMC_D, then the change in producer surplus is

$$dPS_D = D.dMC_D + 0.5D.ED.dMC_D \tag{12}$$

Table 2
Parameters used in simulations and their values

Symbol	Definition	Values
η_{cd}	Domestic wholesale price elasticity demand for cigarettes	−0.3
η_{ce}	Export wholesale price elasticity demand for US cigarettes	−0.55 and −3
η_{ddd}	Own-price elasticity domestic demand for domestic tobacco	−1 and −2
η_{dde}	Own-price elasticity export demand for US tobacco	−2.33
μ	Elasticity of marginal cost of tobacco w.r.t. output	0.078, 0.25
ϵ	Output response elasticity of US tobacco	0, 1 and ∞
α_{cd}	Quantity share of domestic demand for cigarettes	0.74
β'_D	Cost share of domestic tobacco	0.035
β_T	Tax share of domestic wholesale cigarette price	0.20
α_{dd}	Quantity share of domestic tobacco used by cigarette manufacturers	0.63
β_L	Cost share of the quota lease rate w.r.t. domestic tobacco price	0.20
σ	Elasticity of substitution between domestic and imported tobacco	10
$\beta_k\,\beta_G$	Partial multiplier EP_{cd}/Ek	0.017
γ	Partial multiplier ED_d/Ek	1.1484

By solving the system of Eq. (1) to (12) we obtain impact multipliers of imposing a content requirement (change in k) on the endogenous variables. By imposing more structure on the model, it is possible to gain some analytical insight on the effect of the content on some of the endogenous variables and on what parameters are the most instrumental in determining results. [2] To illustrate, we look at the multiplier ED/Ek in the simple case of a fixed program price P_D (quotas are adjusted). The multiplier is

$$ED/Ek = \{[\alpha_{cd}\eta_{cd} + (1-\alpha_{cd})\eta_{ce} \times (1/(1-\beta_T))]\,\beta_k\,\beta_G\} + \gamma$$

The substitution effect of the content is expressed by γ, which is positive for a binding constraint, and which increases with an increasing elasticity of substitution between the two tobaccos. The negative output effect is expressed by the term in brackets. The output effect gets smaller under three conditions. First, the smaller the cost share of tobacco in cigarette manufacturing β_G, the smaller the output response. Second, a small coefficient β_k means that the increase in the cost of the composite tobacco G induced by the distorting increase in the content k is small. The response β_k is smaller when the ratio $(k = D/D + I)$ is closer to its pre-policy or free-trade level, in which case the distortion induced by an increase in k is small. The expression β_k increases dramatically when the policy ratio k deviates strongly from its free trade level. Third and finally, when the elasticity of cigarette demand, domestic or exports, is small in absolute value, the output effect will also be smaller. In sum, the effect of an increase in k on D will be positive when the content is set close to its pre-policy level, when the share of tobacco in total cost is small, when tobaccos D and I are highly substitutable in cigarette manufacturing, and when cigarette demand is not "too elastic". These conditions are entirely consistent with the US case. [3]

5. Parameter values

The parameter values used in the simulations are listed in Table 2. The demand and supply elasticities are obtained from prior studies. The average cost and market shares are computed based on data from USDA Economic Research Service's *Tobacco Situation and Outlook*, 1988–1992. Estimates of the elas-

[2] We thank a referee for suggesting this approach.

[3] Similar derivations under the assumption of a fixed quota reveal that EP_D/Ek and ED/Ek are positive under the exact same conditions. Further, if cigarette demands are relatively inelastic, the effect on D of the increase in price via the farm program (EP_D/Ek) is always smaller than the partial effect of the content, and therefore the total response ED/Ek is always positive when the four conditions are met.

ticity of domestic demand for cigarettes are widely available (Viscusi, 1992, pp. 103–105). Most of studies, despite the various methods and data used, yield values of demand elasticities in the range from −0.4 to −1.0. Recent studies include factors such as governmental smoking restrictions (Wasserman et al., 1991) and addictive effects of smoking (Chaloupka, 1991; Becker et al., 1994) in estimating the elasticity of demand for cigarettes. Their results provide estimate demand elasticities in the range from −0.28 to −0.8. With the wholesale price of cigarettes at about 65% of its retail price, the wholesale price elasticities demand for cigarettes are between −0.18 and −0.52. A mid-range value, −0.3, which is similar to the estimate result in Sumner and Alston (1987) is used in the simulations. The estimate of export demand elasticity is less known. Sumner and Wohlgenant (1985) use a value of −3.0. A recent estimate elasticity of US cigarette export to the EU computed by Brown (1995) is −0.55. This inelastic export elasticity may indicate that US premium brand cigarettes are perceived as a luxury and have a very small share of the EU cigarette market.

Econometric results from Sumner and Alston (1987) and from Beghin and Chang (1992) yield large elasticities of substitution, larger than the value assumed by Sumner and Wohlgenant (1985). We set the elasticity of substitution between D and I equal to 10, which is within the range of econometric estimates reported in the literature. We set the compensated-demand elasticity for domestic tobacco equal to, successively, −1 and −2 to accommodate sensitivity analysis. Estimates of export elasticity of demand for US tobacco are from Johnson and Norton (1983). To compute the effect of the policy on quota rental rates and producers' rent we use an estimate of elasticity of marginal cost with respect to output from Sumner and Goodwin (1992).

The output response elasticity is controlled through the tobacco program. While the current tobacco program is more likely directed to maintain a stable tobacco price (Brown, 1995), the simulations consider three scenarios: fixed quota ($\epsilon = 0$), fixed support price ($\epsilon = \infty$), and an intermediate situation allowing both quota and price to adjust ($\epsilon = 1$). For the policy shock we consider the relative change in k corresponding to the change from its pre-regulated level to the level imposed by the regulation, i.e. from 0.659 to 0.75. The value 0.659 represents the average actual domestic content for 1989–1992.

6. Simulation results

The impact of the policy on the endogenous variables are summarized in Table 3 for the scenario where the compensated-demand elasticity for domestic tobacco is equal to −1. The table shows that in

Table 3
Impact of the domestic content policy [a]

	$\epsilon = 0$	$\epsilon = 1$	$\epsilon = \infty$
Total demand for US cigarettes	−0.55	−0.44	−0.27
Domestic demand for US cigarettes	−0.14	−0.11	−0.07
Export demand for US cigarettes	−1.71	−1.37	−0.86
Domestic wholesale price of cigarettes	0.46	0.37	0.23
Domestic demand for US tobacco	8.85	11.52	15.58
Export demand for US tobacco	−15.06	−9.08	0
Total demand for US tobacco	0	3.90	9.82
Price of US tobacco	6.47	3.90	0
Demand for imported tobacco	−31.65	−28.97	−24.91
Total domestic tobacco revenue	6.47 (106.7)	7.80 (128.6)	9.82 (162.0)
Quota lease rates	32.33	15.59	−9.82
Total quota rent	32.33	19.49	0
Producers' rent	(0)	(13.1)	(34.0)
Total US welfare	(−51.66)	(−49.91)	(−45.16)

[a] This simulation assumes $\eta_c^e = -3$ and $\eta_{dd}^d = -1$. The results are in percent except figures in parentheses which are in millions of US dollars.

all scenarios an exogenous increase in the domestic content ratio yields larger domestic demand for US tobacco and a substantially lower use of imported tobacco. Imports are hit twice: by the negative substitution effect imposed by the content and by the negative output effect. A large increase in domestic demand for tobacco induces a small increase in cigarette price because the cost shares of tobacco input in cigarette production are very small. As a result, the policy induces a moderate negative output effect translating into a small decrease in domestic, export and total demand for US cigarettes.

Under a fixed quota ($\epsilon = 0$, see column 1), the policy increases domestic demand for US tobacco by almost 9% and reduces imported tobacco by 31.6% (a larger percentage fall in imported tobacco is needed to reach the domestic content requirement, 75%). Export demand for tobacco falls by more than 15%. The domestic tobacco price increases by 6.5%. By fixing the tobacco quota the marginal cost of tobacco does not change, producers' rent remains constant, and the higher tobacco price is captured by a 32.3% increase in both quota lease rate and quota rent. Total revenue increases by 6.5% ($106.7 million) generated by the tobacco price increase. Total welfare is estimated by the changes in Marshallian surpluses for quota holders, tobacco producers and cigarette consumers. Given constant return to scale in cigarette manufacturing, and omitting the controversial monopoly mark-up, manufacturers' surplus remains unchanged. Total welfare decreases by $51.66 million.

Under the constant tobacco price scenario ($\epsilon = \infty$, see column 3 of Table 3) domestic demand for US tobacco increases by more than 15%, demand for tobacco export does not change, and total demand for domestic tobacco increases by almost 10%. Adjustment in quota level allows domestic tobacco producers to earn more rent resulting from increases in the marginal cost and tobacco output ($34.0 million). Lease rate falls, total quota rent remains constant, but total revenue increases by almost 10% ($162.0 million), about 50% larger than revenue increase under fixed quota. In this second scenario total welfare decreases by $45.16 million. The loss in consumer surplus is smaller than in the fixed quota case; growers gain and tobacco quota rents do not change.

In the intermediate scenario ($\epsilon = 1$) both price and tobacco quota adjust. As shown in column 2 of Table 3, values of changes are between those in the first and third scenarios. Both quota holders and tobacco producers increase their rents. However, the first scenario is preferred by quota holders since they could earn more from quota rent, but they earn nothing under the fixed price scenario. In contrast, tobacco producers' surplus is maximized under the constant price scenario where it increases by about $34.0 million. Under the intermediate scenario, total welfare decreases by $49.91 million. In this case quota holders have smaller gains than in the fixed quota case.

To analyze the robustness of the results we use various values of domestic and export wholesale price elasticities of demand for US cigarettes, and demand elasticity for domestic tobacco. First, variations in the domestic and export wholesale price elasticities of cigarettes do not alter our qualitative results. The only significant difference in magnitude appears in cigarette demand changes. A steeper cigarette export demand produces smaller decreases in the export quantity of cigarettes (-0.32% under fixed quota and -0.16% under constant price with the elasticity set at -0.55). When the demand for domestic tobacco is more elastic (elasticity equal to -2) and under fixed quota, domestic demand for US tobacco increases by more than 6% causing export of US tobacco and demand for imported tobacco to decrease by 10.7% and 34.2%, respectively. The lease rate increases by almost 23%. We also consider a more elastic marginal cost elasticity of 0.078, as in Babcock and Foster (1992). Under fixed tobacco price the increase in producers' rents is about $10 million, or about one-third of the producers' rent shown in Table 3.

The robustness of the results is determined by the stylized facts of the US tobacco and cigarette industries as mentioned in the model section. The observed small cost share of tobacco, β_G, and the content ratio k set just above pre-policy level both lead to a moderate negative output effect in manufacturing, which is smaller in absolute value than the favorable substitution effect. The latter substitution effect is driven by the general consensus on the high substitutability between foreign and US flue-cured and burley tobacco. Overall, domestic demand for

US tobacco increases leading to benefits to the US tobacco growing industry, and to moderate welfare losses for manufacturers. The only parameter that could influence this fundamental result is the cigarette demand elasticity because it has some influence on the price feedback effect EP_D. The sensitivity analysis just discussed in this section shows that this parameter is not a source of concern.

The political economy of the domestic content policy offered additional incentives for manufacturers to comply with the requirement. Content requirement policies often happen in imperfectly competitive and/or declining industries where cooperative behavior between manufacturers and input suppliers increases their political clout in an adverse environment (e.g. US and Australian tobacco and cigarette industries). In the US case it is likely that cigarette manufacturers benefit from the existence of the political constituency of numerous and small tobacco growers and are willing to pay a premium to secure that domestic political support. The antiquated and inefficient US auction and warehouse system can be rationalized similarly. This political economy argument re-enforces the incentive effects provided by the stiff penalty of the US domestic tobacco content requirement policy because cigarette firms would be unwilling to risk to undermine their political alliance with growers.

7. Conclusions

Our simulation results showed that domestic growers benefited in the short run from the content requirement. Tobacco imports were substantially penalized and manufacturing output decreased as well, but to a lesser extent. The change in the content ratio resulted in a large substitution effect, but induced a very small output effect in cigarette manufacturing.

The long-run impact of such policies on input sales and use is unclear since manufacturers can shift production abroad and decrease their export of manufacturing goods in favor of off-shore manufacturing. In the case of US tobacco content policy, the policy was interrupted and changed too quickly to observe a shift of production capacity abroad. However, the tariff-rate–quota policy, which supersedes the content policy is equally protectionist with its prohibitive tariffs and is a quantitative policy in disguise. Its effects are similar to those of the domestic content because it raises the domestic use and price of US tobacco by artificially making foreign tobacco unattractive.

Different manufacturers are likely to have different long-term responses to these protectionist policies. Philip Morris and R.J. Reynolds dominate both domestic and export markets of US cigarettes. They also have expanded production facilities abroad on local foreign markets for their products, whereas other firms have emphasized domestic production. However, it is difficult to do a quantitative analysis due to lack of data on capital and production capacity in other countries. US cigarette manufacturers face a declining domestic cigarette market, and there may be some excess production capacity in the US and also abroad. Therefore, the protectionist policies may not be the dominant factor in relocation decisions of US cigarette manufacturers, but it may well be pivotal at the margin given the negative context existing in the US.

Appendix A

The appendix explains how to incorporate retaliation by foreign policy makers and off-shore shift of US manufacturing capacity.

A.1. Retaliation

Retaliation could be mimicked in the following ways. First export demands for US cigarette and tobacco could be modeled as more elastic. This would boil down to increase the magnitude of η_{ce} and η_{dde} in our model. The second way would be to change the export price of tobacco and cigarettes to reflect the retaliatory barriers abroad. Eq. (6) and Eq. (7) could be

$$EP_{ce} = [1/(1-\beta_T)]EP_{cd} + (\beta_T/(1-\beta_T))ET,$$

and

$$ED_e = \eta_{dde}[(1/(1-\beta_T)) \times (EP_D + (\beta_{TD}/(1-\beta_{TD}))ET_D],$$

where T_D is a retaliatory per unit tariff on cigarette exports and β_{TD} is the share of the tariff in the domestic price P_D.

Either approach would result in lower exports of US tobacco products.

A.2. Off-shore shift of capacity

We assume that only manufacturing for exports would be influenced by this decision; the domestic market would be supplied by domestic manufacturing. Transportation costs motivate this assumption. US cigarette manufacturing for exports, Q_{ce}, would decrease, as well as total cigarette output Q_c. This could be done by incorporating a shifter Γ in Eq. (3):

$$EQ_{ce} = \eta_{ce} EP_{ce} + \Gamma,$$

with Γ negative and indicating the shift of production abroad in percent of Q_{ce}.

The second element to take into consideration is the increase in export demand for US tobacco coming from the increased off-shore capacity. Some slippage may occur so it is unlikely that a one-to-one correspondence exists between the decrease Γ and the increase in export demand.

Accordingly we modify Eq. (7) as follows:

$$ED_e = \eta_{dde} EP_D + (1 - s)(-\Gamma),$$

with s indicating the slippage occurring by substituting other tobacco than US tobacco in off-shore production of US cigarettes.

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