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## Smoking and environmental pollution: Why there could be a free lunch

### Abstract

This research examines the perpetually overlooked gap between the U.S. Tobacco Buyout and tobacco product litter. The authors highlight how a specific policy change can have widespread effects when environmental externalities are taken into account. The benefit-cost ratio associated with the controversial U.S. Tobacco Buyout will grossly underestimate the positive impact of the program if externalities are not accounted for. This ratio more than doubles from 1.25 to 2.66 when reductions in tobacco related litter are included.

**Keywords:** Tobacco buyout, tobacco product litter, pollution, clean up costs, externalities.

**JEL Classification:** Q00, Q11, Q18, Q52, Q53.

### Introduction

The United States (U.S.) Tobacco Program was established in 1938 to increase the income of tobacco producers. Its main feature was the use of production quotas, wherein tobacco production was restricted below competitive levels. This benefited tobacco producers and landowners (collectively labeled quota holders/owners) by artificially raising the price of tobacco (Schmitz et al., 2010). There is generally a concern over government enforced production quotas, subsidies, and the like, because of the inefficiencies that arise due to their implementation. Particularly with the case of tobacco, these concerns are amplified due to the unhealthy and harmful nature of the commodity. Over time, various public organizations (mostly public health organizations such as the American Cancer Society) pressured the government to eliminate the Tobacco Program and to cease supporting the tobacco industry. As a result, “The Fair and Equitable Tobacco Reform Act” (Tobacco Buyout) was signed into law by President George W. Bush on October 22, 2004. The 2004 Act effectively eliminated the U.S. Tobacco Program, deregulated U.S. tobacco production and prices, and provided compensation to quota owners (a buyout) for the loss of the quota, which was essentially an asset (Dohlman, Foreman and Da Pra, 2009). Within the legislation, compensation payments were outlined to be funded by a tobacco consumption tax. These payments were to be made in 10 equal annual installments of \$1.00 per pound of tobacco quota (Womach, 2005).

We examine the impact of the U.S. Tobacco Buyout by taking into account an important negative externality – the amount of litter produced from smoking. We highlight how a specific policy change can have widespread effects when externalities – positive or negative are taken into account. Our results show

that the benefit-cost ratio calculation associated with the controversial U.S. Tobacco Buyout will grossly understate the positive impact of the program if externalities are not accounted for. This study is the first to bridge the gap between research on the historic U.S. Tobacco Buyout and research on tobacco product litter (TPL).

### 1. Literature review

**1.1. Tobacco buyout.** Previous work by Pasour (2005) questioned the legality of the buyout and concluded that there was no legal, ethical or economic reason to “...compensate those who have benefited from a government-enforced cartel.” Other work by Schmitz et al. (2013) analyzed the impact of the buyout in both a partial and general equilibrium framework. Dohlman, Foreman and Da Pra (2009), outlined the buyout and showed how it (1) provided compensation to quota owners and (2) effectively deregulated the U.S. tobacco production and prices. Brown, Rucker and Thurman (2007), examined the effects of the historic legislation on tobacco markets and considered the appropriateness of the buyout payments under alternative views. Kirwan, Uchida and White (2012) examine the distortionary effects of the tobacco buyout on Kentucky, specifically focusing on farm productivity and reallocation. Finally, Serletis, and Fetzer (2008) estimated the impact of the U.S. Tobacco Buyout in both the U.S. and in foreign markets.

Our findings are at odds with the official buyout legislation that determined there would be no significant environmental impact as a result of the buyout (Federal Register, 2005).

*“The environmental impacts of this rule have been considered under the National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. 4321 et seq., the regulations of the Council on Environmental Quality (40 CFR parts 1500-1508), and FSA regulations for compliance with NEPA, 7 CFR part 799. An Environmental Evaluation was completed and it*

was determined that the proposed action does not have the potential to significantly impact the quality of the human environment and, therefore, the rule is categorically excluded from further review under NEPA.”

**1.2. Tobacco product litter.** Consider some simply staggering statistics regarding cigarette consumption and tobacco product litter (TPL) provided by Chapman (2006):

*“In 2005, matches and lighters were struck under an estimated 5.494 trillion cigarettes consumed by the world’s 1.3 billion smokers. The great majority of their non-biodegradable butts are thrown on the ground. Butts are easily the single most common form of litter, with one analysis showing they constitute 39% by weight of all litter.”*

The same study reviewed quite a few anti-littering campaigns started by several countries including the U.K. and Australia and holds that these campaigns are just band aids to a much larger problem; and, that the inherent problem of the amount of litter produced by cigarettes is the amount of people smoking.

Novotny et al. (2009) detailed many of the known ways that cigarette butts harm the environment (the butt is actually a filter that traps many of the carcinogens present in tobacco smoke; because they are for the most part not biodegradable, all of the toxins remain in the environment with the cigarette butts) and propose banning the sale of cigarettes with filters.

Schultz et al. (2009) conducted one of the largest (if not the largest) national litter studies ever conducted:

*“The study reports on three nationwide studies – behavior observations, intercept interviews, and a national telephone survey...and explore how frequently people litter, the individual and contextual variables that contribute to littering, and the effectiveness of various approaches to reduce littering.”*

They found that over 51 billion pieces of litter land on U.S. roadways each year; litter is primarily the result of individual behavior (attributable to up to 85% of all litter); the most frequently littered items are cigarette butts (approximately 38% of all U.S. roadway litter); smokers had a 65% littering rate; and, litter clean-up costs the U.S. more than an estimated \$11.5 billion each year (Schultz et al., 2009). Schneider et al. (2011) cite the ERS/USDA and note that 360 billion cigarettes were sold in 2007<sup>1</sup>. Given the 65% smoker littering rate, in 2007,

roughly 234 billion cigarettes would have been disposed of improperly.

Schneider et al. (2011) present a framework and methodology for calculating tobacco product littering costs and abatement fees and conclude that a possible policy option to address tobacco litter is to levy fees on cigarettes sold. Smith and Novotny (2011) highlighted the behavioral issues and attitudes behind smokers and their views on littering. Their paper also focused on possible ways of mitigating the damage done by TPL and concluded:

*“...public TPL direct abatement costs range from about US\$0.5 million to US\$6 million for a city the size of San Francisco. The costs of mitigating the negative externalities of TPL in a city the size of San Francisco can be offset by implementing a fee of approximately US\$0.20 per pack. Tobacco control and environmental advocates should develop partnerships to compel the industry to take financial and practical responsibility for cigarette butt waste.”*

## 2. Methodology and theory

**2.1. Methodology.** The methodological framework of Schmitz et al. (2013) is followed to first determine the impact of the U.S. Tobacco Buyout without externalities, and second to estimate the impact of the buyout on TPL. These results are then combined to calculate aggregate benefit cost ratios. We argue that the U.S. Tobacco Buyout resulted in the reduction of TPL and provide present value calculations on the economic effects of the tobacco buyout on producers, consumers, society (including clean-up costs).

**2.2. Theory.** *2.2.1. Quota removal.* We address an important question: Given a tobacco buyout, how could the economic savings from a reduction in TPL compare with the net gains (or losses) to producers and consumers within a welfare economics context?<sup>2</sup> Additionally, what is the effect of including these economic savings in benefit-cost ratios?

We do this by following the theoretical welfare economics framework proposed by Just, Heuth and Schmitz (2004). Consider the model in Figure 1, where  $S$  is the supply schedule,  $D_D$  is the domestic demand schedule and  $D_T$  is the total demand schedule. The competitive price is  $p_0$  and the corresponding output is  $p_0$ . By introducing a production quota  $q_1$ , the price increases to  $q_1$ , and as a result, consumers lose  $(p_1 p_0 b a)$  with domestic consumers and foreign consumers losing  $(p_1 p_0 i r)$  and  $(r i b a)$ , respectively.

<sup>1</sup> Note that 470 billion cigarettes were smoked in the United States in 1998 translating to a total of 176,250,000 pounds of discarded butts in one year in the United States alone (Register, 2000).

<sup>2</sup> Schmitz, Haynes and Schmitz (2013) consider the implications of a government-funded buyout and compare it with a consumer-tax-funded buyout.

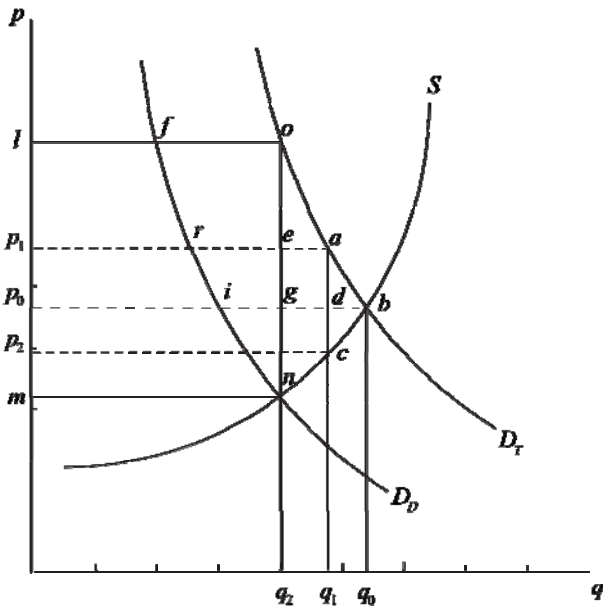


Fig. 1. Theoretical implementation and removal of production quota (consumer tax)

Producers gain  $[(p_1 p_0 da) - (dcb)]$  and receive the value of the quota from the market  $(p_1 p_2 ca)$ .<sup>1</sup> The deadweight loss created by the quota is  $(acb)$ .

As the U.S. Tobacco Buyout was funded by consumer tax dollars, we model the effects of eliminating a production quota program given this consideration. Eliminating a quota program and providing compensation with the value of the quota as the basis of compensation does not result in a net producer gain, especially when compensation is derived from a consumer tax.<sup>2</sup> There is also no difference to consumers in the event of a buyout given the use of the value of the quota because they continue to lose  $(p_1 p_0 ba)$  as they would have if the quota remained in place. Society does not gain or lose under this scenario.

Now consider the case when an inflated value of the quota  $(lmno)$  is used as the basis for compensation, where  $q_2$  is output rather than  $q_1$ .<sup>3</sup> There is a net producer gain of  $(lp_1 eo - enca)$ . Consumers are worse off under this compensation method as they

<sup>1</sup> As shown, this value of the quota is equal to the per-unit quota value  $(p_1 - p_2)$  multiplied by the given quota level  $(q_1)$ .

<sup>2</sup> When modeling the effects of removing a production quota, one could take the analysis a step further by accounting for changes that may occur at the end of the buyout (e.g., the restoration of competitive equilibrium). We do not specify this two-period model in the present research as our focus is to determine the potential economic impact on producers, consumers, and society during the buyout (Period I). Schmitz, Schmitz and Haynes (2012) account for these considerations.

<sup>3</sup> In the 2004 U.S. Tobacco Buyout, the money paid to quota owners (i.e., producers and landowners who rented land to producers) was generated from a tobacco tax. The net gain to quota owners from the buyout was far less than the tax revenue. In addition, the net gain depended on several factors, including the quota value used as the basis for the buyout.

lose  $(lp_1 ao)$ . There is also an increasing loss to efficiency  $(onca)$ .

2.2.2. Benefit-cost ratios. We now discuss the above theory within the context of benefit-cost analysis. The basic B/C formula is:

$$BCR = \frac{\text{Benefits}}{\text{Costs}} \tag{1}$$

The following ratio includes the economic impact of the buyout on producers (PI) and domestic consumers:

$$BCR_{(PI \text{ and } DCI)} = \frac{[(lp_1 eo) - (enca)]}{(lp_1 rf)} \tag{2}$$

However, equation (2) does not account for the impact of removing the tobacco program on externalities. How can we deal with litter externalities in our model? Consider Figure 2 where the average cost of firms cleaning up litter is  $AC$ . The amount of tobacco product litter produced is  $q_1$  (note: there is no demand curve for litter).

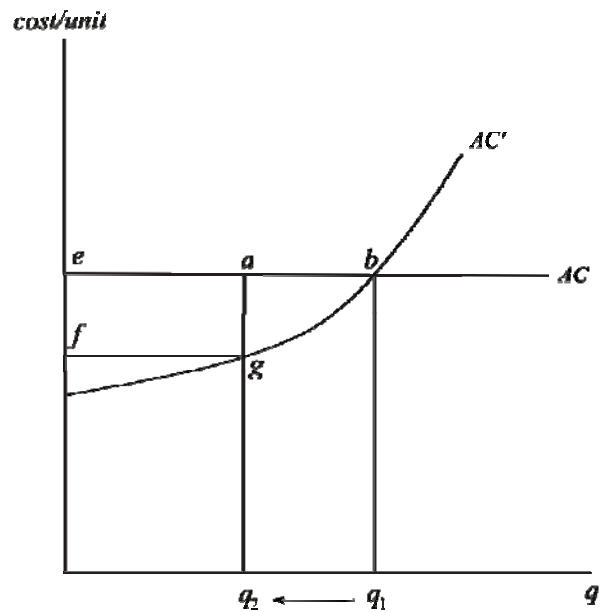


Fig. 2. Theoretical reduction in TPL clean-up costs

In light of a consumer tax funded production quota buyout that both increases the price of, and reduces demand for tobacco products, a reduction in smoking causes TPL to decrease to the amount  $q_2$ . The gross savings from a reduction in cigarette smoking  $(GS)$  is  $(aq_2 q_1 b)$ . Given this consideration, the new BCR is:

$$BCR_{(PI, DCI, GS)} = \frac{\{[(lp_1 eo) - (enca)] + (aq_2 q_1 b)\}}{(lp_1 rf)} \tag{3}$$

Suppose instead that the waste clean-up industry's average cost is  $AC'$ . In this case, firms lose  $(efgb)$ , but society gains  $(efgbq_2 q_1 b)$ . Given these inclusions  $(NE)$ , the new B/C ratio is:

$$BCR_{(PI, DCI, NE)} = \frac{\{[(p_1eo) - (enca)] + (efgq_2q_1b)\}}{[(p_1rf) + (efgb)]} \quad (4)$$

The areas in these BCRs represent yearly theoretical gains and losses to producers and consumers due to the implementation of a production quota buyout where compensation to producers for the loss of the quota program is funded by a consumer tax. In application, depending on the duration of the buyout being modeled, there may be more than one year to consider. In the case of the U.S. Tobacco Buyout, since payments to producers were made in equal instalments for 10 years, we provide present value calculations over a 10 year period.

As a caveat, Schmitz, Kennedy and Hill-Gabriel (2013) develop the notion of an environmental equivalent which is the dollar amount of environmental benefits needed from a given project to generate benefits that are as great as or greater than the costs. In the present study, we explore this concept with reference to the U.S. Tobacco Buyout.

### 3. Results

Schmitz et al. (2013) calculated the producer and consumer (domestic), effects of the U.S. Tobacco Buyout to be \$201.9 million and \$162.1 million, per year, respectively. We further this analysis to also include present value calculations (Table 1).

Table 1. Economic impact over 10 year U.S. Tobacco Buyout

Impact	Area	Dollars/Year (Millions)	Present value in millions (5%, 10 years)
Producer gain	$[(p_1eo) - enca]$	201.9	1,558.8
Domestic consumer loss	$(p_1rf)$	-162.1	-1,251.5
Foreign consumer loss	$(f_1rao)$	-130.4	-1,007.0
Total consumer loss	$(p_1ao)$	-292.5	-2,258.5
Domestic societal gain	$[(p_1eo) - enca] - (p_1rf)$	39.8	307.1
Societal Loss (domestic and foreign)	$[(p_1eo) - enca] - (p_1ao)$	-90.6	-699.7

Source: Authors' calculations.

Schultz et al. (2009) estimate that 40% of litter is from tobacco products. This amounts to \$4.6 billion in TPL clean-up costs per year. Assuming, for an example, that after the buyout legislation passed, smoking decreased, and litter clean-up costs attributable to tobacco products decreased by 5%, there would be a \$230 million savings in clean-up costs per year based on Figure 2. Table 2 provides estimates on TPL reduction and accompanying savings in clean-up costs. They range from \$3.47 billion to \$4.26 billion.

Table 2. Reduction in both tobacco product litter and clean-up costs\*

Percentage reduction in TPL	Total pieces per year (billions)	Clean-up costs (\$ billions)	Clean-up costs (\$/piece)
0	20.40	4.60	0.23
5	19.38	4.26	0.22
10	18.36	3.86	0.21
15	17.34	3.47	0.20

Notes: \*Given an average cost elasticity of 2.05. Source: Author calculations.

Table 3 (based on Figure 2) includes the environmental impact of the tobacco buyout under two different average industry cost elasticities (2.05 and 0.72)<sup>1</sup>. The more elastic the average cost curve, the smaller the societal gain; however, the larger the net benefit. While the societal gains are larger under a more inelastic cost curve, so are the gross costs.

Table 3. Environmental impact of tobacco buyout (given 5% reduction in smoking)\*

Impact	Area	Dollars/Year (millions)
AC = ∞		
Gross benefit (AC)	$(aq_2q_1b)$	230.0
Gross cost (AC)	$(aq_2q_1b)$	230.0
Net benefit (AC)	N/A	0
AC' = 0.72		
Societal gain (AC')	$(efgq_2q_1b)$	530.2
Gross cost (AC')	$(efgb)$	308.1
Net benefit (AC')	$(gq_2q_1)$	222.1
AC' = 2.05		
Societal gain (AC')	$(efgq_2q_1b)$	336.4
Gross cost (AC')	$(efgb)$	109.2
Net benefit (AC')	$(gq_2q_1)$	227.2

Source: Calculated.

Notes: \*Where the areas correspond to those in Figure 2 and the average cost elasticity is 2.05.

**3.1. Benefit cost ratio results.** We calculate the associated benefit-cost ratios given equations (2) through (4) above (Table 4). The inclusion of environmental externalities has the effect of doubling the BCR.

Table 4. Benefit-cost ratios: with and without tobacco externalities

Equation	Description*	Benefit-cost ratio
1	N/A	N/A
2	PI and DCI	1.25
3	PI, DCI, and GS	2.66
4	PI, DCI, and NE	1.58

Source: Calculated.

Notes: \*Where PI is producer impact, DCI is domestic consumer impact, GS is gross savings, and NE is net effects. These BCRs are associated with an average cost curve elasticity of 2.05.

<sup>1</sup> As in the theoretical section AC represents a constant average cost curve and AC' represents a dynamic average cost curve.

With reference to environmental equivalents, note that the BCR from the tobacco buyout is positive, even without accounting for externalities. Therefore, the calculation of an environmental equivalent is not necessary in this case.

## Conclusions

This research examines the perpetually overlooked gap between the U.S. Tobacco Buyout and tobacco product litter. In a partial equilibrium framework,

there are welfare losses to consumers of tobacco products and society due to the consumer-tax funded buyout. However, in a general equilibrium framework, used here, these losses can be overshadowed by the potential gains to society from a reduction in smoking – one of which is the reduction in TPL. When environmental externalities are incorporated into the analysis, the benefit-cost ratio associated with the Tobacco Buyout more than doubles from 1.25 to 2.66.

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