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Journal of Agricultural and Applied Economics, 45,3(August 2013):411–419
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The U.S. Tobacco Buyout: A Partial and General Equilibrium Analysis

Andrew Schmitz, D.J. Haynes, Troy G. Schmitz, and Evan D. Schmitz

This article analyzes the impact of removing the U.S. tobacco program in both a partial and general welfare economics framework. In a partial-equilibrium framework, a consumer tax-funded quota buyout can result in producer gains, consumer losses, net losses resulting from higher prices, and deadweight losses. In a general-equilibrium framework, society can gain from the buyout resulting from considerable potential savings from reduced healthcare costs attributable to a reduction in smoking. Additionally, we present a model that addresses the addictive qualities of tobacco while considering the effects of the quota buyout. We also conclude that another possible effect of the buyout is an increase in worker productivity because employees who are able to quit smoking reduce the amount of smoking-related sick days taken.

Key Words: addiction, general equilibrium, healthcare costs, production quotas, tobacco, welfare economics

JEL Classifications: I10, J20, Q00, Q11, Q18

Since 1938, the Agricultural Adjustment Act (in particular, the federal tobacco program) has limited the tobacco supply through production controls as a means to raise and stabilize the domestic tobacco price. Through the years, the Federal tobacco program received criticisms, especially from health advocates, partly because of growing health concerns about smoking. In the late 1990s, several costly lawsuits were brought against tobacco companies. These lawsuits produced court settlements that included the limitation of cigarette advertising as well as an agreement for the tobacco industry to pay states in excess of $200 billion over 25 years (Brown, Snell, and Tiller, 1999).

In January 1998, the "Core Principles of Agreement between the Public Health Community and the Tobacco Producer Community" (produced by both health advocates and tobacco producers) was signed by nearly 100 organizations, including the American Cancer Society, the American Heart Association, the Burley Stabilization Corporation, the Burley Tobacco Growers Cooperation, Inc., and the Flue-Cured Tobacco Stabilization Corporation (Schmitz et al., 2010). This document was designed to examine ways to reduce diseases caused by tobacco products (by effectively regulating tobacco production) and to aid the future prosperity and stability of the American tobacco farmer.

In 2003, tobacco buyout legislation was proposed in both the U.S. House and Senate. At approximately the same time, legislation proposing Food and Drug Administration (FDA) regulation of the cigarette industry was introduced

Andrew Schmitz is the Ben Hill Griffin Jr. Eminent Scholar and professor in the Department of Food and Resource Economics at the University of Florida, Gainesville, Florida. D.J. Haynes is a former graduate student in the Department of Food and Resource Economics at the University of Florida, Gainesville, Florida. Troy G. Schmitz is an associate professor in the Morrison School of Agribusiness and Resource Management at Arizona State University, Mesa, Arizona. Evan D. Schmitz is a pulmonologist, Richland, Washington.

in the Senate. The effort to approve both the FDA regulation of cigarettes and a tobacco buyout stalled in October 2003 when some health advocates rejected the version of FDA regulation offered in the House Bill. Health advocates not only wanted FDA regulation of cigarettes, but also continued federal oversight and regulation of tobacco production.

On October 22, 2004, President George W. Bush signed into law H.R. 4520 (the American Jobs Creation Act). Among the provisions was "The Fair and Equitable Tobacco Reform Act of 2004," which terminated the 66-year-old federal tobacco program and provided compensation to owners of tobacco quotas (possession of which required marketing tobacco at the support price under the program) and to tobacco producers. Ending the tobacco program effectively deregulated U.S. tobacco production and prices, which had been constrained by acreage allotments, marketing quotas, and price supports since the 1930s.

The passage in 2004 of "The Fair and Equitable Tobacco Reform Act" is viewed by some as a substantial defeat for health advocates because H.R. 4520 not only lacked provisions for FDA regulation of cigarettes, but it also eliminated regulation of tobacco production and marketing (Brown, Rucker, and Thurman, 2007).

A primary concern of legislators from the tobacco states, who generally supported termination of the tobacco program, was obtaining compensation for quota owners and tobacco growers. To move the legislation forward, they were willing to ally themselves with health advocates in supporting FDA regulation of cigarette manufacturing and marketing. Those nontobacco-state legislators who were opposed to increased government regulation of the cigarette industry generally also endorsed terminating the tobacco program and providing compensation to tobacco quota owners and growers. Cigarette manufacturers generally were opposed to FDA regulation of their activities and were in favor of terminating the tobacco program.

This article presents a benefit–cost analysis of the termination of the U.S. tobacco program. In addition, negative externalities associated with smoking are integrated into the analysis. The results show clearly that cutting back on the demand for tobacco products through many factors such as ending the tobacco program can generate large societal benefits. However, if the negative externalities are not taken into account, cases arise in which the costs of eliminating and/or reducing tobacco consumption can exceed the accompanying benefits.

Theory

The focus is the impact of the U.S. tobacco program on tobacco users. Consider Figure 1, where S is the producer supply schedule and D_t is the total derived demand for tobacco. The competitive price and output are p_0 and q_0, respectively.

Now consider the effect of a production quota that restricts quantity to q_1 (Just, Hueth, and Schmitz, 2004). The price rises to p_1 and producers gain $[(p_1p_0da) - (dcb)]$, whereas consumers lose, measured by the area under the derived demand curve, (p_1p_0ba). The true value of the quota for quota owners is (p_1p_2ca) and the deadweight loss of introducing the quota is (acb).

Figure 1 also depicts a theoretical, consumer tax-funded production quota buyout where a true value of the quota is (p_1p_2ca) and

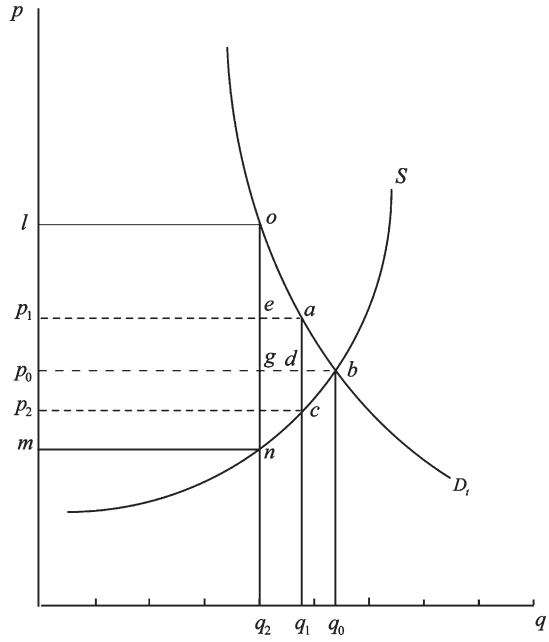

Figure 1. Theoretical Quota Implementation and Removal

an inflated value of the quota used for the buyout is $(lmno)$.[1]

Consider now the effect when the production quota is removed. If the buyout exactly equaled the true value of the quota through a tobacco tax, quota owners would have neither reason nor incentive to support the buyout. This is because their net gain would be zero over the time period when the tax would be in place to pay for the buyout. After that period, the net gain to producers falls because prices are no longer supported. The net effect of the buyout on quota owners and consumers from a consumption tax is zero until the competitive equilibrium is restored (Schmitz, Schmitz, and Haynes, 2012).

When the production buyout occurs under an inflated value of the quota, the consumer tax is put into place and this causes the consumer price to rise to l, whereas the producer price falls to m. Under the inflated quota case, producers gain an amount $[(lp_1eo) - (enca)]$ and consumers lose (lp_1ao). These gains and losses are incurred per year, every year that the tax/buyout is in place. It is important to note that the deadweight loss increases from (acb) to (onb) as a result of the quota buyout. When competitive equilibrium is restored at the end of the compensation period, immediately producers lose $[-(lp_0go) + (gnb)]$, consumers gain (lp_0bo), and the deadweight loss is eliminated.

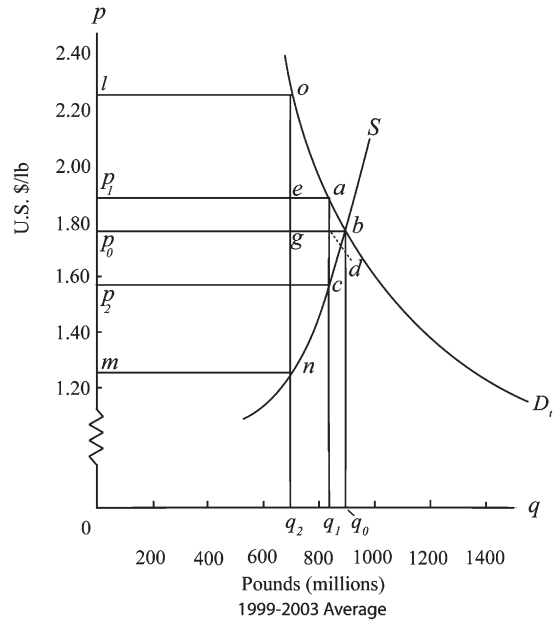

Figure 2. $1.00/lb. Quota Buyout

The Consumer Tax Buyout Effect

Partial Equilibrium

Within this framework, we can determine empirically the effect of the tobacco buyout on consumers and producers. Consider Figure 2, in which a $1.00/lb. quota buyout is depicted.[2] The net producer gain from removing the quota is $202 million per year (Table 1). The total net consumer loss from removing the quota is $292 million per year (Table 1). Therefore, given a present value calculation (with a 5% discount rate), over the 10-year compensation period, producers gain $1.3 billion and consumers lose $2.3 billion. Given these gains and losses, the benefit–cost ratio for this period is 0.70. On the culmination of the 10-year buyout, when competitive equilibrium is restored, producers immediately lose $295 million, because the consumer tax is no longer in place. Meanwhile, consumers gain $390 million in the absence of the tax (Table 2). In this case, the benefit–cost ratio at this point in time is 1.32.

Declining Demand Conditions and General Equilibrium

Although the previously described model assumes a demand schedule for tobacco at the time of the buyout, the demand for tobacco products has actually fallen sharply since that time. According to Brown and Snell (2012): "With large increases in both federal and state excise taxes late last decade, U.S. cigarette consumption had declined from 4–8% per year from 2007–2010 ... According to the Centers for Disease Control cigarette consumption in 2011 was 292.7 billion cigarettes, down from 435.6 billion in 2000."

[1] Through effective lobbying, quota values can be manipulated or inflated so as to improve the compensation to producers and quota holders.

[2] Like with the theoretical case, there is no distinction made between foreign and domestic consumers. Therefore, the consumer results are likely overstated.

Consider the U.S. tobacco production quota buyout under falling demand conditions. As time moves forward, the demand for tobacco shifts left as less tobacco is consumed. Importantly, this results in a loss in consumer surplus from the decreasing demand when measured only in the tobacco market.

In a general equilibrium framework, however, at least part of the consumer surplus losses that occur during a buyout can be attributed to both a change in preferences away from tobacco and a change in relative prices that favors nontobacco product consumption. As we show subsequently, the losses measured in the tobacco market are overstated. Under this scenario there could be subsequent impacts in additional markets (e.g., healthcare costs decrease because fewer people are smoking for reasons including higher prices for tobacco products).[3]

Consider Figure 3A in which at price p_1 the quantity demanded of tobacco is q_1 and consumer surplus is (ap_1d). If demand shifts to D', quantity demanded falls to q_2 for price p_1. The loss in consumer welfare is $(abcd)$. Note that the expenditure on tobacco has been reduced by $(cefd)$. Given a general equilibrium framework, as an example, consider a potential change in tastes and preferences wherein consumers transfer the would-be expenditure on tobacco $(cedf)$ to another market (organic food). In Figure 3B the price and quantity of organic food are p_1 and q_1, respectively, with the tobacco demand of D. Now, if $(cefd)$ from Figure 3A is spent on organic food and we set $(cefd)$ equal to $(p_2p_1hq_1q_2i)$ in Figure 3B, price rises to p_2 and consumption rises to q_2. There is a gain in consumer welfare of $[(kp_2i) - (jp_1h)]$, which is positive, plus a producer gain of (p_2p_1hi). Thus, the impact of reducing smoking is:

$$[(kp_2i) - (jp_1h)] + (p_2p_1hi) - (abcd) + (\textit{savings in health costs from reduced tobacco consumption}).$$

Table 1. Economic Gains and Losses under an Inflated Quota Buyout of 1.00/lb (with a true quota value of \$0.30/lb.)[4]

Component	Area	1999–2003 Average (U.S. million dollars)
Inflated value of quota	$lmno$	700
Net producer gain	$(lp_1eo - enca)$	201.9
Consumer loss	lp_1ao	292.5
Deadweight loss	onb	95.0
$E_{DT} = -1.1$, $E_S = 0.7$		

Demand for Tobacco and Addiction

An important consideration regarding the demand for tobacco overtime is the fact that it is an addictive good. This addictive property somewhat complicates the analysis of the quota buyout; in fact, Weimer, Vining, and Thomas (2009) acknowledge this and state that "The valuation of changes in consumption of addictive goods resulting from policy interventions presents a challenge for cost-benefit analysts." Although the demand for tobacco has been

Table 2. Economic Gains and Losses on Culmination of Inflated Quota Buyout (\$1.00/lb. quota buyout value)

Component	Area	1999–2003 Average (U.S. million dollars)
Net producer loss	$[(lp_0go) - (gnb)]$	294.55
Consumer gain	lp_0bo	389.55
$E_{DT} = -1.1$, $E_S = 0.7$		

[3] There is a very interesting twist to this analysis because of the negative health effects from smoking. In these models, when competitive equilibrium is restored at the end of the buyout, it is assumed that a price decrease in tobacco (and subsequently cigarettes) results in a gain to consumers. However, health advocates argue that the tobacco program originally generated gains to consumers by keeping tobacco prices high, thereby reducing the demand for tobacco. Using their argument, the tobacco program results in net societal gains because both producers and consumers gain from tobacco-production quotas. Conversely, under the same logic, the tobacco quota buyout results in a loss to both producers and consumers as producers no longer have prices supported by the quota and consumers increase consumption as a result of lower prices.

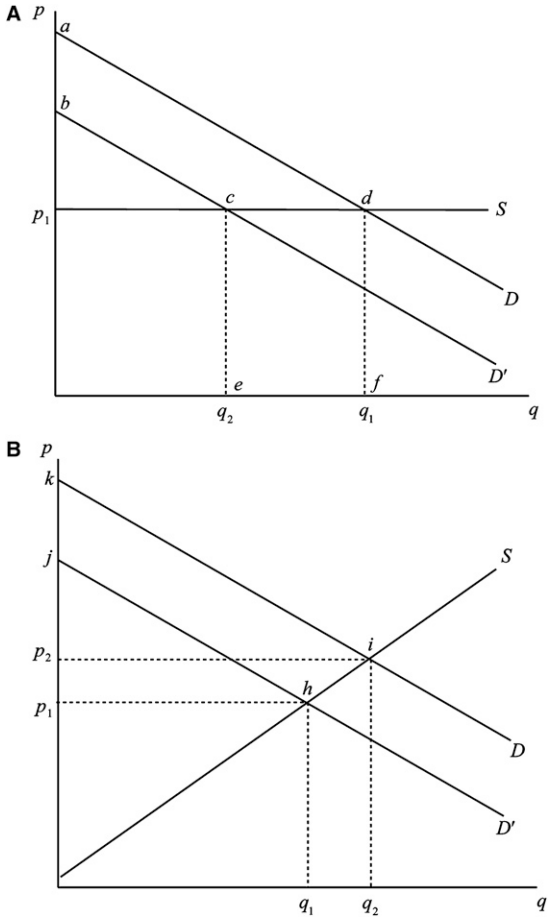

Figure 3. (A) Demand for Tobacco, (B) Demand for Organic Food

falling since the tobacco buyout (mostly as a result of rising federal and state taxes, which subsequently raise prices), there are a certain number of consumers whose demand is not likely to be affected by higher prices as a result of their addiction.

According to the Centers for Disease Control and Prevention (CDC), over 50% of smokers have tried to quit at least once and failed (Tirrell, 2012). Understandably, it is important to try to include addiction into the demand for cigarettes. Figure 4 depicts a theoretical model where D_A is the addicted demand schedule, D_N is the nonaddicted demand schedule, and D_T is the total demand schedule (summed horizontally). In the case of a consumer-tax buyout, because of consumer price increases, the nonaddicted smokers eventually leave the market

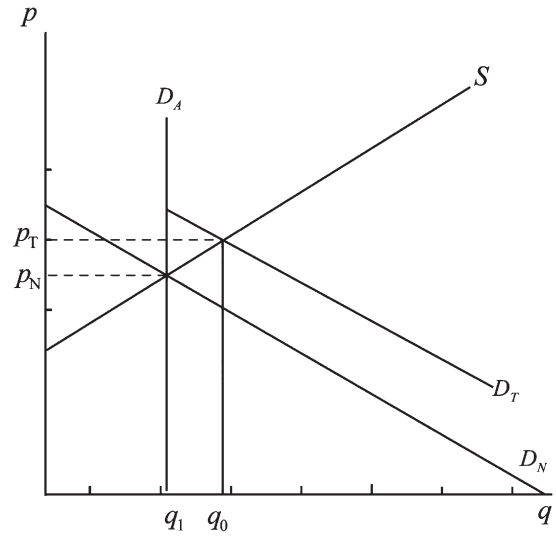

Figure 4. Theoretical Model for Demand of Addictive Good

(reducing societal healthcare costs). If the remaining smokers are truly addicted, facing demand $D_A D_N$, their consumption of cigarettes is not affected by the high taxes and/or price of cigarettes. These trends continue until there are only addicted smokers left in the market and healthcare costs can no longer be reduced.

An issue with the demand for a harmful and addictive good is that of utility. More specifically, Gruber (2003/2004) states that "With respect to smoking, people may recognize that smoking provides them with utility (benefits) in the current time period, but that they will experience some disutility (such as impaired health) in some future time periods."

Taken a step further, future impaired health is not only a disutility to the individual; it is also a disutility to society, especially regarding healthcare costs. This ties right into the next section on healthcare costs associated with smoking.

Negative Externalities from Smoking: Review of Articles

In Appendix A, we discuss the effect of smoking on worker productivity. Annual costs resulting from smoking-related absences total $97 billion (Centers for Disease Control and Prevention, 2008). In Appendix B, we examine healthcare expenditures in relation to cigarette

consumption. Annual healthcare costs attributable to smoking total $96 billion (Centers for Disease Control and Prevention, 2008).

Cigarette smoking is the primary risk factor for the development of chronic obstructive pulmonary disease (COPD) in the United States. COPD is the third leading cause of death in America, claiming the lives of 124,477 people in 2007 (Centers for Disease Control and Prevention, 2010). Approximately 85–90% of COPD deaths are caused by smoking (Centers for Disease Control and Prevention, 2004). Cigarette smoking and exposure to tobacco smoke are associated with premature death from chronic disease and account for at least 30% of all cancer deaths and early cardiovascular disease and deaths (Centers for Disease Control and Prevention, 2004). Between 2000 and 2004 an estimated 443,000 persons in the United States died prematurely each year as a result of smoking or exposure to secondhand smoke (Centers for Disease Control and Prevention, 2005).

Secondhand smoke exposure predicted COPD and other tobacco-related mortality in a 17-year cohort study in China. The study followed 910 subjects that were exposed to secondhand smoke at home or at work, of which 249 died as a result of coronary heart disease, lung cancer, COPD, or ischemic stroke. The authors concluded that there is evidence supporting that secondhand smoke causes COPD and ischemic stroke (He et al., 2012).

According to the CDC, in 2009, the incidence of lung cancer in the United States was 205,974 and the number of deaths was 158,081 (Centers for Disease Control and Prevention, 2013). Lung cancer deaths surpass colon, breast, and prostate cancer combined (American Cancer Society, 2012). The lung cancer 5-year survival rate is 16.3% compared with colon, breast, and prostate cancer at 65.2%, 90%, and 99.9%, respectively (Howlader et al., 2012). Active smoking is responsible for approximately 90% of lung cancer cases (Alberg and Samet, 2003).

In a major ruling (November 27, 2012), Federal Judge Gladys Kessler ordered that major tobacco companies must (1) say that they have deliberately deceived smokers; (2) tell the public the truth regarding the dangers of smoking; and (3) inform the public that smoking kills more people than murder, car crashes, drug abuse, and AIDS combined (USA Today.com, 2012). In 1999, a large class action suit was launched against the tobacco companies and a settlement occurred. The Master Settlement Agreement awarded: (1) $206 billion to the states spread out over 25 years; (2) $1.5 billion over ten years to support state antismoking measures; and (3) $250 million to fund research into reducing youth smoking; banned the use of cartoon characters in tobacco marketing; and dissolved of tobacco trade organizations (Jones, 2010).

He et al. (2012) reported that "a frank and graphic nationwide media campaign to motivate smokers to quit seems to be working." A key component of the campaign called "Tips from Former Smokers" began airing in March 2012. The advertisements are broadcast on virtually every form of media from newspapers to the Internet. The most extreme part of the campaign are TV commercials wherein "a dozen or so ex-smokers offered very personal and often harrowing testimonials on the devastating health consequences that can result from years of tobacco use."

HealthDay.com (2012) reports on new estimates from the U.S. Congressional Budget Office (CBO) that "a 50-cent increase in the

[4] Previous work has provided demand elasticity estimates for tobacco between –0.3 and −0.5 (Chan and Capehart, 2004; Sloan et al., 2003). Total demand elasticity estimates for U.S. burley and flue-cured tobacco are −0.53 and –1.75, respectively, according to Brown, Snell, and Tiller (1999). Serletis and Fetzer (2008) estimate demand elasticities for flue-cured ranging from−0.72 to −1.24 and demand elasticities for burley ranging from −0.03 to −0.11. Weimer, Vining, and Thomas (2009) provide price elasticities of between –0.09 and –0.34. Goodwin and Sumner (1990) estimate the aggregate supply elasticity under the tobacco program to be approximately 4.0, whereas Fulginiti and Perrin (1993) estimate the supply price elasticity to be 7.0. In view of the wide range of price elasticities, we derived both the total demand elasticity (E_{DT}) and supply elasticity (E_S) used in Tables 1 and 2. In the case of addicted demand (almost perfectly inelastic demand), producer gains would likely exceed the estimates provided in Table 1. Likewise, consumer losses would also be greater under addicted demand conditions.

U.S. tax on cigarettes could have a big impact on public health, though the benefits for the national wallet are less clear." The CBO reports that the increase, from the current federal tax of $1.01, "could result in more than three million more nonsmokers by 2085—by either spurring people to quit or keeping would-be smokers from ever lighting up."

Investigators analyzed data on more than 47,000 patients who had undergone colorectal resection resulting from cancer, inflammatory bowel disease, or diverticular disease (Sharma et al., 2012). The researchers found that smokers faced a 30% higher likelihood of experiencing some type of major complication in the first 30 days after surgery compared with those who had never smoked. The investigators also found that smokers were more likely to die within that 30-day period than patients who had never smoked.

Conclusions

The end of the U.S. tobacco production quota program (paid for by a consumer tax) had a significant negative impact on the consumers of tobacco products. This may have been slightly offset by the fact that some consumers could have become better off because the higher prices persuaded them to give up smoking and find healthier substitutes. Within this context, addiction plays a role, because those who truly could not quit smoking paid even more to continue smoking. Importantly, the tobacco buyout led to a decrease in society's smoking-related healthcare costs as a result of the decrease in demand for tobacco. It also led to an increase in worker productivity because employees reduced the amount of smoking-related sick days taken. Of course, these two outcomes depend on what percentage of the smoking population was or was not truly addicted. Additional research would be necessary to determine the true impact that nonaddicted smokers had on reducing demand.

Further work on this subject might explore "healthcare-cost equivalents" borrowed from Schmitz, Kennedy, and Hill-Gabriel (2012) on environmental equivalents. If we compare our estimates on the consumer loss resulting from the U.S. tobacco buyout ($2.3 billion over 10 years) with the CDC's estimates of $193 billion per year in economic loss attributable to smoking, it is clear that the money saved in healthcare costs by even a slight reduction of smoking would heavily outweigh the consumer loss incurred resulting from higher tobacco prices. The benefit–cost ratios attached to programs aimed at reducing smoking can greatly exceed one when healthcare costs are taken into account.

One could also extend the benefit–cost analysis associated with smoking by including the environmental costs of removing cigarette butts from sidewalks and streets. Additionally, given that the most frequently littered items are cigarette butts—approximately 38% of all US roadway litter (Schultz et al., 2009), it would be interesting to examine how much of the tobacco product litter (TPL) could have been reduced by the U.S. Tobacco Buyout.

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Appendix A. Smoking and Worker Productivity

Each year there are at least $97 billion worth of productivity losses caused by smoking; unbelievably, this estimate does not even include the costs from smoking-caused disability during work lives, smoking-caused sick days, or smoking-caused productivity declines while on the job (Centers for Disease Control and Prevention, 2008). The only costs included were those estimated from productive work lives that were shortened by smoking-caused death. Additionally, a study done by Weng, Ali, and Leonardi-Bee (2012) concluded that quitting smoking seemed to reduce absenteeism in the workplace and, as a result, there were substantial cost-savings for employers.

Consider Figure A1, in which we examine the effect of quitting smoking on productivity of laborers. The supply of labor is denoted by S and the demand is denoted by D. Hourly wage is represented by W and quantity of hours worked is represented by Q. Once again, given a consumer tax funded buyout, we can assume that demand for cigarettes decreases. The effect on productivity is captured in a supply shift outward from S to S', where quitting has reduced health problems associated with smoking and thereby increased the amount of hours laborers can work from Q_1 to Q_2.

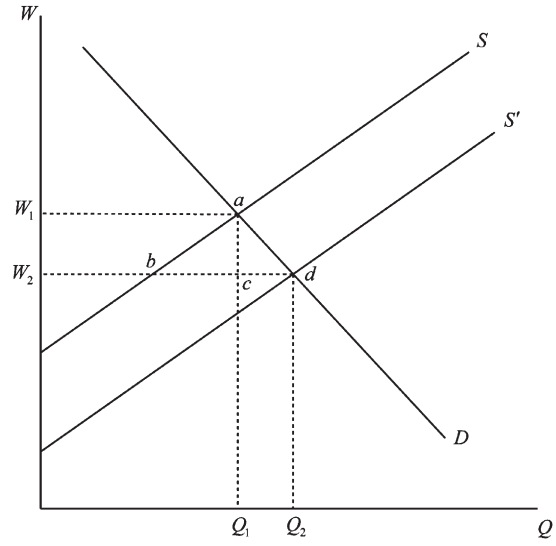

Figure A1. Labor Market Effect

Appendix B. Healthcare Costs

The following is a discussion of healthcare costs, recognizing that to some, they are likely to be controversial. Although the estimated costs from consuming tobacco are estimated as being large, one should keep in mind that there may be several major drawbacks from the various studies that have been done. The CDC (2008) report that during 2000–2004, cigarette smoking was responsible for $96 billion in direct medical costs (or roughly 4% of the healthcare costs in 2010). Consider Figure B1, in which we examine healthcare expenditures in relation to cigarette consumption. Healthcare expenditures are denoted by E and quantity of cigarettes consumed is denoted by Q. The supply of cigarettes is represented by S, whereas the initial demand for cigarettes is represented by D_0. In the event of a consumer tax-funded quota buyout, as the price rises, a reduction in the demand for cigarettes is captured in a shift from D_0 to D_1. The quantity demanded shifts from Q_1 to Q_2, and healthcare expenditures decreases from E_1 to E_2.

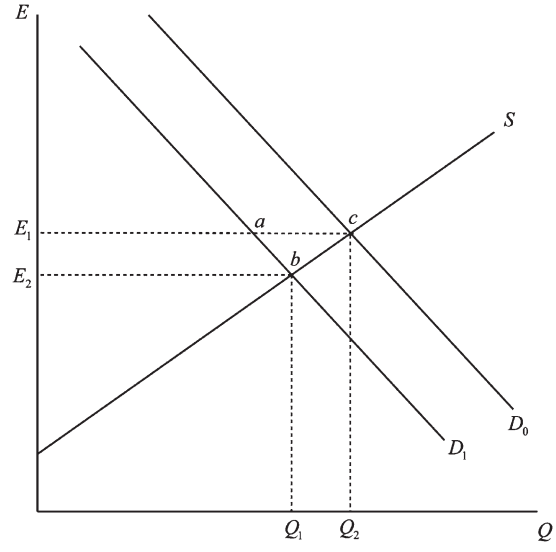

Figure B1. Healthcare Costs