Sweet Persuasion

Soft Drinks, School Funding, and Children's Health

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Short Abstract

"Pouring rights" contracts between soft drink companies and schools have created substantial controversy. Treating the issue as externality problem, we analyze the Pigouvian tax solution and propose a contract between the government and schools to provide an incentive compatible method for government to utilize the tax revenue.

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Introduction

"Pouring rights" contracts between soft drink companies and schools have become increasingly controversial (e.g., Brownell, 2003). Companies offer sweet persuasion — school soft drink contracts or "pouring rights" contracts — to schools because they see the immense buying power the children possess and know that they are tomorrow's adult consumers. Companies hope to inculcate brand loyalties in children and boost consumption by paying school districts and others for exclusive marketing agreements. The lure of such contracts to school administrators is strong, especially in the atmosphere of tight school funding that persists in many areas. As communities are more and more reluctant to raise taxes, schools see pouring rights contracts as a way to increase funding. According to the Center for Commercial-Free Public Education, by October 1999, 150 "pouring rights" contracts existed in at least 30 states. Texas Department of Agriculture (TDA) conducted a survey in 2003, the results showed that 53% of the surveyed school districts have exclusive vending contract and the total annual revenue reported from these vending contracts in Texas is estimated to be $54,180,182.

However, such contracts are not without controversy. The long-term relationships between schools and the companies vary according to the individual contract. But they mainly include: money up front or certain amounts of the school educational items companies "give" to the schools; and a percentage of proceeds from beverage sales on campus. These certainly greatly help schools to cure their "money illness" and may provide better education environment to the children. However, what are the costs involved? The contracts open the schools gates to vending machines, a la carte[1], and food and drink ads on school TV (Channel One) and school buses, etc. Without even considering the effect on children's health, the advertising campaigns have cost considerable amount of school time which may results in the loss of classroom

[1] Foods and drinks that are not part of the core school lunch or sold in vending machines.

productivity. Schools find themselves in a compromising position when the contracts set minimum sales figures and when the schools earn a percentage of what is sold. This leads in some cases to highly questionable behavior by school officials: school system may become a sales agent for the companies (DeGette).

Mounting researches showed that children's increased consumption of soft drinks is contributing to growing rates of obesity, diabetes, dental caries, and even osteoporosis (e.g. Jacobson, 1998; CDC, 2002; James et al., 2004). Jacobson showed that as teens have doubled or tripled their consumption of soft drinks, they cut their consumption of milk by more than 40%; teenage boys and girls who frequently drank soft drinks consumed about 20% less calcium than non-consumers. James et al. drew a link between lower rates of childhood obesity and schools' discouragement of soda consumption. The study showed that a yearlong 'ditch the fizz' campaign encouraging children to drink fewer sweetened and diet soft drinks resulted in a drop in the percentage of elementary school children who were overweight or obese. It even found that consuming just one less can a day had an impact.

Cullen et al. (2002) showed that children who consume more soft drinks take in more calories overall, are less likely to eat fruit, and have increased risk for obesity. A twelve-ounce Coke or Pepsi has more than nine teaspoons of sugar and the currently default serving size — twenty-ounce — contents fifteen teaspoons of sugar. According to USDA recommended diet guidelines, average teens just about hit their recommended sugar limits from soft drinks alone. With candy, cookies, cake, ice cream, and other sugary foods, most exceed those recommendations by a large margin (Jacobson). The study also showed that as teens have doubled or tripled their consumption of soft drinks, they cut their consumption of milk by more than 40%; teenage boys and girls who frequently drank soft drinks consumed about 20% less calcium than non-consumers.

Unbalanced nutrient intake will have negative impact on children's health and these will lead to huge burden to future medical care system. Now the estimated societal cost of the overweight and obesity issue is about $117 billion. This is comprised of $61 billion in direct costs (i.e., medical expenditures) and $56 billion in indirect costs (i.e., lost wages, disability, premature death) related to diet-related health outcomes or diseases such as diabetes, heart disease, and cancer (Food Review, p. 34).

Federal regulations have been trying to regulate this issue from very early on. The regulations implementing the statutory requirement on FMNV are found in Section 210.11 of the National School Lunch Program (NSLP) regulations and Section 220.12 of the School Breakfast Program (SBP) regulations, while the nutrition standards are provided in Section 210.10 of the NSLP regulations and Section 220.8 of the SBP regulations. In addition, some more specific national policies (such as USDA momentum "National School Lunch Program/School Breakfast Program: Foods of Minimal Nutritional Value", 2001) have been made to support efforts to improve the school nutrition environment by reemphasizing the requirements prohibiting serving foods of minimal nutritional value (FMNV) in the food service area during meal periods. The American Academy of Pediatrics (AAP) recommended in January, 2004, that soft drinks be eliminated from schools to help tackle the obesity epidemic.

However "pouring rights" contracts are still pacing their ways into schools and more specific and stricter legislation to prohibit the sale of soft drinks, candy, and high-fat snacks in schools typically receives strong opposition from schools. The TDA study estimated that Texas statewide food service operations potentially lose $60 million per year to competitive food sales.

The loss of federal meal reimbursement ($3.25 average per participating student per day) resulting from substituting colas and snacks for a school meal is not known, but the true net loss to school food service operations would be much higher. The soft drink and sugar lobbyists also fight such stricter legislations, aided by the National School Boards Association and the National Association of Secondary School Principals (Rothstein, 2002). Industry representatives call the legislative efforts to outlaw or limit school soda and snack sales misguided. Michael C. Burita, the communications director for the Center for Consumer Freedom (a nonprofit organization that represents restaurants and food companies), said, “The irony is that most of the money from these contracts helps pay for after-school programs and sports, things that arguably do more to prevent obesity than soda bans.” (Bowman, 2003).

Problem Description and Literature Review

As this on-going debate heats up, it calls for society actions. Brownell (2003) listed several proposed actions: eliminate soft drinks from schools (create environment that children only can make their choices from among healthy products); change prices (modify prices in ways that encourage the consumption of healthy beverages); create nutrition advisory councils in schools (develop intervention programs to weave nutrition education into school curriculum and provide specific help to obese children); and find creative ways to replace food and soft drink money.

In order to know the feasibility of the above proposed actions, we should be able to provide thorough research analysis. Many studies have investigated this issue from a medical perspective, providing scientific evidence of the negative health effects of these diets and the influence of advertising. However, no systematic analysis exists that takes into account the rational behavior of all economic agents: children, schools, soft drink companies, and society.

Also, the incentive compatibility of the government regulations and related monitoring feasibility are questionable. Besides the national policies, Arkansas enacted a school nutrition law in June, 2003, that prohibits access to vending machines in elementary schools and requires middle and high schools to restrict those sales to students until after lunch. Similar legislative proposals to ban or curtail soda and candy sales in schools have been introduced in at least 19 other states, according to the National Conference of State Legislatures (Bowman, 2003). However, the results are not effective as planed, "current federal regulations require snack and soft drink machines be turned off during school meal periods, but a number of schools do not comply and federal officials do not impose penalties," said spokeswoman Susan Acker of the USDA Food and Nutrition Service (ASBO AccentsOnline). The news reported that some schools even donate soft drinks to students at mealtime to get around the current regulation barring sales.

Three questions emerge naturally: What kind of problem is it in terms of economics analysis? How can we address this kind of problem using economic tools? How do we implement the tools in the real world where private incentives complicate matters? This paper tries to answer them.

First, in order to find the right economic tools to address the issue, we should be able to categorize it in terms of economics concepts. This paper looks at the issue as "externality" in the welfare analysis. According to Myles, there are two major categories of definition of "externality". The first defines it by its effects: an externality is present whenever some economic agent's welfare (utility or profit) includes real variables whose values are chosen by others without particular attention to the effect upon the welfare of the other agents they affect.

The second defines the externality by its existence and consequences: an externality is present whenever there is an insufficient incentive for a potential market to be created for some good and the non-existence of this market leads to a non-Pareto-optimal equilibrium. The schools and soft drink companies issue can fit well with either one of the definitions.

There are two ways to see the points. One way is that the pouring rights contracts between schools and companies link them together as a production unit which produces education quality to the society with the "production costs" of sacrificing certain extent of classroom productivity. Meanwhile, this unit also produces externality which is the negative health impact on the children by creating unhealthy food market on the campus. These negative children health impacts result in current and future medical care burdens on society and a series of social problems. So, if we see from the general way, there is an externality problem according to the first definition: representative student's utility is negatively affected by the contracting relationship between schools and companies.

Another way is to treat schools and companies separately and assume that schools are aware of the negative health impact.[2] However, the externality on children's health arises because there are not enough incentives (ways to alleviate schools financial pressure) for the schools to incorporate the health effects into the contract negotiation. It may be due to the fact that schools face huge unmet funding needs and society does not incorporate the health effects into schools ranking criteria either. This meets the second definition.

This paper will employ the common tool — Pigouvian taxes — on the campus soft drink sales as the way to internalize the externality. This may seem to fall into the mainstream modern welfare treatment with its origins in Pigou. But it is actually consistent with Coase analysis in

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[2] This is a reasonable assumption which has been stated by Schulte that school food service directors get stuck in a tug-of-war: they have desire to serve healthy foods to see children thrive; but the pressure from the schools to make money is huge.

this particular problem. Coase's works focus on the all-important concept of transaction costs as preventing certain trades which otherwise would be mutually beneficial if carried out (Dahlman). According Dahlman, 'in the presence of costly transaction costs, Coase analysis implies one of two corrective measures: (i) find out if there is a feasible way to decrease the costs of transacting between market agents through government action, or (ii), if that is not possible, the analysis would suggest employing taxes, legislative action, standards, prohibitions, agencies, or whatever else can be thought of that will achieve the allocation of resources we have already decided is preferred.' In this case, it leads to non-negligible costs for a third party to rationalize and quantify the negative health impact and incorporate it into the schools' side contract negotiation decision making. Simply passing laws to prohibit the contracts also may not be desirable (and has been the case in reality) because schools may suffer from financial crisis.

The Pigouvian tax rule requires the optimal tax to be set equal to marginal social damage and Pareto efficiency also requires recycling of the tax revenues in some way: either through utilizing the Pigouvian tax revenue to reduce distortions in the tax system[3] (Tullock); or through a lump sum household refunds when there are no other distorting taxes exist and if there is no need to collect taxes in order to finance public goods (Lange and Requate). This paper will examine the implications of utilizing the soft drink campus sales tax revenue. Because of the specific problem nature, we utilize the tax revenue to indirectly provide incentives for schools to promote nutrition education instead of cutting other distorting taxes. In other words, we assume the other distorting tax rates are independent of the Pigouvian tax rate.

Also, this paper will use incentive theory — so called principal-agent theory or contract theory — to design an incentive compatible contract between government and schools in order to

[3] Double dividend hypothesis: a tax on externalities can both improve the environment and reduce distortions in the tax system.

make sure the tax revenue redistribution plan will be carried out without moral hazard problem distortion. The central theme of the principal-agent theory is how the principal can best motivate the agent to perform as the principal would prefer, taking into account the difficulties in monitoring the agent's activities (Sappington). This paper will treat government as the principal with schools as the agent and government will have certain reward and punishment plan (contract) to make sure schools exert high effort to carry out nutrition education programs in schools following the theoretical contract design modeling presented by Laffont and Martimort.

Modeling

Defining the Externality on Its Effects

First, let us treat the school and company as an education production unit bounded by a "mutual beneficial" contract; treat representative household as a consumer (household child consumes the education which brings positive utility to the household). We treat this production unit as monopoly which faces downward sloping demand curve for education. So following the modeling structure and analysis used by Ebert and Hagen, we examine the tax effect under this imperfect competition.

By the same logic used by Ebert and Hagen, we assume the contracted education production unit is facing the following downward sloping demand: $P(X, E)$, where X is the amount of education produced by the contract relationship and E is the negative externality on the consumer — negative health impact on the representative student which bring negative utility to the household. $P(X, E)$ here represents soceity's willingness to pay for this contracted education provided and it can be the society's willingness to sacrifice in terms of social medical care costs. By the law of demand, $P_X (X, E)$ — the first derivative of the inverse demand function with respect to X — is negative, which means that as the contracted education amount increases the society's willingness to sacrifice becomes less and less. The production process also involves a production cost function $C(X, E)$ which is convex in X ($C_X > 0$, $C_{XX} > 0$). This is the costs in terms of loss of classroom productivity. For this specific problem, we have $C_E > 0$ in the sense that externality (negative health impact) increasing will result in increasing loss of classroom productivity due to the positive relationship between student's health and its academic performance. Given that society is aware that the negative externality is caused by the production of X, the amount of this sort of education product demanded will decrease with increasing externality ($X_E < 0$), which results in decreasing in the production costs by $C_X > 0$. Also, for a well-behaved cost function, marginal cost of E is always increasing ($C_{EE} > 0$). Because of the positive relationship between X, quantity demanded, and E produced, we have $C_{XE} > 0$ which means that the marginal cost of X is increasing in E.

For simplicity, we assume that the externality E has a linear relationship with campus soft drink sales, Q, such as $E = k * Q$. When government levies a unit tax rate t on the campus soft drink sales, it equals to levying ($k * t$) tax rate on the externality. Without loss of generality, we just let it equals to t, then the contracted education production unit faces the following profit maximizing problem

$$\underset{X,E}{Max}\,\Pi(X,E) = P(X,E)*X - C(X,E) - t*E$$

Taking the total derivatives on the first order conditions, we have:

$$\begin{pmatrix} (P_{XX}X + 2P_X - C_{XX}) & (P_{XE}X + P_E - C_{XE}) \\ (P_{EX}X + P_E - C_{EX}) & (P_{EE}X - C_{EE}) \end{pmatrix} \begin{pmatrix} dX \\ dE \end{pmatrix} = \begin{pmatrix} 0 \\ dt \end{pmatrix} \qquad (1).$$

From (1), we can get the impact of taxation on the production unit's behavior:

$$\begin{cases} \dfrac{dX}{dt} = -\dfrac{P_{XE}X + P_E - C_{XE}}{\det H} & (2) \\ \dfrac{dE}{dt} = \dfrac{P_{XX}X + 2P_X - C_{XX}}{\det H} & (3). \end{cases}$$

Assume we have interior solutions, the H denotes the Hessian which is negative definite ($\det H > 0$) and this implies that the numerator in (3) which is the main diagonal component of H should be negative. So we have (3) < 0. As we discussed before, C_{XE} is positive. Then the sign of (2) depends on P_{XE} and P_E. From $X_E < 0$ (X and E are substitutes to each other), we know that when E increases the demand curve for X will shift to the left and we get $P_E < 0$ (See Figure 1). Also, from Figure 1, we can see that the slope in point A's is smaller than the one in point B's (because of the negative sign in the slope), so we get $P_{XE} > 0$. Then the sign of (2) is indeterminate and depends on the trade off between $P_{XE}*X$ and $(P_E - C_{XE})$. So from the above analysis, we know that taxation will have negative impact on the externality amount and it is the Pigouvian taxation's goal.

From consumer's point of view, the representative household has the utility function $U(X,E)$ and it is concave in X ($U_X > 0$, $U_{XX} < 0$) and has increasing marginal damages ($U_E < 0$ and $U_{EE} < 0$). The social optimal tax rate will be derived from the social welfare maximization problem

$$\underset{X,E}{Max}\, W(X,E) = U(X,E) + \Pi(X,E) - \mathrm{T}(t,E)$$

$$= U(X,E) + P(X,E)*X - C(X,E) - t*E - r*t*E$$

where $T(t,E)$ is the taxes deadweight losses function with r the marginal social welfare cost of a dollar of government spending. According to Alston and Hurd, the range for r in United States is from 20% to 50%. Then we have the following F.O.C

$$\partial W / \partial E = U_E + P_E X - C_E - t - r*t = 0$$

which gives us

$$t^* = \frac{U_E + (P_E X - C_E)}{1+r} \qquad (4).$$

Equation (4) tells us that the social optimal tax rate will be depend on the social net benefit: the trade off between marginal damage of *E* and the marginal impact on the production unit's (monopolist's) net profits. This result is different from the competitive market case where optimal tax rate equals to marginal damage. The imperfect competition market structure adds one more level.

Defining Externality on Its Existence and Consequences

This definition fits better with this problem because there does exist obvious hinders for the schools to incorporate the negative health effect into contracting negotiation. From this definition point of view, we treat company and school separately to see the effect of taxation on the campus drink sale volume *q* and the socially optimal tax rate composition.

Company is the profit maximizer with net production net profit function $R(q,t)$[4] and the contract transfer function $K(q)$[5]. It faces the problem

$$\underset{q}{Max}\,\Pi(q;t) = R(q;t) - K(q).$$

F.O.C. gives us:

$$R_q(q;t) = K_q(q) \qquad (5).$$

School has the utility function $U\{B[K(q); G], C(q)\}$. Education net benefit function[6], $B[K(q); G]$, is a concave function in $K(q)$ and G, where G is the exogenous funding government allocated to

[4] Because most of the pouring rights contracts involve Coca or Pepsi and include exclusive terms, we can treat the company as monopoly who can influence market prices.
[5] It is the amount of funds given to schools condition on certain contracting causes. For example, it may take the following form: $K(q) = a + b*q$ if $q \geq \underline{q}$ and adv=adv(.), $K(q) = a$ if $q < \underline{q}$ and adv=adv(.), where $\underline{q}$ is the minimum sale requirement stated in the contract and adv(.) is the contracted advertising requirements.

school. Promotion cost function, $C(q)$, is a convex function in q and it is the costs of promoting contracted soft drink. School is maximizing its utility

$$\underset{q}{Max}\, U(q,G) = B[K(q);G] - C(q)\,.$$

It gives us the following F.O.C

$$K_q(q) = {C_q(q)}\big/{B_K} \qquad (6).$$

Then, (5) and (6) give us the private equilibrium condition

$$B_K R_q = C_q \qquad (7).$$

After taking total differentiation on (7), we have the marginal impact of tax rate t on the private optimal campus soft drink sale volume q.

$$dq\big/dt = -\frac{B_K R_{qt}}{B_{KK} K_q R_q + B_K R_{qq} - C_{qq}} \qquad (8).$$

As the above stated, B is an increasing function in K and concave in K, so $B_K > 0$ and $B_{KK} < 0$; Net production profit is concave in q so $R_{qq} < 0$ and convex education cost function leads to $C_{qq}>0$; The funding from companies is an increasing function of q ($K_q > 0$); Tax rate t increase the marginal cost so decrease the marginal net profit, $R_{qt} < 0$. So (8) < 0 which means that the campus sale taxation will have negative impact on the campus soft drink sales.

Social welfare maximization is the following

$$\underset{t,G}{Max}\, W = \Pi(t;q) + U(G;q) - H(q) - T(G,t;q)$$

$$= R(t;q) - K(q) + B[G;K(q)] - C(q) - H(q) - T(t,G;q)\,.$$

[6] It can be the standardized tests scores ranking et al.

The social welfare has one new term: $H(q)$ is the social medical care costs due to the contracts' negative health effect and it should be convex in q. This is where the negative externality comes into social decision making. And we can get the following F.O.C:

$$R_q q_t - K_q q_t + B_K K_q q_t - C_q q_t - H_q q_t - T_t - T_q q_t = 0$$

By putting (5) and (6) into the above F.O.C, we have the following:

$$H_q q_t + T_q q_t = -T_t \qquad (9)$$

This condition (9) gives us the social optimal tax rate t. LHS of (9) is the sum of social marginal benefit occurred due to the taxation: decreased marginal social medical care costs and the decreased indirect marginal tax distortion cost through soft drink sale volume decreasing. The RHS is the marginal tax distortion cost incurred due to taxation.

Tax Revenue Reutilization

Analyzing this issue using second definition of externality, schools lack of enough incentive for them to take account of the negative externality. By Pigouvian taxation, we can internalize the externality. Instead of using these additional tax revenues to correct other distortion taxes, we find a way to provide incentives for schools to promote healthy eating habit among students. This will bring extra improvement for the children's health and their future diet patterns. Schools can be motivated to cooperate with government intervention programs etc. so that nutrition education can be woven into the school curriculum.

However, which way is the better way to go? Directly incorporate $T(t) = t * q$ into G? Or design an incentive compatible contract between government and schools and using $T(t)$ as the funding source for the reward-punishment system?

Let us take a look at the first suggestion using the model from the second externality definition point of view. When government just collects tax revenue and redistributes it directly back into each school's government funding (G) amount, school's utility function will have some change because now G is not exogenous any more, it is a function of q which school can control q to some extent. School is maximizing

$$\underset{q}{Max}\, U(q,G) = B[K(q),G(q)] - C(q).$$

And the F.O.C becomes

$$K_q = \frac{C_q - B_G G_q}{B_K} \qquad (10).$$

Then (10) and (5) give us the following relationship:

$$B_K R_q + B_G G_q = C_q \qquad (11).$$

Figure 2 shows that because of direct redistribution, schools will have extra incentive to promote unhealthy beverages and they can get more funding both from companies and from government.

Then, what kind of indirect way is better to distribute this tax revenue? In order to give schools enough incentives to cooperate with government's nutrition intervention programs, we need an incentive compatible contract that induces the effort level the principal wants. Let us start from a simple modeling that we only consider discrete case where agent exert high effort $e = 1$ or low effort $e = 0$. Government (the principal) sets up a contract with school. If one school cooperates with government (exerts high effort $e = 1$), it will have the probability π_1 to have high healthy food consumption per student in the school ($\varphi = \overline{\varphi}$) and probability 1-$\pi_1$ to have low healthy food consumption per student ($\varphi = \underline{\varphi}$). If school exerts low effort ($e = 0$), probability to have $\overline{\varphi}$ is π_0 and it will have (1- π_0) probability to have $\underline{\varphi}$. And we assume $\pi_1 > \pi_0$ in the sense that when school try their best to promote nutrition education it is more likely the school will have high healthy food consumption pattern observed. And the government will give school a certain transfer $\tau(\varphi)$ based on the observed healthy food consumption per student in the school: $\bar{\tau} = \tau(\bar{\varphi})$ and $\underline{\tau} = \tau(\underline{\varphi})$ with $\bar{\tau} > \underline{\tau}$.

Principal has the following cost function: $V = S(\varphi) - \tau(\varphi)$, where $S(\varphi)$ is the transformation function that transfer healthy food consumption amount into health care costs saving amount. And define $\bar{S} = S(\bar{\varphi})$ and $\underline{S} = S(\underline{\varphi})$. So principal is a cost minimizer. School is a utility maximizer with utility function: $U = B(\tau) - \psi(e) = \theta\tau - \psi(e)$, where $\psi(e)$ is the disutility associated with exerting effort to promoting nutrition education and θ is the education production for the transfer amount. For simplicity, we normalize $\psi(e = 1) = \psi$ and $\psi(e = 0) = 0$. So the principal-agent problem can be modeled as the following:

$$\underset{\bar{\tau},\underline{\tau}}{Min}\, E(V) = \pi_1(\bar{S} - \bar{\tau}) + (1 - \pi_1)(\underline{S} - \underline{\tau})$$

s.t. $\pi_1 B(\bar{\tau}) + (1 - \pi_1)B(\underline{\tau}) - \psi \geq \underline{U}$ (12)

$\pi_1 B(\bar{\tau}) + (1 - \pi_1)B(\underline{\tau}) - \psi \geq \pi_0 B(\bar{\tau}) + (1 - \pi_0)B(\underline{\tau})$ (13).

Equation (12) and (13) are the two constraints to make this contract work: (12) is called individual rationality constraint which makes sure that participating this contract will make school at least be as well as its reservation utility $\underline{U}$, if not better off. The reservation utility can be calculated form the social maximization problem utilizing Pigouvian taxation without any reutilization of the tax revenue. For simplicity, we normalize the reservation utility $\underline{U}$ to 0 without loss of generality (Laffont and Martimort). (13) is the incentive compatibility constraint which makes sure that school will prefer exerting high effort to exerting low effort. This is the constraint that will lead to incentive compatible contract.

According to Laffont and Martimort, in this moral hazard problem, IRC and ICC will both bind. So, we can solve the problem to get the following results:

$$\bar{\tau} = \frac{1-\pi_0}{\theta\Delta\pi}\psi \quad (14)$$

$$\underline{\tau} = -\frac{\pi_0}{\theta\Delta\pi}\psi \quad (15).$$

Because we know π, $\Delta\pi$, θ and ψ are all positive, then $\bar{\tau} > 0$, $\underline{\tau} < 0$. It means that government will employ a reward-or-punish contract that reward the high healthy food consumption schools and punish those with low healthy food consumption per student.

Also, because government utilizes the additional tax revenue generated form the Pigouvian taxation, government should have one more constraint in the optimization problem:

$$\pi_1\bar{\tau} + (1-\pi_1)\underline{\tau} \le t^* q^* \quad (16).$$

where t^* and q^* are the social optimal tax rate and campus soft drink sales without tax reutilization. After substituting (14) and (15) results into the (16), we get the following

$$\psi \le \theta * (t^* * q^*) = B^* \quad (17).$$

This means that for the contract to work, we need to make sure the school's effort cost when it exerts high effort will not exceed its education benefit generated from the tax reutilization.

Conclusion

Children's health issue deserves the social attention. The long-term dependent relationship between soft drink companies and schools bring a lot of controversial debates. This paper tries to start from analyzing the simple models in order to explain the complex problem. From two different aspects of externality definition, this paper examines the relationship between tax rate and externality amount, the optimal tax rate composition. Also, to answer Brownell's calling for action, this paper employs incentive theory to come up with an incentive contract design to arm the government with another tool to motivate schools to join the against tide battle. Although it is just a simple contract modeling, it does capture the essence of the problem and give us a taste of what kind of criteria should be met in order to carry out the proposed action plan.

The future work will be developing advanced incentive modeling which treats government as the single principal and schools, companies as multiple agents with schools have multi-task situation. Schools as an agent will have to exert two efforts: one for promoting contracted brand drinks (including non-carbohydrate ones) on campus, one for implementing nutrition education program on campus. This common agency and multi-task problem has been studied by Martimort and Stole. However it needs more complicated modeling to fit it into this case. Also from the above modeling analysis, we know that if the tax reutilization is implemented, the children's health will be improved to some extent and this may alleviate the original externality problem and in turn it may result in lower tax rate than before. In order to capture this recursive impact, common agency game will be of great help.

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Appendix

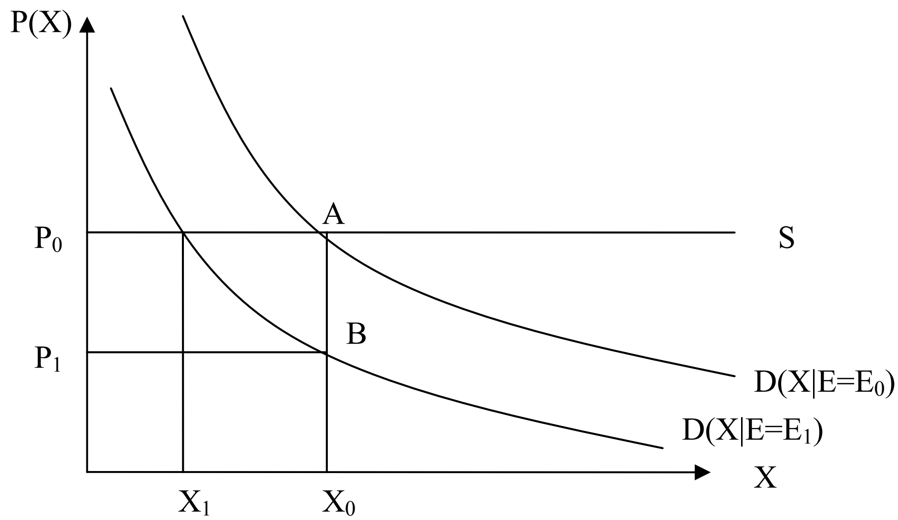

Figure 1: As externality level increases, demand for X decrease. [$P_E < 0$]

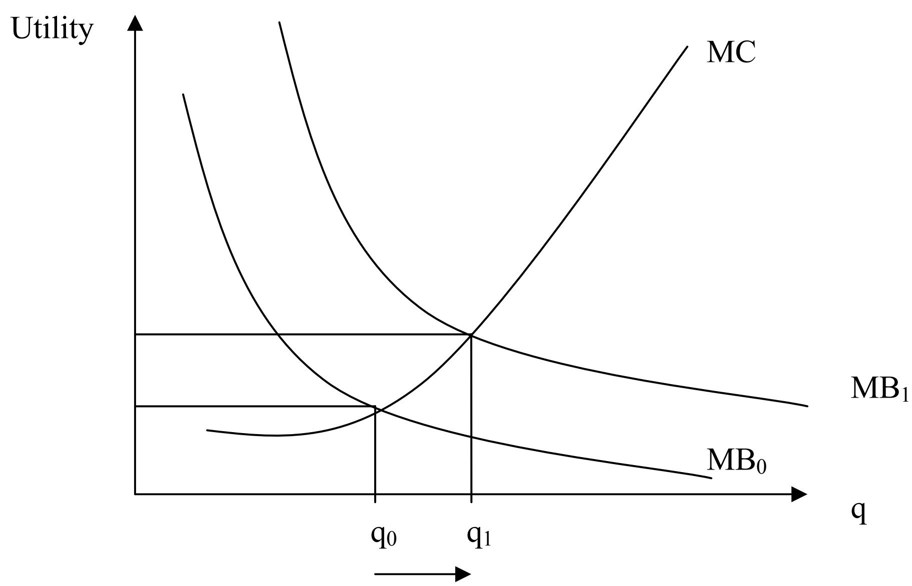

Figure 2: Directly distribute $T(t)$ back into G will result increasing q.