School of Economic Sciences

Working Paper Series
WP 2016-9

Corruption, Public Spending and Tobacco Use by Adolescents

Gregory I. Galinato
Yeon A Hong

April 15, 2016

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

Corruption, Public Spending and Tobacco Use by Adolescents

Abstract

This article investigates the link between corruption and tobacco use by adolescents. We theoretically model how corruption influences the policymaker to increase government spending that subsidize production by firms to the detriment of providing public goods such as education and health services, which leads to an increase in the consumption of addictive goods. We test our theoretical results using a two-equation system. The first equation estimates the effect of a corruption proxy on education and health spending per capita. The second equation measures the effect of education and health spending per capita, instrumented by our corruption proxy, on adolescent tobacco use in the United States. We find that less corruption increases the probability of never smoking and decreases the frequency of smoking but the results are more robust in the former than the latter. If California, the most corrupt state in our sample, reduced its corruption level to the same level as Delaware, the least corrupt state in our sample, the probability that an adolescent will never smoke increases by 4%.

Key words: Corruption; education and health spending; tobacco use

JEL Codes: D73, H51, H75, I18

I. Introduction

Reducing tobacco use in the United States is critically dependent on preventing tobacco use during adolescence because 90% of cigarette smokers first tried smoking by the age of 18 (USDHHS, 2012). Even though cigarette consumption by U.S. youths have decreased, the use of tobacco products such as electronic cigarettes and hookahs by middle school and high school students have increased from 2011 to 2014 (CDCP, 2015). If the smoking trend continues, 7% of Americans younger than 18 years old will die early from a smoking related illness (USDHHS, 2014).

A variety of social, environmental, genetic and mental health factors are direct determinants of tobacco use among adolescents. For instance, peer pressure, stress and depression, as well as a mother's smoking during pregnancy are important contributors to the decision of an individual to smoke (USDHHS, 2012). One important factor that can correct for this behavior is education and health programs. Health and community programs that counter advertise messages from tobacco advertisements or education programs that encourage tobacco free environments prevent youth tobacco use (USDHHS, 2012). Furthermore, education, in general, helps individuals understand how consumption of different types of goods affect their health outcome (Grossman, 1975).

The availability of such educational and health programs that reinforce the negative link between tobacco use and health are dependent on the allocation of funds. The policymaker who allocates funds to various services such as public infrastructure, education, health and business development may be influenced by lobby groups (Allcott et al., 2006). Lobby groups composed of business firms who are few but have more financial capital and common interests are likely to be more influential than those that are composed of regular citizens who are more dispersed and can have varying motives (Olson 1965). Lobby groups for businesses may be driven to obtain subsidies to increase their own production. A

policymaker more susceptible to corruption and influence is more likely to provide business lobby groups with such subsidies to the detriment of funding availability for other services such as education and health.

This article studies the effect of corruption on tobacco use by adolescents. First, we adapt a common agency model to show how corruption skews spending away from education and health services towards subsidies that benefit firms if business groups lobby to influence the government's spending decision. The reduction in education and health expenditure induces more consumption of an addictive good. Second, we test the theoretical linkages in our model by first estimating the effect of a corruption proxy variable on education and health spending per capita and then determine how tobacco use is affected by these spending variables instrumented by the corruption variable. This is the first study to theoretically link and empirically measure how corruption affects adolescents' tobacco use through public education and health expenditure. From a policy standpoint, we show that reducing corruption and influence of lobby groups not only increase economic welfare by providing optimal allocation of fiscal revenues but also show that it reduces an adolescent's decision to engage in tobacco use.

This article contributes to two branches of economic literature. First, we contribute to the literature on the effect of education and health programs on tobacco use. Education allows individuals to better understand the relationship between the type of health inputs they consume and their relationship to a health outcome (Grossman 1975). Strong correlations exist between education and health outcomes such as tobacco use (Van der Pol, 2011). When controlling for education using an instrument such as parental education, education also has a causal effect on reducing smoking participation (Kenkel et al., 2006; Nayga, 1998; Sander, 1995, 1998). State tobacco programs have also been shown to be effective in preventing tobacco use among youths (Ong et al. 2003; Pierce et al. 1998) though causality has not been

rigorously proven.

Several studies have relied on the use of national state expenditure data to examine the effect of tobacco programs on tobacco use. Higher state tobacco program expenditures are more likely to have less self-reported cases of smoking among adolescents (Taurus et al. 2005; Wakefield and Chaloupka, 2009) and college students (Ciecierski, 2011). Cumulative state tobacco program expenditures also seem to reduce smoking in young adults (Farrelly 2008). These studies show strong correlation in preventing smoking as well as the frequency of tobacco use. However, they do not show causality because they do not control for the endogeneity of spending. There may be a bi-causal relationship since more spending occurs in states that have higher prevalence of tobacco use. This study contributes to the literature by offering an instrument, a corruption proxy, which affects tobacco use only through spending of education and health programs. This instrument is identified from our theoretical model that hypothesizes how corruption affects spending composition in the state; which, in turn, affects adolescent tobacco use.

Second, we extend the literature on the effects of corruption on policy instruments. The literature classifies two types of corruption. Petty corruption involves payments to avoid the effects of legislated policies, while grand corruption is said to occur when associations act like special interest groups and attempt to influence policy by offering political support (Wilson and Damania 2005; World Bank 2000). Throughout the paper when we mention corruption, it refers to grand corruption.The seminal work by Grossman and Helpman (1994) highlighted the role of lobbying in distorting trade policies that benefited a particular lobby group. Import barriers are higher in countries where organized lobbying is more prevalent (Gawande and Bandyopadhyay, 2000; Goldberg and Maggi, 1999). Trade regulations are not the only policy distorted by lobbying. Damania et al. (2003) and Damania and Fredriksson (2003) find that lobbying affects the effectiveness of environmental policy. Countries that are

open to trade and foreign direct investment may choose more lax environmental regulations due to the effect of lobbying contributions. Campaign contributions also influence tax policy. Chirinko and Wilson (2010) show that for every $1 in campaign contributions, businesses derive a $4 gain from lower corporate taxes.

Lobby groups can also affect public spending of the government. Keefer and Khemani (2005) write that for the poor to obtain public services, their ability to organize and lobby the government is important. Liu and Mikesell (2014) empirically estimate the effect of corruption on different types of state expenditures to show that it has adverse effects on education and health services but can increase capital construction and public infrastructure. They employ a dynamic panel model that does not account for annual dummies, does not cluster standard errors, and assumes that such expenditures are stock variables and not flows. We add to the literature by providing a theoretical framework relating corruption to education and health spending and empirically estimates a model that accounts for state and year effects, clusters standard errors and treats annual expenditures as flows rather than stocks.

We adapt a common agency model where businesses organize lobby groups to obtain a larger share of state expenditures to the detriment of providing social services. The policymaker weighs lobbying contribution and aggregate social welfare when choosing the composition of public spending between businesses and social services. The policymaker's weight on political contribution is a measure of corruption. We show that a more corrupt policymaker will decrease spending on social services such as education and health programs to increase subsidies to businesses. By instrumenting spending with a corruption measure, we determine the causal extent to which it plays a role in affecting tobacco use in adolescents.

To test our theoretical results, we use individual level data on adolescent health choices and characteristics across states in the U.S. from 1993 to 2011 from the Youth Risk Behavior Surveillance System (YRBSS) and match them with state level education and

health spending data along with a proxy for state level corruption. Our corruption proxy measures the number of convicted public officials per state legislator. The measure of corruption is an instrument for education and health spending since corruption only affects tobacco use through public education and health spending and does not directly influence the demand for cigarettes by teenagers.

We find that corruption has a negative and significant effect on public education and health spending per capita indicating it is a strong instrument. Public education spending per capita decreases by $145 to $150 per capita for every 1 public official conviction per legislator. The instrumental variable estimates indicate that public education expenditure per capita has a negative and significant effect on adolescents' tobacco use. An additional hundred dollars of public education spending per capita increases the probability that a respondent will never smoke by 4%. Combining our results, we find that less corruption significantly increases the probability of never smoking by adolescents. If California, the most corrupt state in our sample, reduced its corruption level to the same level as Delaware, the least corrupt state in our sample, the probability that an adolescent will never smoke increases by 4%.

This article is organized in the following way. The theoretical model is described in Section 2. Based on the theoretical model, we outline the empirical model and issues with estimation in Section 3. We present the data in Section 4 and provide results from the estimation in Section 5. Finally, we conclude the study in Section 6.

II. Theoretical Framework

We present a theoretical model that illustrates a mechanism linking corruption to the consumption of an addictive good in order to derive testable theoretical hypotheses and identify an instrument for our empirical estimation.

2.1 Set up and Assumptions

There are two sectors in an economy. The first sector produces an addictive good that decreases the health level of an individual and its consumption creates negative externalities to the overall economy. For example, consumption of tobacco products creates second hand smoke and alcohol consumption could lead to drunk driving accidents. The second sector produces a composite good. Consumers decide how much to consume of each good given a budget constraint. The government chooses how much of its budget to allocate between educating the populace on the link between using the addictive good and health and subsidizing production in the two sectors. The government can be influenced in their decision to allocate spending between education and input subsidies by a lobby group from the firms in the two sectors in the economy.

The representative individual has quasilinear utility over their consumption of the addictive good and composite good, $V = v(a, \theta(e)h(a); \boldsymbol{Z}) + c$ where a is the quantity of addictive good consumed, c is the quantity of composite good consumed, $h(a)$ is the true health level of the individual, e is the level of education chosen by the government, $\boldsymbol{Z}$ is a vector of individual characteristics and $\theta(e)$ is the weight that the individual places on how their own health yields utility. We define $H \equiv \theta(e)h(a)$ as the perceived health level of the individual. An increase in consumption of the addictive good decreases the true health level of the individual at a decreasing rate, i.e. $h_a < 0$ and $h_{aa} < 0$ (Chaloupka, 1991). Furthermore, more educated individuals have a larger weight on how health influences utility, i.e. $\theta_e > 0$ (Cutler and Lleras-Muney, 2008, 2010; Grossman, 1972). Note that in our specification, if $a = 0$ then $v(0, \theta(e)h(0); \boldsymbol{Z}) > 0$. However, we do allow for direct consumption of the addictive good to increase utility at a decreasing rate along with perceived health level, i.e. $v_a > 0$, $v_{aa} < 0$, $v_H > 0$, $v_{HH} < 0$ and $v_{aH} < 0$.

Output in each sector is sold in a competitive market. The price in the composite goods sector is normalized to 1. The production function for a representative firm in each

sector is $f^j(k+g)\ \forall\ j\ \in a,c$ where k is privately purchased capital and g is government provided capital. In both sectors, output is increasing at a decreasing rate in privately purchased capital, i.e. $f_k^j > 0$ and$f_{kk}^j < 0$ and k and g are substitutes, $f_{kg}^j < 0$.

We solve a three-stage complete information game for the subgame perfect Nash equilibrium using backward induction. In the first stage, a lobby group comprised of firms in both sectors presents a contribution-expenditure schedule to the government where it promises to provide contributions to the policymaker if a particular level of government provided capital, g, is chosen. In the second stage, the government sets the composition of spending between the publicly provided input and education given a fixed budget while accounting for the contribution-expenditure schedule from the lobby group. Finally, firms in each sector simultaneously and independently select their capital purchases and individuals buy the addictive and the composite good.

2.2 Solution Through Backward Induction

We start by solving the third stage and continue recursively.

2.2.1 Third Stage – Firm Input and Household Consumption Decision

The representative firms in each sector maximize profit,

(1) $\pi^j(p,r,g) = max_k\{pf^j(k+g) - rk - t^j\}$

where r is the price of capital, t^j is a flat tax and p is the relative price of the addictive good such that the price of the composite good is normalized to 1. The flat tax is used by the government to raise revenues to produce the government provided input or education. The first order condition with respect to k is,

(2) $pf_k^j(k+g) - r = 0,$

which states that the value of marginal product of capital is equal to its input price. Because of our assumption of substitutability between privately purchased capital and government

provided capital, more government provided resources will decrease the amount of privately purchased capital such that $\frac{dk}{dg} < 0$.

The representative household maximizes utility subject to the following budget constraint, $(1 - t^l)I = pa + c$, where I is income and t^l is an income tax rate. Given the quasilinear utility function, the optimal condition that determines the level of consumption of the addictive good is,

(3) $v_a + v_H\theta(e)h_a - p \leq 0.$

Here, if the marginal disutility from the health effect of consuming the addictive good along with the price of purchasing outweighs the marginal utility of its consumption, then $a = 0$. In this case, the utility from not consuming the addictive good is greater than the utility from consuming any positive level of the addictive good,

(4) $\Omega \equiv v^*(0, \theta(e)h(0); \boldsymbol{Z}) - (\hat{v}(\hat{a}, \theta(e)h(\hat{a}); \boldsymbol{Z}) - p\hat{a}) > 0 \quad \forall\ \hat{a} > 0.$

An interior solution exists if (3) holds with equality yielding a positive optimal level of the addictive good,

(5) $a^* = a(p, e; \boldsymbol{Z})$.

In this case, consumption of the addictive good is only dependent on its price, education and individual characteristics.

We find that an increase in education has two effects on the consumer. First, if the individual's optimal level of addictive consumption is zero, the difference in utility from not consuming the addictive good versus consuming the addictive good will increase when education rises, i.e. $\frac{d\Omega}{de} > 0$ (see Appendix 1). Second, if the consumer is already consuming the addictive good, an increase in education decreases the level of consumption of the addictive good, i.e. $\frac{da}{de} < 0$ (see Appendix 1). Therefore, education increases the possibility that an individual will never consume the addictive good as well as decrease the frequency of

use if the individual already consumes it. Here, education makes the individual more aware of the impact of the addictive good on their own health.

The resulting indirect utility function is, $V^*(p, e, t^l, I; \boldsymbol{Z}) = S + (1 - t^l)I$ where $S \equiv v^*(a^*, \theta(e)h(a^*); \boldsymbol{Z}) - pa^*$ is a measure of consumer surplus from the joint consumption of health and the addictive good. Even if no addictive good is consumed, consumer surplus is still positive since $S = v^*(0, \theta(e)h(0); \boldsymbol{Z}) > 0$. An increase in educational provision by the government, unambiguously increases consumer surplus since $\frac{dS}{de} = v_H^* \theta_e h > 0$.

2.2.2 Second Stage – Government's Budget Allocation Decision

The aggregate welfare in the economy is a summation of the aggregate profits in the two sectors; welfare of the representative consumer net of disutility from the negative externality; and tax revenues net of the cost of providing education and government provided input,

$$(6)\ W = m^a \pi^{a*}(p, g, r, t^a) + m^c \pi^{c*}(p, g, r, t^c) + V^*(p, e, t^l, I; \boldsymbol{Z}) - X(p, e; \boldsymbol{Z}) + m^a t^a + m^c t^c + t^l I - w^g g - w^e e,$$

where $X(p, e; \boldsymbol{Z})$ is aggregate disutility that is external to the individual consumer, m^j are the total number of firms in sector $j \in a, c$, w^g is the price of the government provided input and w^e is the price of education.

A government planner who only maximizes the welfare function optimally selects the level of education and government provided inputs to maximize welfare subject to the budget constraint that aggregate tax revenues equal aggregate expenditures, i.e. $m^a t^a + m^c t^c + t^l I = w^g g + w^e e$. Substituting the constraint into the welfare function and solving for e yields the following condition,

$$(7)\ \frac{\partial W}{\partial e} = \left(m^a p f_g^a + m^c f_g^c\right) \frac{dg}{de} + v_H^* \theta_e h - X_a \frac{da}{de} = 0,$$

where $\frac{dg}{de}\Big|_{d(m^a t^a + m^c t^c + n t^l I)=0} = -\frac{w^e}{w^g}$. Here, the marginal benefits from education in the form of increased marginal utility from health and reduction in the marginal disutility from the externality equal the summation of the value of marginal product from the government provided input from all firms.

Following Grossman and Helpman (1994), a government planner who cares about lobby contributions as well as aggregate economic welfare maximizes the following function subject to the same budget constraint,

(8) $max_e\, G = W + \alpha L \qquad s.t. m^a t^a + m^c t^c + t^l I = w^g g + w^e e,$

where L is the aggregate lobby contributions by all firms and α is the weight that the government planner places on the lobby contribution. The aggregate lobbying contribution in the government's welfare function can be viewed as monetary earnings that can be used to run for re-election or used privately by the government planner. When α is large, the government places more weight on own self-interest relative to the welfare of their constituents. A number of studies interpret this weight, α, as a measure of corruption because a larger value implies more selfish behavior (see Damania et al. 2003, Damania and Fredriksson 2003, Fredriksson and Svensson 2003, Fredriksson et al. 2003).

The first order condition from the government's problem is,

(9) $\frac{\partial G}{\partial e} = \left(m^a p f_g^a + m^c f_g^c\right)\frac{dg}{de} + v_H^* \theta_e h - X_a \frac{da}{de} + \alpha \frac{dL}{dg}\frac{dg}{de} = 0.$

The government equates the marginal benefits from education (as shown in the second and third term) to the marginal benefits from government provided inputs (first term) and marginal cost of losing lobby contributions (last term). Note that the last term is derived from the lobby group's decision in the first stage to determine the impact of α on budget allocation decisions.

2.2.3. First Stage – Lobby Group's Decision

The lobby group is composed of all the firms in both sectors of the economy. The lobby group chooses the amount to contribute to maximize aggregate net profit for the entire production sector,

(10) $max_L\, m^a\pi^{a*}(p,g,r,t^a) + m^c\pi^{c*}(p,g,r,t^c) - L.$

Taking the first order condition with respect to L, we find,

(11) $\left(m^a p f_g^a + m^c f_g^c\right)\frac{dg}{dL} - 1 = 0.$

The lobby group offers contributions to the government up to the point where the marginal cost of lobbying equals the rise in the value of marginal product of the government provided input from lobbying. Using the inverse function rule, we can re-write the above first order condition as, $\left(m^a p f_g^a + m^c f_g^c\right) = \frac{dL}{dg}$. The association offers a contribution – expenditure schedule to the government planner where for an interior solution to hold, we need $\frac{dL}{dg} > 0$, which implies that the lobby group offers more contributions to the government only if more government provided capital is produced. Bernheim and Whinston (1986) and Grossman and Helpman (1994) refer to this as the local truthfulness condition.

Substituting the local truthfulness condition into the first order condition of the government's problem in (9) yields (see Appendix 1),

(12) $(1+\alpha)\left(m^a p f_g^a + m^c f_g^c\right)\frac{w^e}{w^g} = v_H^* \theta_e h - X_a \frac{da}{de}.$

Note that compared to equation (7) where $\alpha = 0$, more weight is placed on the value of marginal product of the government provided input for all firms when the policymaker cares about contributions from the lobby group. From this expression, we can derive the optimal level of education that is provided by the government, which depends on the price of the addictive good, prices of government provided inputs, measure of corruption and the size of the sector,

(13) $e(\alpha, w^e, w^g, p, m^a, m^c; \boldsymbol{Z})$.

The weight the government places on own welfare acts to increase the marginal value it places on the government provided input. More formally, we find that the impact of α on e is the following, $\frac{de}{d\alpha} < 0$ (see Appendix 1). Thus, more weight on lobbying contribution decreases education provision.

The total effect of the lobbying weight on the consumption of addictive goods is derived by combining the results in Stages 1 and 3. Since we find that an increase in the weight attached to the lobby reduces education and education reduces the consumption of an addictive good, the total effect of an increase in corruption leads to an increase in the consumption of the addictive good, such that $\frac{da}{d\alpha} > 0$ (see Appendix 1).

III. Empirical Model

To test the theoretical results, we estimate a two-equation model. Based on equations (13) and (5), we specify an instrumental variable - state fixed effects model to account for endogeneity of spending in the latter equation by using a proxy for corruption as an instrument in the former equation. From equation (5), the estimating equation is written as,

$$(14) \quad a_{isy} = \gamma_0 + \gamma_1 e_{sy} + \gamma_2 p_{sy} + \sum_{j=3}^{n} \gamma_j Z_{isy}^{j} + \vartheta_s + \rho_y + \epsilon_{isy}$$

where a_{isy} is the amount of addictive good consumed by an individual i in state s at year y, e_{sy} is a measure of education spending per capita in state s during year y, p_{sy} is a measure of the price of the addictive good which we proxy with the tobacco tax rate per pack in state s during year y, $Z_{isy}^{j}$is the jth demographic characteristic of an individual i in state s at year y, ϑ_s is a state fixed effect, ρ_y is a year fixed effect and ϵ_{isy} is a random disturbance term. For education to adversely affect the consumption of the addictive good, we expect $\gamma_1 < 0$.

One important issue regarding the estimation of equation (14) is the endogeneity of the education spending variable. There is likely to be bi-directional causality where states that have more individuals consuming addictive goods will see an increase in spending on

education and health programs to reduce such a phenomenon. A fixed effects regression that does not account for this endogeneity is likely to find a smaller value of γ_1 compared to the case where endogeneity is controlled. We estimate this equation using an instrumental variable model where our instrument comes from the equation below.

From our model, we write the following equation showing the determinants of education spending,

$$(15) \quad e_{sy} = \beta_0 + \beta_1 \alpha_{sy} + \sum_{j=2}^{n} \beta_j Z_{isy}^{j} + \sigma_s + \varepsilon_y + \mu_{isy}$$

where α_{sy} is a measure of corruption in state s during year y, σ_s is a state fixed effect, ε_y is a year fixed effect and μ_{isy} is a random disturbance term. For the measure of corruption to adversely affect education spending, we expect, $\beta_1 < 0$. Our corruption measure acts as an instrument for education spending in equation (14) since it is not likely to directly affect the consumption of addictive goods except through the budget spending decision of the policymaker. The total effect of corruption on the consumption of the addictive good equals $\beta_1 \gamma_1 > 0$.

There are several issues regarding the estimation of both equations. First, based on equation (13), we also identify prices of government provided inputs and the number of firms in each sector as determinants of education spending. In our empirical framework, they can be interpreted as additional instruments suggested by our theoretical model. However, unlike our measure of corruption, which serves as our main instrument, prices of government provided inputs and the number of firms may affect the purchase of addictive goods though other mechanisms aside from education spending. For instance, an increase in the number of firms providing the addictive good increases supply which can reduce equilibrium price of the addictive good leading to more of its purchase. Also, if government provided inputs substitute or complement the privately purchased inputs by a firm, any change in the input

price of the government provided good will affect input use by the firm and consequently, supply of the addictive good. We use as our baseline estimation a just-identified system where only the corruption proxy is our instrument. However, we also estimate an over-identified system that includes proxies for prices of government provided inputs and the number of firms as additional instruments to provide an additional robustness check that follows from our theoretical model.

The second issue is that there may be other state characteristics that create an environment where an individual becomes more or less likely to consume an addictive good. We include proxies for wealth and experience of the population, economic conditions, cultural composition and political environment to control for these environmental factors at the state level. The third issue is the presence of unobserved state characteristics that are fixed over time or there may be time varying unobserved variables that equally affect all states. We use state level fixed effects and annual dummies to account for these variables. Finally, we cluster observations to account for autocorrelation among individuals within states.

IV. Data.

In our analysis, the most important variables are a measure of addictive good consumption, a measure of education and health spending, and a measure of corruption. We use individual level data on adolescent health choices and characteristics across 42 states in the U.S. from 1993 to 2011 and match them with state level spending along with a proxy for state level corruption. Table 1 presents the summary statistics and Appendix 2 details the definition and sources of the data.

Our main measure of addictive good consumption is tobacco use by adolescents from the YRBSS. We use two measures of tobacco use in adolescents. The first is an indicator variable stating if they have ever smoked or not, which reflects the case that compares if $a = 0$ yields a higher level of utility than if a is some positive level. The second is a measure

indicating the frequency an adolescent has smoked in the past 30 days which reflects the case where $a > 0$. The average number of adolescents who have never smoked is 52% in our sample and there exists a wide degree of variation. For example, 80 % of the adolescent respondents in Utah have never smoked a cigarette whereas in Rhode Island it is only 35%. The average frequency of smoking days in the past month is 3.5 days. The highest frequency is in Minnesota at 6.3 days per month while the lowest is in Utah at a rate of 1.2 days per month.

We focus on state spending on two programs that could influence tobacco use by adolescents: education and health programs. For state education spending, we choose spending on elementary and secondary education per capita using data from the U.S. Census Bureau. Health spending per capita refers to public health programs excluding support from Federal health programs. The largest spending per capita for these services are found in states in the West Coast and Northeast regions.

Our corruption measure is based on the number of public officials who have been convicted for violations of federal corruption laws reported in the Public Integrity Section of the U.S. Department of Justice.[1] We compile the total number of convicted public officials by state from 1993 to 2011 and divide them by the total number of state legislators in the State Senate and the State House of Representatives. Our corruption index is the number of the convicted public officials per legislator where a larger value indicates a more corrupt state. Other empirical studies on corruption have used similar corruption proxies (Adserà et al., 2003; Alt and Lassen, 2008, 2014; Glaeser and Saks, 2006; Liu and Mikesell, 2014; Meier and Holbrook, 1992; Zuo and Schieffer, 2013). This variable serves as our main instrument in

[1] The federal official bribery and gratuity statute, 18 U.S.C. § 201 (enacted 1962) defines the term "public official" as "a Member of Congress, Delegate, or Resident Commissioner, either before or after such official has qualified, or an officer or employee or person acting for or on behalf of the United States, or any department, agency or branch of Government thereof, including the District of Columbia, in any official function, under or by authority of any such department, agency, or branch of Government, or a juror."

identifying the effect of education and health spending on tobacco use. There is considerable variation of our measure over time and within states where we find an R-squared of 0.79 when regressing our corruption measure with state and time dummies.

There are two potential criticisms of our corruption measure. First, the number of convicted public officials may not embody the true level of state corruption. Meier and Holbrook (1992) and Glaeser and Saks (2006) show how strongly correlated the state's public official conviction rankings match the general perception of state corruption. According to our corruption index, the five most corrupt states are California, Florida, Texas, Ohio and Illinois while the five least corrupt states are Delaware, Idaho, Rhode Island, Nebraska and Iowa. The second potential criticism is that our measure of corruption captures the effect of law enforcement ability and not corruption. Liu and Mikesell (2014) show that the conviction rate of public officials is not correlated with working hours of U.S. attorneys, number of Federal state judges or district court caseloads which are measures of the degree of law enforcement or availability of court resources.

We use other control variables from the YRBSS database in order to capture adolescents' characteristics, preferences and risk attitudes such as sex, race, age, using seatbelts, having sexual experiences or considering suicide. We also include state demographic variables, racial composition, unemployment levels, and political composition of state congressional houses to control for the environment within the state using data from the U.S. Census Bureau.

V. Results

We present Two-Way Fixed Effects regressions to estimate equation (15) and IV Two-Way Fixed Effects regressions to estimate equation (14). To increase the reliability of inference in our estimation, we cluster observations at the state level to obtain robust standard errors. We present three sets of regressions. The first set is our baseline model using

corruption as our only instrument for education and health spending. The second set of regressions also uses corruption as our only instrument but we include a set of state variables to account for the environment of the individual as a robustness check. The third set follows closer to our theoretical model by including more instruments that proxy equation (13) as an additional robustness check. This includes the number of firms by state and the housing price index to proxy for the price of government provided inputs.[2]

5.1 *Baseline Results*

Table 2 presents the results measuring the effect of corruption on state level spending. The effect of corruption on education per capita spending alone may be different than education and health spending per capita together so we ran separate regressions. The effect of corruption on education spending alone is negative and significant in all specifications and we obtain reasonable magnitudes which indicate that our instrument is not weak. Based on our estimates, for every 1 public official conviction per legislator public education spending decreases by $145 to $150 per capita. For an average state in our sample, the corruption measure is 0.28. This corresponds to a drop in education spending per capita by $41 which is approximately a 3% reduction from the mean level.

If we include health spending along with education spending, the effect of corruption is slightly larger. Here, we find that for every 1 public official conviction per legislator, education and health spending decreases by $157 to $173 per capita. For a state with an average level of corruption, this corresponds to a drop in education and health spending per capita by $48. The rise in the marginal effect of corruption on these two types of spending categories may indicate that education and health spending are complements in the policymaker's optimal decision.

[2] The first two sets of results constitute a just identified system with one instrument and one endogenous variable while the last set of results is an over-identified system with three instruments for one endogenous variable.

Table 3 summarizes the effect of education and health per capita on the choice of adolescents to smoke after instrumenting with our corruption measure.[3] We find a robust, significant and consistent result that an increase in education spending per capita by $100 leads to an increase in the probability that an adolescent will never smoke by 4% after instrumenting with our corruption variable. The average spending on education per capita is $1610. If it increased by one standard deviation, the probability that an adolescent will never smoke increases to 14%. Not surprisingly, adolescents who are more risk averse, female and younger are more likely to never smoke than their peers.

Note that even when health spending is included, the probability of never smoking remains at 4% for every $100 in education and health spending per capita. This result indicates that the main driver affecting an adolescent's decision to never smoke is education spending. One plausible explanation regarding the insignificant contribution of health spending relative to education spending is that most of health spending is used for treatment rather than prevention.

Farrely et al. (2008) find that if tobacco program expenditures per capita doubled, it would lead to a reduction in adult smoking by 1% to 1.7%. Similarly, Ciecierski et al. (2011) find that a doubling in expenditures related to tobacco prevention per capita reduced college smoking by 3.8%. The average spending on tobacco programs per capita is $0.92 (Ciecierski et al. 2011). Our results regarding overall education and health spending that do not specifically target tobacco reduction is relatively small in comparison to the targeted spending on tobacco programs. We find that an equivalent $0.92 per capita increase in education and health spending results in a .04% reduction in youth smoking. Our magnitudes are reasonable given that overall education and health spending may not directly reduce tobacco smoking habits but instead set a foundation for good behavior, one of which is to not

[3] The Durbin-Wu-Hausman test for endogeneity shows that we reject the null that our spending variables are not endogenous at the 1% level.

smoke.

Table 4 shows the effect of education and health spending per capita on the frequency of smoking per month by adolescents.[4] The effect of education and health spending reduces the number of smoking days by adolescents where an additional hundred dollars of public education spending per capita decreases a respondent's smoking days in the past month by 0.6 days. In other words, if an average state increases their education spending per capita by one standard deviation, the frequency of smoking days will decrease by 2 days per month. Since the average number of smoking days for adolescents is 3.5 days per month, this would amount to a 60% decline in the frequency by which adolescents smoke.

The absolute value of the spending coefficient on our tobacco use variables using instrumental variables is larger than the case where we only employ Fixed Effects estimation without instruments as summarized in Appendix 3. Without accounting for endogeneity of spending, we expect such a downward bias in the Fixed Effects coefficient estimate relative to the IV-Fixed Effects estimate. One possible explanation is that more education and health spending leads to lower tobacco use; which in turn, could lead to less education and health spending and, consequently, more tobacco use. The net effect is a smaller impact of spending on tobacco use when not controlling for endogeneity which may explain the downward bias in the Fixed Effects coefficient estimates.

A simple check to determine if our measure relating public primary and secondary education spending on adolescent tobacco use is causal is to test if our results become insignificant when we use the prevalence of adult smoking by state as the dependent variable. We expect that by replacing adolescent smoking with adult smoking, the impact of primary and secondary education spending, after instrumenting with corruption, would be negative but no longer significant. Based on our baseline specification using adult smoking prevalence

[4] Similar to the previous specification, the Durbin-Wu-Hausman test for endogeneity shows that we reject the null hypothesis that our spending variables are not endogenous at the 1% level.

in Appendix 4, we do find that the spending effect is insignificant for adults which give us more confidence in the causal interpretation of our spending results with adolescent smoking behavior.

5.2 Total Effect of Corruption on Tobacco Use

The total effect of corruption on tobacco use is summarized in Table 5. The empirical results support our theoretical predictions. As our corruption measure increases, the probability of not smoking decreases while the frequency of smoking days in the past month increases. The effect of corruption on the former tobacco decision is more robust than the latter. We find that for every 1 public official conviction per legislator, the probability of not smoking decreases by 5% to 6%. Based on our sample, California is the most corrupt state with an index of 0.76 and Delaware is the least corrupt with an index of 0.02. If California reduced its corruption to the level of Delaware, the probability that an adolescent will not smoke will increase by 4%.

Corruption increases the frequency of smoking per month but the magnitude is not significant across all specifications. The lack of robustness in our corruption coefficients when examining the frequency of smoking days as opposed to the binary decision to smoke or not smoke may point to the limits of effectiveness of general education in affecting an adolescent's decision. Our results indicate that corruption can have a significant impact on the choice of an adolescent to engage in a risky activity through education but once the adolescent chooses to do so, the effect of corruption through education on reducing the frequency of the activity is not as robust.

VI. Conclusion

This article investigates the link between corruption and tobacco use. We theoretically model how corruption influences the policymaker to increase government spending that subsidizes production by firms to the detriment of providing public goods such as education

and health services. The reduction in spending on both services, especially education, leads to an increase in consumption of non-healthy goods. Thus, our theoretical model predicts that an increase in corruption increases consumption of non-healthy goods.

We test the results of our theoretical model by estimating a two-equation system. The first equation estimates the effect of convicted public officials per number of legislators, our proxy measure for corruption, on education and health spending per capita. The second equation measures the effect of education and health spending on two variables relating to tobacco use: the choice never to smoke and the frequency of smoking in the past month. The second equation uses an instrumental variable Fixed Effects approach where the instrument is our measure of corruption in the first equation.

We do find that corruption significantly and consistently reduces education and health spending. Furthermore, we find that education spending per capita significantly and consistently increases the probability of not smoking and decreases the number of smoking days. Here, a $100 increase in education spending per capita increases the probability of not smoking by 4% and reduces the frequency of smoking days by 0.6 days per month.

The total effect of higher corruption on our indicators of tobacco use is significant and positive. More corruption decreases the probability of never smoking and the results are robust across various specification. Furthermore, corruption does increase the frequency of smoking but the results are not as robust. If California, the most corrupt state in our sample, reduced its corruption level to the same level as Delaware, the least corrupt state in our sample, the probability that an adolescent will never smoke increases by 4%.

The effect of corruption on our tobacco use indicators indicates that it is inelastic. The magnitude of the marginal effect is reasonable and relatively small. Unlike other direct factors such as prices, social pressure or family environment, we would not expect an underlying factor such as corruption to have a large magnitude. However, its significance is

interesting from a policy standpoint since this is the first paper that we are aware of the empirically links corruption to adverse health effects. Thus, any potential reduction in corruption not only provides for better regulations and higher economic welfare (Djankov et al., 2002; Lambsdorff, 2001; Olken, 2006) but we also show that it has a direct effect on an individual's health quality.

References

Adserà, A., C. Boix, and M. Payne. "Are You Being Served? Political Accountability and Governmental Performance." *Journal of Law, Economics, and Organization*, 19(2), 2003, 445–490.

Allcott, H., D. Lederman, and R. Lopez. "Political Institutions, Inequality, and Agricultural Growth: The Public Expenditure Connection." Policy Research Working Paper Series 3902, The World Bank, 2006.

Alt, J. E., and D. D. Lassen. "Political and Judicial Checks on Corruption: Evidence from American State Governments." *Economics and Politics*, 20(1), 2008, 33–61.

Alt, J. E., and D. D. Lassen. "Enforcement and Public Corruption: Evidence from the American States 2014." *Journal of Law, Economics, and Organization*, 3(2), 2014, 306–338.

Bernheim, B. D. and M. D. Whinston. "Menu Auctions, Resource Allocation, and Economics Influence." *Quarterly Journal of Economics*, 101(1), 1986, 1-31

Centers for Disease Control and Prevention (CDCP). "Tobacco Use Among Middle and High School Students—United States, 2011–2014." Morbidity and Mortality Weekly Report, 64(14), 2015, 381–385 [accessed 2015 Oct 14].

Chaloupka, F. J. "Rational Addictive Behavior and Cigarette Smoking." *Journal of Political Economy*, 99(4), 1991, 722–742.

Chirinko, R. S., and D. J. Wilson. "Can Lower Tax Rates Be Bought? Business Rent-Seeking and Tax Competition Among U.S. States." Federal Reserve Bank of San Francisco Working Paper 2009-29, 2010, available at http://www.frbsf.org/publications/economics/papers/2009/wp09-29bk.pdf

Ciecierski, C. C., P. Chatterji, F. Chaloupka, and H. Wechsler. "Do State Expenditures on Tobacco Control Programs Decrease Use of Tobacco Products Among College Students?" *Health Economics*, 20(3), 2011, 253–272.

Cutler, D. M., and A. Lleras-Muney. "Education and Health: Evaluating Theories and Evidence." Making Americans Healthier: Social and Economic Policy as Health Policy, edited by J. House, R. Schoeni, G. Kaplan, and H. Pollack. New York: Russell Sage Foundation, 2008.

Cutler, D. M., and A. Lleras-Muney. "Understanding Differences in Health Behaviors by Education." *Journal of Health Economics*, 29(1), 2010, 1–28.

Damania, R., and P. G. Fredriksson. "Trade Policy Reform, Endogenous Lobby Group Formation, and Environmental Policy." *Journal of Economic Behavior and Organization*, 52(1), 2003, 47–69.

Damania, R., P. G. Fredriksson, and J. A. List. "Trade Liberalization, Corruption, and Environmental Policy Formation: Theory and Evidence." *Journal of Environmental Economics and Management*, 46, 2003, 490–512.

Djankov, S., R. L. Porta, F. Lopez-de-Silanes, and A. Shleifer. "The Regulation of Entry." *Quarterly Journal of Economics*, 117(1), 2002, 1–37.

Farrelly, M. C., T. F. Pechacek, K. Y. Thomas, and D. Nelson. "The Impact of Tobacco Control Programs on Adult Smoking." *American Journal of Public Health*, 98, 2008, 304–309.

Fredriksson, P. G., and J. Svensson. "Political Instability, Corruption and Policy Formation: The Case of Environmental Policy." *Journal of Public Economics*, 87(7-8), 2003, 1383–1405.

Fredriksson, P. G., J. A. List, and D. L. Millimet. "Bureaucratic Corruption, Environmental Policy and Inbound US FDI: Theory and Evidence." *Journal of Public Economics*, 87(7-8), 2003, 1407–1430.

Gawande, K., and U. Bandyopadhyay. "Is Protection for Sale? Evidence on the Grossman-Helpman Theory of Endogenous Protection." *Review of Economics and Statistics*, 82(1), 2000, 139–152.

Glaeser, E. L., and R. E. Saks. “Corruption in America.” *Journal of Public Economics*, 90(6-7), 2006, 1053–1072.

Goldberg, P. K., and G. Maggi. “Protection for Sale: An Empirical Investigation.” *American Economic Review*, 89(5), 1999, 1135–1155.

Grossman, M. “On the Concept of Health Capital and the Demand for Health.” *Journal of Political Economy*, 80(2), 1972, 223–255.

Grossman M. “The Correlation Between Health and Schooling.” Household Production and Consumption, edited by N. E, Terleckvj. New York: Columbia University Press for the National Bureau of Economic Research, 1975, 147–211.

Grossman, G. M., and E. Helpman. “Protection for Sale.” *American Economic Review*, 84(4), 1994, 833–850.

Keefer, P., and S. Khemani. “Democracy, Public Expenditures, and the Poor: Understanding Political Incentives for Providing Public Services.” *The World Bank Research Observer*, 20(1), 2005, 1–27.

Kenkel, D. S., D. R. Lillard, and A. D. Mathios. “The Roles of High School Completion and GED Receipt in Smoking and Obesity.” *Journal of Labor Economics*, 24, 2006, 635–660.

Lambsdorff, J. “How Corruption in Government Affects Public Welfare: A Review of Theory.” Governance and Economic Development Research Discussion Papers No. 9, Georg-August-University of Gottingen, 2001.

Liu, C., and J. L. Mikesell. “The Impact of Public Officials’ Corruption on the Size and Allocation of U.S. State Spending.” *Public Administration Review*, 74(3), 2014, 346–359.

Meier, K. J., and T. M. Holbrook. “I Seen My Opportunities and I Took 'Em: Political Corruption in the American States.” *Journal of Politics*, 54(1), 1992, 135–155.

Nayga, R. M. “A Note on Schooling and Smoking: The Issue Revisited.” Education Economics, 7, 1998, 253–258.

Olken, B. A. “Corruption and the Costs of Redistribution: Micro Evidence from Indonesia.” *Journal of Public Economics*, 90(4-5), 2006, 853–870.

Olson, M. *The Logic of Collective Action*. Harvard University Press, 1965.

Ong, M., B. Alamar, and S. Glantz. “Health and Economic Effects of Two Proposals to Increase the California State Cigarette Excise Tax.” Center for Tobacco Control Research and Education, 2003.

Pierce, J., E. Gilpin, S. Emery, M. White, M. Rosbrook, and C. Berry. “Has the California Tobacco Control Program Reduced Smoking?” *Journal of the American Medical Association*, 280, 1998, 893–899.

Sander, W. “Schooling and Quitting Smoking.” *Review of Economics and Statistics*, 77, 1995, 191–199.

Sander, W. “The Effect of Schooling and Cognitive Ability on Smoking and Marijuana Use by Young Adults.” *Economics of Education Review*, 17, 1998, 317–324.

Tauras, J., F. Chaloupka, M. Farrelly, G. Giovino, M. Wakefield, L. Johnston, P. O’Malley, D. Kloska, and T. Pechacek. “State Tobacco Control Spending and Youth Smoking.” *American Journal of Public Health*, 95, 2005, 338–344.

U.S. Department of Health and Human Services (USDHHS). “Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General.” Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2012.

U.S. Department of Health and Human Services (USDHHS). “The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General.” Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking

and Health, 2014 [accessed 2015 Oct 14].

Wakefield, M., and F. Chaloupka. “Effectiveness of Comprehensive Tobacco Control Programmes in Reducing Teenage Smoking in the USA.” *Tobacco Control*, 9. 2009, 177–186.

Wilson, J. K., and R. Damania. “Corruption, Political Competition and Environmental Policy.” *Journal of Environmental Economics and Management*, 49, 2005, 516–535.

Van der Pol, M. “Health, Education and Time Preference.” *Health Economics*, 20(8), 2011, 917–929.

World Bank. 2000. Anticorruption in Transition: A Contribution to the Policy Debate. Washington DC.

Zuo, N., and J. Schieffer. “Crowding-out Effect or Institutions? The Resource Curse Revisited with an Investigation of U.S. States.” presented for Southern Agricultural Economics Association Meeting, Orlando, FL, 2013, available at http://purl.umn.edu/142974.

Table 1: Summary statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
State level					
Never smoke	108577	0.525	0.499	0	1
Smoking days	105887	3.482	8.181	0	30
Education Spending Per Capita	110198	1609.645	345.580	895.768	2821.133
Prevalence	110397	21.065	3.497	9.800	31.500
Education and Health Spending Per Capita	110198	1832.841	376.127	1069.213	3146.452
Corruption	110198	0.282	0.253	0	1.200
Firms	110399	264148.900	203956.700	14128	730789
Housing price index	110399	0.801	0.249	0.334	1.553
Cigarette tax	110198	77.942	62.653	3.219	414.884
Median age	110198	35.393	2.189	28.100	41.500
Median income	110198	6.339	1.162	3.937	9.412
Democratic portion	110198	54.510	12.375	19.048	88.000
Unemployment	110198	6.356	2.230	2.600	13.500
Hispanic portion	110198	16.066	17.513	0.499	167.856
Male portion	110198	49.009	0.624	47.895	50.548
Individual level					
Male	110198	0.491	0.500	0	1
Hispanic	110198	0.275	0.447	0	1
Combined race	110198	3.856	1.965	1	8
Other race	110198	0.358	0.479	0	1
Age	110198	16.178	1.228	12	18
Seatbelt	109928	3.873	1.186	1	5
Never fight	108761	0.860	0.346	0	1
Never unsafe	109907	0.938	0.241	0	1
Considering suicide	109594	0.184	0.388	0	1
Never sex	104124	0.464	0.499	0	1

Table 2: Estimating the Determinants of Education and Health Spending per Capita using Two-Way Fixed Effects, 1993-2011

	Just-Identified Baseline		Just-Identified with Added State Control Variables		Over-Identified Robustness Check	
	(1)	(2)	(3)	(4)	(5)	(6)
	Education Spending per capita	Education and Health Spending per capita	Education Spending per capita	Education and Health Spending per capita	Education Spending per capita	Education and Health Spending per capita
State Characteristics						
Corruption	-150.259**	-173.016**	-145.259*	-157.214*	-118.552	-133.062*
	(70.489)	(66.872)	(77.964)	(79.082)	(71.698)	(66.078)
Cigarette tax	0.719	0.943**	0.093	0.351	0.584	0.816*
	(0.475)	(0.453)	(0.476)	(0.446)	(0.446)	(0.421)
Firms			-0.002**	-0.002*	-0.0003	-0.0001
			(0.001)	(0.001)	(0.001)	(0.001)
Housing price index			473.679***	471.615***	496.091***	491.917***
			(123.596)	(125.788)	(85.591)	(81.541)
Median age			-30.345	-27.587		
			(31.987)	(30.141)		
Median income			-15.151	-29.994		
			(36.299)	(33.498)		
Democratic portion			-0.169	-0.259		
			(1.816)	(1.753)		
Unemployment			-34.227**	-34.911**		
			(15.161)	(14.525)		
Hispanic portion			2.641***	2.319**		
			(0.956)	(0.914)		
Male portion			-174.331**	-153.555*		
			(73.947)	(80.993)		
Individual Characteristics						
Male	-1.590*	-1.952**	-0.603	-0.879	-0.909	-1.204
	(0.794)	(0.823)	(0.624)	(0.782)	(0.691)	(0.772)
Hispanic	11.548*	15.065**	5.847	9.036**	5.461	8.825*

	(6.837)	(6.163)	(4.551)	(4.426)	(4.880)	(5.056)
Combined race	-2.924*	-3.079**	-3.342*	-3.414**	-2.724	-2.879*
	(1.663)	(1.510)	(1.690)	(1.642)	(1.653)	(1.604)
Other race	-5.230	-2.523	-1.979	0.542	-4.490	-1.698
	(6.445)	(5.829)	(5.480)	(5.035)	(6.757)	(6.247)
Age	0.735*	0.896**	0.190	0.394	0.086	0.261
	(0.406)	(0.335)	(0.381)	(0.391)	(0.405)	(0.357)
Seatbelt	1.673	1.280	2.430*	1.913	2.524	2.188
	(1.902)	(1.694)	(1.391)	(1.332)	(1.862)	(1.683)
Never fight	-0.937	-1.016	-1.111	-1.148	-1.256	-1.349
	(1.167)	(1.136)	(0.997)	(0.988)	(1.053)	(1.028)
Never unsafe	5.366*	5.503*	5.952**	5.804**	5.517**	5.606**
	(3.037)	(3.114)	(2.735)	(2.647)	(2.479)	(2.467)
Considering suicide	0.672	0.855	1.251	1.472	1.121	1.373
	(1.348)	(1.271)	(0.816)	(0.926)	(1.015)	(1.065)
Never sex	0.585	0.780	0.354	0.576	-0.504	-0.278
	(2.222)	(2.232)	(1.149)	(1.195)	(1.613)	(1.483)
Year and state dummies	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	102609	102609	102609	102609	102609	102609
R-squared	0.932	0.942	0.952	0.959	0.945	0.954

Note: Standard errors are clustered at the state level. Standard errors in parentheses. * p<0.1 ** p<0.05 *** p<0.01

Table 3: The Determinants of Adolescents Choosing Not to Smoke using IV Two-Way Fixed Effects, 1993-2011

	Just-Identified Baseline		Just-Identified with Added State Control Variables		Over-Identified Robustness Check	
	(1)	(2)	(3)	(4)	(5)	(6)
	Never smoke	Never smoke	Never smoke	Never smoke	Never smoke	Never smoke
State Characteristics						
Education Spending per capita	0.0004*		0.0004**		0.0002**	
	(0.0002)		(0.0002)		(0.0001)	
Education and Health Spending per capita		0.0003**		0.0004**		0.0002**
		(0.0001)		(0.0002)		(0.0001)
Cigarette tax	-0.0001	-0.0001	0.0001	0.00004	0.00003	-0.00001
	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0002)
Firms			-0.00000001	-0.0000001		
			(0.0000004)	(0.0000004)		
Housing price index			-0.073	-0.074		
			(0.095)	(0.091)		
Median age			-0.008	-0.009		
			(0.017)	(0.016)		
Median income			0.009	0.015		
			(0.021)	(0.022)		
Democratic portion			0.001	0.001		
			(0.001)	(0.001)		
Unemployment			0.015	0.016		
			(0.011)	(0.012)		
Hispanic portion			-0.001**	-0.001**		
			(0.001)	(0.001)		
Male portion			0.001	-0.001		
			(0.017)	(0.016)		
Individual Characteristics						
Male	-0.035***	-0.035***	-0.035***	-0.035***	-0.035***	-0.035***

	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Hispanic	-0.029*	-0.030*	-0.028*	-0.030*	-0.027*	-0.028*
	(0.016)	(0.016)	(0.015)	(0.015)	(0.015)	(0.015)
Combined race	-0.014***	-0.014***	-0.014***	-0.014***	-0.015***	-0.015***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Other race	0.019	0.018	0.018	0.016	0.018	0.018
	(0.015)	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)
Age	-0.019***	-0.019***	-0.019***	-0.010***	-0.019***	-0.019***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Seatbelt	0.046***	0.046***	0.046***	0.046***	0.046***	0.046***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Never fight	0.096***	0.096***	0.096***	0.096***	0.096***	0.096***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Never unsafe	0.047***	0.047***	0.047***	0.047***	0.048***	0.048***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Considering suicide	-0.143***	-0.143***	-0.143***	-0.143***	-0.142***	-0.142***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Never sex	0.262***	0.262***	0.262***	0.262***	0.262***	0.262***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Year and state dummies	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	101314	101314	101314	101314	101314	101314
R-squared	0.177	0.178	0.177	0.177	0.180	0.180

Note: Standard errors are clustered at the state level. Instrument for just-identified specification is the corruption variable. The instruments for the over-identified specification include the corruption variable, number of firms and housing price index. * p<0.1 ** p<0.05 *** p<0.01. Endogeneity Test using Durbin-Wu-Hausman test shows that we reject the null hypothesis that Education and Education & Health Spending variables are not endogenous at the 1% level.

Table 4: The Determinants of the Frequency of Adolescent Smoking Days in the past Month using IV Two-Way Fixed Effects, 1993-2011

	Just-Identified Baseline		Just-Identified with Added State Control Variables		Over-Identified Robustness Check	
	(1) Smoking days	(2) Smoking days	(3) Smoking days	(4) Smoking days	(5) Smoking days	(6) Smoking days
State Characteristics						
Education Spending per capita	-0.006*		-0.006**		-0.002*	
	(0.003)		(0.003)		(0.001)	
Education and Health Spending per capita		-0.005**		-0.006**		-0.002*
		(0.003)		(0.003)		(0.001)
Cigarette tax	-0.0001	0.001	-0.004	-0.003	-0.003	-0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Firms			-0.0000003	0.000001		
			(0.000005)	(0.000005)		
Housing price index			1.803	1.869		
			(1.483)	(1.457)		
Median age			0.144	0.161		
			(0.266)	(0.242)		
Median income			0.033	-0.065		
			(0.339)	(0.363)		
Democratic portion			-0.006	-0.006		
			(0.017)	(0.017)		
Unemployment			-0.072	-0.087		
			(0.184)	(0.185)		
Hispanic portion			0.020**	0.019**		
			(0.010)	(0.009)		
Male portion			0.140	0.172		
			(0.270)	(0.258)		
Individual Characteristics						
Male	0.580***	0.580***	0.582***	0.581***	0.586***	0.585***

	(0.132)	(0.133)	(0.133)	(0.133)	(0.132)	(0.132)
Hispanic	-1.087***	-1.077***	-1.128***	-1.107***	-1.143***	-1.136***
	(0.165)	(0.169)	(0.147)	(0.156)	(0.142)	(0.145)
Combined race	0.220***	0.222***	0.220***	0.218***	0.234***	0.233***
	(0.057)	(0.056)	(0.058)	(0.058)	(0.055)	(0.055)
Other race	-0.337**	-0.318**	-0.309**	-0.294**	-0.321**	-0.314**
	(0.138)	(0.139)	(0.143)	(0.141)	(0.144)	(0.145)
Age	0.403***	0.403***	0.400***	0.401***	0.401***	0.402***
	(0.031)	(0.031)	(0.030)	(0.030)	(0.030)	(0.030)
Seatbelt	-0.900***	-0.903***	-0.899***	-0.901***	-0.907***	-0.908***
	(0.049)	(0.048)	(0.049)	(0.049)	(0.049)	(0.049)
Never fight	-1.826***	-1.825***	-1.826***	-1.826***	-1.824***	-1.824***
	(0.100)	(0.100)	(0.099)	(0.100)	(0.099)	(0.099)
Never unsafe	-1.107***	-1.111***	-1.109***	-1.109***	-1.132***	-1.132***
	(0.151)	(0.151)	(0.153)	(0.152)	(0.148)	(0.148)
Considering suicide	2.566***	2.566***	2.568***	2.569***	2.567***	2.567***
	(0.194)	(0.193)	(0.192)	(0.192)	(0.193)	(0.193)
Never sex	-3.117***	-3.117***	-3.125***	-3.123***	-3.122***	-3.121***
	(0.147)	(0.146)	(0.143)	(0.143)	(0.141)	(0.141)
Year and state dummies	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	98995	98995	98995	98995	98995	98995
R-squared	0.130	0.132	0.132	0.132	0.135	0.135

Note: Standard errors are clustered at the state level. Instrument for just-identified specification is the corruption variable. The instruments for the over-identified specification include the corruption variable, number of firms and housing price index. * p<0.1 ** p<0.05 *** p<0.01. Endogeneity Test using Durbin-Wu-Hausman test shows that we reject the null hypothesis that Education and Education & Health Spending variables are not endogenous at the 1% level.

Table 5. The Effect of Corruption on Adolescent Tobacco Use

Marginal Effect of Corruption	Probability of Not Smoking	Frequency of Smoking Days in the Past Month
Just-Identified Baseline		
Education Spending per capita	-0.053	0.938
	(0.037)	(0.676)
Education and Health Spending per capita	-0.053**	0.938**
	(0.031)	(0.565)
Just-Identified with Added State Control Variables		
Education Spending per capita	-0.058*	0.816
	(0.039)	(0.584)
Education and Health Spending per capita	-0.064*	0.924
	(0.043)	(0.643)
Over-Identified Robustness Check		
Education Spending per capita	-0.022	0.255
	(0.016)	(0.202)
Education and Health Spending per capita	-0.023*	0.280
	(0.015)	(0.200)

Note: Standard errors are calculated using the delta method. **p<0.1, *p<0.15.

Appendix

Appendix 1. Proofs in the Theoretical Model

To derive the effect of education on Ω, we take the derivative of (4) with respect to e,

(A1) $\frac{d\Omega}{de} = v_H^* \theta_e h(0) - \hat{v}_H \theta_e h(\hat{a})$.

Since $h(0) > h(\hat{a})$ and $v_H^* > \hat{v}_H$, $\frac{d\Omega}{de} > 0$.

To derive the effect of education on addictive goods consumed, i.e. $\frac{da}{de}$, recall that the first order condition from the consumer's problem when an interior solution exists is, $v_a + v_H \theta(e) h_a - p = 0$. Totally differentiating the first order condition yields,

(A2) $\frac{da}{de} = -\frac{v_{aa}\theta_e h + v_H \theta_e h_a + v_{HH}\theta\theta_e h_a}{\frac{\partial^2 V}{\partial a^2}}$.

Since $v_{aa} < 0$, $v_{HH} < 0$, $\theta_e > 0$, and $h_a < 0$, the numerator is negative. Also if V is concave, the denominator is negative which leads to $\frac{da}{de} < 0$.

The optimal allocation of education spending is derived by substituting the local truthfulness condition, $\left(m^a p f_g^a + m^c f_g^c\right) = \frac{dL}{dg}$, and $\left.\frac{dg}{de}\right|_{d(m^a t^a + m^c t^c + n t^l I)=0} = -\frac{w^e}{w^g}$, into equation (9) resulting in,

(A3) $\frac{\partial G}{\partial e} = -(1+\alpha)\left(m^a p f_g^a + m^c f_g^c\right)\frac{w^e}{w^g} + v_H^* \theta_e h - X_a \frac{da}{de} = 0$.

Finally, re-arranging (A3) yields equation (12).

Totally differentiating (A3), we find

(A4) $\frac{de}{d\alpha} = -\frac{-(m^a p f_g^a + m^c f_g^c)\frac{w^e}{w^g}}{\frac{\partial^2 G}{\partial e^2}}$. If G is concave, then $\frac{\partial^2 G}{\partial e^2} < 0$. Since the numerator is negative then $\frac{de}{d\alpha} < 0$.

The total effect of corruption on addictive good use is derived from totally differentiating equation (5). Here,

(A5) $\frac{da}{d\alpha} = \frac{da}{de}\frac{de}{d\alpha}$.

From (A2), $\frac{da}{de} < 0$ and from (A4), $\frac{de}{d\alpha} < 0$. Therefore, $\frac{da}{d\alpha} > 0$.

Appendix 2. Data Definition and Sources

Variable	Definition	Source	Time range
Never smoke	Indicating an adolescent who never smoked a cigarette, 1=never	Center for Diseases Control and Prevention Youth Risk Behavior Survey (YRBS) data	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Smoking days	Smoking days in the past 30 days for adolescents	Center for Diseases Control and Prevention Youth Risk Behavior Survey (YRBS) data	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Prevalence	Current cigarette smoking prevalence among adults (%)	Center for Diseases Control and Prevention	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Education Spending Per Capita	Education spending divided by population, deflated by 2009 Consumer Price Index (CPI)	US Census Bureau	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Education and Health Spending Per Capita	Education and health spending divided by population, deflated by 2009 CPI	US Census Bureau	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Corruption	A number of convictions per legislator	US Department of Justice Book of States	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Firms	A number of firms by state	US Census Bureau County Business Patterns	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Housing price index	Housing price index, not seasonally adjusted (base year: 2009)	Federal Housing Finance Agency	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Cigarette Tax	Cigarette tax (cent) per pack, deflated by 2009 CPI	Orzechowski and Walker, The Tax Burden on Tobacco, 2014	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Median age	Median age in population	US Census Bureau	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Median income	Median household Income in $10k, deflated by CPI 2009	US Census Bureau	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011

Democratic portion	The portion of democratic politicians in state legislature (%)	Book of States	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Unemployment	Unemployment rate (%)	Bureau of Labor Statistics	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Hispanic portion	The portion of people who are identified with Hispanic origin in population (%)	US Census Bureau	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Male portion	The portion of male in population (%)	US Census Bureau	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Male	Indicating a male adolescent 1=male, 0=female	Center for Diseases Control and Prevention Youth Risk Behavior Survey (YRBS) data	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Hispanic	Indicating a Hispanic or Latino adolescent 1=Hispanic or Latino	Center for Diseases Control and Prevention Youth Risk Behavior Survey (YRBS) data	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Combined race	Indicating an adolescent in combined race and ethnicity 1=Combined race and ethnicity	Center for Diseases Control and Prevention Youth Risk Behavior Survey (YRBS) data	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Other race	Indicating an adolescent in other races, neither white, black, Hispanic, nor combined 1=Other races	Center for Diseases Control and Prevention Youth Risk Behavior Survey (YRBS) data	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Age	Adolescent age in years	Center for Diseases Control and Prevention Youth Risk Behavior Survey (YRBS) data	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Seatbelt	How often wore a seatbelt for an adolescent 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Most of the time, 5 = Always	Center for Diseases Control and Prevention Youth Risk Behavior Survey (YRBS) data	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Never fight	Indicating an adolescent who never fought in the past 12 months 1= never	Center for Diseases Control and Prevention Youth Risk Behavior Survey (YRBS) data	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011

Never unsafe	Indicating an adolescent who never felt unsafe in the past 30 days 1=never	Center for Diseases Control and Prevention Youth Risk Behavior Survey (YRBS) data	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Considering suicide	Indicating an adolescent who considered suicide in the past 12 months 1=yes	Center for Diseases Control and Prevention Youth Risk Behavior Survey (YRBS) data	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011
Never sex	Indicating an adolescent who never had a sexual intercourse 1=never	Center for Diseases Control and Prevention Youth Risk Behavior Survey (YRBS) data	1993, 1995, 1997, 1999, 2005, 2007, 2009, 2011

Appendix 3: Estimating the Effect of Education and Health Spending on Adolescent Tobacco Use Using Two-Way Fixed Effects, 1993-2011

	(1) Never smoke	(2) Never smoke	(3) Smoking days	(4) Smoking days
State Characteristics				
Education Spending per capita	0.00003		-0.0001	
	(0.00004)		(0.001)	
Education and Health Spending per capita		0.00004		-0.0004
		(0.00004)		(0.001)
Cigarette tax	0.0001	0.0001	-0.004*	-0.004
	(0.0001)	(0.0001)	(0.002)	(0.002)
Individual Characteristics				
Male	-0.035***	-0.035***	0.589***	0.588***
	(0.008)	(0.008)	(0.134)	(0.134)
Hispanic	-0.025	-0.025	-1.171***	-1.165***
	(0.015)	(0.015)	(0.152)	(0.155)
Combined race	-0.015***	-0.015***	0.240***	0.239***
	(0.004)	(0.004)	(0.055)	(0.055)
Other race	0.018	0.018	-0.312**	-0.312**
	(0.017)	(0.017)	(0.152)	(0.151)
Age	-0.019***	-0.019***	0.401***	0.401***
	(0.002)	(0.002)	(0.030)	(0.030)
Seatbelt	0.046***	0.046***	-0.911***	-0.911***
	(0.002)	(0.002)	(0.052)	(0.051)
Never fight	0.096***	0.096***	-1.823***	-1.823***
	(0.007)	(0.007)	(0.100)	(0.100)
Never unsafe	0.049***	0.049***	-1.145***	-1.143***
	(0.008)	(0.008)	(0.152)	(0.152)
Considering suicide	-0.142***	-0.142***	2.567***	2.567***
	(0.005)	(0.005)	(0.195)	(0.195)
Never sex	0.262***	0.262***	-3.124***	-3.123***
	(0.008)	(0.008)	(0.141)	(0.142)
Year and state dummies	Yes	Yes	Yes	Yes
# Obs.	101314	101314	98995	98995
R-squared	0.181	0.181	0.135	0.135

Note: Spending variables are not instrumented. Standard errors are clustered at the state level. Standard errors in parentheses. * p<0.1 ** p<0.05 *** p<0.01

Appendix 4: The Determinants of Prevalence of Adult Cigarette Smoking using IV Two-Way Fixed Effects, 1993-2011

	(1) Prevalence	(2) Prevalence
State Characteristics		
Education Spending per capita	-0.002	
	(0.007)	
Education and Health Spending per capita		-0.002
		(0.006)
Cigarette tax	-0.002	-0.002
	(0.005)	(0.005)
Individual Characteristics		
Male	-0.006	-0.007
	(0.021)	(0.022)
Hispanic	-0.002	0.001
	(0.093)	(0.100)
Combined race	-0.034	-0.034
	(0.039)	(0.037)
Other race	0.063	0.070*
	(0.044)	(0.042)
Age	0.022**	0.022**
	(0.011)	(0.011)
Seatbelt	-0.002	-0.003
	(0.010)	(0.010)
Never fight	0.003	0.003
	(0.014)	(0.014)
Never unsafe	0.008	0.006
	(0.039)	(0.037)
Considering suicide	0.030	0.030
	(0.023)	(0.023)
Never sex	0.048*	0.048*
	(0.027)	(0.027)
Year and state dummies	Yes	Yes
# Obs.	102609	102609
R-squared	0.903	0.904

Note: The dependent variable is the percentage of adults who are smokers in the state population. Standard errors are clustered at the state level. The estimation is based on our just-identified specification using corruption as our only instrument.* p<0.1 ** p<0.05 *** p<0.01.