

NBER WORKING PAPER SERIES

EVEN FOR TEENAGERS, MONEY DOES NOT GROW ON TREES:
TEENAGE SUBSTANCE USE AND BUDGET CONSTRAINTS

Sara Markowitz
John Tauras

Working Paper 12300
<http://www.nber.org/papers/w12300>

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 2006

Corresponding Author: Sara Markowitz, Department of Economics, Rutgers University, Newark, 360 Dr. Martin Luther King Jr. Blvd. Newark, NJ 07102 Phone: 973-353-5350 Email: smarkow@newark.rutgers.edu
The authors would like to thank Vincy Fon, Robert Goldfarb, Chris Ruebeck, Carlos Seiglie, and seminar participants at Lafayette College and Columbia University for extremely helpful suggestions and comments. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

©2006 by Sara Markowitz and John Tauras. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

Even For Teenagers, Money Does Not Grow on Trees: Teenage Substance Use and Budget Constraints

Sara Markowitz and John Tauras

NBER Working Paper No. 12300

June 2006

JEL No. I0, D0

ABSTRACT

This paper is about the spending choices of youth, with a particular focus on how the demand for cigarettes, alcohol and marijuana are influenced by changes in the prices of other products. Youth tend to have small incomes and limited wants, with the result that many students spend the bulk of their income on only a few items. Fast food, clothing and entertainment make up the majority of products purchased by teenagers. The hypothesis to be tested in this project is that changes in the prices of the other goods commonly bought by teenagers will affect budget allocations and thereby affect the demand for substances. We estimate own and cross price effects using the prices of cigarettes, alcohol, marijuana and other consumer products including gasoline, clothing, entertainment, and fast food. Income effects are also estimated and show that teens with higher incomes and allowances are more likely to use substances. The policy implications of the results are discussed.

Sara Markowitz

Rutgers University

Department of Economics

360 Dr. Martin Luther King Jr. Blvd.

Newark, NJ 07102

and NBER

smarkow@rutgers.edu

John A. Tauras

Department of Economics

University of Illinois at Chicago

601 S. Morgan Street, Room 2129

Chicago, IL 60607-7121

and NBER

tauras@uic.edu

1. Introduction

Teenage “bad” behaviors, including smoking, drinking and drugs use, have been the cause for much concern over recent years. Many public and private resources have been devoted to the reduction of these behaviors, with efforts ranging from anti-use campaigns to community education to excise tax increases and even a war (i.e. the war on drugs). The tremendous effort exerted to reduce teenage substance use is not unwarranted. Current estimates show that 23.2 percent of 12th graders smoke, 47 percent drink alcohol and 23.1 percent use illegal drugs (Johnston et al. 2005a; 2005b). The harm which can result from these behaviors include poor schooling and labor market outcomes, violence, crime, injury and even death (Chaloupka and Warner 2000; Cook and Moore 2000).

Economist have tended to focus their research on the ways in which policy tools-- primarily excise taxes--can reduce teenage smoking and drinking. Other policies that have been studied include laws relating to drunk driving, youth access laws (pertaining to both alcohol and cigarettes), clean indoor air laws, and fines and penalties associated with drug use. This paper extends this research by examining the effects of prices of other items in a teenager’s budget constraint on their demand for cigarettes, alcohol and marijuana. Youth tend to have small incomes and limited wants, with the result that many students spend the bulk of their income on only a few items. Fast food, clothing and entertainment make up the majority of products purchased by teenagers (Klein 1998). We explore the possibility that changes in the prices of the other goods commonly bought by teenagers will affect budget allocations and thereby affect the demand for alcohol, marijuana and cigarettes. We pay particular attention to the role of increasing gasoline prices in affecting substance use since gasoline may be an important

component of the budget for some teenagers. The policy implications of higher gas taxes and other excise taxes are discussed.

2. Background

Sources of Income

Teenagers primarily get their income from allowances, wages, and gifts (Meeks 1998; Doss et al. 1995). McNeal (1990) estimates that family members supply 83 percent of a child's income while the rest comes from outside the home. Estimates of the proportion of children receiving allowances range from a high of 90 percent (Doss et al. 1995) to a low of 50 percent (Meeks 1998).

The Bureau of Labor Statistics reports that during the 1996-1998 period 2.9 million youths ages 15-17 worked during the school months and 4 million worked during the summer months. The probability of working increases with age, with only 9 percent of 15 year olds working during the school year and 18 percent working during the summer, while 26 and 36 percent of 16 year olds work during the school year and summer, respectively. Thirty-nine percent of 17 year olds work during the school year and 48 percent work in the summer (BLS 2000). Earnings of these working teens are fairly low. Sixty-three percent earn less than \$2,000 per year, 32 percent earn between \$2,000 and \$5,000 per year, and 7 percent earn more than \$5,000 (Johnson and Lino 2000).

Meeks (1998) finds that teenage girls are more likely to earn money from wages (55 percent for girls versus 47 percent for boys), while boys are more likely to earn money from paid jobs at home (50 percent for boys versus 38 percent for girls). A recent poll of teenagers ages 12-17 found that 73 percent of teens earn money from doing odd jobs and 36 percent hold down

a regular or part-time job (Coinstar 2003). These earnings outrank parents and gifts as the primary source of spending money.

Expenditures

One estimate of teenage expenditures shows that in 1994 teens had an aggregate income of \$96 billion and spent 68 percent of that income (Zollo 1995). Studies highlighting exact products on which teens spend their incomes are scant, although it is known that most of a teenager's income is used for discretionary purchases (Meeks 1998). Doss et al. (1995) report that middle school children ages 10-15 spend 73 percent of their income, save 18 percent and use the rest on gifts. Younger children may have different spending habits as Belk et al (1985) show in a study of seventh graders. These children spend 39 percent of their income on themselves, save 37 percent, and spend the rest on gift purchases. Teenage contributions to household expenses are also very low. Using data from the National Survey of Families and Households, Meeks (1998) finds that only 20 percent of teens are expected to contribute to family expenses.

The products that youth buy and the corresponding spending patterns differ by gender but typically most income is spent on clothing, stereos and music, televisions, eating out, gas, recreation, gifts and personal expenses (Bachman 1983; Doss et al. 1995; Bailey 1992; Zollo 1995). In studies that examine the proportion of income spent on certain products, food and clothing top the list. Doss et al. (1995) find that 26 percent of middle school children's total income is spent on clothing, 9 percent is spent on food, 6 percent is spent each on books/magazines and sports/recreation, and 5 percent is spent on videos and movies. Older children have slightly different spending habits. Klein (1998) finds that 34 percent of teenagers'

expenditures go towards clothing, 22 percent go for entertainment and 16 percent go towards food. The most popular items within each of these categories are jeans, music and fast food.

Transportation is a major source of expenditures for families with teenagers, particularly those families with employed teenagers. Johnson and Lino (2000) analyze the 1997-1998 Consumer Expenditure Survey and find that transportation accounts for 26.2 percent of total expenses for households with an employed teen, compared to 22.5 percent for households with teens who are not employed. The authors hypothesize that “teenage employment likely results in families driving more miles in a vehicle, using public transportation more often, or even having a second vehicle.” (p 19) This indicates that transportation expenses, including gas prices, are likely have an influence on a teenager’s probability of working and the hours or days worked.

Data on expenditures on alcohol, cigarettes and illegal drugs by teenagers are not readily available for the U.S. However, a survey of Dutch teenagers measured spending patterns for 20 categories of goods. In 1992, the latest year reported by Warnaar and Van Pragg (1997), average monthly expenditures by students were the highest among the following categories: clothes and shoes (103 Dfl.), alcoholic beverages (95 Dfl.), savings (76 Dfl.), drugs (72 Dfl.), school books (67 Dfl.) and smoking (63 Dfl.). Note that the average expenditure amounts are calculated only for students who report buying the product. Only 37 percent of students report buying alcoholic beverages, 24 percent smoke, and 6 percent report buying drugs.

Using an Almost Ideal Demand System, Warnaar and Van Pragg (1997) estimate some cross price elasticities that are relevant for this study. They use pseudo-prices of clothing, school, traveling (i.e. public and private transport) and magazines in the system. These pseudo-prices are the fraction of expenditure that adolescents have to pay themselves, with parents acting as co-spenders paying the rest. They find that as the pseudo-price of clothing and magazines increases

(the student pays more of the total) the share of alcohol in the budget decreases. A similar result holds for the category of vice which includes expenditures on gambling and drugs. The share of tobacco in the budget, by contrast, is not statistically related to these cross prices except for girls when the price of clothing is considered, and boys, when travel expenses are considered. These results hold in only one of the two years analyzed. The authors also find that the income elasticities of alcohol, tobacco, and vice (gambling and drugs) are all positive and greater than one for teens of both genders. However, having a job, *ceteris paribus*, lowers spending on tobacco and vice.

The relationships between drugs, alcohol, and cigarettes for youth.

There is much debate in the existing literature as to whether cigarettes, drugs, and alcohol are complement or substitute goods. Differences in the age of the sample respondents, time periods, level of consumption (individual vs. state aggregate), measures of substance use, measures of prices and methodology all contribute to the diverging estimates among studies. Even the subset of literature on teenagers reaches contradictory conclusions.

Alcohol and Marijuana: The bulk of the evidence shows that alcohol and marijuana are substitutes for youth (Theis and Register 1993; Chaloupka and Laixuthai 1997; Chaloupka et al. 1999; DiNardo and Lemieux 2001), although Pacula (1998) finds alcohol and marijuana to be complements among teenagers and Williams et al. (2004) finds the same result for college students. Theis and Register (1993), Williams et al. (2004), Chaloupka and Laixuthai (1997), Chaloupka et al. (1999) and Pacula (1998) all use individual level data and look at participation decisions, and the latter three studies also examine quantity decisions conditional on participation. DiNardo and Lemieux (2001) examine state level rates of use. In these studies, the price of alcohol is measured by beer prices (Chaloupka and Laixuthai 1997), beer taxes

(Chaloupka et al. 1999, Pacula 1998; Williams et al. 2004) or by the alcohol component of the CPI (DiNardo and Lemieux 2001). All of these papers include as a measure of the price of marijuana an indicator of whether or not the state has decriminalized the possession of small amounts of marijuana for personal use. Two studies also use a measure of the monetary price of marijuana (Chaloupka and Laizuthai 1997 and Williams et al. 2004). Pacula (1998) includes an additional proxy for the price of marijuana which is the crime per officer ratio. It is this variable, not the decriminalization variable used in the other studies, that shows complementarity with alcohol consumption, which partly explains why her results differs from the others.

Alcohol and Cigarettes: Only a few studies have examined specifically the relationship between alcohol and cigarettes consumption for youth, although a number of other studies have examined this relationship among adults (Picone et al. 2004; Goel and Morey 1995; Bask and Melkersson 2004; Cameron and Williams 2001; Zhou and Harris 2004). The literature for both youth and adults shows very mixed results. Among youth in the United States, Dee (1999) finds that alcohol and cigarettes are complements. Using state-level rates of smoking and drinking for teenagers, Dee estimates reduced form models, where consumption is regressed on own and cross prices, and structural models, where consumption of the other good is entered on the right hand side of the equation. Both models suggest that alcohol and cigarettes are complements. Using individual level data, Chaloupka et al. (1999) and Williams et al. (2004) also find evidence of complementarity between these two goods for high school age children and college students, respectively, but their estimates are statistically insignificant. Pacula (1998) finds that the coefficient on the cigarette taxes in the probability of drinking equation is positive and significant, implying that smoking and drinking are substitutes. However, this relationship does not persist when the frequency of drinking is considered.

Cigarettes and Marijuana: The evidence regarding the relationship between cigarettes and marijuana consumption for youth is extremely limited. Farrelly et al. (2001) find evidence of a complementary relationship for youth ages 12-20. A similar result arises in Chaloupka et al. (1999), but only when marijuana consumption is regressed on the price of cigarettes. Insignificant coefficients result when cigarette consumption is regressed on the proxies for the price of marijuana. In addition, the studies by Pacula (1998) and Williams et al. (2004) find no statistically significant relationship between the price of cigarettes and marijuana consumption.

3. Theory

The relevant theory for this paper is the basic theory of consumer demand. We ignore the role of addiction in determining the demand for cigarettes, alcohol, and marijuana primarily because we estimate models for teenagers who are typically not addicted to these substances, who may discount the future heavily and who may lack information about their capacity to become addicted (Grossman et al. 1994; Glied 2002; Ross and Chaloupka 2003). Following Pacula (1998) and Dinardo and Limieux (2001), the model starts with a utility function that includes alcohol (A), cigarettes (C), marijuana (M), and a vector of other goods purchased by teenagers (G).

$$1) \quad U = u(A, C, M, G).$$

The youth maximizes utility subject to a budget constraint:

$$2) \quad I = P_a A + P_c C + P_m M + P_g G,$$

and

$$3) \quad A \geq 0, C \geq 0, M \geq 0, G \geq 0.$$

In the budget constraint, total youth income (I) consists of earned and unearned income, the latter of which includes allowances and gifts. Income is spent on the goods described in the utility

function. The prices of alcohol (P_a), cigarettes (P_c) and the vector of prices of other goods (P_g) are monetary prices. Data on the market price of marijuana (P_m) are difficult to obtain and therefore will be represented by the statutory monetary penalty that a person may incur if caught possessing marijuana. Details on all price measures are below.

The constraints laid out in equation (3) allow for both interior solutions (positive levels of consumption) and corner solutions (abstinence). The Kuhn-Tucker conditions resulting from the maximization problem take the general form:

$$4) \quad U_s - \lambda P_s \leq 0, \quad S[U_s - \lambda P_s] = 0$$

where S is one of the commodities in the utility function and λ is the marginal utility of income.

For positive values of consumption, the youth will consume at the point where the marginal gain in utility equals the marginal loss in terms of utility. Participation decisions for each substance are determined by comparing the marginal benefits to the marginal loss, evaluated at a zero consumption level. For any specific S , when the loss is greater than the benefit, a youth will abstain. Note that when substances are complements or substitutes, the probability of use of one substance will depend in part of the marginal utility of the other substances. Dinardo and Limieux (2001) consider the joint decision to consume alcohol and marijuana and present a detailed theoretical model deriving the possible combinations of use and abstinence. We refer the reader to their paper for details.

The basic reduced form demand equations that are derived for both the probability of use and the quantity consumed conditional on use take the same general form:

$$5) \quad A = a(P_a, P_c, P_m, P_g, I),$$

$$6) \quad C = c(P_a, P_c, P_m, P_g, I),$$

$$7) \quad M = m(P_a, P_c, P_m, P_g, I).$$

Equations 5, 6, and 7 are estimated below. Our interest lies not only in the signs of the coefficients on the own and cross prices of alcohol, cigarettes, and marijuana, but also of P_g , the vector of prices of other goods in the budget constraint. Specifically, these are the prices of gasoline, clothing, movies, bowling, sporting goods, soda, and fast food.

Linear probability models are used to estimate all probability equations and Ordinary Least Squares is used for the frequency models. The standard errors in all models are adjusted for clustering at the state level. Also, all prices and income variables are expressed in real (1982-1984) dollars.

These demand equations provide estimates of gross (Marshallian) cross price effects. For purposes of public policy, the gross price effects are relevant since they represent the total change in quantity resulting from a change in price, irrespective of whether the source of the change is an income or substitution effect. From a public health perspective, for example, a reduction in cigarettes smoked resulting from a tax increase is desirable no matter whether the reduction comes from people substituting away from smoking in order to consume other goods that provide utility, or whether it comes from a reduction in the available amount of income to spend on all goods. One caveat with the gross estimates is that the relationships between the goods need not be symmetric.

4. Data

Data on individuals come from the National Longitudinal Survey of Youth 1997 Cohort (NLSY97). The NLSY97 is a nationally representative sample of 9,022 youths aged 12-16 as of December 31, 1996. The first wave was conducted in 1997, with follow-ups annually. The last wave used in this paper is the 2001 wave (which includes some interviews conducted in 2002)

because this represents the last year with a significant number of respondents still in high school. We limit the sample to high school students because we want to capture the time period for which the students are most likely to be in school, live with their parents, derive most of their income from part-time work or allowances, and have limited wants and expenditures.

In each year of the survey the respondents are asked about their current smoking, drinking and marijuana use. The responses to these questions are used to construct six different dependent variables. For each substance, a indicator of probability of use is constructed as well as a measure of consumption among current users.

Participation in current smoking is represented by a dichotomous indicator that equals one for respondents who indicated that they smoked cigarettes in the 30 days prior to the survey and is equal to zero otherwise. Participation in drinking is represented by a dichotomous indicator equal to 1 for respondents who indicate that they drank any amount of alcohol in the 30 days prior to the survey and is equal to zero otherwise. A similar marijuana participation measure is created based on whether the respondent had smoked any amount of marijuana in the 30 days prior to the survey.

Average smoking among current smokers is a continuous measure of monthly cigarette consumption based on the number of days each smoker smoked in the past 30 days multiplied by the average number of cigarettes smoked per day on days smoked. This number is divided by 20 to get the number of packs smoked per month. Average drinking among current drinkers is a continuous measure of monthly alcohol consumption based on the number of days each person drank in the past 30 days multiplied by the average number of drinks consumed per day on days that they drank. Lastly, frequency of marijuana use among users is represented by the number of days in the past 30 on which the respondent used marijuana.

Table 1 shows the proportions and means of the substance use variables. Twenty-two percent of the respondents in high school are current smokers, 29 percent are current drinkers and 12 percent smoke marijuana. The average consumption among current smokers is 7.4 packs of cigarettes per month, the average consumption among current drinkers is 34 drinks per month, and marijuana is used an average of 9 days by users.

Table 1 also shows summary statistics for only those students who have a driver's license. We impose this restriction on the sample in the regressions so that we can examine the effects of higher gas prices on the substance use behaviors of teenagers who drive and who therefore are much more likely to have gasoline expenditures in the budget constraint. This group of students is obviously older than the full sample and displays different substance use patterns. Among this group, 27 percent smoke, 41 percent drink alcohol, and 15 percent use marijuana. Average levels of consumption is only slightly higher. Smokers consume 8.3 packs of cigarettes per month, drinkers consume 35 drinks per month, and marijuana is used an average of 9 days per month.

In all regression models, certain characteristics of the youth and family are included as additional regressors: age, gender, race (black, Hispanic, mixed race, and all other races as the omitted reference category) household size, and family structure (child lives with no parents, child lives with a step parent, child lives with one parent, and child lives with both parents as the omitted reference category). Youth income is measured separately by earned income and allowances from parents. Earned income includes money from salary, wages, odd jobs, temporary or seasonal jobs, commission and tips. Parental income is also included along with an indicator if this income is missing. Table 1 shows means and standard deviations for all of these variables.

It is important to account for as much of the unobserved heterogeneity in the error term as possible that may be correlated with prices and consumption. To do so, all models include indicators for the survey year, the female labor force participation rate in the state, the percent of state residents with at least a college degree, and the unemployment rate of the state. Beyond including these variables, we take two alternative approaches to the heterogeneity problem. The first is to include state fixed effects which will account for time-invariant state-level sentiment towards the outcomes. However, the state fixed effects tend to be highly correlated with the prices, and including them can result in the problems of multicollinearity and induce wide swings in the magnitude and significance of the price coefficients. The alternative approach we take is to exclude the state fixed effects and include other variables designed to represent the characteristics of the state that may be correlated with substance use. These models contain indicators for the nine census regions of the country and two variables that are specific to the beer and cigarette industries. The first is an indicator for whether the respondent lives in one of the six tobacco producing states: Kentucky, North Carolina, Georgia, South Carolina, Tennessee, and Virginia. The second is the number of persons in each state employed in breweries.¹ These data come from the Beer Institute for 2004. Both of these variables reflect a strong presence of the industry in the state, which in turn may influence legislated tax rates, and state sentiment towards using the products.

Prices

Cigarette price data were obtained from the annual *Tax Burden on Tobacco*. Until 1999, the Tobacco Institute published state level cigarette prices, since then, Orzechowski and Walker (2001) have published the data. The prices are weighted averages for a pack of 20 cigarettes and

¹ Models were tested with the per capita number of employees and results do not change. The absolute number of employees is used as a proxy for presence of large breweries within the state.

are inclusive of state level excise taxes applied to cigarettes but are exclusive of local cigarette taxes. The cigarette price data are merged in with the survey data based on the quarter and year of the interview and the state of residence.

ACCRA provides market prices for a number of different consumer goods in the *Inter-City Cost of Living Index*. Price are available quarterly for between 250 and 300 cities, although not all cities are represented in every quarter of data. From ACCRA, we use the prices of the following consumer products: 1) a six-pack of beer; 2) a man's long sleeve dress shirt; 3) a first run evening movie ticket; 4) a game of bowling on a Saturday night; 5) a can of 3 Wilson or Penn brand tennis balls; 6) a 2-liter bottle of Coca Cola; 7) a ¼ lb hamburger sandwich with cheese from McDonalds; 8) an 11-12'' pizza from Pizza Hut or Pizza Inn; and 9) a thigh and drumstick chicken meal from KFC or Church's. These products are chosen because they represent the categories of products commonly consumed by teenagers. The ACCRA prices are merged with the NLSY97 data by year and quarter of interview and residence. The merge based on location depends on whether a respondent lives within an area represented in the ACCRA data. NLSY97 reports the county of residence for all respondents. All ACCRA cities are placed in a county, and all counties are placed within a Core Based Statistical Area (CBSA). The merging of prices to the NLSY data therefore is done first based on county and second by CBSA. When a respondent lives in a CBSA that does not have an ACCRA city, the respondent is assigned a state price which is simply the average price of the ACCRA cities in that state. Dummy variables indicating the level of the residential match are included in all regressions.

No reliable state-level data are available for the price of marijuana. Following Farrelly et al. (2001) and Williams et al. (2004) we use the midpoint of the statutory minimum and maximum monetary penalty for possession of a small amount of marijuana to represent this

monetary price. These fines come from state statutes, collected by the lawyers and policy analysts for the ImpacTeen Illicit Drug Team.

Monthly gasoline prices come from the U.S. Department of Energy, Energy Information Administration., and data on state and federal gas taxes come from U.S. Department of Transportation Federal Highway Administration. The monthly price and tax data were combined to create the full price, inclusive of sales and excise taxes, on gallon of regular grade gasoline. These gas prices are merged with the NLSY97 data based on the respondent's state and the month and year of the interview.

RESULTS

Tables 2, 3 and 4 show the results of the participation demand equations for cigarettes, alcohol, and marijuana respectively. The columns 1 and 3 include the region dummies, the indicator for tobacco producing states, and employment in breweries, and columns 2 and 4 include instead the state fixed effects. The models in columns 1 and 2 include all individuals in high school, while in columns 3 and 4, the sample is limited to those individuals who report having a driver's license. This restriction is imposed so that we can examine the effects of higher gas prices on the substance use behaviors of teenagers who drive and who therefore are much more likely to have gasoline expenditures in the budget constraint.

Smoking Participation: Own Price and Cross Price Effects

Table 2 shows the results for the probability of smoking. The first result to note is the negative own price effect, and these coefficients are statistically significant in three of the four models. As expected, adding the state dummies to the models changes the size of the

coefficients and standard errors. In column order, the elasticities of demand are -0.43 and -0.26 for the full sample and -0.53 and -1.03 for drivers.

The results also show some interesting cross price elasticities with regard to the probability of smoking. Higher fines for marijuana use are negatively related to the probability of smoking and are statistically significant in three of the four models. The beer price coefficients are negative in three of the four models, but are statistically insignificant. The coefficient on gasoline prices, by contrast, are positive and statistically significant in all models indicating that gas is a substitute for cigarettes.² The magnitude of this effect increases when the sample is limited to drivers only. The elasticity of the probability of smoking with respect to gas taxes is approximately 0.30 for the full sample and 0.41 for drivers.

Few of the other consumer products are related to the probability of smoking, and those that are, vary according to the sample under consideration. The different effects are not surprising since the sample of drivers tend to be older, work more and earn more. For the full sample of teens, bowling is a complement to smoking, while none of the other products displays a relationship. For the sample of drivers, bowling is no longer related, but here fast food chicken may be a substitute good.

Drinking Participation: Own Price and Cross Price Effects

Table 3 contains the results for the probability of drinking. The own price effects for the probability of drinking are negative and statistically significant for the full sample and negative, but not significant for the sample of drivers. The elasticities of participation are inelastic and average -0.37 for the full sample and -0.17 for drivers.

² Teens who do not have a driver's license may still incur gasoline expenditures if they contribute to their peer's driving expenses in exchange for rides.

Recall that the cross price effect of the price of beer on the probability of smoking implies complementarity (without achieving statistical significance). When the probability of drinking is considered, however, the cross price effect is positive and statically significant in the full sample, implying that beer and cigarettes are substitutes. Recall that in Marshallian demand estimates, symmetry is not guaranteed.

The fines associated with marijuana use are negatively related to the probability of drinking for the full sample when state fixed effects are excluded, but are positively related in the sample of drivers when state fixed effects are included. Gas prices are negatively related and achieve significance in the sample of drivers. The models also present some evidence that bowling, clothing, and fast food chicken may all be complements to the probability of drinking. However, pizza appears to be a substitute for drinking participation.

Marijuana Participation: Own Price and Cross Price Effects

Table 4 contains the results for the probability of using marijuana. The own price effects for the probability of marijuana use are measured very imprecisely. However, the coefficients on cigarette prices are positive and statistically significant in three of the four models. These results indicate that marijuana and cigarettes are substitute goods, which is contrary to the relationship implied in Table 2.

Beer prices are negatively related to the probability of marijuana use for the full sample, but the coefficients are at about the 10 percent level of significance. Gas prices are not related to the probability of marijuana use, nor are many of the other consumer products. However, bowling and fast food hamburgers may be complements to the probability of marijuana use.

Frequency of Substance Use

Full results for the frequency of smoking, drinking and marijuana are not shown for brevity but we discuss the results here and will make the full results available upon request. In general, we do not estimate precise own and cross price effects when the frequency of substance use is concerned. The lack of precision may come from a severely reduced sample size as the percent of all high school teens and the percent of teens with drivers' licenses who use the substances are relatively small. In the full sample, 22 percent smoke, 29 percent drink and 12 percent use marijuana. Among the drivers, 27 percent smoke, 41 percent drink and 15 percent use marijuana.

The cigarette, beer, and marijuana own and cross price elasticities for the frequency of use are shown in Table 5, along with the participation elasticities. For the frequency of smoking conditional on positive use, the own price coefficient is negative only in the models with the state fixed effects, and is statistically insignificant in all models. Despite the insignificance, the calculated elasticities of frequency (-0.37 and -0.62) from the models with state fixed effects are reasonable and in line with those found in previous studies of youth (Lewit et al. 1981; Chaloupka and Grossman 1996; Tauras, Markowitz, and Cawley 2005). The own price elasticity for beer is also always insignificant. As for marijuana, the fine for marijuana is the only own price effect that is negative and statistically significant. Such a finding could indicate that legal penalties are a determinant of use primarily for the heaviest users.

The cross price effects for frequency of use in Table 5 reveal that higher prices of beer and marijuana are negatively associated with the frequency of cigarette use, although statistical significance depends on the sample and model under consideration. Note that the same

complementary relationship is also found for the probability of smoking. The coefficients and corresponding elasticities for marijuana fines are also negative and statistically significant in the alcohol frequency equations, again indicating complementarity.

Few consumer products are related to the frequency of smoking, drinking or marijuana use. The only relationships worth discussing are some of the fast food results. We find that the price of hamburgers is negatively related to the frequency of marijuana use within both samples and also to the frequency of smoking for the sample of drivers. While hamburgers may be complements to smoking and marijuana, strangely, fast food chicken appears to be a substitute for all three substances among the sample of drivers.

Income Effects

We measure youth income with earned wages and allowance/gifts. These income effects for the probabilities of use are shown in Tables 2-4. Not surprisingly, earned income is positively related to the probability of use for all three substances. Earned income is also positively related to the frequency of use of all three substances, although in the models examining the frequency of alcohol use the coefficients achieve statistical significance at just above the 10 percent level. Among the full sample, every additional \$100 in annual earned income increases the probability of smoking by 0.11 percentage points, the probability of drinking by 0.17 percentage points and the probability of marijuana use by 0.06 percentage points.

Increases in youths' allowances are associated with a higher probability of smoking in the full sample. Higher allowances are also positively associated with a higher probability of alcohol and marijuana use for the full sample and for drivers. Allowances, however, do not

predict an increase in frequency of use for any of the substances. The magnitudes of the allowance effect are much larger than the earned income effects. Among the full sample, every additional \$100 in annual allowances (about \$1.92 per week) increases the probability of smoking by 0.62 percentage points, the probability of drinking by 0.96 percentage points and the probability of marijuana use by 0.45 percentage points.

Holding youth income constant, parental income is negatively associated with both measures of smoking indicating that this income measure is likely reflecting some unobserved levels of household environment or parental smoking. Previous research has shown that both adults and children in low income families are more likely to smoke (USDHHS 1994; Husten and Jackson 2004). However, the results show that unlike with cigarettes, higher parental income will not prevent teenagers from any use of alcohol or marijuana, although higher parental income reduces the frequency of drinking and marijuana among users.

Discussion

Generally speaking, we find that marijuana use is a complement to smoking, but smoking is a substitute for marijuana. We find similar contradictory results between alcohol and cigarettes. Alcohol is a complement to smoking, but smoking is a substitute for alcohol. Marijuana and alcohol appear to be complements. All of these conclusions are made with the caveat that some estimates are statistically insignificant.

The finding of complementarity between marijuana and alcohol does not help settle the question of the nature of this relationship in the literature. Our finding corresponds to that of Pacula (1998) and Williams et al. (2004), but disagrees with the aforementioned earlier studies. One explanation is that the nature of the relationship may simply have changed over time. Our

study along with that by Williams et al. are the only studies to use data collected after the mid-1990s. Another explanation is that all studies suffer from poor measures of the price of marijuana. Without a reliable representation of the monetary price, it will be difficult to get consistent price effects across studies. This data problem may also explain the inconsistent results for marijuana and cigarettes.

The lack of symmetry in the cross price elasticities between cigarettes and alcohol is somewhat perplexing, but is not inconsistent with the results found by other researchers. For example, the papers by Chaloupka et al. (1999) and Pacula (1998) find evidence of complementarity and substitutability, respectively. However, Chaloupka et al. only examine the effect of the price of alcohol on cigarette consumption, while Pacula only examines the effects of the price of cigarettes on alcohol consumption. Our results confirm the findings from both of these studies. In a sample of adults, Decker and Schwartz (2000) estimate the own and cross price elasticities for cigarette and alcohol consumption. Their results are also similar to ours: higher beer prices decrease smoking participation, while higher cigarette prices increase drinking participation. They offer the explanation that as higher beer prices reduce the propensity for individuals to go to bars, they lose the social environment for smoking and therefore smoke less. The converse is that as cigarette prices rise, people may quit smoking and use alcohol to replace the palliative effects of smoking.

We know that state and federal governments can use excise taxes to influence smoking and drinking among youth. Gasoline is another product that is subject to state and federal excise taxes, and the relationship between gasoline and youth substance use makes gas taxes another potential policy tool to influence youth behaviors. We find that among students with driver's licenses, higher gas prices are associated with a reduced probability of drinking but an increased

probability of smoking. In other words, gas is likely to be a complement to drinking, in that teens may have to drive to get to places where they can consume alcohol. When higher gas prices reduce driving, drinking may also diminish. Gasoline, however, appear to be a substitute for smoking. This result likely arises from a strong substitution effect, where teens replace driving with time spent smoking.

Fast food is currently not taxed separately from other food products, but the idea has been mentioned as a solution to the growing problem of obesity (Propper 2005). Increasing the prices of fast foods may have an influence on substance use behaviors of teenagers in the following ways: Higher hamburger prices may reduce the probability and frequency of use of marijuana and the frequency of smoking among drivers. However, fast food chicken has a positive relationship with the frequency of use for all three substances among teens who are drivers, indicating substitutability. Pizza also is a substitute for the probability of drinking as well. Therefore, raising the prices of fast food chicken and pizza are predicted to increase some substance use as teenagers reallocate their budgets away from these fast food towards mind-altering substances.

The price of a game of bowling is negatively related to the probability of use for all three substances. The price of a man's shirt, which may represent the price of clothing generally, is negatively related to the probability of drinking among older teens. It is impossible to know whether such negative relationship arises because of strong income effects or whether the goods are complements in the sense that the consumption of one enhances the consumption of the other. It is easy to imagine a story where bowling and the substances are jointly consumed and enjoyed. For clothing and drinking, complementarity could arise if having the right party clothing or a new outfit enhances the drinking experience, however, it is more likely that the

coefficient reflects a strong income effect.

Given the robust result that higher youth earned incomes increase the probability and frequency of substance use, a relevant policy question is whether increases in state or federal minimum wage laws would have the unintended consequence of increasing teenage substance use. The Bureau of Labor Statistics estimates that slightly more than one-quarter of minimum wage workers (about 605,000 workers) in 2002 are teenagers (BLS 2003). However, in our sample of high school teens, 79 percent of the teens who work at employer based job earn an hourly wage higher than the legislated state minimum. Given this, it is not clear the extent to which changes in the minimum wage would affect the income of these teens and their corresponding substance use. This is a direction for future research.

References

- ACCRA. *Inter-city cost of living index*. Louisville, KY: ACCRA, Various years.
- Bailey, Anne W. Teenagers' Employment, Earnings and Spending." *Journal of Home Economics*, Summer 1992, 20-24.
- Bask, Mikael; Melkersson, Maria. Rationally Addicted to Drinking and Smoking?. *Applied Economics*. Vol. 36 (4). p 373-81. March 2004.
- Belk, Russell W, Clifford Rice and Randall Harvey. "Adolescents' Reported Saving, Giving, and Spending as a Function of Sources of Income," *Advances in Consumer Research*, Vol. 12, eds. Elizabeth C. Hirschman and Morris B. Holbrook, Provo: Association for Consumer Research, 1985, 42-46.
- Bureau of Labor Statistics, U.S. Department of Labor. *Report on the Youth Labor Force*. June 2000. Available at <http://www.bls.gov/opub/rylf/rylfhome.htm> [accessed October 6, 2005].
- Bureau of Labor Statistics, U.S. Department of Labor. "Characteristics of Minimum Wage Workers: 2002" August 8, 2003. Available at <http://www.bls.gov/cps/minwage2002.htm>. Accessed April 2006.
- Cameron, Lisa; Williams, Jenny. Cannabis, Alcohol and Cigarettes: Substitutes or Complements?. *Economic Record*. Vol. 77 (236). p 19-34. March 2001.
- Chaloupka, FJ and Grossman M (1996). Price, Tobacco Control Policies, and Youth Smoking. NBER Working Paper, No. 5740.
- Chaloupka, Frank J; Laixuthai, Adit. Do Youths Substitute Alcohol and Marijuana? Some Econometric Evidence. *Eastern Economic Journal*. Vol. 23 (3). p 253-76. Summer 1997.
- Chaloupka, Frank J; Pacula, Rosalie Liccardo; Farrelly, Matthew C; Johnston, Lloyd D; O'Malley, Patrick M. Do Higher Cigarette Prices Encourage Youth to Use Marijuana?. [Working Paper] National Bureau of Economic Research, Inc, NBER Working Papers: 6939. 1999.
- Chaloupka, FJ and KE Warner. "The Economics of Smoking," in *The Handbook of Health Economics*, Anthony J. Cuyler and Joseph P. Newhouse (eds.). North-Holland, Elsevier Science B.V.: New York, 2000; 1539-1627.
- Coinstar, "First Coinstar Teens Talk Poll Reveals Adolescents Spend at Least \$264 Each Month." <http://www.coinstar.com/US/PressReleases/453946?OpenDocument> [accessed October 6, 2005]
- Cook PJ and MJ Moore. "Alcohol," in *The Handbook of Health Economics*, Anthony J. Cuyler and Joseph P. Newhouse (eds.). North-Holland, Elsevier Science B.V.: New York, 2000; 1630-1673.

Decker, Sandra L; Schwartz, Amy Ellen. Cigarettes and Alcohol: Substitutes or Complements?. National Bureau of Economic Research, Inc, NBER Working Papers: 7535. 2000.

Dee, Thomas S. The Complementarity of Teen Smoking and Drinking. *Journal of Health Economics*. Vol. 18 (6). p 769-93. December 1999.

DiNardo, John; Lemieux, Thomas. Alcohol, Marijuana, and American Youth: The Unintended Consequences of Government Regulation. *Journal of Health Economics*. Vol. 20 (6). p 991-1010. November 2001.

Doss, Vonda S. Julia Marlowe and Deborah D. Godwin. "Middle-School Children's Sources and Uses of Money" *Journal of Consumer Affairs*, 29:1, Summer 1995. 219-241.

Farrelly, Matthew C, et al. The Joint Demand for Cigarettes and Marijuana: Evidence from the National Household Surveys on Drug Abuse. *Journal of Health Economics*. Vol. 20 (1). p 51-68. January 2001.

Glied, Sherry. "Youth Tobacco Control: Reconciling Theory and Empirical Evidence." *Journal of Health Economics*. Vol. 21 (1). p 117-35. January 2002.

Grossman, Michael, Frank J. Chaloupka, Henry Saffer, and Adit Laixuthai. "Effects of Alcohol Price Policy on Youth: A Summary of Economic Research." *Journal of Research on Adolescents*, 4(2), 347-364, 1994.

Goel, Rajeev K; Morey, Mathew J. The Interdependence of Cigarette and Liquor Demand.. *Southern Economic Journal*. Vol. 62 (2). p 451-59. October 1995.

Husten, C and, K Jackson, Cigarette Smoking Among Adults --- United States, 2002 MMWR, May 28, 2004, 53(20); 427-431.

Johnson, David S. and Mark Lino. "Teenagers: Employment and Contributions to Family Spending." *Monthly Labor Review*, September 2000, 15-25.

Johnston, L. D., O'Malley, P. M., Bachman, J. G. & Schulenberg, J. E. (December 19, 2005a). *Decline in teen smoking appears to be nearing its end*. University of Michigan News and Information Services: Ann Arbor, MI.[On-line]. Available: www.monitoringthefuture.org; accessed 02/12/06.

Johnston, L. D., O'Malley, P. M., Bachman, J. G. & Schulenberg, J. E. (December 19, 2005b). *Teen drug use down but progress halts among youngest teens*. University of Michigan News and Information Services: Ann Arbor, MI. [On-line]. Available: www.monitoringthefuture.org; accessed 02/12/06.

Klein, Matthew. "Teen Green" *American Demographics*, 20:2, February 1998, 39.

Lewit, EM, Coate D, and Grossman M (1981). The Effects of Government Regulations on Teenage Smoking. *Journal of Law and Economics*, 24, 545-569.

McNeal, J.U. "Children as customers." *American Demographics* 12(9), 36-39, September 1990.

Meeks, Carol B. "Factors Influencing Adolescents' Income and Expenditures." *Journal of Family and Economic Issues*, 19:2 Summer 1998, 131-150.

Orzechowski, WP and Walker R (2001). *Tax Burden on Tobacco*. Arlington, VA: Orzechowski and Walker.

Pacula, Rosalie Liccardo. Does Increasing the Beer Tax Reduce Marijuana Consumption?. *Journal of Health Economics*. Vol. 17 (5). p 557-85. October 1998.

Picone, Gabriel A; Sloan, Frank; Trogdon, Justin G. The Effect of the Tobacco Settlement and Smoking Bans on Alcohol Consumption. *Health Economics*. Vol. 13 (10). p 1063-80. October 2004.

Propper, Carol. "Why economics is good for your health. 2004 Royal Economic Society Public Lecture." *Health Economics* 14: 987-997 (2005).

Ross, Hana; Chaloupka, Frank J. "The Effect of Cigarette Prices on Youth Smoking." *Health Economics*. Vol. 12 (3). p 217-30. March 2003.

Tauras, John, Sara Markowitz and John Cawley "Tobacco Control Policies and Youth Smoking: Evidence from a New Era," in *Advances in Health Economics and Health Services Research, Vol. 16-Substance Use: Individual Behavior, Social Interactions, Markets and Politics*, edited by Bjorn Lindgren and Michael Grossman, Elsevier, Oxford, England, 2005.

Thies, Clifford F.; Register, Charles A. "Decriminalization of marijuana and the demand for alcohol, marijuana and cocaine." *Social Science Journal*, 1993, Vol. 30 Issue 4, 385-400.

U.S. Department of Health and Human Services. Preventing Tobacco Use Among Young People: A Report of the Surgeon General. Atlanta, Georgia: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 1994.

Warnaar, Marcel and Bernard van Praag. "How Dutch Teenagers Spend their Money." *De Economist*, 145, 367-397, 1997.

Williams, J, et al. Alcohol and Marijuana Use among College Students: Economic Complements or Substitutes?. *Health Economics*. Vol. 13 (9). p 825-43. September 2004.

Zhao, Xueyan; Harris, Mark N. Demand for Marijuana, Alcohol and Tobacco: Participation, Levels of Consumption and Cross-Equation Correlations. *Economic Record*. Vol. 80 (251). p 394-410. December 2004.

Zollo, Peter. "Talking to Teens." *American Demographics*, 17:11, November 1995, 22-28.

Table 1
Means and Standard Deviations

Variable	Full Sample (n=25,463)		Drivers (n=7495)	
	Mean	Std. Dev.	Mean	Std. Dev.
Smoking participation	0.22		0.27	
Drinking participation	0.29		0.41	
Marijuana participation	0.12		0.15	
Smoking frequency—packs per month	7.38	10.69	8.30	10.51
Alcohol frequency—drinks per month	34.22	131.11	35.34	106.36
Marijuana frequency—days used per month	9.11	10.14	9.38	10.30
Cigarette price per pack (Real price)	2.57 (1.54)	0.66 (0.35)	2.78 (1.63)	0.64 (0.33)
Beer price per six pack (Real price)	4.44 (2.67)	0.39 (0.23)	4.49 (2.65)	0.36 (0.21)
Fine for possession of marijuana (Real fine, \$1000s)	575.63 (0.34)	677.98 (0.40)	668.27 (0.39)	725.78 (0.43)
Gasoline price per gallon regular unleaded (Real price)	1.21 (0.73)	0.18 (0.10)	1.23 (0.73)	0.20 (0.11)
Price of a man's shirt (Real price)	30.43 (18.34)	4.20 (2.85)	29.44 (17.46)	3.86 (2.69)
Price of a first run movie ticket (Real price)	6.64 (3.98)	0.85 (0.47)	6.66 (3.93)	0.74 (0.39)
Price of a Saturday evening game of bowling (Real price)	2.76 (1.65)	0.64 (0.36)	2.78 (1.64)	0.54 (0.29)
Price of a can of tennis balls (Real price)	2.40 (1.45)	0.33 (0.21)	2.37 (1.40)	0.32 (0.20)
Price of a 2 liter bottle of coke (Real price)	1.11 (0.67)	0.16 (0.09)	1.12 (0.66)	0.14 (0.08)
Price of a fast food hamburger (Real price)	2.09 (1.25)	0.25 (0.14)	2.10 (1.24)	0.21 (0.11)
Price of a 12" pizza (Real price)	9.23 (5.55)	0.71 (0.44)	9.26 (5.48)	0.65 (0.40)
Price of a 2 piece chicken meal (Real price)	2.49 (1.50)	0.26 (0.15)	2.51 (1.48)	0.25 (0.15)
Youth's annual earned income (Real income)	1512.78 (417.58)	2354.13 (1047.52)	2130.65 (824.17)	2555.26 (1344.11)
Youth's annual allowance and gifts (Real allowance and gifts)	154.35 (92.84)	318.83 (190.34)	151.56 (89.74)	339.90 (200.52)
Parent's income (Real parent income)	46132.73 (22282.77)	46690.05 (27429.81)	58018.81 (27746.74)	52660.03 (31032.99)
Parent's income missing	0.20	0.40	0.19	0.39
Female	0.48		0.46	
Age	15.65	1.62	16.87	0.84

Black	0.25		0.16	
Hispanic	0.21		0.13	
Mixed race	0.01		0.01	
Household size	4.46	1.53	4.15	1.33
Lives with stepparent	0.14		0.13	
Lives with one parent	0.30		0.24	
Lives with no parents	0.06		0.04	
State female labor force participation rate	60.15	3.53	60.82	3.69
Percent of state population with at least a college degree	24.86	4.04	24.98	4.16
State unemployment rate	4.58	1.00	4.38	0.99
Tobacco producing state	0.15		0.16	
Number of jobs in breweries, 2004	2172.10	2257.57	1843.18	2062.55
ACCRA price match on CBSA	0.29		0.28	
ACCRA price match on state and quarter	0.35		0.39	
ACCRA price match on state and year	0.01		0.00	
Census division is New England	0.04		0.04	
Census division is East North Central	0.16		0.19	
Census division is West North Central	0.07		0.11	
Census division is South Atlantic	0.18		0.19	
Census division is East South Central	0.07		0.08	
Census division is West South Central	0.13		0.11	
Census division is Mountain	0.07		0.09	
Census division is Pacific	0.16		0.11	
Survey conducted in 1998	0.17		0.14	
Survey conducted in 1999	0.24		0.26	
Survey conducted in 2000	0.12		0.18	
Survey conducted in 2001	0.12		0.21	
Survey conducted in 2002	0.03		0.07	

Table 2
Demand for Cigarettes

	Smoking Participation			
	Full Sample (n=25,463)		Drivers (n=7,495)	
	(1)	(2)	(3)	(4)
Cigarette price	-0.061 (-3.58)	-0.037 (-1.29)	-0.089 (-2.77)	-0.172 (-3.12)
Beer price	-0.016 (-1.34)	-0.037 (-1.61)	-0.007 (-0.29)	0.021 (0.61)
Fine for marijuana	-0.028 (-4.75)	-0.037 (-2.69)	-0.034 (-2.66)	-0.024 (-1.07)
Gasoline price	0.097 (3.20)	0.082 (2.31)	0.151 (2.12)	0.156 (1.99)
Price of a man's shirt	-0.002 (-1.26)	-0.002 (-1.12)	-0.003 (-0.85)	-0.005 (-1.34)
Price of a movie ticket	-0.015 (-1.30)	-0.014 (-1.03)	-0.023 (-1.03)	-0.023 (-0.76)
Price of bowling	-0.027 (-2.07)	-0.028 (-2.04)	0.018 (0.84)	0.008 (0.35)
Price of tennis balls	0.002 (0.12)	0.005 (0.31)	-0.009 (-0.25)	-0.018 (-0.38)
Price of Coca-Cola	-0.012 (-0.35)	-0.023 (-0.59)	-0.082 (-1.23)	-0.111 (-1.47)
Price of a fast food hamburger	0.011 (0.32)	0.010 (0.28)	-0.007 (-0.10)	0.002 (0.03)
Price of a pizza	0.006 (0.83)	0.010 (1.26)	0.018 (1.42)	0.006 (0.34)
Price of a 2 piece chicken meal	-0.004 (-0.18)	-0.028 (-1.01)	0.069 (2.01)	0.058 (1.35)
Youth's earned income	0.00001 (3.07)	0.00001 (3.06)	0.00002 (3.00)	0.00002 (2.96)
Youth's allowance	0.0001 (3.70)	0.00006 (3.73)	0.00005 (1.41)	0.00004 (1.23)
Parent's income	-0.000001 (-4.51)	-0.000001 (-4.54)	-0.000001 (-5.12)	-0.000001 (-5.03)
Parent's income missing	-0.019 (-2.61)	-0.018 (-2.51)	-0.029 (-2.03)	-0.028 (-1.96)
Female	-0.007 (-0.71)	-0.007 (-0.73)	0.011 (0.90)	0.011 (0.88)

Age	0.040 (12.24)	0.040 (12.18)	0.036 (3.61)	0.036 (3.62)
Black	-0.166 (-11.47)	-0.167 (-11.02)	-0.213 (-12.55)	-0.211 (-11.64)
Hispanic	-0.063 (-5.01)	-0.061 (-4.52)	-0.043 (-1.93)	-0.039 (-1.70)
Mixed race	0.013 (0.38)	0.012 (0.35)	-0.019 (-0.25)	-0.013 (-0.17)
Household size	-0.005 (-2.09)	-0.005 (-2.08)	-0.013 (-2.46)	-0.014 (-2.44)
Lives with stepparent	0.081 (6.48)	0.079 (6.33)	0.079 (3.44)	0.076 (3.32)
Lives with one parent	0.073 (7.27)	0.073 (7.17)	0.062 (3.57)	0.062 (3.53)
Lives with no parents	0.087 (5.23)	0.086 (5.12)	0.026 (1.10)	0.022 (0.94)
Female labor force participation rate	0.002 (1.73)	-0.003 (-0.82)	0.003 (1.36)	-0.005 (-1.53)
Percent with college degree	0.001 (0.82)	0.001 (0.48)	-0.0003 (-0.17)	-0.001 (-0.31)
Unemployment rate	-0.001 (-0.24)	0.003 (0.33)	0.003 (0.36)	0.001 (0.06)
Tobacco producing state	0.034 (3.72)		0.055 (2.37)	
Number of jobs in breweries	-8.06E-06 (-4.57)		-9.69E-06 (-2.94)	
Area fixed effects	Regions	State	Regions	State
r-squared	0.062	0.064	0.055	0.061
Cigarette own price elasticity	-0.43	-0.26	-0.53	-1.03
Beer price cross elasticity	-0.20	-0.45	-0.07	0.20
Marijuana fine cross elasticity	-0.04	-0.06	-0.05	-0.03

Note: t-statistics in parentheses, intercept not shown. All models also include year indicators and indicators for the area matched to the ACCRA prices. Columns 1, 3 and 5 also include census division indicators. Columns 2, 4, and 6 include state indicators. All prices and income variables are expressed in real (1982-1984) dollars.

Table 3
Demand for Alcohol

	Drinking Participation			
	Full Sample (n=25,321)		Drivers (n=7,453)	
	(1)	(2)	(3)	(4)
Cigarette price	0.056 (2.30)	0.090 (2.66)	0.036 (0.95)	0.022 (0.35)
Beer price	-0.033 (-2.15)	-0.047 (-2.24)	-0.032 (-1.31)	-0.020 (-0.53)
Fine for marijuana	-0.022 (-2.28)	-0.010 (-0.78)	0.003 (0.17)	0.049 (1.66)
Gasoline price	-0.017 (-0.57)	-0.045 (-1.15)	-0.093 (-1.71)	-0.120 (-1.90)
Price of a man's shirt	-0.002 (-1.48)	-0.002 (-1.40)	-0.006 (-1.77)	-0.007 (-2.42)
Price of a movie ticket	-0.002 (-0.14)	-0.011 (-0.80)	0.016 (0.87)	0.011 (0.51)
Price of bowling	-0.021 (-1.61)	-0.007 (-0.47)	-0.058 (-2.50)	-0.022 (-0.65)
Price of tennis balls	0.008 (0.46)	0.014 (0.89)	0.029 (0.73)	0.023 (0.52)
Price of Coca-Cola	-0.016 (-0.39)	0.021 (0.49)	-0.024 (-0.33)	-0.011 (-0.12)
Price of a fast food hamburger	-0.028 (-0.73)	-0.033 (-0.90)	0.028 (0.46)	0.024 (0.41)
Price of a pizza	0.018 (1.69)	0.008 (0.68)	0.038 (2.09)	0.010 (0.46)
Price of a chicken meal	-0.060 (-2.29)	-0.103 (-3.76)	0.036 (0.77)	-0.014 (-0.26)
Youth's earned income	0.00002 (5.52)	0.00002 (5.43)	0.00002 (3.82)	0.00002 (3.73)
Youth's allowance	0.0001 (6.04)	0.0001 (6.19)	0.0001 (3.65)	0.0001 (3.68)
Parent's income	2.6E-07 (1.47)	2.8E-07 (1.58)	3.2E-07 (1.32)	3.7E-07 (1.51)
Parent's income missing	-0.016 (-2.21)	-0.015 (-2.12)	-0.006 (-0.36)	-0.005 (-0.31)
Female	-0.004 (-0.39)	-0.004 (-0.40)	-0.005 (-0.35)	-0.005 (-0.33)

Age	0.054 (19.14)	0.054 (19.13)	0.036 (4.04)	0.038 (4.21)
Black	-0.158 (-15.97)	-0.159 (-15.10)	-0.187 (-9.74)	-0.184 (-8.79)
Hispanic	-0.035 (-2.82)	-0.034 (-2.62)	-0.027 (-1.12)	-0.021 (-0.86)
Mixed race	-0.087 (-3.84)	-0.082 (-3.61)	-0.163 (-1.81)	-0.155 (-1.68)
Household size	-0.011 (-5.08)	-0.011 (-5.04)	-0.028 (-4.90)	-0.028 (-4.80)
Lives with stepparent	0.049 (5.07)	0.052 (5.39)	0.062 (3.55)	0.066 (3.68)
Lives with one parent	0.045 (6.10)	0.048 (6.55)	0.029 (2.02)	0.032 (2.25)
Lives with no parents	0.017 (1.12)	0.021 (1.31)	-0.004 (-0.10)	-0.004 (-0.10)
Female labor force participation rate	0.002 (0.93)	-0.002 (-0.66)	0.003 (1.18)	-0.017 (-2.98)
Percent with college degree	-0.001 (-0.41)	-0.001 (-0.27)	0.0004 (0.21)	0.001 (0.27)
Unemployment rate	0.020 (2.93)	0.016 (1.61)	0.031 (2.95)	0.028 (1.65)
Tobacco producing state	-0.031 (-2.85)		-0.017 (-0.93)	
Number of jobs in breweries	-2.51E-06 (-0.75)		-4.89E-07 (-0.11)	
Area fixed effects	Regions	State	Regions	State
r-squared	0.087	0.09	0.056	0.063
Cigarette cross price elasticity	0.30	0.48	0.14	0.09
Beer own price elasticity	-0.30	-0.43	-0.21	-0.13
Marijuana fine cross elasticity	-0.03	-0.01	0.003	0.05

Note: t-statistics in parentheses, intercept not shown. All models also include year indicators and indicators for the area matched to the ACCRA prices. Columns 1, 3 and 5 also include census division indicators. Columns 2, 4, and 6 include state indicators. All prices and income variables are expressed in real (1982-1984) dollars.

Table 4
Demand for Marijuana

	Marijuana Participation			
	Full Sample (n=25,339)		Drivers (n=7,460)	
	(1)	(2)	(3)	(4)
Cigarette price	0.044 (2.61)	0.077 (2.83)	0.065 (2.68)	0.035 (0.64)
Beer price	-0.017 (-1.63)	-0.032 (-1.69)	-0.004 (-0.21)	0.014 (0.47)
Fine for marijuana	0.005 (0.63)	0.002 (0.20)	0.016 (1.23)	0.023 (1.12)
Gasoline price	-0.015 (-0.50)	-0.020 (-0.61)	-0.057 (-1.25)	-0.020 (-0.42)
Price of a man's shirt	-0.001 (-0.69)	0.000 (-0.19)	-0.001 (-0.56)	-0.002 (-0.63)
Price of a movie ticket	0.001 (0.10)	-0.008 (-0.68)	0.010 (0.71)	0.004 (0.27)
Price of bowling	-0.023 (-2.70)	-0.015 (-1.46)	-0.021 (-1.17)	-0.012 (-0.60)
Price of tennis balls	-0.006 (-0.60)	-0.013 (-1.00)	-0.009 (-0.34)	-0.027 (-0.93)
Price of Coca-Cola	0.031 (1.07)	0.038 (1.09)	0.023 (0.36)	0.051 (0.67)
Price of a fast food hamburger	-0.053 (-1.82)	-0.048 (-1.73)	-0.083 (-1.20)	-0.058 (-0.86)
Price of a pizza	0.0002 (0.03)	0.004 (0.49)	-0.003 (-0.23)	-0.003 (-0.18)
Price of a chicken meal	0.004 (0.11)	-0.037 (-0.97)	0.033 (0.74)	-0.026 (-0.51)
Youth's earned income	0.00001 (2.39)	0.00001 (2.34)	0.00001 (1.19)	0.00001 (1.09)
Youth's allowance	0.00005 (4.04)	0.00005 (4.24)	0.00004 (2.04)	0.00004 (2.06)
Parent's income	-8.1E-08 (-0.90)	-8.3E-08 (-0.91)	7.7E-08 (0.47)	6.3E-08 (0.37)
Parent's income missing	-0.019 (-4.05)	-0.019 (-4.05)	-0.024 (-2.06)	-0.026 (-2.26)
Female	-0.028 (-5.47)	-0.028 (-5.52)	-0.026 (-3.48)	-0.026 (-3.43)

Age	0.024 (10.44)	0.024 (10.33)	0.013 (2.14)	0.013 (2.03)
Black	-0.048 (-6.58)	-0.047 (-6.03)	-0.061 (-5.16)	-0.060 (-4.76)
Hispanic	-0.017 (-1.46)	-0.017 (-1.40)	0.007 (0.41)	0.007 (0.42)
Mixed race	-0.005 (-0.23)	-0.004 (-0.19)	-0.047 (-1.12)	-0.038 (-0.89)
Household size	-0.006 (-3.54)	-0.006 (-3.48)	-0.014 (-4.75)	-0.014 (-4.70)
Lives with stepparent	0.049 (6.50)	0.048 (6.26)	0.062 (5.24)	0.059 (5.02)
Lives with one parent	0.056 (8.09)	0.056 (7.86)	0.059 (3.99)	0.059 (3.98)
Lives with no parents	0.058 (4.39)	0.057 (4.32)	0.054 (1.99)	0.052 (1.92)
Female labor force participation rate	-0.0004 (-0.41)	-0.006 (-2.61)	-0.0003 (-0.13)	-0.013 (-3.25)
Percent with college degree	0.001 (1.29)	0.003 (1.27)	0.001 (0.85)	0.003 (0.81)
Unemployment rate	0.004 (0.77)	0.008 (0.87)	0.010 (1.21)	0.008 (0.59)
Tobacco producing state	0.025 (2.48)		0.044 (2.57)	
Number of jobs in breweries	-3.83E-06 (-2.21)		-2.04E-06 (-0.85)	
Area fixed effects	Regions	State	Regions	State
r-squared	0.04	0.043	0.04	0.046
Cigarette cross price elasticity	0.56	0.99	0.71	0.38
Beer cross price elasticity	-0.38	-0.71	-0.07	0.25
Marijuana fine own elasticity	0.01	0.01	0.04	0.06

Note: t-statistics in parentheses, intercept not shown. All models also include year indicators and indicators for the area matched to the ACCRA prices. Columns 1, 3 and 5 also include census division indicators. Columns 2, 4, and 6 include state indicators. All prices and income variables are expressed in real (1982-1984) dollars.

Table 5
Own and Cross Price Elasticities: Cigarettes, Alcohol and Marijuana

Dependent Variable		Full Sample		Drivers	
		(1)	(2)	(3)	(4)
Cigarette Participation	Cigarette own price elasticity	-0.43**	-0.26	-0.53**	-1.03**
	Beer price cross elasticity	-0.20	-0.45	-0.07	0.20
	Marijuana fine cross elasticity	-0.04**	-0.06**	-0.05**	-0.03
Alcohol Participation	Cigarette cross price elasticity	0.30**	0.48**	0.14	0.09
	Beer own price elasticity	-0.30**	-0.43**	-0.21	-0.13
	Marijuana fine cross elasticity	-0.03**	-0.01	0.003	0.05*
Marijuana Participation	Cigarette cross price elasticity	0.56**	0.99**	0.71**	0.38
	Beer cross price elasticity	-0.38	-0.71*	-0.07	0.25
	Marijuana fine own elasticity	0.01	0.01	0.04	0.06
Cigarette Frequency	Cigarette own price elasticity	0.10	-0.37	0.23	-0.62
	Beer price cross elasticity	-0.22	-0.47	-0.72**	-1.06**
	Marijuana fine cross elasticity	-0.03	-0.09**	-0.01	-0.13**
Alcohol Frequency	Cigarette cross price elasticity	0.06	0.32	0.41	-0.59
	Beer own price elasticity	-0.01	0.36	-0.09	0.85
	Marijuana fine cross elasticity	-0.11**	-0.22**	-0.08	-0.29**
Marijuana Frequency	Cigarette cross price elasticity	0.20	-0.37	0.58*	-0.38
	Beer cross price elasticity	-0.38	0.15	-0.42	0.16
	Marijuana fine own elasticity	-0.04**	-0.06**	-0.04	0.02

** Indicates statistical significance at the 5 percent level. * Indicates statistical significance at the 10 percent level. Columns 1 and 3 include the beer and cigarette industry variables and the regional dummies. Columns 2 and 4 include state fixed effects.