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ECONOMIC AND OTHER FACTORS IN YOUTH ALCOHOL USE

City University of New York

PH.D. 1987

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ECONOMIC AND OTHER FACTORS IN YOUTH ALCOHOL USE

by

GREGORY M. ARLUCK

A dissertation submitted to the Graduate Faculty in
Economics in partial fulfillment of the requirements
for the degree of Doctor of Philosophy,
The City University of New York

1987

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This manuscript has been read and accepted for the Graduate Faculty in Economics in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract

ECONOMIC AND OTHER FACTORS IN YOUTH ALCOHOL USE

by

Gregory M. Arluck

Adviser: Professor Michael Grossman

This dissertation emphasizes the role of economic and regulatory factors in the determination of youth alcohol consumption and participation.

Demand models are estimated on individual data for a national sample of youths twelve to twenty years of age.

We develop three sets of multiple regression models to explain the annual consumption of beer, wine, and liquor. These models evaluate the effects of age, sex, ethnicity, education, family income, and other individual and household characteristics, along with alcohol prices (excise taxes), and legal drinking ages on annual consumption. Another set of multiple regression models are developed, of the linear probability type, which analyze the effects of the same variables on the decision to drink. We combine the elasticity effects from the consumption and participation models to estimate the incremental effects on total expected youth consumption resulting from changes in alcohol prices (excise taxes), and/or the removal of legal drinking ages.

The consumption models generally show that beer is unresponsive to price; that wine has an excise tax elasticity of -0.17; and that liquor has an excise tax elasticity of -0.91. The participation models indicate that wine is unresponsive to excise taxes; that the excise tax elasticity of beer is -0.06; and that of liquor is -0.65.

Legal drinking ages have a mitigating effect on alcohol consumption and participation. Beer consumption of underage youths is reduced by more than 22 percent, and beer participation by more than 7 percent. Neither wine consumption nor wine participation is affected by legal drinking ages. Liquor participation is reduced by nearly 9 percent, but liquor consumption is unaffected.

The lowering of drinking ages has significant short-term effects of significantly increasing individual wine consumption, however, these effects die out within one year. Neither individual beer nor liquor consumption, however, show stimulative responses to lower drinking ages.

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INTRODUCTION

In the last several years increasing attention has been given to the social problems resulting from teenage drinking. Foremost among these problems, and in the attention it has received, by both the public, and academic researchers, is the large number of automobile accidents involving intoxicated teenage drivers. Comprehensive studies of youthful motor vehicle accidents and the relationship of these accidents to legal drinking ages, legal driving ages, and other factors, have been undertaken by Cook and Tauchen (1984), Wagenaar (1983), Weinstein (1983), McCornack (1982), and more recently by Grossman and Saffer (1987).

In this dissertation, we do not seek to evaluate the problems that result from alcohol abuse, but rather seek to evaluate the social, economic, and regulatory factors that determine the U.S. youth demand for alcohol.

Our research makes several unique contributions. First, unlike existing alcohol demand studies, ours concentrates solely on the demand characteristics of youths, those between the ages of twelve and twenty. Second, we investigate the influence of social, demographic, and health factors, as well as economic and regulatory factors, on alcohol demand. Third, our analysis

is performed on the demand responses and characteristics of individuals, and not aggregates of such responses, as in other studies. Fourth, and last, and unique to our study, is our analysis of the social and economic determinants of drinking participation rates.

In the first chapter that follows we discuss the sources of data for our research.

CHAPTER I

DATA SOURCES

In general, our data come from two sources: data on individual alcohol consumption, socioeconomic status, and health come from a periodic national government survey; while data on alcohol prices and drinking-related regulations come from various trade association and government publications.

Source of Social, Economic and Consumption Data

The U.S. government utilizes the services of the U.S. Department of Health and Human Services, more particularly, the National Center for Health Statistics (NCHS), to perform periodic national surveys on nutritional well-being. The primary survey by which this nutritional information is obtained is the Health and Nutrition Examination Survey (HANES).

The HANES surveys are of particular interest to us, because they contain detailed information on the alcohol consumption of individuals, and a substantial amount of associated, detailed information on individual social status, economic well-being, and health.

This unusual combination of detailed alcohol consumption data, and data on detailed individual

characteristics, provides the foundation for our analysis of the youth demand for alcohol.

Significance of Using the HANES I Survey

We use a HANES tape from Cycle I of the U.S. Health and Nutrition Examination Survey (HANES I). This survey covers the years from 1971 to 1975.

The availability of data from HANES I is of particular interest for our research, because this survey covers most of the time period during which many states lowered their legal drinking ages. For example, during the years 1970 to 1975, twenty-five states lowered their legal drinking ages for liquor. These states are listed in table 1. Table 1 also includes estimates of the additional numbers of youths made eligible to drink by the lowering of these drinking ages, and so emphasizes the significant impact on youth drinking that could have resulted.

Our combined HANES I, and drinking-related data on alcohol prices, and legal drinking ages, allow us to estimate the effects of lowering drinking ages on youth alcohol consumption.

Geographic Coverage in HANES I

The interviews and examinations that provide the information for the HANES I survey were conducted at one hundred sites across the U.S. Each HANES site is composed of groupings of counties, and table 24 in appendix 1 displays the listing of the HANES I sample sites.¹

TABLE 1

STATES THAT LOWERED THEIR LEGAL DRINKING AGES FOR LIQUOR
BETWEEN 1970 AND 1975 AND THE RESULTING NUMBER OF YOUTHS
MADE ELIGIBLE TO DRINK

<u>Open States*</u>	<u>Age Lowered From</u>	<u>Date Effective</u>	<u>Youths Affected (Thousands)</u>
1. Alabama	21 to 19	21 July '75	141.3
2. Alaska	21 to 19	25 Sept. '70	11.8
3. Arizona	21 to 19	13 Aug. '72	72.7
4. Connecticut	21 to 18	1 Oct. '72	155.0
5. Delaware	21 to 20	12 July '72	10.7
6. Florida	21 to 18	1 July '73	389.0
7. Georgia	21 to 18	1 July '72	270.0
8. Hawaii	21 to 18	28 March '72	34.0
9. Massachusetts	21 to 18	1 March '73	330.0
10. Minnesota	21 to 18	1 June '73	229.0
11. Nebraska	20 to 19	6 July '72	28.7
12. New Hampshire	21 to 18	3 June '73	42.0
13. New Jersey	21 to 18	1 Jan. '73	363.0
14. Rhode Island	21 to 18	29 March '72	55.0
15. Tennessee	21 to 18	11 May '71	218.0
16. Texas	21 to 18	27 Aug. '73	710.0
17. Wisconsin	21 to 18	23 March '72	255.0

<u>Control States**</u>	<u>Age Lowered From</u>	<u>Date Effective</u>	<u>Youths Affected (Thousands)</u>
1. Idaho	21 to 19	1 July '72	30.0
2. Iowa	21 to 19	1 July '72	103.3
3. Iowa	19 to 18	1 July '73	52.0
4. Maine	20 to 18	9 June '72	37.3
5. Michigan	21 to 18	1 Jan. '72	515.0
6. Montana	21 to 19	1 July '71	25.3
7. Montana	19 to 18	1 July '73	13.7
8. Vermont	21 to 18	1 July '71	27.0
9. West Virginia	21 to 18	9 June '72	93.0
10. Wyoming	21 to 19	25 June '73	14.7

SOURCES: The source of the data in the first three columns is the Distilled Spirits Council of the United States (DISCUS). The data in the fourth column, on the number of youths made eligible to drink, are from Barsby and Marshall, (1977), Table 1.

NOTE: The state of Illinois lowered the drinking age for beer and wine during this time period, but did not lower the drinking age for liquor.

TABLE 1 - Continued

* - Open states are those that allow for the private ownership of the wholesaling and retailing of distilled spirits.

** - Control states are generally characterized as having state ownership of wholesaling and retailing of alcoholic beverages.

In some cases identical groupings of counties are counted as constituting two different sample sites. This occurs if county groupings are sampled over different time periods.

Sampling Methods and Examinations

The HANES I sampling scheme² required households to be selected and interviewed within each of the one hundred sites. Bureau of the Census personnel were utilized to select and interview households, and to obtain answers to approximately twenty categories of questions on demographic, ethnic, housing and income characteristics. These data were gathered in varying detail for individuals, households and families.

A detailed medical history questionnaire was administered by specially trained HANES I personnel to a subsample of individuals from the selected households.

These medical interviews were conducted in the subject's homes. Each interview contained approximately thirty categories of questions on the current and past physical and mental conditions of each individual.

These medical interviews also contained questions on the individual's recent alcohol beverage consumption.

A subset of the individuals given the medical questionnaire was also given an extensive battery of physical exams by specially trained medical doctors. These examinations provide data on the physical conditions of the

major organs and limbs, and the dental hygiene, of each individual.

Merging Data on Alcohol Prices and Drinking Regulations with HANES Data

The addition of data on alcohol prices, drinking ages, and other alcohol-related regulations to the data in HANES, provides the information necessary to estimate alcohol demand models.

The merging of the HANES I data, and data on alcohol prices, legal drinking ages, and other alcohol-related regulations was made possible by the cooperation of the National Center for Health Statistics. Under a confidentiality agreement with NCHS, geographic-specific alcohol-related data were merged with the data from HANES I. The tape produced from the merging of these two sets of data was then provided to us by NCHS.

Description of Alcohol Price and Drinking Regulation Data Merged with HANES

Our study incorporates the effects of lower drinking ages, and/or prices, in border states on youth alcohol consumption. By border states, we mean those states within a twenty mile distance of the HANES I site in which the youth resides.

Wales (1968), for example, has previously noted that ignoring differentials between own and border-state liquor prices biases the estimation of own-state liquor price elasticities.

In our work, we are concerned not only with border-state differentials in alcohol prices, but also with how border-state differentials in legal drinking ages affect the alcohol consumption of youths. It is well known that youths will often seek to purchase alcoholic beverages out-of-state, when they are not of legal age in their own state.

To properly comprehend these "border" effects, the data we added to HANES reflects as much as possible the prices and drinking restrictions that a youth would face at a given HANES site. For example, youths who resided in the northern counties of New Jersey (which border on New York State) during the 1970 to 1975 time period found that New York State's drinking age was three years lower than New Jersey's. We assume that these New Jersey youths who were within twenty miles of New York would travel to New York to avail themselves of the lower drinking age.

Table 2 contains a list of the variables describing the data that were added to HANES; and appendix 2 contains a detailed description of some of the more complicated variable constructions found in table 2. In particular, appendix 2 describes how we measure the influence of differences in alcohol prices and legal drinking ages at state borders.

We would like to elaborate on the significance or descriptions of some of the more important or complex variables found in table 2. We have singled out for

TABLE 2

DATA ADDED TO HANES I DATA TAPE
AS MATCHED WITH HANES I SITES

1. The own-state weighted average liquor price - constructed from data found in the Liquor Handbook (see appendix 2).
2. The lowest weighted average liquor price of the bordering state within twenty miles of the given HANES I site - constructed from data found in the Liquor Handbook and the City and County Data Book (1977) (see appendix 2).
3. The state excise tax rate on a case of malt beverage, in dollars per 24, 12 ounce containers - from Facts and Figures on Government Finance.
4. The state excise tax rate on a gallon of table wine, in dollars - from Facts and Figures on Government Finance.
5. The U.S. Consumer Price Index, All Items, 1967=100 - from the U.S. Statistical Abstract (1979) (see appendix 2).
6. The own-state minimum drinking age for beer - from the Distilled Spirits Council of the U.S. (DISCUS).
7. The lowest state minimum beer drinking age of a bordering state within twenty miles of the given HANES I site - derived from the City and County Data Book (1977) and DISCUS (see appendix 2).
8. Dummy variables that indicate whether grocery, drug or liquor stores can sell beer, wine, or liquor - constructed from data found in the Liquor Handbook.
9. The number of retail liquor licenses per thousand own-state population - from the Liquor Handbook.
10. A dummy variable indicating whether the own-state beer drinking age has changed in the last three years - derived from DISCUS drinking age data (see appendix 2).
11. A dummy variable that indicates whether a state is an open license or control state - from the Liquor Handbook.

TABLE 2 - Continued

12. The own-state age required to obtain the regular operator's license for motor vehicles - from the U.S. Department of Transportation.
13. Dummy variables that indicate in which region a given HANES I site is located; South, Midwest, Northeast, or West - from HANES I.
14. The number of months between the date the own-state beer drinking age was reduced, and the date the person was sampled - derived from drinking age data in DISCUS and HANES I examination dates (see appendix 2).
15. Dummy variables that describe whether a site has lower liquor prices or drinking ages than nearby bordering states, there are four possibilities:
 - a) the site in question has a lower own-state liquor price, but the border state has a lower drinking age.
 - b) the site in question has a higher own-state liquor price and a lower own-state drinking age.
 - c) the site in question has a higher own-state liquor price and a higher own-state drinking age.
 - d) the site in question has both lower own-state liquor prices, and drinking ages, than the bordering states.

These variables are constructed based upon data compiled from this table, lines 1, 2, 6, and 7.

16. The number of on-premise retail liquor licenses per thousand own-state population - from the Liquor Handbook.
17. State-specific consumer price indexes, as calculated by Fuchs, Michael and Scott (1979).

further discussion: the availability of alcohol price data, the relationship of the legal drinking age for beer to that of wine and liquor, our use of driving age data, and state restrictions on the retail availability of alcohol.

Alcoholic Beverage Price Data

Liquor Prices

Most of our liquor price data come from annual issues of Gavin-Jobson's Liquor Handbook. These annual publications tabulate, by state, representative producers' suggested retail prices for nine major brands and types of bottled liquor. Gavin-Jobson gathers these prices from mail surveys sent to the major liquor producers. These prices do not reflect any discounting by local retailers.

For some states and years, brand price data are not available from the Liquor Handbook. In most of these instances, we are able to provide estimates of the missing prices by using a compilation of bottled liquor prices assembled by the Distilled Spirits Council of the United States (DISCUS). (Where missing prices remained after using both the Liquor Handbook and the DISCUS data, we provided prices by interpolation.)

Both the Liquor Handbook and the DISCUS prices are for packaged liquor sales, i.e., bottled liquor sold for consumption at other than the place of purchase. Package liquor prices do not necessarily represent the prices a

customer would pay, per drink, at a bar, restaurant, or other eating establishment.

Beer and Wine Prices

Availability of Data

Beer and wine price data are not compiled by any marketing or government organization on a state-by-state basis. We attempted to gather our own beer and wine prices for the states and years involved in our study.

To obtain beer prices, we wrote to each state beverage control authority. Some states were able to provide us with useful price data, most, however, were not.

Detailed wine price data, by brand, were available to us on a confidential basis. However, we did not have data on a given brand's market share by state. As a result, we did not feel comfortable in selecting any given brand as the representative for its state, and were therefore unable to select a representative wine price, or calculate a weighted average wine price for any state.

Use of Price Proxies

We utilized as proxies for beer and wine prices the state-specific, beer and wine excise tax rates, as found in annual issues of Facts and Figures on Government Finance. (Beer excise tax rates are measured in dollars per case of twenty-four 12 ounce containers. Wine excise tax rates are measured in dollars per gallon of table wine.)

Drinking Age Data

State minimum purchase age data are obtained from the Distilled Spirits Council of the United States (DISCUS). (We will use the term minimum drinking age interchangeably with minimum purchase age, even though in most cases, states regulate the age to purchase alcohol, and not the age to drink it.) These data show the minimum purchase ages for beer (both under and over 3.2 percent alcohol content), wine (both under and over 14 percent alcohol content), and distilled spirits (liquor), and show, for each beverage, the month and year that a state changed its minimum drinking age.

Use of the Beer Drinking Age

We use the drinking age for 3.2 percent beer as the drinking age variable in each state. In almost every instance, the minimum drinking ages for beer, wine, or liquor, are the same, and where they differ, the drinking age for beer is always lower than the minimum drinking age for liquor; and generally lower, but never greater than the minimum drinking age for wine. The use of the legal drinking age for beer thus assures us that we are incorporating the lowest drinking age for which youths can legally purchase and consume alcoholic beverages.

Driving Age Data

Our analysis incorporates the effects of driving age restrictions on drinking behavior. Youths without driving

licenses have less ability to travel freely to states where the drinking age is lower than their own, or to states where alcohol prices are significantly lower than in their own state.

In general, each state has three different driving ages: the age to obtain a learner's permit; the age to obtain a regular operator's license; and the age to obtain a juvenile operator's license. The age requirements for both learner's permits and juvenile licenses are somewhat lower than for regular operator's licenses; however, learner's permits and juvenile licenses restrict the geographical coverage, route, use, or time of day for which the license or permit is valid.

In each state we use the age required to obtain the regular operator's license. This license has the least number of restrictions placed upon it, and would allow youths the greatest freedom of movement, within or outside their own state.

The data on state minimum legal driving ages were obtained from the National Highway Traffic Safety Administration.

Retail Availability

We include three sets of variables that will be used to measure the effects of retail availability on youth demand. The first set uses dummy variables to categorize the organization of the retail market; the second set uses

dummy variables to categorize the retail channels available for each beverage; and the third set contains measures of the population density of retail outlets.

Market Organization State Versus Private Distribution

Both the Liquor Handbook and DISCUS indicate whether or not a state is a control or open license state. Control states (or monopoly states as they are also known) allow only state or local governmental authorities to engage in either the wholesaling or retailing of distilled spirits, and or wine, and occasionally beer.

These states maintain their own government-owned and operated stores to sell alcoholic beverages to the public, and generally sell only by the bottle for off-premise consumption, i.e., consumption not at the place of purchase.

In contrast, open license states (also known as open states) maintain private ownership of the wholesaling and retailing of alcoholic beverages. These states regulate ownership by a system of state and local requirements on license eligibility, and collect fees for these licenses.

Effects on Youth Demand

The organization of a state's alcohol beverage market, i.e., control versus open, has both price and non-price implications. We examine both effects, paying particular attention to the effects of non-price factors on youth demand.

Non-price Effects

Most of the non-price effects on the demand for alcohol can be traced to the differences in the way control or open states regulate advertising for alcoholic beverages.

Control states are generally more restrictive than open states in the types and amounts of advertising allowed. This is most evident for liquor advertising.

For example, in 1977, seven out of the total of eighteen control states absolutely prohibited billboard advertising for liquor.³ In open states, only 4 states out of 35 prohibited billboard advertising for liquor.⁴

Newspaper and magazine liquor advertising are also more restricted in control states, with two states prohibiting it in 1977⁵ and two other states requiring prior approval. In open states, the restrictions on newspaper and magazine advertising are minimal.⁶

Control states restrict not only the type, but also the content of the advertising that may appear in newspapers or magazines. For example, many of the control states restrict or prohibit the use of any liquor advertising that uses religious, female or juvenile subjects.⁷

We have discussed the advertising restrictions that apply to liquor, and not to beer or wine, because there are

very few advertising restrictions on wine, and even fewer for beer. This is true in control as well as open states.

In addition to the different treatment of advertising, control states also maintain different business practices than open states. For example, control states generally have more restrictive hours of operation and are more unwilling to allow credit to be extended to consumers.

Price Effects

There is evidence that the form of market organization is correlated with the price of liquor, and this has been examined by Simon (1966), and more recently by Swidler (1986). However, as liquor prices appear directly in our models, we account for the effect of market structure on price, and on demand.

Retail Channels

Each state has restrictions on the types of alcoholic beverages that can be sold in common retail establishments; and the Liquor Handbook provides us with these restrictions by type of outlet. For example, in many states, grocery and drug stores can sell beer or wine, but are prohibited from selling liquor. At the same time, in many states, liquor stores can sell liquor, but not wine or beer.

Such restrictions on retail outlets tend to favor the consumption of beer and wine at the expense of liquor.

There are two reasons for this.

First, grocery and drug stores are much more common than liquor stores. Grocery and drug stores are also used more frequently for buying staple items.

Therefore, the availability of beer and wine at grocery and drug stores, reduces the incremental costs in travel time, and distance in obtaining these beverages.

Second, we believe that grocery and drug stores are less strict in their enforcement of legal drinking ages than liquor stores. For example, beer and wine are commonly thought to be less intoxicating than liquor, and therefore the purchases of beer, or wine, by underage youths, are more readily tolerated. In addition, the personnel at the check-out counters in grocery and drug stores, who become the de facto enforcers of a state's drinking age laws, are often youths, who are more likely to be sympathetic to the alcohol purchases of their peers. A liquor storeowner, however, has to be more careful to whom he sells liquor. The punishment for the liquor storeowner for ignoring a state's drinking age regulations is potentially much more severe than for the owner of a grocery or drug store; the liquor storeowner could lose his license, and hence jeopardize his livelihood. In contrast, the owner of the grocery or drug store, if caught ignoring minimum purchase ages for alcohol, could lose his right to sell alcoholic beverages, which presumably represent only a small portion of his revenues and profits.

Distribution Density

The distribution of liquor stores, expressed by their ratio to own-state population, varies substantially by state. All other things equal, youths will find it easier, and cheaper, to purchase liquor as the retail distribution density increases. We therefore incorporate three density measures in our models: the number of retail liquor licenses per own-state population; the number of on-premise liquor licenses per own-state population; and/or, the number of off-premise liquor licenses per own-state population. The Liquor Handbook provides these density measures.

In the following chapter we provide summary statistics on the HANES I, alcohol consumption, drinking age, and alcohol price data used in our study.

Footnotes

Chapter I

1

Only 65 of the 100 HANES I sites could be used in this dissertation. The 35 remaining sites sampled in the year ending 1975 contained only individuals 25 years of age or older, and could not, therefore, be used to test the effects of minimum drinking ages.

2

HANES I, and its sampling methodology, are described in detail by NCHS (1973, 1977).

3

Distilled Spirits Council of the United States, Inc., Summary of State Laws and Regulations Relating to Distilled Spirits, Twenty-second Edition, January 1977. The District of Columbia is counted as a state, and both Mississippi and Wyoming are counted as open and control states. This accounts for the apparent total of 53 open and control states.

4

Ibid.

5

Ibid.

6

Ibid.

7

Ibid.

CHAPTER II

OVERVIEW OF SAMPLE CHARACTERISTICS

We provide an overview of the characteristics of the HANES I data by organizing our descriptions into five major categories. These categories are geography, demography, economics, health, and drinking.

We also describe the characteristics of the price and drinking age variables that we added to the HANES I tape.

Geography

Regional Distribution of HANES I Youths

<u>Region</u>	<u>Number of Youths 12 to 20 Years Old</u>
South	711
Midwest	748
Northeast	558
West	538

NOTE: Based upon the 2,555 youths for which we could match HANES I sites with data we provided NCHS.

Degree of Urbanization

Fifty-one percent of all HANES youth twelve to twenty years of age (sample size 2,734) reside in highly urbanized areas; with three quarters of these youth living in areas

containing populations in excess of 250,000 people.

Youths living in rural areas (with populations of below 2,500) account for nearly 37 percent of our sample.

The remaining twelve percent of our youths reside in urban places; where the populations range from 2,500 to 25,000.

Demography of Youths

The demographic characterizations for youths, and the households to which they belong, are based upon the total HANES I sample of 2,734 youths ages twelve to twenty.

Age

Mean age: 15.8 years

Standard deviation: 2.6 years

Sex

<u>Sex</u>	<u>Percent</u>
Males	47
Females	53

Race

<u>Race</u>	<u>Percent</u>
White	76
Black	23
Other	1

Education--Highest Grade Attended

Mean grade level: 9.8 grade levels

Standard deviation: 2.5 grade levels

Marital Status--Youths Seventeen or Older

<u>Status</u>	<u>Percent</u>
Never Married	80
Currently Married	18
Divorced/Separated	1
Widowed	0

Occupational Status--Youths Seventeen or Older

<u>Status</u>	<u>Percent</u>
Working in Last Three Months	38
Student	50
Keeping House	12
Staying Home/Looking for Work/ Unable to Work	2

Demography of Households

Age of Head of Household

Mean age: 42.3 years

Standard deviation: 11.4 years

Sex of Head of Household

<u>Sex</u>	<u>Percent</u>
Male	78
Female	22

Education of Head of Household
Highest Grade Attended

Mean age: 10.9 grade levels
Standard deviation: 3.4 grade levels

Educational Credentials of Head of Household
Highest Grade Attended

<u>Educational Level</u>	<u>Percent</u>
Eighth Grade	12 (graduated)
High School	32 (graduated)
College	23 (4 to 9 percent graduated)

NOTE: Fourteen percent of household heads did not complete the eighth grade. These are not cumulative percentages and do not add to 100 percent.

Persons in Household

Mean number of persons: 5.1 people
Standard deviation: 2.4 people

Relationship of Youth to Head of Household

Eighty-nine percent of the youths were children of the head of household. Six percent of the youths were themselves heads of households. Five percent of the youths were related to the head of household, but were not a child of the household head.

Predominant Language Spoken in the Home

<u>Language</u>	<u>Percent</u>
English	90
Spanish	6
French	2

Main Ancestry of Youths

<u>Ancestry</u>	<u>Percent</u>
German, Irish or English	44
Black	23
Italian, French or Spanish	10
Polish or Russian	3
Mexican or American Indian	5
Base Group	14
Chinese, Japanese or Jewish	(1)
Other	(5)
"American"	(6)
"Don't Know"	(2)

These ethnic categories were created by aggregating the component ancestries found in HANES I. We grouped these ancestries to test for the influence of subcultures on beverage preferences and beverage consumption. The Chinese, Japanese, Jewish, Other, "American", and "Don't Know" categories are aggregated to form a reference, or base, category. Except for the Chinese, Japanese, and Jewish youth category (which has a small number of youths), this reference group has no clear ethnic identification.

Economic Characteristics

Distribution of Nominal Family Incomes

<u>Bracket</u>	<u>Percent</u>
\$ 0-- 7,000	36
7,001--14,999	45
15,000 and up	19

Mean family income: \$10,003

Standard deviation: \$ 6,775

Families on Welfare or Public Assistance

Thirty-three percent of the families whose incomes were below \$7,000 had received welfare or public assistance in the last twelve months.

Health Status of Youths

Current Ailments

The presence of certain health conditions, e.g., ulcers, can seriously lessen the ability of an individual to tolerate alcohol. Such conditions, other things equal, would reduce a person's demand for alcohol.

We therefore paid special attention to those health conditions which would reduce alcohol consumption. Youths were examined with respect to nearly forty physical or mental health conditions they currently have, or have had, and we selected fourteen of these forty conditions as having a potential mitigating effect on alcohol

consumption. (These fourteen conditions are found in chapter 3.)

Out of the fourteen conditions considered, only the following five conditions were found to have substantial numbers of responses.

<u>Condition</u>	<u>Number of Youths</u>
Asthma	86
Heart Murmur	55
High Blood Pressure	23
Bronchitis	42
Kidney Problems	31

Pregnancy

Forty of the two hundred females eighteen years of age or older were pregnant at the time of their interviews.

Drinking Behavior of Youths

HANES I asks several questions related to the individual's drinking behavior. These questions are:

1. During the past year, have you had at least one drink of beer, wine, or liquor? Yes or No
2. How often do you drink? Every day; Just about every day; About 2 or 3 times a week; About 1-4 times a month; More than 3 but less than 12 times a year; No more than 2 or 3 times a year
3. Which do you most frequently drink -- beer, wine or liquor? Beer, Wine, or Liquor

4. When you drink (beer/wine/liquor/) how much do you usually drink over 24 hours? ___ Glasses of beer; ___ Glasses of wine; ___ Drinks of liquor.

If a person did not answer yes to question 1, no further drinking questions were asked. If they answered affirmatively to question 1, question 2 was asked.

If they responded to question 2, with an answer of "no more than 2 or 3 times a year", they were not asked questions 3 or 4. A person drinking more than 3 times a year was asked questions 3 and 4.

Calculation of Drinking Measures

Annual

We converted the responses to question 2 into a set of annualized drinking measures. Therefore, people who drank: every day, drink 365 days a year; just about every day, drink 260 days a year; 2 or three times a week, 130 days a year; 1-4 times a month, drink 30 days a year; more than 3, but less than 12 times a year, drink 8 days a year; no more than 2 or 3 times a year, drink 3 days a year.

For each individual, we calculated the number of drinking days per year, and multiplied that number by the number of drinks he or she consumes per drinking day. These calculations provide estimates of the number of drinks of his preferred beverage that each individual consumes in the course of one year.

Daily

A daily drinking measure is provided in the individual's response to question 4. However, this measure is only available for those who drink more than 3 days per year.

Drinking Characteristics of Youths

Drinking Participation

Fifty percent of 2,726 youths in HANES reported they had drunk beer, wine, or liquor in the past year. This drinking participation rate is similar to that found in the 1974 National Survey on Drug Abuse, performed for the National Institute on Drug Abuse (NIDA).

The 1974 NIDA survey found that 54.6 percent of American youth aged twelve to seventeen had ever consumed an alcoholic beverage.

Beverage Preference

Of the 1,364 HANES youths who drank at least once during the past year, 563 drank three or fewer days in the year. HANES I does not ask the beverage preference or daily drinking questions of these 563 youths.

This leaves us with a sample of 797 youths, who have provided detailed responses on their preferred alcoholic beverage and the daily consumption of that beverage.

As table 3 indicates, youths have a clear preference for beer.

TABLE 3

MOST PREFERRED BEVERAGE

<u>Beverage</u>	<u>Percent</u>
Beer	65
Wine	17
Liquor	18

NOTE: Of 797 youths, 517 prefer beer; 137 prefer wine; and 143 prefer liquor.

The NIDA surveys were not able to provide a comparison for the preferred beverages of youths. NIDA did not question youths on the types of alcoholic beverages consumed. However, a 1975 national study by Rachal for the National Institute on Alcohol Abuse and Alcoholism (NIAAA), does provide information on the type of alcoholic beverages consumed by thirteen to eighteen year olds.

The NIAAA study reports that for youths who drink 1-2 days per week, twice as many prefer beer over wine or liquor, with almost the same number preferring wine and liquor.

The NIAAA findings are generally similar to those in HANES I. However, these results are not directly comparable. The NIAAA study allowed youths to report their consumption for each beverage, unlike HANES I, which required youths to indicate their most preferred beverage.

Amounts Consumed

Daily Consumption

Table 4 presents frequency distributions of the daily consumption of beer, wine, and liquor combined, and each separately.

It should be noted that in terms of absolute alcohol content, two twelve-ounce cans of beer have slightly less alcohol than one two-ounce drink of liquor, and that one twelve-ounce can of beer has slightly less alcohol than one four-ounce glass of table wine. (We are assuming beer of 3.2 percent alcohol content, table wine with 11.5 percent alcohol content, and liquor containing 41.5 percent alcohol.)

Intensity of Daily Consumption

Table 4 also presents the proportions of drinkers consuming various numbers of drinks per day. Let us define light drinkers as those who consume up to two drinks per drinking day; moderate drinkers as those who consume between three and five drinks per drinking day; and heavy drinkers as those who consume six or more drinks per drinking day.

Using these definitions to define daily drinking intensity, and considering the consumption of alcohol in general, we find that 64.1 percent are light drinkers; 23.5 percent are moderate drinkers; and 12.4 percent are heavy drinkers.

In comparison, in the NIAAA study, approximately 44 percent are light drinkers; 41 percent moderate; and 15 percent heavy.

Table 4 also demonstrates that when youths drink, they consume beer more intensively than either wine or liquor.

TABLE 4
DISTRIBUTION OF DAILY CONSUMPTION

<u># Drinks</u>	<u>Beverage</u>							
	<u>All</u>		<u>Wine</u>		<u>Liquor</u>		<u>Beer</u>	
	<u>%</u>	<u>Cum. %</u>	<u>%</u>	<u>Cum. %</u>	<u>%</u>	<u>Cum. %</u>	<u>%</u>	<u>Cum. %</u>
1	38.0	38.0	48.9	48.9	43.4	43.4	33.7	33.7
2	26.1	64.1	28.5	77.4	25.2	68.6	25.7	59.4
3	14.2	78.3	11.7	89.1	14.7	83.3	14.7	74.1
4	5.5	83.8	2.9	92.0	5.6	88.9	6.2	80.3
5	3.8	87.6	4.4	96.4	2.8	91.7	3.9	84.2
6	6.4	94.0	1.5	97.9	4.9	96.6	8.1	92.3
7	0.5	94.5	0.0	97.9	0.7	97.3	0.6	92.9
8	1.5	96.0	0.7	98.6	0.7	98.0	1.9	94.8
9	0.6	96.6	0.0	98.6	0.7	98.7	0.8	95.6
10	1.5	98.1	0.7	99.3	0.7	99.4	1.9	97.5
12	0.9	99.0	0.0	99.3	0.0	99.4	1.4	98.9
...
30	1.0	100.0	0.7	100.0	0.6	100.0	1.1	100.0
	(N=797)		(N=137)		(N=143)		(N=517)	

In fact, using our classification scheme for defining light, moderate and heavy drinkers, we can use table 4 to produce table 5. Table 5 shows how daily drinking intensity varies by beverage.

TABLE 5
DAILY DRINKING INTENSITY

<u>Intensity</u>	<u>Beverage (Percent)</u>		
	<u>Beer</u>	<u>Wine</u>	<u>Liquor</u>
Light	59.4	77.4	68.6
Moderate	24.8	19.0	23.1
Heavy	15.8	3.6	8.3

Table 5 shows that beer drinkers drink much more heavily than wine or liquor drinkers on a daily basis.

Annual Consumption

Table 6 presents frequency distributions of annual consumption for beer, wine, and liquor.

TABLE 6
 DISTRIBUTION OF ANNUAL CONSUMPTION
 (CUMULATIVE PERCENT)

<u># Drinks</u>	<u>Beer</u>	<u>Wine</u>	<u>Liquor</u>
0 - 30	36.4	57.7	48.3
31 - 60	52.4	72.3	68.5
61 - 90	61.3	81.0	80.4
91 - 150	72.1	86.9	86.7
151 - 300	86.8	90.5*	93.7
301 - 520	91.9	94.9**	95.1
521 - 1040	95.7	98.5	100.0
1041 - 3650	100.0	100.0	100.0

* 91-260 drinks per year

** 261-520 drinks per year

Intensity of Annual Consumption

We define consumption of thirty drinks a year or less to be low usage, consumption of between 31 to 150 drinks to be medium usage, and consumption above 150 drinks to be high usage.

Using these classifications for annual consumption, we use table 6 to produce table 7. Table 7 shows how annual consumption intensity varies by beverage.

TABLE 7

ANNUAL DRINKING INTENSITY

<u>Intensity</u>	<u>Beverage (Percent)</u>		
	<u>Beer</u>	<u>Wine</u>	<u>Liquor</u>
Low	36.4	57.7	48.3
Medium	35.7	29.2	38.4
High	27.9	13.1	13.3

Table 7 demonstrates that beer drinkers also drink more heavily than wine or liquor drinkers on an annual basis.

Drinking Age Restrictions on Youths

The youths in our sample face different drinking ages according to the states in which they reside, and have been exposed to their current drinking ages for different lengths of time, depending upon the dates on which drinking ages were lowered in their respective states.

Current Drinking Ages

We find that 64.7 percent of the 2,555 youths for whom we have beverage-specific prices reside in states where the current drinking age is 18; 2.9 percent reside where it is 19; and 32.4 percent reside where it is 21.

Length of Exposure to Current Drinking Ages

Most youths, 69.2 percent, live in states where the drinking age has not been lowered in the most recent

twenty-seven month period: for these youths, current drinking ages have been in effect since 1933, the year Prohibition was repealed. There are, however, 787 youths residing in states where drinking ages have been lowered in the most recent twenty-seven months, and of these youths, 43.8 percent have faced lower drinking ages for twelve months; and 56.2 percent have faced lower drinking ages for the last thirteen to twenty-seven months.

Incentives to Cross State Borders

The drinking behavior of youths can be affected by proximity to locations where either drinking ages or alcoholic beverage prices are lower than in their immediate vicinity. We have determined all HANES I sites that are within twenty miles of neighboring states, and assume that youths within twenty miles of states with lower drinking ages or liquor prices avail themselves of these additional drinking opportunities.

An examination of this phenomenon for our youths shows that:

1. There are 76 youths who live in HANES I sites where liquor prices are lower at home than across state borders, but where drinking ages are lower in at least one neighboring state. We expect such youths to purchase some of their liquor, or other alcohol across state lines.

2. There are 340 youths who live in sites where liquor prices are lower outside of their own state. These same youths, however, face drinking ages at home that are lower than across their state borders.

We expect these youths to consume their liquor and other beverages where they reside.

3. There are 416 youths who face lower liquor prices and drinking ages outside of their own state. These youths have the strongest incentive to cross state lines to purchase alcoholic beverages.
4. There remain 1,723 youths, or 67.4 percent of our 2,555 youths, who reside in states where their own liquor prices and drinking ages are lower than in neighboring states. These youths have the least incentive to cross state lines to purchase alcohol.

Youths and Market Organization

We have 1,739 youths who live in control or monopoly states: these states maintain state ownership of the retailing and wholesaling of liquor; and sell for off-premise consumption. (Control states allow the private ownership of stores that sell beer or wine either at wholesale or at retail.)

The remaining 816 youths reside in open states, where private stores sell liquor, by the bottle, for off-premise consumption.

We expect the alcohol consumption of youths residing in control states to be adversely affected by the restrictions that control states place on advertising, credit, store hours and beverage variety.

Mean Values and Standard Deviations of Prices, Consumption and Drinking Ages

Real Beverage Excise Taxes and Prices

<u>Beverage</u>	<u>Mean</u>	<u>Standard Deviation</u>
Beer	28.7 cents/case	27.3 cents/case
Wine	35.1 cents/gallon	31.7 cents/gallon
Liquor	\$4.24/fifth	40.0 cents/fifth

Annual Consumption in Drinks per Year

<u>Beverage</u>	<u>Mean</u>	<u>Standard Deviation</u>
Beer	200	387
Wine	129	361
Liquor	107	195

Legal Drinking Age for Beer

Mean drinking age: 18.9 years

Standard deviation: 1.3 years

Summary

We have described the major characteristics of the youths in our sample, including among these, descriptive features of the households to which these youths belong. A substantial amount of information was provided on the drinking patterns of our sample youth. Where possible,

these drinking patterns were compared with other national surveys. We have also described the drinking age and market environment which affect our youths and discussed our expectations of the effects these variables will have on drinking behavior.

In the next chapter, we discuss the specifications of our alcohol demand models, and review our major findings.

CHAPTER III

DEMAND MODELS FOR ALCOHOL CONSUMPTION

Object of Demand Models

Based upon the data from HANES I and the data that we added to the HANES I tape, we provide answers to two broad questions:

1. For the youths in our sample who are drinkers (those who drank at least four times in the year prior to their sampling), how responsive is the quantity drunk to price, the current drinking age, the length of exposure to the current drinking age and other demand influences?
2. For our entire sample, (including both drinkers and nondrinkers) how responsive is the decision to drink, i.e., become a drinker, to price, the current drinking age, the length of exposure to the current drinking age and other demand influences?

General Considerations in Specifying the Models

Variables

In specifying our models we have tried to incorporate the significant variables that affect an individual's demand for alcoholic drinks.

These significant variables fall into several categories: alcoholic beverage prices; income; demographic characteristics; physical and mental well-being; drinking ages; and marketing restrictions.

Functional Forms

Plots of the annual and daily drinking measures versus such explanatory variables as income and age suggested functions that increased at a decreasing rate. These findings are similar to those found for most commodities, as documented in family budget studies, as for example, in Prais and Houthakker (1971).

It is reasonable to expect that the individual consumption of alcohol reaches saturation levels, based either upon the physical capacity of the individual to hold liquids, or upon the ability of the individual to tolerate the alcohol imbibed.

For example, as an indication of the saturation levels reached, the frequency distributions of alcohol consumption displayed in tables 4 and 6, respectively, demonstrate that on a daily basis, 98 percent of the individuals consume less than 10 drinks per drinking day, and that on an annual basis, at least 95.7 percent of the individuals consume less than 1040 drinks per year.

This suggested to us that the general functional form of the consumption models should (with respect to at least some variables) be of the logarithmic reciprocal

transformation type; ¹ particularly with respect to income. This specification allows for asymptotic consumption levels and diminishing marginal rates of consumption. ²

In addition, preliminary investigations of consumption within income classes, and of the residuals from some simple regressions, suggested that the residuals grow with income, i.e., there is heteroscedasticity.

We took the logarithm of consumption to reduce this heteroscedasticity.

Specific Treatment of Variables in the Models

1. All nominal prices and tax rates were converted to real terms, by dividing by either the U.S. Consumer Price Index, or the Fuchs-Michael-Scott state-specific price indexes.
2. Nominal family income was converted into real terms by again dividing by either the U.S. Consumer Price Index, or the Fuchs-Michael-Scott price indexes. The real income variables created were entered inversely in the regression models, consistent with our view that consumption is asymptotic with respect to income. (We model consumption as a logarithmic reciprocal transformation of ¹ income.)
3. We defined the variable measuring the length of the youth's exposure to the lower drinking age to be the inverse of the number of months the current drinking

age has been in effect.³ Therefore, consumption is modeled as a logarithmic reciprocal transformation of the length of exposure to a new and lower drinking age. This modeling of consumption implies that exposure to the lower drinking age has diminishing marginal consumption effects and that consumption reaches an asymptotic level.⁴

4. We incorporated the drinking age restrictions by recognizing that for a given youth, the drinking age is binding only if that youth is below the legal drinking age. Youths at or above the drinking age (holding other variables fixed) would be indifferent to the existence of that legal drinking age. Therefore, instead of entering the legal drinking age directly into our models, we created a dummy variable which measured whether or not a youth was above or below the legal drinking age (taking into account all relevant border drinking ages). This dummy variable was defined to be "one" if the youth was one or more years below the legal drinking age, and zero if the youth was as old as, or older, than the legal drinking age.

Our drinking age variable permits us to test whether the existence of legal drinking ages has any effect on youth drinking.

5. We created an interactive variable, consisting of the product of price and our drinking age variable, to

measure the differential effects on price elasticity of the youth's legal drinking status.

6. Similarly, we created an interactive variable, consisting of the product of the variables representing the length of exposure to the lower drinking age and the youth's legal drinking status, to measure the differential response of legal and non-legal drinkers to lower drinking ages.
7. Ethnic dummy variables were constructed by combining the finer disaggregations of ethnic breakdowns found in HANES I. We combine HANES I categories based upon findings, as for example, in Cahalan (1970), Cahalan and Room (1974), or based upon our own definitions of relevant subgroups.

The remaining HANES I variables used in our models come directly from HANES I, and were not transformed.

Checking Consistency of HANES I Data

We considered approximately forty HANES I variables for our analyses, and examined the nearly three thousand observations associated with each variable. We did not find any apparent anomalies or outliers.⁵

List of HANES I Variables Used in Models

Our model specifications have drawn upon the following list of variables:

1. The population size of the HANES I site
2. The region of the country in which the site is located

3. The number of rooms in the household
4. The number of people in the household
5. The nominal household income
6. The welfare status of the household
7. The age, sex, education, and race of the head of household
8. The age, sex, weight, education, ethnic group, marital status, and employment status (student or nonstudent) of the youth, and his relationship to the head of household
9. The primary language spoken in the home
10. The health of the youth as specified by whether he has: ulcers, had a nervous breakdown, asthma, heart murmur, high blood pressure, enteritis, colitis, gallstones, bronchitis, hepatitis, chronic cough, low blood pressure, diabetes, or kidney disease or stones
11. The pregnancy status of the youth
12. The youth's health as measured by whether he has taken any medicine in the last six months for: sleep problems, pains, or nerves

Non-HANES Variables Used in Models

1. The legal right of drug, grocery or liquor stores to sell either, beer, wine, or liquor
2. The organization of the alcohol beverage market, as indicated by the control or open status of the state
3. The number of liquor licenses per own state population
4. The state minimum driving age

Modeling Approach

Modeling the Quantity Drunk for Drinkers

As we have data available on each individual's consumption of beer, wine or liquor, we develop demand models for each one of these beverages. The specifications for these models (as presented in their final forms) are nearly identical. The major difference between models is that each beverage is modeled as a function only of its own price (without incorporating the other two beverage prices).⁶

Algebraic Formulations of the Consumption and Participation Models

The general model forms that we use are:

$$\text{Consumption Model: } \ln Q_i = \sum a_i X_i + u_i$$

$$\text{Participation Model: } D = \sum b_i X_i + v_i$$

In these models "Q" is the annual consumption of the beverage under study; "X" represents the economic, demographic and regulatory variables; and "D" is a dummy variable, taking on the value of one for drinkers, and zero for nondrinkers. The "u" and "v" represent random error variables.

Table 8 includes a list of the HANES I and other variables for which we report final regression results.

TABLE 8

DEFINITIONS OF EXPLANATORY VARIABLES

INTERCEPT = Intercept in the regression

AGE = The age of the examined youth

SEX = A dummy variable that is "1" if the youth is male, "0" otherwise

N. EUROPE = A dummy variable that is "1" if the youth's main ancestry is northern european, i.e., German, Irish or English, "0" otherwise

S. EUROPE = A dummy variable that is "1" if the youth's main ancestry is southern european, i.e., French, Italian or Spanish, "0" otherwise

SLAVIC = A dummy variable that is "1" if the youth's main ancestry is slavic, i.e., Russian or Polish, "0" otherwise

MEXICAN/AM INDIAN = A dummy variable that is "1" if the youth's main ancestry is Mexican American or American Indian, "0" otherwise

BLACK = A dummy variable that is "1" if the youth is black, "0" otherwise

EDUCATION = The highest school grade attained by the youth

WORKING = A dummy variable that is "1" if the youth (age 17 to 20) worked in the last three months

PREGNANT = A dummy variable that is "1" if the youth is a pregnant female 18 to 20 years of age

ILLEGAL = A dummy variable that is "1" if the individual is three or more years under the lowest current legal drinking age within twenty miles of the HANES I sampling site, "0" otherwise.

AGEHD = The age of the head of household

SEXHD = A dummy variable that is "1" if the head of household is male, "0" otherwise

EDHD = The highest school grade attained by the head of household

PERHD = The number of people in the household

TABLE 8 - Continued

INCOME = The inverse of real family income, i.e., $1/\text{real family income}$; where real family income is nominal family income divided by a consumer price index

WELFARE = A dummy variable that is "1" if the family received welfare payments in the last three months, "0" otherwise.

PRICE = The real beverage price, i.e., the price (or excise tax) of the beverage, divided by a consumer price index

PRICE*ILLEGAL = A variable that interacts the beverage price and the youth's drinking age status. The aim is to differentiate the price elastic responses of legal and nonlegal drinkers.

DURATION = The inverse of the number of months between the date the drinking age was lowered, and the date the youth was examined

ILLEGAL*DURATION = A variable that interacts exposure to the current drinking age and the youth's drinking age status. The aim is to measure the differential responses of legal and nonlegal drinkers to the lowering of drinking ages.

Regression Results and Analyses

Our consumption models are specified in semilog form; (with respect to the transformed and nontransformed variables), and our participation models are specified in linear form. The results of our regression analyses are presented in tables 28-33, in appendix 3.

The calculation of elasticities, incremental, and categorical effects from these models requires some additional algebra and arithmetic, and we present the necessary formulas in table 9. Utilizing the formulas found in table 9, we display tables 10 through 15, which summarize our findings for beverage elasticities, incremental impacts and categorical effects. All estimates are evaluated at the means of the explanatory variables.

Consumption Model Findings

Beer Models

Drinking Age

We find that an important determinant of beer consumption is the youth's age, in relation to the youth's local minimum drinking age. A youth who is three or more years below the local minimum drinking age consumes 78.3 percent of what he would consume if he were within two years of the legal drinking age.

In other words, holding the youth's age fixed, we find that the existence of state minimum drinking ages reduces beer consumption (of underage individuals) by roughly twenty percent.

TABLE 9

SUMMARY OF FORMULAS NECESSARY TO CALCULATE ELASTICITIES,
CATEGORICAL AND INCREMENTAL EFFECTS

I. Consumption Model

$$\ln Q_i = \sum a_i X_i$$

"Q_i" = Annual consumption in drinks per year

"X_i" = The demographic, economic, or regulatory variables
that are in the model

Price Elasticity Calculation

If X_i is the real price of the beverage, then a_iX_i
is the price elasticity.

Income Elasticity Calculation

If X_i is the real income of the household, then
-(a_i / X_i) is the real income elasticity.

Categorical Impact Calculations

If X_i is a dummy variable, then (Q₁ / Q₀), which
reduces to e^{a_i}, measures the ratio of the consumption when
the dummy takes on the value of "1", to when it takes on
the value of "0".

Incremental Impact Calculations

If X_i is a unit variable such as age, or education,
then the incremental impact of an additional unit, e.g.,
year of age, on consumption, is given by a_iQ_i.

TABLE 9 - Continued

Incremental Impact of Exposure to Drinking Age

If X_i is the number of months since the current drinking age has been in effect, then $-(a_i Q_i / X_i^2)$ is the impact of an additional month on consumption.

II. Participation Model

$$P_i = \sum_i b_i X_i$$

"P" = Participation probability of drinking

" X_i " = Any of the demographic, economic, or regulatory variables that are in the model

Price Elasticity Calculation

If X_i is the real price of the beverage, then $(b_i X_i / P_i)$ is the price elasticity, where "P" is the participation probability.

Income Elasticity Calculation

If X_i is the income of the household, then $-(b_i / X_i P_i)$ is the income elasticity, where "P" is the participation probability.

Incremental Impact of Exposure to Lower Drinking Age

If X_i is the number of months since the current drinking age has been in effect, then $-(b_i / X_i^2)$ is the impact of an additional month on the participation probability.

TABLE 10

BEER CONSUMPTION

SUMMARY TABLE OF CATEGORICAL EFFECTS,
INCREMENTAL IMPACTS, AND ELASTICITIES

Categorical Effects

<u>Variable</u>	<u>Consumption as Percent of Base</u>
ILLEGAL	78.3
MEXICAN/AM INDIAN	210.1
BLACK	58.0
SEX	214.8
WORKING	138.0
SEXHD	70.3

Incremental Impacts

<u>Variable</u>	
AGE	8.2 drinks per year

Elasticities

No significant price or income elasticities.

TABLE 11

WINE CONSUMPTION

SUMMARY TABLE OF CATEGORICAL EFFECTS,
INCREMENTAL IMPACTS, AND ELASTICITIESCategorical Effects

<u>Variable</u>	<u>Consumption as Percent of Base</u>
N. EUROPE	188.5
S. EUROPE	377.0
SLAVIC	299.1
MEXICAN/AM INDIAN	233.2
BLACK	188.3
PREGNANT	2736.2
SEXHD	63.9
WELFARE	269.9

Incremental Impacts

<u>Variable</u>	
AGE	13.9 drinks per year
EDUCATION	-6.5 drinks per year
AGEHD	-0.9 drinks per year
EDHD	-2.4 drinks per year
DURATION	64.0 drinks per year*

Elasticities

<u>Variable</u>	
PRICE	-0.17
INCOME	0.07

* This represents the increase over the first twelve months. Later increases are very small. (see pp. 63-64.)

TABLE 12

LIQUOR CONSUMPTION

SUMMARY TABLE OF CATEGORICAL EFFECTS,
INCREMENTAL IMPACTS, AND ELASTICITIES

Categorical Effects

<u>Variable</u>	<u>Consumption as Percent of Base</u>
N. EUROPE	146.6
BLACK	51.5
SEX	242.0
PREGNANT	228.9
SEXHD	61.2

Incremental Impacts

<u>Variable</u>	
AGE	7.3 drinks per year

Elasticities

<u>Variable</u>	
PRICE	-1.81

TABLE 13

BEER PARTICIPATION

SUMMARY TABLE OF CATEGORICAL EFFECTS,
INCREMENTAL IMPACTS, AND ELASTICITIES

Categorical Effects

<u>Variable</u>	<u>Percent Added to Base</u>
ILLEGAL	-7.3
N. EUROPE	3.3
S. EUROPE	3.9
SEX	17.5
PREGNANT	-17.7

Incremental Impacts

<u>Variable</u>	<u>Percent</u>
AGE	3.6 per year
EDUCATION	0.8 per year
AGEHD	-0.2 per year
EDHD	-0.4 per year
PERHD	-0.4 per person

Elasticities

<u>Variable</u>	
PRICE	-0.06

TABLE 14

WINE PARTICIPATION

SUMMARY TABLE OF CATEGORICAL EFFECTS,
INCREMENTAL IMPACTS, AND ELASTICITIESCategorical Effects

<u>Variable</u>	<u>Percent Added to Base</u>
N. EUROPE	2.4
S. EUROPE	2.6
SLAVIC	11.2
MEXICAN/AM INDIAN	2.6
BLACK	2.1
SEX	-3.2
PREGNANT	-6.0
WORKING	2.5
SEXHD	-1.5

Incremental Impacts

<u>Variable</u>	<u>Percent</u>
AGE	0.7 per year
EDUCATION	0.8 per year
AGEHD	0.1 per year
EDHD	0.5 per year

Elasticities

<u>Variable</u>	
INCOME	-0.05

TABLE 15

LIQUOR PARTICIPATION

SUMMARY TABLE OF CATEGORICAL EFFECTS,
INCREMENTAL IMPACTS, AND ELASTICITIESCategorical Effects

<u>Variable</u>	<u>Percent Added to Base</u>
ILLEGAL	-8.6
N. EUROPE	-2.2
MEXICAN/AM INDIAN	-3.3
BLACK	-3.4
SEX	-4.0
WORKING	5.0
SEXHD	-3.5

Incremental Impacts

<u>Variable</u>	<u>Percent</u>
AGE	0.9 per year
AGEHD	-0.1 per year
EDHD	0.3 per year
PERHD	-0.2 per person

Elasticities

<u>Variable</u>	
PRICE	-1.30
INCOME	-0.08

Ethnicity

Ethnicity and national background are found to have significant effects on beer consumption. Mexican American and American Indian youth have 2.1 times the average consumption of our base category. Black youth on the other hand, consume little more than half of the base category. (Our findings on the relationship of black to white beer consumption, are generally consistent with those found in the 1975 NIAAA study.)

Somewhat surprisingly, there is no significant difference between the consumption of our Northern European youths and the base category. We expected youths from German, English or Irish ancestry to have greater than average beer consumption.

Sex

The sex of the youth has one of the largest impacts on beer consumption: male youths consume 2.1 times as much beer as females.

Employment Status

Youths who work (17-20 years of age), and who are not in school, consume 1.4 times as much beer as students of the same age. We think this is an interesting result, for which we offer two possible explanations.

The first explanation is that working youths simply have greater disposable incomes than their student counterparts, with similar or higher income elasticities of

demand for beer. The second explanation, is that working youth have personal characteristics, not accounted for by any of our variables, that lead them to drink more beer.

Sex of Head of Household

Youths who grew up with a female head of household (most probably as a result of divorce or desertion) drink more than if the head of household is male. Youths from male-headed households drink only 70.3 percent as much as youths from female-headed households. This suggests that the dissolution of the family, in itself, holding all other factors constant, leads to higher youth drinking.

Age

We find that each year of calendar age is associated with an additional 8.2 drinks.

Price and Income Elasticities and Lower Drinking Ages

Notable by their absence were any significant price or income elasticities.

We do not find short-term increases in consumption from having lowered drinking ages.

Wine Models

Ethnicity

Our five race and ethnic variables indicate that each group consumes considerably more wine than our base group. Not surprisingly, the Southern European group (consisting of youths of French, Italian or Spanish ancestry) has the

highest average consumption. The group with the next highest average consumption is the Slavic group (made up of youths with Russian or Polish ancestry). Blacks and our Northern European group consume the least, with the Mexican American and American Indian groups in the middle.

Sex of Head of Household

Youths that are brought up in households headed by females drink 1.6 times as much wine as youths brought up in male-headed households. Again, as in the case of beer, this phenomenon probably reflects the fact that female-headed households are mainly the result of divorce or desertion, and that these households produce increased psychological, social and economic stresses, or premature adoption of adult roles, which lead to higher alcohol consumption.

This result is particularly interesting, since it must be remembered that we are already controlling for the household's income, size and ethnic makeup. There are obviously factors associated with family dissolution, that go beyond income, that explain higher drinking levels.

Welfare Status

In fact, youthful wine drinkers whose families were recently on welfare drink 2.7 times as much wine as do youths from non-welfare families. Again, as we are already controlling for the effects of income and family size, this "welfare" effect is in theory independent of the effects of

real per capita household income. This result suggests that the WELFARE variable in our model is accounting for perhaps a state of mind, e.g., hopelessness, that is not accounted for by our other economic variables. This finding points to psychological factors, as in the case of family dissolution, that account for increased alcohol consumption.

Pregnancy

We find that pregnant 18 to 20 year olds consume 27.4 times as much wine as nonpregnant 18 to 20 year olds. This result is again suggestive of the fact that psychological stresses play a large part in alcohol consumption.

One can speculate that many of the pregnant females in our sample are either unmarried, and having severe psychological problems coping with this situation, or even though married, are overwhelmed by their looming parental responsibilities.

Age and Schooling

We find that consumption increases with age at the rate of 13.9 drinks per year; while years of schooling and drinking have an inverse relationship: wine consumption is reduced by 6.5 drinks per year for every additional year of schooling.

Age and Schooling of Head of Household

We find that the age and years of schooling of the head of household are both inversely related to the annual

wine consumption of their children, with the parent's schooling having the larger negative effect on consumption. For example, if college graduates become parents five years later than non-college graduates, we would expect that (other things equal) the children of college graduates would consume 14.1 fewer drinks of wine per year.

Price and Income Elasticities

Wine consumption has an excise tax elasticity of -0.17. This excise tax elasticity converts into a price elasticity of about -1.64 ,⁷ which is quite substantial. A ten percent increase in the real price of table wine, (which could result from increases in factor costs or from an increase in the excise tax on wine) leads to a 16.4 percent decline in annual wine consumption. The income elasticity is found to be 0.07, and is quite small. A ten percent increase in real family income would increase annual consumption by 0.7 percent.

Lower Drinking Ages

The short-run effects of lower drinking ages are measured by our DURATION variable. Our findings indicate that with everything else held fixed, the lowering of a state's drinking age has a significant positive impact on wine consumption. Currently legal or newly legal drinkers respond to the lowering of drinking ages by increasing their consumption from 57 to 121 drinks per year during the first twelve months after the drinking age is lowered.

(This increase in consumption can result either from the availability of additional "drinking buddies" or the time interval required to develop the taste for alcohol.)

Underage drinkers, in comparison, respond by consuming at an annual rate of 144 drinks per year one month after the lowering of the drinking age, with consumption declining to 130 drinks per year eleven months later. (Consumption declines as the novelty of drinking wears off.)

Over time, both currently legal drinkers and underage drinkers approach the long-run consumption rate of 129 drinks per year; with underage drinkers approaching it at a faster rate. (Figure 1, in footnote 3 of this chapter, illustrates these consumption responses.)

Liquor Models

Ethnicity

Two ethnic or nationality groups show significantly different consumption levels than our base group. Northern European youths consume 147 percent as much liquor as the base group; while Black youth consume 52 percent as much.

Sex

Males are by far heavier drinkers of liquor than females, consuming 2.4 times as much. This is similar to our findings for beer consumption, where male youths consume 2.1 times as much as females.

Pregnancy

Again, somewhat surprisingly, young pregnant women, who are already drinkers, consume more than their nonpregnant counterparts: 2.3 times as much. This, as in the case of wine, suggests that these pregnant women, many of whom are unmarried, are using alcohol to escape from stressful situations.

Sex of Head of Household

As with beer and wine, children from female-headed households consume more liquor than children raised in male-headed households. Youths raised in male-headed households (presumably with both parents present), consume 61 percent of the amount consumed by youths raised in female-headed households.

Age

There is a positive relationship between consumption and age, with each year adding 7.3 drinks. This is similar to the result for beer consumption, but about half as strong as found for wine consumption.

Income Elasticities and Working Status

We did not find any significant income elasticity effects; nor did we find any significant differences in consumption between working youths and students.

This finding surprises us: we expected liquor to have an income elasticity value close to one, reflecting its presumed status as a luxury good.

Price Elasticity

We do however, find liquor to have a high price elasticity, of -1.81. We do not find any differential price elasticity by age group. (In our models we tested for differential price elastic effects between "legal" and "illegal" drinkers.)

Such a high liquor price elasticity, implies that higher excise taxes on liquor (which at the federal level already make up about fifty percent of the retail liquor price), would lead to substantial reductions in youth liquor consumption. For example, a twenty percent increase in this excise tax would lead to a ten percent increase in the retail price of liquor, (if the tax were completely passed on to the consumer), and would result in an 18.1 percent decline in youth liquor consumption.

Minimum Drinking Ages

We are somewhat surprised that minimum drinking ages do not show statistically significant negative effects on liquor consumption. As we indicated earlier, from the enforcement perspective, we expected drinking age enforcement on the part of retailers and law enforcement officials to be tougher for liquor, than for either beer or wine.⁸

Lower Drinking Ages

We do not find any short-term changes in youth liquor consumption resulting from lower drinking ages.

This suggests that the adjustment to lower drinking ages is nearly instantaneous, or perhaps, that the circumvention of current drinking ages by confirmed underage liquor drinkers is nearly universal.

Participation Models

Up to this point we have used regression models to analyze the alcohol consumption of youths who currently drink four or more days per year. In particular, we have tried to determine how a youth's annual beverage consumption is affected by demographic, economic, health and regulatory factors.

In this section, we determine how the percentage of the youth population that chooses to drink, regardless of amount, is affected by demographic, economic and regulatory factors.

We accomplish this analysis by constructing linear probability discrete choice models.^{9,10} These models allow us to obtain, in a relatively easy computational manner, unbiased estimates of the coefficients of the explanatory variables.

In linear probability models (where the dependent variables take on discrete values), the value of the dependent variable, conditional upon the valuation of the explanatory variables, can be interpreted as the conditional probability that a given state of the model will occur.

In our models, there are only two states considered: that of being a drinker, or that of being a nondrinker.

Our models therefore estimate the conditional probabilities that a person with given characteristics will drink, and they determine the coefficients which allow us to estimate the incremental impacts on the conditional probabilities that result from unit or categorical changes in explanatory variables.

A conditional probability in these models can be interpreted as a drinking participation rate, i.e., the proportion of the sample that drinks.

Participation Model Findings

Beer Participation Models

Sex

The sex of the youth is found to be the most important determinant of the decision to drink beer. Males have participation rates 17.5 percentage points higher than females.

Age

The youth's age also has significant incremental effects on the drinking participation rate. Each year of age contributes another 3.6 percentage points. For example, youths five years older would have drinking participation rates 18 points higher.

Ethnicity

Ethnic or national background has little influence on the decision to drink beer. The Northern and Southern European groups (the only groups showing significantly different participation rates than the base group) have drinking participation rates averaging only 3.6 percentage points higher than for the base category.

Schooling

The youth's education is positively correlated with the decision to drink beer, but has very weak effects of 0.8 percentage points per year of schooling.

Age and Education of the Head of Household and Household Size

Household size, and the age and educational level of the head of household, were negatively related to the youth's decision to drink. However, their quantitative impacts were relatively minor. For example, considering education, if one youth's parents had sixteen years of schooling, and another youth's parents had twelve, we would expect to find a drinking participation rate 1.6 percentage points lower for the youth whose parents had the additional four years of schooling.

Pregnancy

Pregnant females 18 to 20 years of age have drinking participation rates 17.7 percentage points lower than nonpregnant females of the same age group. The lower

participation rates of pregnant females presumably reflect the concerns of these women about the effects of alcohol on their unborn children.

Minimum Drinking Ages and Price Elasticities

Drinking ages and excise taxes each reduce the drinking participation rate for beer. Youths who are three or more years beneath their legal drinking age have drinking participation rates 7.3 percentage points lower than "legal" youths. The excise tax elasticity with respect to drinking participation is small: -0.06.

The elasticity of beer participation with respect to the price of beer, however, (as opposed to the excise tax on beer) is higher, and is about ¹¹-0.87. Therefore, if the price of beer should rise by 10 percent, the beer participation rate would fall by 8.7 percent. (The price increase could result either from increases in the underlying factors that determine the cost of beer, or changes in the excise tax on beer.)

Wine Participation Models

Ethnicity

Unlike the beer participation results of the previous section, we find the most important variable in wine participation to be related to national background. Youths of Slavic ancestry, (defined to be Russian or Polish in this study) participate at a rate 11.2 percentage points higher than the base category. The four remaining groups

participate at rates between 2.1 and 2.6 percentage points higher than the base group.

Sex

Male youths participate in wine drinking at a rate 3.2 percentage points less than females. This is clearly different than for beer, where the males participate at a higher rate.

Pregnancy

Pregnant females (18 to 20 years of age) participate in wine drinking at a rate 6.0 percentage points less than nonpregnant females. This result is consistent with the findings for beer participation; where pregnant youths participate less.

We found before that those pregnant women who drink wine or liquor drink more of these beverages than nonpregnant women.

The beer and wine participation models tell us that pregnant women are deterred from beer or wine drinking.

These sets of results are not inconsistent: it is likely that young women who persist in drinking after they are pregnant are already heavy drinkers, but those women who are light drinkers before they become pregnant give it up during pregnancy, or if nondrinkers, are further deterred by pregnancy from becoming drinkers.

Age and Schooling

The age and schooling of a youth have substantial effects on his or her wine participation rate: each is positively correlated with drinking participation, with age adding 0.7 participation points per year, and schooling adding 0.8 participation points per year.

Age and Schooling of Head of Household

The age and education of the head of household are also positively related to the youth's participation rate: age adds 0.1 percentage points per year, while schooling adds 0.5 percentage points per year.

Working Status

Working youths (17 to 20 years of age) have participation rates 2.5 participation points higher than similarly aged students.

Sex of Head of Household

Youths in households headed by males participate at a rate 1.5 percentage points less than those in female-headed households.

Income Elasticity

The income elasticity of wine participation is found to be -0.05. This result is extremely unlikely, as it indicates that wine (with respect to drinking participation) is an inferior good. It is more likely the

case that the income elasticity is zero, or very close to it.

Liquor Participation Models

Age

The youth's age has the largest effect on the decision to drink liquor. The drinking participation rate increases 0.9 percentage points per year.

Minimum Drinking Age

Youths who are three or more years below their local minimum drinking age, participate at a rate 8.6 percentage points less than youths who are legal, or are within two years of the local drinking age.

This result provides an interesting contrast to the lack of an effect of minimum drinking ages on liquor consumption.

For although drinking ages do not seem to affect the liquor consumption of underage drinkers, they do affect the rates at which they participate in liquor drinking.

Age and Schooling of the Head of Household

The head of household's age is negatively related to the youth's liquor participation, while the parent's years of schooling are positively related. Each year of age reduces participation by 0.1 percentage points; while each year of schooling increases participation by 0.3 percentage points.

Household Size

Each additional person reduces youth participation by 0.2 percentage points. As real household income is held fixed in the regressions, this implies that participation is positively related to real per capita household income.

Ethnicity

Only three groups showed significantly different liquor participation rates than the base group: the Northern European, Mexican and American Indian, and Black. Each of these three groups showed less of a tendency to drink liquor than the base group. These effects are relatively small however, with the blacks showing the greatest difference of 3.4 percentage points.

Sex

Males participate at a lower rate than females; the difference is 4.0 percentage points. This result is similar in direction and in magnitude for wine participation.

Sex of Head of Household

Again, as in the case of liquor, wine, and beer consumption, and wine participation, liquor participation is promoted by having a female head of household. Liquor participation for youths in male-headed households is 3.5 percentage points less than for female-headed households.

Working Status

Working youths (17 to 20 years of age) participate at rates 5.0 percentage points higher than students. This is consistent with the notion that working students have higher disposable incomes, and view liquor as a normal good.

Price and Income Elasticities

The liquor price elasticity of participation is found to be elastic: -1.30 . This suggests that a ten percent increase in the real price of liquor would reduce youth participation by thirteen percent.

The income elasticity with respect to liquor participation is -0.08 . This suggests that liquor participation is an inferior activity, which is very unlikely. An income elasticity of zero would be a more reasonable estimate.

In the next chapter we summarize the findings from our consumption and participation models. We also extend these results to analyze the effects of prices and legal drinking ages on total expected market demand.

Footnotes

Chapter III

1

Johnston, J., Econometric Methods. Third Edition, McGraw-Hill Book Company, 1984, p. 71.

2

Ibid.

3

Our DURATION variable is intended to capture the short-term consumption effects resulting from exposure to lower drinking ages.

Consider two youths, youth A and youth B. These two youths are assumed to be identical in every respect, except that youth A resides in a state where the drinking age has recently been reduced, e.g., twelve months ago; youth B, on the other hand, resides in a state where the drinking age has not been changed since 1933, the year Prohibition was repealed. This latter situation fits the majority of youths in our sample.

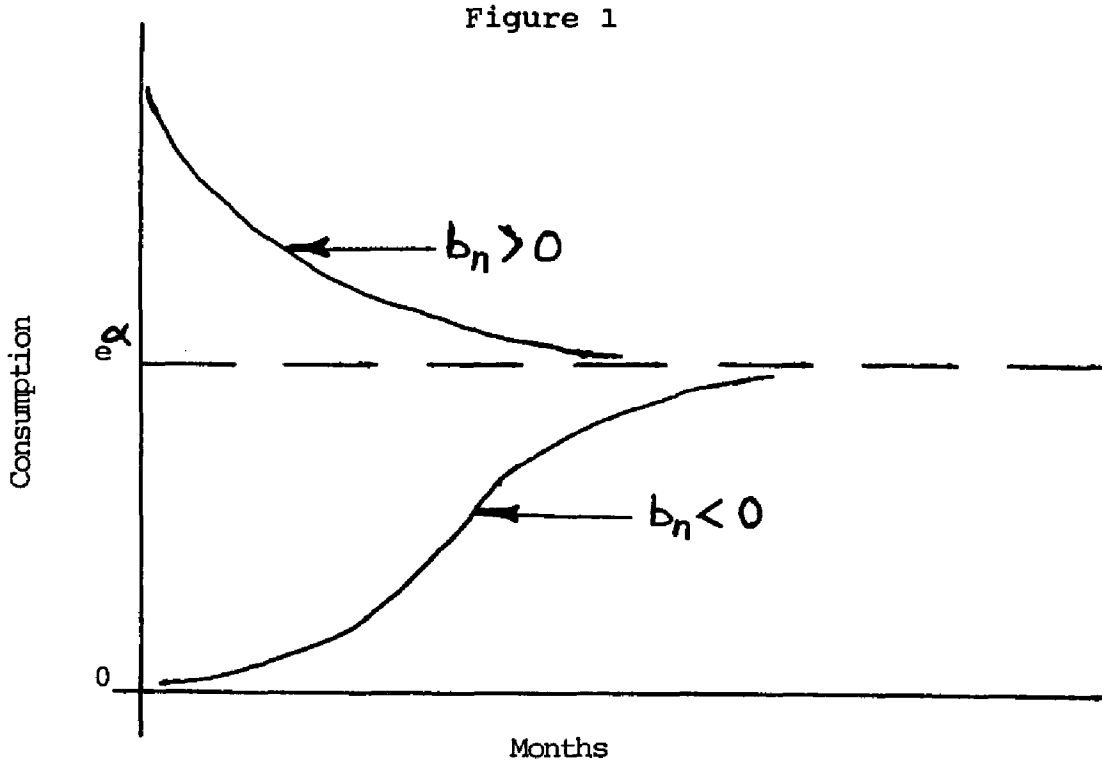
It is reasonable to believe that youth A will respond to a lower drinking age by gradually increasing his consumption (reflecting, for example, a development process of acquiring a taste for alcohol), and that youth A's consumption will eventually approach the consumption of youth B. (We expect the consumption rate of youth A to approach that of youth B as the youths are identical in every other respect, and the change in the drinking age is a one-time effect.)

It is also possible, but perhaps less likely, that some youths, identical to youth A, and recently exposed to a lower drinking age (particularly underage youths), will respond to a lower drinking age by sharply increasing their rates of consumption. In fact, the individual consumption rates of these youths could initially surpass the consumption rate of youth B.

For example, for a youth whose consumption increases sharply as a response to lower drinking ages (primarily as a result of the novelty of using alcohol), we expect the novelty of alcohol use to fade, and the youth's consumption to gradually decrease over time, until his individual consumption rate approaches the rate of consumption of youth B. (Again, as we assume that youths are otherwise identical, the one-time effect of a lower drinking age

on consumption should decline over time, resulting in the convergence of the two rates of consumption.)

In Figure 1, we illustrate the consumption effects described in this footnote.



$$\text{Our model: } Q = e^{a_0 + b_1 X_1 + \dots + b_n X_n^{-1}}$$

where X_n is our MONTHS variable (which measures the amount of time the youth has been exposed to the lower drinking age), captures the possible reactions of consumption to lower drinking ages discussed in this footnote.

For example, if b_n , the coefficient of X_n , is negative, the consumption path is as shown in Figure 1, and approaches the long-run level from below. If, however, b_n is greater than zero, then the consumption path approaches the long-run level from above, as shown in Figure 1.

We hypothesize that currently legal drinkers would be in the former category, and would react by gradually increasing their consumption; and that underage drinkers would be in the latter category, initially consuming more than legal drinkers.

Our model in fact tests to see whether underage youths respond to lower drinking ages differently than legal drinkers.

We test for this difference in our models by including the DURATION variable, along with the DURATION variable interacted with the ILLEGAL variable (DURATION*ILLEGAL).

The coefficient on the DURATION variable measures the effects of exposure to the lower drinking age on currently legal drinkers, whereas, the sum of the coefficients from the DURATION and DURATION*ILLEGAL variables measures the effects on underage drinkers.

A negative coefficient on DURATION, and a positive coefficient on DURATION*ILLEGAL (exceeding in absolute value the coefficient on DURATION) would support the hypothesis that underage drinkers react more strongly than legal drinkers to a lower drinking age.

4

From the model given in footnote 3, above, the marginal rate of consumption with respect to the length of exposure to the lower drinking age is:

$$dQ/dX_n = e^{a_0 + b_1X_1 + \dots + b_nX_n} (-b_n X_n^{-2}).$$

If b_n is less than zero, then dQ/dX_n is always positive, and consumption increases for all values of X_n . However, it is clear that the marginal rate of consumption varies with the length of exposure to the lower drinking age.

Looked at in another way, we note that the percentage change in consumption varies inversely with the square of the length of exposure to the drinking age.

$$(dQ/Q)/dX_n = -b_n X_n^{-2}.$$

We also observe that as X_n grows to infinity, the value of consumption approaches an upper limit of:

$$Q = e^{a_0 + b_1X_1 + \dots + b_nX_n}.$$

Lastly, when b_n is less than zero, we note that the consumption curve has a point of inflection at $b_n/2$; at times before $b_n/2$, the marginal rate of consumption is increasing, and beyond $b_n/2$, the marginal rate of consumption, although positive, starts to decline towards zero.

If b_n is greater than zero, the marginal rate of consumption is negative, and the consumption curve declines continuously throughout.

The second derivative of this consumption curve is positive with respect to X_n , and therefore the consumption curve, although declining, flattens out and approaches an asymptote.

The asymptotic consumption level when b_n is positive is the same as when b_n is negative.

5

We did, however, eliminate seven youths from our sample who reported consuming more than 4,000 drinks per year.

6

Models were developed that used all three beverage prices in the demand for each beverage. Results were inconclusive, however, similar to the findings in Ornstein (1983). Generally speaking, the three beverages under study do not act as clear substitutes or complements for each other.

Utilization of the Fuchs, Michael, Scott (1979) and state-specific price indexes to deflate nominal prices and incomes did not lead to substantially different results than using the U.S. Consumer Price Indexes.

Lastly, alternative specifications of border drinking age and price interactions were tested, and did not lead to superior results. (See Lewit, E.M.; Coate D.; and Grossman, M. "The Effects of Government Regulation on Teenage Smoking.", *Journal of Law and Economics*, 24, No. 3 (December 1981).

7

We can estimate the relationship between excise tax and price elasticities by using the following formula:

$$\text{Price elasticity} = \text{Excise tax elasticity} * [(P+T)/T],$$

where P is the price of the beverage (which we are assuming is uniform across states), and T is the state-specific excise tax rate. From the Brewing Industry Survey '73, we estimate the price of a gallon of table wine to be \$4.00. Based upon the responses we received from the state beverage control authorities, we estimate the price of a case of twenty-four twelve-ounce containers of beer to be \$5.00. (The price elasticities are not particularly sensitive to the estimates of the base prices we use for wine and beer.) We evaluate the formula at the mean values of the beer and wine excise tax rates.

8

For a different point of view see Ornstein, S. I., Hanssens, D. M., "Alcohol Control Laws, Consumer Welfare, and the Demand for Distilled Spirits and Beer", Working Paper Series, Center for Marketing Studies, Paper No. 102, March 1981, University of California, Los Angeles, page 17.

9

Gujarati, D., Basic Econometrics. McGraw-Hill Book Company, 1978, pp. 312-18.

10

Pindyck, R. S., Rubinfeld, D., Econometric Models and Economic Forecasts, McGraw-Hill Book Company, 1976, pp. 239-44.

11

See footnote 7, chapter 3, page 79.

CHAPTER IV

SUMMARY OF FINDINGS

We have presented a substantial number of results in chapter 3. In order to make those findings more comprehensible, we present overall tabular summaries of the most important results, and comment upon them.

In addition, we extend the findings in chapter 3, by noting that one can combine the elasticities and other effects from continuous and discrete choice models to give the total expected impact on consumption, given changes in the explanatory variables. We present and discuss these total expected effects in this chapter.

Summary Table for Consumption Models

Table 16 presents an overall summary of the effects of the explanatory variables on consumption for each one of the three alcoholic beverages.

Overall Results for Consumption Models

Price and Income Elasticities

Wine and liquor show substantial price elastic effects. We are, however, more confident in our estimate of liquor price elasticity, as the underlying liquor price data are more reliable and more accurate indicators of

TABLE 16

OVERALL SUMMARY TABLE FOR CONSUMPTION MODELS
 CATEGORICAL EFFECTS, INCREMENTAL IMPACTS
 AND ELASTICITIES

<u>Variable</u>	<u>Beverage</u>		
	<u>Beer</u>	<u>Wine</u>	<u>Liquor</u>
ILLEGAL	78.3
N. EUROPE	...	188.5	146.6
S. EUROPE	...	377.0	...
SLAVIC	...	299.1	...
MEXICAN/AM INDIAN	210.1	233.2	...
BLACK	58.0	188.3	51.5
PREGNANT	...	2736.2	228.9
SEXHD	70.3	63.9	61.2
WELFARE	...	269.9	...
WORKING	138.0
AGE	8.2	13.9	7.3
SEX	214.8	...	242.0
EDUCATION	...	-6.5	...
AGEHD	...	-0.9	...
EDHD	...	-2.4	...
DURATION	...	64.0	...
PRICE	...	-0.17* -1.64**	-1.81
INCOME	...	0.07	...

* - The estimated excise tax elasticity.

** - An estimate of the wine price elasticity based on a gallon of table wine.

price than the wine excise tax rates and wine price estimates. Beer consumption, however, shows no indication of price sensitivity within the range of excise taxes measured.

Wine is the only beverage to show some sensitivity to real income, with an elasticity of 0.07.

Lowering Drinking Ages

Wine is the only beverage which exhibits a dynamic short-run increase in consumption in response to the lowering of drinking ages. This increase, however, quickly approaches the asymptotic long-run rate of consumption, so that within twelve months of the lowering of the drinking age the youth has almost fully adjusted his consumption to the long-run level.

Neither beer, nor liquor, however, demonstrate short-run adjustments in consumption to the lowering of drinking ages. Individual beer and liquor consumption appear to adjust very quickly to their long-run consumption levels.

Current Drinking Ages

Beer is the only beverage that shows the deterrent effect of minimum drinking ages on the consumption of underage youth. Overall, minimum drinking ages reduce underage beer consumption by more than twenty percent.

Neither the wine nor liquor consumption of underage youth are reduced by the presence of minimum drinking ages.

This suggests that the circumvention of already

existing drinking age laws is very pervasive, particularly as they affect wine and liquor, and that the consumption of wine and liquor by underage, or "illegal" youths, is due in large part to the availability of these beverages, either in the households in which these youths reside, or through older youth, with which they have contact.

Sex of Youth

Males drink more than twice as much beer and liquor as females. However, there is no discernible difference in wine consumption by sex.

Marital Status of Head of Household

It is remarkable, at least in a statistical sense, that the sex of the head of household has almost uniform effects, across beverages, on the alcohol consumption of youth. In each instance, youths who are living in households headed by males consume approximately two-thirds of the amounts of beer, wine or liquor consumed by youths living in households headed by females.

Since the regression models control for a substantial number of social and economic factors (in addition to the marital status of the head of household), divorce or desertion stand out as having a very powerful influence in increasing youth consumption.

Ethnic Group

Blacks consume only slightly more than one-half the amount of beer, and liquor of the base category. The wine consumption of blacks is nearly double that of the base category. However, black wine consumption is also the lowest of the other four ethnic groups.

The Mexican and American Indian group has more than double the beer and wine consumption of the base group. However, Mexican and American Indian youth do not differ from the base group with respect to liquor consumption.

Northern European youth have substantially higher liquor consumption than the base group: they consume about one-and-a-half times the liquor of that group.

No other ethnic group differs from the base group, with respect to liquor consumption.

The Northern European youth consume more wine than the base group, but at about the same level as black youth.

Southern European youth are relatively heavy consumers of wine; they consume nearly four times the amount of the youth in the base group. They do not however, differ from the base group, in either beer or liquor consumption.

Slavic youth, like the Southern European youth, are relatively heavy consumers of wine; they consume three times the amount of wine of youth in the base group. Again, like the Southern European youth, they do not differ from the base group, in either beer, or liquor consumption.

Age of Youth

Each year of age adds between seven to eight drinks per year, for beer and liquor, and nearly fourteen drinks per year, for wine.

Pregnancy

We expected pregnant females to have lower alcohol consumption than nonpregnant females. However, young pregnant women between the ages of eighteen and twenty, appear to have substantially higher wine and liquor consumption than nonpregnant women of the same age.

We recognize that the number of pregnant women in our sample is small; however, we find these results on the drinking of pregnant women to be significant enough to suggest the need for further research in this area.

Welfare Status of Family

The fact that a family is, or recently was, on welfare has significant implications for a youth's wine consumption; youths from welfare families consume nearly three times the amount of wine of youths from nonwelfare families. A family's welfare status does not affect the beer or liquor consumption of its youth.

Employment Status of Youth

Working youth (aged seventeen to twenty) who are not in school, show higher consumption only for beer; they consume nearly one-and-a-half times the amount of beer of youths in the base group.

If the beer consumption of working youth is positively related to additional disposable income, we would expect that the wine and liquor consumption of working youth would similarly be higher than the base group's.

As the wine and liquor consumption of working youth is not higher than for students, we suspect that other influences are operating. For example, working youth may do a lot of their drinking with people from work, where beer is the commonly accepted after-hours drink.

Education

Additional years of education for either the youth or the head of household show significant effects only in the case of wine consumption. In each instance, additional education reduces the annual consumption of wine. These effects range from two drinks per year less, for each additional year of schooling for the head of household, to nearly seven drinks a year less, for each additional year a youth attends school.

Age of Household Head

Again, as in the case of education, the age of the head of household, has significant effects only for wine consumption. Each additional year reduces youth consumption by one drink per year. Neither beer nor liquor consumption appear to be affected by the age of the household head.

Overall Results for Participation Models

We present table 17 for the participation models, which summarizes our findings for all three beverages.

Current Drinking Ages

Legal drinking ages reduce the drinking participation rates for beer and liquor, by approximately seven to nine percentage points, respectively. Therefore, we would expect that, in the long run, the removal of these drinking age restrictions would increase the drinking participation rates for underage youths for these two beverages by like amounts.

The willingness of youths to drink wine was not impeded by the existence of minimum drinking ages.

Lowering Drinking Ages

We have not found evidence of short-term effects on drinking participation from the lowering of drinking ages. The absence of these effects holds for each one of the three beverages we investigated.

Whereas wine consumption is stimulated by the lowering of drinking ages (the only beverage where consumption is so affected), individuals do not accelerate their willingness to begin drinking.

Price and Income Elasticities

Of the three beverages, only liquor shows a substantial price elastic effect of -1.30. Beer has a

TABLE 17

SUMMARY TABLE OF PARTICIPATION MODELS FOR CATEGORICAL EFFECTS, INCREMENTAL IMPACTS AND ELASTICITIES

<u>Categorical Effects</u> (<u>Percent Added to Base</u>)			
	<u>Beer</u>	<u>Wine</u>	<u>Liquor</u>
<u>Variable</u>			
ILLEGAL	-7.3	...	-8.6
N. EUROPE	3.3	2.4	-2.2
S. EUROPE	3.9	2.6	...
SLAVIC	...	11.2	...
MEXICAN/AM INDIAN	...	2.6	-3.3
BLACK	...	2.1	-3.4
SEX	17.5	-3.2	-4.0
PREGNANT	-17.7	-6.0	...
WORKING	...	2.5	5.0
SEXHD	...	-1.5	-3.5
<u>Incremental Impacts</u> (<u>Percent Per Unit</u>)			
	<u>Beer</u>	<u>Wine</u>	<u>Liquor</u>
<u>Variable</u>			
AGE	3.6	0.7	0.9
EDUCATION	0.8	0.8	...
AGEHD	-0.2	0.1	-0.1
EDHD	-0.4	0.5	0.3
PERHD	-0.4	...	-0.2
<u>Elasticities</u>			
	<u>Beer</u>	<u>Wine</u>	<u>Liquor</u>
<u>Variable</u>			
PRICE	-0.06	...	-1.30
INCOME	...	-0.05	-0.08

small excise tax elasticity of -0.06 , with a larger price elastic effect (based on the price of a case of beer) of -0.87 . Wine shows no evidence of price elasticity with respect to drinking participation.

The income elasticity of drinking participation is not significant for beer; however, we do get rather small but negative income elastic responses of -0.05 and -0.08 , for wine and liquor respectively.

The negative income elasticities for wine and liquor are somewhat puzzling, as we expect that drinking participation, as well as consumption, would each act as if they were normal goods, i.e., would increase as real income increases.

The negative income elasticities are more likely the result of collinearity than meaningful findings.

For purposes of policy analysis, we would suggest that the wine and liquor elasticities be treated as if they were equal to zero.

Sex of Youth

If a youth is male, he tends to participate in beer drinking at a rate nearly eighteen percentage points higher than for females. At the same time, males tend to participate less, by roughly three to four percentage points, for both wine and liquor drinking.

Marital Status of Head of Household

As in the case of consumption, youths living in households headed by males tend to participate less in drinking. However, drinking participation is not affected as strongly by the marital status of the head of household as is consumption.

Beer participation is unaffected by the household head's marital status. Wine and liquor, although affected, show rather small impacts of between roughly two to four percentage points, respectively.

Ethnic Group

Northern European youths participate in wine and beer drinking, at rates of two to three percentage points higher, respectively, than do youths in the base group. Their liquor participation, however, is approximately two percentage points lower than for youths in the base category.

Southern European youths have drinking participation rates for wine and beer extremely close to those of Northern European youths. The drinking participation rates of Southern European youths, for liquor, are not significantly different from the base group.

Slavic youth have a wine participation rate 11.2 percentage points higher than the youths in the base group: this differential is the greatest for any group, and for

any beverage. This high differential for wine participation parallels the high wine consumption of Slavic youth.

Slavic youth do not, however, differ in drinking participation, for either beer or liquor, in comparison to the base group.

Mexican and American Indian youth have drinking participation rates approximately three percentage points higher for wine consumption, and three percentage points lower for liquor consumption, in comparison to the base group. The drinking participation rate for beer, of Mexican American or American Indian youth, is not significantly different than that of the base group.

Black youth have very similar drinking participation rates in comparison to both the Northern European youth, and the Mexican American and American Indian youth: all three groups have drinking participation rates that are two to three percentage points higher for wine, and two to three percentage points lower for liquor, in comparison to the base group.

Black youths do not, however, have different drinking participation rates for beer than from those of youths in the base group.

With respect to drinking participation in general, Black youth and Mexican American and American Indian youth, have drinking participation rates that are remarkably similar.

Pregnancy

Pregnant, as compared to nonpregnant females, have sharply lower drinking participation rates for beer, by nearly eighteen percentage points: pregnant females, again in comparison to nonpregnant females, have drinking participation rates that are six percentage points lower for wine.

Pregnant and nonpregnant females do not differ with respect to drinking participation rates for liquor.

Pregnant females exhibit sharply different behavior in their consumption responses, as compared to their participation responses.

Pregnant females consume from two to twenty-seven times the amounts of liquor and wine, respectively, of nonpregnant females: at the same time, pregnant females participate less in wine and beer drinking, than nonpregnant females.

We interpret these findings to suggest that pregnant women are generally deterred from drinking, particularly for beer; however, pregnant women who choose to drink, drink relatively heavily, particularly with respect to wine.

Employment Status of Youth

Working youth aged seventeen to twenty who are not in school participate in wine and liquor drinking, at rates from nearly three to five percentage points higher,

respectively, than for students. Working youth and students do not differ with respect to beer participation.

Age of Youth

The drinking participation rates for all three beverages are positively correlated with the youth's age. For each additional year, beer participation goes up by 3.6 percentage points; wine participation goes up by 0.7 percentage points; and liquor participation goes up by 0.9 percentage points.

Clearly, beer drinking is the most substantially impacted as the youth ages. For example, as a youth passes from age twelve to age twenty, (the ages spanned in our study) his drinking participation rate would increase by more than twenty-eight percentage points.

Education

Each additional year of schooling for a youth (while controlling for the youth's age) adds about one percentage point to drinking participation, for both beer and wine drinking. Liquor participation rates are unrelated to the number of years of schooling.

The number of years of schooling attained by the head of household adds less than one-half of a percentage point to drinking participation for wine and liquor, and reduces drinking participation by about one-half of a percentage point for beer.

This suggests that the drinking participation rates of youths are not substantially affected by the educational achievements of the head of household. An additional four years of schooling for the head of household would add or subtract (depending upon the beverage) approximately two percentage points to drinking participation rates.

Age of Household Head

As the age of the head of household increases by one year, beer and liquor drinking participation rates decline by 0.2 and 0.1 percentage points, respectively. The drinking participation rate for wine increases by 0.1 percentage points per year, however.

The "maturity" of the head of household, as measured by age, clearly has a small effect on the drinking participation rates of its offspring: an additional ten years in the age of the head of household will decrease the drinking participation for liquor and beer by one to two percentage points, and will add one percentage point for wine participation.

Number of People in the Household

Each additional household member has the effect of reducing the drinking participation rate of household youth by 0.4 percentage points for beer, and 0.2 percentage points for liquor. The drinking participation rate for wine is unaffected by additional household members.

These overall results suggest that, holding real household income fixed, increases in the number of people in the household would reduce drinking participation rates.

Calculating the Expected Value Effects of Changes in
Taxes, Prices, or Drinking Ages
on Beverage Consumption

Our models have analyzed how alcohol consumption and drinking participation are affected by various demographic, economic and regulatory factors. We have summarized the effects of these factors by the calculation of categorical effects, incremental impacts and elasticities.

We now calculate how changes in the values of the explanatory variables will affect the expected value of consumption (as defined in the probability sense) by combining the effects from the consumption and participation models.

Calculation of the Expected Values of Consumption

Consumption models generally explain how the consumption of current market participants varies in response to changing values in the models' explanatory variables. These models do not explain how agents not currently participating in those markets will react to changes in the levels of explanatory variables.

For example, if one is interested in analyzing how prices affect the aggregate market demand for any product, one realizes that as prices of a product are lowered, not only do existing customers consume more of that product,

but also that new customers enter the market, and also make purchases. The new, lower prices are now low enough to draw some previous, potential customers into the market.

The total effect on the consumption of that product, as measured by market demand, is clearly some combination of the increased consumption due to already existing customers, and to the new consumption of previously potential customers.

We can estimate the expected value of the change in this market demand, due to the change in price, by use of a simple formula.

The expected value of the percentage change in consumption, due to a one percent change in price, is the sum of the price elasticities from both the consumption and participation models.^{1, 2}

This result can be generalized to any of the other explanatory variables found in the consumption and participation models: the total expected effect on consumption, due to changes in the values of any of the explanatory variables, is found to be the sum of the partial effects from the consumption and participation models.

Summary Results for Changes in Taxes,
Prices or Drinking Ages

By use of the formula discussed in the previous paragraph, we calculate the total expected effect on consumption due to changes in prices, taxes, and drinking

age restrictions. The total expected effect on consumption, for changes in each variable, is the sum of the partial effects for each variable, as found in each model.

In table 18, we demonstrate the calculation of the total expected effect on consumption, due to changes in prices (or excise taxes), or the removal of legal drinking ages. We utilize the summary of categorical effects and elasticities found in tables 16 and 17.

We calculate the expected effect on consumption due to a change in prices (or excise taxes), by measuring price (excise tax) changes in percentage terms. The partial effects of these percent changes in prices (excise taxes) on the dependent variables in the consumption and participation models have already been estimated, and are shown in table 18 as price and tax elasticities.

Similarly, in table 18, we calculate how youths react to the presence of legal drinking ages. These consumption and participation effects are calculated as categorical effects, and measure how the dependent variable responds to the presence or absence of legal drinking ages, and not to gradations in drinking ages.

TABLE 18

CALCULATION OF TOTAL EXPECTED CONSUMPTION EFFECTS
FOR TAXES, PRICES AND DRINKING AGES

	<u>Prices or Taxes</u>		
	<u>Beer</u>	<u>Wine</u>	<u>Liquor</u>
Participation Effect	-0.06	...	-1.30
Consumption Effect	...	-0.17	-1.81
Total Effect	-0.06	-0.17	-3.11

	<u>Removal of Minimum Purchase Ages</u>		
	<u>Beer</u>	<u>Wine</u>	<u>Liquor</u>
Participation Effect	7.3	...	8.6
Consumption Effect	22.7
Total Effect	30.0	...	8.6

NOTE: The beer and wine elasticities are tax elasticities, whereas the liquor elasticities are price elasticities. We can convert the liquor price elasticities into excise tax elasticities by roughly dividing them by two. This would give a liquor excise tax participation elasticity of -0.65, and a liquor excise tax consumption elasticity of -0.90. The combined expected liquor excise tax elasticity would be about -1.56.

Table 18 demonstrates that the total expected effect on consumption of, for example, a ten percent increase in the real excise tax on beer, and wine; and a ten percent increase in the real price of liquor (which could be achieved by roughly a twenty percent increase in the federal excise tax on liquor), would be declines in expected consumption of 0.6, 1.7 and 31.1 percent, respectively.³ Clearly, the liquor consumption of youth

would fall substantially with a ten percent real price increase.

Table 18 also shows that the removal of minimum purchase or legal drinking ages would result in a 30.0 percent increase in the expected value of underage beer consumption. The removal of minimum purchase ages would also increase the expected market demand for liquor of underage youths by 8.6 percent, but would, however, have no effect on the market demand for wine.

In the next chapter, we derive some conclusions from our findings, and compare our results to the findings of related recent research on alcohol demand studies.

Footnotes

Chapter IV

1

Goldberger, A.S., Econometric Theory. McGraw-Hill Book Company, 1964, pp. 251-3.

2

Rosen, H. S., Small, K. A. "Applied Welfare Economics with Discrete Choice Models." New York: National Bureau of Economic Research Working Paper No. 319, February 1979, pp. 39-40.

3

The following tables demonstrate the relationship between our excise tax and price elasticities.

Youth Excise Tax Elasticities

<u>Beverage</u>	<u>Consumption</u>	<u>Participation</u>	<u>Total</u>
Beer	0.00	-0.06	-0.06
Wine	-0.17	0.00	-0.17
Liquor	-0.91	-0.65	-1.56

Youth Price Elasticities

<u>Beverage</u>	<u>Consumption</u>	<u>Participation</u>	<u>Total</u>
Beer	0.00	-0.87	-0.87
Wine	-1.64	0.00	-1.64
Liquor	-1.81	-1.30	-3.11

CHAPTER V

CONCLUSIONS

The elasticities, categorical effects, and incremental impacts estimated from our study cannot be compared directly to the findings from other studies: previous demand studies estimate the demand responses of the general population, and not of youth. However, we believe a review of elasticity findings from studies on the general population is useful, because these findings do provide benchmarks for our own estimates.

Findings from Other Consumption Studies

An excellent critical review of alcohol studies on the general population has been performed by Ornstein (1983). We use his conclusions as the basis for our benchmarks on price and income elasticities.

Ornstein reviews twenty-two major domestic and foreign alcohol demand studies. The major objective of his survey is to determine U.S. price and income elasticities for beer, wine and liquor.

His best estimates of U.S. price and income elasticities for beer, wine and liquor, are found in table 19.¹

TABLE 19

ORNSTEIN'S ESTIMATES OF U.S. PRICE AND INCOME
ELASTICITIES FOR BEER, WINE, AND LIQUOR

<u>Beverage</u>	<u>Price Elasticity</u>	<u>Income Elasticity</u>
Beer	-0.3	No Judgment
Wine	-1.0	No Judgment
Liquor	-1.5	No Judgment

Our own careful review of Ornstein's survey leads us to suggest some modifications to his set of price and income elasticities. We present this set of elasticities in table 20.

TABLE 20

ORNSTEIN'S ESTIMATES OF U.S. PRICE AND INCOME ELASTICITIES
FOR BEER, WINE, AND LIQUOR AS MODIFIED BY ARLUCK

<u>Beverage</u>	<u>Price Elasticity</u>	<u>Income Elasticity</u>
Beer	-0.3	0.0 to 0.4
Wine	-0.5	0.04
Liquor	-1.5	No Judgment

We have modified Ornstein's conclusions primarily to give more weight to the findings contained in the Canadian studies of Johnson and Oksanen (1974, 1977), cited by Ornstein.

Ornstein says that the 1977 study of Johnson and Oksanen, "... is probably the best econometric work on price and income elasticities for alcoholic beverages".²

Our modification of Ornstein's table is based upon our greater willingness to use the range of results found by Johnson and Oksanen, even given their lack of statistical precision, rather than to assume no knowledge of the true elasticities.

Comparing Youth and Adult Elasticities

In table 21 we present a summary of our youth price and income elasticities, and compare them with the findings from table 20.

TABLE 21

A COMPARISON OF YOUTH PRICE AND INCOME ELASTICITIES WITH THOSE OF THE GENERAL POPULATION

<u>Beverage</u>	<u>Youth Elasticities</u>		<u>General Elasticities</u>	
	<u>Price</u>	<u>Income</u>	<u>Price</u>	<u>Income</u>
Beer	0.00	0.00	-0.3	0.0 to 0.4
Wine	-1.64	0.07	-0.5	0.04
Liquor	-1.81	0.00	-1.5	No Judgment

NOTE: The youth elasticities are expressed as price, and not excise tax elasticities, so as to make them comparable to those from other studies.

After considering the comparisons between our estimates of youth price, and income elasticities, and those of the general population found in table 21, it appears that our findings on youth consumption elasticities are generally close to those of the general population. The one exception is our finding that the youth price

elasticity for wine is substantially greater than one.

One U.S. study on the demand for liquor, that is not included in Ornstein's survey, is that by Barsby and Marshall (1977). Barsby and Marshall attempt to quantify the short-term changes in the liquor consumption of states during the 1970 to 1975 time period. As noted in table 1 of chapter 1, twenty-five states lowered their legal drinking ages for liquor in this period. The lowering of these drinking ages created an estimated 3.32 million newly legal drinkers in open states, and another estimated 911,000 newly legal drinkers in monopoly states.

Barsby and Marshall do not find any significant short-term increases in liquor consumption resulting from the lowering of drinking ages.

Their demand study estimates the price elasticity of liquor to be in the range of -1.1 to -1.4. This estimate is substantially lower than ours for youths, but closer to Ornstein's estimate for the total population. Their estimate of the per capita income elasticity of demand for liquor is about 1.2, and is substantially higher than found in either this dissertation or in the studies summarized by Ornstein.

Comparisons with Findings from Other Participation Studies

We cannot compare the findings from our participation models with those from previous studies. Our study is unique in its attempt to quantify the effects of economic,

social, demographic and regulatory variables on the decision to drink.

Subsequent to the discrete choice participation models estimated in this dissertation, Grossman, Coate and Arluck (1987) estimated dichotomous and multinomial logit models on HANES I data using a different set of alcohol beverage prices and different model constructions. In addition, Grossman and Coate (1985) estimated multinomial logit models on data from HANES II (Cycle II of HANES for the years 1976 to 1980).

Participation Results from the Grossman, Coate and Arluck Study

The Grossman, Coate and Arluck (GCA) study, based upon a sample of 790 youths, ages sixteen to twenty-one, residing in large metropolitan areas (population sizes of 250,000 or more) analyzes the effects of economic, demographic and regulatory variables on the following discrete choices: the decision to drink the preferred beverage; the decision to drink the preferred beverage, by drinking category, where the categories are defined in terms of the number of drinking days per year; and the decision to drink the preferred beverage, by category, where the categories are defined by the number of drinks on a typical drinking day.

In general, Grossman, Coate and Arluck find that beverage prices and legal drinking ages are inversely related to drinking frequency and intensity. In

particular, their study estimates that a ten cent increase in the price of a twelve-ounce container of beer; a thirty cent increase in the price of a bottle of liquor; or a one year increase in legal drinking ages (for beer, wine and liquor) lead to roughly equal percentage reductions of three percentage points, for the participation rates for beer and wine, and for beer, wine and liquor combined, respectively.

In table 22 we compare the participation elasticities from this dissertation with those found by Grossman, Coate and Arluck.

TABLE 22
COMPARISON OF PARTICIPATION ELASTICITIES

	<u>Beer</u>	<u>Wine</u>	<u>Liquor</u>
Arluck	-0.87	0.0	-1.30
GCA study	-1.54	0.0	-3.29 to -4.08

NOTE: We are using price, not excise tax elasticities, to make the results comparable between studies.

Neither study could find significant wine price or participation elasticities. GCA find substantially higher beer and liquor participation elasticities than does this study. Such large differences in these elasticities cannot easily be explained, although part of the explanation no doubt stems from the different characteristics of the two samples. This dissertation uses a sample of 2,555 youths, ages twelve to twenty, residing anywhere from rural to large urban centers; GCA use a more restricted geographic

and age sample, which limits them to older youths in large metropolitan areas.

The GCA study could not find any evidence of the effect of legal drinking ages on liquor participation. This dissertation finds that the existence of a legal drinking age for liquor reduces liquor participation by 8.6 percent.

Participation Results Using the HANES II Data

The Grossman and Coate study (GC) on the HANES II data for the period 1976 to 1980 analyzes the consumption responses of 1,761 sixteen to twenty-one year olds; however, unlike the GCA study, Grossman and Coate do not restrict their youths to large metropolitan areas. They utilize a confidential set of beer prices for a national brand of beer to estimate beer demand models, but unlike this dissertation, or the GCA study, do not estimate wine demand models.

In general, Grossman and Coate find that legal drinking ages, and own-price are inversely related to the frequency of consumption. (In HANES II, unlike in HANES I, each youth reports his frequency of consumption over the past three months, for each of beer, wine or liquor.) In fact, GC find that higher beer prices have their largest impacts on those categories of youths who drink the most. The findings from their liquor models are not as consistent; frequent liquor drinkers show a

positive price elastic effect; while youths who are less frequent drinkers show negative price elastic effects.

We report Grossman and Coate's findings on beer and liquor participation elasticities, and compare them with ours in table 23.

TABLE 23

COMPARISON OF GROSSMAN AND COATE'S PARTICIPATION ELASTICITIES WITH ARLUCK'S

	<u>Beer</u>	<u>Liquor</u>
Arluck	-0.87	-1.30
GC	-0.40 to -0.49	-0.39 to -0.57

NOTE: We are using price, not excise tax elasticities, to make the results comparable between studies.

The beer and liquor price participation elasticities found in this dissertation are substantially higher than found by GC. However, we note that in the study by Grossman, Coate and Arluck, the beer participation elasticity was found to be -1.54, and the liquor participation elasticity was found to be in the range of -3.29 to -4.08.

Overall Conclusions in this Dissertation

Our study finds that higher excise taxes and prices, and the existence of legal drinking ages, reduce the youth consumption of alcoholic beverages, and reduce the probability that youths will begin to drink.

These results are substantiated in varying degrees by the findings of the youth drinking studies of Grossman, Coate and Arluck, and of Grossman and Coate.

This dissertation finds that equal percentage increases in the excise taxes on alcoholic beverages have their greatest percentage effect on expected liquor consumption. A ten percent increase in the real excise tax on each beverage would decrease expected liquor consumption by nearly 15.6 percent; expected wine consumption by 1.7 percent; and expected beer consumption by 0.6 percent.

We cannot detect any difference in the price elastic effect for legal compared to illegal youth (as defined in this study) for any of the alcoholic beverages.

The existence of legal drinking ages has its largest impact on the expected value of underage beer consumption reducing this consumption thirty percent. Expected liquor consumption is similarly reduced by the existence of legal drinking ages; reducing this consumption more than eight percent. Expected wine consumption shows no response to the existence of legal drinking ages.

In general, except for wine, we could not find short-term responses on the part of individuals, in either consumption or participation, to the lowering of legal drinking ages. Wine consumption shows a short-term rapid response to the lowering of drinking ages, that, however, approaches the long-run consumption levels (that are fully adjusted to the current drinking age) within one year.

Our study demonstrates the relative importance that social and demographic factors play in youth drinking, and in particular highlights the substantial increase in youth alcohol consumption and participation associated with divorce or desertion resulting in female-headed parental households.

Family income, adjusted for family size, seems to play little part in explaining youth drinking. However, youths in welfare families (holding real per capita household income fixed) do consume substantially more wine than do youths from families not on welfare: welfare status does not affect beer or liquor drinking. Youths who are not in school, but who are working (presumably with some additional disposable income) consume more beer than do students in school of the same age. Working youth do not, however, consume any more wine or liquor than students in school.

Males generally drink substantially more than females, with both sexes drinking more as they grow older.

The age and education of the head of household, and the education of the youth have no effect on beer or liquor consumption. Wine consumption, however, is reduced in the presence of an older and more educated head of household, and more so by additional years of schooling for the youth.

Ethnic groups display different levels of consumption and participation, and show distinct preferences among beverages. Of the five ethnic groups that we identify,

Blacks consume less beer, wine and liquor than the other four. Mexican and American Indian youths, at the other extreme, consume twice the amount of beer of any of the other groups, and somewhat more than the average wine consumption compared to other ethnic groups. Southern European youth, as we expected, show a strong preference for wine, drinking substantially more than the other four ethnic groups, and nearly four times the amount of the base group. Northern European youth show a distinct preference for liquor, in comparison to the other ethnic groups, and consume nearly 1.5 times the amount of the control group. Slavic youth only show a strong preference for wine, of which they consume three times the amount of the control group, and their consumption is second highest amongst the five ethnic groups.

Last, but not least, we find a disturbing tendency for pregnant youth to consume more alcohol than their nonpregnant counterparts.

Suggestions for Further Research

Our price elasticity estimates for beer and wine would benefit from more accurate and reliable price data for these beverages. As we indicated earlier, accurate wine price data are available on a confidential basis, and their use could be made contingent upon either selecting a leading brand for each state or using a leading national brand. Likewise, prices for leading brands of beer have been made available to other researchers (Ornstein 1981) on

a confidential basis, and such data would improve the accuracy of our estimates.

Other statistical techniques, such as multiple discriminant analysis, could be applied to drinking categories created from the typical drinking day data, and so identify those characteristics that are most closely associated with heavy daily drinking. Such analyses could efficiently pinpoint those youths most likely to be at risk of alcohol abuse.

The passage of the U.S. Federal Uniform Drinking Age Act in 1984, which attempts to force all states to raise minimum drinking ages to twenty-one, will present additional data upon which to test the efficacy of legal barriers to youth drinking.

There are now several economic studies on the youth demand for alcohol, and we believe that this dissertation has increased the social understanding of how prices, drinking ages, and demographic characteristics relate to this phenomenon. It is our expectation that future studies will further improve this understanding.

Footnotes

Chapter V

1

Ornstein, S., "Price and Income Elasticities of Demand for Alcoholic Beverages." In Recent Developments in Alcoholism, Vol. I, ed. by Mark Galanter and Alfonso Paredes, New York: Plenum, 1983. (Actual citation from manuscript prior to publication; page numbers would not match those in book.)

2

Ibid.

APPENDIX 1

GEOGRAPHIC DESCRIPTION OF HANES I SAMPLE SITES

TABLE 24

THE GEOGRAPHICAL LOCATIONS AND EXAMINATION
PERIODS FOR THE HANES I SAMPLE SITES

<u>Site No.</u>	<u>City and State</u>	<u>Counties</u>	<u>Sample Period</u>
1.)	Irvington, NJ	Essex, Morris,	5/71-10/72
)		Union, Somerset,	
)		Hudson, Middlesex	
2.)			7/74-10/75
3.)	Garden City, NY	Nassau, Queens,	5/71-10/72
)		Suffolk	
4.)			7/74-10/75
5.)	Bronx, NY	Bronx	5/71-10/72
)			
6.)			7/74-10/75
7.	Brooklyn, NY	Kings, Richmond	10/75-6/74
8.)	Orangeburg, NY	Westchester, Bergen	10/72-6/74
)		Rockland (NY),	
)		Passaic (NJ)	
9.)	Philadelphia,	Bucks, Chester,	5/71-10/72
)	PA	Delaware, Montgomery,	
)		Philadelphia	
10.)			7/74-10/75
11.	Philadelphia,	Philadelphia (PA),	10/72-6/74
	PA	Camden, Gloucester,	
		Burlington, (NJ)	
12.)	Boston, MA	Essex, Middlesex,	5/71-10/72
)		Norfolk, Plymouth,	
)		Suffolk	
13.)			7/74-10/75
14.)	Pittsburgh, PA	Allegheny, Beaver,	5/71-10/72
)		Washington,	
)		Westmoreland	
15.)			7/74-10/75
16.	Albany, NY	Albany, Schenectady,	5/71-10/72
		Rensselaer, Saratoga	
17.	Scranton, PA	Lackawanna	10/72-6/74
18.	Springfield, MA	Holyoke, Chicopee,	5/71-10/72
		Springfield	

TABLE 24 - Continued

<u>Site No.</u>	<u>City and State</u>	<u>Counties</u>	<u>Sample Period</u>
19.	Providence, RI	Bristol, (RI), Newport, Kent, Providence, Washington, (RI)	10/72-6/74
20.	Manchester, CT	Hartford, Tolland	5/71-10/72
21.	Elmira, NY	Chemung, Tioga Tompkins	10/72-6/74
22.	Mercer, PA	Mercer	5/71-10/72
23.	Bedford, PA	Bedford, Fulton	10/72-6/74
24.	Rochester, NY	Monroe	7/74-10/75
25.	Altoona, PA	Blair	7/74-10/75
26.	Middletown, CT	Middlesex, New Haven	7/74-10/75
27.	Glens Falls, NY	Warren	7/74-10/75
28.)	Chicago, IL	Cook, Will, Kane, Lake, Porter, Ind.	10/72-6/74
29.)			5/71-10/71
30.	Chicago, IL	Cook, DuPage, Kane, Lake, McHenry; all in Illinois	10/72-6/74
31.)	Detroit, MI	Macomb, Oakland, Wayne	5/71-10/72
32.)			7/74-10/75
33.	Milwaukee, WI	Milwaukee, Waukesha	5/71-10/72
34.	Minneapolis, MN	Hennepin, Ramsey, Anoka, Dakota, Washington	10/72-6/74
35.	Cleveland, OH	Lake, Cuyahoga	5/71-10/72
36.	Columbus, OH	Franklin	10/72-6/74
37.	St. Joseph, MO	Buchanan	5/71-10/72

TABLE 24 - Continued

<u>Site No.</u>	<u>City and State</u>	<u>Counties</u>	<u>Sample Period</u>
38.	Fargo, ND	Cass, ND; Clay, MN	10/72-6/74
39.	St. Louis, MO	Jefferson, St. Clarks, St. Louis (MO); Madison, St. Clair (IL)	10/72-6/74
40.	Bay City, MI	Bay	5/71-10/72
41.	Angola, IN	DeKalb, Steuben, (IN); Branch, (MI)	5/71-10/72
42.	Three Rivers, MI	Cass, St. Joseph	10/72-6/74
43.	Chillicothe, OH	Fayette, Ross	10/72-6/74
44.	LaPorte, IN	Laporte, Marshall, Starke	5/71-10/72
45.	Boone, IA	Boone, Greene	5/71-10/72
46.	Cresco, IA	Howard (IA); Fillmore (MN)	10/72-6/74
47.	Kansas City, MO	Cass, Clay, Aatte, Jackson	7/74-10/75
48.	Indianapolis, IN	Marion	7/74-10/75
49.	Dayton, OH	Montgomery, Greene, Miami	7/74-10/75
50.	Jackson, MI	Jackson	7/74-10/75
51.	Leavenworth, KS	Jefferson, Leavenworth (KS); Platte (MO)	7/74-10/75
52.	Wilmington, OH	Brown, Clinton	7/74-10/75
53.	Ladysmith, WI	Rusk	7/74-10/75

TABLE 24 - Continued

<u>Site No.</u>	<u>City and State</u>	<u>Counties</u>	<u>Sample Period</u>
54.)	New Orleans, LA	St. Bernard, Jefferson, Orleans Parishes	10/72-6/74
55.)			7/74-10/75
56.	Washington, DC	Wash. (City); Fairfax, Arlington (VA); Prince Georges, Montgomery (MD)	5/71-10/72
57.	Columbia, SC	Richland, Lexington	5/71-10/72
58.	Knoxville, TN	Knox, Anderson, Blount	10/72-6/74
59.	Roanoke, VA	Roanoke	10/72-6/74
60.	Savannah, GA	Chatham	5/71-10/72
61.	Tampa, FL	Hillsborough, Pinellas	10/72-6/74
62.	West Palm Beach, FL	Palm Beach	5/71-10/72
63.	Natchitoches LA	Natchitoches	10/72-6/74
64.	Columbia, MI	Lamar, Marion	5/71-10/72
65.	Cabarrus, NC	Cabarrus, Stanley, Union	5/71-10/72
66.)	Morristown, TN	Hancock, Hamblen, Hawkins, Claiborne	10/72-6/74
67.)			7/74-10/75
68.	Eutaula, AL	Barbour	5/71-10/72
69.	Statesboro, GA	Bullock, Jenkins	10/72-6/74
70.	Georgetown, DE	Sussex, (DE); Worcester, (MD)	5/71-10/72
71.	Oakhill, WV	Fayette	10/72-6/74

TABLE 24 - Continued

<u>Site No.</u>	<u>City and State</u>	<u>Counties</u>	<u>Sample Period</u>
72.	Greenville, SC	Greenville	7/74-10/75
73.	New Castle, DE	New Castle	7/74-10/75
74.	Birmingham, AL	Jefferson	7/74-10/75
75.	Daytona Beach, FL	Volusia	7/74-10/75
76.	Saluda, SC	Edgefield, Saluda	7/74-10/75
77.	Spencer, WV	Clay, Calhoun, Roane	7/74/10/75
78.))	Los Angeles, CA	Orange, LA	5/71-10/72
79.)			7/74-10/75
80.	Los Angeles, CA	Los Angeles	10/72-6/74
81.)))))	San Francisco, CA	Alameda, Solano, Contra Costa, San Mateo, San Fran.	5/71-10/72
82.)			7/74/10/75
83.	Dallas, TX	Collin, Denton, Dallas, Ellis	10/72-6/74
84.	San Antonio, TX	Bexar	5/71-10/72
85.	Tucson, AZ	Pima	5/71-10/72
86.	Omaha, NE	Douglas (NE) Pottawattamie (IA)	10/72-6/74
87.	San Diego, CA	San Diego	10/72-6/74
88.	Fresno, CA	Fresno	5/71-10/72
89.	Monterey, CA	Monterey	10/72-6/74
90.	Port Angeles, WA	Clayburn, San Juan	5/71-10/72
91.	Moses Lake, WA	Grant	5/71-10/72
92.	Globe, AZ	Gila	10/72- 6/74

TABLE 24 - Continued

<u>Site No.</u>	<u>City and State</u>	<u>Counties</u>	<u>Sample Period</u>
93.	Marksville, LA	Avoyelles	5/71-10/72
94.	Fergus Falls, MN	Ottertail	10/72-6/74
95.	Denver, CO	Adams, Arapahoe, Denver, Jefferson, Boulder	7/74-10/75
96.	Sacramento, CA	Sacramento	7/74-10/75
97.	Greenville, TX	Hunt, Rains	7/74-10/75
98.	Olympia, WA	Mason, Thurston	7/74-10/75
99.	Fullerton, NE	Greeley, Nance	7/74-10/75
100.	Oklahoma City, OK	Canadian, Cleveland, OK	7/74/10/75

APPENDIX 2

METHODOLOGY FOR CONSTRUCTION OF DATA IN TABLE 2

1. Construction of Weighted Average Liquor Prices

Each annual issue of the Liquor Handbook lists the suggested retail bottle prices, as of January of each year, for nine leading brands and types of distilled spirits. These brands and types are: Seagram 7 Crown (blend), Old Crow (straight), Old Forester (bond), Haig & Haig (scotch), Seagram V.O. (Canadian), Gordon's (gin), Bacardi (rum), Christian Brothers (brandy) and Smirnoff (vodka).

We weight the prices for each of these nine brands of liquor by their respective state bottle sales. (Bottle liquor sales per 100 resident state population are found in the Liquor Handbook.)

These weighted average liquor prices are calculated for each state, for each of the years 1971 to 1975.

2. Selection of Bordering States

HANES I sampling sites consist of groupings of one or more contiguous counties.

We used the City and County Data Book of 1977 to locate each of the 100 HANES I sites, and the counties that comprised each site.

At a given site, we noted the boundaries of each of the component counties. Using the mileage scale provided

with the maps, we extended the boundaries of each county by twenty miles. If a county within a site was found to be within twenty miles of one or more states, the names of those states were recorded. (If a site was not within twenty miles of another state no additional information was recorded.)

In some instances, where we determined that the populations involved in bordering counties were small (based upon the locations of population centers provided on the City and County Data Book maps), we did not record the names of bordering states.

3. Determination of Drinking Ages and Alcohol Beverage Prices at State Borders

Drinking Ages

From Section 2, above, we can determine those sites having bordering states. If one or more bordering states are found at a site, the drinking age for that site is set to be the lowest drinking age, for beer, among the bordering states.

Liquor Prices

The liquor price, for a site within twenty miles of bordering states, is set to be the liquor price of that state having the lowest beer drinking age, as determined in Section 3. This liquor price, is a weighted average liquor price, as calculated in Section 1.

Beer and Wine Prices

We examined the differentials in excise tax rates, for each of beer and wine, between own, and bordering state tax

rates, for those sites and bordering states, as found in Section 2.

These differentials are compiled for the affected sites, with the beer tax differentials presented in table 25, and the wine tax differentials in table 26.

The findings from table 25 indicate that the largest differential in excise tax rates for beer is about two cents per twelve-ounce can, with the average differential closer to one cent. Table 26 shows that the largest differential for wine is about twelve cents per quart, with the average differential close to six cents.

We conclude from looking at these small differentials, that youths have almost no incentive to travel across state lines to purchase slightly cheaper beer or wine. Therefore, at each site, (whether near bordering states or not) the beer and wine prices are set to be the own-state prices.

TABLE 25

BORDER DIFFERENTIALS IN STATE EXCISE TAX RATES, AS OF
9/1/74, FOR A CASE OF TWENTY-FOUR 12-OUNCE CONTAINERS
OF MALT BEVERAGES, FOR BORDERING STATES IN THE
HANES I SURVEY BY REGION OF THE COUNTRY

Midwest Region

<u>State</u>	<u>Spread</u> <u>(Dollars per Case)</u>
Indiana	
Illinois	
Wisconsin	.05
Ohio	
Michigan	.10
Wisconsin	
Minnesota	.00
Kansas	
Missouri	.24
Minnesota	
North Dakota	.21
Illinois	
Missouri	.03
Ohio	
Michigan	
Indiana	.26
Indiana	
Michigan	.26
Minnesota	
Iowa	.17
Kansas	
Missouri	.20
Kentucky	
Ohio	.18

NOTE: The median spread for the Midwest Region is
0.18, and the average spread is 0.15.

TABLE 25 - Continued

West Region

<u>State</u>	<u>Spread</u> <u>(Dollars per Case)</u>
Iowa	
Nebraska	.09

NOTE: The average and median spreads for the West Region are 0.09.

Northeast Region

<u>State</u>	<u>Spread</u> <u>(Dollars per Case)</u>
New York	
Pennsylvania	.14
New Jersey	
New York	.03
New Jersey	
Delaware	
Maryland	.13
New Hampshire	
Massachusetts	.07
West Virginia	
Ohio	
Pennsylvania	.16
New York	
Massachusetts	
New Hampshire	.17
Connecticut	
Massachusetts	.01
Connecticut	
Massachusetts	
Rhode Island	.05
Maryland	
Pennsylvania	.04
New York	
New Hampshire	.17

NOTE: The median and average spreads for the Northeast Region are 0.10.

TABLE 25 - Continued

South Region

<u>State</u>	<u>Spread</u> <u>(Dollars per Case)</u>
Mississippi	
Louisiana	.23
Virginia	
Maryland	
Washington, D.C.	.32
West Virginia	
Virginia	.08
South Carolina	
Georgia	.65
South Carolina	
North Carolina	.53
Tennessee	
Virginia	.23
Alabama	
Georgia	.12
Delaware	
Maryland	.05

NOTE: The median spread for the South Region is 0.23, and the average spread is 0.28.

NOTE: The state groupings in the regional tables represent every instance where HANES I sites were within twenty miles of bordering states.

TABLE 26

BORDER DIFFERENTIALS IN EXCISE TAX RATES, AS OF 9/1/74, FOR
A GALLON OF TABLE WINE, FOR BORDERING STATES IN THE
HANES I SURVEY--BY REGION

<u>Region</u>	<u>Spread</u> <u>(Dollars per Gallon)</u>
Midwest	0.10 to 0.30
West	0.25
Northeast	0.10 to 0.40
South	0.00 to 0.50

NOTE: A large number of states use ad valorem taxes, where the taxes are based on the value of the wine. In these instances, we estimated the price of a gallon of table wine, and calculated the tax collected. This accounts for the estimates of the ranges provided.

4. Determining the HANES I Examination Dates for Individuals

Per our agreement with NCHS, we were not permitted to use the actual calendar date on which a sample person was examined. At each site, we therefore calculated the midpoint of the sampling period for that site, and assigned that date as the examination date for individuals from that site.

The HANES I sampling periods, and their calculated midpoints are shown in Table 27.

TABLE 27

DETERMINING HANES I SAMPLE DATES

<u>HANES I Sample Period</u>	<u>Midpoint Selected</u>
May 1971 - October 1972	February 1, 1972
October 1972 - June 1974	August 15, 1973
July 1974 - October 1975	March 1, 1975

5. Determining the Length of Exposure to Lower Drinking Ages

For each site, we calculated how many months had passed from the time its own state had lowered its drinking age, to the time a person was examined (where the examination date is based upon the calculations in Section 4).

If a state had not lowered its drinking age in the past five years, we recorded that as a zero month change. If a state changed its drinking age after the midpoint date for its sampling period, we treated that change as if it had occurred after the end of the sampling period, and recorded a zero month change. Lastly, changes in drinking ages beyond the end of the sampling period were also recorded as zero month changes.

Drinking ages that were either lowered more than five years before a person was examined, or after that person was examined, were treated as having no effect on consumption.

6. The Selection of Consumer Price Indexes and Values

Using our calculated examination dates, we selected the annual average U.S. Consumer Price Index values for 1972, 1973 and 1975 as our primary measure of consumer price levels.

As an alternative measure of consumer price levels, we utilized state-specific price indexes developed by Fuchs, Michael and Scott (1979).

Fuchs, Michael and Scott developed state-specific price indexes for the years 1967 and 1972. We extended these index values to the years 1973 and 1975 by using growth rates based upon the growth in the U.S. Consumer Price Index.

Each state-specific price index therefore grows at the same rate over the 1972 to 1975 period.

APPENDIX 3

TABLES 28 - 33

REGRESSION RESULTS FOR CONSUMPTION AND PARTICIPATION MODELS

Some General Observations and Comments
on the Regression Results

The adjusted R-Squared values in all of our models are generally quite low. In large measure this can be attributed to the level of disaggregation of our data: our data report the responses of individual decision makers for three narrow categories of beverages. It is well known that as data is disaggregated into finer units of observation, and into finer classifications of commodities, over shorter time intervals, that the adjusted R-Squared values from regressions using these data fall. In fact, as Theil (1978, p. 136) points out, adjusted R-Squared values in cross-sectional studies using household (let alone individual) data are often below 0.5.

Another, but unrelated reason for the low values of the adjusted R-Squared in our linear probability models is noted by Pindyck and Rubinfeld (1976, pp. 255-6.). They point out that the adjusted R-Squared, as a measure of explained variance, is biased downward in linear probability models.

The "t" values in the linear probability models are asymptotically normal as the sample size is 2,555.

We have generally included as statistically significant, all those variables whose "t" values exceed one in absolute value. This is not common practice, as most econometric studies use "t" values that do not go below the ten percent level of significance; using a "t"

value of one goes almost to the thirty percent level of significance on a two-tailed test.

In those instances where a variable has a "t" value close to one, we generally know the direction of the sign of the variable, and can use a one-tailed "t" test: such variables pass at the fifteen percent level of significance.

Our decision to use the fifteen percent level of statistical significance depends heavily upon our view that our study is exploratory in nature, and that there were no previous estimates of the parameters for youth alcohol demand.

We note that our "decision-rule" for inclusion of variables in the regression discussions could be more rigorously justified, if we were willing and able to specify loss functions for the probability of making a Type I error. Good discussions relating to the choice of appropriate significance levels for variables in regression models, and the often neglected distinction between economic and statistical significance, are found in McCloskey (1985) and Arrow (1960).

TABLE 28

REGRESSION RESULTS FOR BEER CONSUMPTION

<u>Explanatory Variable</u>	<u>Coefficient</u>	<u>t Ratio</u>
INTERCEPT	1.4453	1.48
<u>Individual Characteristics</u>		
AGE	0.1129	2.06
SEX	0.7645	5.99
EDUCATION	0.0465	0.97
WORKING	0.3224	2.38
PREGNANT	-0.4235	-0.58
ILLEGAL	-0.2446	-1.13
N. EUROPE	-0.0304	-0.18
S. EUROPE	0.1643	0.72
SLAVIC	-0.0146	-0.04
MEXICAN/AM INDIAN	0.7423	2.17
BLACK	-0.5451	-2.40
<u>Family Characteristics</u>		
AGEHD	-0.0031	-0.54
SEXHD	-0.3524	-2.16
EDHD	0.0116	0.50
INCOME	145.2220	0.62
PERHD	0.0200	0.64
WELFARE	-0.1429	-0.60
<u>Price and Regulation</u>		
PRICE	-0.0001	-0.02
PRICE*ILLEGAL	0.0008	0.13
DURATION	-0.1068	-0.47
ILLEGAL*DURATION	0.1150	0.21

Summary Statistics

Number of Observations = 481

Adjusted R = 0.1960

F = 6.57, significant at 0.0001

Dependent Mean = 4.290

TABLE 29

REGRESSION RESULTS FOR BEER PARTICIPATION

<u>Explanatory Variable</u>	<u>Coefficient</u>	<u>t Ratio</u>
INTERCEPT	-0.3599	-3.25
<u>Individual Characteristics</u>		
AGE	0.0361	5.28
SEX	0.1752	12.26
EDUCATION	0.0085	1.41
WORKING	0.0003	0.01
PREGNANT	-0.1770	-2.91
ILLEGAL	-0.0732	-2.57
N. EUROPE	0.0325	1.52
S. EUROPE	0.0391	1.35
SLAVIC	-0.0104	-0.26
MEXICAN/AM INDIAN	-0.0194	-0.51
BLACK	0.0224	0.85
<u>Family Characteristics</u>		
AGEHD	-0.0025	-3.55
SEXHD	0.0101	0.49
EDHD	-0.0041	-1.61
INCOME	31.0355	0.97
PERHD	-0.0044	-1.26
WELFARE	-0.0049	-0.19
<u>Price and Regulation</u>		
PRICE	-0.0004	-1.03
PRICE*ILLEGAL	0.0001	0.24
DURATION	0.0062	0.18
ILLEGAL*DURATION	0.0023	0.04

Summary Statistics

Number of Observations = 2555

Adjusted R² = 0.1828

F = 28.21, significant at 0.0001

Dependent Mean = 0.1883

TABLE 30

REGRESSION RESULTS FOR WINE CONSUMPTION

<u>Explanatory Variable</u>	<u>Coefficient</u>	<u>t Ratio</u>
INTERCEPT	1.3909	0.75
<u>Individual Characteristics</u>		
AGE	0.3384	2.92
SEX	-0.1480	-0.62
EDUCATION	-0.1594	-1.66
WORKING	-0.2332	-0.87
PREGNANT	3.3091	2.80
ILLEGAL	-0.0431	-0.11
N. EUROPE	0.6342	1.64
S. EUROPE	1.3270	2.94
SLAVIC	1.0957	2.37
MEXICAN/AM INDIAN	0.8467	1.21
BLACK	0.6327	1.36
<u>Family Characteristics</u>		
AGEHD	-0.0225	-2.19
SEXHD	-0.4474	-1.35
EDHD	-0.0583	-1.45
INCOME	-549.9468	-1.37
PERHD	-0.0379	-0.55
WELFARE	0.9930	2.24
<u>Price and Regulation</u>		
PRICE	-0.0049	-1.34
PRICE*ILLEGAL	0.0035	0.43
DURATION	-0.8099	-1.76
ILLEGAL*DURATION	0.9168	0.86

Summary Statistics

Number of Observations = 133

Adjusted R² = 0.3190

F = 3.941, significant at 0.0001

Dependent Mean = 3.714

TABLE 31

REGRESSION RESULTS FOR WINE PARTICIPATION

<u>Explanatory Variable</u>	<u>Coefficient</u>	<u>t Ratio</u>
INTERCEPT	-0.2170	-3.20
<u>Individual Characteristics</u>		
AGE	0.0071	1.70
SEX	-0.0316	-3.61
EDUCATION	0.0082	2.23
WORKING	0.0247	1.77
PREGNANT	-0.0602	-1.62
ILLEGAL	0.0171	0.97
N. EUROPE	0.0244	1.86
S. EUROPE	0.0258	1.44
SLAVIC	0.1116	4.48
MEXICAN/AM INDIAN	0.0263	1.11
BLACK	0.0206	1.29
<u>Family Characteristics</u>		
AGEHD	0.0006	1.30
SEXHD	-0.0146	-1.15
EDHD	0.0047	3.03
INCOME	20.1381	1.04
PERHD	-0.0012	-0.54
WELFARE	-0.0042	-0.26
<u>Price and Regulation</u>		
PRICE	-0.0002	-0.77
PRICE*ILLEGAL	-0.0001	-0.39
DURATION	-0.0128	-0.60
ILLEGAL*DURATION	-0.0122	0.39

Summary Statistics

Number of Observations = 2555

Adjusted R² = 0.0477

F = 7.10, significant at 0.0001

Dependent Mean = 0.0521

TABLE 32

REGRESSION RESULTS FOR LIQUOR CONSUMPTION

<u>Explanatory Variable</u>	<u>Coefficient</u>	<u>t Ratio</u>
INTERCEPT	4.1311	1.72
<u>Individual Characteristics</u>		
AGE	0.1519	1.34
SEX	0.8839	3.02
EDUCATION	-0.0692	-0.82
WORKING	-0.0603	-0.24
PREGNANT	0.8283	1.43
ILLEGAL	0.3135	0.08
N. EUROPE	0.3829	1.32
S. EUROPE	0.1288	0.34
SLAVIC	0.4082	0.86
MEXICAN/AM INDIAN	-0.4518	-0.43
BLACK	-0.6636	-1.62
<u>Family Characteristics</u>		
AGEHD	-0.0061	-0.58
SEXHD	-0.4912	-1.55
EDHD	-0.0323	-0.62
INCOME	285.5825	0.81
PERHD	0.0351	0.57
WELFARE	-0.2974	-0.64
<u>Price and Regulation</u>		
PRICE	-0.4271	-1.39
PRICE*ILLEGAL	-0.0746	-0.08
DURATION	-0.1572	-0.40
ILLEGAL*DURATION	0.0227	0.01

Summary Statistics

Number of Observations = 136

Adjusted R² = 0.0531

F = 1.36, significant at 0.1532

Dependent Mean = 3.873

TABLE 33

REGRESSION RESULTS FOR LIQUOR PARTICIPATION

<u>Explanatory Variable</u>	<u>Coefficient</u>	<u>t Ratio</u>
INTERCEPT	0.0381	0.39
<u>Individual Characteristics</u>		
AGE	0.0089	2.14
SEX	-0.0395	-4.57
EDUCATION	0.0027	0.75
WORKING	0.0495	3.61
PREGNANT	0.0205	0.56
ILLEGAL	-0.0855	-0.88
N. EUROPE	-0.0222	-1.72
S. EUROPE	0.0005	0.03
SLAVIC	0.0023	0.09
MEXICAN/AM INDIAN	-0.0329	-1.42
BLACK	-0.0342	-2.17
<u>Family Characteristics</u>		
AGEHD	-0.0009	-2.01
SEXHD	-0.0349	-2.80
EDHD	0.0026	1.67
INCOME	35.1385	1.83
PERHD	-0.0024	-1.11
WELFARE	-0.0110	-0.69
<u>Price and Regulation</u>		
PRICE	-0.0164	-0.93
PRICE*ILLEGAL	0.0144	0.63
DURATION	0.0148	0.70
ILLEGAL*DURATION	-0.0080	-0.26

Summary Statistics

Number of Observations = 2555

Adjusted R = 0.0918

F = 13.29, significant at 0.0001

Dependent Mean = 0.0532

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