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Please make the following changes in your copy of:

Alcohol-Related Casualties and Alcohol Beverage Market Response to Beverage Alcohol Availability Policies in Michigan, Volume 1

Richard L. Douglass and Jay A. Freedman

Page 3.

The first sentence, paragraph 1, should read:

"In 1971 Michigan elected to lower the legal drinking age from 21 to 18.

The third sentence, paragraph 1, should read:

"The Michigan proposal, put to vote in 1971, included..." The word "November" is deleted.

The first sentence, paragraph two, should read as printed with the word "referendum" deleted and replaced with "vote".

Page 4.

Last sentence, the word "national" should be deleted and replaced with "natural".

Page 5.

Sentence one, paragraph one, the word "people" should be deleted and replaced with "legislature".

Page 48.

Line 8 should read as follows:

"925 x 5 = 4625 more three-factor-surrogate crash involvement among 18-to-20-"

Wolfe

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Alcohol-Related Casualties and Alcohol Beverage Market Response to Beverage Alcohol Availability Policies in Michigan

Final Report

Volume I

August 1977

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16. Abstract

The research reported is an examination of the consequences of the 18-year-old drinking age in Michigan on traffic crash involvements between 1972 and 1975. Also the interaction of retail alcohol availability with the lower legal drinking age is analyzed.

Crash data representing Michigan and specific subunits of Michigan were used. Comparisons of different age groups with time-series analyses isolated a persistent traffic accident increase among 18-20-year-old drivers. Analyses of data provided by the Michigan Liquor Control Commission revealed that many factors affect the number of retail sales applications that are approved for different types of alcoholic beverage licensure. These factors include legislation, court decisions, policy and repeating events such as the U.S. Census.

The lower legal drinking age has been responsible for at least 4600 alcohol-related crash involvements between 1972 and 1975, of which at least 89 included at least one fatality. The availability of beverage alcohol increased at or about the same time that the legal drinking age became 18 and the volume of beer, wine and distilled spirits increased steadily during the time period. Draught beer consumption increased significantly probably directly associated with the lower legal drinking age.

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SUMMARY

In January of 1972 the State of Michigan lowered the legal drinking age from 21 to 18. Opponents of that legislation argued that the change would increase traffic crashes and other alcohol-related problems among young people 18 to 20 years of age. In 1974 R.L. Douglass, of the University of Michigan Highway Safety Research Institute, completed a study of alcohol-related crashes in Michigan for the period January, 1971, through June, 1973. The findings showed that for the period of January, 1972 through June, 1973, the frequency of involvement of 18-to-20-year-old male drivers in alcohol-related traffic crashes increased between 10% and 26% over the 1968-1971 time period.

To establish if that level of increased crash frequency extended beyond 1973, a second study was conducted by Douglass and Freedman in 1976-1977, under sponsorship of the Office of Substance Abuse Services, Michigan Department of Public Health. This study differed from the 1972-1973 study in two ways. First, it included analyses of crash involvements of four age ranges of male drivers for the years 1968 through 1975: ages 16 and 17, 18 to 20, 21 to 24, and 25 to 45. The data included a sample of crashes throughout the State of Michigan, a census of fatal crashes, a census of crashes in 27 rural counties, and individual county data from Ingham, Oakland, and Washtenaw Counties. Choice of those jurisdictions permitted analyses to compare crash involvements in the various age groups, and to isolate significantly elevated frequencies of alcohol-related involvements among male drivers aged 18 through 20.

The second way in which this study differed from the 1972-1973 study is that it analyzed changes that have occurred in the availability of alcoholic beverages in Michigan during the period 1970-1976. Data on licensing actions by the Michigan Liquor Control Commission were analyzed, as were changes in the sales volume of various alcoholic beverages distributed in Michigan. The availability and sales data showed that since 1971 the number of establishments licensed to sell beverage alcohol has significantly increased, and since 1969 the consumption of beverage alcohol has steadily increased.

The study findings show that during the four-year period, 1972-1975, the elevated frequency of alcohol-related crashes involving male drivers aged 18 to 20 persisted. At least 4600 alcohol-related traffic crashes resulting in at least 89 fatalities are attributable to the 1972 lowering of the legal drinking age and to the increases in availability and consumption of alcoholic beverages. No significant increases in alcohol-related crash involvements occurred among the driver age groups of 21 to 24 or 25 to 45. As for alcohol-related crash involvements among male drivers aged 16 and 17, a statistically significant increase was identified in Oakland County.

It is suggested that the legal drinking age be raised. If it were raised a decline in the frequency of alcohol-related crash involvements among male drivers 18-to-20-years-old could be expected. But, because of increases in the availability of alcoholic beverages, combined with uncertainties concerning the level of enforcement of such legislation and other factors, it is unlikely that the frequency of such crash involvements would be lowered immediately to the 1971 level.

Several recommendations for further research and policy are offered. Analyses should be conducted to determine at which age the current youth alcohol-related crash problem is greatest. Specific analyses of young, female crash-involved drivers should be conducted to determine if young women have been affected by the lower legal drinking age.

The availability of beer, wine, and distilled spirits should be monitored throughout the State of Michigan. The data for monitoring beverage alcohol availability are at hand and should be utilized for research and policy-making purposes.

Alcohol availability should be investigated to establish the relationship of different levels of availability to a wide range of social and health problems associated with abusive drinking. These problems include but are not limited to traffic crashes, violent crime, child abuse and neglect, and alcoholism.

The drinking practices and patterns of young people should be systematically researched. Little is known regarding the circumstances

in which young people drink, why they drink, or their expectations regarding the beverage alcohol. Until these dynamics of youth drinking practices are known, little can be done to prevent youth drinking problems.

PREFACE AND ACKNOWLEDGMENTS

This is the final report of A Study of Alcohol Related Casualties and Alcohol Beverage Market Response to Beverage Alcohol Availability Policies in Michigan, research being performed under contract for the Michigan Department of Public Health, Office of Substance Abuse Services, Lansing, Michigan.

Several organizations and individuals have contributed to the work, including Mr. Tom Reel and associates of the Michigan Office of Highway Safety Planning (OHSP) who provided support under a separate contract with HSRI to prepare Michigan data files for analysis in the present study. At HSRI, Lyle Filkins, Research Scientist, and Charles Compton, Research Associate, were instrumental in the interface between the OHSP contract and our work for the Department of Public Health.

Ms. Jane Martin of the Michigan State Police was helpful in the identification of critical characteristics of the 1968 to 1975 Michigan State Police Accident data.

Mr. Roger Rosendale of the State of Michigan Liquor Control Commission was responsible for our acquisition of all available records of concluded licensing transactions by the Commission since 1970, and for distilled spirits wholesale distribution data since 1968. Ms. Beth Squires, of the Michigan Liquor Control Commission, provided essential information regarding legal, legislative, policy, and administrative changes of liquor control laws and regulations. The historical significance of specific events between 1969 and 1976 would not have been clarified without Ms. Squires's assistance.

Mr. Rae Dehneke of the Michigan Beer and Wine Wholesaler's Association provided all available data regarding wholesale beer and wine distribution throughout Michigan since 1968.

While others contributed valuable services,we remain fully responsible for the methodologies, findings,and interpretations contained in this report.

Richard L. Douglass, MPH, Ph.D.
Jay A. Freedman, M.S.W.
August 1977
Systems Analysis Division, HSRI

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1.0 INTRODUCTION

The research reported herein reflects project activities conducted by HSRI under contract with the Michigan Department of Public Health, Office of Substance Abuse Services. The project was initiated as a pilot effort for a proposed, ongoing policy research program by the Office of Substance Abuse Services. The contract period began in October, 1976.

In 1972 Michigan lowered the legal drinking age from 21 to 18 and a storm of controversy erupted regarding the impact of the legal change on traffic accidents among 18-to-20-year-old drivers. In 1973 HSRI contracted with the National Highway Traffic Safety Administration, Washington, D.C., to do conclusive research regarding Michigan, Vermont, and Maine. The research identified statistically and socially significant increases of 18-to-20-year-old alcohol-related crashes subsequent to the reduced legal drinking ages in Michigan and Maine. No impact was detected in Vermont.

In 1976 and early 1977 legislation was introduced in the Michigan legislature to raise the legal drinking age to 19 or 21, on the premise that the human toll under the 18-year-old drinking age was too great. The Office of Substance Abuse Services requested prospective contractors to investigate the lasting effects of the traffic casualty situation in Michigan since 1972 among young drivers. Phase I of the research reported herein is an analysis of the 48-month experience in Michigan of the effects of the lower legal drinking age on youth crash involvement. The research of Phase I replicates many of the methodologies and statistical procedures of the original work HSRI conducted and reported in 1974. The research design and analysis methods have been expanded and modified to provide an in-depth analysis of Michigan's experience between 1972 and 1975.

Phase II of the project involves an exploratory analysis of alcoholic beverage licensing and distribution dynamics in Michigan. The general thrust of the research in Phase II is to detect any role of the licensing system of alcoholic beverages that might have interacted with the lower legal drinking age in Michigan. The analysis measured the wholesale volumes of alcoholic beverages consumed before and after the lower legal drinking age. In addition, changes of licensing and policy regarding places of alcohol consumption were studied to detect changes relevant and concomitant with the lower legal drinking age. Data analysis and conceptual models developed during Phase II have not been previously reported.

Phase III of the research is independent of Phases I and II. The Office of Substance Abuse Services hoped to develop objective techniques for setting priorities for policy attention among the range of social problems associated with alcohol abuse. A review of relevant literatures was conducted. Recommendations based upon that review reflect the current state-of-the-art regarding techniques of quantitatively assessing the public costs of alcohol abuse.

Volume I includes the methods and findings of Phase I and Phase II with a chapter integrating the findings. Research and Policy recommendations are offered regarding the legal drinking age and closely associated issues revealed by this research. Volume II includes the summary findings of the literature review and an annotated bibliography on cost-accounting of alcohol-related problems.

2.0 BACKGROUND

In 1971 ~~the people of~~ Michigan ~~voted~~ elected to lower the legal drinking age from 21 to 18. The legal drinking age was one of three components in an age of majority proposal modeled after the July 1971 U.S. Constitutional amendment which permitted 18-year-olds to vote in federal elections. The Michigan proposal, put to vote in ~~November,~~ 1971, included questions of the right to vote in local and state elections, to enter into binding contracts, and to purchase, possess and consume distilled spirits, beer and wine according to the provisions of alcoholic beverage control policies in the State of Michigan.

Considerable national, state, and local controversy erupted during the months prior to the 1971 ~~referendum~~ vote and subsequent to the effective date of the new law, January 1, 1972.[1] The beverage alcohol industry in concert with most of the intellectual community supported lowering the legal drinking age on several grounds. On the basis of surveys of high school students,[2] proponents claimed that lowering the legal drinking age would have little effect on drinking patterns or alcohol consumption levels among heretofore under-aged young drinkers. It was claimed that young people already drank, that they could acquire alcoholic beverages at will, and the legal change would simply legitimize existing behaviors.

In addition the intellectual community, civil liberties advocates and others argued that thousands of young people served in the armed forces in Vietnam and elsewhere, yet were unable to legally purchase or consume alcoholic beverages at home. This apparent inequity of rights and responsibilities helped create a groundswell of emotion that characterized the debate throughout 1971.

Another factor influencing public opinion in 1971 was the widely-publicized increase in marijuana, heroin,and other "dry drugs." This was depicted in the public media as approaching epidemic proportions. A move to replace poorly understood, illegal,and socially unacceptable drugs with legally available alcohol had considerable appeal to some parents'groups and some educators.

These and other factors, including the attractiveness to merchants of an expanded beverage alcohol market, combined to form a coalition in favor of lowering the legal drinking age along with other rights of majority. The coalition was vocal, broadly based,and large.

The opposition to lowering the legal drinking age was also vocal, but not nearly as broadly based as the proponents. Religious organizations, residuals of the temperance movement, and similar groups argued that if 18-to-20 year-olds were given the right to purchase and consume alcoholic beverages, then alcohol-related traffic accidents, public drunkenness,and early alcoholism would increase.[3] Associated with these immediate social costs, some opponents argued, would be an increase in the general moral decay of Michigan's youth. These groups also argued that the younger peers and siblings of 18-to-20 year-old new drinkers would become involved, and Michigan would experience increasing alcohol-related problems among early adolescents and the very young.

Another major coalition opposing the 18-year-old minimum drinking age was composed of the Department of State Police and county and local police departments. These organizations argued that the lower legal drinking age would cause an increase in traffic casualties associated with drinking and driving as well as increases in driving while intoxicated incidents and other difficult-to-enforce problems.

A pervasive element in this debate was a lack of adequate research to predict the impact of the proposed lower legal drinking age. No one really knew what would happen and it is probably true that it was not possible to predict the consequences of the legal drinking age change without actually trying it with a ~~national~~ natural population.

The age of majority legislation was strongly approved by the legislature of Michigan in November, 1971. The law became effective on January 1, 1972. When most elections and referendums are approved, the pre-existing debates typically dissipate and attendant energies are directed toward new issues. Not so with the legal drinking age. Within six months of the effective date of the 18-year-old drinking age, the Michigan Department of State Police reported an increase of more than 100% in alcohol-related accidents in which the 18-to-20 year-old drivers had been drinking, compared with the same time period of 1971.[4] This report touched off a new, more emotional, debate than the pre-election speculations of 1971.

Armed with statistics, the opposition to the lower legal drinking age launched a campaign to move the minimum age back to 21. Charges of unreliable reporting, bias, and statistical misrepresentation were made by the proponents of the 18-year-old drinking age and the situation was again deadlocked. Once again, the public media were filled with claims and counterclaims.

The issues raised in 1972 and 1973 were based on the need to explain events rather than postulate them. Specifically, it had been alleged that traffic casualties had increased in Michigan and that drinking had become a problem in the public schools; the debate involved the fundamental question of to what extent the lower legal drinking age was responsible for traffic casualties and public school problems.

In 1973, the U.S. Department of Transportation, National Highway Traffic Safety Administration, contracted with the Highway Safety Research Institute, to conduct a scientific analysis of the effects of the lower legal drinking age on youth crash involvement. The Department of Transportation's initiative was in response to the public's reactions to the initial effects of the lower legal drinking age being reported by several states, including Michigan.

The initial study, reported in 1974[5], revealed that Michigan experienced a frequency increase in alcohol-related traffic crashes, conservatively estimated to be between 9.99% and 25.66% for the first 12 to 18 months subsequent to January 1, 1972 among the 18-to-20 year-old drivers. The increases in alcohol-related traffic accidents were statistically and socially significant.*

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*Often total reliance on arbitrary levels of statistical significance is too conservative to equate with social costs. In the 1973-1974 HSRI study clear statistical significance was measured for alcohol-related crashes of all severity levels. However, the statistical significance of the alcohol-related fatal accidents was borderline at the $p \leq .05$ level.

The 1973-1974 HSRI study demonstrated an immediate impact of the lower legal drinking age on youth crash involvement. However, two research questions were generated by the investigation. First, was the initial increase in alcohol-related crashes temporary or permanent? Secondly, what intervening factors might help explain the relationship between the change in legal drinking age and a consequent increase in alcohol-related casualties? These unresolved issues constitute the focus of the present investigation.

The original HSRI study developed several methodological and measurement innovations in order to satisfactorily conduct the research. These developments set the initial study apart from other scientific findings which, while in agreement with the HSRI findings, did not fully control over alternative interpretations of traffic accident data.[6]

2.1 The Conceptual Issues

A lower legal drinking age has no necessarily direct relationship to any change in youth alcohol-related crash involvements. The cause-effect relationship between the legal change and traffic casualties is, at best, several steps removed. A general conceptual model associating the legal change with subsequent behavioral and casualty impacts is shown in Figure 2.1. The figure depicts only conceptualized changes as were addressed by Douglass et al. in 1974.

If it can be assumed that any problem associated with a misuse of a commodity such as alcoholic beverages is determined by the demand and supply of the commodity, then Figure 2.1 is focused on factors of change in the demand for alcoholic beverages, but not its availability. Figure 2.2 depicts a more adequate model in which both availability and demand are represented as logically interacting, intervening variables relating to the lower legal drinking age to measured increases in traffic casualties of young drivers.

This study investigated two research questions based on prior research and on the conceptual model depicted above, namely;

1) Were the previously reported increases in youth crash involvement in Michigan persistent through the 48 months subsequent to the effective date of the lower legal drinking age?

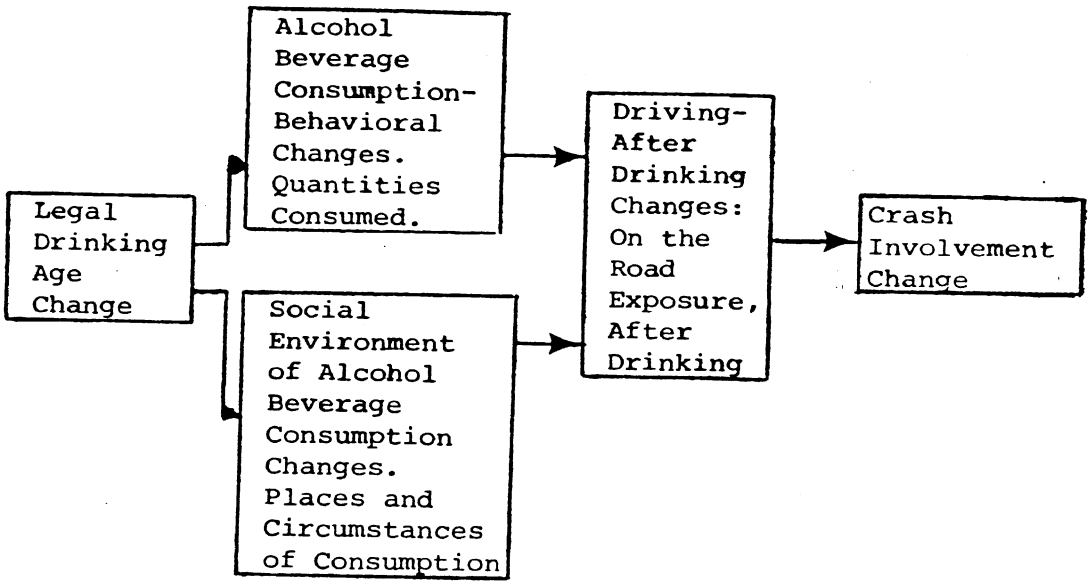

Figure 2.1 A Conceptual Model of the Relationship Between a Lower Legal Drinking Age and Highway Crash Involvement of Drinking Drivers with Demand-Type Intervening Variables (Douglass et al. 1974)

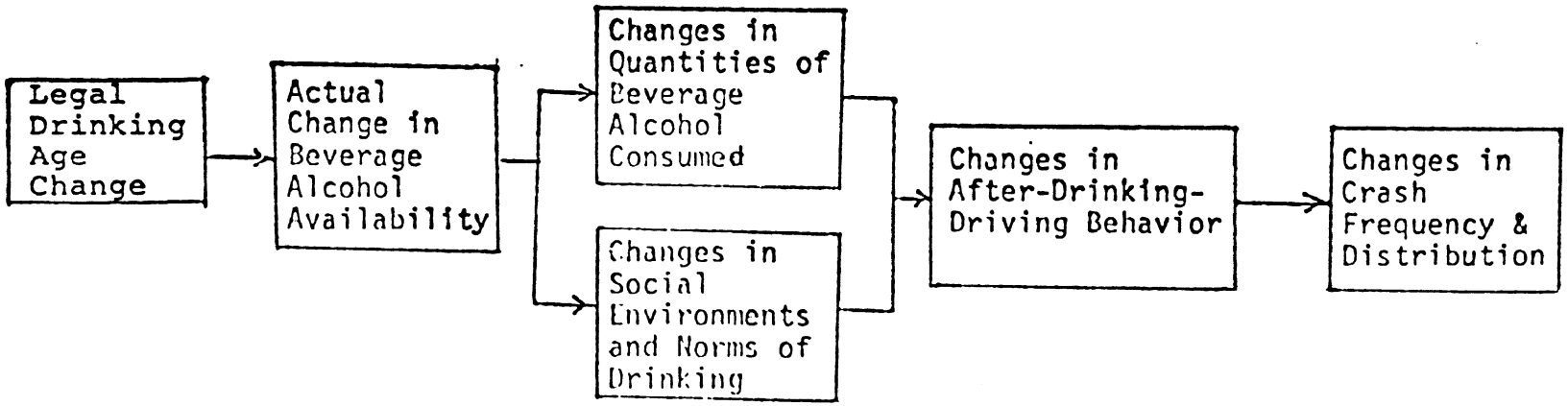

Figure 2.2 A Model of the Relationship of the Lower Legal Drinking Age Change to Changes in Crash Frequency and Distribution

2) Were measurable changes in the availability and marketing of alcoholic beverages concomitant with the lower legal drinking age and increases in youth crash involvements?

These research questions and the attendant methodologies, findings, and conclusions will follow. The following chapters include the detailed hypotheses, methods, and findings of Phases I and II of this research and the interactive conclusions and implications. Recommendations based on the research findings are included in the final chapter.

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3.0 ALCOHOL-RELATED TRAFFIC CRASHES

The initial phase of the present investigation consisted of expanding upon the time-frame of prior HSRI research to include the 1972-1975 period in order to test the hypothesis that initial increases in youth crash involvement persisted. Several fundamental methodological issues were addressed and resolved prior to deciding the study design and statistical procedures. This section discusses the methodological issues, their resolution, and the detailed methodology which emerged.

There were two underlying methodological objectives of the present study. Its methods needed to be consistent with prior research in order to provide data comparable with that of the 1974 study of Michigan's experience. Secondly, the study methods needed to allow a rigorous examination of whether or not the lower legal drinking age was a principal causal factor associated with increases in alcohol-related crashes among 18-to-20-year-old drivers.

To satisfy the need for consistency between studies, the basic methodological decisions in 1973 needed to be reviewed. These decisions, fully developed and reported in 1974,[1] included issues of design, variable development, and selection of statistical procedures and tests. Further, these decisions of methodology were also relevant to achieving the rigorous analysis of causality.

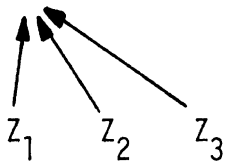
3.1 Methodology

Any causal argument (X→ Y) depends upon the satisfaction of four requirements:

1) Proper time sequence. The causal independent variable (X) must precede the dependent variable (Y).

2) Co-variation. Both the X and Y variables must be measurably different between observations; both must vary.

3) Controls for spuriousness. Plausible alternative explanations for changes in Y should be controlled-for through design or analysis such that the X → Y relationship is the most plausible among competing alternative explanations, where:



and,

Z_1 - Z_3 represent potential alternative causal factors.

4) Congruence with the state of knowledge regarding determinants of change in the dependent variable.

Because the dependent variable of interest in this investigation was limited to the period of time since January, 1972, and the legal drinking age was changed effective January 1, 1972, the requirement for proper time sequence was satisfied. Similarly, the frequency of traffic crashes has increased since 1972 the age of majority was reduced from 21 to 18, which has satisfied the requirement for co-variation.

Although the relationship of changes in the legal drinking age to changes in alcohol-related crash frequencies is not necessarily direct (see Section 2.1), it is consistent with the current state of knowledge and the common-sense notion that increasing the population of potential drinkers might well cause the population of crash-involved drinking drivers to change.[2] Thus the remaining requirement to be addressed was the issue of control over plausible alternative explanations to the legal drinking age of the observed increases in alcohol-related crashes among young drivers since 1972.

To assist in the pursuit of control, this study utilized the work of Campbell and Stanley (1966).[3] Campbell and Stanely set forth a classification of research strategies, known as quasi-experimental designs, which were adapted to legal impact studies by Lempert in 1966.[4]

The development of the quasi-experimental, or "almost experimental," design assists investigators seeking a causal interpretation of real-world events, including the effects of legal changes. Definitions and notations included below are those used by Campbell and Stanley.

Fundamental to the development of a sound research design is the delineation of conceptual benchmarks that provide a basis for design evaluation. Three such conceptual topics are of particular importance: plausible rival hypotheses and the extent to which these are controlled; internal design validity; and external design validity.

A plausible rival hypothesis represents a possibility that an event or combination of events, long-term phenomena, or characteristics of a population might explain an observed change,rather than the experimental variation being investigated. Thus, rival hypotheses are sources of spurious interpretation. Optimally, the full range of plausible rival hypotheses is controlled in a laboratory situation, and it is this level of control that a social investigator is compelled to approximate. Rival hypotheses come in a variety of forms from the obvious and dramatic to the more subtle and easily overlooked. Factors which define plausible rival hypotheses jeopardize the validity of conclusions drawn from empirical investigations.

Design validity, logically preceding validity of interpretation, can be classified into two distinct forms: internal validity and external validity. Internal validity is the basic minimum without which any experiment is uninterpretable; without it, no confident conclusions can be made regarding the relationship of observed effects and experimental changes. Without internal validity, external validity is not tenable.

Regarding the internal validity of legal impact research in the highway safety area, six classes of extraneous variables warrant attention. If not controlled, such sources of variation might confound analyses of the effects of a legal change. These variable classes are:

(1) History, the specific events influencing the population between the first and last observation of the experimental period. Examples of this are specific changes in laws other than the age of majority; changes in administrative procedures; short-term economic and social dynamics; extraneous stimuli (including potential effects of age-of-majority-related mass media messages and the effects of such stimuli both on the newly enfranchized 18-to-20-year-old drinking-driving population , and the legal-enforcement-administrative groups, including police).

(2) Maturation, processes acting on the affected populations as a normal function of the passage of time. Long-term economic, demographic, and social trends constitute the basic components of such gradual effects. Specifically, the linear trends of relative affluence, population growth, alcohol beverage consumption, age-specific population growth rates, vehicle population growth, increase of personal vehicle ownership or accessibility, and long-term trends of roadway improvement, taken as a whole, contribute to the explanation of changes in highway safety over a period of time.

(3) Instrumentation, in which changes in the operational measurement of variables are altered. An example, as will be seen subsequently, is a change in the recording of reported alcohol involvement in crashes that occurred in Michigan during the period under study.

(4) Statistical regression, in which high outcomes or frequencies tend to be followed by lower outcomes and vice versa. Accident data exhibit diurnal, weekly, seasonal, and long-range cyclic characteristics in which peaks in time-series measurements are invariably followed by troughs.

(5) Selection of analysis groups, if uncontrolled, introduces biases which are large or small, depending upon the total comparability of the groups. In the present case it is obvious that no

one county is like another in all respects. By selecting age group comparisons within counties and a representative sample of Michigan counties the major threats of a selection bias can be avoided.

(6) Any of the above sources of alternative explanation can interact and create a plausible rival hypothesis unlike each acting independently. Frequently selection, maturation, and history have been found to have interactive effects.

3.2 The Multiple-Time-Series Approach

The availability of the "running record" in the form of representative accident data over a reasonable time period provides the opportunity of implementing what Campbell and Stanley defined as the multiple time-series quasi-experimental design. Lempert defended this design as the "design par excellence for legal impact theory experimentation." [5]

The design is basically a series of comparable, consistent measurements at regular time intervals taken on two or more populations interrupted by a social or legal dynamic in one or more of the populations. The appeal of this design, when coupled with appropriate statistical analyses, is its ability to achieve maximal control over plausible rival hypotheses as expressed by the defined classes of extraneous variables.

The design can be represented in the abstract with the following formulation:

	t_1		t_9	t_{16}
Group 1	0000000	X		00000000
Group 2	0000000			00000000

where:

O = an observation or measurement, taken at equal time intervals, $t_1, t_2, \ldots, t_{16}$.

X = an experimental variable introduced to Group 1, the experimental group, at time point t_9.

-- = indicates that group assignment was prescribed by circumstance, and not according to random selection methods.

With this design, comparisons are made between the affected "experimental" population and the unaffected "control" population on parameters of interest. The comparisons become more internally valid the larger the number of time-ordered measurements and the greater the equivalence of measurements before and after the introduction of the social dynamic or experimental variable. The design increases in external validity, or generalizability, with increased representativeness of demographic, geographic, and other pertinent characteristics among the measured populations.

3.3 Jurisdictions and Age Groups

Unlike the earlier HSRI analysis the present investigation is limited to the state of Michigan.* This limitation is significant in that the long-term 18-year-old and 21-year-old control states used previously, which did not change the legal drinking age, permitted a strong causal argument relating changes in Michigan crash involvements to the legal change in Michigan.

Also, the selection of counties within Michigan in the 1974 study was not fully representative of the urban-rural mixture of environments across the state. Thus the critical question of the consistency of response of 18-to-20-year-olds to the legal drinking age among the different regions of Michigan could not be adequately pursued.

Therefore two important decisions in the present study involved the choice of analytic jurisdictions within Michigan and a selection of a quasi-control or comparison population to replace the unavailable control states previously used.

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*The 1974 study included Michigan, Maine, Vermont, New York, Pennsylvania, Louisiana and Texas.

To investigate the consistency of 18-to-20-year-old response to the lower legal drinking age, we reasoned that the urban-rural mix of the Michigan population should be separately analyzed. Therefore a systematic sample of 27 rural counties with 1970 populations under 100,000 residents was taken and aggregated to form a "Rural" analytic jurisdiction (Table 3.1, 3.2). Ingham County was selected as a mid-Michigan analytic jurisdiction with a substantial metropolitan and rural population mixture.

Other jurisdictions included are Washtenaw County, Oakland County, Statewide jurisdictions(with those localities consistently reporting all accidents since 1968) and Fatal driver-crash involvements. These jurisdictions formed the basic set of Michigan jurisdictions in the earlier HSRI study and were included to permit consistency and comparability with the results of the two investigations.*

The set of analytic jurisdictions selected for the present study is listed in Table 3.1. These jurisdictions represent urban, suburban and rural areas of Michigan. Places of rapid population growth (Oakland County); high youth population density (Washtenaw County); mixed population (Ingham County), and stable, low-youth-population density (Rural counties) are all represented.

Table 3.1

Analytic Jurisdictions with Time-Periods and Sample Descriptions

Jurisdiction	Time-period	Sample Description
Statewide	1968-1975	20% Random Sample. Represents approximately 55% of total Michigan experience at any point in time because only reporting jurisdictions consistently reporting to Michigan State Police in 1968 included.
Oakland County	1968-1975	Census
Washtenaw County	1968-1975	Census
Ingham County	1968-1975	Census
Rural Counties	1968-1975	Census of 27 Counties with 10,000-100,000 residents (1970) Systematic sample
Fatal Accidents	1968-1975	Census, fatal accidents only

*The 20% Statewide sample is composed only of those counties and home-rule cities which have consistently and completely reported traffic accidents to the Michigan State Police since 1968. This sample is, therefore, smaller than a simple 20% sample of all reported crashes and inferences will be very conservative.

Table 3.2

Rural Michigan Analytic Jurisdiction *

Alpena	Livingston
Antrim	Marquette
Barry	Mecosta
Cass	Menominee
Cheboygan	Montcalm
Clare	Newaygo
Delta	Ogemaw
Eaton	Osceola
Gladwin	Presque Isle
Grand Traverse	St. Joseph
Hillsdale	Shiawassee
Huron	Van Buren
Iron	
Isabella	
Leelanau	n=27 counties

*This list represents a systematic sample of counties in Michigan with population of between 10,000-100,000 as of the 1970 Census. The Computing Center, Michigan Department of State Police (MDSP), Lansing has confirmed that the counties included in this sample are 95% complete for the 1968-1975 time-period.

These jurisdictions will permit an investigation of the consistency of the response of 18-to-20-year-olds throughout different areas and residential environments of Michigan.

3.4 Analytic Variables

The 1973-1974 HSRI research required the design and development of several methodological innovations which were necessary in order to overcome measurement and operational dilemmas. It was necessary to isolate a legal impact effect distinct from many sources of measurement bias and logical or operational inconsistency.[6]

The most important innovation was the development of a surrogate variable to replace total reliance on the officially reported alcohol involvement variable in Michigan State Police accident data. The operational definition of the "Had Been Drinking" variable was altered in 1971 such that a valid "Unknown if Drinking" code value was deleted. This format change is exhibited in Figure 3.1. The effect in practice subsequent to this measurement change was to force a proportion of previously "Unknown if Drinking" crash-involved drivers into either "Had Been Drinking" or "Had Not Been Drinking" categories, thus creating a serious inconsistency in the 1968-1971 versus 1971-1975 time period comparisons.

An alternate dependent variable entitled the three-factor surrorage was developed.[7] Analyses of crash data from various jursidictions, including Michigan, different time periods, and of dirvers of a wide range of age groups revealed that a surprisingly consistent subset of all alcohol-related crash involvements was delimited by just three parameters, namely: sex of driver, time of crash, and number of moving vehicles. Specifically it was discovered that single-vehicle crashes with a male driver occurring between 9:00 P.M. and 6:00 A.M. tend to be consistently 58%-63% alcohol-related. This proportion appears to remain true regardless of the age of the driver (16- to-45-year-old) or the precise operational definition of the officially reported crash documentation. Furthermore it is unlikely that investigator discretion or bias would affect the reporting of the driver's sex, number of moving vehicles or time of the crash, and the 58 to 63% alcohol-related proportion is relatively uniform and constant over

passage of time. Thus, the three-factor surrogate, being operationally consistent, provided a reliable alternative for purposes of comparative analyses between age groups of crash-involved drivers and of single age groups between time periods.

Michigan Department of State Police data used in these analyses were reviewed regarding the completeness of reporting and other topics of concern. While some cities and portions of cities reported with some inconsistency until 1971, the data are generally complete. For state-wide analysis it was necessary to use only the full set of jurisdictions that were reporting all crash involvements prior to 1971 to insure a consistent population definition for the full 1968-1975 time-series.

As mentioned above, the 1971 reported alcohol involvement question on police accident reporting forms change created an operational inconsistency over time within the state data set. (See Figure 3.1). The form change is noticeable in time-series of the "Had Been Drinking" variable, being relatively subjective, and is a readily identifiable bias (Figure 3.2).

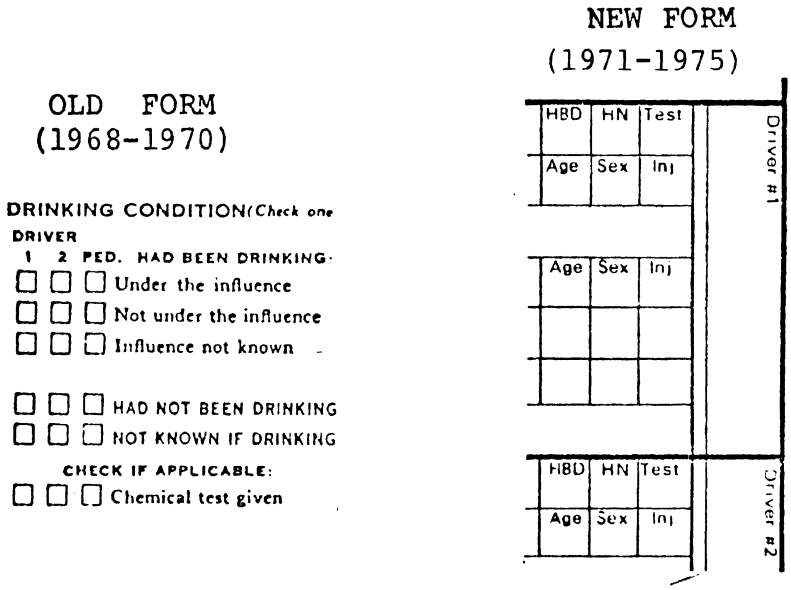
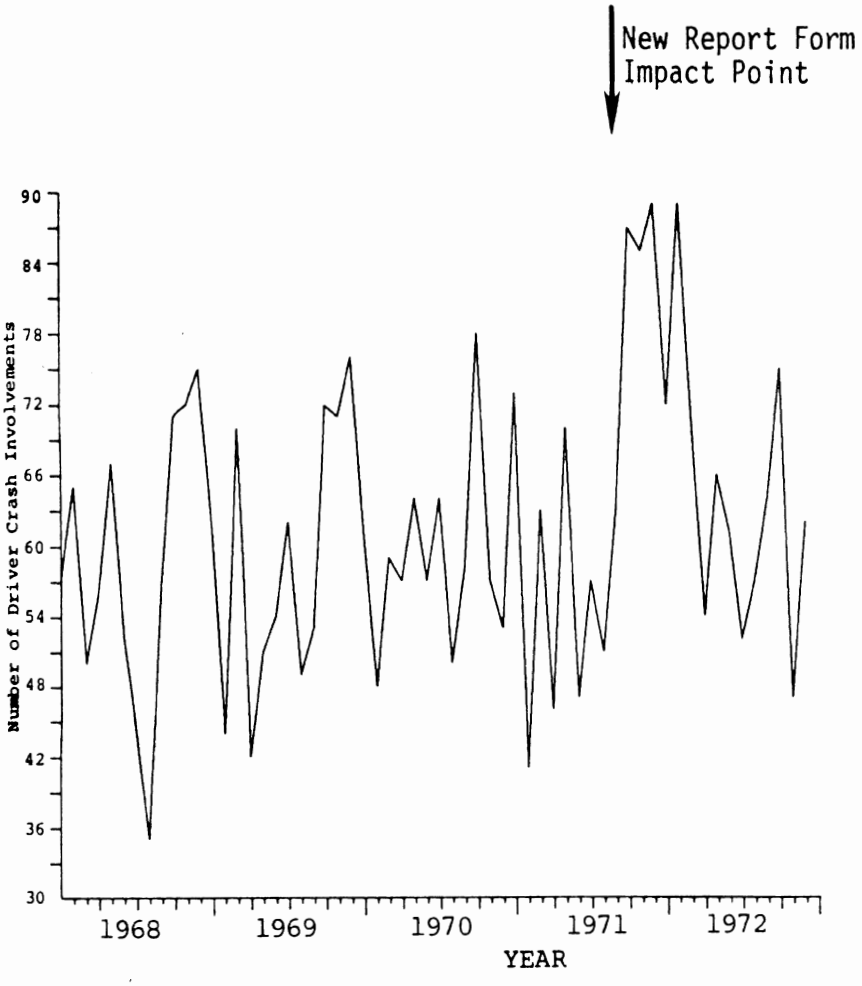


FIGURE 3.1. MICHIGAN ALCOHOL INVOLVEMENT - OFFICIAL OPERATIONAL FORMAT 1968-1970 and 1971-1975

Figure 3.2 Total Reported "Had Been Drinking" Crash Frequencies Demonstrating Initial Reporting Artifact of Operational Definition Change for Alcohol Involvement in 1971. Monthly Frequencies, 1968-1972. Washtenaw County, Michigan.



In 1974 the Michigan Department of State Police initiated a new program, the Fatal Accident Reporting System (FARS). One consequence of the system was to greatly reduce missing data from documentation of accidents resulting in one or more fatalities. This system, while long overdue and appropriate, created another methodological problem regarding officially reported alcohol involvement (Had Been Drinking, HBD) in Michigan data. The virtual elimination of missing data created a step-increase in the number of accidents reported to have involved a drinking driver. The consequence was an additional operational inconsistency between the 1968 and 1973 time period and 1974 and 1975 fatal accident data. Because of these inconsistencies in data collection, the availability of the three-factor surrogate, which is objectively measured for fatal accidents, is a genuine asset in the present investigation.

Operational consistency is closely associated with the concept of measurement reliability. In a comparative analysis involving comparisons of different groups and different time periods it is essential that the measurement is consistent both between groups and time periods. In that driver sex, number of vehicles and time of crash are objectively recorded, we have considerable confidence in the variable's consistency. The measure is conservative in that not all alcohol-related crashes take place at night, or with a male driver and a single vehicle. Therefore the value of the three-factor surrogate is its consistency which is of relatively greater importance for our purposes of analysis than the absolute value of the measure's precision.

For each of the six analytic jurisdictions the following design matrix was produced:

Age Group \ Analytic V_i	Total	HBD	3-Factor Surrogate (3FS)	3FS/Total	HBD/Total
All Drivers					
16-17 Yrs.					
18-20 Yrs.					
21-24 Yrs.					
25-45 Yrs.					

Thus, with five age groups, six analytic jurisdictions, and five basic analytic variables, the 5 x 6 x 5 matrix is a 150-cell design. This should provide adequate coverage of the state with a balance between precision and efficiency.

3.5 Statistical Analyses

The two analytic objectives were to determine if increases in alcohol-related crash frequencies and rates persisted following the initial months of the lower legal drinking age, and to determine whether such increases remain causally attributed to the legal change. It has been determined in preceding sections that certain plausible rival hypotheses can be controlled through appropriate selection and use of statistical procedures. This section will detail the basis for selection of an additive time-series conceptual model and an autoregressive statistical test. The general design involves the evaluation of a shift in level of time-ordered change intervention. The selection of an appropriate time-series model and a statistical test were critical to the validity of the research and will be treated separately below.

3.5.1 The Time-Series Model.

A time-series (Y) is best conceptualized as the functional combination of four component factors:

$$Y = f\{T,S,C,I\}$$

where:

T is the trend, or long-term growth factor;
S is the seasonal, cyclic factor;
C is the non-seasonal, cyclic component; and
I is the irregular, residual component

Trend (T), in the data available for analysis in the present study, was conceptualized as being linear and associated with economic and population growth factors. In that the time-related units of analysis in the research were calendar months, the seasonal (S) component was defined as the expected monthly value of a variable. Non-seasonal cycles (C) were not identified in crash data in any of the jurisdictions. The absence of these long-term cycles is likely to be a consequence of the relatively short time-series available for analysis.

The irregular (I) components are of central concern. Because irregular residual frequencies are unexpected by definition, this component was conceptualized as being subject to change by the influence of an external event - such as a legal change. If the other, more regular, components were absent or removed by analysis, then the effects of an unexpected influence could be estimated as a shift (δ) in the level of the I component of the several time-series under consideration.

It was essential, before attempting to control trend and seasonal factors, to identify an appropriate conceptual method of composing (combining) the time-series components. Additive, multiplicative, or mixed methods of composition were candidates. It was recognized that the selection would impose a model on the crash data.

An additive model was selected, such that

$$Y = T + S + I.$$

The basis of the selection was an identified good fit of the additive combination of trend and seasonal values to the data. The goodness-of-fit of the additive model was discussed in 1974.[8]

Decomposition and isolation of the irregular or residual components of the time-series data were achieved through a series of analytic steps replicated for each variable series in each jurisdictional data file. For each variable decomposition, linear regression estimates (both for 96 months, and the first 48 months and projected into the second 48 months) were computed and subtracted from each monthly observation, producing a series such that Y-T = S+I. Monthly mean values were then computed for each series already controlled for linear trend, and the residual values were calculated by subtracting the mean "expected" monthly value from each observation. The additive model was then transformed to (Y-T) - S = I, and the irregular components, or second-level residuals, remained.

This process was replicated for all frequency measures as well as for the age-specific rates. In the latter case, the end-product was characterized by control for age-specific population growth as well as general linear trend (T) and monthly mean values (S)--a third-level residual. Third-

level residuals were computed only with 96-month trend estimates. In terms of interpretation the residuals represent the proportion of all driver-crash involvements in each variable category not better explained by the long term processes of trends and seasonal cycles.

The analyses of time-series data for purposes of testing hypotheses required us to pay particular attention to the effects of the decomposition and residual analyses on the analytic outcomes. Any decomposition of time-series data makes certain assumptions, and the results of the analysis will certainly be affected by those assumptions. Crash data tend to be stationary, or predictable, for certain periods of time. Stationary means that aside from irregular components the long term trend and seasonal effects are relatively stable. The additive time-series model is fully dependent upon stationarity to be appropriate for the methodologies developed here.

When testing hypotheses it was essential to decide upon the direction of error that would be acceptable. Thus the difference between Type I and Type II errors became quite important; we were equally concerned with answering both of two questions:(1) Did the 18-to-20 year old drivers remain uniquely affected by the legal drinking age change, with a minimum probability of reporting an impact when there was none? and(2) What was the size of the frequency change of crash involvements, due to the legal change? These two objectives were associated with different error directions and the analyses needed to reflect these strategic differences.

To determine most conservatively if the impact was restricted to the 18-to-20-year-olds(i.e., to maximize the probability of a type-II error), we used a 96-month trend estimate, which would minimize the residual in all age groups. This highly conservative means of analysis is more likely to deny a significant difference, when one indeed exists, than to claim a statistically significant impact when one is truly absent.

The size of the impact, hopefully, would be represented by an accurate residual estimate, given the assumptions of the time-series model. Trends were estimated both as linear regression lines for 96 months and the pre-intervention 48 months. The 96-month trend estimate would present minimal impacts,while the 48-month estimates, we believe, would permit more accurate

residual frequencies. Both hold the potential of isolating target groups. Trend was estimated on the basis of the first 48 months of the time-series (1968-1971) and projected into the second 48 months. This required certain assumptions about the stability of trend in an eight year time-series. This analysis, in effect, was directed to the proposition that if, with all things approximately equal, in 1971 we were to estimate the expected frequency of crash involvements for certain age groups for the 1972-1975 period, how different from the predictions would the observed frequencies be as of 1975? If the projected forecasts were accurate we could be confident that our assumptions and the additive model were appropriate. If the forecasts were accurate for non-18-to-20-year-old groups while a residual remained for the target group of directly affected young drivers, then the residual would represent the net effects of total crash involvement increases over the passage of time associated with the legal drinking age change.

3.5.2 Statistical Tests. The statistical significance of differences in level between the pre-1972 and post-1972 periods was calculated for each variable, for each jurisdiction. The statistic used was the autoregressive time-series t statistic ($t\ \hat{\delta}$) developed for such problems for the research conducted by Douglass and co-workers in 1973. This statistic was first described by Box and Tiao in 1965 and adopted by the Department of Biostatistics, School of Public Health at the University of Michigan. The logic and mathematics of the autoregressive statistic were reported in 1974.[9]

3.6 Findings

It will be recalled (Section 2.1 and prior page) that the principal objectives of Phase I activities were to test the hypotheses that: (1) the increases of alcohol-related crash involvements of 18-to-20-year-old drivers in the months immediately following the reduction of the legal drinking age persisted through the first four years, and (2) the response of the lower legal drinking age on 18-to-20-year-old crash involvement was consistent throughout the state of Michigan. In addition, an estimate of the number of driver-crash involvements associated with the legal drinking age change will be developed.

3.6.1 Time-Series Analyses. This section presents the basic findings of Phase I analyses of Michigan traffic accident data. Findings of statistical procedures for each analytic jurisdiction are presented first, with 96-month estimates of linear trends, followed by a comparison of these findings with those using the n_1 48-month pre-intervention estimates of linear trend in 1974 for Ingham, Washtenaw, and Oakland Counties, Rural Counties, Statewide data and a separate analysis of fatal crashes.

Table 3.3 summarizes the complete time-series statistical analysis findings with 96-month trend estimates. The table is constructed to present all 150 t $\hat{\delta}$ statistics associated with the 6 jurisdictions x 5 age-groups x 5 variable design matrix. The left margin lists the 15 frequency variables and ten age-specific rates. Age strata are identified in the left margin as Total, 16-to-17-year-old, 18-to-20-year-old, 21-to-24-year-old and 25-to-45-year-old crash-involved drivers. The column headings in the table include Variable Code values for each discrete variable, and auto-regressive t $\hat{\delta}$ statistics and probability levels for one-tailed hypothesis tests for each of the six analytic jurisdictions.

It is clear from an inspection of Table 3.3 that consistent statistical significance is found only among the 18-to-20-year-old drivers. The statistical significance of shifts in the level of measurements of the frequency variables, not attributed to 96-month linear trend or seasonality, is consistent for reported alcohol involvements (HBD) and three-factor-surrogate involvements (3FS). It is clear, too, that for fatal accidents, none of these tests with 96-month trend controlled are statistically significant. This point is discussed separately below. None of the 21-to-45-year-old measures demonstrated statistically significant changes, nor were there significant shifts among 16-to-17-year-old drivers, with the exception of total crash involvements in Ingham County.

A closer analysis of these statistics reveals that only in the Statewide data was the age-specific rate for reported alcohol involvement statistically significant. In no jurisdiction was an age-specific rate for the three-factor surrogate statistically significant. However, it must be remembered that these tests are highly conservative.

Table 3.3 Full Quasi-Experimental Time Series Design, Autoregressive $t_{\hat{\delta}}$ statistics, by variable age group, and jurisdiction. 1968-1975, Michigan Data. n_1=48 months, n_2=48 months (Residual Input Data, controlled for linear trend and seasonality)

	Residual Variable Code	Washtenaw County $t_{\hat{\delta}}$	$\rho \leq$	Oakland County $t_{\hat{\delta}}$	$\rho \leq$	Ingham County $t_{\hat{\delta}}$	$\rho \leq$	Rural County $t_{\hat{\delta}}$	$\rho \leq$	Fatal $t_{\hat{\delta}}$	$\rho \leq$	Statewide $t_{\hat{\delta}}$	$\rho \leq$
Total													
HBD	301	0.6372		0.991		1.111		1.005		0.146		1.030	
3FS	303	0.4408		1.873	.03	1.245		0.911		-0.356		1.119	
All (Total)	302	0.6291		0.788		1.618	.05	0.519		0.391		0.948	
HBD Rate	319	0.179		0.279		0.295		0.475		-0.009		0.211	
3FS Rate	320	0.417		1.324	.09	0.213		01494		-0.017		0.705	
16-17 Year old													
HBD	304	1.6921		0.676		0.489		0.077		0.279		0.428	
3FS	306	0.5041		1.204		0.002		-0.544		0.333		0.173	
Total	305	0.622		0.807		1.389	.09	0.122		0.971		0.704	
HBD Rate	321	0.776		0.663		0.183		-0.014		0.123		0.348	
3FS Rate	322	0.488		0.917		-0.753		-0.541		-0.158		-0.146	
18-20 Year old													
HBD	307	1.651	.06	1.834	.03	1.894	.03	2.391	.01	0.600		2.401	.01
3ES	309	1.601	.06	1.777	.04	1.366	.09	1.713	.04	0.796		1.564	.06
Total	308	1.093		1.609	.06	1.073		1.494	.08	0.971		1.492	.08
HBD Rate	323	0.972		1.153		1.181		1.182		0.462		1.887	.03
3FS Rate	324	0.841		0.871		0.821		0.677		0.367		0.605	
21-24 Year old													
HBD	310	0.387		0.046		0.991		-0.225		-0.805		-0.679	
3FS	312	0.275		0.209		0.717		-0.520		-0.528		-0.002	
Total	311	0.518		0.625		1.212		0.337		-0.756		0.957	
HBD Rate	325	0.341		0.327		0.199		-0.340		-0.859		-0.496	
3FS Rate	326	-0.144		-0.000		0.195		-0.114		0.462		-0.430	
25-45 Year old													
HBD	313	0.619		0.381		0.472		0.191		0.429		0.367	
3FS	315	0.273		0.765		0.686		0.406		0.425		0.406	
Total	314	0.696		0.855		1.158		0.425		0.003		0.906	
HBD Rate	327	0.111		-0.588		-0.140		-0.149		-0.764		0.581	
3FS Rate	328	0.009		0.229		0.137		0.204		-0.175		0.663	

In Oakland County, the Total three-factor-surrogate frequency underwent a significant shift in level. However, this appears to be explained by the 18-to-20-year-old experience,in that no other age-subset experienced a statistically significant shift. The significant shift for total crash frequencies in Ingham County appears to be explained entirely by the 16-to-20-year-old drivers,in that no other age groups demonstrated significance in either frequencies or age-specific-rates.

Upon noticing that none of the 18-to-20-year-old age-specific rates (except HBD-statewide) were statistically significant,we were concerned that the level-3 residual controlling for 96-month linear-trend, seasonal factors and age-specific population-growth ((Y-T-S/Total Frequency)=I,) was too restrictive and was unnecessarily masking a valid and significant shift. In other words, we identified the need to test the hypothesis that if age-specific rates for reported and surrogate alcohol involvement were tested (with the autoregressive time-series $t\delta$ statistic) <u>without</u> prior removal of 96-month linear trend and seasonality,then significant shifts in 18-to-20-year-old rates might be revealed.

Table 3.4 displays the results of this sub-analysis. Fatal reported and surrogate alcohol-related age-specific rates for all age groups were tested with and without the removal of 96-month linear trend and seasonality. The results show clearly that all level-3 residual measures were non-significant,while several level-1 residuals of these rates were statistically significant. Particularly among the reported alcohol involvement (HBD) rate measures, high levels of statistical significance were reached, as they were among 18-to-20-year-old and 25-to-45-year-old surrogate rates. The absence of differential effects <u>only</u> among 18-to-20-year-old drivers lessens the concern that a type-II interpretive error has been made. The consistently significant tests for HBD measures is confounded by changes in reporting practices and procedures that have been discussed previously.

What do statistics in the above table mean? It seems that the effect of the lower legal drinking age has remained specific to the 18-to-20-year-old experience and has not apparently spilled over to younger drivers.

Table 3.4 - Comparison of Fatal Alcohol-Related Crash Rates for Statistical Significance Pre-1972 Against Post-1972

With and Without Time-Series Controls Imposed for 96-month Linear Trend and Seasonality

Variable	Level-3 Residual With Time-Series Control for Linear* Trend & Seasonality (Y-T) - S = I		Level-3 Residual Without Time-Series Control for Linear Trend & Seasonality Y = T + S + I	
	$t\hat{\delta}$	$p\leq$	$t\hat{\delta}$	$p\leq$
Total HBD Rate**	-0.009		2.825	.005
Total 3FS Rate***	-0.017		-0.468	
16-17 HBD Rate	0.123		3.094	.005
16-17 3FS Rate	-0.158		0.038	
18-20 HBD Rate	0.462		3.230	.005
18-20 3FS Rate	0.367		2.571	.01
21-24 HBD Rate	-0.859		2.354	0.25
21-24 3FS Rate	0.462		0.228	
25-45 HBD Rate	-0.764		4.037	.005
25-45 3FS Rate	-0.175		1.975	.05

*96-month linear trend

**HBD Rate = Age-specific rate for Reported Alcohol Involvement "Had Been Drinking."

***3FS Rate = Age-specific rate for surrogate alcohol involvement Late Night (9:00 pm. - 6:00 am.) Single vehicle crashes with male drivers.

When the current findings are compared to those of 1974 some interesting dynamics are suggested. Table 3.5 compares the 18-to-20-year-old statistics of the 1973-1974 investigation with those of the present study. It can be seen that the initial (1972-1973) effects were most strongly revealed in Washtenaw and Oakland Counties. The magnitude expressed in frequencies, as well as the age-specific rate of increase of alcohol-related crashes, shifted dramatically after January 1, 1972. The current findings show that the level of statistical significance of alcohol-related crash frequencies in Washtenaw and Oakland Counties is less now than in 1973 and the rate of increase is currently stable, whereas the age-specific rates were highly significant in 1973. On the contrary, the significance of shifts in statewide data are not greatly changed.

It is noteworthy, too, that the more urban counties (Washtenaw, Oakland, and Ingham) demonstrate less than significant shifts currently than Rural and Statewide jurisdictions. This perhaps reveals a "ripple effect" in which the initial effects of the lower legal drinking age in 1972 and 1973 on crash involvement were identified in relatively nigh 18-to-20-year-old areas and these strong effects are more recently found in Rural counties or generalized throughout the remainder of Michigan. It is clear that the $p \leq .01$ level of significance was attained only for reported alcohol involvement (HBD) frequencies in the Rural and Statewide jurisdictions, and that lower levels of significance are associated with the other measures (Table 3.3).

These data must be interpreted cautiously, because the results of a time-series analysis are different from other analysis methods in several respects. Unlike more conventional analyses, the absolute magnitude of the difference in frequency and age-specific-rate measurements is not the focus of time-series analysis (especially with the 96-month trend). Instead, the present analysis has intended to test the hypothesis that the 1972-1975 period of observations was distinctly different than the 1968-1971 period, and that the contrast is attributed to something unique to 1972 rather than long-term trends or cycles. Thus this time-series analysis sought to identify changes in events subsequent to the intervention (the legal drinking age change) that are most probably causally linked to that

Table 3.5
18-to-20-year-old Autoregressive
$t\delta$ Statistics on the Basis of n_2=12-18
Versus n_2=48 months experience
After January 1972

Jurisdiction	Variable	n_2=12 to 18 months $t\delta$	$\rho \leq$	n_2=48 months $t\delta$	$\rho \leq$
Washtenaw	HBD*	3.553	.001	1.651	.06
	3FS*	2.103	.016	1.601	.06
	HBD Rate	-----	**	0.972	n.s.
	3FS Rate	3.733	.001	0.841	n.s.
Oakland	HBD	3.247	.001	1.834	.03
	3FS	3.697	.001	1.774	.04
	HBD Rate	-----	**	1.153	n.s.
	3FS Rate	2.204	.014	0.871	n.s.
Statewide	HBD	3.294	.01	2.401	.01
	3FS	2.366	.01	1.564	.06
	HBD Rate	-----	**	1.887	.03
	3FS Rate	1.644	.05	0.605	n.s.

*HBD="Had Been Drinking" Reported Alcohol Involvement
3FS=Three Factor Surrogate Alcohol Involvement

**Not Calculated

intervention. This is quite different from simply measuring the significance of differences in the magnitude of phenomena before and after a new law became effective.

The 1972-1975 crash experience of 18-to-20-year-olds is the result of long term trends, seasonal effects,and also events associated with the lower legal drinking age. The 1968-1975 time period was characterized by steady and often rapid increases in the frequency of traffic crashes and resultant casualties in Michigan. Alcohol-related and non-alcohol-related crashes have increased yearly and, with the possible exception of certain categories of fatal accidents, the long-term growth of the problem is cause for concern. The rate of increase in crash frequency among young people is of particular concern,as this phenomenon was identified in all the analytic jurisdictions in this investigation.

The central research question here, however, has not been whether the frequency of crashes, and particularly those associated with drinking, has increased in recent years. The research question, rather, has been, what proportion of this growing problem is best explained by the lower legal drinking age?

Table 3.6 presents the statistical significance of the 96-month linear trend (T) component of time-series measures of 16-to-20-year-old driver-crash involvements in all six jurisdictions in the present analysis. It is clear from the high levels of statistical significance (F statistics) that the long-term linear trend in the 1968-1975 time period is quite dominant in all variables except three among Fatal accidents. Thus trends that preceded 1972 and which have continued, rather than just the legal drinking age, are partially responsible for the growing problem among 16-to-17-year-old drivers and to an increasing degree among 18-to-20-year-old drivers.

Table 3.6 - Statistical Significance of Linear Trend for Selected 16-20-Year-Old Frequencies by Jurisdiction

(Statistical Significance of Least Squares Regression Estimates of Linear Trend) n=96 df=1

	Washtenaw		Oakland		Ingham		Rural		Fatal		State	
	F	p≤	F	p≤	F	p≤	F	p≤	F	p≤	F	p≤
16-17-Year-Old-Drivers												
HBD*	43.188	.0001	143.54	.0001	106.000	.0001	90.401	.0001	16.967	.0001	228.44	.0001
3FS*	12.264	.0007	45.338	.0001	27.253	.0001	43.588	.0001	.024667	n.s.	130.60	.0001
Total	91.642	.0001	33.985	.0001	88.934	.0001	38.154	.0001	.013320	n.s.	184.78	.0001
18-20-Year-Old-Drivers												
HBD	132.24	.0001	295.46	.0001	175.98	.0001	325.93	.0001	44.619	.0001	421.26	.0001
3FS	34.183	.0001	119.66	.0001	79.557	.0001	115.18	.0001	10.673	.0015	232.29	.0001
Total	64.428	.0001	54.651	.0001	55.414	.0001	70.185	.0001	.061938	n.s.	216.48	.0001

*HBD = "Had Been Drinking" Reported Alcohol Involvement.
3FS = Three Factor Surrogate Alcohol Involvement.

3.6.2 Unpredicted Percentage Residuals.* Although conclusions can be made solely on the basis of the statistical $t\hat{\delta}$ significance levels and test directions (sign) it is more meaningful to relate these statistics with the frequencies and percentages they represent. Tables 3.7 to 3.12 present, for each analytic jurisdictions, $\hat{\delta}$ residual frequencies (unpredicted crash involvements) and the $\hat{\delta}\%$ percentage of the total for each of three frequency variables in all age groups.

Analysis of these tables expands upon the insights suggested by Table 3.3 through the additional meaning conveyed by real numbers and percentages. The 48-month experience in Michigan since the 18-year-old drinking age became effective has been consistent throughout the state. In most jurisdictions increases of residual Three-Factor Surrogate crashes among 18-to-20-year-old drivers were concurrent with decreases among 16-to-17-year-old and/or 21-to-24-year-old drivers. When all under-25-year-old groups experienced percentage residual increases of alcohol-related crashes, the 18-to-20 year-old group usually had much larger increases than any other age group. The impact of the legal drinking age change is generally found only among the 18-to-20-year-old drivers, except in Oakland County,where the 16-to-17-year-old drivers were also involved. This latter finding was not revealed by the analyses until the 48-month residuals were computed.

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*The percentage values were computed according to the following equation:

$$\%\hat{\delta} = \frac{\Sigma_1 \hat{\delta}}{\Sigma (f_a - \hat{\delta})} \times 100$$

where:

$\%\hat{\delta}$ is the percentage of the total 1972-1975 frequency not better explained by linear trend or seasonal cycles;

$\hat{\delta}$ is the monthly frequency residual not better explained by linear trend or seasonal cycles;

f_a is the actual monthly frequency

Inspection of these tables reveals a great deal about the adequacy of the research methodology and the research questions themselves. The adequacy of time-series analysis in this type of investigation is best stated in terms of the ability of the model to isolate the effect among target groups while accurately predicting frequencies of crash involvements among all groups. Both the 96-month and 48-month residuals isolate the 18-to-20-year-olds as having unusually large residuals subsequent to the lower legal drinking age change in January,1972. The 48-month residuals more accurately represent the unpredicted crash involvements because of changes in trend in 1972 and 1973 among 18-to-20-year-old drivers.* As with the conservative 96-month residuals, the 48-month residual frequencies are remarkably small except for the 18-to-20 year-old drivers (and the 16-to-17-year-olds in Oakland County). This "goodness of fit" is a means of testing the adequacy of the model. The tables show that the predicted frequencies of three-factor surrogate and other crash involvements is consistently within a small percentage of observed frequencies which holds the additive model, with 48-month predicted linear trend as a quite satisfactory way of controlling spurious variability.

The tables clearly isolate the young drivers, particularly 18-to-20-year-olds,as being uniquely affected by the lower legal drinking age. These findings are more dramatic when it is observed that total residual crash involvement throughout the state stabilized or declined considerably in this same time period. Among drivers 21 and older the 48-month residuals reveal consistently fewer crash involvements than predicted; except for Oakland County, this holds as well for 16-to-17-year-old drivers.

The energy crisis might well explain the considerable reduction of crash involvements, particularly among older drivers.[10] It is noteworthy that alcohol-related crash involvement residuals are consistently higher than others,which suggests that alcohol-related crashes are a more persistent problem than the more general traffic safety dilemma. Even the

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*In 1974 Douglass reported that the age specific rates of 18-to-20-year-old three-factor surrogate and HBD crash involvement throughout Michigan were changed dramatically by the initial impact of the lower legal drinking age.

Table 3.7 Washtenaw County Residuals Expressed as Percentage Deviations from Predicted Frequencies using 1968-1975 (96 months) and 1968-1971 (48 months) as basis for Linear Trend (T) Time-Series Component, 1968-1975 (96 months) as Basis for Seasonality (S), by Age Group and Analytic Variable

Variable	96 Month Trend Residual		48 Month Trend Residual	
	$\hat{\delta}$ (Residual f)*	$\hat{\delta}$ %	$\hat{\delta}$ (Residual f)*	$\hat{\delta}$ %
Total (All Ages)				
HBD	37	0.71	- 40	-0.76
Total	466	0.78	-5620	-8.54
3fs	- 48	-1.29	- 79	-2.12
16-17 Year Old				
HBD	- 7	-3.09	10	4.79
Total	52	1.16	- 146	-3.10
3fs	- 6	-1.69	2	0.48
18-20 Year Old				
HBD	38	4.03	260	35.55
Total	162	1.73	- 456	-4.59
3fs	35	4.11	119	15.63
21-24 Year Old				
HBD	- 8	-0.80	- 58	-5.28
Total	118	1.02	-1583	-12.02
3fs	- 7	-0.84	- 72	- 8.34
24-45 Year Old				
HBD	22	0.98	- 95	-4.08
Total	199	0.92	-1746	-7.38
3fs	6	0.47	16	1.28

*Rounded to nearest integer

Table 3.8 Oakland County Residuals Expressed as Percentage Deviations from Predicted Frequencies using 1968-1975 (96 months) and 1968-1971 (48 months) as basis for Linear Trend (T) Time-Series Component, 1968-1975 (96 months) as Basis for Seasonality (S), by Age Group and Analytic Variable

Variable	96 Month Trend Residual		48 Month Trend Residual	
	$\hat{\delta}$ (Residual f)*	$\hat{\delta}$ %	$\hat{\delta}$ (Residual f)*	$\hat{\delta}$ %
Total (All Ages)				
HBD	213	1.04	1055	5.38
Total	2002	0.81	-6111	-2.39
3fs	365	3.20	1152	10.86
16-17 Year Old				
HBD	25	2.24	240	26.90
Total	212	0.91	131	0.51
3fs	45	3.18	180	14.05
18-20 Year Old				
HBD	159	4.60	1051	40.88
Total	745	2.02	921	2.51
3fs	96	3.81	500	23.52
21-24 Year Old				
HBD	1	0.02	222	7.21
Total	220	0.65	-1732	-4.87
3fs	5	0.27	100	5.64
25-45 Year Old				
HBD	37	0.44	- 132	-1.54
Total	869	1.02	-1445	-1.65
3fs	43	1.34	- 40	-1.23

*Rounded to nearest integer

Table 3.9 Ingham County Residuals Expressed as Percentage Deviations from Predicted Frequencies using 1968-1975 (96 months) and 1968-1971 (48 months) as basis for Linear Trend (T) Time-Series Component, 1968-1975 (96 months) as Basis for Seasonality (S), by Age Group and Analytic Variable

Variable	96 Month Trend Residual		48 Month Trend Residual	
	$\hat{\delta}$ (Residual f)*	$\hat{\delta}$ %	$\hat{\delta}$ (Residual f)*	$\hat{\delta}$ %
Total (All Ages)				
HBD	165	2.84	323	5.72
Total	1712	2.11	-6056	-6.81
3fs	94	2.81	- 166	-4.61
16-17 Year Old				
HBD	5	2.66	71	56.21
Total	156	3.04	- 50	-0.94
3fs	1	0.01	- 52	-14.78
18-20 Year Old				
HBD	70	7.08	394	59.09
Total	263	2.10	- 789	-5.81
3fs	31	3.88	70	9.10
21-24 Year Old				
HBD	32	2.70	80	7.13
Total	379	2.52	-1658	-9.73
3fs	20	2.95	- 80	-10.26
25-45 Year Old				
HBD	37	1.49	- 159	-5.92
Total	717	2.38	-1644	-5.06
3fs	26	2.41	- 78	-6.51

*Rounded to nearest integer

Table 3.10 Rural Counties Residuals Expressed as Percentage Deviations from Predicted Frequencies using 1968-1975 (96 months) and 1968-1971 (48 months) as basis for Linear Trend (T) Time-Series Component, 1968-1975 (96 months) as Basis for Seasonality (S), by Age Group and Analytic Variable

Variable	96 Month Trend Residual		48 Month Trend Residual	
	$\hat{\delta}$ (Residual f)*	$\hat{\delta}$ %	$\hat{\delta}$ (Residual f)*	$\hat{\delta}$ %
Total (All Ages)				
HBD	169	0.65	818	3.24
Total	130	0.06	-10329	-4.54
3fs	180	0.68	1188	4.63
16-17 Year Old				
HBD	- 1	-0.07	95	8.71
Total	11	0.05	- 614	-2.82
3fs	- 20	-0.75	- 119	-4.38
18-20 Year Old				
HBD	222	4.05	1280	28.90
Total	492	1.33	405	1.09
3fs	123	1.96	693	12.16
21-24 Year Old				
HBD	- 41	-0.78	- 98	-1.84
Total	- 77	-0.25	-2525	-7.53
3fs	- 39	-0.78	- 111	-2.18
25-45 Year Old				
HBD	10	0.11	- 128	-1.29
Total	114	0.16	-3276	-4.44
3fs	25	0.29	- 410	-4.96

*Rounded to nearest integer

Table 3.11 Fatal Residuals Expressed as Percentage Deviations from Predicted Frequencies using 1968-1975 (96 months) and 1968-1971 (48 months) as basis for Linear Trend (T) Time-Series Component, 1968-1975 (96 months) as Basis for Seasonality (S), by Age Group and Analytic Variable

Variable	96 Month Trend Residual		48 Month Trend Residual	
	$\hat{\delta}$ (Residual f)*	$\hat{\delta}$ %	$\hat{\delta}$ (Residual f)*	$\hat{\delta}$ %
Total (All Ages)				
HBD	7	0.23	152	5.11
Total	42	0.41	- 292	-2.76
3fs	- 22	-1.15	22	1.53
16-17 Year Old				
HBD	3	1.60	24	17.70
Total	23	3.12	60	8.58
3fs	2	1.83	1	1.18
18-20 Year Old				
HBD	16	2.74	123	26.15
Total	34	2.12	97	6.34
3fs	16	3.86	89	26.73
21-24 Year Old				
HBD	- 22	-3.50	5	0.78
Total	- 26	-1.64	- 86	-5.15
3fs	- 12	-3.25	1	0.21
25-45 Year Old				
HBD	10	0.78	16	1.20
Total	2	0.04	- 182	-4.61
3fs	4	0.73	- 11	-1.83

*Rounded to nearest integer

Table 3.12 Statewide Residuals Expressed as Percentage Deviations from Predicted Frequencies using 1968-1975 (96 months) and 1968-1971 (48 months) as basis for Linear Trend (T) Time-Series Component, 1968-1975 (96 months) as Basis for Seasonality (S), by Age Group and Analytic Variable

Variable	96 Month Trend Residual		48 Month Trend Residual	
	$\hat{\delta}$ (Residual f)*	$\hat{\delta}$ %	$\hat{\delta}$ (Residual f)*	$\hat{\delta}$ %
Total (All Ages)				
HBD	361	0.91	2541	6.76
Total	4591	1.05	10153	2.34
3fs	506	1.67	2815	10.05
16-17 Year Old				
HBD	12	0.72	171	11.60
Total	224	0.62	- 474	-1.29
3fs	8	0.28	- 14	-0.50
18-20 Year Old				
HBD	293	4.44	1772	34.61
Total	1187	1.84	2122	3.35
3fs	172	2.72	925	16.61
21-24 Year Old				
HBD	- 49	-0.72	150	2.27
Total	691	1.14	- 173	-0.28
3fs	- 9	-0.18	166	3.33
25-45 Year Old				
HBD	51	0.31	215	1.32
Total	1717	1.17	2273	1.55
3fs	34	0.37	282	3.20

*Rounded to nearest integer

unavailability of fuel failed to significantly reduce the frequency of alcohol-related traffic crashes. This is true for all age groups. In Washtenaw County there were more than 5600 fewer crash involvements than predicted in the 1972-1975 time period. 18-to-20-year-olds, however, experienced 119, or 15.63% more three-factor surrogate crashes than expected, while the rest of the county had fewer three-factor surrogate crashes than predicted. Particularly striking is the comparison of the 18-to-20-year-old and 21-to-24-year-old three-factor-surrogate involvements. While the 18-to-20-year-olds experienced 15.63% more three-factor-surrogate crashes,their proximal age-group peers experienced a reduction of 8.34%.

In Oakland County, the most rapidly growing jurisdiction in Michigan, the 1972-1975 period had over 6000 fewer total crash involvements than predicted,with 1152 more three-factor-surrogate involvements than expected. Of the unexpected three-factor-surrogate crashes 680 involved 16-to-20-year-old drivers and 500 were in the 18-to-20-year-old group. The magnitudes of the residuals in Oakland County are large,with an increase of between 14% and 24% for 16-to-20-year-olds and -1.2% and +6% for 21-to-45-year-old drivers. The reported alcohol-involvement group (HBD) among 18-to-20-year-olds was 41% higher than expected. However, this impact is likely to be somewhat inflated by inconsistent reporting. The 16-to-17-year-olds in Oakland County were the only under-aged drivers we found to have large three-factor-surrogate residuals, probably associated with the lower legal drinking age.

Like Washtenaw and Oakland Counties, Ingham County and the rural counties experienced significant increases in three-factor-surrogate crash involvements only among the 18-to-20-year-old drivers. In Ingham and the rural jurisdictions, the difference between HBD and three-factor-surrogate residual involvements among the young drivers is large. Again, because of the subjectivity of the HBD variable we are limiting our conclusions to the three-factor surrogate because we have a better basis for believing this measure to be operationally consistent.

The residuals for fatal crashes and the statewide sample file permit a statement of the statewide impact of the lower legal drinking age on

crash involvement in Michigan. In general, only the directly affected 18-to-20-year-old drivers were involved. While total three-factor surrogate fatal involvements increased by only 1.53%,the 18-to-20-year-olds experienced an impact of fatal crash involvements of 26.73%,or at least 89 lives. The 10.05% residual increase in statewide three-factor surrogate appears to be almost totally explained by the 16.61% increase of these crashes among 18-to-20-year-old drivers. This percentage residual represents at least 925 x 5 = 4625 more three-factor-surrogate crash involvements among 18-to-20-year-old drivers than predicted between 1972 and 1975.*

The basic Phase I hypotheses can now be addressed directly. The effect of the legal drinking age measured after the initial 1972 experience appears to have persisted through 1975. On a statewide basis (1972-1975) we estimate that minimally 4625 three-factor surrogate (8860 HBD) alcohol-related crashes have occurred due primarily to the 18-year-old drinking age (Table 3.12) of which at least 89 three-factor surrogate (123 HBD) were fatal accidents. (See Table 3.11).

It is possible also to test the hypotehsis that the effect of the drinking age change was consistent throughout the state (Table 3.13). Among the four discrete county-based jurisdictions, HBD involvements had residual percentage increases of between 28.90% and 59.0%, while three-factor-surrogate increases varied between 9.10% and 23.52%. No jurisdiction appears to have been uniquely unaffected.

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*The 925 residual frequency is multiplied by five to account for the fact that the residuals were derived from a 20% sample.

Table 3.13

18-to-20-year-old Three-Factor Surrogate (3FS) and Reported Alcohol-Related (HBD) Crash Percentage Increases Associated with the Lower Legal Drinking Age in Michigan (1972-1975)

	HBD	3FS
Washtenaw County	35.55%	15.63%
Oakland County	40.88	23.52
Ingham County	59.09	9.10
Rural Counties	28.90	12.16
Fatal Statewide	26.15	26.73
Statewide (20% Sample)*	34.61	16.61

*20% sample of all reported crashes in counties and home-rule cities consistently reporting traffic accidents since 1968.

3.7 References

1.

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Douglass, R.L. (August 1974) op cit. pp. 36-40.

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4.0 ALCOHOL BEVERAGE AVAILABILITY AND CONSUMPTION

Phase II activities as introduced in Section 2.0 were conducted to investigate changes in the market and distribution system for alcoholic beverages which preceded and followed the legal change. In investigating alcohol beverage availability, two types of time ordered data were utilized. The first type of data was concerned primarily with the licensing aspects of alcohol availability. Since the alcohol market is partially controlled by government regulations, changes in liquor control legislation or policy can be expected to affect beverage alcohol availability by altering the number, the type, or hours of operation of alcohol distributing units. Utilizing data supplied by the Michigan Liquor Control Comission,it was possible to generate monthly frequencies for a number of categories of licenses, permits, and related Commission actions. Plotting these numbers, which included data points both prior to and after the lower legal drinking age, made it possible to note any unusual fluctuations in the monthly frequencies, i.e., deviations from the normal range. These findings were then shared with staff members from the Michigan Liquor Control Commission,who assisted in reconstructing the historical events (i.e., new legislation, voter referendums, unusual events, internal policy changes, and relevant court cases) which might explain the irregularities in the data.

The second type of data was beverage alcohol consumption as it is reflected in the wholesale volume or dollar value of sales of various types of alcoholic beverages. Drawing upon data from the Liquor Control Commission and the Michigan Beer and Wine Wholesalers Association, it was possible to generate a picture which reflects changes in consumption of various categories of alcoholic beverages over time.

Utilizing these two sets of data it became possible to study the relationships among alcohol beverage regulations, alcohol availability (as measured by the number, type, and hours of operation of licensed alcohol distributing units), and alcohol consumption. From the study of these relationships inferences were made concerning changes in availability

concurrent with known increases in youth crash involvement. The absence of age-specific consumption data,however, has limited our ability to make conclusive statements concerning the causal relationship between these two variables.

4.1 Hypotheses

The analysis of Phase-II data was necessarily somewhat exploratory. Prior to the present study, the investigation of Liquor Control regulations and effects on alcohol consumption and alcohol-related crash involvement have been limited. For this reason it was not possible to proceed along conventional lines of pre-specifying hypotheses; instead, hypotheses were generated from preliminary analyses. Lack of certain key data sets, too few cases to test for relationships between variables, and missing data all contributed to the need to alter the original Phase II hypotheses as the investigation progressed.

The original hypothesis for Phase II was:

> The availability of beverage alcohol in retail sales, and in the form of new products, increased concurrently with the reduction of the legal drinking age in 1972 throughout Michigan and to a greater extent in counties with high 18- to-20-year-old populations than in other jurisdictions.

This hypothesis was later altered and expanded to:

H_1 The availability of beverage alcohol,as measured by the number of wholesale barrels of beer and wholesale gallons of wine shipped, increased concurrently with (or within a 1 year lead/anticipation of) the reduction of the legal drinking age in January,1972, throughout Michigan.

H_2 The availability of beverage alcohol,as measured by the dollar values of wholesale liquor sales, increased concurrently with (or within a 1 year lead/anticipation of) the reduction of the legal drinking age in January, 1972, throughout Michigan, and for selected areas in Michigan.

H_3 The availability of beverage alcohol,as measured by the number of approvals and transferred licenses (and other significant Liquor Control Commission transactions), increased concurrently with (or within a 1 year lead/anticipation of) the reduction of the legal drinking age in January,1972,throughout Michigan, and for selected areas of Michigan.

As well as the following sub-hypotheses:

H_4 In that enforcement of beverage alcohol sales to and consumption by minors in Michigan is imperfect, on-premise sales and consumption measures would be more likely than packaged-sales measures to reflect impacts of the change in the legal drinking age.*

H_5 De-regulation of a Liquor Control Commission licensing or permit practice resulting from a legislative action, a court decision, or a policy change, contributes to an increase in the frequency of license or permit transactions of the type affected by the change in regulation.

H_6 When a liberalization of a Liquor Control Commission licensing or permit practice has occurred, counties experiencing the greatest increase in the density of 18-34-year-olds will experience the greatest increase in the frequency of license or permit transactions of the type affected by the change in regulation.**

H_7 Counties experiencing larger increases of 18-to-34-year-old population densities relative to other counties will experience increases in distilled spirits consumption.

H_8 When the de-regulation of a Liquor Control Commission licensing or permit practice has occurred, counties experiencing the greatest increase in population growth will experience the greatest increase in the frequency of license or permit transactions of the type affected by the change in regulation.***

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*It is our impression that it is far more difficult to enforce the existing law with regards to off-premise consumption by minors, than it is to enforce the law regarding on-premise consumption.

**The 18-34 age range has been selected as a high-consumption, high-accident at-risk population. A broader range such as 17-40 would be equally appropriate.

***In addition to population growth, economic growth may also be a contributing factor;however,data were not available with which to test this proposition.

H_9 Increases in the number of beverage alcohol distributing units are associated with comparable increases in consumption.

4.2 Michigan Liquor Control Commission Data: Summaries of Concluded Actions.

This section describes each of the variables from the Michigan Liquor Commission Daily Summaries utilized in this investigation. The data set includes both new licenses and permits, transfers of license ownership, and changes in the classification of existing licenses.

The Daily Summaries list each concluded action taken by the Michigan Liquor Control Commission on behalf of a licensee or potential licensee. A concluded action is one in which a decision has been made by the Commission in favor of the licensee to either issue a new license/permit, transfer ownership of an existing license, or transfer the status of an existing license to a different classification. Denials by the Commission for requested licenses or permits are not included in the data set. Included with each listing is the type of action taken, as well as the name and address (including County) of the establishment with which the action is concerned. Thus it is possible to generate aggregate monthly totals for indivudual counties and the State, for each of the variables in the data set.

The time period covered by this data set is from January, 1970, through November, 1976. Data were not available from the Commission for the period between January and June of 1971.

4.2.1 Definition of Variables

New Licenses

The Michigan Liquor Control Commission is authorized under the Michigan Liquor Control Act to issue licenses which grant authority to licensees to sell distilled spirits and/or beer and wine. Licenses to sell beer and wine or spirits for consumption on the premises require the approval of the local legislative body in which an applicant's place of business is located (except in counties with 1,000,000 population or over), before the Commission will grant a license. Only the issuance of new licenses is included under this variable heading (as opposed to the transfer of already existing licenses). What follows is a short description of each of the license types issued by the Commission:

1. SDD, Specially Designated Distributor - an establishment licensed by the Commission to distribute alcoholic liquor other than wine under 16% alcohol by volume and beer in the original package for consumption off the premises.

2. SDM, Specially Designated Merchant - an establishment licensed by the Commission to sell beer and/or wine containing not more than 16% of alcohol by volume at retail for consumption off the premises.

3. Class C - an establishment licensed by the Commission to sell at retail beer, wine, and spirits for consumption on the premises.

4. Tavern - an establishment licensed by the Commission to sell at retail beer and wine for consumption on the premises.

5. Club - an association whose members join together for the promotion of some common objective (not including associations organized for any commercial or business purpose, the objective of which is money profit), that is licensed by the Commission to sell at retail beer, wine, and spirits for consumption on the premises.

6. Hotel, B-Hotel & A-Hotel - an establishment for the feeding and lodging of guests, that is licensed by the Commission to sell alcoholic liquor. Class "A" hotels are those hotels licensed by the commission to sell beer and wine. Class "B" hotels are those hotels licensed by the Commission to sell beer, wine, and spirits.

New Permits

Permits are issued by the Commission to allow licensees to engage in certain practices, which in the absence of the permit would be in violation of the Michigan Liquor Control Act. For example the Act states that "No licensee other than a class "A" hotel, class "B" hotel, or club licensee shall have living quarters or any room containing any equipment for living quarters connected with his licensed premises..." However, licensees can obtain permission from the Commission to maintain living quarters which are connected with a licensed establishment, if the Commission

will issue them a Living Quarters Permit. Of the many permit transactions included in the Liquor Control Commission data set, only the three permit transactions which seemed most relevant to the change in the legal drinking age were tabulated.

1. Dance Permit - a permits which sanctions dancing on licensed premises. Permits are issued by the Commission, with the approval of the chief law enforcement officer and the local governing body in which an applicant's place of business is located, (local governing body approval is not required in the City of Detroit.)

2. Entertainment Permit - a permits which allows entertainment such as dancing, monologues, dialogues, and other types of performing on the licensed premises. Permits are issued by the Commission with the approval of the chief law enforcement officer and the local governing body in which an applicants place of business is located, (local governing body approval is not required in the City of Detroit). An entertainment permit is not required for the playing of musical instruments or singing.

3. Sunday Sales - any licensee who elects to sell spirits on Sunday. Sunday Sales are permitted ONLY when the legislative body or citizens (through a referendum) have authorized the sale of spirits for consumption on the premises on Sunday, and when the gross receipts from the sale of food or other services exceed 50% of the total gross receipts of the licensee. In addition the licensee must pay to the Liquor Control Commission an additional fee in the amount of 15% of the fee charged for the issuance of the original license.

Transfer of Ownership

Liquor licenses cannot be sold outright from one licensee to another under Michigan law. Instead,establishments are sold from one owner to another, with full or partial interest in the license (depending on the particular business arrangement) transferring from one owner to the next, with Commission approval. Dropping or adding on of a business partner, spouse, son or daughter to a license is included as a transfer. Transfers of ownership were categorized as follows:

1. SDD, Specially Designated Distributor - an establishment licensed by the Commission to distribute alcoholic liquor other than wine under 16% alcohol by volume and beer in the original package for consumption off the premises.

2. SDM, Specially Designated Merchant - an establishment licensed by the Commission to sell beer and/or wine containing not more than 16% of alcohol by volume at retail for consumption off the premises.

3. Class C - an establishment licensed by the Commission to sell at retail beer, wine, and spirits for consumption on the premises.

4. Tavern - an establishment licensed by the Commission to sell at retail beer and wine for consumption on the premises.

5. Hotel, B-Hotel & A-Hotel - an establishment for the feeding and lodging of guests, that is licensed by the Commission to sell alcoholic liquor. Class "A" hotels are those hotels licensed by the commission to sell beer and wine. Class "B" hotels are those hotels licensed by the Commission to sell beer, wine and spirits.

Transfer of Classification

Under various sections of the Michigan Liquor Control Act certain licenses may be changed from one classification (or license type) to another. In general these changes have been from more restrictive to less restrictive control over the types of beverage alcohol sold. The upgrading from Tavern license to Class C was the most common transfer of classification, with all other types of transfers combined representing a very small percentage of the total. Therefore Transfers of Classification are categorized as follows:

1. From Tavern to Class C. This is the designation applied to the reclassification of a Tavern license to a Class C license, which is approved by the Commission.

2. Other, All Transfers of Classification Other than (1.). This is the designation applied to the reclassification of all licenses other than the reclassification of a Tavern license to a Class C license. Most common in this category is the reclassification of an A-Hotel to a B-Hotel, or the reclassification of a B-Hotel to a Class C license.

It should be noted that while all of the variables listed in this data set were analyzed, only a subset of them are documented in this report. In most cases variables were excluded from the report because their frequency was too small to make inferences. We have chosen to report, in most cases, those variables associated with changes in frequency which could be related to specific policy, legislative or other events.

4.2.2 Coding of Michigan Liquor Control Commission Daily Summaries. Each action of the Liquor Control Commission is placed under the appropriate variable heading(s), and tallied with the appropriate code value(s), for monthly intervals. In addition, each transaction is labeled by a code value which indicates the county in which the licensed establishment is located. Thus, monthly, yearly, etc., totals for each of the variables described can be made for the state as a whole, as well as for selected counties.

A large number of the transactions listed on the Liquor Control Commission Daily Summaries reflect multiple actions taken by the Commission on behalf of a single licensee. For example, in Figure 4.1 the transaction between "Chick's & Ann's" and the Commission involves three separate actions by the Commission.

1. Adding wife as partner on tavern license (this is defined as a transfer of ownership in the data set);
2. Transfer of classification from a tavern license to a Class C license;
3. Purchase and approval of a new SDM license.

Each of these actions is tallied under the appropriate variable and code value utilizing the County Code value for the county in which the license is located.

4.3 Michigan Beer and Wine Wholesalers Association, Monthly Bulletin data: Definition of Variables.

The Michigan Beer and Wine Wholesalers Association represents wholesalers within Michigan. The Association publishes The Michigan Beer and

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★ The data from the Michigan Beer and Wine Wholesaler's Association represents approximately 90% of Beer and Wine Wholesale sales in Michigan. This is an estimate based on the fact that about 90% of beer and wine wholesalers in the state are members of the association.

Figure 4.1

Procedural Schematic Representation of Liquor Control Commission Data Coding

Commission Daily Summary List

TRANSFERS OF OWNERSHIPS APPROVED BY THE COMMISSION
JANUARY 3, 1972

TRANSFERS OF CLASSIFICATION

1. **CHICK'S** & ANN'S, FRANK PIETRANTONIO, ANNA PIETRANTONIO, 416 FOURTH ST., DICKINSON CO., IRON MOUNTAIN. '71 C 6419 & SDM 14665 W/LQP. ADD ANNA PIETRANTONIO,WIFE, AS PTNR ON '71 TAV 504 LIC. W/LQP; TRF CLASS FR TAV TO CLASS C LIC UND ACT #7, P.A. 1970; NA SDM **LIC**; ADD DBA OFCHICK'S & ANN'S & CORRECT SPELLING OF LAST NAME FR PIETRANTINIO. **STORE**#342

TRANSFERS OF OWNERSHIP (LIQUOR BY THE GLASS)

1. **CHARLES** HOTEL BAR, KENNETH R. ARMSTRONG, 200-20 STATE ST., CHEBOYGAN CO., CHEBOYGAN. '71 B-H 30381 & SDM 14664 W/DP. TRF. OWN. '71 30140 & SDM 1777 LIC'D. BUS. W/DP FR. **JOHN** H. HINER. STORE#276

2. **DRAGONETTI'S**, DRAGONETTI, INCORPORATED, 1923-19 W MICHIGAN AVE., JACKSON CO., SUMMIT TWP. **JACKSON**. '71 C-SS 6420 & SDM 14666 W/DP. TRF. N. '71 C 3357 & SDM 1217 LIC'D. BUS. W/DP & SS FR. VINCENT & BEULAH DRAGONETTI. STOI 205

3. **ADAIR** BAR, ROBERT J. BRUNNER, 8033 ST. CLAIR HWY ST CLAIR CO., CASCO TWP., ADAIR, PO **RICHMOND**. '71 C-SS 6421 & SDM 14669 W/DP. TRF. N. '71 C 538 & SDM 1408 LIC'D. BUS.

Information Relevant to Phase II

ADD WIFE AS PTNER ON TAV LIC
TRF CLASS FR TAV TO CLASS C LIC
NA SDM
DICKINSON CO. (county code=22)

Coding Sheet

JANUARY 1972

NEW LICENSES					TRANSFER OF OWNERSHIP				TRANSFER CLASS.	
SDD	SDM	C	TAV	HOTEL	SDD	SDM	C	TAV	TAV to C	OTHER
	22							22	22	

Wine Wholesalers Association Monthly Bulletin which contains monthly wholesale distribution volumes for the state of Michigan. A full collection of these bulletins from January,1969 through September,1976* was made available through the Association and formed the basis of this data set.

The Monthly Bulletin lists the number of packaged and draught barrels of beer shipped in Michigan from brewer to wholesaler for a given month. The Bulletin also lists the number of wholesale gallons of wine shipped within the state for a given month.

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*At the time of analysis beer data were not available for July 1969 and November,1975. Nor were wine data for November,1970 and 1975 and July through September of 1976 available. Sometime after the analysis of this data set figures were made available for some of the above dates, and are included below :

Date	Beer (in Barrels) Packaged	Draught
January 1969	478,798	61,830
July 1969	520,023	85,790
November 1975	439,382	60,350
October 1976	508,458	63,103
November 1976	451,402	59,249
December 1976	471,077	63,783

	Wine (in Gallons)
November 1975	1,152,283
November 1976	1,216,213
December 1976	1,105,264

The variables coded from the Michigan Beer and Wine Wholesaler's Association data include:

Packaged Barrels - Beer - Totals for Packaged Barrels reflect all beer shipped within Michigan in cans or bottles from brewer to wholesaler in any given month. Included in this designation are both packaged barrels produced within Michigan and out of state. A barrel equals 31½ U.S. Gallons.

Draught Barrels - Beer - Under this variable heading is included all draught beer shipped in Michigan in barrel form from brewer to wholesaler in a given month. Included in this designation are draught barrels produced both in Michigan and out of state.

Gallons of Wine - This variable reflects all wholesale gallons of wine shipped within the State from winery to wholesaler by month. This designation represents total wine distribution for both Michigan and out of state wineries.

4.4 Liquor Control Commission Data: Wholesale Distilled Spirits Sales: Definition of Variables

This data set lists the dollar value of wholesale receipts received by the Michigan Liquor Control Commission, which serves as the wholesaler for distilled spirits in the State of Michigan. Sums of receipts expressed in dollars were aggregated by year, and reported for the State, and for Ingham, Kent, Marquette, Washtenaw and Oakland Counties. The data set covers the time period of 1968 through 1976. Variables include:

SDD Sales (Specially Designated Distributor) - SDD sales include all over-the-counter purchases (by the bottle), for off-premise consumption of distilled spirits, expressed in wholesale dollars.

Table Top Sales - This is the designation given by the Liquor Control Commission for all on-premise consumption (by the glass) of distilled spirits, also expressed in wholesale dollars.

4.5 Analysis of Influences upon the Frequency of License and Permit Approvals

Through a review of Michigan liquor control laws, Liquor Control Commission practices,and other areas,including court decisions, we have formulated a conceptual model of the determinants of the numbers of concluded licensing transactions per month. The factors included in the model are only those for which direct evidence has been found linking factors to licensing transaction frequencies. In terms of a time-series model, these data appear to be dominated by cyclic, seasonal, and irregular components with little apparent constant trend.

The model, as currently formulated is:

$$Y = f\{X_1, X_2, X_3, X_4, X_5, X_6\}$$

where;

Y = License and permit transaction frequencies (monthly sums)

X_1 = Regular seasonal activity patterns of the Liquor Control Commission

X_2 = Non-repeating changes in the Liquor Control Commission, usually resulting in written policy

X_3 = Regular cyclic patterns influencing Liquor Control Commission decisions

X_4 = Court actions and judicial decisions

X_5 = State legislative actions (including those of the State Attorney General)

X_6 = Local government unit actions and decisions

Each of these factors will be discussed with examples below.

This model is an initial attempt to systematically describe the dynamics of licensing and permit transactions and will undoubtedly fail to consider several influences whose impacts are unknown to us at this time. Also, the factors we have included are directly related to transaction frequency impacts which are isolated and do not include the political, economic, and lobby activities which frequently preceded the factors we have included.

4.5.1 Regular Seasonal Activity Patterns. Figures 4.2, 4.3, and 4.4 are typical frequency plots for the Liquor Control Commission data. According to L.C.C. staff*, each April certain applications are held for an annual year-end accounting. The holding process creates a build-up each May of transactions to be concluded,and each May the data for certain reflected categories experience a sharp frequency surge.

Each year certain categories of transactions experience seasonal patterns of activity associated with the entrepreneurial activities of applicants. Also, the annual holiday and vacation periods appear to be somewhat associated with lower monthly transaction frequencies.

4.5.2 Non-Repeating Events. Two agency-related events typify this category of influences on the frequency of transactions. During the Spring of 1976 the L.C.C. had a personnel problem that resulted in a reduction of force. This staff reduction took place during May, a normally heavy activity month. In Figures 4.2 - 4.6 a noticeable drop in transaction frequencies is associated with April through June, 1976 when the L.C.C. personnel problem was manifest.

During August and September, 1976 the agency moved to a new building with the normal disruption in routine activities. Figures 4.4 and 4.5 reveal the disruptive effect on certain licensing activities.

4.5.3 Regular Cyclic Factors. The most dominant, regularly repeating influence on L.C.C. activities is the decennial U.S. Census. These data, when available, are used to determine the allowable number of consumption-on-premise establishments (Class C and Tavern Licenses) in that a maximum of one per 1500 residents is permitted to local government units. Thus, when new Census baseline data become available, the number of available (open) licenses is changed; with growing population the change is usually an increase. The general activity associated with the U.S. Census is

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*Much of the insights into these data have been generously provided by Ms. Beth Squires, L.C.C.

Figure 4.2

Frequency of New Class C License Transactions 1970-1976, State of Michigan

Source: Michigan State Liquor Control Commission

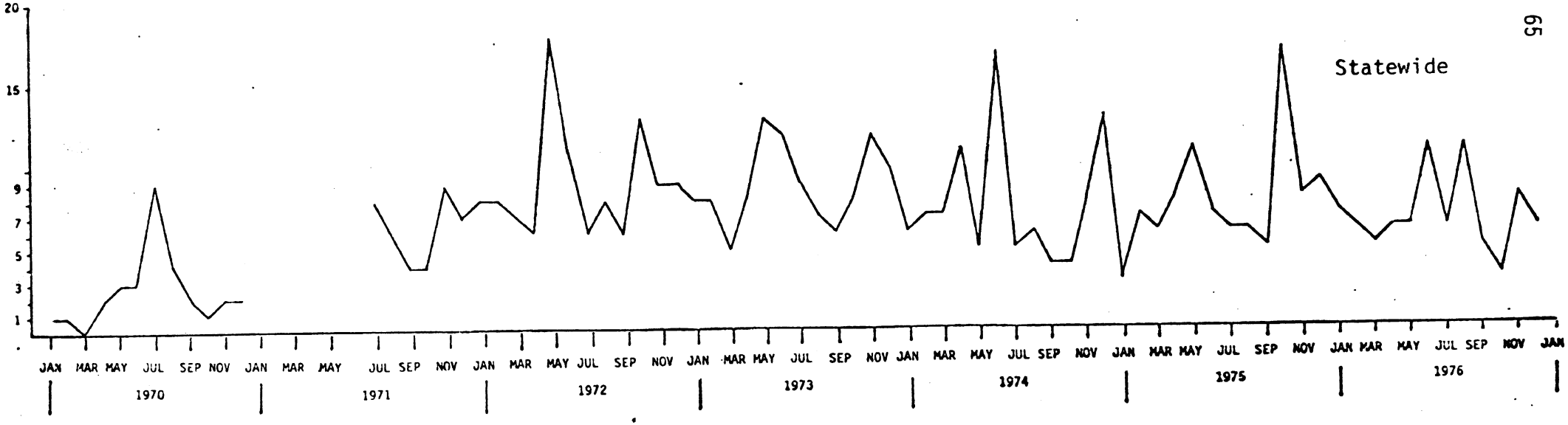


Figure 4.3

Frequency of Transfer of SDM Licenses 1970-1976, State of Michigan

Source: Michigan State Liquor Control Commission

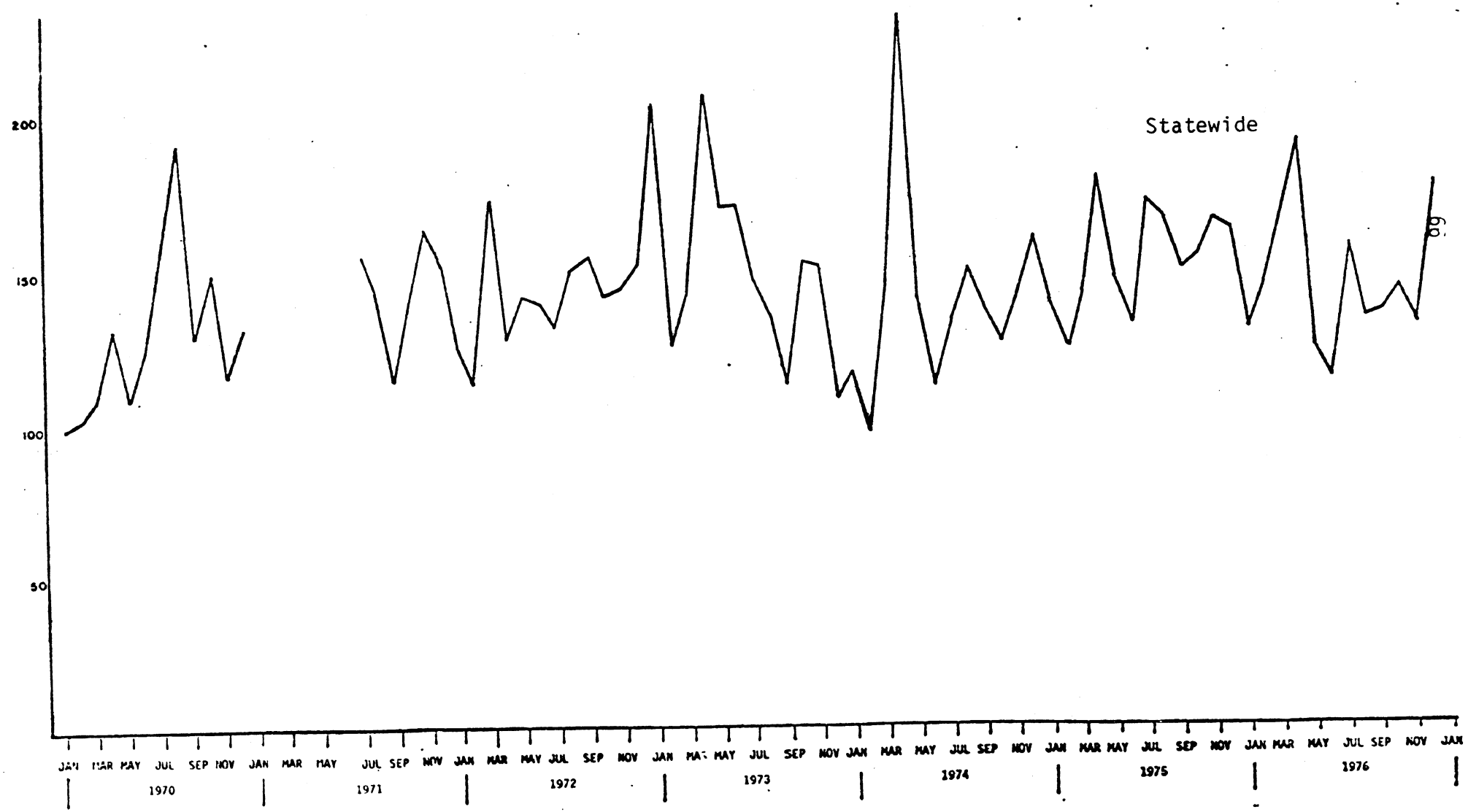
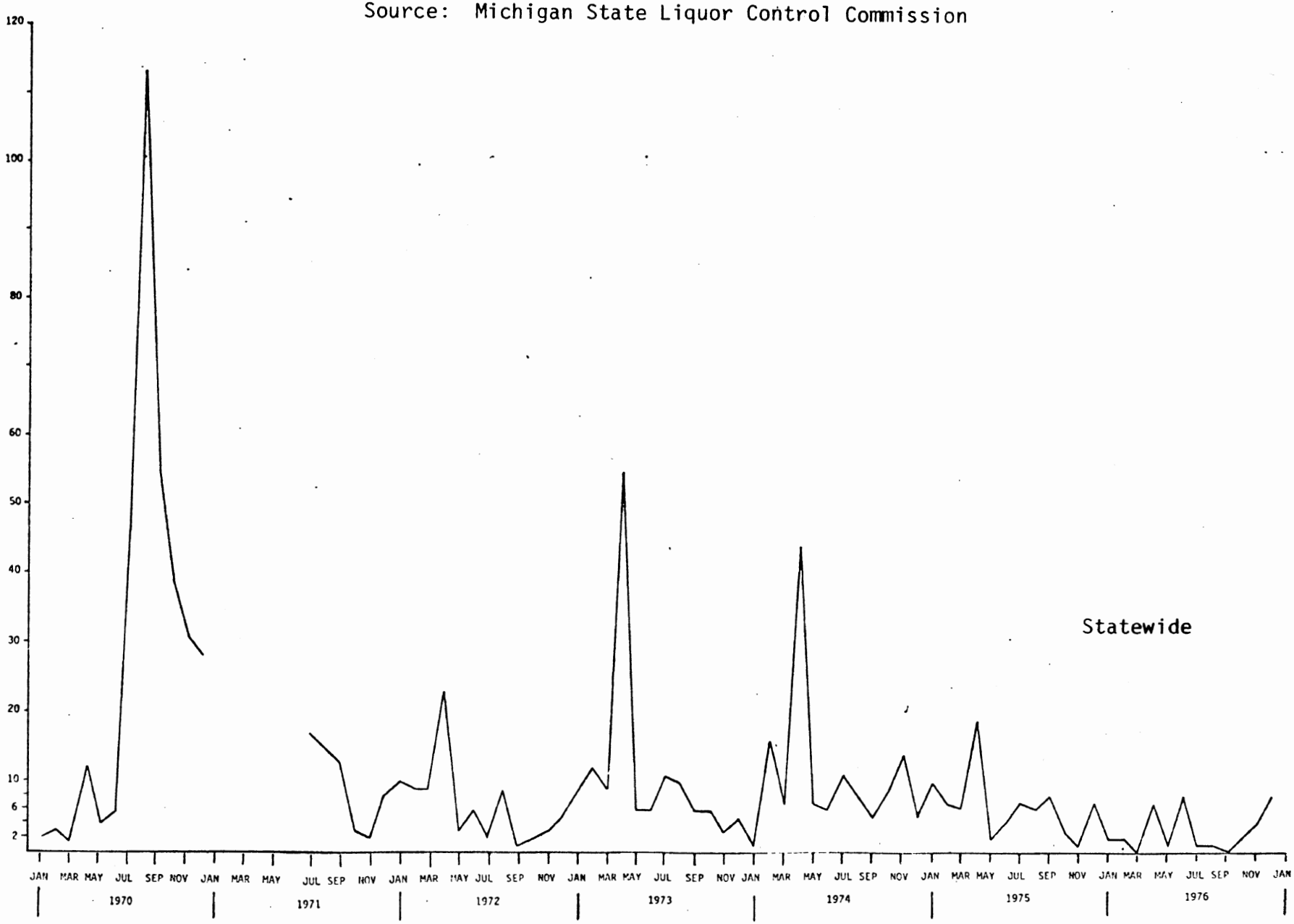


Figure 4.4

Frequency of Transfer of Classification
Tavern License to Class C License 1970-1976, State of Michigan
Source: Michigan State Liquor Control Commission



quite apparent in Figures 4.2 and 4.7 showing new and Transfer Class C license frequencies. The 1970 U.S. census data became available in April, 1971 and a decided shift in the level of frequencies is apparent. Unfortunately the first six months' experience of 1971 is missing throughout the data set. This hampered interpretation of these changes.

4.5.4 Legislative Action. New or amended legislation regarding specific provisions of Michigan State Liquor Law is the most frequent source of change in the frequency and patterns of licensing and regulation. There are several examples which demonstrate that, on the whole, most recent legislative action has had the effect of increasing the frequency of affected license approvals and license transfers of the Liquor Control Commission.

Figures 4.5 and 4.6 for instance,show New and Transfer frequencies of SDD licenses. The legal history of these transactions, in summary, indicates that the enabling legislation* became effective on December 5, 1973. The initial impact, as shown in Figure 4.6 was a surge of SDD transfers in the Winter of 1974. The regulation was amended in May,1974 and again in May,1975 when Act 245 of the Public Acts of 1975 permitted the use of a Special Census to establish the need (on the basis of one SDD per 3,000 population or fraction thereof) in rapidly growing areas of the state. As seen in Figure 4.5 the special census amendment paved the way for a large increase in New SDD transactions; the increment subsided only during the staff decrease and moving complications of the LCC during the Spring and Summer of 1976.

There are other examples of legislative actions which have had a generally de-regulating effect. In 1969 the Liquor Control Laws regarding the location restrictions on SDM licenses were amended. The original

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*For many years, up to 1973 the Liquor Control Commission had a moratorium on issuance and transfer of SDD licenses. As part of a new SDD policy, based on the Michigan Liquor Control Act,the Commission's posture toward SDD license was effectively changed in December, 1973. Michigan Liquor Control Commission. Law-Order-Rule Manual. pp. 23-25.

Figure 4.5

Frequency of New SDD License Transactions 1970-1976, State of Michigan

Source: Michigan State Liquor Control Commission

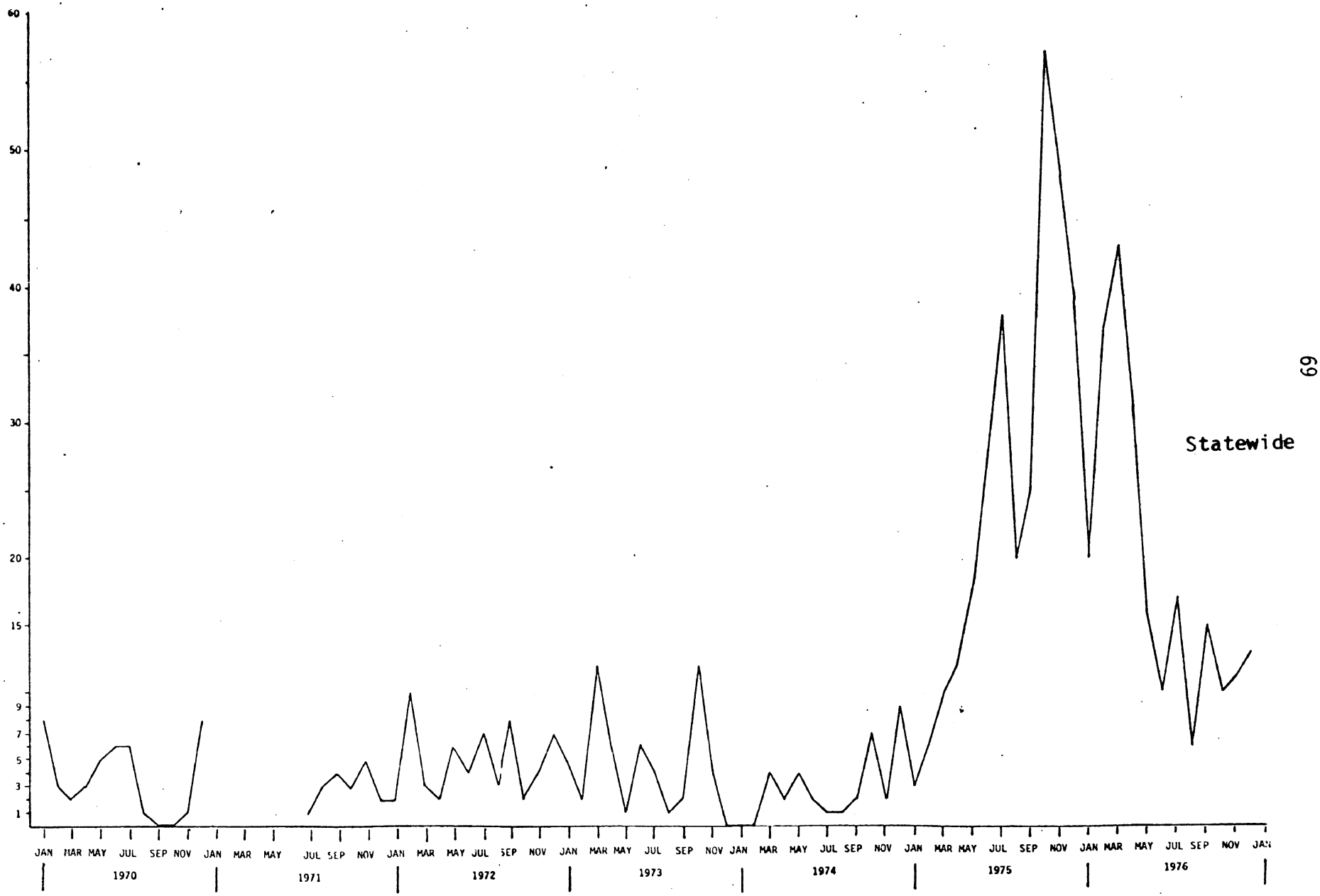


Figure 4.6

Frequency of Transfer of SDD Licenses 1970-1976, State of Michigan

Source: Michigan State Liquor Control Commission

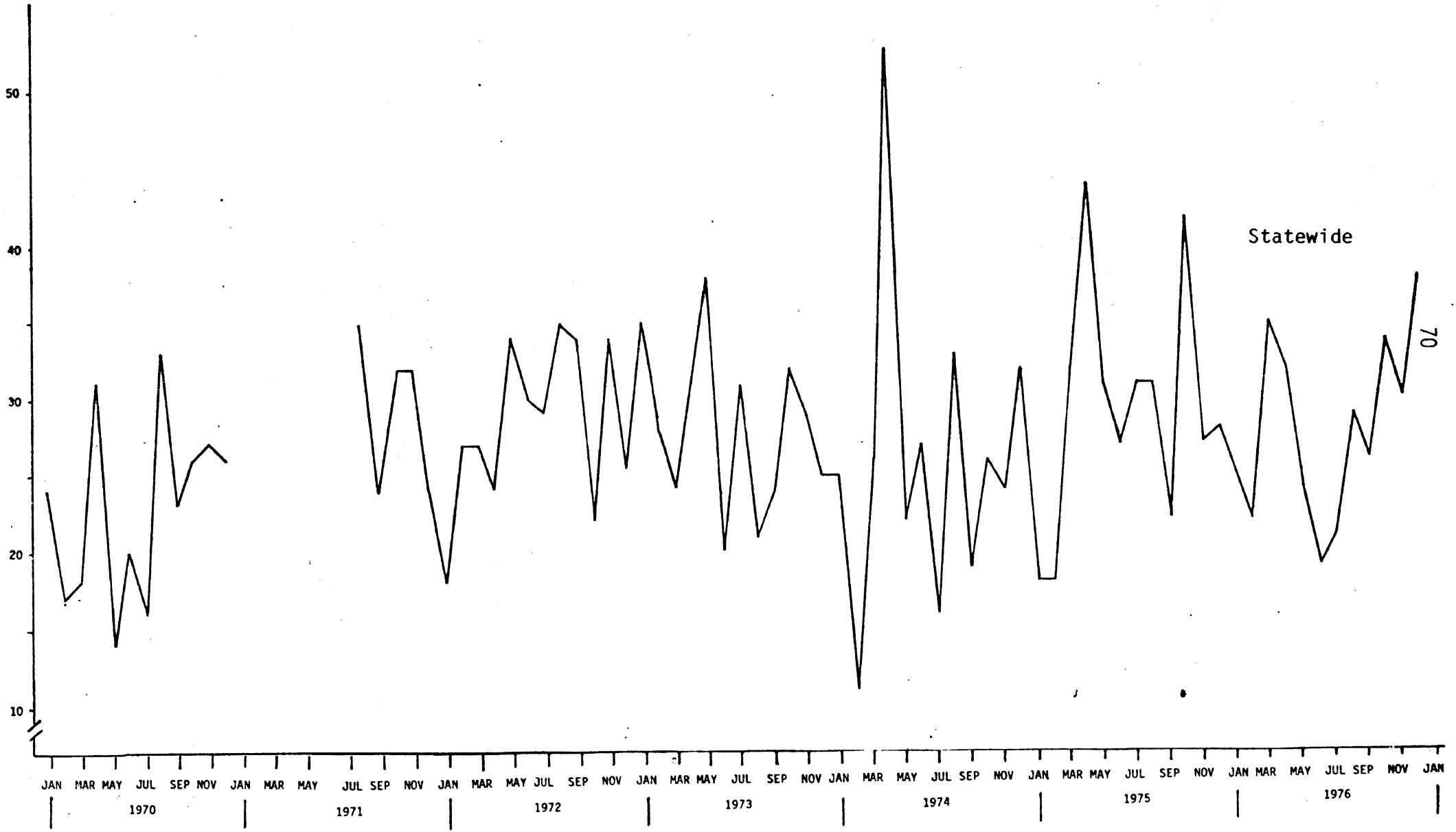


Figure 4.7

Frequency of Transfer of Class C Licenses 1970-1976, State of Michigan
Source: Michigan State Liquor Control Commission

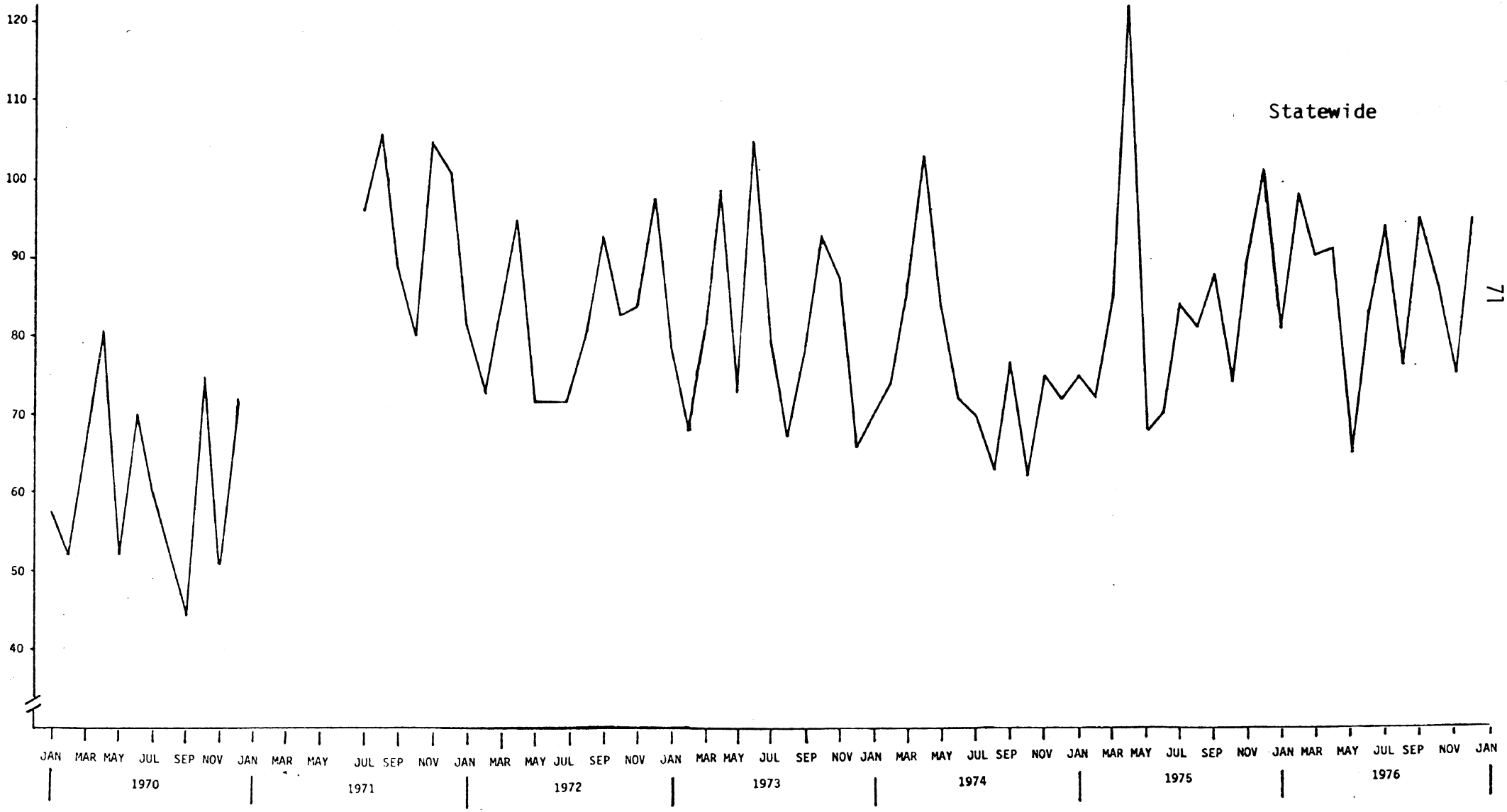
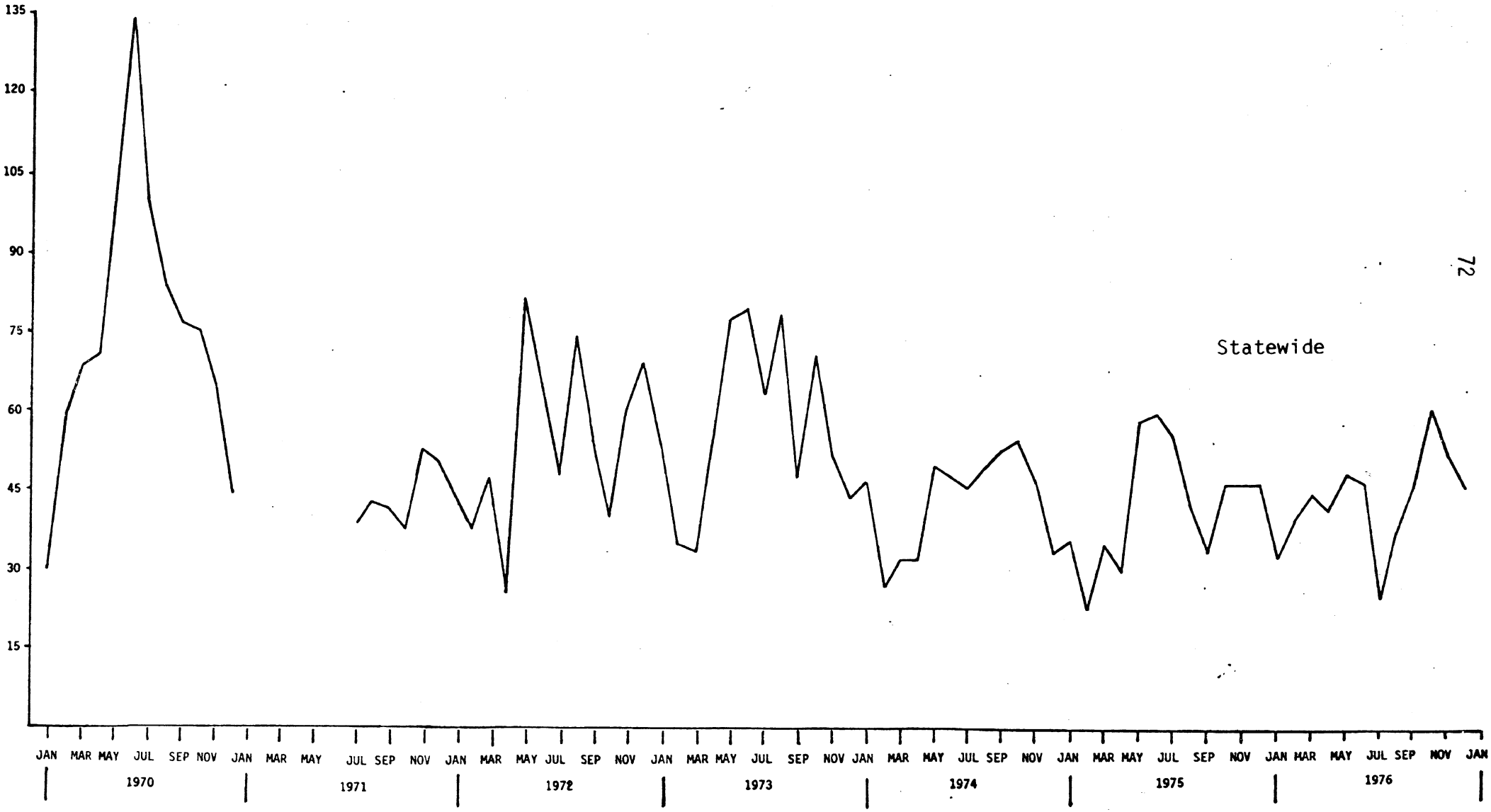


Figure 4.8

Frequency of New SDM License Transactions 1970-1976, State of Michigan

Source: Michigan State Liquor Control Commission



legislation prohibited the approach for a new SDM license or the transfer of each "...in the event the contemplated location is within 500 feet of a church or a school building."[2] In 1969, and effective in 1970 the amended regulation included language enabling the commission to waive the location provisions of the section (17.a), "If no objection is filed by the church or school...If an objection is filed, the commission shall hold a hearing...prior to making a decision on the issuance of the license."[3] In Figure 4.8 the effect of alteration of section 17.a is suggested with increased transactions of SDM licenses throughout 1970.

A final example of the impact of legislative action on licensing activities can be seen in Figure 4.4. Enabling legislation in 1970 freed the restrictions controlling transfer from tavern (Beer and Wine) to Class C license classification. Throughout 1970 and at each annual May increase in activities the frequencies of Tavern to Class C license transfers has been high; the unusually high frequency in 1970 appears to have been the direct result of the 1969 legislative action.

4.5.5 Court Decisions. Court decisions within the last seven years have been major determinants of increased frequencies of certain L.C.C. activities as reflected in the data. One of the most interesting examples is the case of Sunday Sales Permits and a series of legal opinions and critical decisions that eventually de-regulated a major factor of beverage alcohol availability.

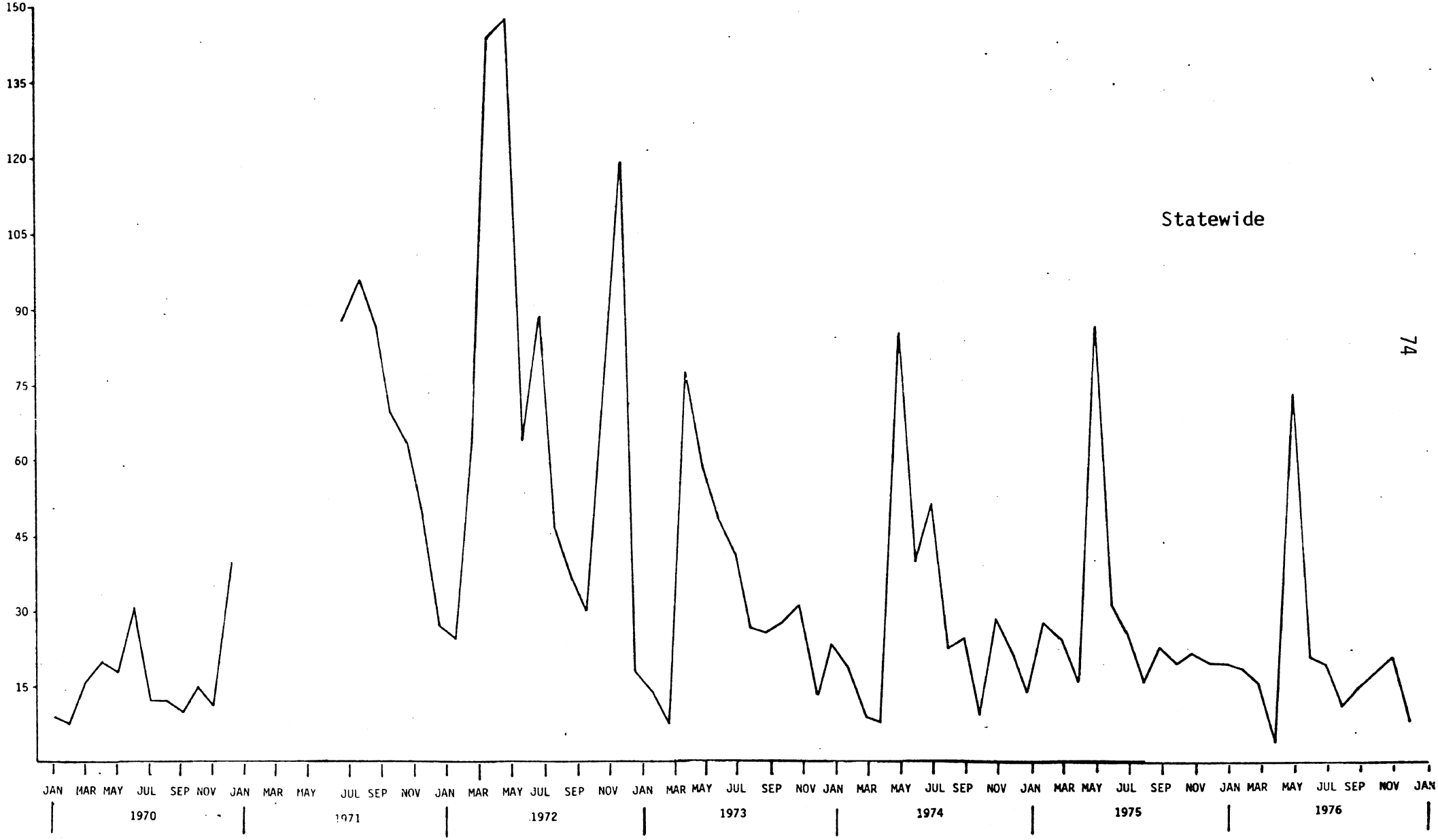
Figure 4.9 documents a large peak of Sunday Sales Permit transaction frequencies during 1972. It appears that court decisions prior to 1972 were primarily responsible for the large increase in Sunday Sales licenses in 1972.

4.5.6 The Sunday Sales Regulation Change. Few changes in the laws, policies or interpretations of laws have the effect of expanding the most basic foundations of market availability; the Sunday Sales issue was such a change. Because the court decisions are both important and interesting this particular discussion will be more detailed then others in this section.

Figure 4.9

Frequency of New Sunday Sales Permit Transactions 1970-1976, State of Michigan

Source: Michigan State Liquor Control Commission



A Detroit couple made application in the Spring of 1969 for "authorization to sell spirits for consumption on the premises on Sunday after 2:00 p.m. in conjunction with a 1969 Class C and SDM Licenses".[4] This case became the focal point of a lengthy legal battle over the correct interpretation of the Michigan Liquor Control Laws dealing with eligibility to sell spirits on Sundays after 2:00 p.m.

By Public Acts of 1968, No. 313, Section 19.e of the Michigan Liquor Control Act was amended to read, in part, as follows:[5]

> "...the legislative body of any county may authorize sale of spirits, for consumption on the premises, on Sunday after 2:00 p.m....in any establishment licensed under the act in which the gross receipts derived from the sale of food and other goods and services exceeds 50% of the total gross receipts."

In July 1969 the Attorney General responded to the Liquor Control Commission's request for an opinion prior to the Commission's denial of the Detroit couple's application for a Sunday Sales Permit.

The Attorney General, in his July, 1969 letter to the Liquor Control Commission, stated,

> "Application for authorization to sell spirits for consumption on the premises on Sunday after 2:00 p.m. in conjunction with 1969 Class C and SDM Licenses...
>
> It is the contention of the applicants' counsel that "beer and wine" are to be deemed as food within the meaning of the language of amendatory Act 313 and hence sales of "food and other goods and services" constituted more than 50% of the gross receipts of the licensees.".. The Commission has asked for the opinion of the writer...
>
> It is the opinion of the writer that the contention is unsound in view of Sec. 27 of the liquor law which prohibits a rule of the Commission requiring the purchase of food with the purchase of alcoholic liquor or the gift of food in connection with the sale of alcoholic liquor...
>
> Accordingly, it is the opinion of this writer that the application should be denied."[6]

Until this time the Liquor Control Commission, interpreting the "intent" of the Michigan law, included beer and wine with "alcoholic beverages" when computing the "50% or more" of the applicant's gross receipts. Thus the confrontation involved the appropriateness of the Liquor Control Commission to treat beer and wine differently from other goods and services, which had the effect of imposing a Sunday sales regulation on beer and wine as well as distilled spirits.

Plaintiffs in this petition sought to have the determination of the Michigan Liquor Control Commission and the Attorney General's decision reviewed.

The excerpts from the appellate ruling follow.

> The sole issue presented before the Court is in the interpretation and construction of section 19e of the "Liquor Law" (P.A. 1933, Extra Session, #3) as amended by P.A. 1968, #313 effective July 3, 1968 (MCLA 436.19e). Specifically, the question before the court is whether or not Plaintiffs may include their gross sales of beer and wine in their computation of "qualifying" gross receipts in their application for authorization to sell spirits for consumption on the premises on Sundays after 2:00 p.m.
>
> "The Court is at once confronted with a classic example of a legislative failure to clearly resolve an obviously litigious issue, one far more amenable to legislative solution than to judicial 'second guessing'. However, it is now left to this Court to determine the legislative intent of the phrase, "food and other goods and services." In approaching this "simple task," the Court is confronted with many so-called rules of "statutory interpretation." Certainly, in the case of ambiguity, we can turn to the legislative journals. However, in the instant case, assuming such ambiguity, the house journals to which the Court has been referred by counsel create nothing but a "Mexican standoff." Referring to the journal of the House, No. 96, for June 6, 1968, pgs. 3051-54, we find that that body rejected by almost identical votes the opportunity of injecting both the phrase "including beer and wine" and the phrase "excluding beer and wine," as qualifications to the term "other goods." The only legislative intent that becomes clear from this record is the intent of the Legislature to avoid the thorny thicket of direct confrontation with the issue before us.

Plaintiff first contends that beer and wine, as defined by the "Liquor Law", are to be included in the definition of "food." This contention is summarily rejected by this Court as not only a strained construction, but a construction that would do violence to the entire thrust of the law. Since we must construe the act as a whole, it is clear that for the purposes of the "Liquor Law," food is clearly a separate commodity from alcoholic liquor, i.e., spirits, beer or wine.

Next Plaintiff contends that the expression "other goods" is inclusive of beer and wine. Neither the specific act (P.A. 1968, #313) nor the "Liquor Law" itself define "other goods". Nor has our attention been directed to any other specific definition which even by analogy would be helpful here. We must therefore turn to the rules of construction commonly applied in such instances.

...Having previously referred to the question of "legislative intent," and this Court's inability to determine the same from the house journals, it is necessary to here indicate that this court finds no patent or latent ambiguity in the language used by the Legislature; that is, as imprecise as the Legislature might have been in stating their "political" intent, this court is convinced that in this case a literal interpretation of the words "other goods" in the common and approved usage of the English language must prevail, since it is in no way obvious from a survey of the whole act that such a construction would defeat the intention of the Legislature, i.e., the true intention of the Legislature in this matter is not ascertainable. Thus in the instant case, applying the common and approved usage of the term "other goods," the term as used in its everyday parlance as well as in legal usage, connotes a comprehensive name for almost all personal property. This "inclusive" definition of "goods" is evident from innumerable authority...

...In light of this Court's ruling that the word "food" does not include beer and wine, it might be argued that the use of the word "food" restricts the more general term "goods" be limited in its scope to the identical things specifically named, i.e., "food." Clearly from the content in which the expression "other goods"is used here, there is no legislative intention to limit the scope of that expression, other than perhaps to limit it to those things which have historically been sold in conjunction with spirits in the licensed establishments in this State.

> Recapitulating, it is the Opinion of this Court that the language of the statute is plain and unambiguous, that no legislative intention contrary to the clear and unambiguous language of the statute is apparent, that the words "other goods" are not technical terms or terms that have acquired a peculiar and appropriate meaning, that the general words "other goods" used in this statute must receive a general construction and since there is no express exception within the statute, this Court has no duty or right to create one... Therefore, the general words "other goods" includes within its meaning, purport and definition "beer and wine." It is not for this Court to pass upon the wisdom, policy or consequences of said act nor is it our right here to speculate on the legislative purpose to be accomplished by the act. Here, if the Legislature meant something other than they stated in clear terms according to the common and approved usage of the language, they could have,and can in the future, make such intention known.
>
> For the reasons stated, the decision of the Defendant, Michigan Liquor Control Commission, denying Plaintiff's application for authorization to sell spirits for consumption on the premises on Sunday after 2:00 p.m. is reversed, and the matter is remanded to the Michigan Liquor Control Commission for proceedings therein in accordance with this Opinion...."

Following this judicial decision no counter-appeal was made by the State of Michigan. The L.C.C. initiated policy to review past cases where application was denied as well as making approval/denial decisions on a "new" interpretation of the law and a considerably larger proportion of the applicants were able to qualify for Sunday Sales permits (computing beer and wine receipts with those of other goods and services increased the proportion of non-distilled spirits gross receipts above 50%). Figure 4.9, as mentioned above, clearly shows that 1972 experienced a large increase in Sunday Sales permits and each annual cycle after 1972 also experienced more approved Sunday Sales permit applications than in years prior to the court action described here.

This court action is of particular importance because the impact of this legislation converged with the impact of the lower legal drinking age in Michigan. This convergence and other covariate impacts have been

identified throughout these analyses and again, regarding Sunday sales of beverage alcohol, we find that several counties elected to authorize Sunday Sales for the first time in 1972, which brings us to the final factor.

4.5.7 Local Government Unit Actions. The most prominent example of local government actions affecting the frequency of Liquor Control Commission license and permit transactions can be seen in the case of Sunday Sales permits. While most counties elected to permit Sunday Sales when enabling legislation became effective in 1968 (Table 4.1), no other counties chose to allow Sunday Sales until 1972, when 11 additional counties so elected.

4.5.8 Interactions of Factors. Changes in one licensing activity can directly influence other areas. When it became permissible to transfer Tavern to Class C during 1970 (Figure 4.4),the total number of Class C licenses increased dramatically. The direct result of the classification transfer process in 1970 is seen in transfer of ownership transaction of Class C licenses. As seen in Figure 4.7,transfer of ownership of Class C licenses underwent a step increase in 1971 that persisted through 1976. Also in 1970 the decennial census was taken which interacted with the enlarged population of Class C licenses in 1971 and the legal drinking age in 1972.

4.6 Analyses of Alcohol Beverage Consumption Data

4.6.1 Distilled Spirits. Figures 4.10-4.13 report the yearly wholesale dollar totals for Table Top and SDD distilled spirit sales in the State of Michigan and for selected counties. In Figures 4.10 and 4.11 general upward trend in on-premise consumption of distilled spirits can be seen both for Statewide and selected counties. Of particular importance

Table 4.1

Authorization for Sunday Sales by County and Year of Authorization
(Source: Michigan Liquor Control Commission)*

1968 N=66

Alcona	Clare	Jackson	Montmorency
Alger	Clinton	Kalamazoo	Muskegon
Allegan	Crawford	Keweenaw	Newaygo
Alpena	Delta	Lake	Oakland
Antrim	Dickinson	Leelanau	Ontonagon
Arenac	Eaton	Lenawee	Oscoda
Baraga	Emmet	Livingston	Otsego
Barry	Genesee	Luce	Presque Isle
Bay	Gogebic	Mackinac	Roscommon
Berrien	Grand Traverse	Macomb	Saginaw
Branch	Houghton	Manistee	St. Clair
Calhoun	Huron	Marquette	Schoolcraft
Cass	Ingham	Mason	Van Buren
Charlevoix	Iosco	Mecosta	Washtenaw
Cheboygan	Iron	Menominee	Wayne
Chippewa	Isabella	Midland	Wexford
		Monroe	

1972 N=11

Benzie	Kalkaska	Osceola	Shiawassee
Gladwin	Montcalm	St. Joseph	Tuscola
Gratiot	Oceana	Sanilac	

1973

Ionia

1975

Lapeer

*Counties not permitting Sunday Sales: Hillsdale, Kent, Missaukee, and Ottawa.

Figure 4.10
WHOLESALE DISTILLED SPIRITS TABLE TOP SALES IN MILLIONS OF DOLLARS
STATE OF MICHIGAN 1968-1976
Source: Michigan State Liquor Control Commission

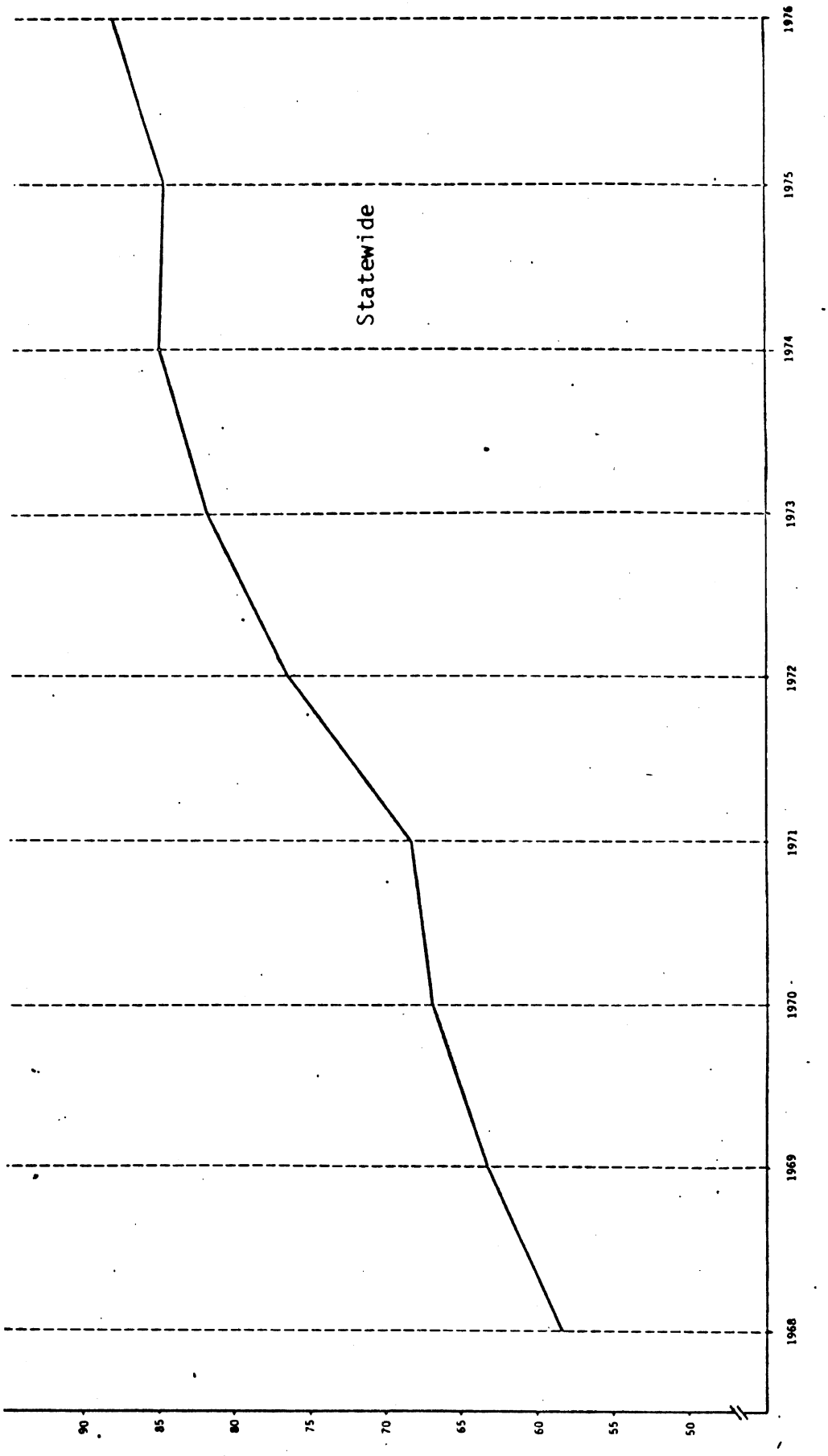


Figure 4.11

WHOLESALE DISTILLED SPIRITS TABLE TOP SALES IN MILLIONS OF DOLLARS
Michigan Counties 1968-1976
Source: Michigan State Liquor Control Commission

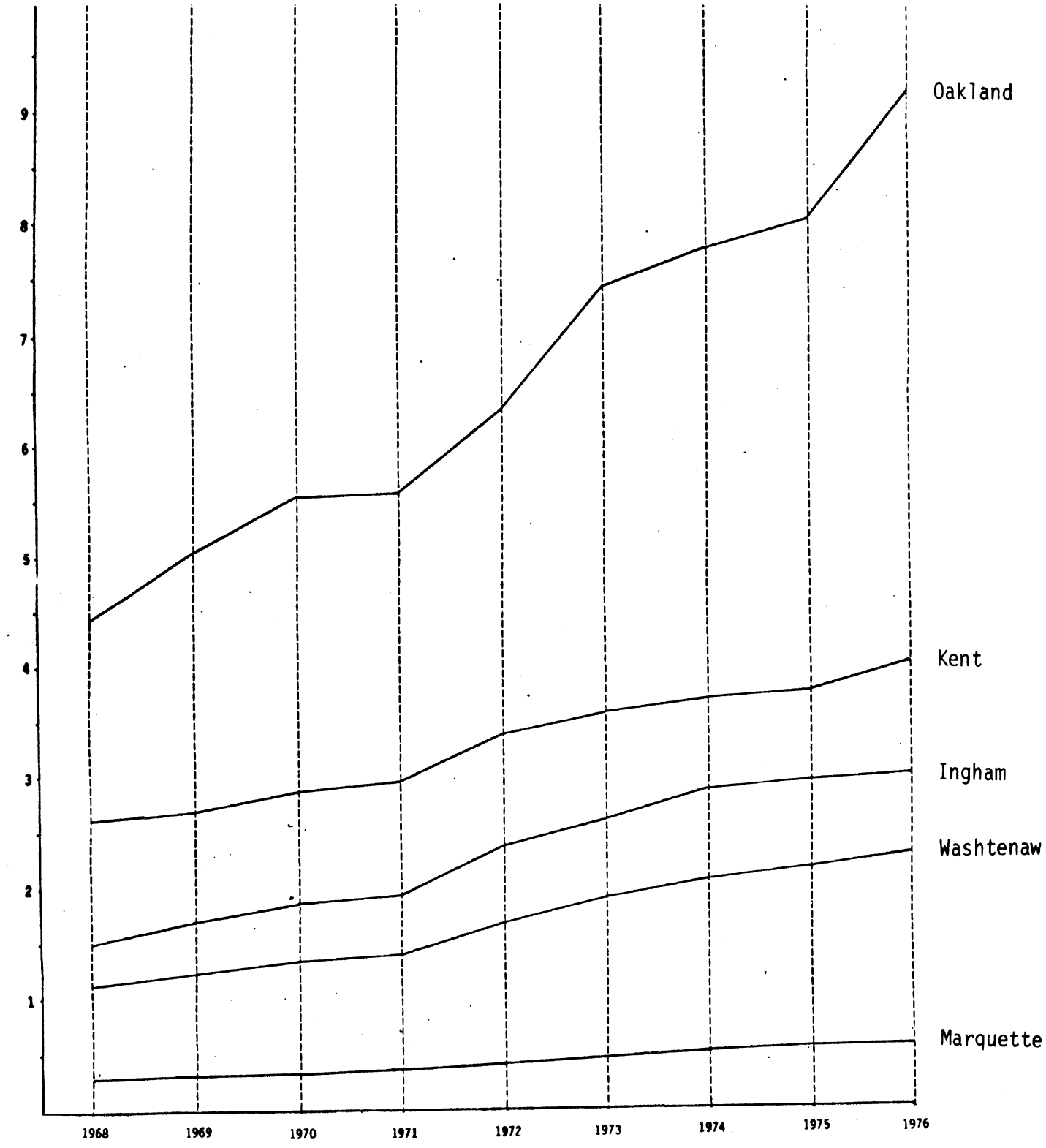


Figure 4.12

WHOLESALE DISTILLED SPIRITS SDD SALES IN MILLIONS OF DOLLARS
STATE OF MICHIGAN 1968-1976
Source: Michigan State Liquor Control Commission

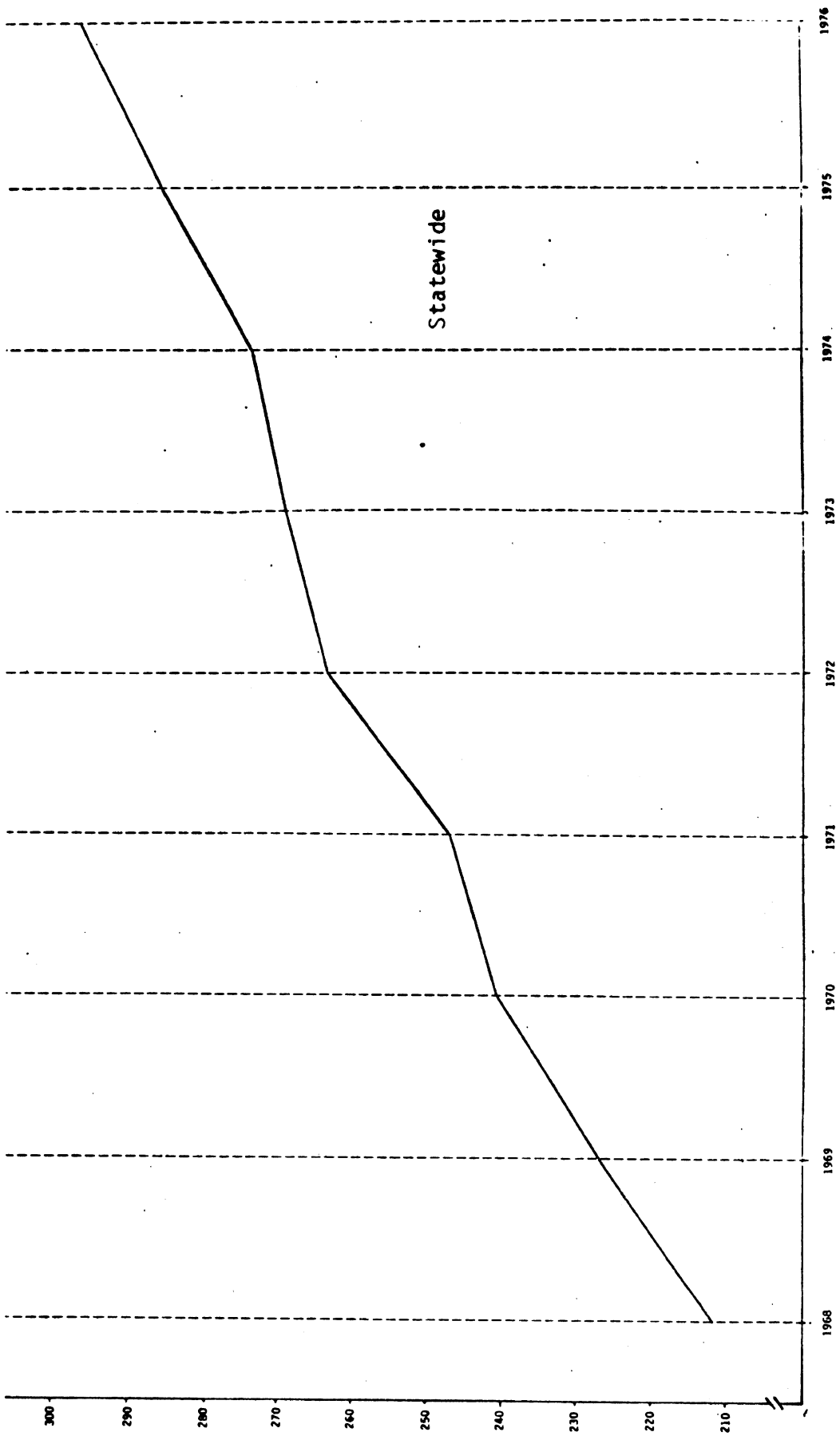
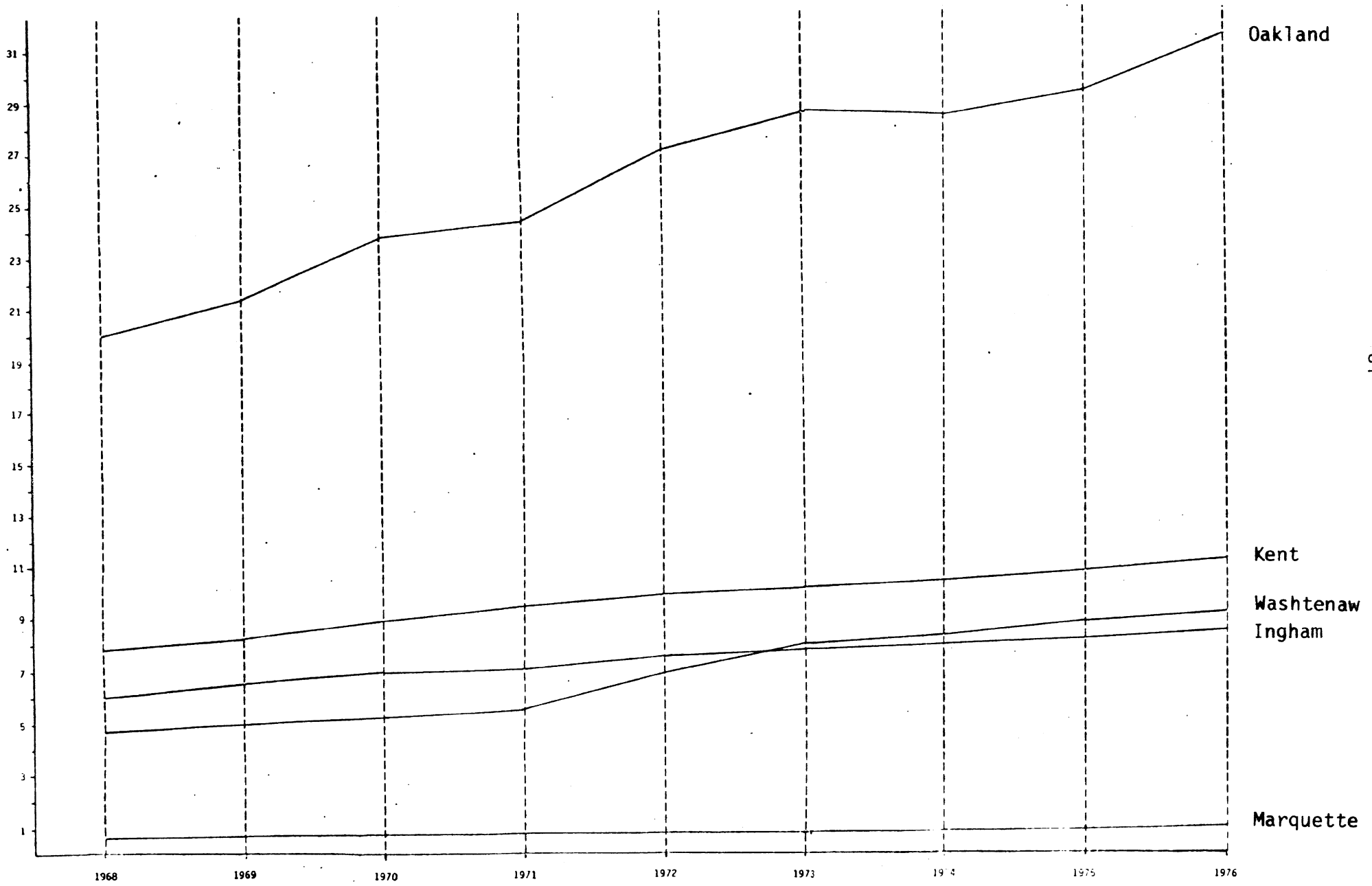


Figure 4.13

WHOLESALE DISTILLED SPIRITS SDD SALES IN MILLIONS OF DOLLARS
Michigan Counties 1968-1976
Source: Michigan State Liquor Control Commission



in Figure 4.11 is the regression discontinuity which is apparent in 1972 at the time of the lower legal drinking age change for the selected counties.*

In Figures 4.12 and 4.13 an upward trend is also noted, this time for off-the-premise consumption of distilled spirits. While no regression discontinuity is evident statewide, or for the counties of Oakland, Kent, Ingham, and Marquette, at the time of the 1972 legal change, it is clear that in Washtenaw County a regression discontinuity has taken place.

Both figures 4.11 and 4.13 confirm the immense expansion in the alcohol beverage market in Oakland County,which was shown earlier in the Liquor Control Commission Licensing data. While it is not possible to relate specific fluctuations in the licensing data to specific changes in the consumption data,** it is clear that the relative level of market activity (as indicated in the frequency of new and transferred licenses) in each of the selected counties is consistent with the relative level of alcohol consumption for each of these same counties.

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*Regression discontinuity refers to changes in the level and/or slope of straight lines. When frequency data are plotted over units of time and changes are observed,the term regression-discontinuity is a generic reference to the changes observed. In many of the frequency time-series plots of Liquor Control Commission data, average levels of monthly activities have changed (such as the frequency of New SDD License transactions, Figure 4.5). We have used "regression discontinuity" to refer to abrupt changes in slope or level because it is unambiguous and more accurate than the simple term "change."

**There are several reasons for the above including the following: (1) lack of licensing data for the years 1968-1969; (2) missing data for 6 months of 1971; and (3) lack of baseline data from which cumulative frequencies, by county, could be compared for each of the licensing varaibles.

4.6.2 Beer and Wine. Figures 4.14 through 4.16 report the State-wide frequencies for wholesale gallons of wine and barrels of beer. Evident in all three sets of data is an upward linear trend, as well as a regular cyclical pattern. For example, wholesale packaged beer sales consistently peak during the months of July and August, while wholesale draught beer sales peak during the months of May through August.

Of particular interest in this set of data is Figure 4.16 which shows a statistically significant increase in wholesale draught beer sales during 1972.* In that beer is the preferred alcohol beverage among young people, and because on-premise consumption represents a sphere of the alcohol beverage market not open to 18-to-20-year-olds prior to the legal change (as opposed to off-premise consumption which, although illegal prior to 1972, was impossible to totally restrict), this increase would appear to represent a temporary surge in on-premise consumption of beer by 18-to-20-year-olds. Also present in this series is a regression discontinuity. It is evident when the slope of the line encompassing the observations prior to 1972 is compared with the slope of the line which follows the 1972 surge.

Figure 4.14, Wholesale Wine Sales, appears to have a dramatic change in slope, disparity,and level at the end of 1970. Clearly the 1968 through November, 1971 period is distinct from the remainder of the time-series. The cause of such a change is now unknown, and there is no statistically significant difference in 1972 when the legal drinking age became 18.

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*Time-Series Analyses were performed on each of the data sets in this Section. Only the series in Figure 4.16 demonstrated statistically significant shifts. For Wholesale draught beer sales, using January, 1972 as the impact point the following statistical results were obtained:

n_1 = 36 months, n_2 = 12 months } $t\hat{\delta} = 3.15$ $\rho \leq .001$

n_1 = 36 months, n_2 = 24 months } $t\hat{\delta} = 2.61$ $\rho \leq .01$

n_1 = 36 months, n_2 = 57 months } $t\hat{\delta} = 1.56$ $\rho \leq .04$

Figure 4.14

WHOLESALE WINE SALES
STATE OF MICHIGAN 1969-1976 (x10,000 GALLONS)
Source: Michigan Beer and Wine Wholesalers Association

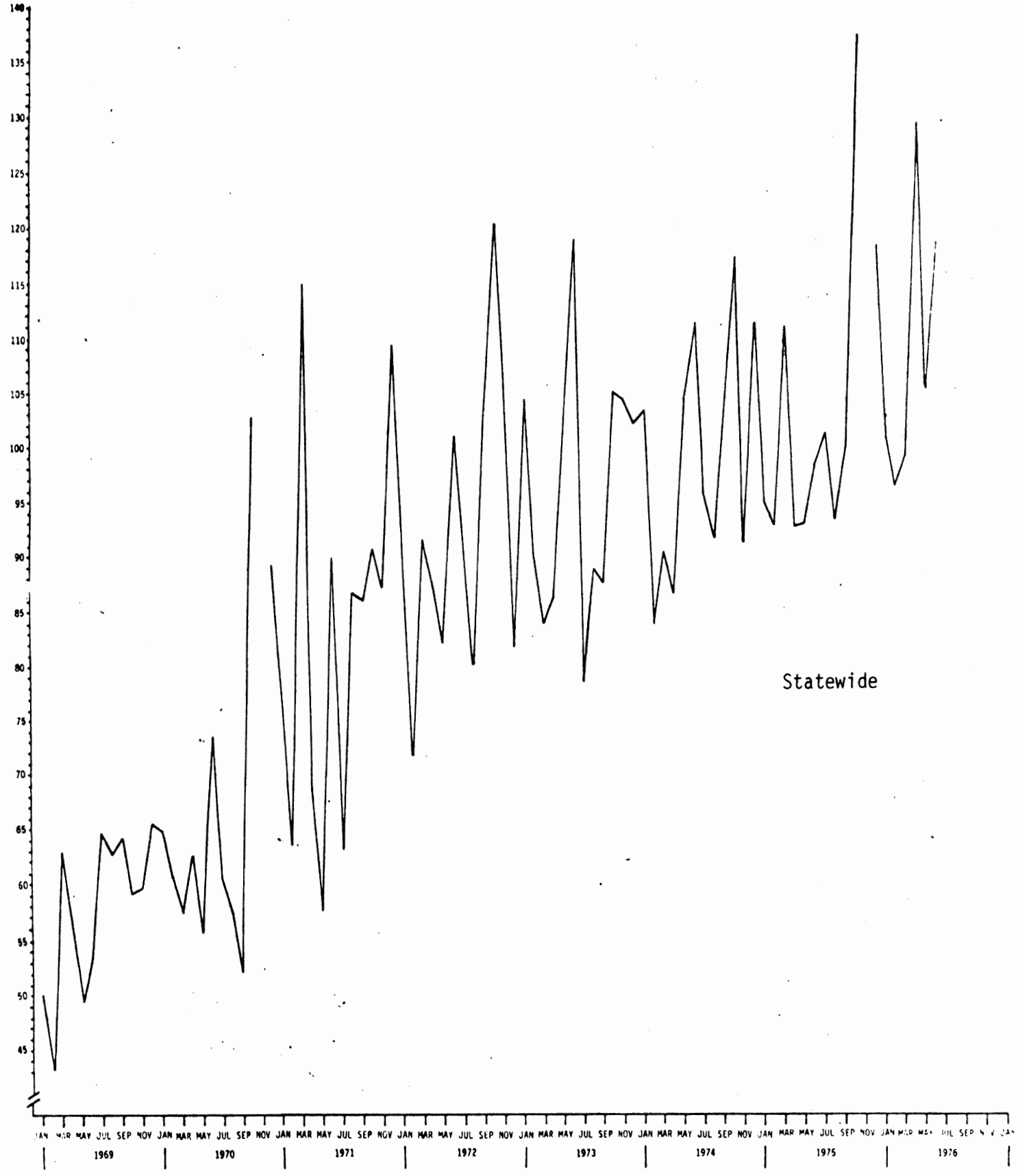


Figure 4.15

WHOLESALE PACKAGED BEER SALES
STATE OF MICHIGAN 1969-1976 (X 10,000 BARRELS)
Source: Michigan Beer and Wine Wholesalers Association

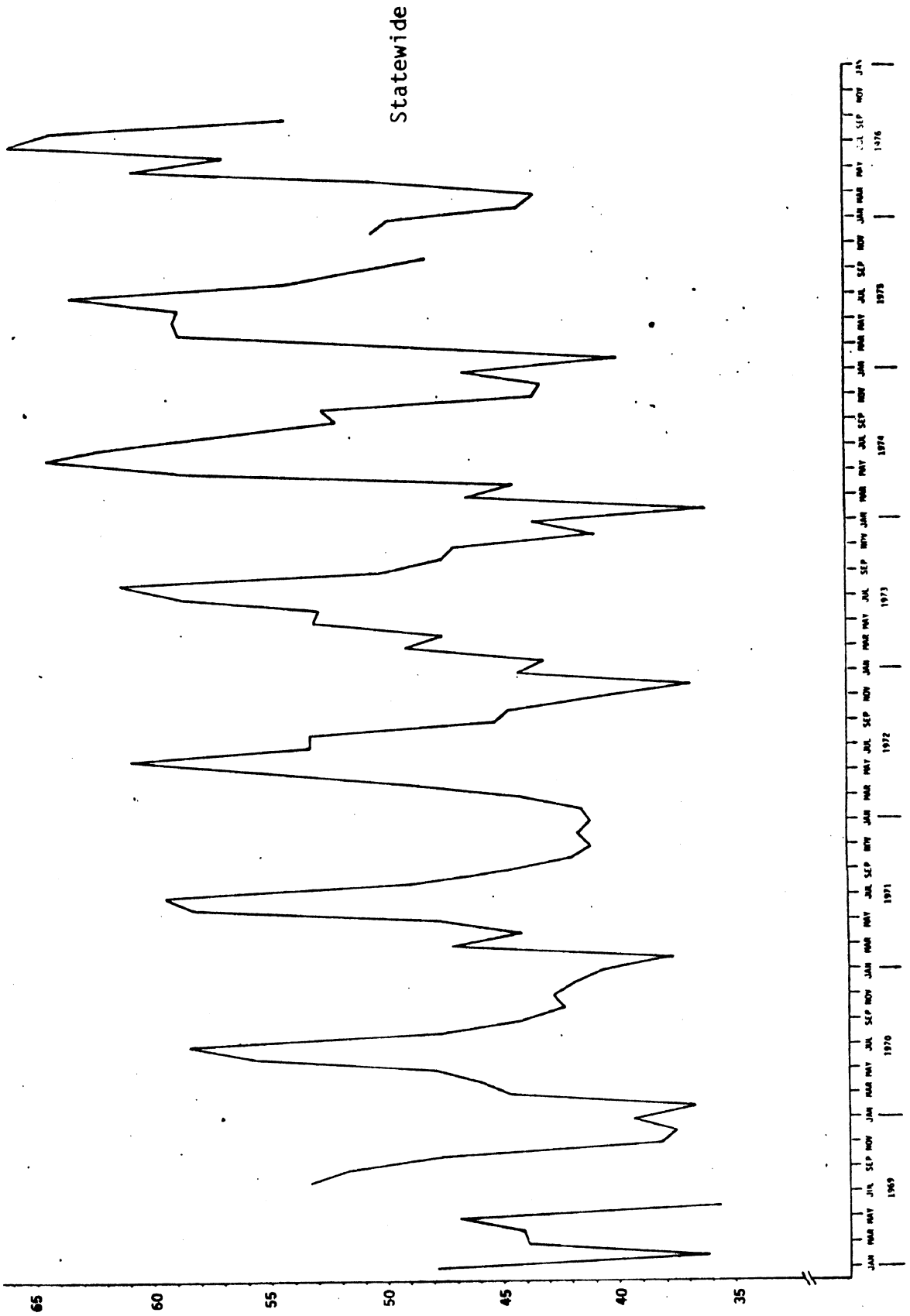
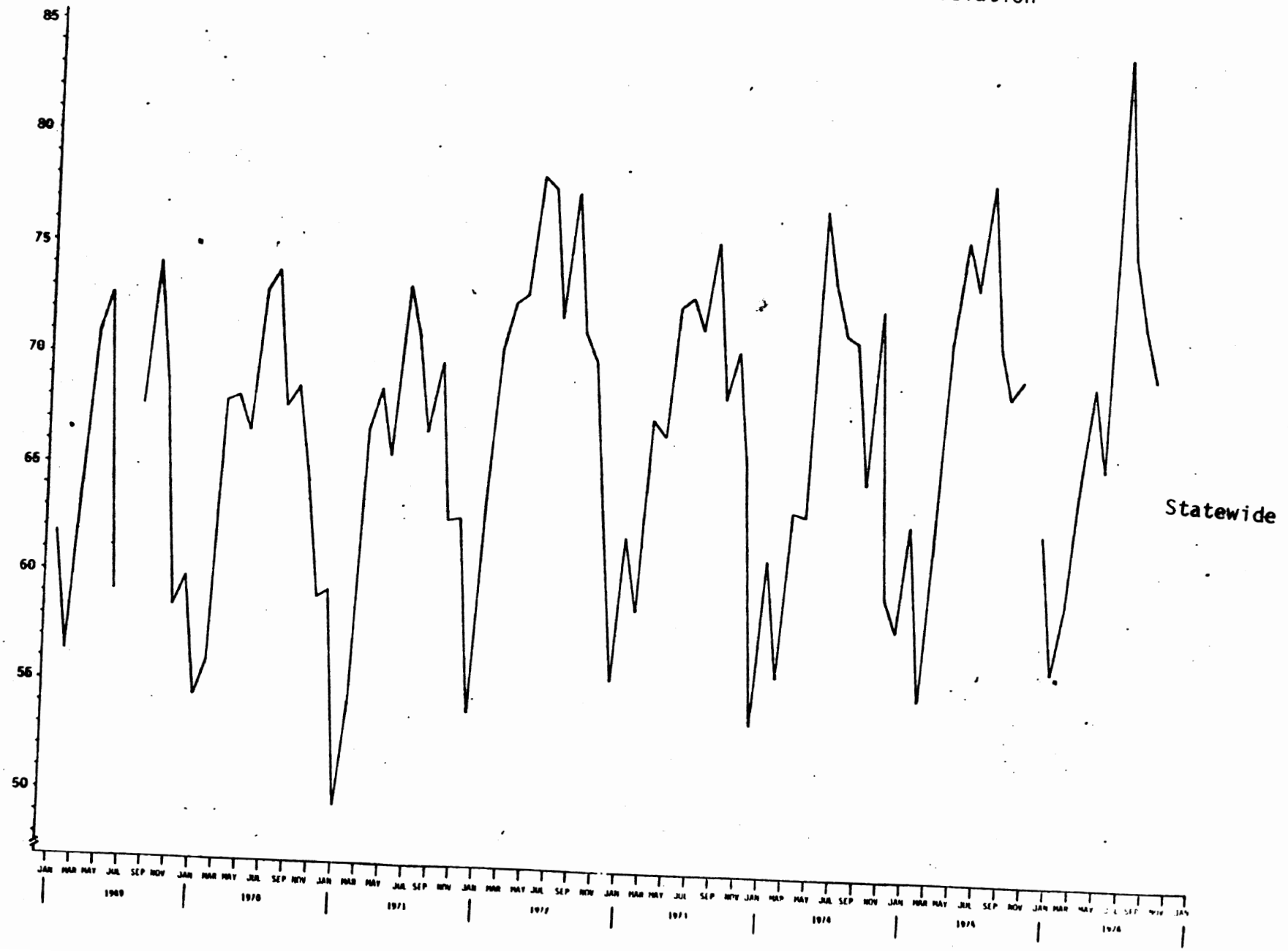


Figure 4.16

WHOLESALE DRAUGHT BEER SALES
STATE OF MICHIGAN 1969-1976 (x 1,000 BARRELS)
Source: Michigan Beer and Wine Wholesalers Association



4.7 Summary and Findings

The above analysis permits us to address the several hypotheses as developed on pages:

H_1 The availability of beverage alcohol,as measured by the number of wholesale barrels of beer and wholesale gallons of wine shipped, increased concurrently with (or within a 1 year lead/anticipation of) the reduction of the legal drinking age in January, 1972, throughout Michigan;

H_2 The availability of beverage alcohol as measured by the dollar values of wholesale liquor sales, increased concurrently with (or within a 1 year lead/anticipation of) the reduction of the legal drinking age in January 1972, throughout Michigan, and for selected areas of Michigan.

The findings concerning these two hypotheses are mixed. It is apparent that draught beer sales in Figure 4.16 experienced a significant increase in 1972, while no such change is apparent for packaged beer or wine sales (Figure 4.15 and 4.14). Similarly, while table top sales of distilled spirits (Figure 4.11) shows a regression discontinuity for selected counties in 1972, no shift in consumption (with the exception of Washtenaw County) is apparent for SDD sales (Figure 4.13). These two findings suggest that, possibly associated with imperfections in the enforcement of beverage alcohol control laws prior to 1972, changes in alcohol consumption resulting from the legal change will more likely be reflected in on-premise consumption sales than in over-the-counter packaged sales, suggesting the following hypothesis:

H_4 In that enforcement of beverage alcohol sales to and consumption by minors in Michigan is imperfect, on-premise sales and consumption measures would be more likely than packaged-sales measures to reflect impacts of the change in the legal drinking age.

The third general hypothesis tested stated that:

H_3 The availability of beverage alcohol as measured by the number of approvals and transferred licenses (and other significant Liquor Control Commission Transactions), increased concurrently with (or within

a 1-year lead/anticipation of) the reduction of the legal drinking age in January,1972 throughout Michigan, and for selected areas of Michigan.

While the frequency of a number of categories of license and permit transactions have changed over time, only the increase in Sunday Sales permits as outlined in Section 4.5.6 was exactly concurrent with the 1972 legal drinking age change. This suggests that at this level of analysis, non-market factors more directly affect the frequency of license and permit transactions then any entreprenerial anticipation of the soon-to-be expanded population of legal drinkers in 1972.* Of course, the exclusion of an entreprenerial motivation cannot be fully supported with data that include only concluded transactions. Data measuring applications for licenses and rates of application approvals would more specifically test H_3.

If non-market factors rather than market related initiatives are related to changes in licensing frequencies, the following hypothesis is suggested:

H_5 De-regulation of a Liquor Control Commission licensing or permit practice resulting from a legislative action, a court decision, or a policy change, contributes to an increase in the frequency of license or permit transactions, of the type affected by the change in regulation.

The discussion of factors that influence licensing activities (Section 4.5) provided support for this hypothesis. Clearly the legislative, legal, policy,and other factors all affected partial deregulation of the beverage alcohol distribution industry; each event was followed by an increase in particular categories of licenses or permits. During the 1970-1971 time period,increases in alcohol distribution, permit transactions, and license and alcohol-related crash involvements covaried, particularly

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*For purposes of this analysis the word "market" has been defined rather narrowly. The extent to which market factors influence non-market regulatory decisions has not been examined by this study.

in 1971 and 1972. While those factors are not necessarily causally related, there is sufficient correlation in consequence.

Oakland County has experienced the greatest population growth in Michigan in recent years. The permit changes for on-premise consumption outlets has a direct influence in Oakland County. Of particular interest in alcohol-related traffic problems are the 18-to-34-year-old population densities, in that this age bracket is exceptional in both casualty occurrence and alcohol consumption. Hypotheses 6 and 7 specifically relate population growth to licensing and permit transaction frequencies and consumption (county-specific consumption data were available only for distilled spirits).

H_6 When the de-regulation of a Liquor Control Commission licensing or permit practice has occurred, counties experiencing the greatest increase in the density of 18-34-year-olds will experience the greatest increase in the frequency of license or permit transactions of the type affected by the change in regulation.

H_7 Counties experiencing larger increases of 18-34-year-old population densities relative to other counties will experience increases in distilled spirits consumption.

Of the individual counties investigated, Oakland experienced the most rapid population growth of young people, the largest increase in distilled spirits consumption, and the greatest number of licensing and permit transactions within the period studied. Of the three counties (Oakland, Washtenaw,and Ingham) only Oakland's 20-to-34-year-old population density increased (see Appendix A).

Hypothesis 8 postulates that population size and rate of population growth are associated with Liquor Control Commission transaction rates and frequencies. When a specific deregulating event has taken place it follows that the more populous counties, and those with the most rapidly growing populations, will be affected more than other counties. The analyses reported above support this conclusion.

H_8 When the de-regulation of a Liquor Control Commission licensing or permit practice has occurred, counties experiencing the greatest increase in population growth will experience the greatest increase in the frequency of license or permit transactions, of the type affected by the change in regulation.*

Throughout the Phase II analyses it has been shown that because of numerous factors the number of alcoholic beverage distributing units in Michigan has increased steadily between 1970 and 1976. The beer, wine, and distilled spirits data support Hypothesis 9 to the extent that there is an association between licensing activities and beverage consumption.

H_9 Increases in the number of beverage alcohol distributing units are associated with comparable increases in consumption.

At this point,however, it is not clear if the rates of distributing unit growth and those of consumption are other than expected on the basis of population growth.

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*In addition to population growth, economic growth may also be a contributing factor;however,data were not available with which to test this proposition.

4.8 References

1.

Michigan Liquor Control Commission, Michigan Department of Commerce. Law-Order-Rule Manual. Lansing, Michigan, (Undated).

2.

Michigan Liquor Control Commission. The Michigan Liquor Control Act and Rules and Regulations Governing the Sale of Alcoholic Beverages at Retail.

State of Michigan. Enrolled House Bill No. 3372, P.A. 339, 1969, pp. 196-197.

3.

Ibid.

4.

Michigan Liquor Control Commission. op cite. 1972, p. 23.

5.

Ibid. pp. 23-24.

6.

Rauner, Franklin J. Assistant Attorney General, State of Michigan. Inter-Office Correspondence to Roger J. Rosendale, Director, License Division, Liquor Control Commission, July 29, 1969.

7.

Reisig, Donald L., Circuit Judge, Ingham County, Michigan Circuit Court. Opinion of the Court of Appeals. February 16, 1970.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The basic findings of Phase I and Phase II demonstrate that in the time period surrounding Michigan's reduction of the legal drinking age to 18 in 1972,alcohol-related casualties increased for 18-to-20 year-olds and many concurrent dynamics occurred in the control and consumption of beer, wine, and distilled spirits. This section discusses the inter-relationships of alcohol control, consumption, and associated traffic casualties.

5.1 Conceptual Models and Hypotheses

In this section reference will be made to the analytic and descriptive findings of all analyses in Phases I and II. Before addressing specific empirical relationships, we will review the hypotheses that directed the research.

In reviewing the findings for Phases I and II it is apparent that the original model for the relationship between the lower legal drinking age change and changes in the number of youth crash involvements (Figure 5.1) no longer adequately reflects a number of system dynamics which have been subsequently revealed. In Figure 5.2 beverage alcohol availability is linked only to the change in the legal drinking age. However, non-market factors affect the number of alcohol distribution units, which in turn affect beverage alcohol availability, as stated in Hypothesis 5.

H_5 De-regulation of a Liquor Control Commission licensing or permit practice resulting from a legislative action, a court decision, or a policy change contributes to an increase in the frequency of license or permit transactions, of the type affected by the change in regulation.

Figure 5.1 A Conceptual Model of the Relationship Between a Lower Legal Drinking Age and Highway Crash Involvement of Drinking Drivers with Demand-Type Intervening Variables (Douglass, 1974)

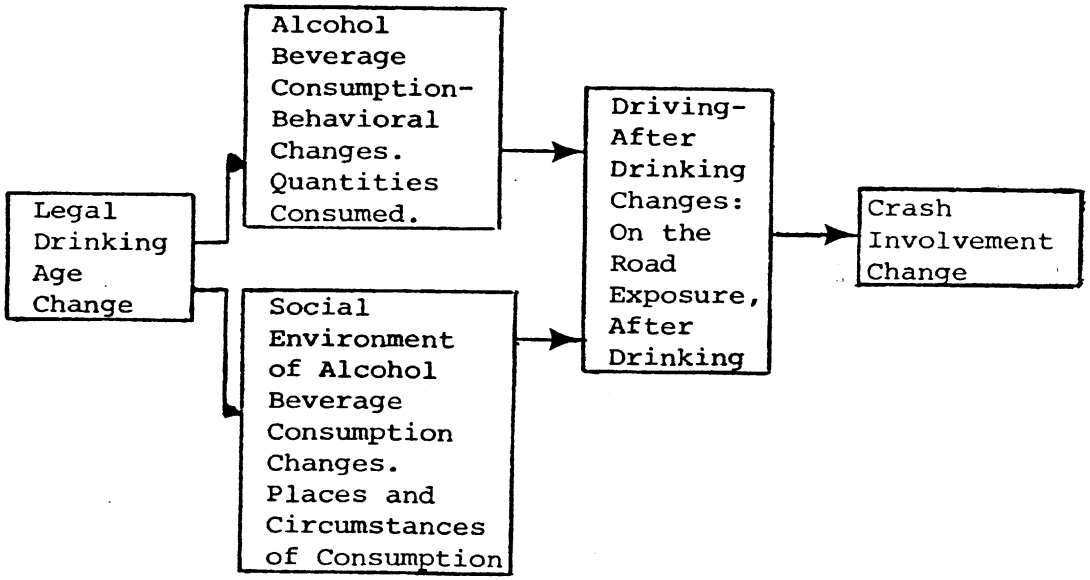
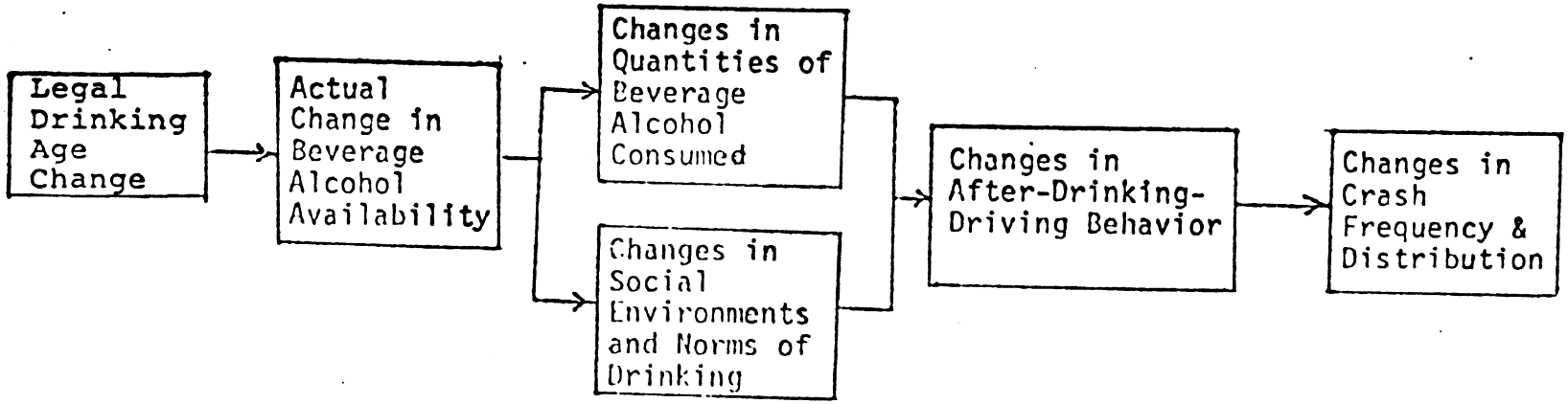


Figure 5.2 A Model of the Relationship of the Lower Legal Drinking Age Change to Changes in Crash Frequency and Distribution with Both Demand-and Supply Type Intervening Variables



Hypothesis 9 then proposes that this increase in availability may also be directly associated with increases in alcohol beverage consumption.

H_9 Increases in the number of beverage alcohol distributing units are associated with comparable increases in consumption.

Hypothesis 4 suggests that in addition to liquor control regulation, other non-market factors may affect alcohol beverage consumption—most noticably enforcement of existing beverage alcohol laws.

H_4 In that enforcement of beverage alcohol sales to and consumption by minors in Michigan is imperfect, on-premise sales and consumption measures would be more likely than packaged sales measures to reflect impacts of the change in the legal drinking age.

When these non-market factors are included in the analysis, only part of the variance in alcohol consumption by county is explained, suggesting that other factors,as yet unmeasured, contribute to the level of beverage alcohol availability and its associated impact on beverage consumption and crash involvement. These factors can be divided into two categories of variables. The first category consists of market factors,including:

1) Types of alcohol beverage products available (including new products)
2) Location of alcohol distributing units
3) Costs of alcohol beverage products
4) Types of alcohol distributing units (i.e., discos, bars, hotels, resturants, etc.).
5) Number, type, cost, and social stigma of non-alcoholic alternatives

The second category consists of demographic characteristics present in the geographic area under study. Included under this category would be the following:

1) Density of 18-20 and 18-34-year-old population*
2) Per capita income
3) Degree of urbanization
4) Rate of economic growth

Hypotheses 6 through 8 begin to examine some of the implications that demographics may have on alcohol beverage consumption and crash involvement.

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*The 18-34 age range has been selected as a high consumption, high accident at-risk population. A broader range such as 17-40 would be equally appropriate.

H_6 When a liberalization of a Liquor Control Commission licensing or permit practice has occurred, counties experiencing the greatest increase in the density of 18-34-year-olds will experience the greatest increase in the frequency of license or permit transactions, of the type affected by the change in regulation.

H_7 Counties experiencing larger increases of 18-to-34-year-old population densities will experience increases in distilled spirits consumption.

H_8 When the de-regulation of a Liquor Control Commission licensing or permit practice has occurred, counties experiencing the greatest increase in population growth will experience the greatest increase in the frequency of license or permit transactions, of the type affected by the change in regulation.*

These hypotheses, when taken together with the findings from Phases I and II of this study, as well as the findings from other relevant research in the field, suggest a model of the relationship among the lower legal drinking age, alcohol availability, and youth crash involvement that is more elaborate than either of the two models previously outlined in Figures 5.1 and 5.2. Figure 5.3 presents this new model. Factors which have been investigated by this study are indicated in bold-face type, while factors which this research, or the research of others suggests may be important contributors to the lower drinking age-youth crash involvement relationship are indicated in italicized type.

Central to the model is the interaction between beverage alcohol availability and a set of social environments which set the norms of drinking and consequently the demand for beverage alcohol. With beverage alcohol availability loosely representing the supply side of the equation, the factors of supply and demand interact,seeking some level of dynamic equilibrium. Certain demographic characteristics contribute to the social environments which dictate the drinking norms in any given area and, when altered over time, these characteristics will affect the demand for beverage alcohol. We alluded in Section 4.7 to the probable impact of the 18-20- and 18-to-34 year-old population densities on selected areas of Michigan.

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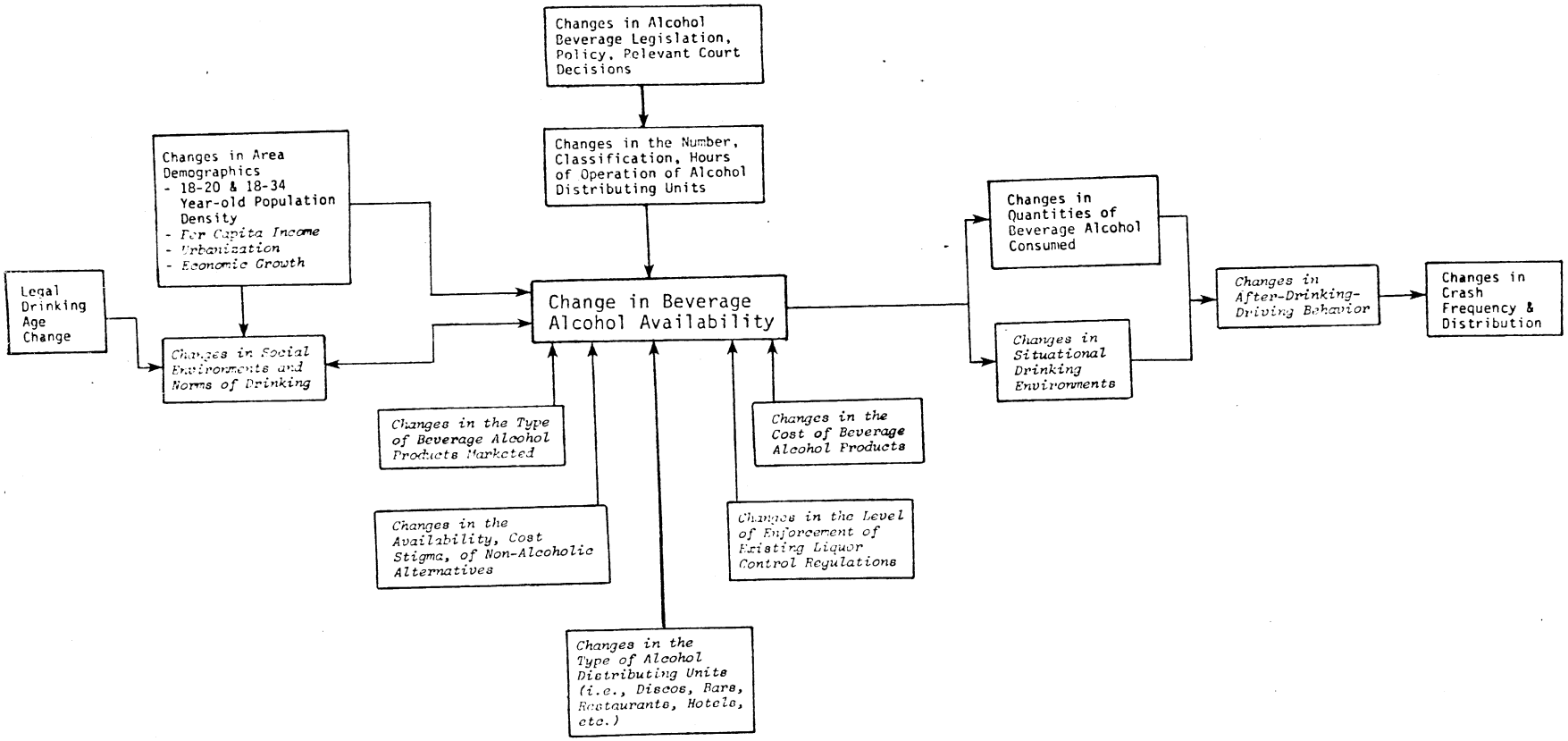
*The 18-34 age range has been selected as a high-consumption, high-accident at-risk population. A broader range such as 17-40 would be equally appropriate.

Figure 5.3 A Conceptual Model of the Relationship of the Lower Legal Drinking Age Changes in Crash Frequency and Distribution with Both Demand and Elaborated Availability Type Intervening Variables



Other research suggests the importance of per capita income, urbanization, and economic growth on the demand for beverage alcohol.[1]

As the model indicates, changes in the legal drinking age alter the drinking norms of an area and thereby affect the demand for beverage alcohol. The relative impact of the legal drinking age change on beverage alcohol demand in any given area will be influenced by the interaction of demographic variables, beverage alcohol availability, and drinking norms and practices.

Just as the demand for beverage alcohol does not remain static over time, neither does the supply. As this investigation has indicated, many factors affect beverage alcohol availability,most noticeably including changes in liquor control legislation and policy, which alter the number of alcohol distributing units. Other factors influencing beverage alcohol availability include:

1. The number, type, and cost of alcohol products marketed;
2. The type of places from which beverage alcohol is available (i.e., discos, bars, restaurants);
3. The level of enforcement of existing liquor control regulations;
4. The cost, availability, and social stigma of non-alcoholic alternatives (for example drugs).

Thus the model suggests that alcohol availability is dynamic, affected not only by the demand for beverage alcohol and other market mechanisms, but also by a series of non-market factors as well.

The model suggests that when expansion in the demand for beverage alcohol occurs concurrently with increases in the availability of beverage alcohol, increases in beverage alcohol consumption can be expected (as measured in wholesale beer, wine, and distilled spirits sales). The fact that draught beer sales increased significantly at the time of the legal change, while packaged beer sales did not, suggests that the environments in which 18-to-20-year-olds drink (i.e., on-premise, vs. off-premise drinking) was uniquely affected by the lower legal drinking age. We believe that there is sufficient evidence, albeit covariance in time, to directly associate the 1972 increase in draught beer sales to the lower legal drinking age and with increased numbers of alcohol-related crashes.

While it is not clear how each of the above factors have affected the after-drinking-driving behavior of the 18-to-20-year-old population, other evidence does indicate an increase in such behavior concurrent with the change in the legal drinking age, as well as increases in consumption of alcoholic beverages by this group. General public surveys were conducted in Washtenaw County during the Spring of 1971 and 1973 for the Washtenaw County Alcohol Safety Action Program. The authors, in reviewing the findings from the two surveys, found that,

> "...the two surveys show a substantial increase from 1971 to 1973 in alcohol consumption in the county, an increase that is particularly marked among 18-to-20-year-olds but is also substantial in all age groups under 35. Along with this there is a smaller but still considerable increase in the reported extent of "driving after drinking too much", an increase found almost entirely in the 18-20-year-old group."[2]

Clearly, increases in the number of youth involved in after drinking-driving behavior, as well as increases in the frequency of such behavior, will ultimately affect the number of alcohol involved youth crashes.

5.2 The Problem of Establishing Causality

In the methodological development of the many analyses reported here great care has been exercised to maximize our control over spurious or plausable alternative explanations of increases in traffic casualties and alcohol consumption. There is a point, however, beyond which the limits of data quality and data availability prohibit further systematic control over spuriousness, the process of integrating the findings of Phase I and Phase II approaches that point.

We have established that many historical, legal and social changes took place at or about the same point in time that 18-to-20-year-olds in Michigan became enfranchized to purchase and consume beverage alcohol. We know, too, that traffic casualties related to alcohol increased during and subsequent to 1972, and that draught beer sales increased during and since 1972. Distilled spirits, packaged beer, and wine sales

have increased markedly since 1969. All of these events, combined, represent a compelling argument that the changes in alcohol availability, consumption and related traffic casualties are not independent but linked together. While the most scientifically desirable conditions are not available, we suggest that the evidence we have presented is not trivial and requires equally compelling evidence to be denied.

The final conceptual model we have developed includes many components remaining to be investigated fully. Recent advertising practices, alleged to be directed at youth, new products, including "pop wines" and milk-based packaged mixed-drinks, changed social norms and attitudes and other variables are unmeasured and not available for analysis. The next step to be taken to understand the current increases in alcohol-related problems should include rigorous measurement and analysis of these factors.

5.3 The Clarity of Hindsight

Clearly the association of beverage alcohol control and consumption, various formulations of availability and related traffic casualties is complex. We have included in the conceptual development both those factors for which empirical analysis has demonstrated change and those which seem to us to be relevant on the basis of other research or theory. But what do these findings mean to policy makers attempting to understand and reduce the frequency of alcohol-related traffic casualties, how can these findings help decision makers today and in the future?

During the countless discussions and arguments about the probable impact of the lower legal drinking age during 1971 little, if any, serious attention was paid to the entire notion of the availability (supply) of beverage alcohol in Michigan - most people involved in the debates presumed the availability to be primarily stable. During this period of debate the influx of new young drinkers and drinking drivers was conceived as a change in demand for alcoholic beverages. A potential change in alcohol-related casualties was thought to be the result of an increase in the population of young drinkers.

To many, the lower legal drinking age was little more than the legitimization of presumed existing drinking, and drinking-driving behaviors among the enfranchized 18-to-20-year-old populations and predicted little or no change in either demand or availability (supply) of alcoholic beverages. This latter group supported the position that potential increases in alcohol-related traffic crashes due to the lower legal drinking age, as well as other alcohol-related problems, would be minimal because "nothing real" would be changed (except a poorly enforced minimum drinking age).

Our position, on the basis of the analyses reported here, is that in 1971 most individuals and organizations engaged in the debate over the legal drinking age were not provided with adequate information about the factors influencing the likely impacts of that legislation. Assumptions of stability of beverage alcohol consumption, supply and demand of beverage alcohol were fallacious. We have identified that the distribution of beer, wine and spirits is highly variable over time, although predictable. Especially draught beer consumption appears to have been directly affected by the lower legal drinking age.

We are struck by the apparent disassociation of beverage alcohol from potential problems related to alcohol during the continuing debate about the effects of the lower legal drinking age. Specifically, the technical and popular literatures directed to the issue have consistently failed to consider the supply and distribution of beverage alcohol as a potential factor in any expected social impact.

In examining increases in the frequency of concluded license or permit transactions by the Liquor Control Commission, the implications for such increases are not always immediately clear. It is important to note, for example, that retail alcohol sales establishments gaining access to the market as a result of changes in liquor control regulation will not necessarily be the same as establishments having access to the market prior to the regulation change. It is entirely possible, for instance, that in recent years many of the changes identified in this study have had a disproportionate effect on young, newly enfranchised drinkers. The increase in Sunday Sales Permits in 1972 made beverage alcohol considerably more available during weekends

when young people are most likely to be involved in social activities that include alcohol. Because beer and wine were excluded from the administrative definition of "beverage alcohol" subsequent to 1971, more establishments with relatively high beer and wine sales volumes (compared with sales of food, goods or services) would be available on Sundays than before. High beer and wine volume establishments would be expected to have a unique appeal to young drinkers. Other changes in availability might have had similar effects, including the 1970 changes in proximity of distributing units to schools and churches, and opportunities to transfer license classification from Tavern to Class C.

We wonder, on the basis of this research, why the distribution and volume of beverage alcohol was not investigated during the debate concerning the impact of Michigan's lower legal drinking age. Although the precise contribution of changes in beverage alcohol control policies and practices to increases in traffic crashes related to drinking cannot be measured we believe that increases in the number of outlets, increases in Sunday Sales Permits, increases in the volume of beer, wine and spirits distributed, transfers of Tavern to C licenses, and the influence of the 1970 Census, plus other factors, certainly contributed to the magnitude of the effect of the lower legal drinking age on youth crash involvement. It is clear that Michigan has had a persistent increase of 18-20-year-old, alcohol-related crash involvements since 1972. It is our conclusion that the relatively simultaneous alterations of the influences of alcohol availability and the lowered legal drinking age have interacted to create a traffic casualty problem that might have been reduced if one or the other were held constant. This retrospective perception will only have meaning if similar situations involving legal changes and alcohol problems will be thoroughly analyzed before new laws are created.

5.4 Recommendations

Empirical research is a process which begins with questions, proceeds to the acquisition of new knowledge and returns to more questions. No credible research is absolutely conclusive just as no other creative activity is beyond improvement. This study is no exception.

Throughout the study we have attempted to exercise restraint in both the interpretations of the data analyses and in making conclusions. The analyses of traffic accident data have been conducted to provide a cautious estimate of the size of a problem that resulted from well-intentioned social policy. The exploratory investigation of retail outlet licensing data was designed to describe the immediate effects of numerous factors that influence the number and kind of places in which beverage alcohol can be purchased. The analyses of beer, wine and distilled spirits wholesale data were principally descriptive.

On the basis of the research conducted and reported here we offer the following recommendations for policy and administrative changes and for additional research. Many more researchable questions and potential policy changes came to mind than will be listed here, however these are the most important. The policy recommendations are not limited to any single agency or department of the State government. Research recommendations should be considered to add-to rather than to challenge the methods or findings we have reported. The research we have suggested will increase the State's ability to pursue the policy and administrative recommendations.

5.4.1 Policy and Administrative Recommendations.

1. The State of Michigan should give serious consideration to raising the minimum legal drinking age. This recommendation is made with due regard for arguments supporting the 18-year-old drinking age on some economic and human rights positions; we cannot, however, in clear conscience report that a legal change responsible for at least 4600 crash involvements of which at least 89 involved one or more deaths, between 1972 and 1975, should be sustained (see Section 3.6.2). Human costs of such magnitude require action.

> We wish to express our opinion that it is not likely that if the legal drinking age is increased the frequency of alcohol-related crashes among young drivers will immediately also decrease. We have identified that, while the legal drinking age change in 1972 was primarily responsible for increased numbers of crash-involved youth, other factors influencing alcohol availability also changed. Changing only the legal drinking age, in 1977, will not alone restore the levels of alcohol-related crash involvement of the time period before the legal drinking age was lowered in 1972.*

2. Legislation should be initiated to require empirical evaluation of the impact on social and health problems and on alcohol distribution and availability of any changes in liquor control laws, court decisions affecting the interpretation of liquor control laws and any changes in the minimum legal drinking age (see Section 4.5).

3. Legislation should be initiated to require analyses of alcohol distribution and availability prior to any legislative changes in liquor control policies or laws (see Section 4.5).

4. In the process of gathering data we found little inter-agency communication. On-going, open communication linkages should be established between the Departments of Public Health, Office of Substance Abuse Services, State Police, Office of Highway Safety Planning, State, and Education with the Michigan Liquor Control Commission Office of Licensing and Enforcement.

5. On-going descriptive analyses and monitoring of alcohol beverage outlets, based on data currently available through the Liquor Control Commission should be initiated. Decision makers throughout the State govern-

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*This recommendation should be carried-out without retracting rights of people currently within the 18-to-20-year-old range, rather the increase should be made in stepwise fashion over a period of time. It is our belief that the long range expected costs sustained by the State in medical and disability compensation, and lost earnings of injured and dead young people because of the 18-year-old legal drinking age are greater than the state can afford. This recommendation will only be meaningful if minimum drinking age laws are enforced. In raising the legal drinking age, the State has the responsibility to make youth, their parents, and persons who influence youth aware of the seriousness and of the magnitude of the teenage drinking-driving problem, as well as to facilitate the creation of non-alcoholic alternative social environments.

ment concerned with alcohol problems should have ready access to current information regarding alcohol distribution throughout Michigan. Also, on-going monitoring of distribution volumes, by county, of beer, wine and distilled spirits should be conducted and this information should be available to the State's decision makers and legislators.

6. The participation and cooperation of the Liquor Control Commission with the Office of Substance Abuse Services should be encouraged to help facilitate effective policies and programs directed at the prevention of alcohol problems. We believe that the Liquor Control Commission has a unique and valuable perspective on the distribution and availability of beverage alcohol which would greatly assist the Office of Substance Abuse Services in conducting its affairs directed at the abuse of alcoholic beverages.

5.4.2 Research Recommendations - Crash Data Anslysis

1. Our conclusions have been highly dependent upon the reliability and validity of the three-factor surrogate measure of alcohol-related crash involvement which was originally developed by Douglass, et al., in 1974. This measure, which remains the best measurement comparing time periods, should be re-tested for data more recent than 1972 which were used in the original development of the surrogate. This recommendation would hold for any critical measurement in policy-relevant research such as this.

2. To-date, time-series analyses have been focused on age groups including 16-17, 18-20, 21-24, and 25-45. While the grouped data analyses have proven to be of value, more insights might be gained by conducting time-series tests of integral ages instead of grouped ages. This would permit the identification of specific ages when the lower legal drinking age impact is greatest (18-, 19- or 20-years-old).

3. Following individual driving populations aged 18-, 19-, and 20-years-old in 1972 through the first five years under the legal drinking age would reveal differences between ages and epidemiologic patterns.

4. Discrete analyses of grouped and discrete-age driver-involvement populations stratified by fatal, injury-producing and property damage levels of crash severity would provide a basis for estimation of the social costs of the lower legal drinking age to the State of Michigan.

5. Analyses of female-only driver-crash involvement populations would fill the information gaps left by current utilization of the three-factor surrogate which is limited to male drivers. There is reason to believe that young females may approximate the crash experience of male counterparts, especially between early evening hours and midnight, raising hypotheses that the lower legal drinking age could have had an effect on females heretofore unmeasured.

6. The validity of the three-factor surrogate for 16-to-17-year-old drivers should be tested. It is quite likely that these very young drivers drive, drink and subsequently become crash-involved during earlier and/or more constricted time periods of the evening than 18-to-20-year-old drivers which would invalidate our utilization of the surrogate measure of alcohol involvement for 16-to-17-year-olds.

5.4.3 Research Recommendations - Alcohol Availability and Consumption Data Analysis

1. The Liquor Control Commission data utilized in this investigation should be computerized and built into readily accessible computer files. This would permit efficient and more complex analyses than were possible in the present effort.

2. An on-going relationship of the research and policy-making community with the Liquor Control Commission should be established whereby the Liquor Control Commission activity data on licensing and permit-approval transactions would be routinely provided to up-date the analysis files currently available.

3. Cumulative frequency plots of key transaction frequencies should be computed with Liquor Control Commission transaction data to permit analyses of the growth of the number of beverage alcohol retail outlets. These cumulative frequency plots should be compared with per capita consumption for individual jurisdictions.

4. Total population sizes of each licensed alcohol outlet category, by county, should be measured to provide the opportunity of studying rates

of change among categories of retail sales, on-premise sales, and other types of distribution outlets.

5. The statistical association of beer, wine and distilled spirits distribution volumes and the cumulative population magnitude of each type of retail outlet should be determined. Also, per capita distribution volumes and per capita outlet population rates should be tested for statistical association.

6. The concept of alcohol availability should be subjected to the development of empirical indices based on data including, but not limited to, Liquor Control Commission transaction frequencies. The developed indices should be correlated with wholesale distribution data for beer, wine and distilled spirits, individually for each county in Michigan. These measures would permit testing hypotheses relating alcohol availability with consumption for a full range of population types.

7. Indices of alcohol availability should be calculated and, controlling for stratification variables such as urbanization, population density, and other factors, statistical associations should be measured relating the indices to alcohol-related health and social problems including traffic accidents, homocide, rape and other violent crimes, suicide, child abuse, and other measurable problem areas.

8. The Liquor Control Commission should develop a licensing classification system which distinguishes alcohol distributing units on the basis of size, type of clientele, and type of operation (i.e., discos, bars, hotels, restaurants, etc).. The data resulting from this system should be made available for on-going analysis. It would not be difficult to implement this recommendation using information contained in license application documents.

9. A data base should be created of new applications and approvals of Liquor Control Commission licenses and permits capable of generating monthly frequencies for the state and each of its counties.

10. Longitudinal cohort analyses should be conducted following individual drinking-driving populations aged 16-, 17-, 18-, 19-, 20-, and 21-year-old to reveal differences between ages with regards to the frequency, volume, alcohol type, and location of beverage alcohol consumption, as well as differences in after-drinking-driving behavior and attitudes.

5.5 References

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APPENDIX A

POPULATION SIZES AND DYNAMICS FOR

OAKLAND, INGHAM AND WASHTENAW COUNTIES

Source: U.S. Census, 1970

Population Sizes and Dynamics for
Oakland, Ingham and Washtenaw Counties
Source: U.S. Census, 1970

	1960		1970		
OAKLAND	Total	% of Total	Total	% of Total	Rate of Increase
Total Pop.	690,259	-----	907,871	-----	.32
16-17	22,394	3.24	38,788	4.27	.73
16-18	30,233	4.38	54.601	6.01	.81
18-20	19,920	2.88	41,276	4.55	1.07
20-24	33,769	4.89	63,388	6.98	.88
25-29	42,940	6.22	62.345	6.87	.45
30-34	53,040	7.68	51,925	5.72	-.02
20-34	129,749	18.80	177,658	19.57	.37
21+	388,689	56.31	523,973	57.71	.35
INGHAM					
Total Pop.	211,296	-----	261.039	-----	.24
16-17	6,515	3.08	8.928	3.42	.37
16-18	11,238	5.32	17,587	6.74	.56
18-20	13,490	6.38	21,170	11.17	1.16
20-24	18,572	8.79	38,045	14.57	1.05
25-29	14,781	7.00	21,001	8.04	.42
30-34	13,941	6.60	13.804	5.29	-.01
20-34	47,294	22.38	72.850	27.91	.54
21+	121,161	57.34	146,731	56.21	.21
WASHTENAW					
Total Pop.	172,440	-----	234,103	-----	.36
16-17	4,766	2.76	7,046	3.01	.48
16-18	9,413	5.46	15,751	6.73	.67
18-20	13,909	8.06	28,238	12.06	1.03
20-24	19,859	11.52	38,545	16.46	.94
25-29	13,993	8.11	21,665	9.25	.55
30-34	12,137	7.04	13,989	5.98	.15
20-34	45,899	26.62	74,199	31.70	.62
21+	101,815	59.04	135,703	57.97	.33