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**EFFECTS OF MICHIGAN'S MANDATORY BEVERAGE CONTAINER DEPOSIT  
LAW ON THE MARKET FOR BEVERAGES**

*Michigan State University*

**Ph.D. 1984**

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EFFECTS OF MICHIGAN'S MANDATORY  
BEVERAGE CONTAINER DEPOSIT LAW  
ON THE MARKET FOR BEVERAGES

By

Richard Sjolander

A DISSERTATION

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## ABSTRACT

### EFFECTS OF MICHIGAN'S MANDATORY BEVERAGE CONTAINER DEPOSIT LAW ON THE MARKET FOR BEVERAGES

By

Richard Sjolander

A Study was designed to determine the effect of a public policy, the Michigan Mandatory Beverage Container Deposit Law (MBCDL) on five characteristics of the market for beverages: total industry sales, border area sales, package mix, distribution systems energy use, and product prices. The beer industry was selected for study because comprehensive data for sales and container types were available from the Michigan Liquor Control Commission.

Because other changes were taking place at the time the MBCDL was being implemented, several key variables were explicitly analyzed to separate their effect from that of the MBCDL. These included another public policy measure (raising the legal drinking age), plus changes in economic, population, and price variables.

The evidence from three separate demand models which were developed for the study indicated that the volume of beer sold in Michigan dropped

because of the MBCDL. A decline of between 5 and 7 percent was attributed to the policy. An even greater impact was found along the southern border of Michigan. The first tier of southern counties in Michigan experienced an additional 9 percent decline in sales.

The package mix shifted away from cans with a decline from 70 percent of the market when the law took effect to 40 percent after. Cans have since increased to 50 percent. Non-refillable bottles increased their market share and have been about equal to refillable bottles. No evidence was found that the difference in deposits (5 cents on certified refillable bottles and 10 cents for all others) was effective in directing consumer demand toward certain containers.

The change in energy consumption for the beverage delivery system was calculated based on the actual Michigan package mix. The energy intensity for each type of container was compiled from five other sources. The results showed a 40 percent drop in systems energy use in Michigan resulting from the MBCDL. This resulted primarily from the increased recycling of cans.

The price to consumers of the MBCDL was estimated to be 3 cents per container for bottles and 4.5 cents per cans during the first three years after the law was implemented. In the last two years national average price levels have almost caught up with Michigan beer prices.

Raising the minimum drinking age from 18 to 21 years of age in 1978 was estimated to reduce beer consumption throughout Michigan by about 1 percent of total sales.

Policy recommendations for state and federal government as well as the beverage industry are suggested.

## ACKNOWLEDGMENTS

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## CHAPTER I

### Introduction to the Beverage Container Problem

#### Introduction

Many individuals and groups consider beer and soft drink containers to be a significant environmental or social problem. Attention became focused on non-refillable beverage containers for a number of reasons. For example, in 1971 Barry Commoner described an environmental crisis in his book, The Closing Circle:<sup>1</sup>

Several billion years ago life appeared and was nourished by the earth's substance. As life grew, it evolved, its old forms transforming the earth's skin and new ones adapting to the changes... The environmental crisis is a sign that the finely sculptured fit between life and its surroundings has begun to corrode. As the links between one living thing and another, and between all of them and their surroundings, begin to break down, the dynamic interactions that sustain the whole have begun to falter and, in some places, to stop.

He went on to identify the leader in the race to destroy our ecosystem as the non-refillable bottle. According to his 1946-1970 index, these bottles had increased 53,000 percent.<sup>2</sup> The first non-refillable bottles were produced during World War II to supply beer for morale to American troops overseas.<sup>3</sup> Thus, the figure cited by Commoner was comparing sales for an infant industry in 1946 with those of a mature industry in 1970. This point, however, was irrelevant to an increasingly important and influential public called ecologically concerned consumers.<sup>4</sup>

The beverage container problem has been debated at all levels of government and in the popular press since around 1970. The spirit of

this ecologically concerned consumer movement for a ban on non-returnable beverage containers in Michigan was described by Snow and Wright (1977).<sup>5</sup>

For environmentalists the wasp-waisted coke bottle and the red and white Budweiser can strewn across the countryside had become world-wide symbols of America's orgy of consumption and waste. What one industry official had called the "miracle" of American distribution and packaging was for them the source of anger and shame. In a world of exploding population and shrinking resources, and where millions lived in squalor, economic expansion achieved by increased packaging rather than product improvement and by stimulating desire far beyond legitimate need was outrageous.

In fact, the 'wasp-waisted coke bottle' referred to was the characteristic refillable bottle, smaller in the middle than at the shoulder and bottom, which had been in use throughout much of this century for Coca-Cola. Interestingly, it was in almost all instances a refillable bottle. However, such information does not seem to have been important in much of the debate.

Many studies were conducted on the potential effects of mandatory deposits, but in the campaigns for passage of the Michigan Mandatory Beverage Container Deposit Law (MBCDL) the arguments on both sides were presented at an emotional level. In Michigan, the pro-Bottle Bill environmentalists successfully portrayed themselves as defenders of the public interest while depicting their beverage industry opponents as interested only in their own profits. Non-refillable beverage containers became symbols of the "throwaway society." The throwaway and its slogan, "no deposit, no return," became central to an ideological as well as technological battle of lifestyles.<sup>6</sup>

Three factors help to clarify how beverage containers came to be singled out for such widespread attention. First, there has been a dramatic increase in the volume of beer and carbonated soft drink sales during the last thirty years. Total sales increased by 400 percent.<sup>7</sup> At the same time the market share of packaged beverages was increasing in comparison to fountain or draught sales. Within the packaged beverage market there was also a major shift in the package mix. Refillable bottles were declining in favor of cans and non-refillable bottles and cans. The combined effect of increasing sales, increasing market share for packaged beverages, and the changing package mix led to an exponential growth rate for beverage containers since World War II.

The second factor drawing special attention to beverage containers was litter. Litter can be defined as solid waste disposed of in a socially undesirable and illegal manner. Litter and the loss of esthetic values it produced, more than economic values, were receiving increasing attention from policy makers as a social cost resulting from non-refillable beverage containers. The non-refillable beverage container portion of litter had been increasing and was estimated to compose about 20 percent of Michigan litter by volume in 1978.<sup>8</sup> Bottles and cans, unlike paper or garbage, neither blow away from roadsides nor decompose at any appreciable rate. They are a cumulative and easily identifiable portion of litter.

The third factor was a new interest in energy consumption during the 1970s. Bruce Hannon singled out beverage delivery systems for study and employed energy as the unit of analysis. He compared beverage delivery systems and developed energy ratios for the various container systems.<sup>9</sup> His energy ratios were calculated as the quotients of the

energy expended by a non-refillable container system and the energy expended by a returnable bottle system, which he assumed to be the most ecologically sound system. The energy crisis of 1973 occurred shortly after the publication of his work, and made energy consumption an even more important issue.

The beverage container problem can be summarized as increasing public concern for the rapid growth in non-refillable containers and their relation to resource use, litter and energy. There has been increasing pressure from the public during the last 25 years for the government to intervene in the free market system in favor of the interests of the general public in cases of perceived market failure. The non-returnable beverage container was seen by many people to constitute such a market failure. Policies have been proposed at all levels of government as a method of correcting for perceived deficiencies in the free market for beverages through legislating mandatory deposits on all containers.

There are two major types of policy measures which have been proposed to address the beverage container problem. One is a container tax and the other is the more well known deposit system. A package tax, specifically for beverage containers was recommended in 1972 by the Environmental Protection Agency (EPA) in their first study of this problem. Such a tax has not been enacted in this country.<sup>10</sup> As of January, 1984, nine states have implemented mandatory beverage container deposit laws (MBCDL). These are Michigan , Oregon, Vermont, Maine, Iowa, Connecticut, Massachusetts, Delaware, and New York.

The present study analyses the effect of the Michigan MBCDL as a public policy on five characteristics of the market for beer. There is

general agreement among interested parties on certain effects of this policy measure. Some of these are that there will be a reduction in (1) beverage container related litter (2) municipal solid waste equal to the volume of containers reused or recycled instead of being discarded, and (3) resource use, including energy. Predictions on other issues, however, such as consumer reaction to the new assortment of packages offered in the marketplace, the effect of the policy on consumer prices, or the effect on consumer demand are clearly in conflict.

Predictions have been hampered by the lack of an accurate data base from a region with experience under such legislation. Michigan consumers have now lived with the policy for over five years. Many of the assumptions necessary in prior work can be replaced by data. Such an analysis should be of value to other states and the federal government as they consider similar laws.

#### Scope of This Study

This study analyzes five elements of the beverage delivery system that may have changed as a result of the Michigan Mandatory Beverage Container Deposit Law. These are:

- 1) total Michigan beer sales,
- 2) Michigan border county beer sales,
- 3) package mix by container type, refillable bottles, non-refillable bottles and cans,
- 4) energy consumed in Michigan's beer distribution system, and
- 5) beer prices.

The Michigan law covers most carbonated drinks -- soda, water, and malt beverages. The Michigan Liquor Control Commission receives a copy of every invoice for shipments of beer into and within the state in order to collect state taxes on alcohol. These records are comprehensive, accurate, and provide an excellent data base. Therefore, only beer is analyzed in this study. There is no comparable tax on soda, and sales records are the property of each individual bottler.

Social science research is complicated by the limited ability of the researcher to control conditions in the environment in order to isolate a single, uncontrolled variable for study. The present work is no exception. At the same time as the Michigan Mandatory Beverage Container Deposit Law (MBCDL) became effective, another major policy related to beer consumption was implemented. Michigan's legal drinking age was raised from 18 to 21 years of age on December 23, 1978.<sup>11</sup>

In addition to these two discrete public policy changes, two other gradual changes were occurring in Michigan that may have influenced consumer behavior related to beverage consumption. First, the price of beer has risen substantially since implementation of the MBCDL. Second, the Michigan economy, generally more volatile than the national economy, experienced two recessions in the last five years.

All four of these changes occurred concurrently. Therefore, there are four related variables that could have changed Michigan beer consumption patterns significantly. These have all been carefully considered in the present study in an effort to isolate the influence of the target variable, the MBCDL, on beer sales. These changes were studied and the degree of influence that the MBCDL had on all five is

described below. There are many other changes that have been attributed to mandatory beverage container deposit laws in general, and specifically to the results of the Michigan law, that are not discussed in the present report. Some of these involve litter, solid waste, employment, and labor productivity.

Most proponents and opponents agree that a MBCDL will reduce beverage related litter and that it will reduce solid waste by the number of additional containers being reused or recycled as a result of the law. The issue is the cost of these and other benefits. The analysis contained in this study specifically addresses the cost to consumers in the form of higher retail prices.

The study is divided into three sections. In chapter two the literature on the beverage container problem is presented. It starts with the general studies of the issues and then focuses on the work done specifically analysing the policy in Michigan. Chapter three presents the methods and results of each of the five impacts studied. Three demand models for beer sales in Michigan's southern border are studied. A presentation of the numbers of each type of package sold over an eight year period provides the data base for estimating the energy consumed in distributing beer. A comparison is made of energy use before and after enactment of the MBCDL. Finally, the change in prices at all levels of the distribution channel is determined for three years before and five years after the law took effect. The final chapter presents the summary and conclusions from the present study along with policy recommendations and suggestions for future research.

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## CHAPTER II

### Literature Review

#### The First EPA Study - 1972

The first major government-sponsored study on the subject of restrictive beverage container legislation was done for the Environmental Protection Agency (EPA) in 1972.<sup>1</sup> That study was conducted by the Research Triangle Institute and viewed beverage containers as causing an environmental problem, litter. Some consumers of beverages litter their empty containers rather than disposing of them properly, creating social costs. Beverage containers were found to compose an important share of litter (about 20 percent).

The EPA study used a macroeconomic analytical approach and found that beverage containers were not a resource problem at that level of analysis. Metal containers constituted a relatively small portion of the total U.S. consumption of aluminum and steel, and the glass sand and limestone used in bottle manufacture were plentiful resources. An all refillable bottle system would lead to energy savings, but they would be insignificant relative to total U.S. energy consumption.

The EPA report concluded that either a high mandatory deposit or a low package tax with the revenues being used for more frequent litter collections, could provide significant environmental benefits by reducing litter. They favored the tax as the most appropriate government policy because it was predictable, less costly to consumers and producers, and easier to administer.<sup>2</sup> The tax level proposed in the study was between one half and one cent per manufactured container.

Such a tax would increase the price of convenience (beverages in non-refillable containers) by the amount of the nominal tax. It would, however, have a negligible effect on the price of beverages in refillable packages, where the tax would be divided by the number of times the package was filled.

This 1972 EPA report was the first and only study to include a package tax as an alternative policy measure for addressing the beverage container problem. Later studies, although not contradicting the results of this first study, came to different conclusions on policy recommendations. This may have been because analysts did not consider as broad a range of policy alternatives in future studies.

### Energy

Two other events in 1972 helped to set the stage for future beverage container legislation. The first was a study by Hannon at the University of Illinois. Energy was singled out as the accounting unit by which to judge the effectiveness of mandatory beverage container deposit legislation (MBCDL).<sup>3</sup> Hannon was in agreement with the EPA study on the relative portion of the nation's energy consumed by the beverage delivery system, thirty-four one-hundredths of one percent in 1970 according to his figures. At a lower level of aggregation consisting of the beverage delivery system in isolation from the rest of the economy, however, the potential energy savings under a MBCDL were highly significant.<sup>4</sup> Hannon found that 55 percent of that energy used in the beverage industry could be saved through the implementation of an all refillable bottle system. This conceptual level for policy analysis was quickly adopted by both government agency analysts and environmental interest groups.

Robert Weinberg, an industry analyst, reviewed the energy analyses and calculated that the beverage industry was less energy intensive, per dollar of output, than the average dollar of gross national product (GNP).<sup>5</sup> A dollar spent on beer contained only 40 percent as much energy as a dollar of average GNP. Even in aluminum cans, the most energy intensive beverage container, energy use was still below average.

With the loss of convenience packaging through a MBCDL, consumers could easily shift their consumption patterns, spending less money for beverages and more on other far more energy intensive consumption items, reasoned Weinberg. Such a shift could easily dissipate any energy savings that might be expected from a shift to refillables. This argument was in general agreement with the 1972 EPA report finding that energy savings would be insignificant. It did not have the popular appeal which could be generated with images of lighting entire towns by merely switching to a more ecologically sound beverage container. Note that in this context ecologically sound meant saving energy. The same term can be used in many ways to fit the needs of resource depletion, conservation, preservation, recovery, reuse or numerous other concepts. These definitions may be in conflict.

#### The Oregon MBCDL

The other major event in 1972 was the implementation of the Oregon Beverage Container Deposit Legislation, better known as the "Bottle Bill." This was passed by the state legislature with the active support of Oregon Governor McCall, and took effect in October, 1972. The law required deposits on carbonated beverage containers (soft drinks

and beer), and required that members of the distribution channel selling a given product-package also accept the package back and return the full refund value. Finally, it prohibited removable pull tabs from beverage cans.

The "Bottle Bill" was widely hailed by environmentalists as a significant step in reversing the tremendous increase in litter and solid waste represented by packaging materials. It was opposed, to varying degrees, by all sectors of industry directly affected by it.<sup>6</sup> The bill was challenged in the courts on the basis of discrimination, as it did not directly address the health, welfare, or safety of the people. Industry lost. Public opinion was very strong in favor of the legislation.

The Gudger and Bailes study of the Oregon MBCDL, which took effect in 1972, modeled beverage sales over an 11 year period using trend line analysis. They found total sales for 1973 (the only year of data available after the MBCDL) to be at the predicted level (a slight increase over 1972 sales). A disproportionately large amount of the increase of 1973 over 1972 (their graphs indicate all of the increase) was in draught sales.<sup>7</sup> A comparison of 1973 retail prices with 1972 price levels was made in Oregon and the neighboring state, Washington. The price of beer in refillable bottles increased much more in Oregon (about 10 percent more), where refillable bottle sales increased 200 percent in 1973.<sup>8</sup> The relative retail price of beer in cans remained constant between the states.

#### The 1974 EPA Study

In 1974 the EPA published another study on beverage containers, Resource and Environmental Profile Analysis of Nine Beverage Container

Alternatives.<sup>9</sup> This study was conducted by the Midwest Research Institute and analysed alternative beverage container systems on the basis of raw materials consumption, energy use, and environmental pollution. It was a partial analysis of alternative systems in terms of only these three factors in isolation from the rest of the economy. A ranking system was developed on each of the criteria studied, leading to indices of energy use, resource use and pollution for each container type. The refillable bottle system came out "best" in most categories. The energy analysis was similar to the Hannon study, but used a more current data base. The study marked a change in emphasis on the part of the EPA from looking at how the beverage industry fit into the general economy to that of analysing the beverage industry in isolation. The treatment of the subject was thorough, but could be misleading as a general base for policy recommendations because it singled out certain aspects of the beverage container issue to be studied out of the context of the entire system. At this level of analysis the questions of resource use, energy consumption and solid waste generation were all both relevant and significant issues. In the 1972 EPA study these issues were only relevant.

#### Michigan Public Services Commission

The Public Services Commission (PSC) in Michigan completed a major study of the economic and employment effects of a MBCDL in 1975.<sup>10</sup> This study was started in the State Energy Office so a projection of the effect on energy use was included. The study was designed to look at policies to reduce material and energy consumption while not significantly changing the life style of the populace. It reported that

billions of dollars could be saved by reducing material and energy consumption to a "socially desirable level." That level was not defined, but the elimination of non-refillable beverage containers "provided a classic example of how such reductions in resource and energy use could be made without altering the lifestyle."<sup>11</sup>

The study period considered in the Michigan PSC study was 1963-1974. Michigan beverage sales were projected for 1975-1978 by extending the trend lines developed for the base period. The study noted that possible changes in beverage consumption might result from container legislation. A change in demand would depend on the price elasticity of demand for beverages and consumer attitudes toward an all returnable system. The report assumed that beverage prices would be lower and presumably offset any loss in convenience.<sup>12</sup> Therefore, it was assumed that changing to a 100 percent refillable bottle system either through a ban on non-refillables, or by means of a MBCDL would not affect sales levels.

Retail prices in Lansing, Michigan, in December of 1974 were assumed to reflect the cost of goods sold plus a "normal" profit for each package type. Those were the only price data collected. Beverages in refillable bottles were found to be priced lower than beverages in one way packages. This led to the assumption that consumers would spend \$14 million less for the same amount of beverages under the assumed MBCDL.<sup>13</sup> The assumed package mix under the MBCDL consisted of refillable bottles which would replace all non-refillable bottles in the market, and cans which would maintain their pre-law market share. Later in the report, the conclusions on beverage prices changed. The report concluded that prices had increased in Oregon for beverages in bottles

following their MBCDL, that prices had a volatile nature, and that the economic impact on Michigan consumers had not been investigated in the report.<sup>14</sup>

The energy effects of a MBCDL were also analysed. The assumed number of each package type consumed under the proposed MBCDL was compared with the actual package use during 1974. Energy consumption figures for each package type were taken directly from the 1974 study for the EPA by the Midwest Research Institute. They found that a MBCDL would have saved between 20 and 30 percent of the energy used by the delivery system without the legislation. More energy would be saved in the beer industry than in soda because of the greater use of one-way packages for beer.<sup>15</sup>

#### Federal Energy Administration Study

In 1976 the Federal Energy Administration (FEA) published "Energy and Economic Impacts of Mandatory Deposits."<sup>16</sup> This report was authored by Tayler Bingham of the Research Triangle Institute, as was the 1972 EPA report discussed earlier. The energy analysis was sub-contracted to the Franklin Associates. The principals in that firm conducted the 1974 EPA study while employed by of the Midwest Research Institute. This report followed the partial analysis format proposed by Hannon and the 1974 EPA report.

A demand model for beer sales was developed using the relative price of beer, personal per capita income, and the population segment 20 to 34 years of age as the predictor variables. The dependent variable was the per capita beer consumption for the total population. The base period was long, 1947-1973, and included both periods of growing and

declining beer sales. An  $R^2$  of .95 was attained using logged forms of the variables on both sides of the equation.

The price variable was put into relative terms by dividing the Consumer Price Index (CPI) for beer at home by the CPI for all items. The income variable was deflated into 1967 dollars. The criteria for inclusion of two measures of the population variable was not as conceptually simple, or at least not clarified. As a predictor variable the population was restricted to the segment 20 to 34. On the dependent side of the equation, demand for beer was on a per capita (total population) basis. Total population was also used for the per capita income figures.

Demand was forecast for the period 1975-1985. Bureau of Labor Statistics projections were used for the population and income variables. The price variable was assumed constant over the projected period, a surprising assumption given that the relative price of beer had declined during all of the previous 20 years.<sup>17</sup> Demand was assumed to drop less than 1 percent from projected levels under a MBCDL. Two package mix scenarios were presented for comparison with the base forecast which assumed no changes in the current system. In both scenerios the non-refillable bottle was assumed to have been removed from the market and replaced by refillable bottles. The mapket was divided between refillable bottles and cans as in the Michigan Public Services Commission study.

Two other, major assumptions were made. It was assumed that the consumer either peferred refillable bottles over convenience (one-way) packages, or was indifferent between them. This was a strong assumption given that over 90 percent of all off-premise beer sales, those affected

by the proposed legislation, were in convenience packages.<sup>18</sup> On the supply side it was assumed that product pricing could be modeled on the basis of the competitive pricing model; i.e., each change in cost at every level in the distribution channel would be passed on to the consumer.<sup>19</sup> The results derived from the model rest heavily on the validity of these consumer behavior and market assumptions. Current container prices and energy equivalents were entered into the model, along with package mix assumptions, to arrive at estimates of decreased resource and energy use along with increased employment and capital costs from a national MBCDL.

#### General Accounting Office Studies

More recently, the General Accounting Office published Potential Effects of a National Mandatory Deposit on Beverage Containers, (1977).<sup>20</sup> This report updated the FEA model described above through 1976 and developed projections for 1981 and 1985. No change in consumer demand was assumed, although the report reviewed studies from both MBCDL states, Oregon and Vermont, and reported that package sales fell in both states in the year following implementation of MBCDL.<sup>21</sup> Prices were predicted to be lower due to reduced resource and energy requirements, but the prediction was not entered into the demand model.<sup>22</sup>

The General Accounting Office revised their report in 1980 to include the experience of Michigan and Maine in forming their assumptions.<sup>23</sup> Several changes were made based primarily on their analysis of what happened in Michigan following implementation of its MBCDL. Sales were now predicted to stagnate for one year before resuming their established trend. As the basis for that assumption they

had found that total sales declined in three of the four states with MBCDL (Vermont, Maine, and Michigan) and stagnated sales in the fourth (Oregon) during the first year following a MBCDL. The effect on prices was said to be indeterminate, as the GAO could demonstrate savings in resource use and energy but could not explain the observed price increases which they found had occurred in the three states for which price data was presented.

A demand model was developed specifically for beer sales in Michigan. The base period of 1962-1978 was chosen. No clarification was given for using this shorter time series for the regional model of Michigan. A regression technique was used which corrected for second order serial correlation to improve the fit for 1978 and 1979.<sup>24</sup> The independent variables used were per capita income, the real national beer price index (adjusted for Michigan prices in 1978 and 1979), the population 21 to 64 except for the years 1972 through 1978 when the lower legal drinking age was reflected in the choice of 18 to 64 as the population variable, and the Michigan unemployment rate. The report says that high intercorrelation among the variables may make it difficult to distinguish the individual contribution of each variable. However, they appear to ignore the qualifier when reporting their results. A stated goal for the model was that the variables should be significant at the 0.9 level, but the population variable was retained with a t-statistic of 0.15.<sup>25</sup> It is difficult to understand how their model could accurately depict demand for beer in Michigan without a significant effect being assigned to the demographic variable, which varied considerably during the period. Substantial question about the validity of the results of this model were raised by Weinberg in 1981.<sup>26</sup>

The Wharton Study

The Wharton School at The University of Pennsylvania completed a major, industry-sponsored study in 1976.<sup>27</sup> The study assumed that legislation had been passed in 1969 banning non-refillable beverage containers. This simplified the necessary container mix assumptions, but also led to larger impacts than would have been expected under a MBCDL. Using the Wharton Econometric Model, impacts of the legislation were projected through 1974, which allowed comparison with actual data for those years. The model predicted a decline in container cost per beverage filling (as did numerous other studies). However, following the impacts through the distribution channel and assuming that price equals the cost of goods sold plus a constant percent markup, the model predicted an increase in consumer prices.<sup>28</sup> This was due to increased handling costs, reduced demand, depreciation of capital expenditures, and unclaimed deposits. A price elasticity of demand equal to 0.6 was assumed in arriving at the forecast of lower demand. Litter and solid waste were expected to decline, while increased handling would lead to a net gain in employment.

An energy analysis was made by the Wharton study with 1974 as the base year. The summary of prior work in this study was excellent.<sup>29</sup> A 40 to 50 percent energy savings in the delivery system was projected. The report cautioned that this was less than one half of one percent the total U.S. energy consumption and that the legislation would have little effect on the consumption of oil based resources.<sup>30</sup>

Other studies of the impact of container legislation on energy use reached similar conclusions. The Battelle ( 1978) model of energy use for a refillable-only beverage industry, used 1976 as the base

year.<sup>31</sup> The report showed the energy savings from container legislation accruing to plentiful energy resources while petroleum based fuel requirements might even increase. A 1982 study by the Franklin Associates for Alcoa Corporation was an update of their earlier studies for the government.<sup>32</sup> Although some of the specific values changed, the results were congruous with those in the 1976 Federal Energy Administration study.

Finally, "a study of studies" was done by the Office of Technology Assessment in 1979 found agreement among proponents, opponents, and neutral parties that a MBCDL would accomplish all of its major goals to some degree.<sup>33</sup> These were enumerated as a reduction in litter, municipal solid waste, energy consumption, and resource use, as well as serving as a symbol of commitment to resource conservation. The report then qualified the positive effects as being small on a macro level.

Disagreement among the various studies was found on the important issues of the effect of a MBCDL on prices and consumer demand.<sup>34</sup> The often-sited prediction of declining beverage prices was found to hinge on the assumption of a perfectly competitive market. Without that assumption the effect on prices was found to be indeterminate. Demand would be affected by both change in product price and possible change in consumer purchase patterns due to the disappearance of convenience packages for beverages. Many studies assumed that consumers either preferred refillable containers or were indifferent to the choice.

Industry analyst Weinberg proposed that demographic factors were not sufficient for modeling beverage consumption.<sup>35</sup> For the period 1947-1969 a high degree of association was found between increasing beer

sales and the increase in one-way (non-refillable) packaging used for beverages. The implication was that convenience packaging created new markets for the product. Elsewhere, he cautioned against the assumption that current market prices for beer in refillable and non-refillable packages did not accurately reflect the underlying cost structures.<sup>36</sup> His historical analysis of pricing showed beer in non-refillable containers to be subsidizing the product in refillable bottles, which would not be possible in a refillable only system.

#### Michigan Studies

Several studies have been published analysing various aspects of the Michigan MBCDL. A joint committee of the Michigan legislature published a study, and then an update, based on staff research and public hearings addressing the impacts of the law.<sup>37</sup> The committee also commissioned a major study of the law's specific effect on litter.<sup>38</sup> The committee found broad, continuing popular support for the policy. Litter reduction was identified by the legislative committee as the major policy goal. The impact of the MBCDL on litter, however, was mixed. Beverage container litter was down 85 percent, but total litter was found to be up almost 10 percent in a before and after study.<sup>39</sup> Municipal solid waste was reduced because nearly all beverage containers were reported to be either reused or recycled. Prices were found to have increased noticeably for beverages and no explanation could be found within the received theory (perfectly competitive markets and consumer indifference to container type). Dislocations of beverage sales in border areas of the state to retail outlets in neighboring states was discussed. Reasons for declining border area sales included

Michigan price increases, the raising of the legal minimum drinking age in Michigan and the absence of convenience packages in Michigan.<sup>40</sup>

Change in the beverage delivery system during the first 6 months after the Michigan MBCDL took effect was described by Sjolander.<sup>41</sup> He compared one market area ( Flint, Michigan) with a similar city in Indiana during that transitional period. A second descriptive report by Sharkey included many interviews from each segment of the affected industry.<sup>42</sup>

A summary of the issues in Michigan was provided by Kirby.<sup>43</sup> The arguments both for and against MBCDL were identified. The policy was analysed in terms of property rights assignments and shown as a transfer of rights to certain aspects of the environment away from the beverage litterers and to those desiring a beverage container free environment.

The Michigan United Conservation Clubs (MUCC) published a report which clearly stated the results of the policy from an advocate's position.<sup>44</sup> The MUCC actively lobbied for passage of the legislation and considered it an unqualified success. They found that the MBCDL reduced litter, solid waste and encouraged resource conservation.

Porter brought together benefits (reduced litter, solid waste, and resource use) with costs ( loss of consumer convenience and higher beverage prices) into an overall welfare assessment.<sup>45</sup> The analysis was made based on data for one year before and after the Michigan law was implemented. An attempt was made to model the inconvenience cost experienced by consumers in returning containers. That figure was combined with the total increase in the nominal product price to derive beverage consumer welfare losses (costs) due to mandatory deposits, estimated between 67 and 107 million dollars for beer in 1979.<sup>46</sup>

Crosby, Gill, and Taylor identified what they called an ecological market segment in Michigan based on a survey of consumer attitudes toward MBCDL.<sup>47</sup> They found a high correlation between a respondents concern for protecting the environment and expressed preference before the 1976 referendum on the MBCDL in Michigan. A much stronger relationship was found between the respondents belief on the effect of the proposed law on beverage prices and planned voting behavior according to their data.<sup>48</sup> Unfortunately for the purposes of the present study, the researchers were concerned with presenting a model of ecological behavior and not with developing the relationship between consumer expectations of price effects and voting behavior.

The present study has explicitly analysed economic effects of the Michigan MBCDL policy. Five years of experience with both consumer and beverage industry adaptations to life under this legislation were available for analysis. Two of the Michigan demand models are similar to the one developed by Bingham in the Federal Energy Agency study. The third demand model, using regional sales to predict Michigan sales is a logical extension of the (all other things being equal) assumption. The border area sales analysis is an attempt to quantify the effect noted by the Special Joint Committee of the Michigan Legislature. The package mix analysis is an extension of the work reported by the Michigan Public Services Commission in Michigan and Gudger and Bailes in Oregon. Using the actual package mix to estimate the effect of MBCDL is a refinement of the various energy studies which used assumed package mixes due to a lack of actual data. The analysis of prices is an extension of the earlier study by Sjolander.

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## CHAPTER III \*\*

### Methods and Results

#### Purpose of Study

Deposits on containers for most carbonated beverages (beer and soft drinks) have been required by Michigan law since December 3, 1978.<sup>1</sup> This public policy is meant to give special protection to consumers and natural resources by eliminating non-returnable beverage containers. Eight other states have comparable legislation (Oregon, Vermont, Maine, Iowa, Connecticut, Massachusetts, Delaware, and New York). Michigan is the only state, however, that combines a large population, an industrial economic base, and several years of experience under this type of legislation. Therefore, Michigan provides an important case for studying the results of mandatory deposit legislation.

Prior to enactment of the Michigan deposit law, proponents claimed the policy would bring such benefits as energy conservation, litter reduction, solid waste reduction, and the promotion of an environmental ethic. In contrast, opponents expressed concern about declining beverage sales, increased labor costs, and the added cost of unproductive space for storing the empty containers, which was seen as the cost of any benefits.

Most of these expectations were based on theoretical projections and meager data. Since Michigan consumers have now lived with the policy for over five years, significant patterns of behavior by consumers and industry have been established. Documentation of the Michigan experience, therefore, should be of value to other states and the federal government as they consider similar laws.

The industry affected by this legislation is large. Beer sales alone in Michigan amounted to 2.3 billion containers in 1978. Soda (carbonated soft drink) sales were estimated to be about equal to this figure. The Michigan Liquor Control Commission calculated that the purchase of beer consumed more than 1.5 percent of the State's 90 billion dollars of disposable income in 1982, or \$1.4 billion. Assuming soda prices are similar to beer, the affected industry accounted for a total of about 3 percent of disposable income in 1982.

. \*\* This chapter was previously published as, "Effects of Michigan's Mandatory Beverage Container Deposit Law," by Richard Sjolander and Peter Kakela. RDR-84-1, East Lansing, MI: Agricultural Experiment Station Journal Article No. 11158, 1984.

### Scope of This Study

The Michigan law covers most carbonated drinks -- soda, water, and malt beverages. The Michigan Liquor Control Commission receives a copy of every invoice for shipments of beer into and within the state in order to collect state taxes on alcohol. These records are comprehensive, accurate, and provide an excellent data base. Therefore, only beer is analyzed in this study. There is no comparable tax on soda, and sales records are the property of each individual bottler.

Social science research is complicated by the limited ability of the researcher to control conditions in the environment in order to isolate a single, uncontrolled variable for study. The present work is no exception. At the same time as the Michigan Mandatory Beverage Container Deposit Law (MBCDL) became effective, another major policy related to beer consumption was implemented. Michigan's legal drinking age was raised from 18 to 21 years of age on December 23, 1978.<sup>2</sup>

In addition to these two discrete public policy changes, two other gradual changes were occurring in Michigan that may have influenced consumer behavior related to beverage consumption. First, the price of beer rose substantially after implementation of the MBCDL, and then declined. Second, the Michigan economy, generally more volatile than the national economy, experienced two recessions in the last five years.

All four of these changes occurred concurrently. Therefore, there are four related variables that could have changed Michigan beer consumption patterns significantly. These have all been carefully considered in the present study in an effort to isolate the influence of the target variable, the MBCDL, on beer sales.

This report analyzes five elements of the beverage delivery system that may have changed as a result of the Michigan Mandatory Beverage Container Deposit Law. These are:

- 1) total Michigan beer sales, -
- 2) Michigan border county beer sales,

- 3) package mix by container type, refillable bottles, non-refillable bottles and cans,
- 4) energy consumed in Michigan's beer distribution system, and
- 5) beer prices.

These changes were studied and the degree of influence that the MBCDL had on all five is described below. There are many other changes that have been attributed to mandatory beverage container deposit laws in general, and specifically to the results of the Michigan law, that are not discussed in the present report.

Most proponents and opponents agree that a MBCDL will reduce beverage related litter and that it will reduce solid waste by the number of additional containers being reused or recycled as a result of the law. The issue is the cost of these and other benefits. The analysis contained in this report specifically addresses some of the changes in the beverage delivery system. Others, such as employment in the various sectors, labor productivity in breweries or the specific changes in litter and solid waste are not analyzed. Although there is general agreement among proponents and opponents on a number of the effects of such legislation such as the reduction in the amount of beverage related litter and solid waste, a reduction in the number of workers employed fabricating beverage containers and an increase in the number of workers sorting returned packages, agreement has not been reached as to the relative importance of these impacts or the overall cost of supplying beverages in an all returnable package mix.

#### The Michigan Mandatory Beverage Container Deposit Law

The MBCDL applies to carbonated beverages (soda, water, and beer) in bottles and cans containing less than one gallon of product. It bans non-returnable containers and detachable pull tabs on cans. All except specially exempted containers must be clearly printed with the name of the state and the refund value. The minimum deposit is 5 cents on certified bottles and 10 cents on all other containers. To be "certified," a bottle must be accepted and reusable by more than one manufacturer, and approved by the Michigan Liquor Control Commission. For on-premise sales in taverns or restaurants, containers must be

properly labeled, but the deposit by, and refund to, the customer is not required.

Both retailers and wholesalers are required to give cash refunds for any container of a type they sell. Wholesalers charge retailers the deposit on all containers. Brewers are not required by law to refund containers. Currently brewers initiate the deposit only on refillable containers. Non-refillable bottles and cans are disposed of by wholesalers for the scrap value.

### STATE-WIDE BEER SALES

#### Volume of Beer Sales

The Michigan Liquor Control Commission collects beer sales data for tax purposes based on shipments from brewers to wholesalers.<sup>3</sup> The trend in beer consumption in Michigan over the last thirty years appears to fit into three phases (Figure 1). The first phase is from 1954 to 1963 and is characterized by sales fluctuating around a mean value of 5,237,000 barrels per year. The trend line for this period has a slightly negative slope of -12,000 barrels per year.

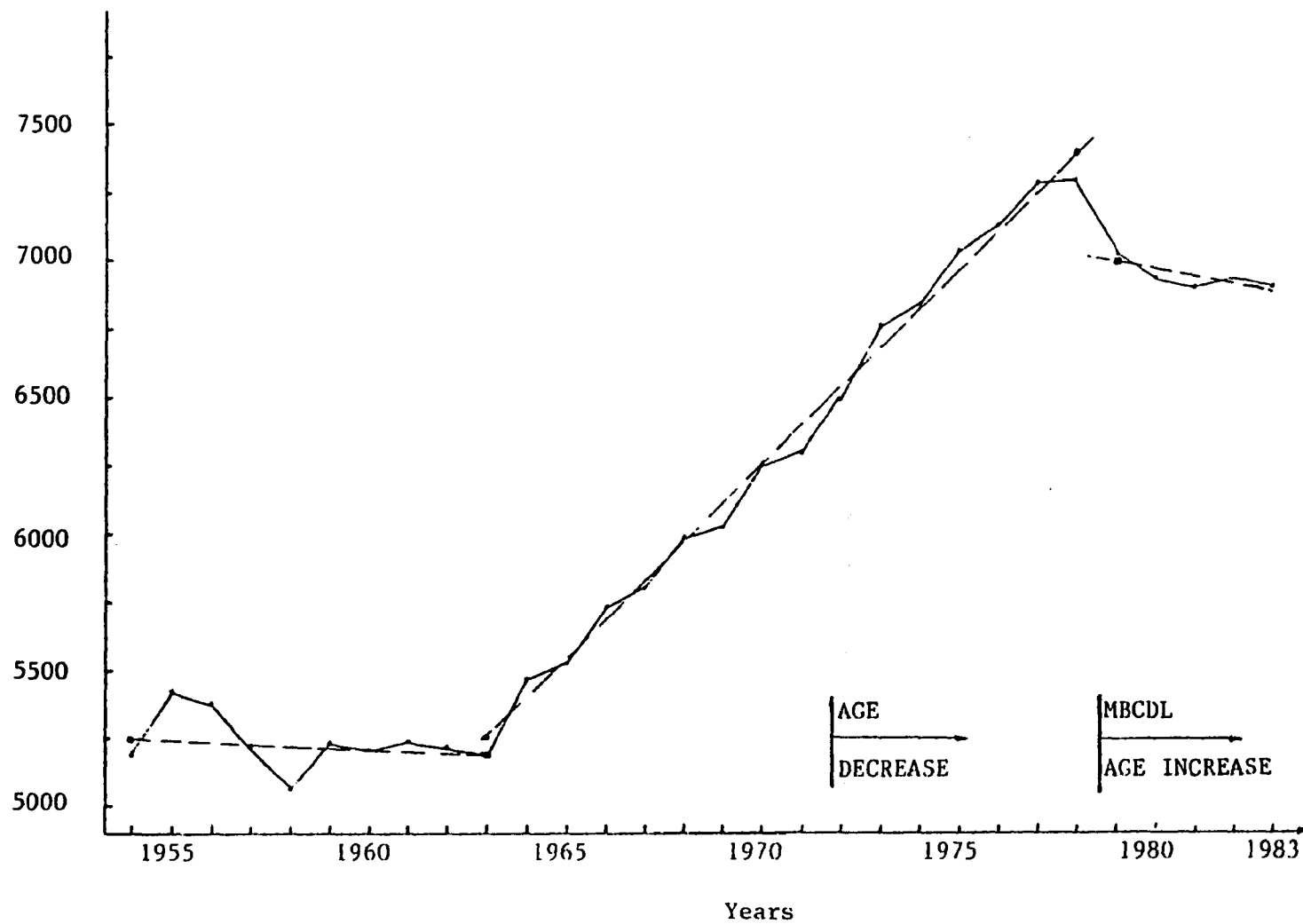
The second phase runs from 1963 through 1978. A positive trend line for this period predicts a gain of 142,000 barrels per year and is related to 99 percent of the variation during the 15 years. Near the middle of the period (January 1, 1972) the legal drinking age was lowered to 18 years of age.<sup>4</sup> The legal drinking population increased by 600,000 people (or 11 percent) for that year.

The third phase begins in 1979 and runs through 1983, the last year for which data are available. There was a major shift downward between 1978 and 1979. This trend line then shows a continuing decline of 34,000 barrels per year. The implementation of the MBCDL coincides with the initial drop in annual sales. To conclude that this drop in sales was caused by the MBCDL, however, would ignore the other major policy measure which also took effect in December 1978, the raising of the legal drinking age from 18 to 21. The legal drinking age population dropped by 470,000 people (or 7 percent) in 1979. The subject of much of the remainder of this report is to isolate and quantify the effects of these two policy measures on beer sales.

Figure 1

Thousands of  
Barrels

Michigan Beer Sales  
With Trend Lines



### Number of Packages Sold

The data in the previous section were based on total sales volume, rather than the number of packages sold. The law, however, specifically applies deposits to packages containing one gallon or less of product, i.e., bottles and cans. Like volume, the number of packages of beer sold in Michigan increased steadily from 1963 to 1978 (Phase II), then declined sharply in 1979 (11 percent) and continued to decline through 1983 (Figure 2). Package sales declined at a decreasing rate in 1983 (under 1 percent) and this may indicate a change in the trend.

The rate of decrease in packages sold since 1978 is greater than the decrease in total volume. Indexed values, with 1967 as the base year (i.e., 1967 = 100), show that the percent change in packaged beer sales (in cases) varied over a wider range than the change in total beer volume sold in Michigan (in barrels). (See Figure 3). Package sales comprise about 90 percent of the total volume sold between 1967-1978; draught beer makes up the remainder. Package sales increased steadily throughout the 1967-1978 period. After 1978, there is a dramatic drop in package sales from an index of 142 in 1978, to 127 the year after. Sales continue to fall to a low of 107 in 1983.

Draught beer sales are not covered under the MBCDL because draught barrels hold more than one gallon. Draught beer is mostly consumed on-premise. Draught beer had a different sales trend than package sales and total sales prior to the MBCDL. Draught sales did not grow prior to the lowering of the legal age in 1972, but increased significantly that year (Figure 3). This gain, however, was temporary and quickly regressed back near the 1967 level. Draught sales during this period accounted for about 10 percent of total beer sales in Michigan. In 1979, draught sales increased rapidly to an index of more than 140 and continued to gain, reaching 151 in 1983.

The large increase in draught beer appears to be a substitution effect in the consumption of beer resulting from the MBCDL. Many restaurants and bars increased their draught beer capacity and varieties as a result of their limited storage space for empty containers. Prior to the MBCDL, these establishments discarded non-returnable containers.<sup>5</sup> With the MBCDL there are no non-returnable containers. Retailers do not

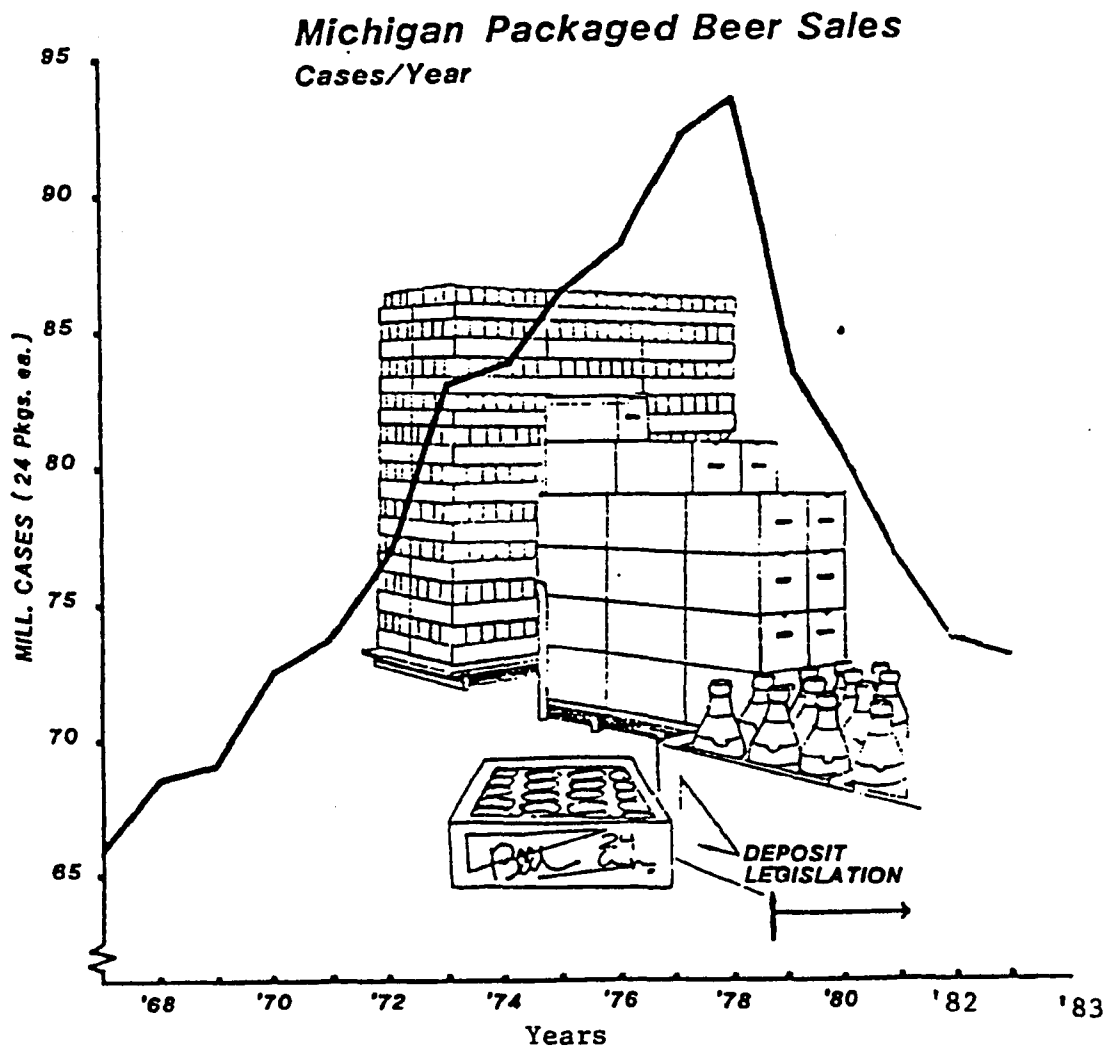
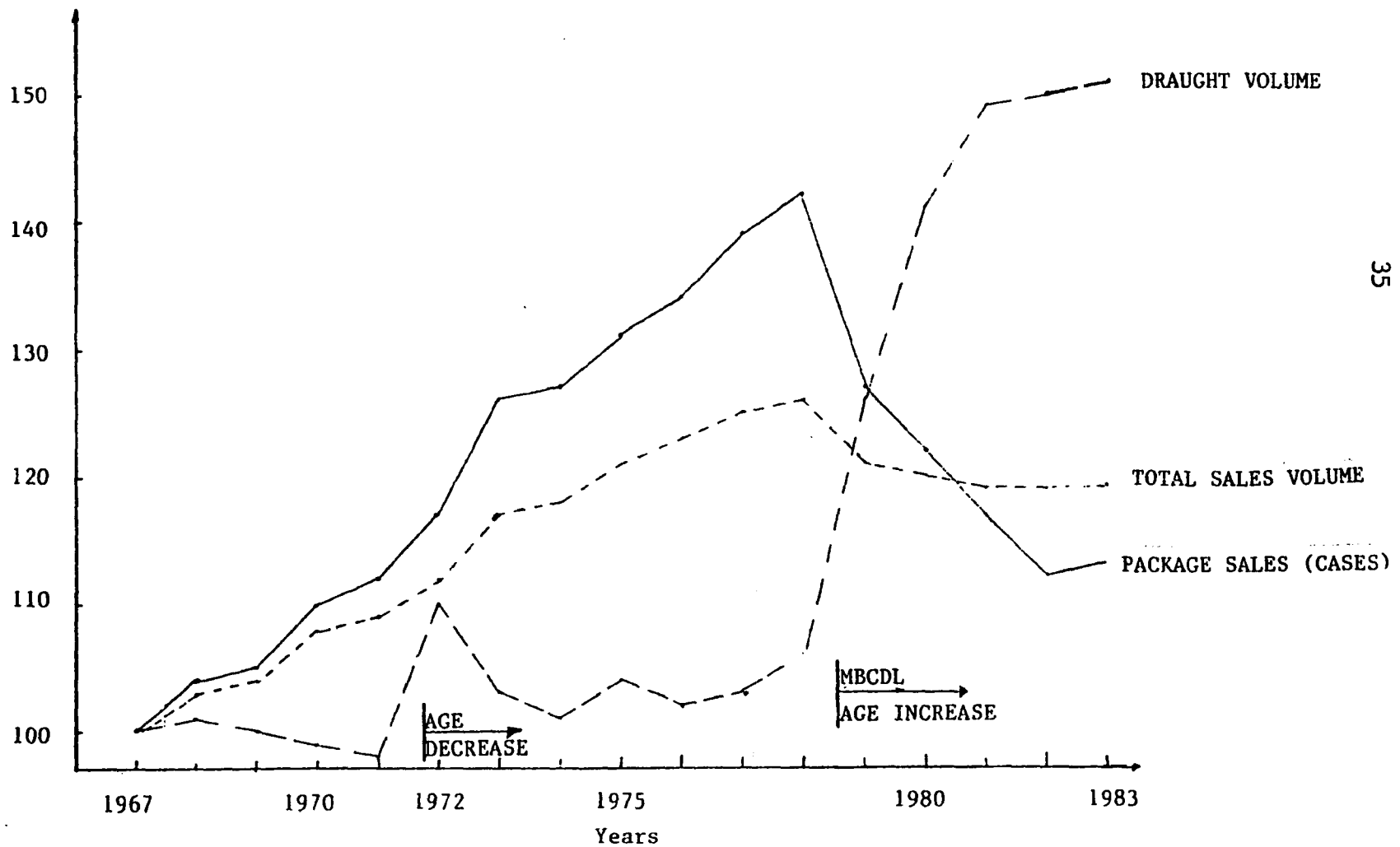
Figure 2

Figure 3

**Michigan Beer Sales**  
As Percent of Base Year 1967

(Percent of 1967 Sales)



have to charge deposits on beverages consumed on site, even if these are in cans or bottles. Wholesalers that supply these retail establishments, however, are required to refund deposits on all of the properly marked empty containers that are subsequently returned to them. As a result, wholesalers initially charge retailers the deposit on all cans and bottles. Retailers, therefore, must retain the containers so that they can be redeemed. This requires additional storage space to temporarily store the empty containers. The increased cost of packaged beer to retailers may also have encouraged additional draught capacity.

In the off-premise market, substitution of draught beer for packaged beer may also have occurred. When there were groups of people large enough to consume more than three cases of beer, quarter or half barrels (three and one half cases and seven cases respectively), off-premise draught held a price advantage. Off-premise draught did not increase in price initially in 1979 and the logistical problem of recovering the empty containers for return was reduced. (Note that what many people think of as a "barrel" of beer is technically only a half barrel containing 15.5 gallons (equivalent to 6.89 cases). Full barrels are only used for accounting purposes when measuring beer sales. They were found to be too heavy for practical use).

### MODELS OF BEER SALES

#### Purpose for the Models

Demand models for beer sales in Michigan were developed by analyzing a number of variables statistically to determine their relationship to beer sales. Mathematical models were fitted to pre-MBCDL sales over the period 1954-1978. Once calibrated for the pre-MBCDL period, the models were used to predict post-MBCDL sales as if the MBCDL did not exist. The difference between predicted sales and actual sales was then modeled to determine what factors could have caused any discrepancies.

### Constructing the Models

A model of consumer demand for beer in Michigan must include or at least consider those factors thought to be most relevant to consumption of the product. These include: 1) the number of potential consumers (or relevant population), 2) the price of the product relative to other consumer purchases, and 3) the amount of consumer dollars available (or discretionary income).<sup>6</sup>

Two causal models were developed using variables within the state to predict beer sales. A third model was developed to compare Michigan sales to regional sales.

For this study, the validity of a model was judged on the basis of the following criteria:

- 1) the logical connection of the predictor variables to beer sales,
- 2) a logical direction of the relationships, and
- 3) the strength of the coefficient of multiple determination ( $R^2$ ).

The economic conditions in Michigan during the period 1979-83 logically suggest that the demand model should include measures of income, unemployment, price, and population. A "logical direction" for the relationships means that the coefficients must have the expected sign. For example, two models were discarded because the best fitting coefficients for population for the time period 1954-1974 were negative, which would illogically suggest that as population increased, beer sales should decrease.

The models were constructed using multiple linear regression analysis. This statistical technique assumes that there are linear (straight line) relationships between the independent (or predictor) variables and the factor to be explained, i.e., Michigan beer sales. The coefficient assigned to each predictor variable was a constant for the entire time period. This technique was chosen because it is a widely used and understood method, and because it has been specifically used to predict the impact of beverage container laws in Michigan and elsewhere.<sup>7</sup> A more sophisticated technique correcting for first order serial correlations of the error terms was used in the estimates of

sales based on regional sales. First order serial correlation of the error terms (auto-correlation) was not a problem in the two causal models based on variables within Michigan.<sup>8</sup>

A relatively high level of statistical significance ( $\alpha = .05$ ) was used in this study. Few demand models for beer sales have been published so comparison was limited. Therefore, the high level of significance was used in order to protect against spurious results. As a result, relationships must be highly significant and contribute greatly to the explanatory power of the model to be retained. This reduced the number of variables in the model. The significance criterion was relaxed for the variable measuring the effect of the legal age change. Although not significant at the .05 level, it was retained in the model. This assumption intentionally biased the model and the estimated effect of the MBCDL is reduced by almost the identical amount attributed to the legal age change variable. The researchers believe that the legal drinking age affects the consumption of beer and therefore have explicitly relaxed their selection criteria to retain this variable in the models. Values are presented in tables both with and without this variable. There is considerably intercorrelation amongst the independent variables which may shroud the true effect of the change in the minimum legal drinking age. There also may be other variables which are important determinants of beer sales which are not in the models. The data used throughout the modeling section are included as Appendix 1.

#### Model Period

The total period analyzed was from 1954 through 1983. Beer sales during this period fell into the three distinct phases described earlier (Figure 1). The first two phases were used as the base period to calibrate the statistical model. This model was then used to predict potential sales that might have occurred in phase three if the MBCDL had not gone into effect. A model which described sales during both of the first two very different phases was considered more reliable than one that was calibrated for only the second, steady-growth phase. Some research has used a shorter period, such as 1962-1978, to model Michigan beer sales.<sup>9</sup> During that time period, however, a secular trend line

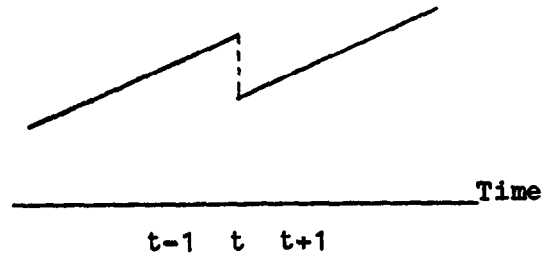
(i.e., simply predicting sales based on the passage of time) was correlated with 99 percent of the variation in Michigan sales which would make a change in the dependent variable occurring after 1978 difficult to model correctly.

Four time periods were used to test for impacts of the MBCDL and age change policy interventions in Michigan. The first period, 1954-1971, stopped just before the legal age decreased from 21 to 18. The second period ran from 1954 through 1974 to include the first three years of lower legal age. The third period was from 1954 to 1978 and included the entire series up to the implementation of the two policy measures of interest. The second period should pick up short-term effects of the age change which may not persist over the full seven years that people 18 years old were legally allowed to drink in Michigan. The third period would model any lasting effects of the age change and provide the base line data for prediction of sales for the years 1979-1983. The fourth period includes the full 30 years from 1954 through 1983.

#### Binary Variables

A simple binary variable was used to study the effect of each policy measure on beer sales. By definition, a binary variable has just two values and in the present situation they are either "on" or "off." This can account for shift (or "step changes") in the trend lines. A simple illustration of this (Figure 4) would have an intervention occur at time "t" causing a step down in the function being modeled, but not a change in the slope. A binary variable can be introduced into the model and assigned a value of 0 for all time periods prior to time "t," and a value of 1 for all periods from "t" onward. The coefficient assigned to the binary variable will be equal to the shift occurring in the function at time t when the sudden change occurred. Obviously the binary step can be either up or down. If the policy change affects the slope of the demand curve, this will be apparent from changes in the coefficients of the other variables in the equation the coefficient of determination ( $R^2$ ).

Figure 4  
Binary Variable Concept



In the case at hand, if all other conditions in Michigan are constant except for the policy under study, then the coefficient assigned to the binary variable will be equal to the effect of the policy intervention on sales. The use of this technique allows one to test the significance as well as the size of a change in beer sales from the pattern developed prior to the intervention. The size of the effect is defined as the coefficient of the binary variable. The significance of the variable to the explanatory power of the model is the  $t$  test statistic for that variable.

Two binary variables were incorporated in the models. The first binary variable represented the MBCDL policy and was given the value of 0 for the years 1954-1978. It was assigned the value of 1 for 1979-1983, the years since the policy was implemented. Another separate binary variable was used for the changes in legal drinking age. It was assigned the value 0 for 1954-1971 before the age was lowered to 18, and again for 1979-1983 after the age was restored to 21. This variable was set at 1 for the years 1972-1978 when the legal drinking age was 18.

#### Population Variable

Consumption of a product is directly related to the number of people who are potential customers. With alcoholic beverages, and especially beer and wine, there are several conflicting hypothesis regarding the definition of the relevant population in a region. Three of them are considered here.<sup>10</sup>

Population Hypothesis I is that the relevant population is composed of individuals in Michigan between the ages of 18 and 44 years. A Simmons Market Research Report Bureau study reported that in 1979 this

group comprised between 70 and 75 percent of both heavy users and all users of domestic and imported beer.<sup>11</sup> An industry source indicated that some brewers use the even smaller segment of 18-34 as the target population in their media impact research. A study funded by the Federal Energy Administration used the even smaller population segment of 20 to 34 years of age as the relevant population for predicting beer sales.<sup>12</sup>

Population Hypothesis II is that the relevant population includes all those individuals in Michigan of legal drinking age. This definition leads to significant changes in the population as a result of legal age changes. In Michigan the legal population increased by 600,000 (or 11 percent) in 1972 and declined by 470,000 (or 7 percent) in 1979. This definition is used by those supporting the control of youthful drinking through age mandates.<sup>13</sup>

Population Hypothesis III is that the relevant population equals those individuals in Michigan 18 years of age and older. This is similar to each of the first two hypotheses. It is similar to I in that it does not consider the change of legal age as significant. It is similar to II in including the population 45 and older which increases the size of the relevant population by at least 70 percent. This definition is often used by those who hold that an increase in legal age will not significantly affect consumption in the excluded group.<sup>14</sup>

All three of these population hypotheses were examined for the 30 year study time period (Figure 5). To compare these hypotheses it was necessary to incorporate all of them into the same model. To do this the population data was divided into three classes: 1) "Younger," aged 18 to 20 years old, 2) "Middle," aged 21 to 44, and 3) "Older," aged 45 and older. Each population hypothesis is based on a combination of these classes. Defined in this way, it was possible to incorporate all three components of population in the same equation and observe the amount of the variation in beer sales that each explained.

Several conclusions can be drawn from this test and the resulting pattern of coefficients and significance levels for the variables (Table 1). The variables for population 18-20 and population 21-44 both had positive coefficients indicating that as the number of people increased, consumption increased. They were both significant (at the .05 level of

POPULATION  
IN THOUSANDS

Figure 5

Population Hypotheses

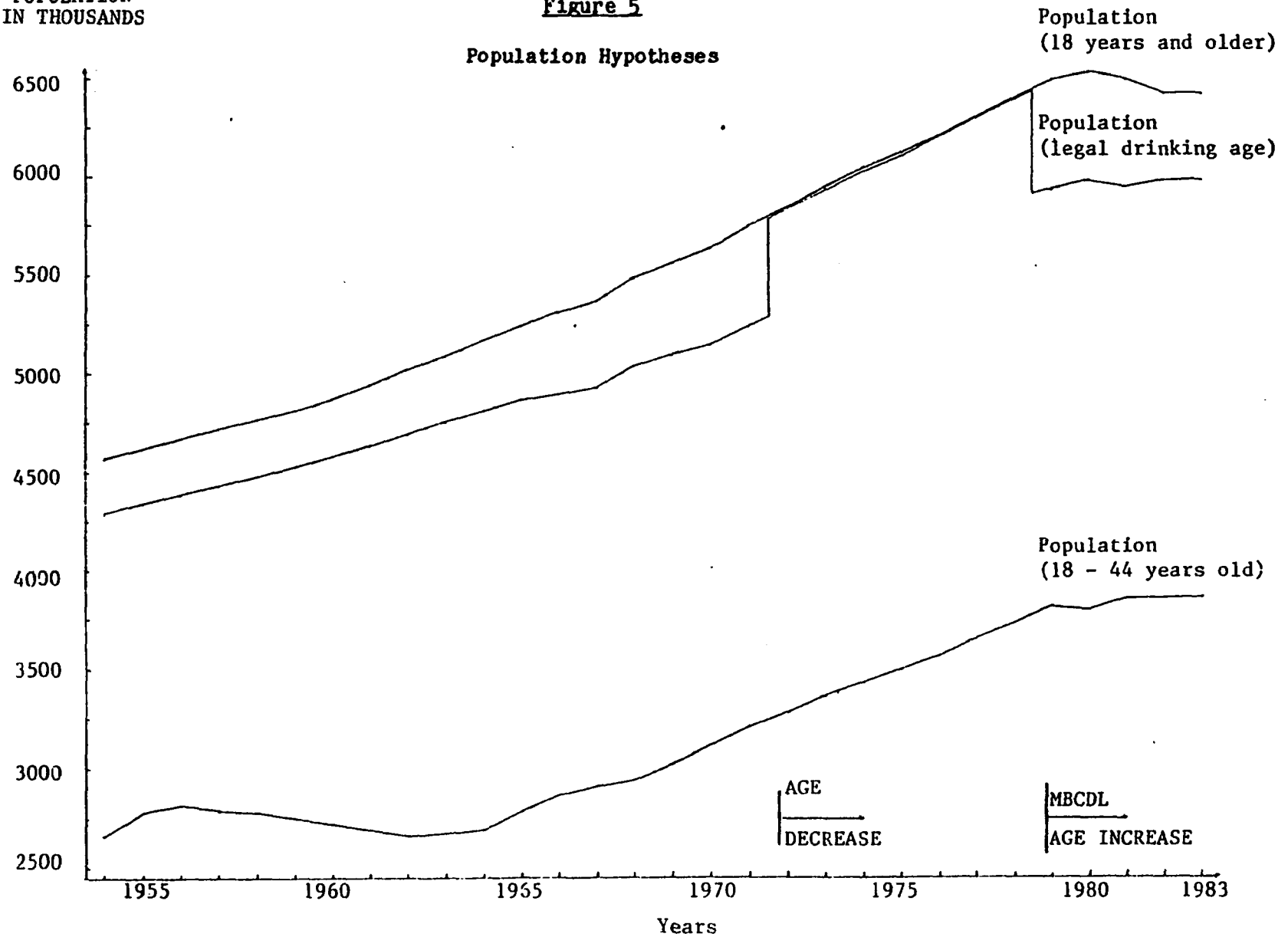


Table 1

Test of Population HypothesesMichigan Beer Sales (Barrels x 100)  
Ordinary Least Squares Regression

| Period                     | I               |                 | II              |                | III            |                 | IV              |                |                |
|----------------------------|-----------------|-----------------|-----------------|----------------|----------------|-----------------|-----------------|----------------|----------------|
| Time Frame                 | 1954-71         |                 | 1954-1974       |                | 1954-1978      |                 | 1954-1983       |                |                |
| Column                     | 1               | 2               | 3               | 4              | 5              | 6               | 7               | 8              | 9              |
| R <sup>2</sup> (Adj.)      | .945            | .973            | .972            | .986           | .986           | .977            | .986            | .988           | .988           |
| Constant<br>(t stat.)      | 3293<br>(2.1)   | 1927<br>(1.6)   | 2676<br>(1.8)   | 903<br>(1.4)   | 1184<br>(1.5)  | 3385<br>(6.7)   | 2631<br>(6.0)   | 904<br>(1.5)   | 1218<br>(1.7)  |
| Pop 18-20<br>(t stat.)     | 5.688<br>(4.4)  | 4.910<br>(4.2)  | 5.246<br>(4.2)  | 4.157<br>(5.2) | 4.171<br>(5.1) | 6.837<br>(9.1)  | 4.972<br>(6.7)  | 4.156<br>(5.5) | 4.173<br>(5.5) |
| Pop 21-44<br>(t stat.)     | .558<br>(1.1)   | 1.024<br>(2.7)  | .765<br>(1.6)   | 1.370<br>(7.0) | 1.269<br>(5.2) | .555<br>(4.2)   | .764<br>(6.6)   | 1.358<br>(7.3) | 1.246<br>(5.4) |
| Pop 45+<br>(t stat.)       | -.514<br>(-1.5) | -.297<br>(-1.0) | -.400<br>(-1.2) | -.104<br>(-.5) | -.122<br>(-.5) | -.727<br>(-3.2) | -.338<br>(-1.7) | -.091<br>(-.4) | -.112<br>(-.5) |
| Age<br>(t stat.)           |                 |                 | 94<br>(.9)      |                | 65<br>(.7)     |                 | 236<br>(4.1)    |                | 72<br>(.8)     |
| MBCDL<br>(t stat.)         |                 |                 |                 |                |                |                 |                 | -457<br>(-5.0) | -357<br>(-2.4) |
| Durbin-Watson<br>Statistic | 2.2             | 1.9             | 2.1             | 1.7            | 1.8            | 1.2             | 1.6             | 1.7            | 1.7            |

Definitions for Model Variables

|                      |                                                                                                                                                                                                                                         |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Pop 18-20</b>     | is the variable for the Michigan population 18 through 20 years of age (in thousands).                                                                                                                                                  |
| <b>Pop 21-44</b>     | is the variable for the Michigan population 21 through 44 years of age (in thousands).                                                                                                                                                  |
| <b>Pop 45+</b>       | is the variable for the Michigan Population 45 years old and older (in thousands).                                                                                                                                                      |
| <b>Age</b>           | is the binary variable for the effect of the lower legal drinking age (1972-1978) when it assumes the value 1. It is 0 for all other years.                                                                                             |
| <b>MBCDL</b>         | is the binary variable for the effect of the Michigan Beverage Container Deposit Law assuming the value 1 for these years (1979-1983). It is 0 for all other years.                                                                     |
| <b>R<sup>2</sup></b> | adjusted is the percent of the variation in Michigan beer sales around their mean which can be related to variation in the independent variables, adjusted downward to account for the number of independent variables in the equation. |
| <b>Durbin-Watson</b> | is the test statistic for serial correlation of the error terms in a regression equation. In the models proposed here, a D-W value of 1.6 or higher indicates that serial correlation is insignificant at the .05 level.                |

confidence) for the 1954-1978 and 1954-1983 time periods. Since the relationships were both logical and significant, they were retained in the model.

The population segment 45 and over consistently had a negative coefficient. This indicated an inverse relationship between this segment of population and beer consumption (i.e., as the number of people 45 and older increased, total beer consumption was predicted to decrease). This was an illogical association, statistically insignificant in most of the equations, (at the .05 level) and therefore, it was deleted.

### Economic Variables

As an index of the Michigan economy, the annual unemployment rate (as a percent of the labor force) was used in building the predictive model (Figure 6).<sup>15</sup> This is the only economic indicator in the model and it is expected to be inversely related to beer sales because a high unemployment rate indicates a sluggish economy. This does not refute the commonly held belief that beer sales increase in bad times.<sup>16</sup> It simply means that beer sales will grow at a slower rate during recessions than they will during healthy growth periods, all other things being equal.

### Model I

Model I was fitted to each of the four time periods (Table 2). This is a time series model so it is important to determine if the error in one year's sales prediction is inappropriately affecting the observed sales for the next year, or what is called auto-correlation. The Durbin-Watson test indicates whether or not auto-correlation is present in time series data.<sup>17</sup> The Durbin-Watson values for Model I were not significant at the .05 level for any of the time periods. Even so, first order serial correlation correction technique was used to double check for auto-correlation effects (Table 3). The coefficients for the comparable variables are essentially identical. In addition, the value for the variable "rho," the correction factor for first order serial correlation, is small and insignificant during all four time periods. For these reasons, auto-correlation was considered to be insignificant in the data and the more common ordinary least squares technique was used.

Figure 6

Unemployment in  
Percent of Labor Force

Michigan Unemployment Rate



Table 2

Model I: Michigan Beer Sales (Barrels x 1000)  
Ordinary Least Squares Regression

| Period                     | I               |                 | II              |                 | III             |                 | IV              |                 |                 |                 |
|----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Time Frame                 | 1954-71         |                 | 1954-1974       |                 | 1954-1978       |                 | 1954-1983       |                 |                 |                 |
| Column                     | 1               | 2               | 3               | 4               | 5               | 6               | 7               | 8               | 9               | 10              |
| R <sup>2</sup> (Adj.)      | .962            | .982            | .982            | .988            | .988            | .971            | .988            | .990            | .990            | .989            |
| Constant<br>(t stat.)      | 929<br>(1.9)    | 544<br>(1.5)    | 811<br>(1.7)    | 473<br>(1.9)    | 790<br>(2.1)    | 1714<br>(6.4)   | 1729<br>(9.8)   | 502<br>(2.2)    | 833<br>(2.3)    | 656<br>(2.8)    |
| Pop 18-20<br>(t stat.)     | 3.368<br>(11.0) | 3.382<br>(11.5) | 3.345<br>(11.2) | 3.600<br>(12.5) | 3.515<br>(11.8) | 4.441<br>(10.5) | 3.546<br>(11.3) | 3.635<br>(13.4) | 3.548<br>(12.7) | 3.846<br>(14.2) |
| Pop 21-44<br>(t stat.)     | 1.441<br>(6.3)  | 1.595<br>(8.9)  | 1.492<br>(6.8)  | 1.567<br>(11.4) | 1.452<br>(8.5)  | .955<br>(5.7)   | 1.071<br>(9.6)  | 1.548<br>(12.0) | 1.428<br>(8.8)  | 1.419<br>(11.6) |
| Munem<br>(t stat.)         | -25.1<br>(-3.0) | -24.9<br>(-3.2) | -25.3<br>(-3.2) | -14.4<br>(-2.0) | -15.9<br>(-2.1) | -16.6<br>(-1.5) | -18.0<br>(-2.5) | -13.9<br>(-2.2) | -15.1<br>(-2.4) |                 |
| Age<br>(t stat.)           |                 |                 | 67<br>(.8)      |                 | 92<br>(1.1)     |                 | 284<br>(6.0)    |                 | 96<br>(1.2)     |                 |
| MBCDL<br>(t stat.)         |                 |                 |                 |                 |                 |                 |                 | -473<br>(-7.1)  | -346<br>(-2.8)  | -482<br>(-6.8)  |
| Durbin-Watson<br>Statistic | 2.4             | 2.2             | 2.3             | 1.8             | 1.9             | .8              | 1.8             | 1.9             | 2.0             | 1.7             |

Munem: is the variable for the Michigan unemployment rate as a percent of the labor force.

Table 3

Model I: Michigan Beer Sales (Barrels x 1000)  
First Order Serial Correlation Correction Regression Technique

| Period                     | I               |                 | II              |                 | III             |                 | IV              |                 |                 |
|----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Time Frame                 | 1954-71         |                 | 1954-1974       |                 | 1954-1978       |                 | 1954-1983       |                 |                 |
| Column                     | 1               | 2               | 3               | 4               | 5               | 6               | 7               | 8               | 9               |
| R <sup>2</sup> (Adj.)      | .989            | .991            | .992            | .987            | .989            | .940            | .984            | .990            | .992            |
| Constant<br>(t stat.)      | 818<br>(2.1)    | 510<br>(1.7)    | 774<br>(2.0)    | 480<br>(1.9)    | 787<br>(2.1)    | 1929<br>(4.8)   | 1758<br>(9.2)   | 498<br>(2.2)    | 817<br>(2.4)    |
| Pop 18-20<br>(t stat.)     | 3.326<br>(13.6) | 3.344<br>(13.6) | 3.300<br>(13.5) | 3.604<br>(12.3) | 3.512<br>(12.0) | 4.552<br>(6.7)  | 3.592<br>(10.4) | 3.632<br>(13.5) | 3.534<br>(13.2) |
| Pop 21-44<br>(t stat.)     | 1.499<br>(8.3)  | 1.620<br>(10.7) | 1.520<br>(8.4)  | 1.563<br>(11.2) | 1.454<br>(8.5)  | .844<br>(3.8)   | 1.048<br>(8.8)  | 1.551<br>(12.1) | 1.438<br>(9.2)  |
| Munem<br>(t stat.)         | -27.9<br>(-3.8) | -27.1<br>(-3.7) | -28.0<br>(-3.9) | -14.3<br>(-1.9) | -16.1<br>(-2.2) | -11.8<br>(-1.4) | -16.3<br>(-2.2) | -14.0<br>(-2.2) | -15.6<br>(-2.5) |
| Age<br>(t stat.)           |                 |                 | 68<br>(-1.0)    |                 | 93<br>(1.1)     |                 | 277<br>(5.4)    |                 | 97<br>(1.2)     |
| MBCDL<br>(t stat.)         |                 |                 |                 |                 |                 |                 |                 | -474<br>(-7.2)  | -348<br>(-2.9)  |
| Rho<br>(t stat.)           | -.292<br>(-1.1) | -.224<br>(-.9)  | -.259<br>(-1.1) | -.025<br>(.1)   | -.158<br>(-.1)  | -.598<br>(3.9)  | .118<br>(0.6)   | -.013<br>(-0.1) | -.058<br>(-0.3) |
| Durbin-Watson<br>Statistic | 1.9             | 1.9             | 1.9             | 1.9             | 1.9             | 2.1             | 1.9             | 1.9             | 1.9             |

Rho: is the variable to correct for first orders serial correlation of the error terms.

The binary variable for the change in legal drinking age was not significant at the .05 or even the .5 level (Table 2). The only equation where this variable was significant was for the period 1954-1983 when the MBCDL variable was excluded from the equation. The age variable does not exhibit a significant relationship with beer sales, but as stated earlier the researchers retained this variable under the assumption that the observed relationship was a true one.

The binary variable for the MBCDL itself was significant and had the expected, negative sign. This variable could only be tested on the full thirty year time period.

The coefficient of determination ( $R^2$ ) value was very high in each of the time periods. The values increase from .962 for the shortest period (1954-1971) to .990 for the longest period. This 4 percent increase in explanatory power is a result of the increased total variation of the longer time series about its mean. The standard error of the regression is the same in both series. Meaningful comparison of small differences in  $R^2$ 's for the goodness of fit can be made only within the same time period.

#### Results of Model I

The two population variables for the segments 18-20 and 21-44 showed significant relationships with beer sales. The segment of the population 45 and over showed a consistently illogical relationship (inverse) with beer sales and was generally insignificant. The binary variable for the age changes had coefficients in the expected direction but was an insignificant predictor of beer sales. The MBCDL binary variable showed a significant relationship in the expected direction with beer sales.

In its final form, Model I is:

Michigan Beer Sales

|           |   |         |                                                                 |
|-----------|---|---------|-----------------------------------------------------------------|
| (barrels) | = | 833,000 | (a constant term)                                               |
|           | + | 3.548   | (x) Population 18-20                                            |
|           | + | 1.428   | (x) Population 21-44                                            |
|           | - | 15,100  | (x) Unemployment as % of<br>labor force                         |
|           | + | 96,000  | During each year<br>legal drinking<br>age was lower (1972-1978) |
|           | - | 346,000 | During each year of MBCDL<br>(1979-1983)                        |

The independent variables were all significant at the .05 level in all time periods with the exception of the constant which was significant first at the .2 level for the 1954-1974 time period and the legal age change variable. The coefficients exhibited stability across the time periods and their signs were consistent (Table 4). The coefficient of determination ( $R^2$ ) increased from .96 for 1954-1971 to .99 for 1954-1983. This was a very high relationship, especially given the three different growth patterns in the sales data.

Model I predicts that the MBCDL had a negative and significant effect on beer sales in Michigan (Figure 7). The best estimate of that effect was a reduction of 346,000 barrels per year. The effect of the change in the legal drinking age was estimated to be 96,000 barrels per year added to sales when the legal age was 18 years old.

#### Purpose for Model II

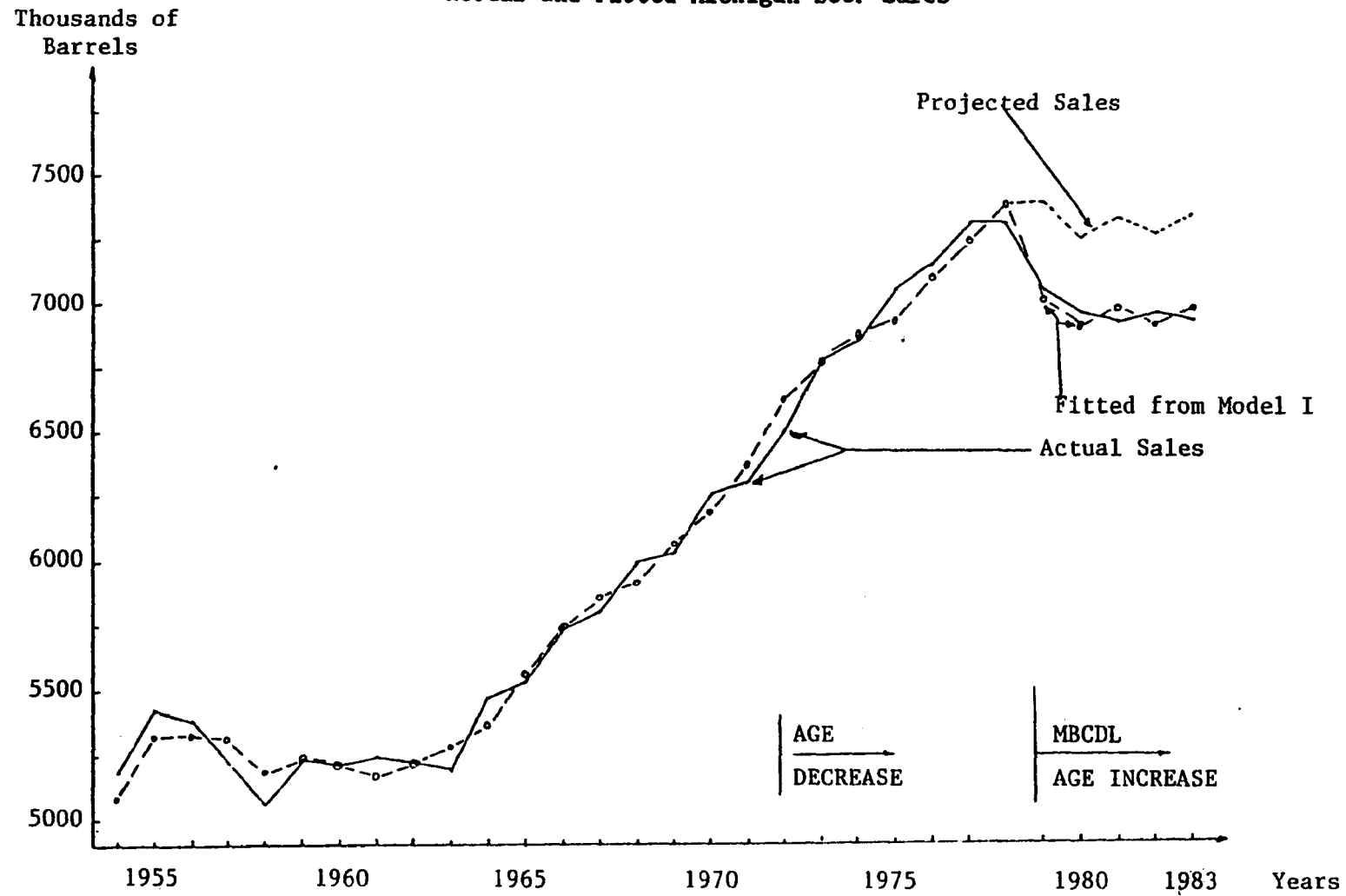
The model described above had the best overall fit with the Michigan data. However, separate measures for price and income could not be incorporated into that model as long as the two population

Table 4Summary of Model IMichigan Beer Sales (Barrels x 1000)  
Ordinary Least Squares Regression

| <u>Period</u>                 | <u>I</u>        | <u>II</u>       | <u>III</u>      | <u>IV</u>       |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|
| <u>Time Frame</u>             | 1954-1971       | 1954-1974       | 1954-1978       | 1954-1983       |
| <u>Column</u>                 | 1               | 2               | 3               | 4               |
| <u>R<sup>2</sup>(Adj.)</u>    | .962            | .982            | .988            | .990            |
| <u>Constant</u><br>(t stat.)  | 929<br>(1.9)    | 811<br>(1.7)    | 790<br>(2.1)    | 833<br>(2.3)    |
| <u>Pop 18-20</u><br>(t stat.) | 3.37<br>(11.0)  | 3.345<br>(11.2) | 3.515<br>(11.8) | 3.548<br>(12.7) |
| <u>Pop 21-44</u><br>(t stat.) | 1.441<br>(6.3)  | 1.492<br>(6.8)  | 1.452<br>(8.5)  | 1.428<br>(8.8)  |
| <u>Munem</u><br>(t stat.)     | -25.1<br>(-3.0) | -25.3<br>(-3.2) | -15.9<br>(-2.1) | -15.1<br>(-2.4) |
| <u>Age</u><br>(t stat.)       |                 | 67<br>(.8)      | 92<br>(1.1)     | 96<br>(1.2)     |
| <u>MBCDL</u><br>(t stat.)     |                 |                 |                 | -346<br>(-2.8)  |
| <u>Durbin</u>                 | 2.4             | 2.3             | 1.9             | 2.0             |
| <u>Watson</u>                 |                 |                 |                 |                 |

Figure 7

MODEL I  
Actual and Fitted Michigan Beer Sales



segments (18-20 and 21-44) were entered as separate variables due to the high level of intercorrelation among the variables. When these two population indicators were aggregated into a single variable for the population 18-44, price and income variables became significant and could be included in a second model, called Model II.

### Income

Total Michigan personal income was used for the income variable.<sup>18</sup> Total income, instead of per capita income, avoids the possible double entry of the population variable or, worse, the clouding of the population variable with a per capita income value based on some different definition of the population. The Index of Buying Power was also tested as an income variable, but its predictive power was similar to personal income so the more commonly known personal income figure was used.<sup>19</sup>

Personal income was deflated to 1967 dollars using the Consumer Price Index (CPI). Real income was increasing throughout the period until 1980 (Figure 8). It increased by a factor of more than 2 during the thirty year period, which was twice the rate of beer sales increase.

### Price of Michigan Beer

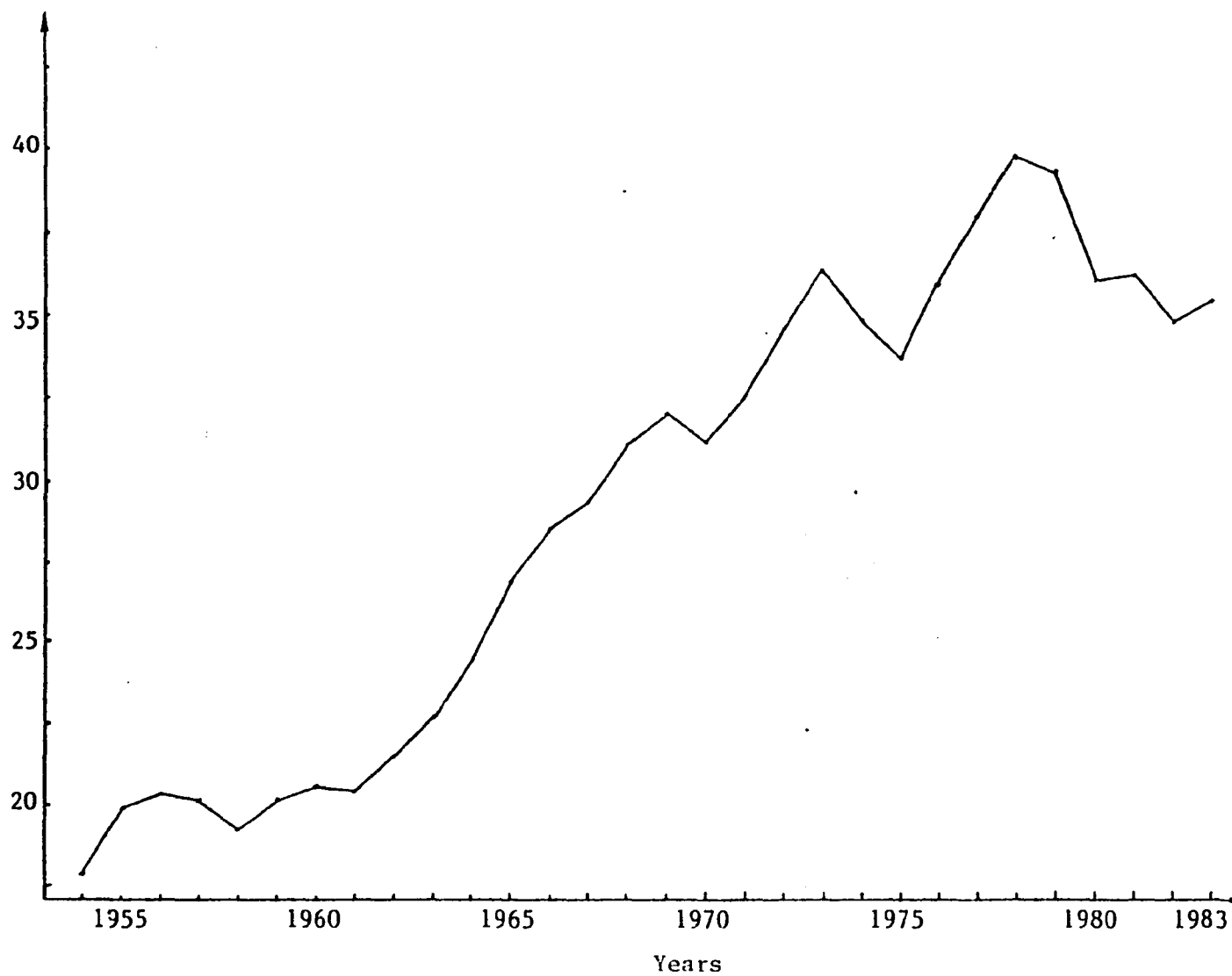
Prior to the MBCDL, there was speculation that the price of beer would change with the law. There have been several studies documenting a price differential for beverages between MBCDL states and non-MBCDL neighboring states.<sup>20</sup> To measure price changes in Michigan, actual beer prices were collected for the period starting with 1976, three years before the law took effect.<sup>21</sup> To incorporate price as a predictor variable in the model, actual Michigan retail shelf prices for the years 1976-1983 were 'spliced into the national Consumer Price Index for beer.<sup>22</sup> The actual Michigan prices used are the average supermarket shelf prices of three premium brands which had a combined market share of about 40% in Michigan during the last five years. Price changes are described in more detail in a later section of this report.

As a check on the validity of the implicit assumption that the price of beer in Michigan prior to 1976 was similar to the average price of beer in the nation (as reflected in the CPI for malt beverages), a

BILLIONS OF  
1967 \$'s

Figure 8

Michigan Total Personal Income  
(1967 Dollars)



comparison was made using the Consumer Price Index for all items. This index is available for the Detroit Metropolitan Area as a sub-set of the national average.<sup>23</sup> The correlation coefficient between these two series was .9998; therefore, Michigan beer prices are assumed to have changed in a similar manner to National beer prices prior to 1976.

A relative Michigan beer price index was derived by dividing the Beer Price index by the Consumer Price Index for Detroit for all items. This relates beer prices to all other consumer expenditures. The relative price of beer declined throughout the period with notable exceptions in 1975 and especially 1979 (Figure 9).

#### Price-Income Variable

Even after aggregating the population descriptors it was not possible to develop a model which included the three main demand variables of population, income, and price separately because of their high degree of intercorrelation. Each was highly significant in combination with one of the others, but together, only two were significant for any time period (at the .05 level). For this reason the two economic indicators, price and income, were combined to form an interactive variable. By multiplying the reciprocal of the price variable times the income variable, a new single variable (PRICINC) was formed. This variable combined the opposite effects of the two component variables (Figure 10). Its form was similar to that of the income variable but the slope of the curve was steeper, especially in the period after 1960. During this period prices were decreasing relatively rapidly and real income was showing large gains. The large increase in relative beer prices in 1979 turned the curve downward. The subsequent price decline in 1981 turned it up again even though income in 1981-1982 was falling. Using this variable, the effects of both price and income could be included in Model II.

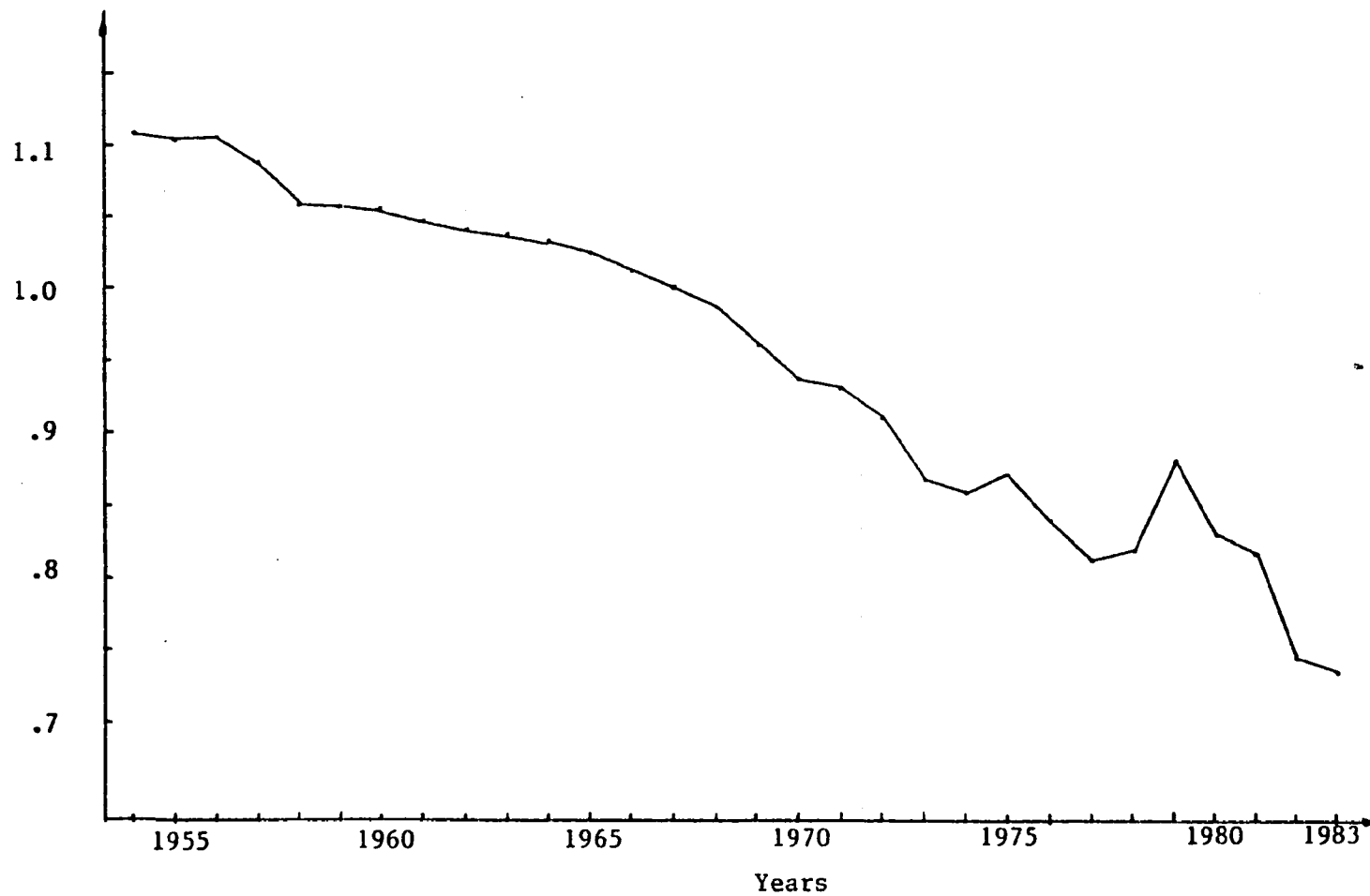
#### Testing Model II

The analysis of Model II was performed similarly to Model I. The two binary variables representing the legal drinking age change and the MBCDL were included. Model II was fitted to the data for the same four time periods that were used earlier. The test statistics indicate that

Figure 9

Michigan Beer Price Index  
(Relative to the CPI-All Items: Detroit)

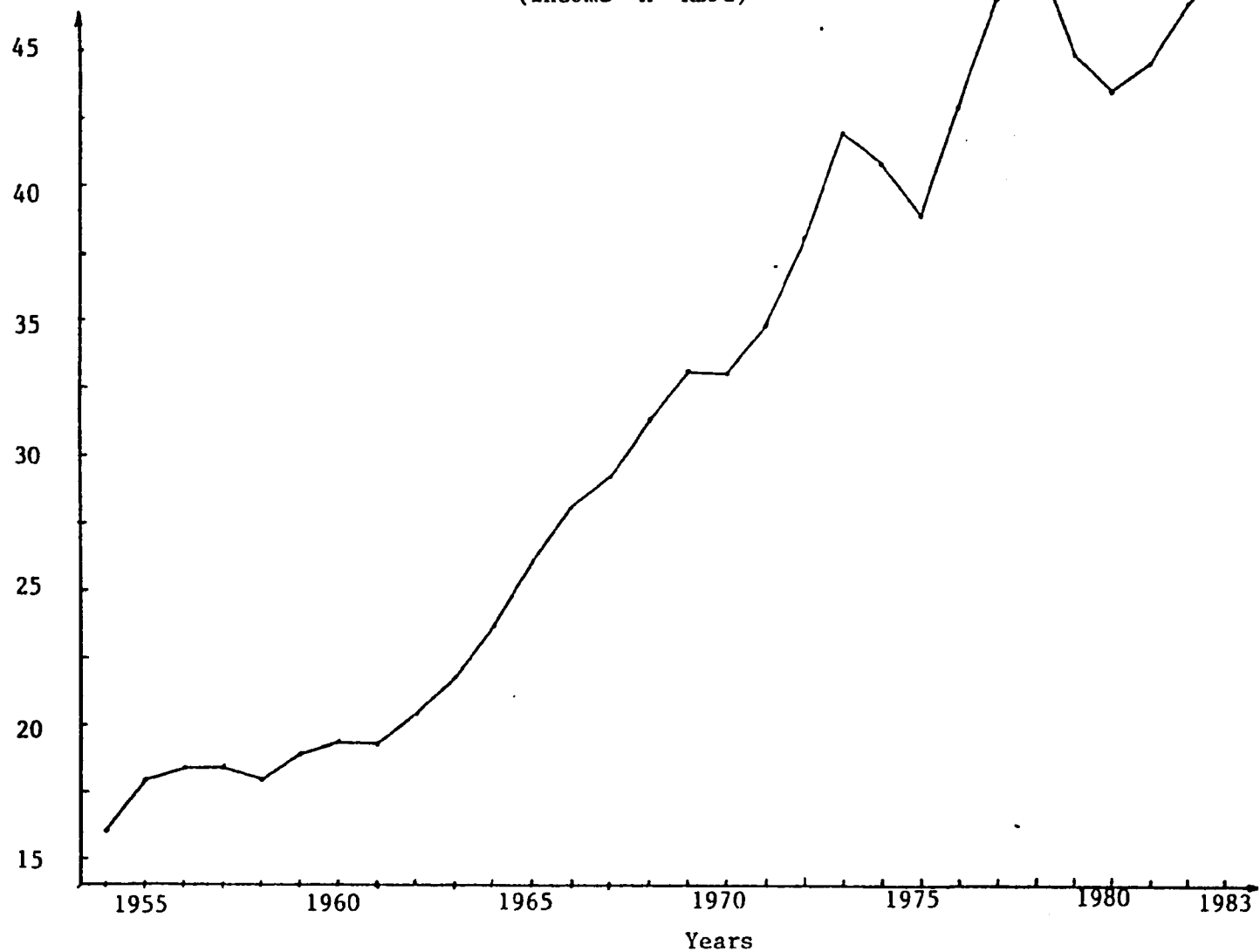
Relative  
Price Index



Billions of  
1967 \$'s

Figure 10

Price-Income Variable  
$$\left( \text{Income} \times \frac{1}{\text{RBPI}} \right)$$



each variable is significant at the .05 level during each time period with the exception of the age change variable (Table 5). Model II describes 94 percent of the variation in actual sales for the shortest period 1954-1971. This percentage increases to over 98 percent for the full 30 year study period.

With prices and income incorporated in the model, the binary variable for lowering the legal drinking age was assigned a negative and insignificant coefficient for the the first three years of the 18 year old legal age. The effect does become positive for the longer periods, indicating an increase in sales as a result of the lower drinking age, but the relationship remains insignificant. Once again, this variable was retained without regard for its statistical significance because the relationship was assumed to be true for the longer periods. If this assumption about the binary age variable is not made, the coefficients for the remaining variables are similar, all significant, and the explanatory power of the model is unchanged.

Model II has a high degree of consistency among the coefficients for the four periods. When the five year MBCDL period (1979-1983) is added to the series, the coefficients remain almost constant. The descriptive power of the model increases marginally from 98.2 to 98.3 percent of the variation in sales (Figure 11).

Numerous other variables were tried in both models, but were rejected for various reasons which are summarized in Appendix II. The major criteria used to include variables were significance of the variables, simplicity of form, and ease of understanding the total resulting model.

Table 5Model II

Michigan Beer Sales (Barrels x 1000)  
Ordinary Least Squares Regression

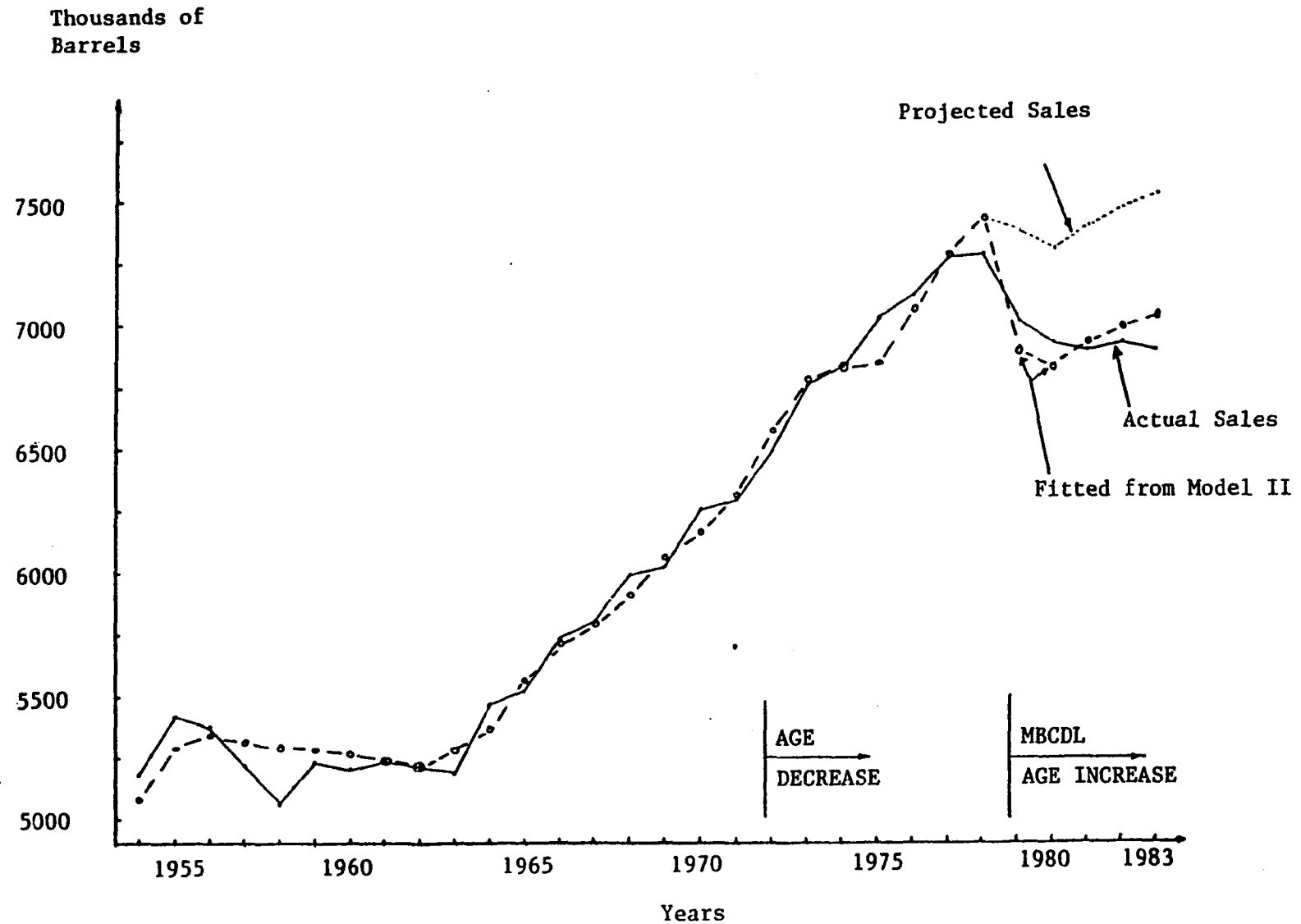
| <u>Period</u>                            | <u>I</u>       |                | <u>II</u>      |                | <u>III</u>     |                | <u>IV</u>     |                |                |
|------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------|----------------|----------------|
| <u>Time Frame</u>                        | 1954-1971      |                | 1954-1974      |                | 1954-1978      |                | 1954-1983     |                |                |
| <u>Column</u>                            | 1              | 2              | 3              | 4              | 5              | 6              | 7             | 8              | 9              |
| <u>R<sup>2</sup>(Adj.)</u>               | .942           | .975           | .974           | .983           | .982           | .956           | .977          | .983           | .983           |
| <u>Constant</u><br>(t stat.)             | 1586<br>(2.4)  | 1544<br>(3.2)  | 1506<br>(2.4)  | 1248<br>(3.0)  | 1410<br>(2.5)  | 3149<br>(6.8)  | 2836<br>(8.3) | 1136<br>(2.7)  | 1325<br>(2.3)  |
| <u>Pop 18-44</u><br>(t stat.)            | 1.089<br>(3.8) | 1.107<br>(5.0) | 1.122<br>(4.3) | 1.248<br>(6.4) | 1.187<br>(4.8) | .400<br>(1.7)  | .627<br>(3.6) | 1.301<br>(6.6) | 1.234<br>(4.9) |
| <u>Pricinc</u><br>(t stat.)              | 3.62<br>(5.1)  | 3.572<br>(5.6) | 3.56<br>(5.4)  | 3.16<br>(4.8)  | 3.193<br>(4.7) | 5.250<br>(5.8) | 3.80<br>(5.2) | 2.93<br>(4.4)  | 2.981<br>(4.4) |
| <u>Age</u><br>(t stat.)                  |                |                | -10<br>(-1.2)  |                | 42.8<br>(.4)   |                | 320<br>(5.1)  |                | 50<br>(.5)     |
| <u>MBCDL</u><br>(t stat.)                |                |                |                |                |                |                |               | -552<br>(-5.7) | -487<br>(-3.0) |
| <u>Durbin-Watson</u><br><u>Statistic</u> | 1.5            | 1.5            | 1.5            | 1.4            | 1.4            | .6             | 1.2           | 1.5            | 1.5            |

Pop 18-44: is the variable for the Michigan population 18 through 44 years old (in thousands).

Pricinc: is the interactive variable equal to the Michigan personal income (constant dollars) times the inverse of the relative Michigan beer price index.

Figure 11

MODEL II  
Actual and Fitted Michigan Beer Sales



Results of Model II

The best estimate of Model II for Michigan beer sales is:

## Michigan Beer Sales

(Barrels)

$$\begin{aligned}
 &= 1,325,000 \quad (\text{a constant term}) \\
 &+ 1.234 \quad (x) \quad \text{Population 18-44} \\
 &+ .00298 \quad (x) \quad \text{Personal Income} \quad (x) \quad \frac{1}{\text{Relative Beer Price Index}} \\
 &+ 50,000 \quad \text{During each year legal drinking} \\
 &\quad \text{age was lower (1972-1978)} \\
 &- 487,000 \quad \text{During each year of MBCDL (1979-1983)}
 \end{aligned}$$

The independent variables are all significant at the .05 level in all four time periods with the exception of the binary variable to represent the lower drinking age during the period 1972-1978 (Table 6). The coefficient of determination is .983 for the full thirty years modeled. The stability of the coefficients assigned to the variables over time frames with distinctly different sales patterns add to the robustness of the model.

Model II predicts a negative effect for the MBCDL. The best estimate of that effect is a reduction of 487,000 barrels per year. The best estimate of the effect of the lower legal drinking age is to add 50,000 barrels per year.

Discussion

A projection of all the independent variables was made to illustrate the dynamic system represented in the model. Beer sales were growing steadily through the 16 year period prior to implementation of the MBCDL (referred to earlier as Phase II). If the factors in the model accurately predict sales, a projection of each of these variables

Table 6Summary of Model IIMichigan Beer Sales (Barrels x 1000)  
Ordinary Least Squares Regression

| Period                     | I              | II             | III            | IV             |
|----------------------------|----------------|----------------|----------------|----------------|
| Time Frame                 | 1954-1971      | 1954-1974      | 1954-1978      | 1954-1983      |
| Column                     | 1              | 2              | 3              | 4              |
| $R^2$ (Adj.)               | .942           | .974           | .982           | .983           |
| Constant<br>(t stat.)      | 1586<br>(2.4)  | 1506<br>(2.4)  | 1410<br>(2.5)  | 1325<br>(2.3)  |
| Pop 18-44<br>(t stat.)     | 1.089<br>(3.8) | 1.122<br>(4.3) | 1.187<br>(4.8) | 1.234<br>(4.9) |
| Pricinc<br>(t stat.)       | 3.62<br>(5.1)  | 3.56<br>(5.4)  | 3.193<br>(4.7) | 2.981<br>(4.4) |
| Age<br>(t stat.)           |                | -10<br>(-1.2)  | 42.8<br>(.4)   | 50<br>(.5)     |
| MBCDL<br>(t stat.)         |                |                |                | -487<br>(-3.0) |
| Durbin-Watson<br>Statistic | 1.5            | 1.5            | 1.4            | 1.5            |

over the years 1979-1983 provides the data base for projecting Michigan beer sales under the assumption that established trends remained as they were in the previous 16 years. For example, in modeling the system as though nothing changed during the projected period, it was necessary to assume that the legal age was still 18 and over, and that deposits on containers were not mandatory.

The difference between projected sales and predictions based on the real 1979-1983 values for the variables shows how much each contributed to the decline in Michigan beer sales (Figure 12). If the system had remained the same in Michigan, the model projected sales of over 8 million barrels in 1983. The difference between the projection and the actual sales of 6.9 million barrels was divided just about evenly between MBCDL and non-MBCDL related factors.

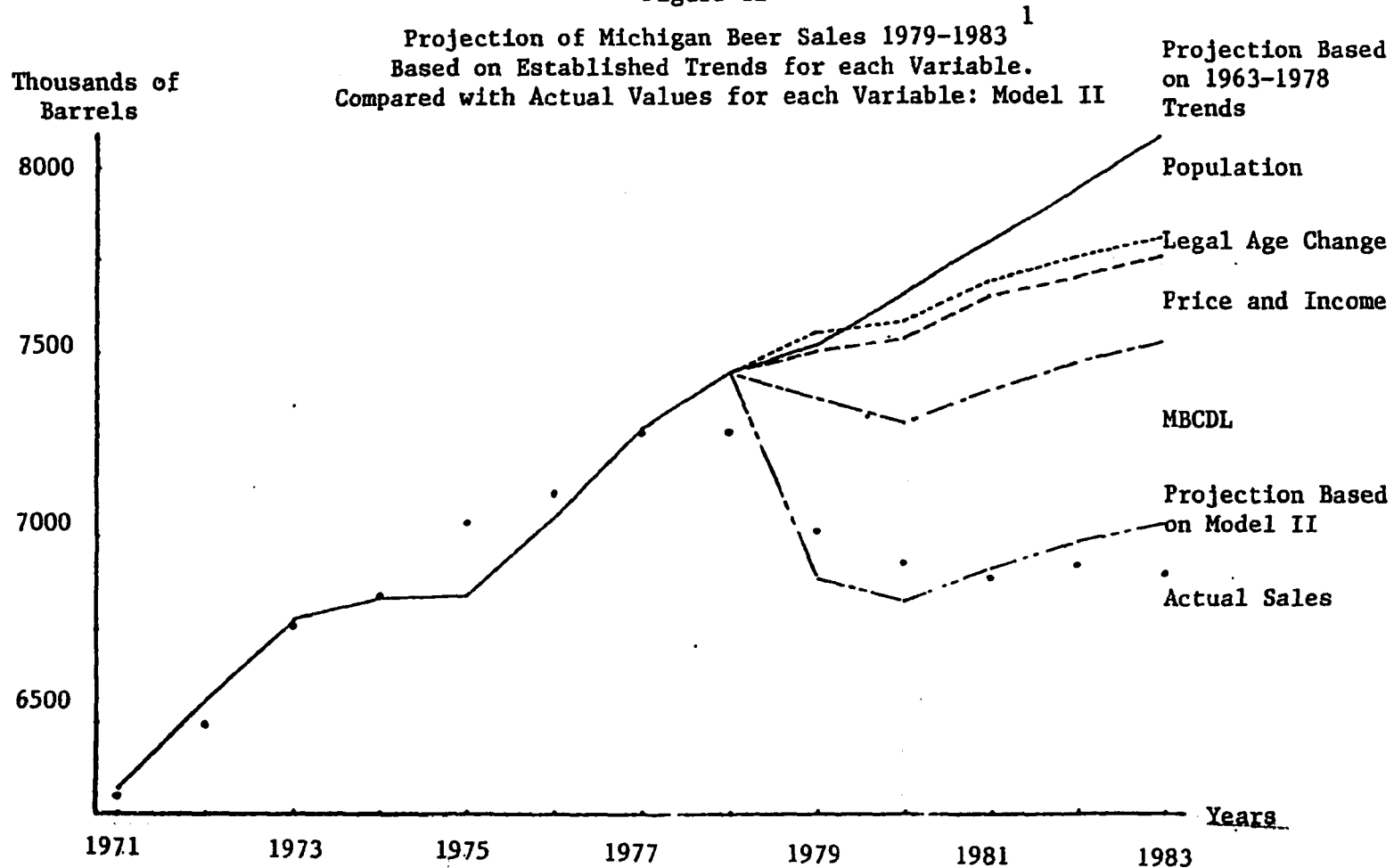
The population 18-44 factor, which was surely unrelated to either the MBCDL or the legal age change, predicted that beer sales would grow at a slower rate during 1980-83 than during the previous 16 years. During 1979, however; this factor predicted sales above the trend.

The smallest portion of the difference was attributed to the legal age change. This was estimated at 50,000 barrels per year.

The price-income variable predicted a decline of 137,000 barrels in 1979 and between 230 to 250 thousand barrels in each of the last four years. Increased prices in 1980 were somewhat offset by increasing income, while in 1981-1983 falling prices offset a decline in income. A portion of the decline in this price-income variable resulted from higher prices associated with the MBCDL and thus would be attributable to the law rather than changes in the economy.

The MBCDL was the major variable and explained 487,000 barrels per year of the difference between projected and predicted sales. It was a binary variable, and therefore measured the effect of all other changes in the system that occurred for the first time in 1979. In contrast, the effect of the MBCDL operating through price increases was explicitly measured by the price-income variable and was an additional effect of the law on sales.

Figure 12



<sup>1</sup> The solid line at the top was made by projecting the trend in each independent variable (1963-78 base) and using the projections to predict 1979-83 sales. This portrays expected sales if everything had remained as it was during the previous 16 years.

The distance between the upper and lower lines for each variable shows how much of the decline in beer sales can be attributed to each variable in Model II, when values computed on the actual data were compared with the trend projected data.

### Associative Model

Sales of beer in Michigan were also compared to beer sales in the four surrounding states of the North-Central census region (Figure 13).<sup>24</sup> The region includes Ohio, Indiana, Illinois, and Wisconsin, all of which share common borders with Michigan. A 30 year period (1954 to 1983) was analyzed. The average of the four states annual beer sales was used to predict Michigan sales using a linear multiple regression technique.

An "associative model" was developed to determine if a pattern existed between regional beer sales and Michigan sales. Such a model could not be used to explicitly explain Michigan beer sales because changes in regional sales obviously do not cause changes in Michigan sales. However, if a pattern did exist, it might be expected to extend beyond the critical year of 1978 if all other things remained equal. Two things were clearly not equal, however; the Michigan MBCDL and the change in Michigan legal drinking age. The increase in legal drinking age is explicitly accounted for in the associative model.

There is a very high degree of similarity between the sales in Michigan and the rest of the region (Table 7). In the period 1954-1971, 97% of the variation is related to regional sales. During the periods covering the 18 year old minimum legal age, the coefficient for the binary age variable is both significant and stable. It adds an estimated 170-190 thousand barrels to sales each year between 1972 and 1978.

In the Associative Model, Michigan sales were fitted to regional sales for the 1954-1978 period and the variable for the legal age change was included (Figure 14). This series was then projected over the years 1979-1983. The binary age variable dropped from 190,000 barrels in 1978 to 0 for the projected period when the legal drinking age reverted to 21. The coefficients for the constant term and regional sales remained the same for the projection (obviously the serial correlation factor is not meaningful for a projection). This projection shows the level of sales which might be expected in Michigan based on the 25 years of prior experience in that region. Projected sales continued to increase through 1981 when actual sales were 10 percent below the projection.

Figure 13

North-Central Region States  
Beer Sales Indices (1967 = 100)

Percent of 1967

Base Year

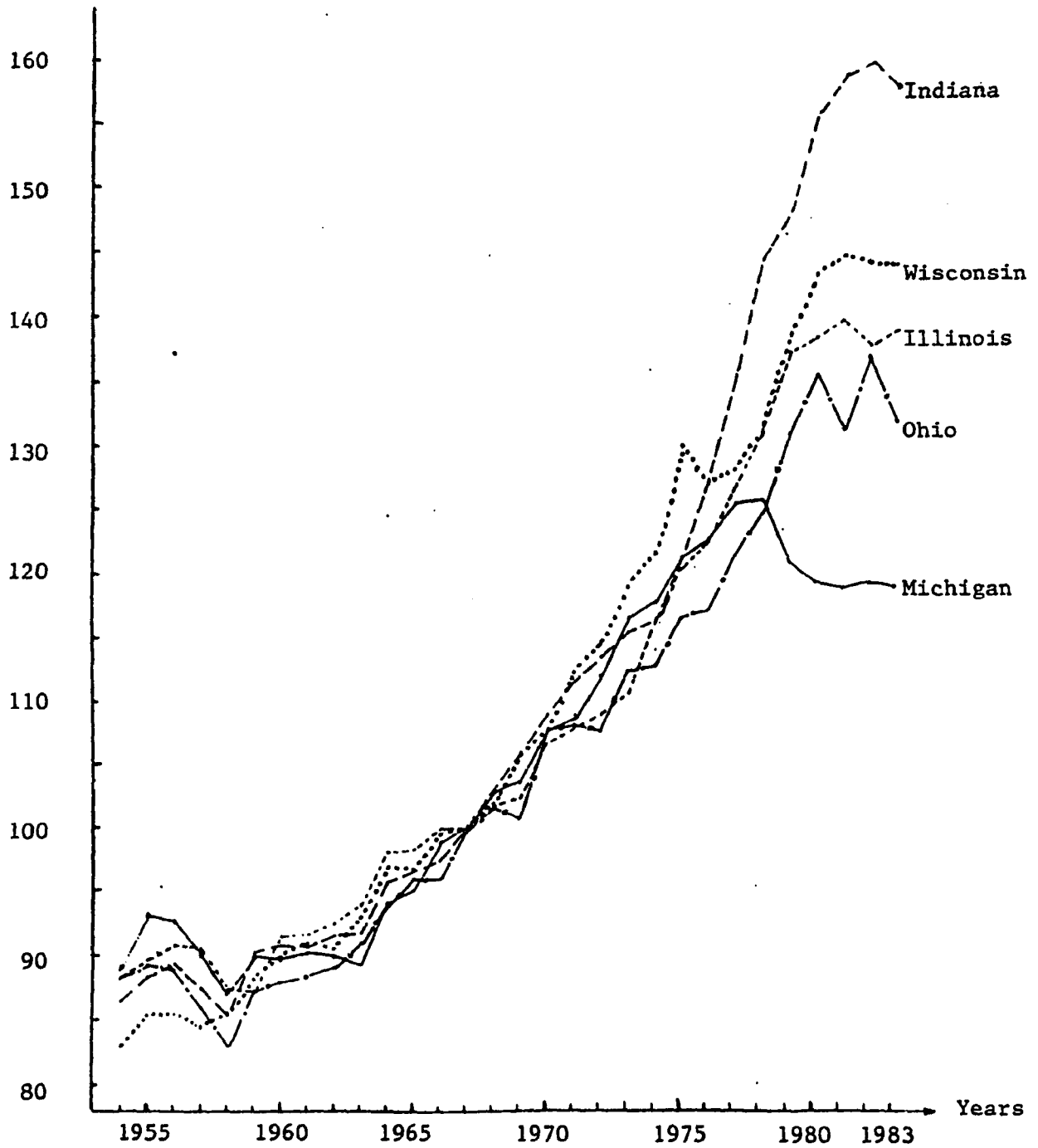


Table 7

Associative Model

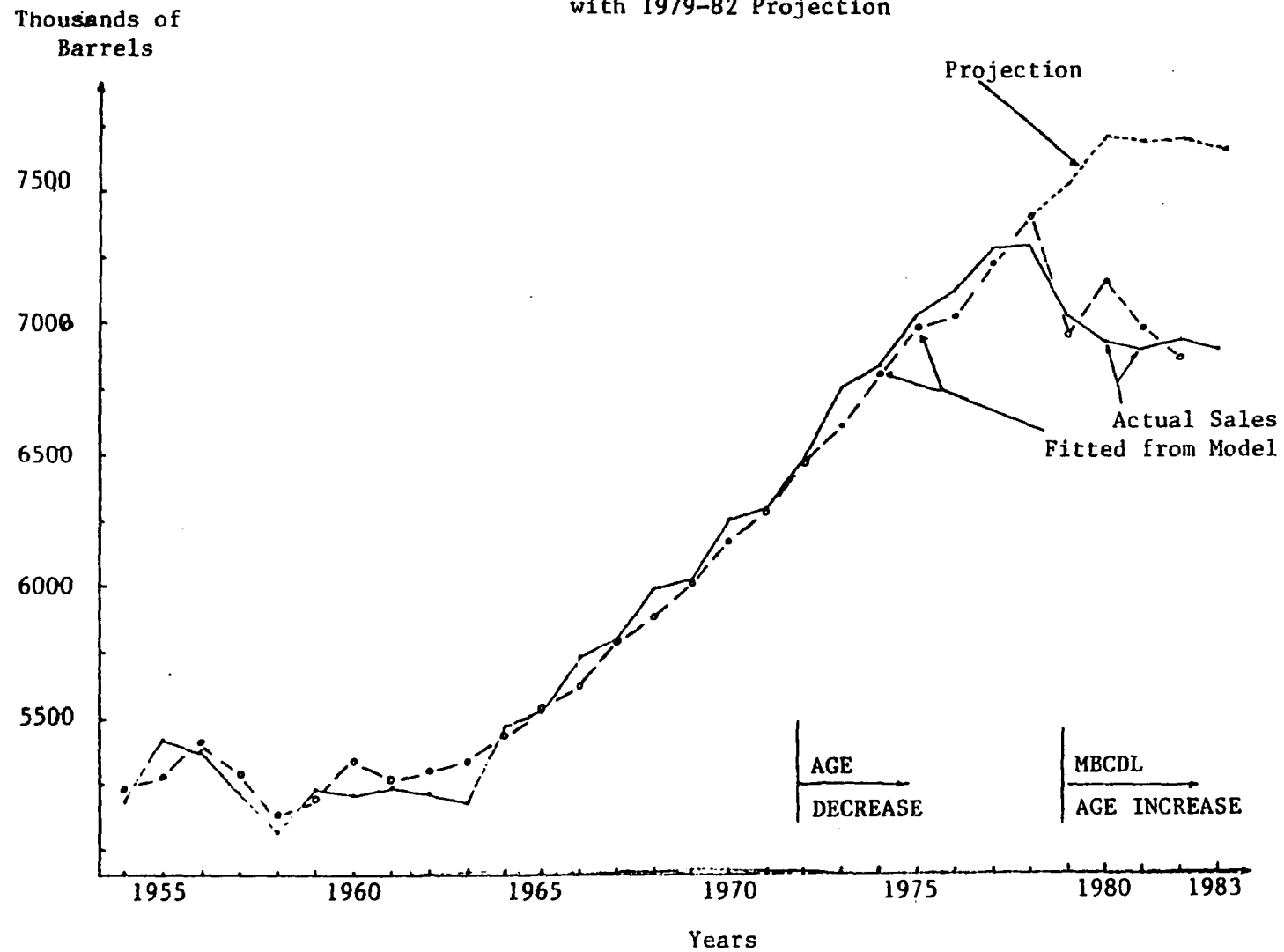
Relating Michigan Beer Sales  
to North-Central Regional Average Sales (Barrels x 1000)  
First-Order Serial Correlation Correction Regression Technique

| Period                     | I              |                 | II              |                 | III            |                | IV            |                |                |
|----------------------------|----------------|-----------------|-----------------|-----------------|----------------|----------------|---------------|----------------|----------------|
| Time Frame                 | 1954-71        |                 | 1954-1974       |                 | 1954-1978      |                | 1954-1983     |                |                |
| Column                     | 1              | 2               | 3               | 4               | 5              | 6              | 7             | 8              | 9              |
| R <sup>2</sup> (Adj.)      | .975           | .969            | .974            | .961            | .968           | .838           | .930          | .937           | .947           |
| Constant<br>(t stat.)      | 513<br>(.9)    | 59<br>(.1)      | 456<br>(1.0)    | 685<br>(1.9)    | 1056<br>(2.9)  | 2661<br>(3.6)  | 2171<br>(5.2) | 1158<br>(2.7)  | 1472<br>(3.5)  |
| NCBA<br>(t stat.)          | 1.115<br>(9.3) | 1.221<br>(12.2) | 1.128<br>(11.4) | 1.083<br>(15.1) | .995<br>(13.0) | .657<br>(4.7)  | .745<br>(9.4) | .981<br>(11.4) | .904<br>(10.4) |
| Age<br>(t stat.)           |                |                 | 171<br>(2.0)    |                 | 190<br>(2.1)   |                | 368<br>(4.8)  |                | 208<br>(2.0)   |
| MBCDL<br>(t stat.)         |                |                 |                 |                 |                |                |               | -600<br>(-5.2) | -395<br>(-2.5) |
| Rho<br>(t stat.)           | .699<br>(4.4)  | .710<br>(4.8)   | .686<br>(4.4)   | .714<br>(5.2)   | .678<br>(4.5)  | .894<br>(12.9) | .796<br>(7.4) | .776<br>(7.0)  | .728<br>(5.8)  |
| Durbin-Watson<br>Statistic | 1.8            | 1.8             | 1.9             | 1.6             | 1.7            | 1.3            | 1.8           | 1.9            | 2.0            |

NCBA: is the average of Illinois, Indiana, Ohio and Wisconsin beer sales in thousands of barrels.

Figure 14

Associative Model  
Actual and Fitted Michigan Beer Sales 1954-83  
with 1979-82 Projection



### Results of the Associative Model

When the full time period was used the Associative Model provided estimates for both binary variables. The MBCDL was estimated to reduce sales by 376,000 barrels per year. The lower legal drinking age was estimated to increase sales by 190,000 barrels per year, for the years 1972 through 1978. The serial correlation correction factor was .83 in this model. This means that 83% of the error in prediction during each year was corrected (added or subtracted depending on the direction of the error) in the following year's estimate. As a result of this correction factor the MBCDL binary variable estimate is conservative.

### Summary of Model Results:

Three models for beer consumption in Michigan have been presented. Model I included two predictors based on significant segments of the population and the unemployment rate as an economic indicator. This model predicted sales for the 30 year period with 99 percent accuracy. The model was especially accurate in predicting sales for the last five years.

Given the abrupt increase in the relative beer price when the MBCDL took effect, a second model was constructed including price and personal income as an interactive predictor variable. Model II also predicts over 98 percent of the change in beer consumption over the thirty year period.

Based on these statistical models, a range can be determined for the best estimate of the effect of both the MBCDL and the legal drinking age change in Michigan. The MBCDL is estimated to have resulted in a decline of between 346,000 barrels per year from Model I and 487,000 barrels per year from Model II. These effects were significant at the .05 level in each case.

The predicted effect of the change in each demand variable in Model II was developed from trends established during the years 1963-1978. If the effect of the price increase during 1979, which exceeded normal inflationary increases, is assigned to the MBCDL, the difference between actual and predicted sales is almost 500,000 barrels or 7 percent of sales. The predicted effect of the law remained constant at 7 percent per year for 1980-1983. Model I and the Associative Model, based on

regional sales trends, both estimated the effect of the MBCDL on sales to be a 5 percent annual decline.

The effect of lowering the legal drinking age from 21 to 18 is estimated to have increased sales by 96,000 barrels per year in Model I and 50,000 barrels per year in Model II. These figures are not significant at even the .8 level, but were included because of the researchers' belief that the relationship was a true one. This assumption reduced the estimated effects of the MBCDL, thus diminishing the risk of overstating the effect of the MBCDL on sales. Illinois raised its legal drinking age from 19 to 21 on January 1, 1980. Beer sales continued to increase in both 1980 and 1981 (figure 13).

The Associative Model was constructed to relate Michigan sales to sales in the four surrounding states of the North-Central census region. This Associative Model showed that sales in Michigan were highly similar to regional sales from 1954 through 1978. The drop in Michigan sales during 1979 was a significant divergence from the regional trends, where average sales continued to increase through 1981. The age variable was significant in this model, supporting the decision to retain it in previous models. Given the goodness of fit for the 25 years preceding the MBCDL, there was no reason to expect the decline in Michigan sales experienced since 1979 based on regional sales.

### MICHIGAN BORDER-COUNTY SALES

#### Introduction

Many border area retailers and wholesalers have claimed that the MBCDL left them at a competitive disadvantage with respect to out-of-state suppliers.<sup>25</sup> In response, in 1980, the legislature made it illegal and a felony to import more than one case of beer into Michigan.<sup>26</sup> The import law is very difficult to enforce, but it indicates that the Michigan Legislature considered the border issue to be significant.

In 1981, a survey of border area wholesalers was conducted by the Michigan Beer and Wine Wholesalers Association at the request of the Michigan Liquor Control Commission.<sup>27</sup> The results showed a very

significant border effect. Unfortunately the study compared package sales in border counties to total volume (in barrels) of state-wide beer sales. They also varied in the base year for the calculations and maximized the difference between border sales and state sales.

Several factors influenced border-county sales. Therefore, care was again taken to isolate the role of the MBCDL. The legal drinking age increase in 1978 was an especially important factor. This may have reversed an earlier border effect which resulted when the legal drinking age was lowered back in 1972. During the years of 1972 through 1978, out-of-state youth age 18-21 could come to Michigan and legally purchase alcohol. The legal drinking age was 21 in Indiana throughout the period and 21 in Ohio except for 3.2 percent alcohol beer which was 18. In Illinois the legal age for beer and wine was reduced from 21 to 19 in September, 1973, and restored to 21 in January 1980.

When the legal drinking age was raised in 1978, these out-of-state youth were removed from the potential market along the border.<sup>28</sup> At public hearings held in the border town of Niles, Michigan, in 1979, most of the retailers and wholesalers who testified felt that about half of their loss in beer sales was caused by Michigan raising the drinking age.<sup>29</sup>

### Method

The present study separated data for the seven counties along Michigan's southern border from the rest of the state and compared sales before and after implementation of the MBCDL (see Appendix 3 for a map of the area). A border effect would also be expected along the border between Michigan's Upper Peninsula and Wisconsin. The minimum legal drinking age for beer in Wisconsin has been 18 since the repeal of prohibition. It is expected that some Michigan 18 to 20 year olds crossed into Wisconsin to legally purchase beer before 1972 and again after 1978. This border effect was not studied. The border with Canada is not affected because it is an international border with customs stations.

Two years of sales data before and after implementation of the MBCDL were used in order to minimize any effects that might have been caused by the transition to an all-refundable system.<sup>30</sup> Beer sales were

divided into draught and packaged sales. Draught was considered to be consumed on-premise and is not regulated by the MBCDL. The data for the rest of the state equal total state sales minus the southern border-county sales.

A study of the 1972 reduction of Michigan's legal drinking age was made to determine if a reverse border effect occurred then, i.e., an increase in Michigan border county beer sales to out-of-state residents 18 to 20 years of age who entered Michigan to legally purchase beer. Such an effect would be assumed to be equal and opposite to that of raising the drinking age in 1978. <sup>31</sup>

### Results:

For 1977 and 1978, beer sales in Michigan's seven southern border counties amounted to 6 percent of the total state sales. The relative change in annual packaged beer sales along the border was similar to the rest of the state through 1978 (Figure 15). The border area showed a much larger decline in 1979 than was experienced in the rest of the state. Since then, border area sales have remained below the rest of the state. The one-time decline was followed by a resumption of the sales pattern experienced in the rest of the state.

Between 1977-1978 and 1979-1980, draught beer sales in the border counties rose by the same amount (28 percent) as total state draught sales (Table 8). Package sales in the border counties, however, declined by more than twice as much as total state sales (-26 percent for border; -10 percent for rest of state). Total sales (in barrels) in the border area declined by 17 percent whereas total sales in the rest of the state declined by only 3 percent.

Industry sources report that young people in Michigan frequent bars proportionately less than other age groups except in university and college towns, and there are no large colleges in the border counties. Thus, the impact of out-of-state youthful drinkers coming into Michigan would be expected to effect package sales, which they could take with them, more than draught. A 28 percent increase in draught sales occurred throughout the state in 1979-1980, despite a 7 percent decline in the number of legal Michigan drinkers. Therefore, the rise in draught sales may be considered more of an effect of the MBCDL and not

Figure 15

**Relative Changes in Package Beer Sales  
Border Sales and State Sales  
(1975=100)**

Percent of  
1975 Sales

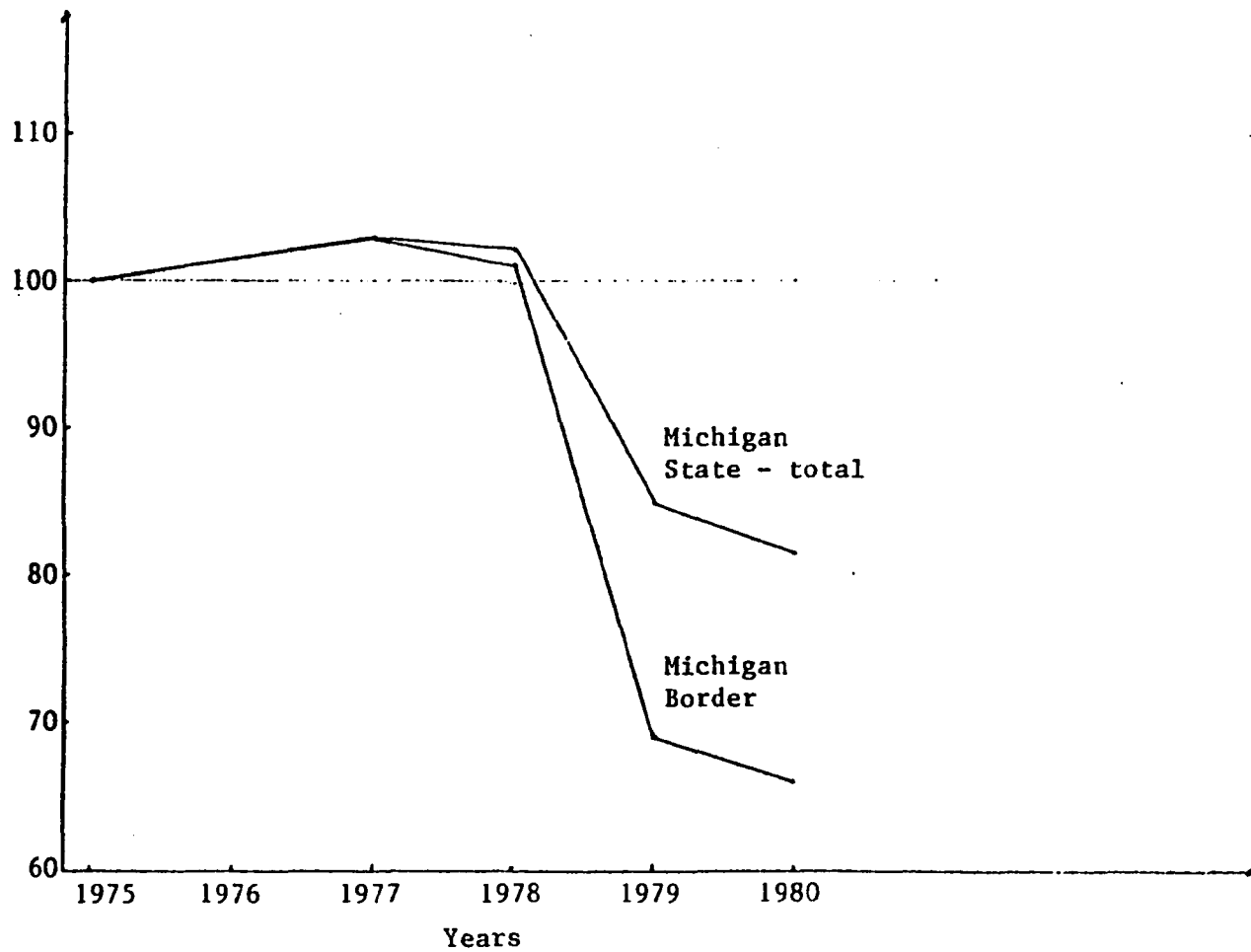


Table 8

Michigan Beer Sales  
1977-1980 Border and State Comparison<sup>1</sup>

|                                        | 1977-1978<br>Average | 1979-1980<br>Average | Percent<br>Change from<br>1977-1978<br>Average |
|----------------------------------------|----------------------|----------------------|------------------------------------------------|
| <u>Border (7 Counties)<sup>2</sup></u> |                      |                      |                                                |
| Packaged (case of 24)                  | 5,680,000            | 4,180,000            | -26%                                           |
| Draught (barrels)                      | 47,600               | 60,700               | +28%                                           |
| Total Volume (barrels)                 | 446,700              | 372,200              | -17%                                           |
| <u>Rest of State (76 Co.)</u>          |                      |                      |                                                |
| Packaged (case of 24)                  | 86,660,000           | 77,760,000           | -10%                                           |
| Draught (barrels)                      | 775,000              | 991,300              | +28%                                           |
| Total Volume (barrels)                 | 6,841,000            | 6,608,500            | - 3%                                           |

Table 9

Michigan Beer Sales  
1971-1972 Border and State Comparison<sup>1,3</sup>

|                               | 1971       | 1972       | Percent<br>Change<br>from 1971 |
|-------------------------------|------------|------------|--------------------------------|
| <u>Border (7 Counties)</u>    |            |            |                                |
| Packaged (cases of 24 ctrs)   | 2,120,000  | 2,540,000  | +20%                           |
| Draught (barrels)             | 15,500     | 18,800     | +21%                           |
| <u>Rest of State (76 Co.)</u> |            |            |                                |
| Packaged (cases of 24 ctrs)   | 35,360,000 | 40,100,000 | +13%                           |
| Draught (barrels)             | 296,600    | 351,200    | +18%                           |

1) Based on shipments of beer to wholesaler's warehouses located in each county. Wholesaler's territories may not conform to county boundaries.

2) These seven counties are Berrien, Branch, Cass, Hillsdale, Lenawee, Monroe, and St. Joseph.

3) Three brands were used comprising 50 percent total of state sales. The data was not available in aggregate form by largest selling brands were compiled.

related to migration over the border. The larger decline in package sales along the border than in the rest of the state, however, may well be related to both the MBCDL and the change in Michigan's legal drinking age.

#### 1972 Age Decrease

To isolate the impact of the age change from the MBCDL, data for before and after the 1972 legal age decrease were analyzed. Sales for three specific brands of beer, representing over 50 percent of total beer sales, in the border area were compared to sales in the rest of the state (Table 9).

In 1972, draught sales in the border counties rose at about the same rate as in the rest of the state. Package sales increased 7 percent more along the border than in the rest of the state. The increased package sales may well have been sales to out-of-state 18-20 year olds. The legal age in Illinois and Indiana in 1972 was 21 for all alcoholic beverages, and in Ohio it was 21 for all alcoholic beverages except 3.2 % beer where it was 18.

The best estimate of the effect of lowering the legal drinking age from 21 to 18 on border-area package beer sales, therefore, is 7 percent. To assume that raising the drinking age back to 21 in 1978 decreased border area package sales by a similar 7 percent may exaggerate the impact on border sales for two reasons. First, the absolute size of the change in the legal population segment was smaller in 1979 than in 1972. Second, the legal drinking age in Illinois was 19 throughout 1979 so a portion of the out-of-state youth who were potential Michigan customers in 1972 were probably not customers in 1979. In reverse, however, some Michigan 19 and 20 year olds may have begun to travel to Illinois in 1979 to legally purchase beer there. To study this effect, package beer sales were analyzed for the Michigan county closest to the Illinois border (Berrien) for 1977-78 and 1979-80. Sales were found to be similar to the other Michigan border counties. This potential out-migration in 1979, therefore, was assumed to be negligible.

Discussion

Just after the MBCDL and the increase in legal drinking age came into effect, package sales in Michigan border counties declined by 16 percent more than in the rest of the state (26 percent - 10 percent). The best estimate of the effect of increasing the legal drinking age to 21 years of age on border sales was a 7 percent decline in package sales. Therefore, it is estimated that the MBCDL caused package beer sales in border counties to drop by 9 percent more than the rest of Michigan (16 percent - 7 percent = 9 percent).

The price of beer in Michigan after 1978 rose faster than the price of beer throughout the nation and, specifically, it rose faster than the price in the border state of Indiana.<sup>32</sup> This is one motivation for Michigan consumers to purchase beer out of state. Although a full discussion of the cost justification of increased beer prices in Michigan is beyond the scope of this report, it is clear that part of the increase in price in 1979 was a result of the MBCDL. Change in the price of beer in Michigan is the topic of the last section of this report. A change in purchase patterns resulting from the price change associated with the MBCDL would also be attributable to the MBCDL.

The convenience of the no-deposit container is another potential reason for leaving the state to purchase beer. Consumers purchasing out-of-state beer may desire the convenience of disposing of the containers rather than returning them. This argument has been forwarded as an explanation of the growing popularity of non-returnable beverage packaging throughout the last 25 years despite the traditionally higher retail prices for such convenience packages.<sup>33</sup> The motivation to purchase convenience packages as a reason for purchasing beverages outside of Michigan is also assignable to the MBCDL.

The price of deposits must also be considered. It is an out-of-the-pocket cost for the consumer at the time of purchase. It increased the cost of a 12 pack of 12 ounce cans, the most popular package before 1979, by \$1.20 or about 35 percent of the product price. This money is subsequently refunded to the consumer when the containers are returned, but there is an obvious time delay. Numerous interviews with retailers confirmed that beverages are purchased in units of 6 or 12 containers but usually returned several cases at a time.

### Conclusions about Border Sales

There is a border effect in Michigan resulting from the MBCDL. The best estimate of this is just under 9 percent of pre-legislation package sales for the seven counties along southern border. The effect is highly localized because of the transportation costs involved when consumers drive out of the state to purchase beer. It is equivalent to about 600,000 cases of beer annually for Michigan's seven southern border counties. This effect obviously would be eliminated if a national MBCDL was enacted. In contrast, however, for small states or states with large population centers near borders, the border effect on state sales, tax revenues, and the effectiveness of the law in eliminating non-returnable beverage packages from the solid waste stream may be significant.

## CONTAINER MIX

### Introduction

This section presents an analysis of the change in package types that resulted in Michigan from the MBCDL.

Mandatory beverage containers deposit laws, as their names state, are restrictive legislation targeted directly at beverage containers. There was much speculation about the effects required deposits would have on the market share of the various containers. Many people in Michigan, especially the voting public, expected can sales to decline sharply or disappear. Required deposits were also expected to reduce the use of non-refillable glass containers.<sup>34</sup>

The Michigan law contained a two tier deposit system to add further economic incentives for consumers to choose refillable beverage containers. It was modeled after the Oregon deposit law and required a five cent minimum deposit on "truly refillable" containers and a ten cent minimum deposit on all others. This political decision of minimum deposit levels was expected to encourage the use of bottles that could be reused by many manufacturers. The high refund value on not-refillable containers also provides more economic incentive for littered containers to be retrieved and refunds collected. Refillable bottles were seen as the environmentally preferred container.<sup>35</sup>

### Methods

Beer shipments to wholesalers by container type were compiled for the four years preceeding the MBCDL and for four years after its implementation (1975-1982). Beer shipments were separated into four container types. These were:

19-trip refillable bottles: These bottles are designed for crown caps, such as the "long neck, export" bottle and the new standard-select "Michigan" bottle. The 19-trips represents an assumed national average of fillings for a refillable bottle before it is discarded either as defective or through not being returned.

4-trip refillable bottles: These bottles are lighter weight bottles with screw-off closures. They are more prone to chipping and breakage than the 19-trip bottles. They are used by Anheuser-Busch and Falstaff. The choice of 4 as a trippage rate was a compromise between user claims of 6 trips and industry estimates of 3 trips.

Non-Refillable bottles: These are designed to be used only once before being discarded or remelted. In non-deposit states, these packages are known as non-returnable bottles.

Cans: These metal containers can be used only once and then discarded or remelted.

Annual data on sales by brewers to wholesalers were aggregated from Michigan Liquor Control Commission annual reports. A number of additional assumptions were made in using that data base for this part of the study.

1. Some miscellaneous bottle sales (less than 1 percent of total) were not identified by type. These were split 50-50 between 19-trip refillable bottles and non-refillable bottles.

2. Miller brewing company glass bottles for 1979-1983 were divided 10 percent 19-trip refillable and 90 percent non-refillable bottles on the basis of wholesaler interviews.
3. All containers of a given type were aggregated regardless of package size.
4. Figures were for all packages sold and include both on-premise (exempt from the MBCDL) and off-premise sales.
5. For 1975-1978 bottle sales, all foreign bottled beer (imported) was assumed to be in non-refillable bottles.
6. The market share of domestic bottled beer in refillable bottles was assumed to be equal to the national average of 36 percent.<sup>36</sup> This was the 1976 estimate and it was used for all four years. As the national average percent of bottled beer refillable glass containers was declining during the period this may slightly inflate actual refillable container share in 1977 and 1978.
7. For Anheuser-Busch, 5 percent of all 12 ounce bottles were assumed to be 4-trip refillable in 1981 during test marketing of this container. All Anheuser-Busch 12 ounce bottles were 4-trip refillable for 1982.
8. All refillable quart bottles were considered to be 4-trip refillable. This reflected the combined effects of being sold in single unit packages which leads to higher breakage of the heavy bottles and the reported low return rates for these bottles.

Changes in container market shares were analyzed by aggregating sales in two ways. Total state sales showed the impact of the MBCDL on package use in Michigan. Segmenting sales by brewer location into Michigan brewers and out-of-state brewers provided a measure of the effect of distance from the market on package use decisions.

### Results

The total number of packages sold in Michigan increased by 2.3 percent each year from 1967 through 1978 (Figure 2). In 1979 sales were down 11 percent from the previous year. Sales continued to decline at a rate of 3 to 4 percent per year through 1983. Sales for 1983 were 70.4 million cases.

The market for cans increased at a faster rate than total sales for the period 1967 to 1973. They continued to grow, but at a slower rate through 1977 before beginning the sharp fall, losing 9 percent in 1978 and then 44 percent in 1979. This dramatic drop in can sales was a result of the MBCDL.

The trend in bottle sales was almost opposite that of can sales. When can sales were growing rapidly bottle sales were declining. After 1973, when the increase in can sales slowed, bottle sales were stable. Bottle sales began to grow in 1977, and in 1979 they increased 50 percent over the previous year. Since 1980, bottle sales have been declining.

The package mix for the four years before and four years after the MBCDL (1975-1982) is presented in Table 10. Only two of the three glass containers types were being used in Michigan prior to the MBCDL. The 4-trip refillable bottle first appeared in 1979 and was the same bottle Falstaff used as a non-refillable in 1978 with the addition of the required Michigan Refund label. This bottle is still being used in other states as a non-refillable container.<sup>37</sup> Anheuser-Busch introduced their proprietary 4-trip bottle in 1981, giving importance to this type of container.

The MBCDL led to major immediate shifts in the market share of the various containers (Figure 16). The total number of packages dropped by 9 percent in 1979. All of that decline came from can sales which dropped 44 percent from their 1978 levels. Refillable bottle sales more than doubled as they once again were stocked on retailer's shelves. Dwindling off-premise sales of beer in refillable bottles during the 1960s had virtually eliminated this container from retail stores. Non-refillable bottles, unexpectedly, maintained sales after the MBCDL and therefore gained a larger share of the shrinking market. These changes are discussed in more detail below.

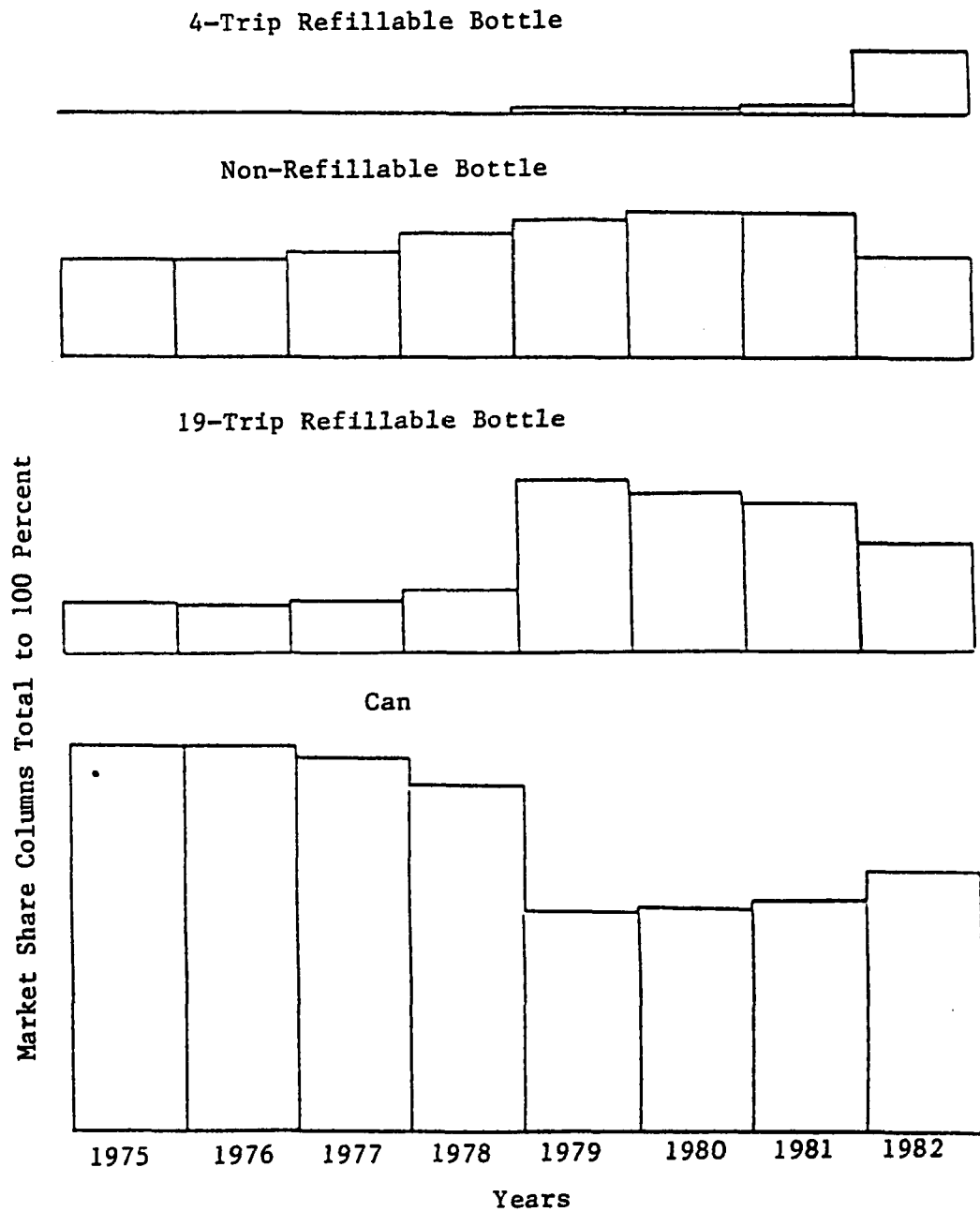
The increase in non-refillable bottles in 1977 and 1978 follows a national trend toward more one-way glass containers. This container retained its absolute position in the market during the first three years of the MBCDL. In 1982, the Anheuser-Busch conversion of its popular Michelob brand to a 4-trip bottle reduced the market share of non-refillable bottles. Sales of beer in non-refillable bottles,

Table 10

Michigan Package Mix by Container Type and Market Share

(Containers in 1000's of cases of 24 containers)

| Container Type                  |                            | 1975            | 1976            | 1977            | 1978            | 1979            | 1980            | 1981            | 1982            |
|---------------------------------|----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 19-Trip<br>Refillable<br>Bottle | Containers<br>Market Share | 8,500<br>10.1%  | 8,266<br>9.7%   | 9,085<br>10.3%  | 10,778<br>12.2% | 26,453<br>33.3% | 23,285<br>30.6% | 20,678<br>28.2% | 14,485<br>20.0% |
| 4-Trip<br>Refillable<br>Bottle  | Containers<br>Market Share | -0-<br>-        | -0-<br>-        | -0-<br>-        | -0-<br>-        | 744<br>.9%      | 854<br>1.1%     | 1,239<br>1.7%   | 8,644<br>12.0%  |
| Non-Refillable<br>Bottles       | Containers<br>Market Share | 16,000<br>19.0% | 16,077<br>18.8% | 18,005<br>20.5% | 21,325<br>24.4% | 21,292<br>26.8% | 21,815<br>28.7% | 20,935<br>28.5% | 14,242<br>19.7% |
| Total<br>Bottles                | Containers<br>Market Share | 24,500<br>29.2% | 24,343<br>28.5% | 27,090<br>30.9% | 32,103<br>36.7% | 48,519<br>61.1% | 45,955<br>60.4% | 42,852<br>58.4% | 37,371<br>57.7% |
| Cans                            | Containers<br>Market Share | 59,513<br>70.8% | 61,198<br>71.5% | 60,688<br>69.1% | 55,414<br>63.3% | 30,792<br>38.8% | 30,168<br>39.6% | 30,538<br>41.6% | 33,933<br>46.9% |
| Total<br>Package                | Containers                 | 84,013          | 85,540          | 87,778          | 87,517          | 79,380          | 76,123          | 73,390          | 72,294          |

Figure 16Michigan Market Share by  
Package Type

therefore, did not decline until four years after the deposit law took effect. The MBCDL did not eliminate non-refillable bottles as many predicted.

The 19-trip refillable "export" bottle increased by more than 150 percent in 1979. The standard select (or so called "Michigan") bottle was introduced with the MBCDL. This bottle was shorter than the traditional "export" refillable bottle and larger in diameter allowing for greater productivity (higher line speeds) on the filling lines. There were also savings in distribution as the new bottle required a third less space in shipping and storage compared with the old "export" bottle. In the ensuing years, however, the use of the standard select bottle declined steadily as brands returned to their distinctive non-refillable bottles. When Anheuser-Busch put its full product line into distinctive proprietary 4-trip bottles in 1982, 19-trip refillable bottles were reduced to approximately their pre-MBCDL level. It appears that the two-tiered deposit system with the higher 10 cent deposit on non-refillable bottles was not effective in altering consumer behavior in favor of the environmentally preferable, refillable container. Anheuser-Busch's new 4-trip refillable bottle also carries the higher 10 cent deposit as do non-refillable bottles and therefore emphasizes this point.

The 4-trip refillable bottle came into use in 1979. These containers were designed for use with twist-off closures which makes the finish (the top of the bottle) thinner and much more prone to chipping than traditional refillable bottles. As the finish is the weakest point in the bottle, the entire bottle is made of lighter weight construction than the 19-trip refillable bottle. The small number of refillable quart bottles are included in this 4-trip containers because in practice they have a high breakage rate and a low return rate. The 4-trip refillable container had an insignificant market share until 1982 when Anheuser-Busch converted all of its 12 ounce bottles to 4-trip refillables. Suddenly, 4-trip containers numbered 40 percent of all refillable bottles. The Anheuser-Busch refillables carry the higher 10 cents deposit because they are proprietary bottles with the special shape and markings of the company. Falstaff uses a certified 4-trip bottle which is allowed to carry a 5 cent deposit.

The sales of cans dropped by 43 percent in 1979. Since that time, can sales have been constant in spite of the decline in total sales. This means that the market share for cans has been increasing. There has been a noticeable shift to aluminum cans (almost 100 percent) in the Michigan market and the rest of the nation. While there is a national trend in this direction, Michigan wholesalers have expressed a strong preference for brewers to supply aluminum cans. Wholesalers initiate the deposits on cans and, therefore, must dispose of them when returned. Scrap aluminum is worth much more than scrap steel. Or, in the words of one wholesaler, "If we're going to be forced into the scrap business, we're going to (expletive deleted) well make money at it."<sup>38</sup>

### Discussion

When the MBCDL was first implemented, many Michigan retailers expedited the decline in can sales by refusing to stock cans. They had three reasons for this action. First, they were not happy with the extra labor burden the legislation placed upon them and decided it was easier for them to handle bottles. In the early months of the MBCDL, wholesalers required retailers to return the cans in the corrugated trays on which they were originally delivered. This proved difficult and time consuming for both retailer and wholesaler alike. Within the first year the system was changed to using the plastic bags in boxes for can returns. The second reason was the popular image of the law as a "bottles bill." Retailers reasoned that consumers had voted in favor of bottles--period. Third, bottles generally had a 30 cents per six-pack lower deposit than cans. Retailers thought this difference in out-of-pocket cost would influence consumer choice.

One expectation of mandatory deposit legislation has been that brewers located close to the market would find it economical to use refillable bottles. Corporate decisions concerning the packages sold in Michigan, however, are made on the basis of numerous criteria. This is particularly true for bottles. For example, the Miller Brewing Company has the largest market share in Michigan (over 30 percent). They are located near the Michigan market but made the decision to retain their distinctive clear-glass non-refillable bottle. Miller changed to a standard brown bottle in Oregon when that deposit law took effect and

lost considerable market share before returning to their distinctive clear bottle. Other brewers located much further from Michigan than Miller did adopt refillable bottles. As another example, in 1982 Anheuser-Busch which brews its super-premium Michelob brand in Ohio, switched to refillable bottles. At the same time, the Stroh Brewery of Detroit introduced its super-premium Signature brand which is only sold in non-refillable bottles. Aggregating Michigan sales on the basis of in-state or out-of-state brewer location and package type did not provide meaningful results. Although distance from the market is one factor in a brewer's decision to use refillable bottles, it does not seem to be the deciding factor in most cases. Some European bottled beer is imported in refillable bottles, but none of these bottles are being shipped back because of the prohibitive cost of small quantity ocean freight. Here the distance factor dominates the decision.

### Conclusions

There was a large decline in the number of packages consumed in Michigan after implementation of the MBCDL. Total sales continued to decline for the next 4 years. The law was passed in 1976, two years prior to its implementation, but no notable change in consumption patterns occurred until it took effect in December, 1978.

Refillable 19-trip bottles increased by 150 percent in 1979, but have declined since. Non-refillable glass containers retained their market share and even increased slightly. The 4-trip refillable bottle was introduced after the MBCDL. In 1982, it amounted to 12 percent of the total package market especially as a result of its adoption by Anheuser-Busch. This increase was split evenly at the expense of the other two types of bottles.

Cans dropped from about 70 percent of the market in 1977 to 40 percent in 1979. Since then the number of cans has remained constant in a declining total market. The market share in cans increased to 47 percent in 1982. The bottle portion of the package mix shifted significantly in 1982. These two factors indicate that the package mix under the MBCDL in Michigan is still evolving.

The two-tiered, 5 cents and 10 cents, minimum deposit system in Michigan does not appear to be effective in directing consumer choice

toward the purchase of "generic" refillable bottles. In 1982, the 19-trip refillable bottle had only a 19 percent market share. Beer is a branded product, highly differentiated in the eyes of the consumer through massive advertising. The consumer has the choice of buying a preferred brand in bottles or cans, but not in different types of bottles. The 5 cent difference in deposit value has not had a significant effect on consumer choice.

## ENERGY

### Introduction

There have been many attempts to predict the effect of required deposits on the energy used by beverage delivery systems. All of them have used hypothetical package mixes. This section applies estimates of the energy required for individual container types to the actual package mix that resulted for beer in Michigan with the MBCDL. These estimates are based on the energy required for the entire beer delivery system including the mining of raw materials, transporting and transforming them into packages, operating the packaging lines, washing and refilling bottles, and delivery to and from retail stores.

Best estimates of the energy intensity for different container types were developed from published sources. These energy intensities were applied to the actual Michigan package mix to develop an energy profile for the Michigan beer delivery system for four years before, and four years after the MBCDL went into effect.

### Method

Energy estimates for beverage container systems were drawn from five different major energy studies conducted between 1974 and 1981.(39-43) These energy figures were averaged to derive the best estimate of energy used for each package type. Annual energy profiles for the beer industry were then developed by multiplying these energy figures by the market share for each container type in Michigan. This produced an annual energy use profile in Btu's consumed per 1000 gallons of beverage delivered.

Energy consumption for the total beer delivery system depends heavily on the volume of sales. The number of packages sold in Michigan during the years studied varied from a high of 2.24 billion containers in 1978 to a low of 1.78 billion containers in 1982. Therefore, energy consumption per constant volume of beverage was calculated to eliminate the change in volume sold.

In this analysis it was assumed that all bottles and cans were 12 ounce containers. At least 90 percent of all bottles and 95 percent of all cans are actually 12 ounce containers. The remaining containers vary between 7 ounces and 32 ounces per container.

An aluminum "two piece draw and iron" can is formed by first "drawing" or pressing a flat "blank" into the form of a cup and then "ironing" or rolling the sides to lengthen them. The aluminum lid is crimped around the top edge of the can after it is filled. All cans were assumed to be aluminum two-piece draw and iron cans. The production of aluminum cans stock is more energy intensive than steel. Therefore, more energy is saved by recycling aluminum than by recycling steel. As a result, the assumption that all cans were aluminum will slightly overstate total system energy consumption before the MBCDL and underestimate it for the post-MBCDL period. In 1982 more than 98 percent of all beer cans sold in the nation were aluminum two piece draw and iron cans.<sup>44</sup> Although this trend can not be attributed to MBCDL, the aluminum can has become the preferred can by Michigan wholesalers since the MBCDL, because scrap aluminum has a much higher value than scrap steel.

### Results

The energy values represent the amount of energy consumed throughout the whole beverage system to deliver 1000 gallons of product in 12 ounce packages (or 10,667 containers). The total system energy consumed per container type, the weights of the containers, and actual weights of current Michigan containers are shown in Table 11. Each of the previous studies predicted that a trend toward less energy per container over time would develop, but considering them all together and the different base years for their data, the trend was negligible. Therefore, this study uses the same energy estimates for each container

**Table 11**  
**Total Energy**  
**For Beer Delivery System by Container Type**  
(in Btu x 10<sup>6</sup> per 1000 gallons)

|                                        | 19-Trip Refillable                 |                           | 4-Trip Refillable                  |                       | Non-Refillable Bottle                  |                       | Aluminum Cans<br>(% in return and recycling rate) |                                           |                                           |                       |
|----------------------------------------|------------------------------------|---------------------------|------------------------------------|-----------------------|----------------------------------------|-----------------------|---------------------------------------------------|-------------------------------------------|-------------------------------------------|-----------------------|
|                                        | Energy<br>Btu x<br>10 <sup>6</sup> | Pkg. (1)<br>Wt.<br>Ounces | Energy<br>Btu x<br>10 <sup>6</sup> | Pkg.<br>Wt.<br>Ounces | Energy (3)<br>Btu x<br>10 <sup>6</sup> | Pkg.<br>Wt.<br>Ounces | 25%<br>Energy<br>Btu x<br>10 <sup>6</sup>         | 90%<br>Energy<br>Btu x<br>10 <sup>6</sup> | 96%<br>Energy<br>Btu x<br>10 <sup>6</sup> | Pkg.<br>Wt.<br>Ounces |
| MIDWEST<br>Research<br>Institute       | 18.95                              | 9.8                       | 45.88                              | 9.8                   | 64.38                                  | 6.6                   | 67.51                                             | 25.71                                     | 21.51                                     | .7                    |
| Franklin<br>for FEA                    | 19.19                              | 7                         | 29.17                              | 7                     | 42.97                                  | 6.1                   | 58.64                                             | 28.20                                     | 25.38                                     | .7                    |
| Franklin<br>for Aloca                  | *                                  |                           | *                                  |                       | 53.97                                  | 7.2                   | 52.50                                             | 24.89                                     | 22.27                                     | .65                   |
| Wharton<br>Center                      | 20.63                              | 8                         | 29.31                              | 8                     | 54.3                                   | 6.1                   | 67.59                                             | 42.23                                     | 39.89                                     | .71                   |
| Battelle                               | 30.41                              | 10.5                      | 42.85                              | 10.5                  | *                                      |                       | 54.1                                              | 33.08                                     | 30.1                                      | .64                   |
| AVERAGE                                | 22.29                              | 8.8                       | 36.80                              | 8.8                   | 53.91                                  | 6.5                   | 60.07                                             | 30.82                                     | 27.83                                     | .68                   |
| Michigan 1983<br>Container Weights (2) |                                    | 9.0<br>(10.8)             |                                    | 9.1                   |                                        | 7.6                   |                                                   |                                           |                                           | .66                   |

\*Empty Cells indicate that a given study did not include that type of package.

(1) Weight of glass bottle without label or cap.

(2) Based on actual containers in the Michigan market, December, 1983 (See Appendix II).

(3) According to the studies, energy is not saved by recycling non-refillable bottles. They are being recycled in Michigan.

system during the eight year period. Not all studies included all four package types. The average of the estimates from these studies is used here as the "best estimate" of energy consumption for each container type in the Michigan package mix.

The relative energy intensities of the four package types is more important to the present study than the accuracy of absolute values. All five studies were consistent in placement of the container types relative to each other.

Obviously the weight of the bottle or can will influence its energy intensity. For some types of bottles the container weights assumed in the energy studies varied by more than 30 percent. A sample of Michigan containers from each package type for 1983 was weighed to obtain reference values for comparison with those used in the published energy studies. The weights of currently used containers in Michigan were remarkably similar to the five-study average, therefore, no attempt was made to adjust the energy values based on current Michigan package weights. Energy intensity is reported in millions of British Thermal Units (Btu's) per 1000 gallons of beer. The various fuels consumed are not differentiated.

The energy profiles for Michigan are easily derived by combining the values (Table 11) with the Michigan package mix (Table 10). Two energy profile tables were constructed using 96 percent and 90 percent return rates for the beverage containers (Figure 17). These are very high return rates, well above the 90 to 95 percent of bottles and 85 percent of cans that were predicted before the law was implemented.<sup>45</sup>

There are several reasons for using the higher 96 percent figure. People of all ages are picking up littered containers in Michigan as well as retrieving them from waste baskets and the solid waste stream. A new supplemental source of income has been created for employees involved with solid waste disposal. Littered containers and discarded containers in the solid waste stream are being retrieved for refund which increases the return rate. The lower value, 90 percent, was believed to represent a conservative rate of return for Michigan.

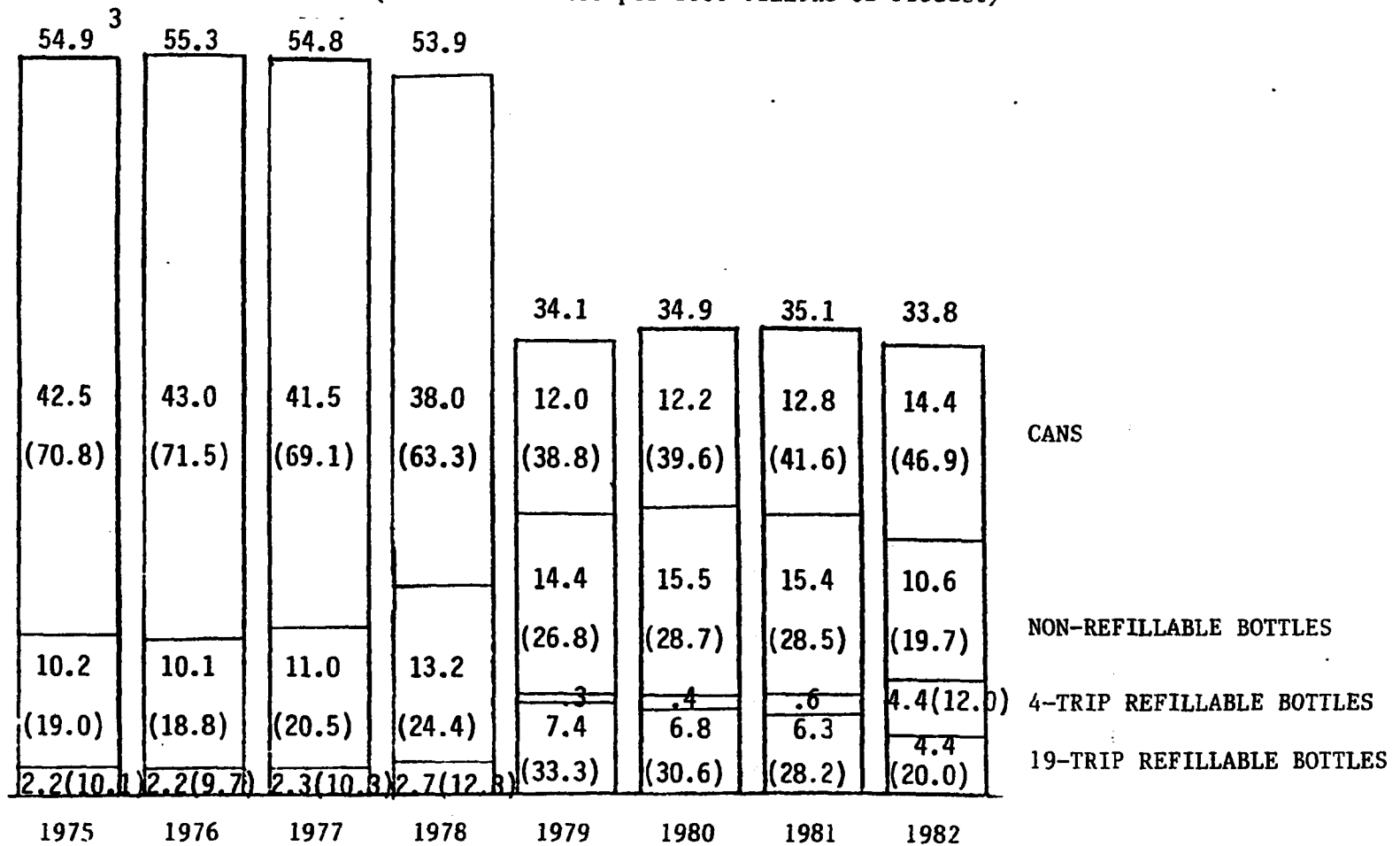
Actual return rates are difficult to estimate. For example, the Stroh Brewery may well be getting more than 100 percent of its certified

Figure 17

Michigan Packaged Beer - Systems Energy Profile  
(Millions of BTUs per 1000 Gallons of Product)

TOTAL

MILLIONS OF BTUs PER 1000 GALLONS OF BEER



1. Millions of BTUs consumed by market share in each container type
2. Market share by container type
3. Assumes a 25 percent recycling rate for cans during 1975-1978
4. Assumes a 90 percent return/recycle rate for cans during 1979-1982

"Michigan" bottles back because several other breweries have discontinued using this bottle in Michigan.

Claimed return rates may also be misleading. In Michigan, the question of who gets to keep unclaimed deposits has been raised. This so-called escheats issue (or reversion to the State of unclaimed property) has focused mostly on the wholesalers where 80 percent of the deposits originate. It is to the wholesalers' advantage, therefore, to suggest that the return rates are very high, making the non-refunded deposits of minor importance.

In short, no one is sure what the actual return rates are in Michigan. For this reason, two different rates were used in hopes of bracketing reality. These are 90 percent return rate (or 10 trips) and 96 percent (or 25 trips). Reality is probably close to this 96 percent level. Only non-refillable bottles and cans are affected by the return rate in this analysis. The return rate is assumed as part of the trippage figure for refillable bottles.<sup>46</sup> The marginal energy savings gained by increasing the trippage beyond about 15 is very small. Most of the energy at that level is consumed in delivery and recovery so increasing trippage from 15 to 25 or even 30 would not materially affect energy use for this container type.

Three things should be noted from the results. First, there was a 38 percent decline in the total energy required to deliver a given quantity of beer when the MBCDL took effect. Second, the total energy to deliver beer in bottles compared to cans shifted unexpectedly. Following the implementation of the MBCDL, cans became less energy intensive than glass containers. This was because cans were less energy intensive than both 4-trip refillable and non-refillable bottles. These two types of bottles accounted for 62 percent of the bottles in Michigan in 1982. Third, there is only a 3 to 4 percent difference in energy consumption between a 96 percent return rate and the conservative estimate of 90 percent.

### Conclusions

There has been a 38 percent drop in the energy required to deliver beer for the actual package mix that resulted in Michigan with the MBCDL. In absolute terms, this is a drop from about 55 million Btu's per 1000 gallons to approximately 34 million Btu's per 1000 gallons given the estimating procedure used. Changes in the requirements for the various types of fuels (petroleum, coal, hydroelectric, atomic) have not been identified, but these have changed. In particular, the inputs of petroleum based fuels have declined relatively little due to the increased energy consumed by the distribution system. The reduction in energy use will occur mostly outside of Michigan. Energy is saved in production of the packages. Since 80 percent of the beer is produced outside of Michigan, it is assumed that the packages come from outside the state as well.

Taken as a whole, cans are now less energy intensive than bottles. The high return rate and assumed all-aluminum cans lead to an estimated energy use of between 27.8 and 29.7 million Btu's per 1000 gallons for cans. Cans had 47 percent market share in 1982. Although the 19-trip refillable bottle uses only 22.3 million Btu's per 1000 gallons, it only had a 20 percent market share. Thirty-two percent of the Michigan market was in non-refillable or 4-trip refillable bottles, both of which are more energy intensive than cans. The non-refillable bottle uses 53.9 million Btu's per 1000 gallons (19 percent market share), and the 4-trip refillable bottle uses 36.8 million BTU's per 1000 gallons.

### PRICE

#### Introduction

Before the MBCDL took effect there were two conflicting theories on the impact of the legislation on consumer prices. Proponents of the legislation, including then Governor Milliken of Michigan, predicted that prices would fall because the container cost for refillable containers would be spread over many fillings. The Michigan Department of Commerce predicted in 1975 that a MBCDL would save consumers 18 million dollars per year through reduced prices for beer and soda.<sup>47</sup>

This savings was based on extrapolation of December, 1974, retail shelf prices for beverages in refillable and non-refillable packages.

Opponents of the legislation predicted that the MBCDL would lead to increased costs and prices because additional storage space and employees would be required to handle the empties, outweighing the package cost savings. The current price of beverages in refillable bottles was based on traditional pricing practices established shortly after World War II, according to Robert Weinberg an industry analyst.<sup>48</sup> Since then there have been significant changes in the industry which have changed the economics of beer distribution. Beverages in refillable containers, he said, were subsidized by sales in non-refillable containers which were the majority of sales. With the elimination of the non-refillable container, this subsidy would no longer be possible.

Beer prices in Michigan increased dramatically following the implementation of the law. This fulfilled the prediction of the beverage industry so well that many proponents of the law suspected foul play on the part of the industry. The Governor initiated a grand jury investigation into price fixing in June, 1979 which, after 2 years of investigation, failed to develop sufficient evidence of a price fixing conspiracy between brewers and distributors and the grand jury was dissolved.<sup>49</sup>

#### Price Versus Cost

The pricing of consumer products is a complex process. The assumption that price is directly related to cost, made by those predicting declining beverage prices, dates from Adam Smith and the classical theory of competition. The strict assumptions, such as many small producers unable to affect the price of their products, homogeneous products, and perfect information for both producers and consumers are often forgotten by economic forecasters. This theory was found by Chamberlain in the early years of this century to be invalid for a great many industries in the United States.<sup>50</sup> In the beer industry, where the four largest brewers control about 80 percent of the Michigan market, Chamberlain's model of monopolistic competition is more plausible. This model recognizes that products, although similar in

form, can be differentiated in the market place. The many price levels to which various brands of beer are targeted (from 5 dollars to 20 dollars a case), can be incorporated into the model. The fact that a case of bottled beer in one supermarket in Flint, Michigan, cost \$11.36 in October, 1983, and less than a block away the same brand of bottled beer cost \$13.80 per case in a convenience store is a reality of our market economy, too. As there is only one wholesale price for any brand of beer in Flint, the cost plus a fair profit assumption of the classical theory for price determination makes this commonly observed phenomenon an anomaly. Obviously, goods are differentiated on many basis in the market place and price is one of them. The continual striving for product differentiation in the market place provides both the driving force for change and precludes the market from obtaining any long-run equilibrium condition. Still, the price-equals-cost-plus assumption is used as the basis for many price projections predicting market effects of a MBCDL.<sup>51</sup>

The present study is explicitly limited to the presentation of price changes at the three levels in the base distribution system in Flint, Michigan. Price changes in Flint are expected to be representative of the State as a whole with a maximum lag of two or three months. The small time lags are unimportant with the semi-annual sampling used. An analysis of cost change is beyond the scope of this report and should not be implied from the price data.

The Liquor Control Commission restricts competition in this industry. The primary function of the Liquor Control Commission is, as the name implies: the control of alcoholic beverage traffic and consumption in Michigan.<sup>52</sup> It does this in numerous ways, some of which may impact product pricing. As most beer is produced outside Michigan the industry is required to be a three tier system.<sup>53</sup> Brewers must sell to wholesalers located within the state who take physical possession of the product before delivery to retail outlets. The Liquor Control Act was revised in 1977 to allow the creation of exclusive wholesale distributorships for brands of beer.<sup>54</sup> The change was proposed well before the referendum on the Michigan MBCDL and appears to have been unrelated to the container legislation. This means that although the various brands of beer are in competition with each other, there will

only be one wholesaler selling any given brand. Although an obvious restriction of intra-brand competition, the exclusive territory provision facilitates the MBCDL. As deposits on the majority of containers originate with the wholesaler those same containers must be returned to the originating wholesaler for the deposits and returns to balance. Consumers have the choice of returning empties anywhere in the state for refund. Wholesalers in resort areas have complained that many consumers purchase beverages before leaving on trips and then return the empties where they are vacationing. To the extent such practices occur, they would be dislocations.

In Michigan, the manufacturer or brewer is the only level in the distribution system where price is not specifically regulated. Wholesalers are required to post their prices with the Liquor Control Commission and to offer that same posted price to every retailer in that market area. There can be no quantity discounts. Any reduction in the wholesale price of beer must remain in effect for at least 180 days with certain exceptions for general price increases. Retailers are not allowed to sell beer below their cost (so-called "loss leaders"). Retailers are not even allowed to advertise the price of the beer they sell, except inside the store. There was a reinterpretation of this point by the Attorney General early in 1982 allowing price advertising in the media but it was overruled in the courts in 1983. Obviously, the pricing strategies for beer, as for most products, are complex decisions.

#### Method

There have been numerous cross-sectional studies of the price of beer in deposit legislation states. A comparison is typically made with the price in bordering non-deposit law states.<sup>55</sup> In the present study a longitudinal study was made of prices in one market area in Michigan. This facilitated construction of a Michigan beer price index which was compared to national indexes, especially the Consumer Price Index for malt beverages.

Beer prices were studied from 1976, three years before the MBCDL, through 1983. Prices at the three levels of distribution were collected. The Michigan market has been divided by the industry into

pricing zones. Therefore, one market, Flint, was used for all sampling. Brewer prices were defined as the free on board purchasers vehicle (F.O.B) prices listed on invoices to specific wholesalers. This information is incidental on the invoices sent to the Michigan Liquor Control Commission for tax purposes. Wholesale prices were the posted prices submitted by beer distributors to the Liquor Control Commission. Wholesale prices included product delivery to the retailer. Retail prices were supermarket shelf prices for specific packages in Flint, Michigan. Convenience stores, drug stores, and all other outlets were excluded from the study. Prices in these stores varied significantly from supermarket prices. The brewer prices included the state beer tax of 45.7 cents per case. The price ultimately paid by consumers was the retail price used here plus the 4 percent state sales tax. Given the exclusive distributor territories there was only one F.O.B. and one wholesale price for each brand and package type in the Flint area. The retail price however, was the average shelf price of eight supermarkets found in the Flint area.

Flint was chosen for several reasons. Flint is an industrial city with a population of 200,000 located 40 miles north of Detroit and 50 miles from Canada. Colleges are a small part of the city. It is predominately a union town and the sample stores were unionized.<sup>56</sup> Industry sources warned that Detroit might not be a "typical" area because it had severe unemployment problems and a predominately low income population.

The prices at all three levels in the system were indexed to show the relative change over time. The indexes were compared with national indexes to identify the direction and magnitude of deviation from national trends.

### Results

Price lining, or the pricing of similar products the same begins at the wholesale level in the beer industry. The F.O.B. dock prices varied from brewer to brewer as well as amongst package types for the same brand. Wholesale prices were the same within any price line for the five wholesalers serving the market. There was, of course, some delay in meeting price changes, but otherwise prices were uniform.

At the retail level, too, there were five basic price lines: local, regional, premium, super-premium, and imports. When one of the two price leaders, the Anheuser-Busch or Miller wholesaler, raised the price of his or her products, all the brands in that price line were increased at the retail level. Thus, it is obvious that the other wholesalers would be motivated to change their prices as well.

Pabst and Stroh moved their namesake brands from regional to premium pricing when the MBCDL came into effect. This increased the premium priced market share to about 75 percent of the total market. There were five brands of beer with a market share of 10 percent or more during the time period studied (1976-1983). Three of these, Miller, Miller-Lite, and Budweiser, formed the basis of this price survey. However, as Miller and Miller-Lite had the same prices throughout the period at all three levels in the system, the price was only used once in averaging (i.e. one Miller and the Budweiser prices). These were all premium beers and had a combined market share of about 40 percent. The other two large brands, Pabst and Stroh, could not be included in the survey as they changed their pricing strategy from regional to premium when they introduced their new containers for the MBCDL.

The prices of 12-packs of 12 ounce cans and 6-packs of 12 ounce bottles were used for the survey. These are the two largest selling packages for beer. The 12/12 can package did not change much during the eight year period. The pull tab openings were changed to stay-on tabs to conform to the MBCDL and the required Michigan 10 cent refund label was printed on the lid. No change was made in the can body for Michigan and only minor adjustments were made to the secondary packaging. The aluminum saving triple-necked can was introduced recently in Michigan as it was elsewhere.

The six pack of bottles was impacted significantly by the MBCDL. The non-refillable bottle was replaced in many cases by the standard select refillable bottle. This generic bottle has since been replaced by proprietary bottles for many brands such as Budweiser, Schlitz, and Busch. After the law Miller and Miller-Lite stayed in the same nonrefillable containers, but Budweiser switched to a refillable bottle. The survey prices are for non-refillable (non-returnable) bottles before the MBCDL. The popular brands of beer in refillable bottles were not

available in the surveyed supermarkets prior to the MBCDL. The few refillables sold for off-premise consumption were house brands in 24 bottle loose-pack cases.

Prices are for one case (i.e., twenty-four 12 ounce containers) for both bottles and cans (Table 12). The container deposits are not included. They would add \$1.20 for certified refillable bottles or \$2.40 for proprietary bottles and cans after 1978. The object of the study was to document price changes. Therefore, the actual prices serve only to form the base for the analysis.

Price indexes for the two packages were constructed using Spring 1976 = 100 (Tables 13 and 14). In this way the relative change in product price could be identified at each level of the distribution system. The brewer and wholesaler price indexes were deflated using the specific Producer Price Indexes (PPI) for bottles or cans. The retail price indexes were deflated using the Consumer Price Index (CPI) for beer consumed at home.<sup>57</sup> The resulting series have been plotted showing the change in Michigan beer prices relative to the national averages (Figures 18 and 19). All three indexes should follow the horizontal axis over time in a stable system for a mature industry (all other things being equal). This was the case in 1976. In 1977 the brewer prices rose more than the national average and pushed up the wholesale and retail prices. The price at one level of the distribution system becomes a cost at the next level. Therefore, the similar increases in the wholesale and retail price indexes indicated that the margins had not changed. In this type of analysis, the brewer price can be conceptualized as the base price trend. Any deviations from this trend by the wholesale price index indicates a change in wholesale margin. Following the same logic, the difference between the wholesale and retail indexes would mark a change in retail margin.

When the MBCDL took effect there was a dramatic increase in prices at the wholesale and retail level. By 1980 the retail price index was 20 points above the CPI for beer. This means the price consumers paid for beer in Michigan was almost 20 percent higher in real terms than the predicted price basis of national price trends. Since then the consumer price of beer in Michigan in real dollars has been declining. In 1982 there were two distinct retail price strategies in the Flint market.

Table 12Average Michigan Premium Beer Prices 1976-1983Flint, MichiganCases of 24 Containers - Current Dollars

|                 | Brewer Price    |               | Wholesale Price |               | Retail Price    |                |
|-----------------|-----------------|---------------|-----------------|---------------|-----------------|----------------|
|                 | 6/12<br>Bottles | 12/12<br>Cans | 6/12<br>Bottles | 12/12<br>Cans | 6/12<br>Bottles | 12/12<br>Cans  |
| 1976 MAR        | 4.46            | 4.52          | 5.95            | 5.85          | (7.14)          | (6.75)         |
| SEPT            | (4.54)          | (4.52)        | (6.08)          | (5.85)        | (7.14)          | (6.75)         |
| 1977 MAR        | (4.54)          | (4.74)        | 6.08            | 6.02          | (7.44)          | (7.15)         |
| SEPT            | 4.64            | 4.74          | 6.20            | 6.20          | 7.44            | 7.15           |
| 1978 MAR        | 4.76            | 4.85          | 6.50            | 6.50          | 7.80            | 7.50           |
| SEPT            | 4.87            | 4.96          | 6.75            | 6.75          | 8.10            | 7.78           |
| -----MBCDL----- |                 |               |                 |               |                 |                |
| 1979 MAR        | 5.08            | 5.21          | 7.20            | 7.20          | 9.00            | 9.00           |
| SEPT            | 5.13            | 5.26          | 7.60            | 7.60          | 9.50            | 9.50           |
| 1980 MAR        | 5.31            | 5.41          | 8.22            | 8.22          | 10.43           | 10.30          |
| SEPT            | 5.47            | 5.57          | 8.35            | 8.35          | 10.43           | 10.44          |
| 1981 MAR        | 5.65            | 5.75          | 8.85            | 8.85          | 11.06           | 10.98          |
| SEPT            | 5.80            | 5.92          | 8.85            | 8.85          | 11.06           | 10.98          |
| 1982 MAR        | 5.77            | 5.92          | 8.85            | 8.85          | 11.16<br>10.06  | 10.98<br>9.98  |
| SEPT            | 5.77            | 5.92          | 8.85            | 8.85          | 11.16<br>10.60  | 10.98<br>9.98  |
| 1983 MAR        | 6.17            | 6.15          | 9.45            | 9.45          | 11.72<br>11.20  | 11.58<br>10.88 |
| SEPT            | 6.17            | 6.38          | 9.45            | 9.45          | 11.36<br>11.16  | 10.58          |

Numbers in parentheses are estimated.

During 1982 and into 1983 there were two distinct retail price strategies for beer sold in supermarkets in Flint, Michigan. At about the same time retail price advertising became legal a large number of supermarkets reduced the price of beer one dollar a case. Both prices are indicated for each time period.

Table 13

Beer Price Indexes for Michigan and the Nation  
1976 = 100

Cases of 4 Six Packs of 12 Ounce Bottles

|                 | Michigan<br>Brewer<br>Price<br>Index<br>Bottles | Producer<br>Price<br>Index for<br>Beer in<br>Bottles | Michigan<br>Wholesale<br>Beer Price<br>Index<br>Bottles | Consumer<br>Price<br>Index<br>for Beer | Michigan<br>Retail<br>Beer Price<br>Index<br>Bottles |
|-----------------|-------------------------------------------------|------------------------------------------------------|---------------------------------------------------------|----------------------------------------|------------------------------------------------------|
| 1976 MAR        | 100                                             | 100                                                  | (100)                                                   | 100                                    | 100                                                  |
| SEPT            | (102)                                           | (100)                                                | (102)                                                   | 101                                    | 100                                                  |
| 1977 MAR        | (102)                                           | 102                                                  | 102                                                     | 101                                    | 104                                                  |
| SEPT            | 104                                             | 103                                                  | 104                                                     | 102                                    | 104                                                  |
| 1978 MAR        | 107                                             | 105                                                  | 109                                                     | 106                                    | 109                                                  |
| SEPT            | 109                                             | 107                                                  | 113                                                     | 110                                    | 113                                                  |
| -----MBCDL----- |                                                 |                                                      |                                                         |                                        |                                                      |
| 1979 MAR        | 114                                             | 113                                                  | 121                                                     | 117                                    | 126                                                  |
| SEPT            | 115                                             | 115                                                  | 128                                                     | 120                                    | 133                                                  |
| 1980 MAR        | 119                                             | 124                                                  | 138                                                     | 128                                    | 146                                                  |
| SEPT            | 123                                             | 129                                                  | 140                                                     | 134                                    | 146                                                  |
| 1981 MAR        | 127                                             | 132                                                  | 149                                                     | 139                                    | 155                                                  |
| SEPT            | 130                                             | 133                                                  | 149                                                     | 142                                    | 155                                                  |
| 1982 MAR        | 129                                             | 133                                                  | 149                                                     | 146                                    | 156<br>141                                           |
| SEPT            | 129                                             | 134                                                  | 149                                                     | 148                                    | 156<br>148                                           |
| 1983 MAR        | 138                                             | 135                                                  | 159                                                     | 152                                    | 164<br>157                                           |
| SEPT            | 138                                             | 142                                                  | 159                                                     | 156                                    | 159<br>156                                           |

Numbers in parenthesis are estimated.

During 1982 and into 1983 there were two distinct retail price strategies for beer sold in supermarkets in Flint, Michigan. At about the same time retail price advertising became legal a large number of supermarkets reduced the price of beer one dollar a case. Both prices are indicated for each time period.

Table 14

Beer Price Indexes for Michigan and the Nation  
1976 = 100

Cases of Two 12 Packs of 12 Ounce Cans

|                 | Michigan<br>Brewer<br>Price<br>Index<br>Cans | Producer<br>Price<br>Index for<br>Beer in<br>Cans | Michigan<br>Wholesale<br>Beer Price<br>Index<br>Cans | Consumer<br>Price<br>Index<br>for Beer | Michigan<br>Retail<br>Beer Price<br>Index<br>Cans |
|-----------------|----------------------------------------------|---------------------------------------------------|------------------------------------------------------|----------------------------------------|---------------------------------------------------|
| 1976 MAR        | 100                                          | 100                                               | 100                                                  | 100                                    | 100                                               |
| SEPT (100)      |                                              | 100                                               | (100)                                                | 101                                    | 100                                               |
| 1977 MAR        | 105                                          | 102                                               | 103                                                  | 101                                    | 106                                               |
| SEPT            | 105                                          | 103                                               | 106                                                  | 102                                    | 106                                               |
| 1978 MAR        | 107                                          | 105                                               | 111                                                  | 106                                    | 111                                               |
| SEPT            | 110                                          | 109                                               | 115                                                  | 110                                    | 115                                               |
| -----MBCDL----- |                                              |                                                   |                                                      |                                        |                                                   |
| 1979 MAR        | 115                                          | 113                                               | 123                                                  | 117                                    | 133                                               |
| SEPT            | 116                                          | 119                                               | 130                                                  | 120                                    | 141                                               |
| 1980 MAR        | 120                                          | 125                                               | 141                                                  | 128                                    | 153                                               |
| SEPT            | 123                                          | 130                                               | 143                                                  | 134                                    | 155                                               |
| 1981 MAR        | 127                                          | 135                                               | 151                                                  | 139                                    | 163                                               |
| SEPT            | 131                                          | 137                                               | 151                                                  | 142                                    | 163                                               |
| 1982 MAR        | 131                                          | 140                                               | 151                                                  | 146                                    | 163<br>148                                        |
| SEPT            | 131                                          | 148                                               | 151                                                  | 148                                    | 163<br>148                                        |
| 1983 MAR        | 136                                          | 148                                               | 162                                                  | 152                                    | 172<br>161                                        |
| SEPT            | 141                                          | 154                                               | 162                                                  | 156                                    | 157                                               |

Numbers in parenthesis are estimated.

During 1982 and into 1983 there were two distinct retail price strategies for beer sold in supermarkets in Flint, Michigan. At about the same time retail price advertising became legal a large number of supermarkets reduced the price of beer one dollar a case. Both prices are indicated for each time period.

Figure 18

Relative Michigan Beer Price Indices<sup>(1)</sup>  
6 / 12 Bottle Package

Percent of  
Base Index

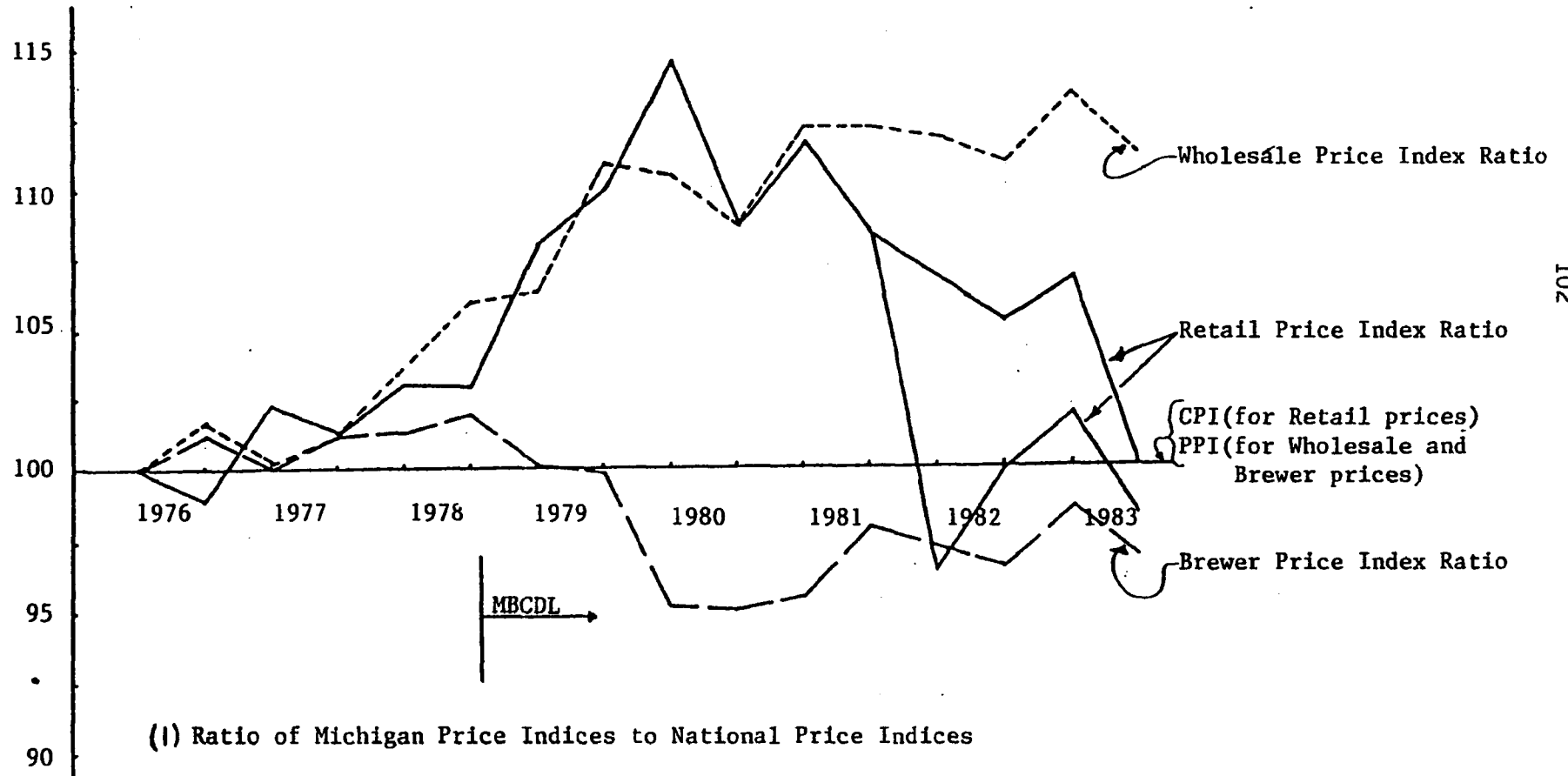
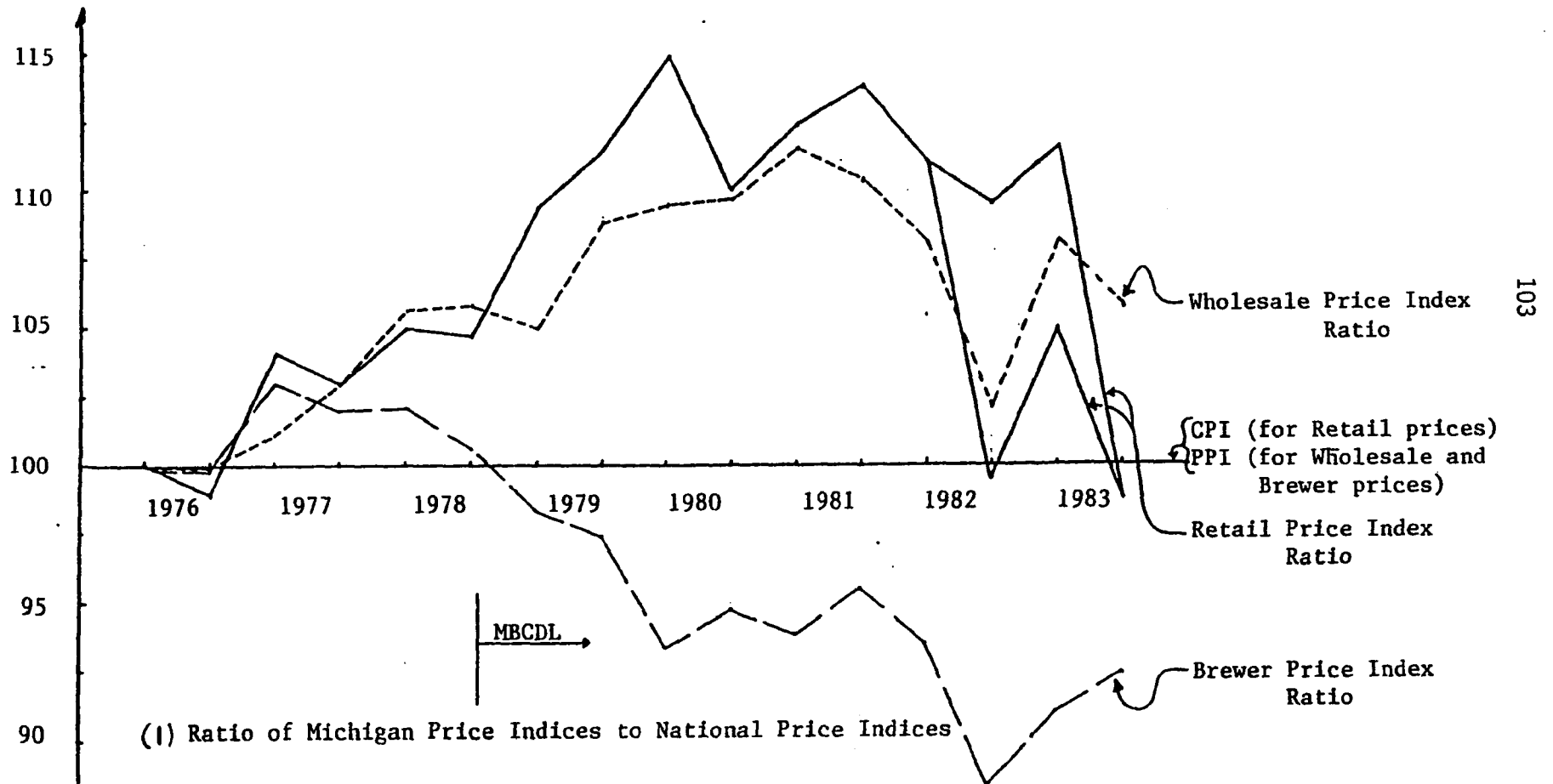


Figure 19

Percent of  
Base Index

Relative Michigan Beer Price Indices<sup>(1)</sup>  
12 /12 Can Package



The stores following each strategy were averaged separately. Prior to 1982 and again in 1983 supermarket shelf prices varied only slightly around one average price.

The retail price index for Michigan was similar to the National price trend before the MBCDL (Figure 9 of the previous section on Beer Sales). Michigan prices increased faster, however, than in the rest of the country during 1979 and 1980. Since then national prices have been rising more rapidly than Michigan prices. In the Fall of 1983 the retail price index for beer in Michigan was again equal to the national average.

Wholesale prices also rose rapidly during 1979 and 1980. These prices have continued to increase at about the same rate as the national PPI since then maintaining their price differential.

The price of beer from the brewer increased at a slower rate in Michigan since the MBCDL than it did nationally. The brewer price was about 5 index points (percent) lower during the years 1980 through 1982. There was a major brewer price increase for bottles in 1983 but can prices in Michigan remained well below the national average. Private industry data indicate that price increases in the entire North-Central Census Region have been lower than the national rate of change in beer prices during the period between 1980 and 1983. Industry sources indicate that prices in the region were held down by the highly competitive situation among large brewers.

The wholesale and retail margins in Michigan have changed considerably over the eight year period (Table 15). The margin is the difference between the price paid per case of beer and the price received. It must cover all other expenses, plus the profit. In current dollars the wholesale margin increased from \$1.33 per case in 1976 to \$3.10 per case in the Spring of 1981. It has remained around three dollars per case since then. The retail margin increased from around \$1.00 before the MBCDL to \$1.80 per case during the first six months of 1979. It continued to rise until the spring of 1981 when it reached \$2.13 per case. In 1982, when half of the retail market lowered its price by a dollar a case, the retail margin for this market segment was back to the pre-MBCDL level in current dollars. The higher priced retailers lowered their prices to meet competition in 1983.

Table 15Gross Margins for Packaged Beer in Michigan  
1976 - 1983

|                 |      | Current Dollars     |                  | 1967 Dollars        |                  |
|-----------------|------|---------------------|------------------|---------------------|------------------|
|                 |      | Wholesale<br>Margin | Retail<br>Margin | Wholesale<br>Margin | Retail<br>Margin |
| 1976            | MAR  | \$1.33              | \$ .90           | \$ .78              | \$ .53           |
|                 | SEPT | 1.33                | .90              | .78                 | .53              |
| 1977            | MAR  | 1.28                | 1.13             | .71                 | .62              |
|                 | SEPT | 1.46                | .95              | .80                 | .52              |
| 1978            | MAR  | 1.65                | 1.00             | .84                 | .51              |
|                 | SEPT | 1.79                | 1.03             | .92                 | .53              |
| -----MBCDL----- |      |                     |                  |                     |                  |
| 1979            | MAR  | 1.99                | 1.80             | .92                 | .83              |
|                 | SEPT | 2.34                | 1.90             | 1.08                | .87              |
| 1980            | MAR  | 2.81                | 2.08             | 1.11                | .82              |
|                 | SEPT | 2.78                | 2.09             | 1.10                | .82              |
| 1981            | MAR  | 3.10                | 2.13             | 1.14                | .84              |
|                 | SEPT | 2.93                | 2.13             | 1.08                | .84              |
| 1982            | MAR  | 2.93                | 2.13<br>1.13     | 1.01                | .78<br>.41       |
|                 | SEPT | 2.93                | 2.13<br>1.13     | 1.01                | .74<br>.39       |
| 1983            | MAR  | 3.30                | 2.13<br>1.43     | 1.09                | .71<br>.47       |
|                 | SEPT | 3.07                | 1.13             | 1.02                | .37              |

In deflated 1967 dollars it is clear that the retail margin increased initially by 50 percent when the MBCDL took effect. Since 1982 retail price competition has caused the margin to decline so that in 1983 the retail margin was 30 percent below the 1976 level in real dollars. The wholesale margin increased by 40 percent over a two year period starting in the fall of 1978. In 1983, the wholesale margin was still 30 percent higher than in 1976 in real (deflated dollar) terms.

### Discussion

There are two recurring questions in the debate on deposit laws which this price study addresses. The first is how prices changed at the three levels in the distribution channel under Michigan's MBCDL. The second question is how much does such legislation cost consumers in the form of higher prices. Following this will be a discussion of the extent to which the Michigan price data may help predict price effects of MBCDL in other states or nationally.

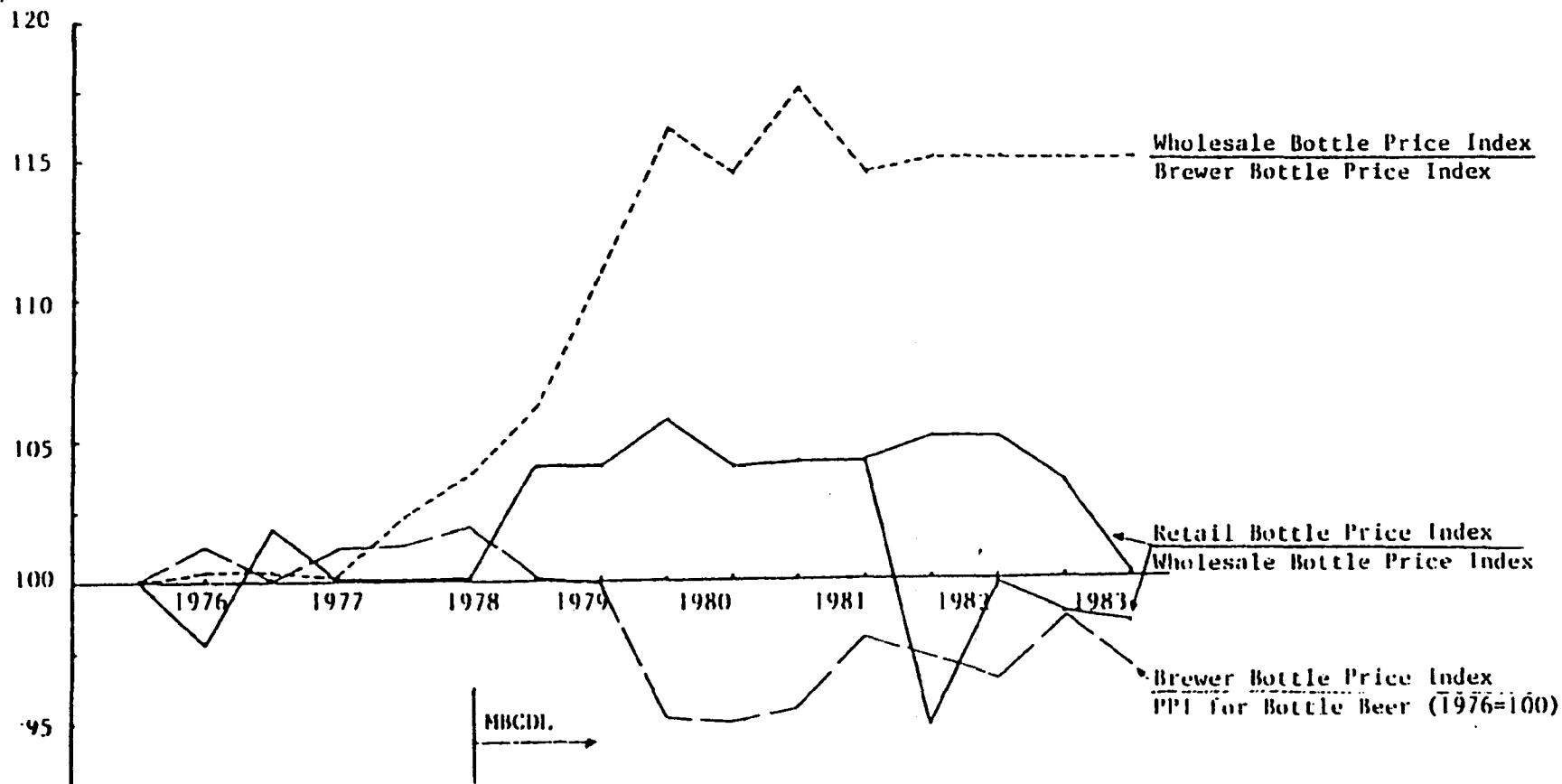
The relative change in beer prices in Michigan at the three levels in the distribution system show the response at each level to changing market conditions during the eight year period (Figures 20 and 21). The change in the relative price of beer at the retail level will be defined as the ratio of the retail price index divided by the wholesale price index. If prices at the two levels change proportionally over time (the expected condition in a steady state system) the ratio between them will be constant and equal to 1. Any change in the ratio of price to cost of goods sold will cause a deviation from 1. The relative wholesale price index is similar but uses the brewer price index as a divisor. There is no cost of goods sold to use in forming the relative brewer price index. Instead, the PPI is used making the assumption that in a steady state system, Michigan would reflect national price trends. (The brewer's indexes are identical in figures 18 and 20, and 19 and 21.)

During 1976 and 1977 there was little change in the relative prices in the system as predicted by the steady state system assumption. In 1978, prices at the wholesale level increased indicating an increased wholesale margin. Immediately following implementation of the MBCDL there was a large increase in the relative retail price. The retail

Figure 20

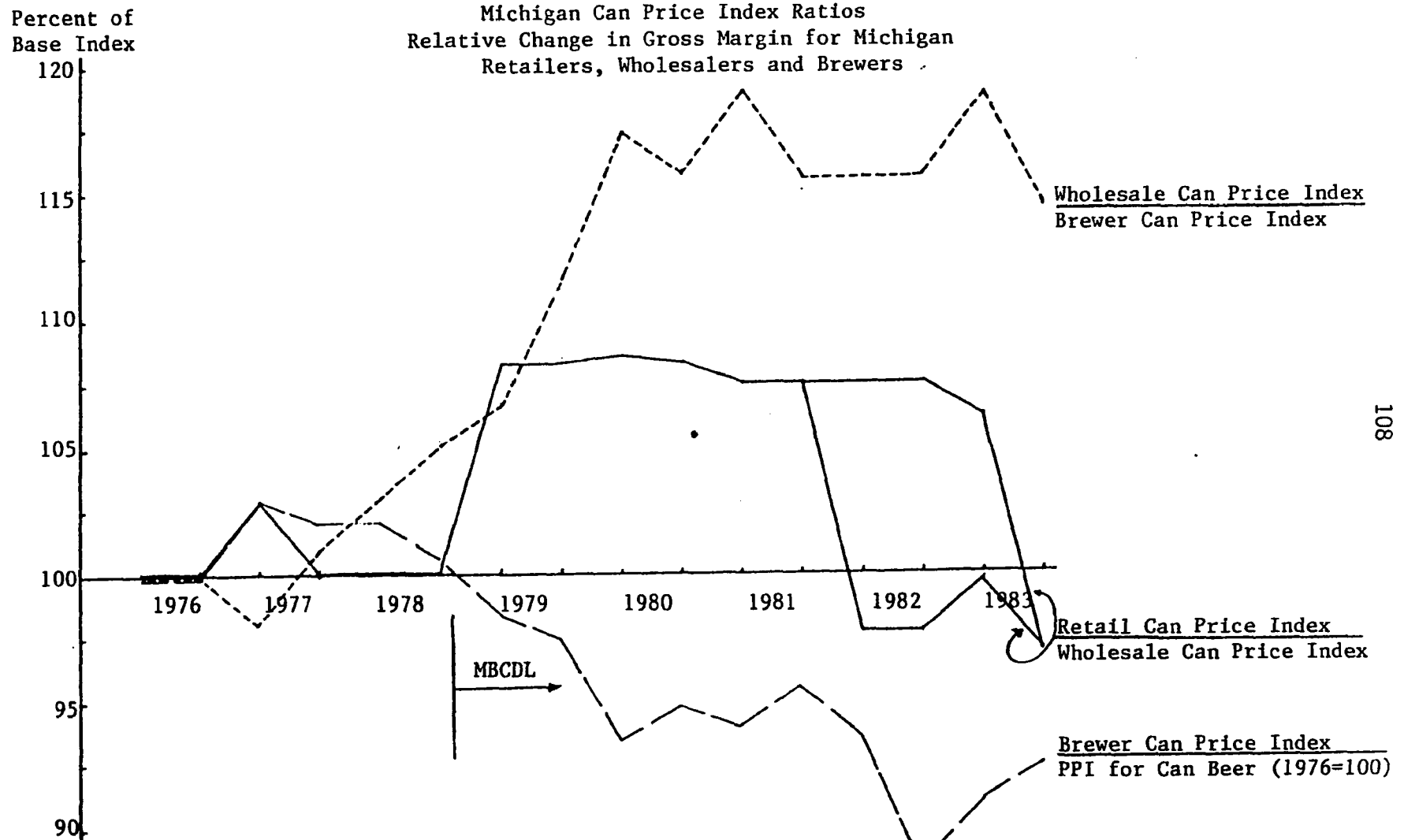
Michigan Bottle Price Index Ratios  
Relative Change in Gross Margin for Michigan  
Retailers, Wholesalers and Brewers

Percent of  
Base Index



Note: If the ratios between the price charged (numerator) and the cost-of-goods sold (denominator) remain constant, the ratio lines will follow the horizontal axis. If the price increases relative to cost, the curve will rise. If the price decreases relative to cost, the curve will fall.

Figure 21



Note: If the ratios between the price charged (numerator) and the cost-of-goods sold (denominator) remain constant at 1976 levels, the ratio lines will follow the horizontal axis. If the price increases relative to cost, the curve will rise. If the price decreases relative to cost, the curve will fall.

margin remained constant at this higher level until a second retail price strategy emerged in 1982 (only supermarket prices were included in the sample). This means that in 1982 some stores decreased their margin (relative to their cost of goods sold) to below 1976 levels as the wholesale price was constant. In 1983 it can be seen that the higher price strategy was abandoned and the entire retail market was at, or below, 1976 margin levels relative to wholesale prices.

Wholesale prices began increasing in 1977 and continued to increase until 1980. The wholesale margin has been constant since then. The relative brewer price indexes have been below 1976 levels since the MBCDL, with one exception (i.e., the bottle index in the first measurement for 1983).

To estimate the price Michigan beer consumers paid for the MBCDL, price data (Table 12) was combined with the annual sales in cases (Table 10). A number of assumptions were needed for this analysis. First, it was assumed that the price of beer in Michigan during the period 1979-1983 changed similarly to the national CPI for beer away from home except for the effect of the MBCDL.<sup>58</sup> The ratios were recalculated, with 1978 as the base year, to eliminate the effect of price changes prior to the MBCDL. The price index ratio was already above the CPI in 1977 and 1978. This means that in figures 18 and 19 the area between a line parallel to the horizontal axis at the level of the Fall, 1978 Retail Price Index and the retail price index ratio was caused by the MBCDL during the years 1979 - 1983. Second, all packaged beer was assumed to be sold at the index prices. The supermarket prices were actually amongst the lowest for beer. If other prices moved proportionately to supermarket prices then the price changes would be similar in form to those used. However, this was a very strong assumption. In fact, convenience stores sell a large volume of beer in Michigan and beer prices in those stores maintained their position relative to wholesale prices in 1982 and 1983. The assumptions for the number of cases sold were enumerated in the section on the package mix. Annual Michigan sales figures were used, which means the derived figures were for actual consumer expenditures.<sup>59</sup> Finally, it was assumed that half of the beer was purchased at each semi-annual price level for each of the five years.

The CPI for beer consumed at home was used to predict the inflationary price increase in Michigan based on actual 1978 Michigan retail prices. The residuals between this predicted price and the actual price for each time period were attributed to factors unique to the State (Appendix V). Beginning in 1979, the price per container for beer in Michigan increased much faster than inflation (Figure 22). The increase in the price of canned beer in 1979 was larger than that for bottles as the retail price differential of about \$0.30 per case for cans was eliminated.<sup>60</sup>

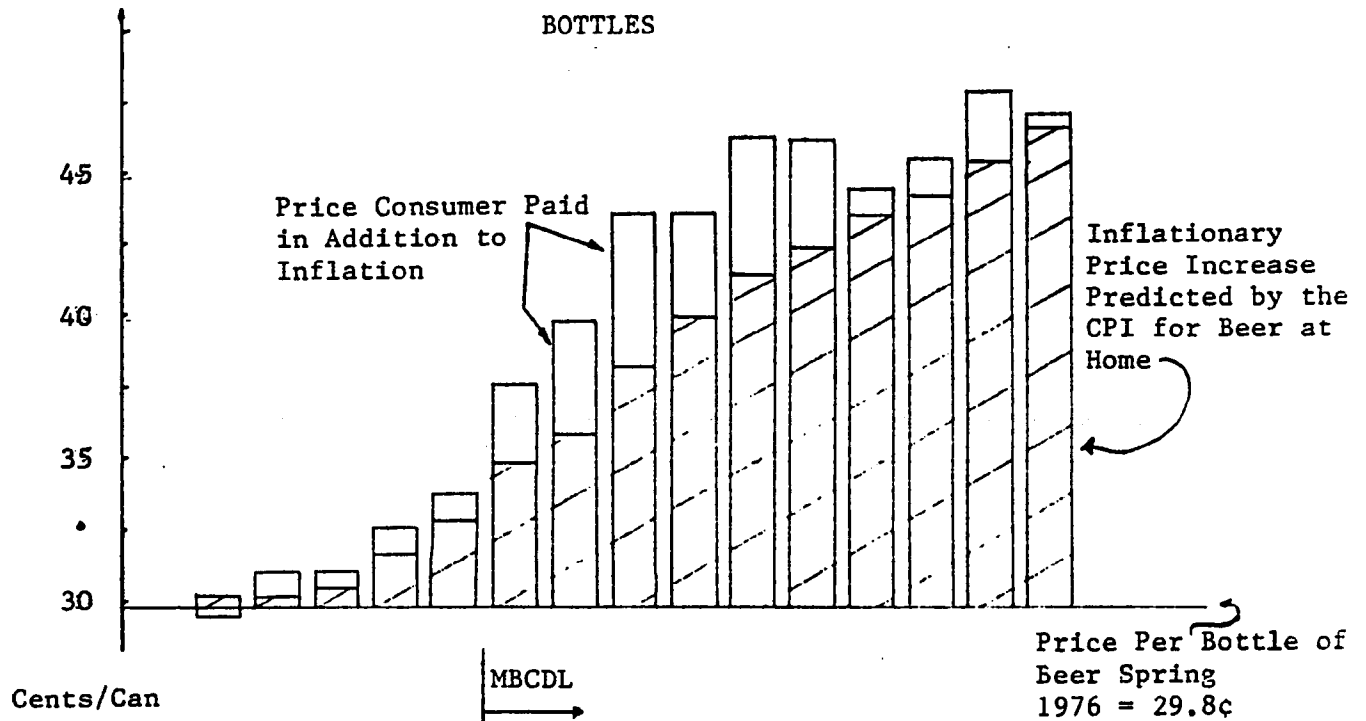
The actual price of beer in Michigan was significantly above the price predicted from national trends during the first three years after the MBCDL took effect. Predicted beer prices, based on national trend, however, have almost caught up to the level of Michigan Supermarket beer prices during 1982 and 1983. The amount paid by Michigan beer consumers in excess of nationally predicted prices reached a high of \$74 million in 1980 (Figure 23). These measures of total extra.consumer spending were based on the actual number of containers purchased which declined each year 1979 through 1982. The added price per container varied from year to year. This additional price per container increased from 2.7 cents in 1979 to 3.8 cents in 1980 and 3.6 cents in 1981, but then decreased back to near national average inflation adjusted levels in 1982 and 1983. Can prices were about 4.5 cents per container higher in Michigan than would be predicted by inflating 1978 prices during each of the first three years following the MBCDL.

That consumer beer prices rose, remained constant or declined relative to national price levels after implementation of a MBCDC could be explained by current theory. However, the Michigan case of first rapidly increasing prices and then regressing back to nationally predicted levels after several years requires close analysis. The recent stagnation in consumer beer prices in Michigan has been primarily the result of two factors. All of the states in the North-Central Census Region have experienced smaller price increases than the national average (PPI) would predict during the period from 1980 through 1983. As Michigan is the only MBCDL state in the region, the lower brewer (F.O.B.) prices are probably caused by the competitive situation in the region rather than the Michigan deposit law. In addition, the retail

Figure 22

Change in the Retail Price  
of Michigan Beer in Current Dollars

Cents/Bottle



Cents/Can

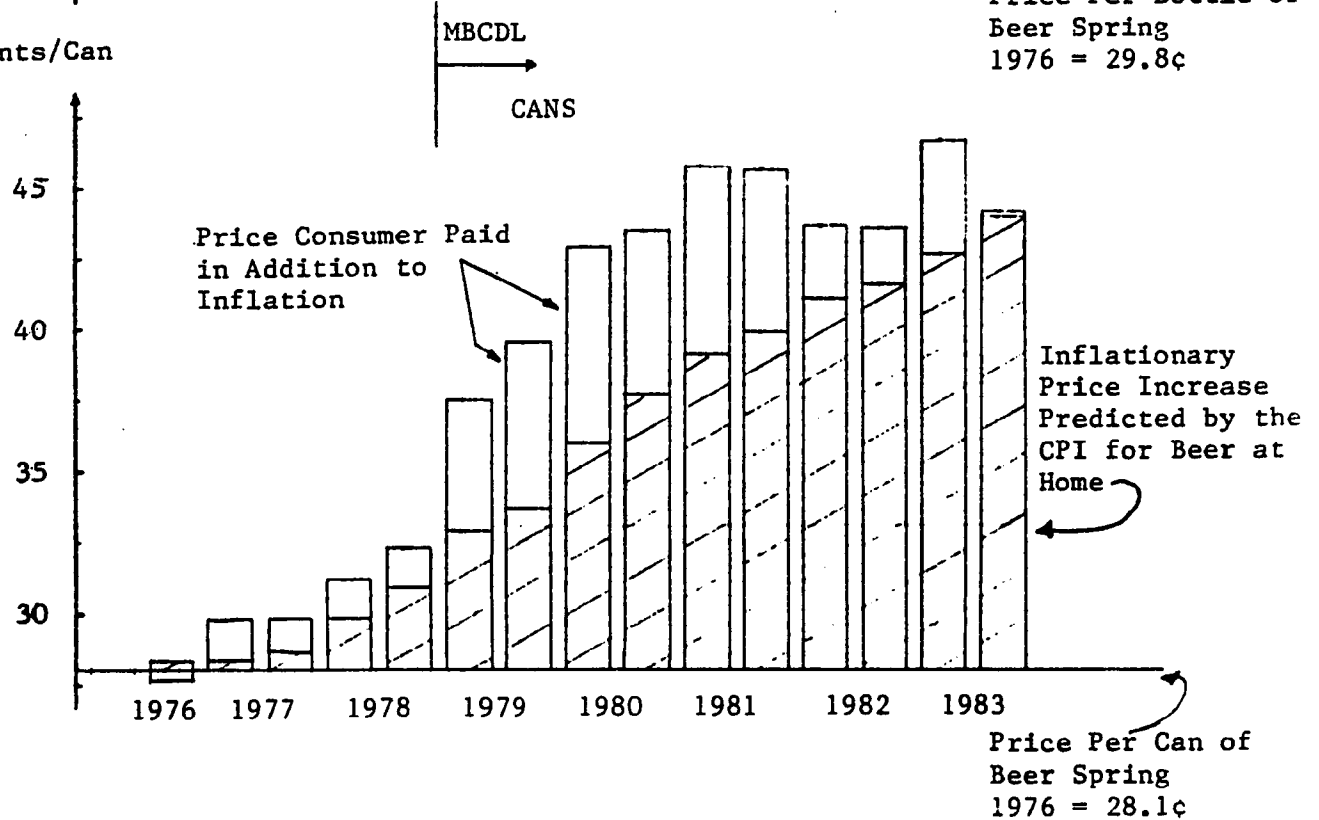
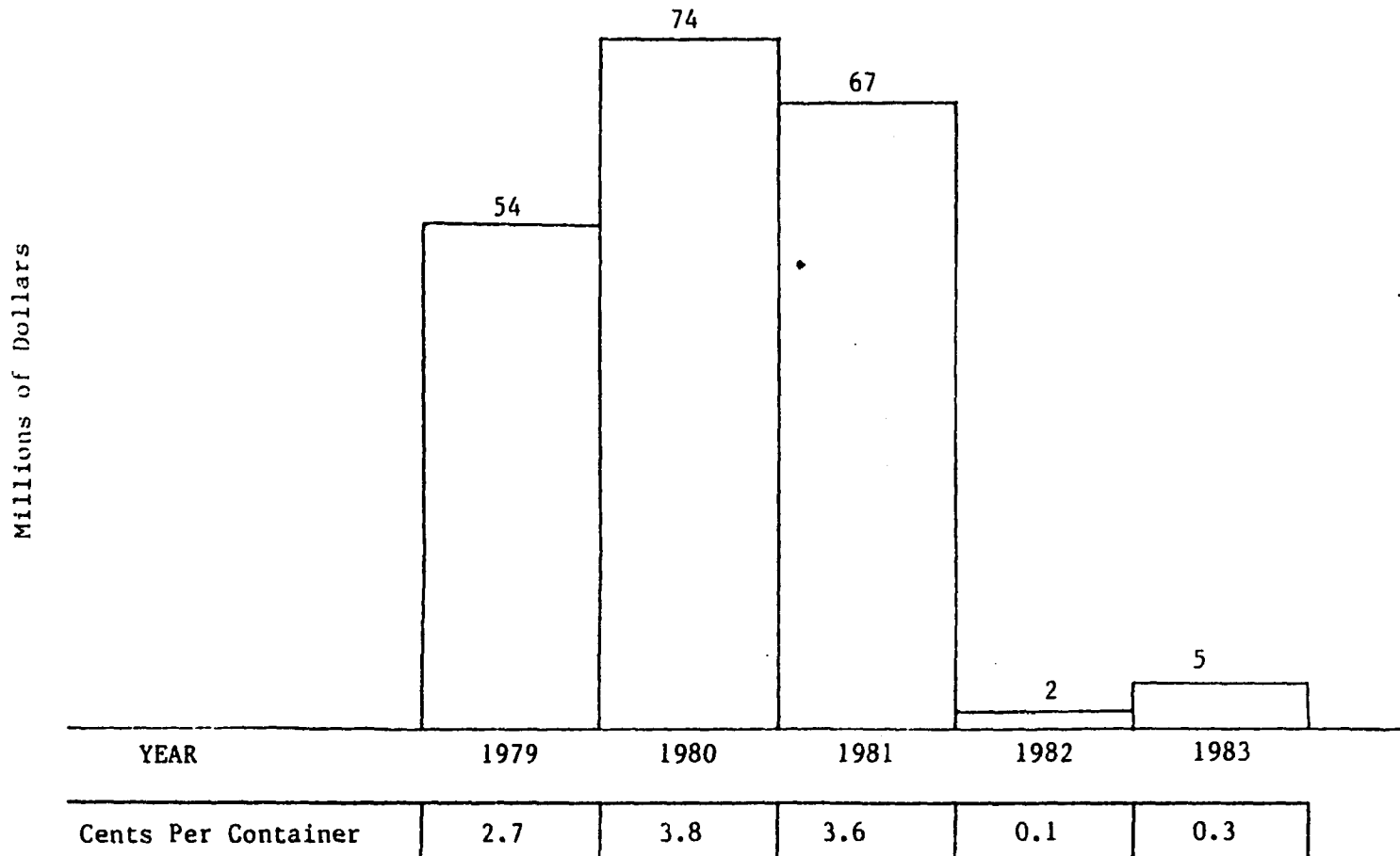


Figure 23

Annual Amount Michigan Beer  
Consumers Paid after 1978 above Inflation<sup>1</sup>  
Total Dollars and Cents per Container<sup>2</sup>



1. Predicted consumer expenditure is number of packages purchased times 1978 actual Michigan price inflated with the CPI for beer at home. The table reports the difference between this prediction and actual consumer spending on beer, based on supermarket prices.
2. Caution must be used in extrapolating these results to other areas without further verification. The system does not appear stable.

margins, which increased during 1979 and 1980, have regressed over the last two years back to pre-MBCDL levels. There is adequate documentation of additional costs for retailer in handling mandatory returns to conclude that either the current retail margin is not covering costs or that the initial assumption of a mature industry in the years prior to the MBCDL was invalid. Most states having a MBCDL compensate retailers at least 1 cent per container as a handling fee.<sup>62</sup> A recent summary of the literature prepared for the Governor of New York when considering their MBCDL estimated actual retail cost to be 2 cents per container.<sup>63</sup> Based on that study the retail margin in Michigan is not sufficient to meet the additional handling costs imposed by the MBCDL and beer sales must be considered a loss item supported by the sale of other items.

There are numerous peculiarities in pricing beer in Michigan which make it of limited use in predicting the effect of MBCDL on prices in other states or nationally. The Michigan pattern needs to be followed further and either verified or shown to be an anomaly in comparison with other deposit states.

### Conclusions

Supermarket prices were surveyed at all three levels of the distribution system during the three years preceding and five years following implementation of the MBCDL (1976-1983). The sample prices were for three brands of premium priced beer. Premium beer had a 75 percent market share in the years following the MBCDL.

After following national trends during the three years prior to the MBCDL, wholesale and retail prices advanced rapidly in 1979 and 1980. Wholesale prices were the constant for 1981 and 1982, before passing on a large price increase from brewers in 1983. Retail prices have been constant or falling since 1981. Retail prices absorbed the 1983 price increase.

Dock prices at the brewer increased at the same rate as the national Producer Price Index for beer during the three years before and first year after the MBCDL. In the last four years they have increased less than the national index in spite of a major price increase in 1983.

This pattern of smaller brewer dock prices has been experienced throughout the North-Central region of the country and is probably not related to the Michigan MBCDL. Brewer dock prices for the various brands in any price class were found to vary, within a small range. Wholesale prices for beer were identical for all brands in each price line with few exceptions. Retail supermarket prices were within two percent of each other for the price of premium beer and, within a store, brands in each price line were similarly priced.

The retail margin in real (deflated dollar) terms was 30 percent lower in 1983 than in 1976. This means that retailers had 30 percent less money to cover the additional burdens placed upon them by the MBCDL. The wholesale margin was up 31 percent in real terms for the same period.

An estimate of the amount of money consumers paid in higher beer prices due to the MBCDL was made. Between 54 and 74 million dollars were spent during each of the first three years due to prices in excess of those predicted by national beer price change. This was between 2.7 and 3.8 cents per container for the three years. Predicted prices based on national trends (CPI) have reached approximately the same level as actual Michigan supermarket beer prices during 1982 and 1983.

Extreme caution must be used in extrapolating these results to other states or nationally without further verification. The relative decline in the retail price of beer in Michigan during the last two years has come from two distinct sources. One is the reduction in the retail margin which occurred in 1982 at the time beer price advertising was allowed in Michigan. The second is the competitive situation among large brewers which has developed in the North-Central region of the country since 1980. Brewer price increases in all of the North-Central States have been below the national average increases in recent years.

**ENDNOTES**

1. Michigan Beverage Container Deposit Law, Michigan Compiled Laws, Section 445.571 - 445.576 (1976). Effective date December 3, 1978.
2. Michigan Compiled Laws. Section 436.33 (1978), or Public Acts 1978. Effective date, December 23, 1978.
3. The State of Michigan, through its Liquor Control Commission, collects \$6.30 tax from the brewer on every barrel of beer sold in the state and, therefore, it keeps accurate records on this product. A barrel of beer is equal to 31 gallons, or 13.78 cases of 24-12 oz. packages.
4. Michigan Compiled Laws. Section 722.51-722.55 (1971) or Public Acts 1971. No. 79. Effective date January 1, 1972.
5. Hybarger, Dennis. Michigan Liquor Control Commission, Hearings and Appeals Section, Lansing, Michigan, Interview, January 1979.
6. Bingham, Taylor, H., et. al., Energy and Economic Impacts of Mandatory Deposits, Research Triangle Institute, Research Triangle Park, North Carolina, for the Federal Energy Administration, September, 1976. Available as NTIS, PB-258-638; and General Accounting Office, State's Experience With Beverage Container Deposit Laws Shows Positive Benefits, report no. PAD 81-08, December 11, 1980, Appendix II.
7. One study of Michigan beer sales, General Accounting Office, State's Experience With Beverage Container Deposit Laws Shows Positive Benefits, used a technique correcting for second-order serial correlation in their model; Another study on national sales data, Bingham, Energy and Economic Impacts of Mandatory Deposits, converted the variables into logs before modeling the relationships. Neither form improved the accuracy of the models in the present study.
8. The ordinary least squares regression solution had Durbin-Watson test statistic values indicating significant auto-correlation (at the .05 level) of the error terms. A regression technique correcting for first order serial correlation of the error terms according to Beach and MacKinnon provided very satisfactory Durbin-Watson test statistics (over 2).
9. General Accounting Office, State's Experience With Beverage Container Deposit Laws Shows Positive Benefits, report no. PAD 81-08, December 11, 1980, Appendix II.
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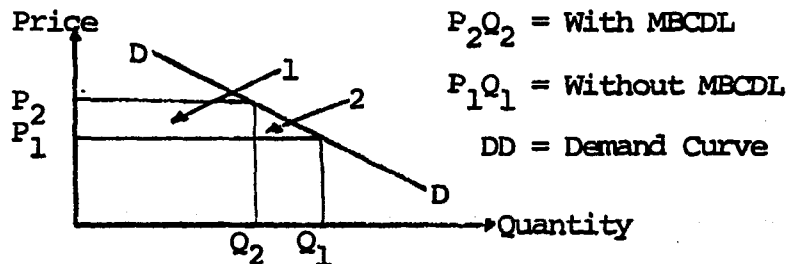
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17. Durbin, J. and Watson, G.S., "Testing for Serial Correlation in Least Squares Regression. II." Biometrika 38 (1951) p. 159-78.
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26. Michigan Compiled Laws, Public Act 235 of 1980.
27. Hybarger, Dennis. Michigan Beer and Wine Wholesalers Association to Martin, Randy, Michigan Liquor Control Commission, Report, June 29, 1981. (Typewritten.)
28. Illinois lowered its legal drinking age for beer and wine from 21 to 19 in September 1973 and put it back up to 21 in January 1980. This is the only age change in the 4 state region except for Ohio eliminating the 18 year old 3.2 beer in 1983. No other state in the region has implemented beverage container deposit legislation.
29. Michigan's Deposit Law: First Year, An Interim Report of the Special Joint Committee to Study the Impact of the Beverage Container Deposit Law. December 4, 1979, p. 18.
30. No beer containers could be sold after December 3, 1978 without the mandated Michigan Refund label both wholesalers and retailers were forced to empty their inventories before that date. As a consequence sales to wholesalers during October were down 30% or 170,000 barrels as compared with the same month in 1977. Some of this was regained during November and December but it is generally accepted that the 30% or 120,000 barrel increase in January 1979 over January 1978 was to fill the pipeline. By February 1979 sales were down to the level of prior year and in March 79 fell behind 1978 levels. No adjustment is made for this effect in the data but sales in 1978 are probably biased downward and the figures used and 1979 retail sales are biased upward in the range of 120,000 barrels or about 2%.
31. In Michigan for example, there were 521,000 18-20 year olds in 1972 and only 554,000 of them in 1979.
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where reuse means that a container was returned to a brewer in usable condition.
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58. This assumption has been made by other analysts, but no attempt to test its validity is known. General Accounting Office, State's Experience with Beverage Container Deposit Laws Shows Positive Benefits, p. 60; and Porter, "Michigan's Experience with Mandatory Deposits on Beverage Containers", p. 187.
59. In terms of the loss of consumer surplus shown in Figure A, only area 1 is included. Projected sales figures are included in the model section so that the interested reader can compute the size of area 2.



60. Can prices were equated with bottle prices at the wholesale level in 1977. It is not known whether this change in pricing strategy was unique to Michigan. Brewer prices have traditionally been lower for bottles than cans. This policy is still evident in 1983 prices in Michigan.
61. "Milliken orders probe into beer price hikes," The Michigan State News, East Lansing, Michigan, 22 May 1979, p. A3, and "Press Release February 4, 1982" Office of the Attorney General, Lansing Michigan. Attorney General Kelley announces that the two-year investigation failed to develop evidence of a criminal price fixing conspiracy.
62. Office of Technology Assessment. Materials and Energy from Municipal Waste. Washington D.C. July, 1979. pp.268.
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## CHAPTER IV

### Summary, Conclusions, Policy Recommendations

#### SUMMARY

This research project analysed the effect of a public policy, the Michigan Mandatory Beverage Container Deposit Law (MBCDL) on five characteristics of the market for beverages. These were: (1) total industry sales, (2) border area sales, (3) package mix, (4) distribution systems energy use, and (5) product prices. The beer industry was selected for study because comprehensive data for sales and container types were available from the Michigan Liquor Control Commission.

Because other changes were taking place at the time the MBCDL was being implemented, several key variables were explicitly analyzed to separate their effect from that of the MBCDL. These include another public policy measure (raising the legal drinking age), plus changes in economic, population, and price variables.

Five major findings can be attributed to the MBCDL.

- 1) The volume of beer sold in Michigan dropped after the MBCDL. A decline of between 345,000 barrels and 485,000 barrels per year was attributed to the MBCDL (Tables 4 and 6). This amounts to between 5 and 7 percent of annual sales, based on volume. The number of packages sold declined even more than total volume -17 percent from 1978 to 1982 (Table 10).

- 2) Packaged beer sales in counties located along Michigan's southern border declined by approximately 9 percent more than packaged sales declined in the rest of the state during the years 1977-1980 (Table 8).
- 3) The package mix in the Michigan market shifted dramatically with implementation of the MBCDL. Cans dropped from about 70 percent of the market to 39 percent the first year, but increased to 47 percent by 1982. The 19-trip refillable bottle initially went from 10 to 30 percent market share, but has now slipped to 20 percent. Non-refillable bottles have remained remarkably steady at around 20 percent of the market and a new, 4-trip bottle has captured about 12 percent of the market (Figure 16 and Table 10).
- 4) The rate of energy consumption in the total beer delivery system dropped by 38 percent as a result of the MBCDL and the resulting package mix (Figure 17).
- 5) The price to consumers of the MBCDL was estimated at 3 cents per container for bottles and 4.5 cents for cans during the first three years after implementation. In the last two years national average price levels have almost caught up with Michigan supermarket beer prices (Tables 13 and 14, Figures 18 through 23 and Appendix V).

Two findings were related to the change in the legal drinking age.

- 1) Lowering the minimum drinking age from 21 to 18 years in 1972 caused beer sales in the southern border counties of Michigan to rise by 7 percent more than the rest of the state (Table 9).
- 2) Raising the minimum drinking age from 18 to 21 years of age in 1978 was estimated to have reduced beer consumption throughout Michigan by between 50,000 and 95,000 barrels per year (or about 1 percent of total sales -- Table 8).

Some potential effects of the MBCDL not analyzed are its impact on litter, solid waste, employment, beverage system costs, and the soft drink industry.

### Conclusions

The Michigan MBCDL had a clearly negative effect on the demand for beer. Demand models developed for Michigan estimated that effect at between 345,000 and 485,000 barrels for each of the five years. This estimate held for demand models based on variables within Michigan and for models where Michigan sales were compared with other states in the North-Central Census Region. The effect of the MBCDL was modeled using a binary variable. This meant that the numerous contributing factors such as perceived consumer inconvenience in returning containers, lack

of desired product-package assortment in retail stores, and changing consumer habits were aggregated into one variable (along with all other changes in the environment occurring at about the same time).

A highly significant border effect was found along the state's southern border. A 9 percent decline in sales remained in border counties after adjusting for both the general statewide decline and the estimated effect of raising the legal minimum drinking age in Michigan. The dislocation of sales across the border was similar in relative terms in both urban and rural counties. A special adjustment for the change in the minimum legal drinking age was required to account for the out-of-state 18 to 20 year olds who had created a positive border effect in these same counties during the years 1972 through 1978 when they could cross the border into Michigan and purchase beer legally.

The theory underlying even the most recent government analysis of MBCDL policies, based on the states' experience, including Michigan, predicted that demand would remain constant for one year and then resume the previously established growth trend. This assumption requires careful reexamination based on the results of the present study.

Draught beer sales increased significantly as a result of the MBCDL. There was a substitution of draught beer for packaged beer, especially in the on-premise market. Although on-premise sales are exempt from requiring container deposits from consumers, they are not exempt from paying deposits to wholesalers for their purchases. Consequently, these containers must also be collected and stored by retailers for return of the deposits from wholesalers. The retrieval and especially storage of empty containers is minimized with draught barrels. Some substitution of draught for packaged beer has also occurred in the off-premise market.

All of the decline in beer sales following the Michigan MBCDL came from packaged beer sales, more specifically, the decline in can sales accounted for the total decline. There was an immediate shift away from cans in the market. Part of this shift is attributed to what can be called a "voluntary shift" in consumer demand. This includes the shift to bottles by consumers who thought that cans were banned by the MBCDL, and others who switched to bottles as they perceived this to be the spirit of the law; i.e. a "bottle bill." Still others could be called "involuntary adapters," who switched their purchases either to bottles or away from beer when they found beer in cans, and especially in six-packs of cans, no longer stocked on their retailer's shelves. Given that the market share of packaged beer in cans was over 70 percent prior to the MBCDL, and that almost all refillable bottle sales were sold in the on-premise market, cans easily comprised 80 percent of off-premise sales. The total disappearance of cans from retail stores was not an isolated occurrence when the law took effect. Several of the large supermarket chains removed cans, while other chains chose a less radical approach of eliminating six-packs, but continuing to stock a limited assortment of 12-pack packages of cans which they placed inconveniently on a high shelf to minimize sales.

Convenience stores continued to stock their pre-law package mix. Even this may have impacted on consumer attitudes toward cans. Consumers found that when returning their empty cans for refund many stores, those discontinuing can sales, would not refund cans of even the most widely sold brands, which they sold in bottles. After about one year retailer attitudes toward accepting returns changed toward viewing them as a customer service instead of a nuisance and additional cost.

Seeking competitive advantage, some retailers began accepting for refund any container, regardless of whether they sold that type of package or even that brand. Many retailers then began to sell the product in cans as well as refunding the empty containers. Cans have regained a portion of their market share and are now widely sold and refunded.

One truly unexpected finding concerning the Michigan package mix was that refillable bottles did not capture a larger market share. They did increase from 10 to 30 percent of the market in 1979, but the non-refillable bottle had an almost equal share. The two tiered 5 cent and 10 cent deposit does not appear effective in directing consumer choice toward the purchase of "generic" refillable bottles. In 1982 the 19-trip refillable had only a 19 percent market share.

Much of the research into the effects of MBCDL policy has assumed that the non-refillable bottle will disappear from the marketplace as a result of the legislation. That assumption is clearly not supported by the current research. The non-refillable bottle market share increased following the Michigan MBCDL. Five years later it was back to the pre-MBCDL level. The recent introduction of the 4-trip refillable bottle has captured market share from both the non-refillable and the 19-trip refillable bottles.

Beer is a highly differentiated product. Consumers purchase this product primarily according to brand preference. They also choose between purchasing bottles and cans. Only one type of bottle is offered in a retail outlet for each brand with very few exceptions. The choice among the various bottle options, 19-trip, 4-trip and non-refillable, is made by the manufacturer, not the consumer. The imposition of a 5 or 10 cent deposit requirement does not appear to be the major determinant in

the choice of bottle type by the brewer. The switch in Michigan by Anheuser-Busch from a 5 cent 19-trip refillable to a 10 cent 4-trip refillable and by Schlitz from a 5 cent 19-trip refillable to a 10 cent non-refillable illustrate this point.

Energy consumption in the beverage delivery system was expected to decline under the MBCDL, and it did. The decline was relatively insensitive to the assumed return rate within the range considered relevant to Michigan, 90 to 96 percent. The 19-trip refillable was the least energy intensive container. However, when the packages were aggregated into just two categories, bottles and cans, cans proved to be less energy intensive than bottles. This was because both the 4-trip refillable and non-refillable bottles consume more systems energy than aluminum cans, when most of the cans are recycled. Most of the energy savings is in non-petroleum based fuels and most savings are realized outside of Michigan.

Current MBCDL theory could explain that consumer beer prices rose, remained constant or declined relative to national price levels after implementation of the law. However, in Michigan prices first increased rapidly and then, after several years, nationally predicted levels caught up to actual supermarket prices. This requires close analysis. Starting from the base, or F.O.B. price the trend is clear for both bottles and cans. Brewer prices in Michigan have not increased as fast as the national average. With bottles it could be argued that the brewer has, in fact, realized package cost savings which are being passed on in the system. This is a weak explanation as Miller (included as one of two brewers in the price survey) did not switch to refillable bottles for the off-premise market in Michigan, which is a required

condition for the package cost savings hypothesis to hold. There is no cost savings explanation for can prices and the price decline for cans was even greater than for bottles. A number of industry analysts have pointed to intense competition among national brewers of premium beer in the midwest. As the "baby boom" portion of the population matured, the drinking population quit growing and the nature of competition changed from increasing the total market to increasing individual market shares. Aquisitions intensified competition in this region of the country. The increase in brewer prices since 1980 has been below the national average throughout the North-Central Region.

At the wholesale and retail levels in the distribution system the relative price index ratios, showing the relative change in operating margins over time, reflect real changes in the revenues-less-cost of goods sold. The relative wholesale price index ratio for beer in bottles increased sharply in 1979 and 1980 and has remained at that higher level since then. This supports the theory that prices would rise as wholesalers experienced increased handling and distribution costs for an all returnable system. A switch to more bottles in the package mix requires additional transport equipment and storage space as bottle packages are larger and heavier than cans. The scrap value of glass cullet amounts to about one half cent per bottle and is roughly half the value of cans. The relative wholesale price index ratio for beer in cans developed similarly to that for bottles. The additional costs for the virtually all aluminum can returns are surely being met through the sale of scrap aluminum and retention of any unclaimed can deposits. It appears that can prices exhibit what is called "sticky prices on the downside" common to situations with few competitors on the

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supply side (usually three to five wholesalers in any market area) and many purchasers on the demand side.

Retail margins increased initially, but have regressed during the past two years back to pre-MBCDL levels in supermarkets. There is adequate documentation of additional costs for retailers in handling mandatory returns to conclude that either the current retail margin is not covering costs or that the initial assumption of a mature beverage industry in years prior to the Michigan MBCDL was invalid. Retail supermarkets are considered to be very competitive. Most states having a MBCDL compensate retailers at least 1 cent per container as a handling fee, and some studies have placed the cost to retailers at nearly two cents per container. To the extent that actual margins are not sufficient to meet retail costs including the costs associated with container returns, beer sales must be considered a loss item supported by the sale of other products.

There are peculiarities in the pricing of beer in Michigan. This makes the Michigan experience of limited use in predicting the effect of a MBCDL on beverage prices in other states or nationally. Until the seeming anomalies are either explained or verified in other deposit states, general conclusions should not be drawn.

It was necessary to model the effect on beer sales of changing the legal minimum drinking age in Michigan to isolate it from the effect due to the MBCDL. Changing the minimum legal drinking age between 18 and 21 had relatively little effect on the trend in aggregate beer sales. This was not the expected result. However, Illinois provides a parallel case. The minimum legal drinking age was raised in Illinois from 19 to 21 a year after Michigan and yet Illinois beer sales

continued to increase for the next two years. Therefore, the results obtained in Michigan may be correct. Either the effect of changing the legal drinking age is small, or the effect may be gradual which would not be correctly modeled using a binary variable.

### Limitations

The largest limitation of the study is that only beer was considered. The soft drink industry has as large a volume as the beer. Unfortunately the data are not available to conduct a detailed study. To simply advise the reader to multiply all effects by two is an unsatisfactory answer to the question of total effects of the policy. Yet, no better answer can be derived from the present study.

There are numerous problems involved with research in the social sciences. It is never possible to control the universe so that just those variables under study are allowed to assume non-constant values. At the same time as the Michigan MBCDL took effect the minimum legal drinking age was raised from 18 to 21. The present study derived best estimates for the effect of both policies on beer sales. Implicit in the binary variable modeling the effect of the age change is the assumption that the effect of the policy on sales will be equal and opposite when the age was lowered and then raised again. This assumption could not be checked using the Michigan data.

The economy in Michigan is more volatile than in many regions of the country. Cars did not sell well during the years following implementation of the MBCDL. Although those two things are unrelated, personal income levels, unemployment, and consumer expectations are affected by the state of the automobile industry and these factors may affect beer sales in ways other than those modeled.

The price the consumer has paid for beer under the Michigan MBCDL may reflect a number of conditions unique to Michigan and the fact that it was the first industrial state with a large population to adopt such a policy. Brewer dock prices may have been restrained in Michigan due to special competitive moves in the midwest. Wholesalers, with exclusive territories and limited numbers of competitors fit the description of oligopolists. Price theory under oligopolistic conditions predicts that prices will be slow to respond to pressures to reduce price, and the lack of knowledge about additional costs imposed by the MBCDL may have pushed prices higher than at least consumers and the other channel members would have considered justified. Retail margins have been so small during the last two years that there is a strong probability that supermarket retailers are not meeting their total costs on beer. The inclusion of retail prices from other types of stores would have made the retail price data more representative of Michigan beer prices.

#### Policy Recommendations

For Michigan all that can be realistically suggested are minor adjustments to the existing law. The legislation has a broad base of popular support which precludes the consideration of alternative policy measures. People feel that they are doing something to improve the environment. There is the additional problem in Michigan of requiring more than a simple majority vote to amend this law because it was passed by a referendum vote.

The container which appears to have the greatest impact on the environment, given the high return rates, is the non-refillable bottle.

The current two-tier system of deposits is clearly not influencing demand significantly. The difference in refund value should either be increased until the desired effect on container use is achieved, or a uniform deposit at the lower level should be effected. There is no evidence of higher return rates for containers bearing the higher refund value. Adopting a single 5 cent deposit level would transfer approximately \$10 million back to consumers in the form of lower deposits. That is, the total amount of money on deposit on an average day in Michigan would be \$10 million less if all deposits were 5 cents.

The handling fee paid by wholesalers to retailers on a per container basis in most MBCDL states would somewhat equalize the impact of the law on retailers. Those who receive relatively more containers back for refund are at a disadvantage to those receiving fewer refunds under the current system in Michigan. Certain types of retail outlets, such as supermarkets and some convenience stores regularly receive far greater returns than others, such as drug stores, discount stores, and bars. To the extent that these types of stores are in direct competition with each other the law may discriminate against those stores which contribute most towards its effectiveness.

The recommendation for local and county governments is that they realize that the border effects on both sales projections and providing the desired effect will be much greater in a small area than in a state the size of Michigan. For example, the Department of Defense concluded after tests in 1979 that military bases were not sufficiently large to even generate a market for the empty non-refillable containers collected. They reported large decreases in beverage demand on the bases that implemented mandatory deposits. In Michigan the impact on beverage sales was much greater along the southern border than the average in the rest of the state.

In states not currently under MBCDL as well as at the federal level it is recommended that careful consideration be given to a number of policy alternatives for meeting the desired environmental goals. The 1972 EPA study probably offers the broadest approach to analysis so far. The results of the present study confirm that there are benefits to MBCDL. However, the study also raises serious questions about some of the major assumptions on which the projected benefits from this type of policy are based. The benefits are not cost-free, as often assumed, and a real question of cost effectiveness can be raised.

Assuming that the annual cost of the MBCDL in the form of higher prices to soft drink consumers was only half of what it cost beer consumers (a conservative assumption) this was a very expensive piece of legislation. That would place the cost at a conservative \$100 million during each of the first three years. This is about 20 times the annual state litter pickup cost and about one half of the total cost for municipal solid waste pickup and disposal in the whole state.

The recommendations for the beverage industry are very direct. In a survey conducted in 1981 as background for the present study there was almost unanimous agreement among brewers that they would support some type of legislation aimed at reducing litter and solid waste. At the same time, the beer industry is against almost all forms of legislation currently proposed. These include MBCDL, bans on non-refillable containers, litter taxes on beverage containers and other broader tax bases. The only acceptable policy appears to be a litter tax addressing all components of litter. Unfortunately, that policy does not experience the broad base of popular support which characterizes MBCDL campaigns. These election contests give the impression to many people

that the beverage industry is not accepting its corporate social responsibility. It is time for the beverage industry to actively support something. If a nominal beverage container tax, say one cent or less per manufactured container, was championed by the industry itself, they could gain a great deal of respect from consumers and probably even from many of the groups which have so vigorously opposed them in the past. Such a tax, earmarked for highly visible programs such as litter cleanup and awareness programs, as well as pilot solid waste management or recovery systems could have a significant impact of the issues addressed, benefit society and provide long term positive publicity for the beverage industry. The industry stands to gain respect as a responsive to social and environmental concerns while guaranteeing the continuance of "business as usual" in the beverage market. Surely a uniform national container tax would be a more predictable policy with smaller impacts on the industry than five or ten more regional MBCDL policies or nationwide legislation which are possible alternatives.

#### Future Research

The present study does not include the soft drink industry. There are approximately the same number of fillings sold of both soft drinks and beer, but the industries are quite different. There are only two tiers in the distribution channel for soft drinks and most of the packages sold in Michigan are also filled at bottling plants within the state. Given these differences, the effects of a MBCDL on the soft drink industry may differ significantly from the beer industry.

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The present study could be improved by including prices from convenience stores. This market for beer differs from supermarkets in both the type of purchase situation and in the significance of beer sales to total store sales.

The present study could be expanded to include other states and/or soft drinks. A second test of the models in another large, industrial state, such as New York, could be used to verify them.

Within Michigan wine and spirit sales could be modeled to identify the effect of changing the minimum legal drinking age on consumption more explicitly. This would check the validity of the small effect attributed to the change in the legal drinking age in the present study.

On a larger scale, a study is needed which would include all states which either increased their drinking age or instituted a MBCDL, or both. Comparing the rate of change in demand in individual states to the national average similar effects could be identified.

Research is needed on the effect of this legislation on cost at all levels of the distribution system. This would ideally identify costs for the various ways in which different brewers, wholesalers, and retailers have adapted to the policy. However, the data required for such a study may not be available.

The apparent ineffectiveness of the 5 and 10 cent deposit system to influence consumer behavior opens another avenue for research. Can a differential deposit system at realistic deposit levels influence consumer behavior enough to pull a desired container through the distribution system.

Consumer behavior offers many additional avenues for future

research. The work of Crosby and Taylor identifies a population segment called ecologically concerned consumers. The present research showed that consumer behavior in the marketplace was not congruous with the traits identified with consumers favoring passage of a MBCDL. There is a need for research linking the broad-based popular support of the Michigan MBCDL (attitudes) with behavior.

Alternative policies for meeting the broad goals of solid waste reduction, litter abatement, and resource conservation need to be identified. There may be more efficient means of meeting these goals which the current singular stress on mandatory deposits preclude.

## APPENDICES

APPENDIX I  
Data Used in the Study

|      | Michigan Total<br>Personal Income<br>(current \$ x 10 <sup>6</sup> ) | Michigan Total<br>Personal Income<br>(constant \$ x 10 <sup>8</sup> ) | Michigan<br>CPI Beer | Michigan CPI | Michigan Relative<br>Beer Price Index | PRICINC |
|------|----------------------------------------------------------------------|-----------------------------------------------------------------------|----------------------|--------------|---------------------------------------|---------|
| 1954 | 143354.0                                                             | 1737.1                                                                | 88.3                 | 100.0        | 1.18532                               | 15.730  |
| 55   | 159900.0                                                             | 1990.4                                                                | 88.3                 | 100.0        | 1.10474                               | 15.730  |
| 56   | 165200.0                                                             | 2003.3                                                                | 88.3                 | 100.0        | 1.10565                               | 15.730  |
| 57   | 158700.0                                                             | 2003.3                                                                | 91.7                 | 100.0        | 1.10776                               | 15.730  |
| 58   | 164700.0                                                             | 2102.7                                                                | 91.7                 | 100.0        | 1.10774                               | 15.730  |
| 59   | 174522.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 60   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 61   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 62   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 63   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 64   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 65   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 66   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 67   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 68   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 69   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 70   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 71   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 72   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 73   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 74   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 75   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 76   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 77   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 78   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 79   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 80   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 81   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 82   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 83   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 84   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 85   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 86   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 87   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 88   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 89   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 90   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 91   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 92   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 93   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 94   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 95   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 96   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 97   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 98   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 99   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |
| 00   | 182200.0                                                             | 2222.2                                                                | 92.3                 | 100.0        | 1.10727                               | 15.730  |

[illegible]

|      | Ohio Beer | Wisconsin Beer | North Central<br>Four State Average |
|------|-----------|----------------|-------------------------------------|
| 1954 | 8287.00   | 5215.00        | 4114.00                             |
| 1955 | 8287.00   | 5215.00        | 4114.00                             |
| 1956 | 8287.00   | 5215.00        | 4114.00                             |
| 1957 | 8287.00   | 5215.00        | 4114.00                             |
| 1958 | 8287.00   | 5215.00        | 4114.00                             |
| 1959 | 8287.00   | 5215.00        | 4114.00                             |
| 1960 | 8287.00   | 5215.00        | 4114.00                             |
| 1961 | 8287.00   | 5215.00        | 4114.00                             |
| 1962 | 8287.00   | 5215.00        | 4114.00                             |
| 1963 | 8287.00   | 5215.00        | 4114.00                             |
| 1964 | 8287.00   | 5215.00        | 4114.00                             |
| 1965 | 8287.00   | 5215.00        | 4114.00                             |
| 1966 | 8287.00   | 5215.00        | 4114.00                             |
| 1967 | 8287.00   | 5215.00        | 4114.00                             |
| 1968 | 8287.00   | 5215.00        | 4114.00                             |
| 1969 | 8287.00   | 5215.00        | 4114.00                             |
| 1970 | 8287.00   | 5215.00        | 4114.00                             |
| 1971 | 8287.00   | 5215.00        | 4114.00                             |
| 1972 | 8287.00   | 5215.00        | 4114.00                             |
| 1973 | 8287.00   | 5215.00        | 4114.00                             |
| 1974 | 8287.00   | 5215.00        | 4114.00                             |
| 1975 | 8287.00   | 5215.00        | 4114.00                             |
| 1976 | 8287.00   | 5215.00        | 4114.00                             |
| 1977 | 8287.00   | 5215.00        | 4114.00                             |
| 1978 | 8287.00   | 5215.00        | 4114.00                             |
| 1979 | 8287.00   | 5215.00        | 4114.00                             |
| 1980 | 8287.00   | 5215.00        | 4114.00                             |
| 1981 | 8287.00   | 5215.00        | 4114.00                             |
| 1982 | 8287.00   | 5215.00        | 4114.00                             |
| 1983 | 8287.00   | 5215.00        | 4114.00                             |
| 1984 | 8287.00   | 5215.00        | 4114.00                             |
| 1985 | 8287.00   | 5215.00        | 4114.00                             |
| 1986 | 8287.00   | 5215.00        | 4114.00                             |
| 1987 | 8287.00   | 5215.00        | 4114.00                             |
| 1988 | 8287.00   | 5215.00        | 4114.00                             |
| 1989 | 8287.00   | 5215.00        | 4114.00                             |
| 1990 | 8287.00   | 5215.00        | 4114.00                             |
| 1991 | 8287.00   | 5215.00        | 4114.00                             |
| 1992 | 8287.00   | 5215.00        | 4114.00                             |
| 1993 | 8287.00   | 5215.00        | 4114.00                             |
| 1994 | 8287.00   | 5215.00        | 4114.00                             |
| 1995 | 8287.00   | 5215.00        | 4114.00                             |
| 1996 | 8287.00   | 5215.00        | 4114.00                             |
| 1997 | 8287.00   | 5215.00        | 4114.00                             |
| 1998 | 8287.00   | 5215.00        | 4114.00                             |
| 1999 | 8287.00   | 5215.00        | 4114.00                             |
| 2000 | 8287.00   | 5215.00        | 4114.00                             |
| 2001 | 8287.00   | 5215.00        | 4114.00                             |
| 2002 | 8287.00   | 5215.00        | 4114.00                             |
| 2003 | 8287.00   | 5215.00        | 4114.00                             |
| 2004 | 8287.00   | 5215.00        | 4114.00                             |
| 2005 | 8287.00   | 5215.00        | 4114.00                             |
| 2006 | 8287.00   | 5215.00        | 4114.00                             |
| 2007 | 8287.00   | 5215.00        | 4114.00                             |
| 2008 | 8287.00   | 5215.00        | 4114.00                             |
| 2009 | 8287.00   | 5215.00        | 4114.00                             |
| 2010 | 8287.00   | 5215.00        | 4114.00                             |
| 2011 | 8287.00   | 5215.00        | 4114.00                             |
| 2012 | 8287.00   | 5215.00        | 4114.00                             |
| 2013 | 8287.00   | 5215.00        | 4114.00                             |
| 2014 | 8287.00   | 5215.00        | 4114.00                             |
| 2015 | 8287.00   | 5215.00        | 4114.00                             |
| 2016 | 8287.00   | 5215.00        | 4114.00                             |
| 2017 | 8287.00   | 5215.00        | 4114.00                             |
| 2018 | 8287.00   | 5215.00        | 4114.00                             |
| 2019 | 8287.00   | 5215.00        | 4114.00                             |
| 2020 | 8287.00   | 5215.00        | 4114.00                             |
| 2021 | 8287.00   | 5215.00        | 4114.00                             |
| 2022 | 8287.00   | 5215.00        | 4114.00                             |
| 2023 | 8287.00   | 5215.00        | 4114.00                             |
| 2024 | 8287.00   | 5215.00        | 4114.00                             |
| 2025 | 8287.00   | 5215.00        | 4114.00                             |
| 2    |           |                |                                     |

## Population in Thousands

Population 18-20    Population 20-44    Population 44+up

| 19   | ..... | ..... | ..... |
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| 2097 | ..... | ..... | ..... |
| 2098 | ..... | ..... | ..... |
| 2099 | ..... | ..... | ..... |
| 2100 | ..... | ..... | ..... |

## Michigan Unemployment

Population 18-44    (rate in %)

| 19   | ..... | ..... | CP    | IR    | FR    |
|------|-------|-------|-------|-------|-------|
| 1954 | ..... | ..... | ..... | ..... | ..... |
| 1955 | ..... | ..... | ..... | ..... | ..... |
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| 1976 | ..... | ..... | ..... | ..... | ..... |
| 1977 | ..... | ..... | ..... | ..... | ..... |
| 1978 | ..... | ..... | ..... | ..... | ..... |
| 1979 | ..... | ..... | ..... | ..... | ..... |
| 1980 | ..... | ..... | ..... | ..... | ..... |
| 1981 | ..... | ..... | ..... | ..... | ..... |
| 1982 | ..... | ..... | ..... | ..... | ..... |
| 1983 | ..... | ..... | ..... | ..... | ..... |
| 1984 | ..... | ..... | ..... | ..... | ..... |
| 1985 | ..... | ..... | ..... | ..... | ..... |
| 1986 | ..... | ..... | ..... | ..... | ..... |
| 1987 | ..... | ..... | ..... | ..... | ..... |
| 1988 | ..... | ..... | ..... | ..... | ..... |
| 1989 | ..... | ..... | ..... | ..... | ..... |
| 1990 | ..... | ..... | ..... | ..... | ..... |
| 1991 | ..... | ..... | ..... | ..... | ..... |
| 1992 | ..... | ..... | ..... | ..... | ..... |
| 1993 | ..... | ..... | ..... | ..... | ..... |
| 1994 | ..... | ..... | ..... | ..... | ..... |
| 1995 | ..... | ..... | ..... | ..... | ..... |
| 1996 | ..... | ..... | ..... | ..... | ..... |
| 1997 | ..... | ..... | ..... | ..... | ..... |
| 1998 | ..... | ..... | ..... | ..... | ..... |
| 1999 | ..... | ..... | ..... | ..... | ..... |
| 2000 | ..... | ..... | ..... | ..... | ..... |
| 2001 | ..... | ..... | ..... | ..... | ..... |
| 2002 | ..... | ..... | ..... | ..... | ..... |
| 2003 | ..... | ..... | ..... | ..... | ..... |
| 2004 | ..... | ..... | ..... | ..... | ..... |
| 2005 | ..... | ..... | ..... | ..... | ..... |
| 2006 | ..... | ..... | ..... | ..... | ..... |
| 2007 | ..... | ..... | ..... | ..... | ..... |
| 2008 | ..... | ..... | ..... | ..... | ..... |
| 2009 | ..... | ..... | ..... | ..... | ..... |
| 2010 | ..... | ..... | ..... | ..... | ..... |
| 2011 | ..... | ..... | ..... | ..... | ..... |
| 2012 | ..... | ..... | ..... | ..... | ..... |
| 2013 | ..... | ..... | ..... | ..... | ..... |
| 2014 | ..... | ..... | ..... | ..... | ..... |
| 2015 | ..... | ..... | ..... | ..... | ..... |
| 2016 | ..... | ..... | ..... | ..... | ..... |
| 2017 | ..... | ..... | ..... | ..... | ..... |
| 2018 | ..... | ..... | ..... | ..... | ..... |
| 2019 | ..... | ..... | ..... | ..... | ..... |
| 2020 | ..... | ..... | ..... | ..... | ..... |
| 2021 | ..... | ..... | ..... | ..... | ..... |
| 2022 | ..... | ..... | ..... | ..... | ..... |
| 2023 | ..... | ..... | ..... | ..... | ..... |
| 2024 | ..... | ..... | ..... | ..... | ..... |
| 2025 | ..... | ..... | ..... | ..... | ..... |
| 2026 | ..... | ..... | ..... | ..... | ..... |
| 2027 | ..... | ..... | ..... | ..... | ..... |
| 2028 | ..... | ..... | ..... | ..... | ..... |
| 2029 | ..... | ..... | ..... | ..... | ..... |
| 2030 | ..... | ..... | ..... | ..... | ..... |
| 2031 | ..... | ..... | ..... | ..... | ..... |
| 2032 | ..... | ..... | ..... | ..... | ..... |
| 2033 | ..... | ..... | ..... | ..... | ..... |
| 2034 | ..... | ..... | ..... | ..... | ..... |
| 2035 | ..... | ..... | ..... | ..... | ..... |
| 2036 | ..... | ..... | ..... | ..... | ..... |
| 2037 | ..... | ..... | ..... | ..... | ..... |
| 2038 | ..... | ..... | ..... | ..... | ..... |
| 2039 | ..... | ..... | ..... | ..... | ..... |
| 2040 | ..... | ..... | ..... | ..... | ..... |
| 2041 | ..... | ..... | ..... | ..... | ..... |
| 2042 | ..... | ..... | ..... | ..... | ..... |
| 2043 | ..... | ..... | ..... | ..... | ..... |
| 2044 | ..... | ..... | ..... | ..... | ..... |
| 2045 | ..... | ..... | ..... | ..... | ..... |
| 2046 | ..... | ..... | ..... | ..... | ..... |
| 2047 | ..... | ..... | ..... | ..... | ..... |
| 2048 | ..... | ..... | ..... | ..... | ..... |
| 2049 | ..... | ..... | ..... | ..... | ..... |
| 2050 | ..... | ..... | ..... | ..... | ..... |
| 2051 | ..... | ..... | ..... | ..... | ..... |
| 2052 | ..... | ..... | ..... | ..... | ..... |
| 2053 | ..... | ..... | ..... | ..... | ..... |
| 2054 | ..... | ..... | ..... | ..... | ..... |
| 2055 | ..... | ..... | ..... | ..... | ..... |
| 2056 | ..... | ..... | ..... | ..... | ..... |
| 2057 | ..... | ..... | ..... | ..... | ..... |
| 2058 | ..... | ..... | ..... | ..... | ..... |
| 2059 | ..... | ..... | ..... | ..... | ..... |
| 2060 | ..... | ..... | ..... | ..... | ..... |
| 2061 | ..... | ..... | ..... | ..... | ..... |
| 2062 | ..... | ..... | ..... | ..... | ..... |
| 2063 | ..... | ..... | ..... | ..... | ..... |
| 2064 | ..... | ..... | ..... | ..... | ..... |
| 2065 | ..... | ..... | ..... | ..... | ..... |
| 2066 | ..... | ..... | ..... | ..... | ..... |
| 2067 | ..... | ..... | ..... | ..... | ..... |
| 2068 | ..... | ..... | ..... | ..... | ..... |
| 2069 | ..... | ..... | ..... | ..... | ..... |
| 2070 | ..... | ..... | ..... | ..... | ..... |
| 2071 | ..... | ..... | ..... | ..... | ..... |
| 2072 | ..... | ..... | ..... | ..... | ..... |
| 2073 | ..... | ..... | ..... | ..... | ..... |
| 2074 | ..... | ..... | ..... | ..... | ..... |
| 2075 | ..... | ..... | ..... | ..... | ..... |
| 2076 | ..... | ..... | ..... | ..... | ..... |
| 2077 | ..... | ..... | ..... | ..... | ..... |
| 2078 | ..... | ..... | ..... | ..... | ..... |
| 2079 | ..... | ..... | ..... | ..... | ..... |
| 2080 | ..... | ..... | ..... | ..... | ..... |
| 2081 | ..... | ..... | ..... | ..... | ..... |
| 2082 | ..... | ..... | ..... | ..... | ..... |
| 2083 | ..... | ..... | ..... | ..... | ..... |
| 2084 | ..... | ..... | ..... | ..... | ..... |
| 2085 | ..... | ..... | ..... | ..... | ..... |
| 2086 | ..... | ..... | ..... | ..... | ..... |
| 2087 | ..... | ..... | ..... | ..... | ..... |
| 2088 | ..... | ..... | ..... | ..... | ..... |
| 2089 | ..... | ..... | ..... | ..... | ..... |
| 2090 | ..... | ..... | ..... | ..... | ..... |
| 2091 | ..... | ..... | ..... | ..... | ..... |
| 2092 | ..... | ..... | ..... | ..... | ..... |
| 2093 | ..... | ..... | ..... | ..... | ..... |
| 2094 | ..... | ..... | ..... | ..... | ..... |
| 2095 | ..... | ..... | ..... | ..... | ..... |
| 2096 | ..... | ..... | ..... | ..... | ..... |
| 2097 | ..... | ..... | ..... | ..... | ..... |
| 2098 | ..... | ..... | ..... | ..... | ..... |
| 2099 | ..... | ..... | ..... | ..... | ..... |
| 2100 | ..... | ..... | ..... | ..... | ..... |

| Indices where Spring, 1976=100 |                    |                 |                     |                     |                  |                   |
|--------------------------------|--------------------|-----------------|---------------------|---------------------|------------------|-------------------|
|                                | PPI<br>Bottle Beer | PPI<br>Can Beer | CPI<br>Beer at Home | PPI<br>Bottle Index | PPI<br>Can Index | CPI<br>Beer Index |
| 1976                           | 144.800            | 131.900         | 142.500             | 1.00000             | 1.00000          | 1.00000           |
|                                | 145.600            | 132.000         | 144.000             | 1.00483             | 1.00075          | 1.01052           |
| 1977                           | 147.500            | 134.200         | 145.000             | 1.01794             | 1.01744          | 1.01754           |
|                                | 148.900            | 135.600         | 146.600             | 1.02761             | 1.02605          | 1.02677           |
| 1978                           | 152.600            | 138.600         | 150.600             | 1.05314             | 1.05080          | 1.05523           |
|                                | 155.000            | 143.800         | 156.800             | 1.06970             | 1.06022          | 1.10064           |
| 1979                           | 164.700            | 154.500         | 166.100             | 1.13665             | 1.17210          | 1.16566           |
|                                | 167.000            | 157.500         | 172.400             | 1.15352             | 1.19409          | 1.20010           |
| 1980                           | 181.200            | 169.200         | 181.500             | 1.25052             | 1.26276          | 1.27368           |
|                                | 187.000            | 171.600         | 191.600             | 1.29059             | 1.30099          | 1.34486           |
| 1981                           | 192.100            | 178.900         | 197.600             | 1.32674             | 1.35663          | 1.36667           |
|                                | 192.200            | 180.800         | 202.800             | 1.32643             | 1.37074          | 1.43616           |
| 1982                           | 192.800            | 184.600         | 205.400             | 1.33657             | 1.39955          | 1.46246           |
|                                | 194.400            | 185.400         | 211.600             | 1.34161             | 1.40143          | 1.48460           |
| 1983                           | 203.000            | 197.000         | 219.100             | 1.40797             | 1.49355          | 1.53775           |
|                                | 207.000            | 201.500         | 226.300             | 1.42657             | 1.52767          | 1.56667           |

| Retail Index Ratios to CPI Beer Index |             |            |             | Wholesale Index Ratios to PPI Indices |             |               |             |
|---------------------------------------|-------------|------------|-------------|---------------------------------------|-------------|---------------|-------------|
| Retail Bottle                         |             | Retail Can |             | Wholesale Bottle                      |             | Wholesale Can |             |
| Strategy I                            | Strategy II | Strategy I | Strategy II | Strategy I                            | Strategy II | Strategy I    | Strategy II |
| 1976                                  | 1.00000     | 1.00000    | 1.00000     | 1.00000                               | 1.00000     | 1.00000       | 1.00000     |
|                                       | .98553      | .98553     | .98553      | .98553                                | .98553      | .98553        | .98553      |
| 1977                                  | 1.02405     | 1.02405    | 1.04100     | 1.04100                               | 1.04100     | 1.04100       | 1.04100     |
|                                       | 1.02287     | 1.02287    | 1.02287     | 1.02287                               | 1.02287     | 1.02287       | 1.02287     |
| 1978                                  | 1.03231     | 1.03231    | 1.04999     | 1.04999                               | 1.04999     | 1.04999       | 1.04999     |
|                                       | 1.03099     | 1.03099    | 1.04748     | 1.04748                               | 1.04748     | 1.04748       | 1.04748     |
| 1979                                  | 1.08141     | 1.08141    | 1.14386     | 1.14386                               | 1.14386     | 1.14386       | 1.14386     |
|                                       | 1.10041     | 1.10041    | 1.16309     | 1.16309                               | 1.16309     | 1.16309       | 1.16309     |
| 1980                                  | 1.14090     | 1.14090    | 1.16304     | 1.16304                               | 1.16304     | 1.16304       | 1.16304     |
|                                       | 1.06544     | 1.06544    | 1.10301     | 1.10301                               | 1.10301     | 1.10301       | 1.10301     |
| 1981                                  | 1.11708     | 1.11708    | 1.17333     | 1.17333                               | 1.17333     | 1.17333       | 1.17333     |
|                                       | 1.08310     | 1.08310    | 1.10100     | 1.10100                               | 1.10100     | 1.10100       | 1.10100     |
| 1982                                  | .96423      | .96423     | .96423      | .96423                                | .96423      | .96423        | .96423      |
|                                       | .99786      | .99786     | .96423      | .96423                                | .96423      | .96423        | .96423      |
| 1983                                  | 1.02022     | 1.02022    | .96423      | .96423                                | .96423      | .96423        | .96423      |
|                                       | .98422      | .98422     | .96423      | .96423                                | .96423      | .96423        | .96423      |

|      | Retail Bottle Index<br>Compared with Wholesale |             | Wholesale Bottle Index Compared<br>with Brewers |          | Brewer Bottle Index Relative<br>to the PPI |          |
|------|------------------------------------------------|-------------|-------------------------------------------------|----------|--------------------------------------------|----------|
|      | Strategy I                                     | Strategy II |                                                 |          |                                            |          |
| 1976 | 1.000000                                       | 1.000000    | 1.000000                                        | 1.000000 | 1.000000                                   | 1.000000 |
|      | .978618                                        | .978618     | 1.000000                                        | 1.000000 | 1.001304                                   | 1.001304 |
| 1977 | 1.000000                                       | 1.000000    | 1.000000                                        | 1.000000 | .999999                                    | .999999  |
|      | 1.000000                                       | 1.000000    | 1.000000                                        | 1.000000 | 1.001304                                   | 1.001304 |
| 1978 | 1.000000                                       | 1.000000    | 1.000000                                        | 1.000000 | 1.001304                                   | 1.001304 |
|      | 1.000000                                       | 1.000000    | 1.000000                                        | 1.000000 | 1.001304                                   | 1.001304 |
| 1979 | 1.000000                                       | 1.000000    | 1.000000                                        | 1.000000 | 1.001304                                   | 1.001304 |
|      | 1.000000                                       | 1.000000    | 1.000000                                        | 1.000000 | 1.001304                                   | 1.001304 |
| 1980 | 1.000000                                       | 1.000000    | 1.000000                                        | 1.000000 | 1.001304                                   | 1.001304 |
|      | 1.000000                                       | 1.000000    | 1.000000                                        | 1.000000 | 1.001304                                   | 1.001304 |
| 1981 | 1.000000                                       | 1.000000    | 1.000000                                        | 1.000000 | 1.001304                                   | 1.001304 |
|      | 1.000000                                       | 1.000000    | 1.000000                                        | 1.000000 | 1.001304                                   | 1.001304 |
| 1982 | .947269                                        | 1.000000    | 1.000000                                        | 1.000000 | .999999                                    | .999999  |
|      | .998117                                        | 1.000000    | 1.000000                                        | 1.000000 | 1.001304                                   | 1.001304 |
| 1983 | .967654                                        | 1.000000    | 1.000000                                        | 1.000000 | .999999                                    | .999999  |
|      | .984127                                        | 1.000000    | 1.000000                                        | 1.000000 | 1.001304                                   | 1.001304 |

|      | Retail Can Index<br>Compared with Wholesale |             | Wholesale Can Index Compared<br>with Brewers |          | Brewer Can Index Relative<br>to the PPI |          |
|------|---------------------------------------------|-------------|----------------------------------------------|----------|-----------------------------------------|----------|
|      | Strategy I                                  | Strategy II |                                              |          |                                         |          |
| 1976 | 1.000000                                    | 1.000000    | 1.000000                                     | 1.000000 | 1.000000                                | 1.000000 |
|      | 1.000000                                    | 1.000000    | 1.000000                                     | 1.000000 | .999999                                 | .999999  |
| 1977 | 1.000000                                    | 1.000000    | 1.000000                                     | 1.000000 | 1.000000                                | 1.000000 |
|      | .999999                                     | 1.000000    | 1.000000                                     | 1.000000 | 1.001304                                | 1.001304 |
| 1978 | 1.000000                                    | 1.000000    | 1.000000                                     | 1.000000 | 1.000000                                | 1.000000 |
|      | .999999                                     | 1.000000    | 1.000000                                     | 1.000000 | 1.001304                                | 1.001304 |
| 1979 | 1.000000                                    | 1.000000    | 1.000000                                     | 1.000000 | 1.000000                                | 1.000000 |
|      | 1.000000                                    | 1.000000    | 1.000000                                     | 1.000000 | 1.001304                                | 1.001304 |
| 1980 | 1.000000                                    | 1.000000    | 1.000000                                     | 1.000000 | 1.000000                                | 1.000000 |
|      | 1.000000                                    | 1.000000    | 1.000000                                     | 1.000000 | 1.001304                                | 1.001304 |
| 1981 | 1.000000                                    | 1.000000    | 1.000000                                     | 1.000000 | 1.000000                                | 1.000000 |
|      | 1.000000                                    | 1.000000    | 1.000000                                     | 1.000000 | 1.001304                                | 1.001304 |
| 1982 | .977326                                     | 1.000000    | 1.000000                                     | 1.000000 | .999999                                 | .999999  |
|      | .977326                                     | 1.000000    | 1.000000                                     | 1.000000 | 1.001304                                | 1.001304 |
| 1983 | .997813                                     | 1.000000    | 1.000000                                     | 1.000000 | .999999                                 | .999999  |
|      | .978300                                     | 1.000000    | 1.000000                                     | 1.000000 | 1.001304                                | 1.001304 |

## APPENDIX II

Other variables tested in Model II

(All statistics based on 1954 - 1978 period.)

Economic Variables

1. Price the relative beer price index correlated positively with beer sales (.96) but was rejected from the model due to its high (.94), intercorrelation with income.
2. Personal Income correlated positively with beer sales (.96) but was rejected due to high intercorrelation with price.
3. Per Capita Income - was positively correlated (.95) but was rejected in favor of total personal income to avoid entry of a population factor in the income variable.
4. Buying Power Index provided similar explanatory power to total income. It was rejected in favor of the more commonly known figure.
5. Price of Wine was only available for the period 1977-1983. Two years of pre-legislation base period were found too short for fitting the model, even using monthly data.

Population Variables

6. Population 18 years old and older was inversely related to beer sales over the shorter 1954-1971 and 1954-1974 time periods meaning that as the population increased beer sales were predicted to decline.
7. Legal Drinking Population was also inversely related to beer sales for the shorter time periods.

Units for the Variables

8. Monthly data was tried, however, given the highly seasonal nature of beer sales any 12 month period really formed only one independent observation. Also, population estimates are yearly and income quarterly so monthly data was not used.
9. Log forms of the variables were tried (as found in several other models of beer sales). The explanatory power was not improved.
10. Exponential variables were tried. Once again the explanatory power was not improved.

## APPENDIX III

## Michigan Counties



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APPENDIX IV

Sample Weights of Michigan Beer Packages in Use December 1983<sup>(1)</sup>

|                                                | Weight in<br>Ounces | Average Weight<br>in Ounces |
|------------------------------------------------|---------------------|-----------------------------|
| <u>Bottles<sup>2</sup></u>                     |                     |                             |
| <u>19-Trip Refillable</u>                      |                     |                             |
| STANDARD Select "Michigan" Bottle <sup>3</sup> |                     |                             |
| Pabst                                          | 9.1                 |                             |
| Stroh                                          | 8.9                 | 9.0                         |
| EXPORT <sup>3</sup>                            |                     |                             |
| Miller Lite                                    | 10.9                |                             |
| Weideman                                       | 10.7                | 10.8                        |
| <u>4-Trip Refillable</u>                       |                     |                             |
| Budweiser                                      | 9.2                 |                             |
| Michelob                                       | 9.4                 |                             |
| Falstaff                                       | 6.4                 | 9.1 <sup>(4)</sup>          |
| <u>Non-Refillable</u>                          |                     |                             |
| Miller                                         | 7.4                 |                             |
| Miller Lite                                    | 7.4                 |                             |
| Signature                                      | 9.0                 |                             |
| Molson                                         | 8.1                 |                             |
| Moosehead                                      | 8.8                 | 7.6 <sup>(5)</sup>          |
| <u>Cans<sup>6</sup></u>                        |                     |                             |
| Miller Lite                                    | .67                 |                             |
| Pabst                                          | .67                 |                             |
| Budweiser                                      | .63                 |                             |
| Stroh                                          | .66                 |                             |
| Old Milwaukee                                  | .64                 |                             |
| Hamm's                                         | .68                 |                             |
| Schlitz                                        | .67                 | .66                         |

1. A convenience sample was drawn from containers in use in East Lansing Michigan in December 1983.
2. Weight of glass only. Labels and closures were removed prior to weighing.
3. Both bottles appeared to have been used before and were manufactured by different bottle makers.
4. Weighted average based on market share. Budweiser (.6); Michelob (.33); Falstaff (.07)
5. Weighted Average based on market share Miller (.4); Lite (.3); Signature (.1); Molson (.1); Moosehead (.1)
6. All cans are two piece aluminum draw and iron cans with stay-on tabs.

## APPENDIX V

Change in Michigan Beer Prices from 1976 Base: Bottle Prices

| Year | Dollars per Case  |                                    |                                        |                       | Cents per Container               |                                    |                                  |
|------|-------------------|------------------------------------|----------------------------------------|-----------------------|-----------------------------------|------------------------------------|----------------------------------|
|      | Actual Beer Price | Predicted Price = Base + Inflation | Michigan Price Dif. Actual - Predicted | Inflation (1976 Base) | Michigan Price Dif. Per Container | Inflation Since 1976 Per Container | Total Price Change Per Container |
| 1976 | 7.14              | 7.14                               | ----                                   | ----                  | ----                              | ----                               | ----                             |
|      | 7.14              | 7.21                               | (-0.07)                                | 0.07                  | (-0.03)                           | 00.3                               | -0-                              |
| 1977 | 7.44              | 7.21                               | .23                                    | 0.07                  | 00.9                              | 00.3                               | 01.2                             |
|      | 7.44              | 7.28                               | 0.16                                   | 0.14                  | 00.6                              | 00.6                               | 01.2                             |
| 1978 | 7.80              | 7.57                               | 0.23                                   | 0.43                  | 00.9                              | 01.8                               | 02.7                             |
|      | 8.10              | 7.85                               | 0.25                                   | 0.71                  | 00.9                              | 03.0                               | 03.9                             |
| 1979 | 9.00              | 8.35                               | 0.65                                   | 1.21                  | 02.7                              | 05.0                               | 07.7                             |
|      | 9.50              | 8.57                               | 0.93                                   | 1.43                  | 03.9                              | 06.0                               | 09.9                             |
| 1980 | 10.43             | 9.14                               | 1.29                                   | 2.00                  | 05.4                              | 08.3                               | 13.7                             |
|      | 10.43             | 9.57                               | .86                                    | 2.43                  | 03.6                              | 10.1                               | 13.7                             |
| 1981 | 11.06             | 9.92                               | 1.14                                   | 2.78                  | 04.8                              | 11.6                               | 16.4                             |
|      | 11.06             | 10.14                              | 0.92                                   | 3.00                  | 03.8                              | 12.5                               | 16.3                             |
| 1982 | 10.61             | 10.42                              | 0.19                                   | 3.28                  | 00.8                              | 13.7                               | 14.5                             |
|      | 10.88             | 10.57                              | 0.31                                   | 3.43                  | 01.3                              | 14.3                               | 15.6                             |
| 1983 | 11.46             | 10.85                              | 0.61                                   | 3.71                  | 02.5                              | 15.5                               | 18.0                             |
|      | 11.26             | 11.14                              | 0.12                                   | 4.00                  | 00.5                              | 16.7                               | 17.2                             |

Change in Michigan Beer Prices from 1976 Base: Can Prices

| Year | Dollars per Case        |                                             |                                                 |                                  | Cents per Container                        |                                                  |                                              |
|------|-------------------------|---------------------------------------------|-------------------------------------------------|----------------------------------|--------------------------------------------|--------------------------------------------------|----------------------------------------------|
|      | Actual<br>Beer<br>Price | Predicted<br>Price =<br>Base +<br>Inflation | Michigan<br>Price Dif.<br>Actual -<br>Predicted | Infla-<br>tion<br>(1976<br>Base) | Michigan<br>Price<br>Dif. Per<br>Container | Infla-<br>tion<br>Since<br>1976 Per<br>Container | Total<br>Price<br>Change<br>Per<br>Container |
| 1976 | 6.75                    | 6.75                                        | -----                                           | -----                            | -----                                      | -----                                            | -----                                        |
|      | 6.75                    | 6.82                                        | (-0.07)                                         | .07                              | (-00.3)                                    | 00.3                                             | -0-                                          |
| 1977 | 7.15                    | 6.82                                        | 0.33                                            | .07                              | 01.4                                       | 00.3                                             | 0.17                                         |
|      | 7.15                    | 6.89                                        | 0.26                                            | .14                              | 01.1                                       | 00.6                                             | 01.7                                         |
| 1978 | 7.50                    | 7.16                                        | 0.34                                            | .41                              | 01.4                                       | 01.7                                             | 03.1                                         |
|      | 7.78                    | 7.43                                        | 0.35                                            | .68                              | 01.4                                       | 02.8                                             | 04.2                                         |
| 1979 | 9.00                    | 7.90                                        | 1.10                                            | 1.15                             | 04.6                                       | 04.8                                             | 09.4                                         |
|      | 9.50                    | 8.10                                        | 1.40                                            | 1.35                             | 05.8                                       | 05.6                                             | 11.4                                         |
| 1980 | 10.30                   | 8.64                                        | 1.66                                            | 1.89                             | 06.9                                       | 07.9                                             | 14.8                                         |
|      | 10.44                   | 9.05                                        | 1.39                                            | 2.30                             | 05.8                                       | 09.6                                             | 15.4                                         |
| 1981 | 10.98                   | 9.38                                        | 1.60                                            | 2.63                             | 06.7                                       | 11.0                                             | 17.7                                         |
|      | 10.98                   | 9.59                                        | 1.39                                            | 2.84                             | 05.8                                       | 11.8                                             | 17.6                                         |
| 1982 | 10.48                   | 9.86                                        | 0.62                                            | 3.11                             | 02.6                                       | 13.0                                             | 15.6                                         |
|      | 10.48                   | 9.99                                        | 0.49                                            | 3.24                             | 02.0                                       | 13.5                                             | 15.5                                         |
| 1983 | 11.23                   | 10.26                                       | (-0.03)                                         | 3.51                             | 04.0                                       | 14.6                                             | 18.6                                         |
|      | 10.58                   | 10.53                                       | 0.05                                            | 3.78                             | 00.2                                       | 15.8                                             | 16.0                                         |

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