Product Variety and Risky Consumption*

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Abstract

This article examines the relationship between product variety and alcohol consumption patterns in the United States. While per capita alcohol consumption decreased between 1970 and 2000, it has gradually increased in recent years. By analyzing product-level and household scanner data, I use multiple identification strategies, such as excise tax increases or resident changes, to demonstrate that a larger product assortment increases alcohol consumption. Thus, recent changes in consumption can be explained by a rise in product variety. I present a stylized model showing that increased health awareness among consumers could lead to larger product assortments that offset the effects of reduced consumption. The mechanisms are similar when considering tax increases. Indeed, I present empirical evidence that tax increases also increase incentives to increase the product spectrum, resulting in increased consumption. The article concludes that regulating product entries is an important but under-researched policy tool in reducing alcohol consumption.

Keywords: Risky Consumption, Product Variety, Alcohol, Excise Tax

JEL codes: D12, I12, L66

*Researcher(s) own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the NielsenIQ data are those of the researcher(s) and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

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1 Introduction

More than 140,000 Americans die yearly from alcohol-related causes, making excessive drinking the leading cause of preventable death in the United States (Centers for Disease Control and Prevention (CDC), 2022). Alcohol plays a role in 40% of all violent crimes, and nearly 40% of all traffic fatalities are alcohol-related (National Council on Alcoholism and Drug Dependence (NCADD), 2015). In addition, alcohol consumption affects labor market (Böckerman et al., 2017; French et al., 2011) and educational outcomes (DeSimone, 2010).[1]

Policymakers have used multiple tools to reduce excessive drinking and its associated harms. Such policies include alcohol taxes (Chaloupka et al., 2002; Cook and Moore, 2002; Griffith et al., 2019; Miravete et al., 2018; Wagenaar et al., 2009) changes in the minimum legal drinking ages (Carpenter and Dobkin, 2009; Wagenaar and Toomey, 2002) restrictions on alcohol outlet densities (Campbell et al., 2009; Livingston et al., 2007; Marcus and Siedler, 2015), general restrictions of alcohol sales (Bernheim et al., 2016; Carpenter and Eisenberg, 2009; Chamberlain, 2014 Hinnosaar, 2016; Kueng and Yakovlev, 2021; Norström and Skog, 2005; Seim and Waldfogel, 2013), etc. While such policies played a crucial role in decreasing alcohol consumption from its all-time high in the 1970s to the beginning of the 1980s, the per capita consumption of alcohol increased gradually from a low in the mid-1990s (see Figure 1a for an overview). This growth in alcohol consumption which accounts for almost 15% is especially surprising because health awareness of health risks associated with alcohol has increased.[2]

The US alcohol market has experienced a significant increase in product variety, accompanied by an increase in consumption. Figure 1b presents Nielsen scanner data, demonstrating a rise in product variation since 2006. For instance, we observe an 40% increase in variation of liquor products between 2006 and 2019.[3] Rather than consuming superstar products with a high market share,

[1] The impact of alcohol consumption extends beyond individual health and economic outcomes and can significantly impact the prenatal health of children and their long-term economic outcomes (Nilsson, 2017).

[2] As an example, a survey by the American Institute for Cancer Research (2019) documents that awareness of alcohol use as a risk factor for cancer among U.S. adults increased from 33% in 2004 to 45% in 2019.

[3] Not only scanner data confirms the strong increase of product variety and general growth. Also, industry reports show that the US spirit industry is increasing (Micallef, 2022).

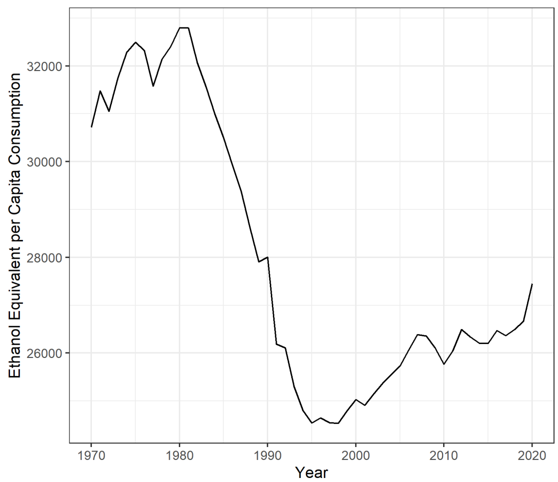
consumers tend to explore different products, resulting in the phenomenon of niche consumption, where households focus on different products from each other.[4] This shift has caused a decrease in market concentration, which is evident from the Herfindahl-Hirschman Index (HHI) for liquor products, as shown in Figure 1d. The index reveals a decrease in market concentration on the product level of almost 40% since 2006.

The main objective of this article is to explore the relationship between product variety and risky consumption, and to address the puzzle of higher consumption despite increased health awareness. The article proceeds in three steps. First, I present a simple stylized model that highlights the mechanisms through which increased product variety leads to increased consumption. This model also examines how higher taxes and greater health awareness can lead to an increase in product variety, which may offset negative pressure on consumption. Second, I present correlative evidence, using store-level data, to support the relationship between product variety and consumption. The correlation is stable, independent of using geographic variation or store-level variation. Additionally, two policy experiments of increased prices due to tax hikes demonstrate that higher taxes result in lower consumption due to higher prices. However, price increases also result in an increase in product variety, which positively impacts consumption. Finally, using household scanner data, I show that increased product exposure at the household level leads to increased consumption. By analyzing residence changes of households, I demonstrate that moving to an area with higher product variety increases consumption, even after controlling for consumption levels in the new area of residence.

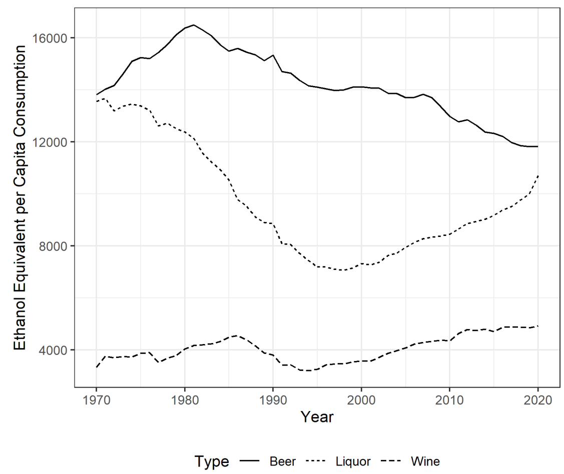
To illustrate the fundamental mechanisms underlying the link between product variety and risky consumption, I begin by presenting a Hotelling-style model where consumers make decisions regarding whether and how much of a risky good to purchase. Consumers have specific preferences, and their distance in preference to the product, health costs, and price not only determine whether they consume but also how much they consume. On the supply side, a single or multi-product firm

[4] See Neiman and Vavra (2019) for a general description of the recent phenomenon of niche consumption.

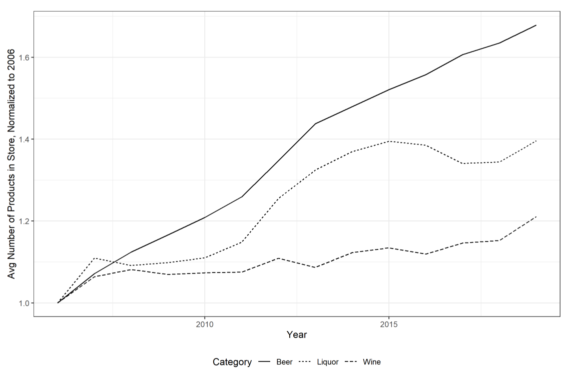
Figure 1: Developments in the US Alcohol Market



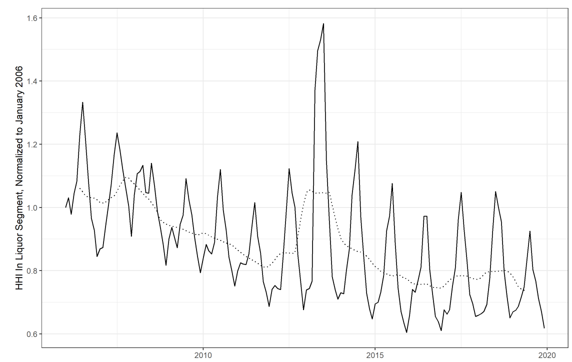
(a) Gallons of Ethanol per Capita



(b) Gallons of Ethanol per Capita by Type



(c) Product Variation across the United States



(d) HHI in the Liquor Market

Notes: The Figures show developments in the US alcohol market. Figure 1a uses data of the National Institute on Alcohol Abuse and Alcoholism (Slater and Alpert, 2022) and reports the Gallons of Ethanol per Capita consumption in the US since 1970. Figure 1b shows results of the same data, differentiating between beer, liquor, and wine. Figure 1c uses Nielsen Scanner Data and shows the number of available products across the US between 2006 and 2019. Further, Figure 1d shows the Herfindahl-Hirschman Index (HHI) for liquor products within the US. The HHI is normalized to the level of 2006, with lower values relating to a less concentrated market.

selects its position in the taste spectrum. The model has two primary predictions: first, a larger assortment of products leads to increased aggregate consumption, and second, an exogenous increase in taxes or health costs reduces consumption while also increasing the incentive to expand the number of products.

To provide strong evidence of the positive relationship between product variety and risky product consumption, I conduct an analysis at the store-product level. By examining data from 2006 to 2019 and taking advantage of the variation in product variety across stores, I demonstrate that there is a clear association between higher product variety and increased consumption in almost all US states. Using robust fixed effects, I present basic regression results that show a 1% increase in beer products is associated with a 1.06% increase in beer consumption. In contrast, a 1% increase in wine or liquor products is linked to a 0.67% and 0.25% increase in consumption, respectively.

I also investigate quasi-experimental settings due to two distinct state-specific policy changes: (1) The deregulation of liquor licenses in 2012 in Washington that came with an excise tax increase and (2) The large excise tax increase of spirits in Illinois in 2009. I show that both reforms increased product variety in stores that sold products before the policy change. In an instrumental variable approach and using other than treated states as a control group, I show that the increase in product availability through the tax change raised purchases. However, the increase in product availability partly is not immediate and delayed. Nevertheless, the results highlight the potential effects of price increases through taxes on product assortment.

Finally, I use household-level data, rich controls, and fixed effects to show that exposure to more alcohol products increases purchases. In detail, I show that a household exposed to 1% more beer products in a month increases its consumption by 0.03%. For wine and liquor, the effect size is 0.5%. Using the identification of excise tax increases, the effect size increases further. Additionally to the impact on average quantity, I also show a positive effect on the external margin, i.e., the probability of purchasing a positive amount within a category. To show robustness, I then analyze product exposure changes due to moving consumers. Controlling for destination-specific average alcohol consumption, I show that a 1% increase in product exposure due to a move increases liquor purchases by 0.11%. Thus the effect size approximately doubled. Also, the effect size of the impact of product variety on the probability of buying any liquor product rises.

This paper has two insights for policymakers. First, I show strong evidence that product variety is important in markets where consumption comes with health costs. Customization of products increases the value for individual households. A household may abstain from the consumption of a product if it is far from its own taste. However, the choice changes when a product satisfies the own taste much more. A potential regulation may create entry barriers for new products to prevent a wide product assortment for consumers.

Second, I show that increased taxes and increased health awareness may decrease consumption, but both have secondary effects that increase the incentive to increase product variety. The intuition is that higher costs may lead consumers to reduce their consumption as the costs outweigh the utility of consumption. Thus, firms have a higher incentive to increase assortment and provide more variation in taste. A policymaker that increases a tax or public health awareness of a risky product may risk incentivizing firms to extend their assortment and thereby reducing the initial policy's effect. A most effective policy approach would connect entry barriers with tax or health awareness measures.

This paper adds to multiple streams of the literature in health economics, industrial organization, and marketing. First, I add to the extensive literature that studies the impact of regulation and other factors that affect risky behavior. Most closely related are papers analyzing the impact of the Washington liquor deregulation and the impact of excise tax increases. In particular, I relate to Illanes and Moshary (2020) who study the Washington liquor deregulation and show that the deregulation increases liquor store outlets and an expansion of product assortment and consumption. This finding is in line with this article. However, I focus on quantifying the relationship between product variety and consumption, in the case of Washington, but also beyond the quasi-experimental setting of the policy reform.[5] Considering the excise tax increases, Gehrsitz et al. (2021), and Saffer et al. (2022) use the Illinois tax increase to show a high pass-through of consumer prices and a considerable impact on consumption. I extend the result by focussing on the exogenous effect on prices on product variety and the secondary effect on consumption.

As my estimation strategy on the household level includes the analysis of resident changes, I relate to the literature on how moving affects behavior and consumption (Allcott et al., 2019; Bronnenberg et al., 2012; Hinnosaar and Liu, 2022; Hut, 2020).[6] The closest approach to this paper is Hinnosaar and Liu (2022). The authors use identical scanner data as in this paper to show that movers adapt to destination-specific alcohol consumption patterns. I show a potential mechanism of the effect. Even after controlling for alcohol consumption at the destination, I observe a strong impact through product variety changes on consumption.

Finally, I add to the literature in marketing on product assortment and product variety. Numerous papers estimate the impact of various factors on assortment planning, for example, Gaur and Honhon (2006) or Wang and Sahin (2018). Other focus on the impact of higher product variety, see, for example, Brynjolfsson et al. (2003) or Sweeney et al. (2023). I add to the literature by showing a first approach that relates product variety to consumption when consumption of the product comes with health risks.

2 A Stylized Model of Product Variety and Risky Purchases

In the following, I present a short stylized Hotelling-type (Hotelling, 1929) model to exemplify a potential relation between product variety and the choice of a product with negative health effects. Consider a number of individuals I with preferences for a good. The preference of an individual

[5]Further, Huang et al. (2018) evaluates how the deregulation affected price setting while Seo (2019) studies the value for consumers and stores due to one-stop shopping. He (2022) estimates the impact of one-stop shopping on consumer behavior. Aguirregabiria et al. (2016) estimate the impact of the deregulation in the Ontario wine retail market. Finally, Yu et al. (2021) shows that the increased product assortment leads to a decrease in price sensitivity.

[6]More generally, the paper also relates to the literature that estimates the impact of moving on health outcomes due to geographic variation in health care (Finkelstein et al., 2016), general drivers of mortality (Finkelstein et al., 2021), or opioid use (Finkelstein et al., 2018).

$i \in I$ for a product is denoted as $\rho_i \in [0,1]$. Thus, the preferences can be summarized by a location between two extremes, zero and one. Individuals are uniformly distributed in their preferences. A location $x_j \in [0.1]$ on the preference line can summarize a product j. Independent of preferences, individuals experience a health cost of h when consuming one unit of the product. Generally, health costs are the perceived costs of an individual when consuming the product.

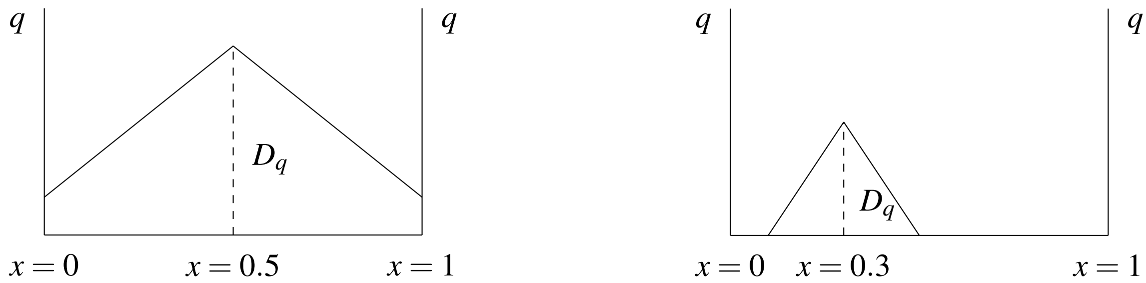
If an individual decides to consume a good, the utility decreases with the distance of their preferences to a product's location, $d_{ij} = |\rho_i - x_j|$. Further, consumption directly comes with health costs and the cost of the product. Thus, I formalize the utility function of consumer i consuming good j as $u_{ij} = (1 - d_{ij} - h_i - p_j)q_{ij} - bq_{ij}^2$, where an individual may a continuous amount of q. $-bq_{ij}^2$ is a technical term that guarantees the utility function is concave. However, the individual also has the choice to abstain from consumption, leading to a utility of $u_{i0} = 0$.

Further, in case multiple products are available, a single individual will always prefer one product or is precisely indifferent. Thus, individuals do not have preferences such that utility is increasing by mixing purchases of two goods. Consider two available goods $j \in \{1,2\}$, then $u_{i1}(q_{i1}) \geq u_{i2}(q_{i2})$ or $u_{i2}(q_{i2}) \geq u_{i1}(q_{i1})$. Intuitively, an individual always chooses only the closest product. Considering a specific product, maximizing the utility function yields a demand for an individual of $q_{ij}^* = \frac{1-d_{ij}-h_i-p_j}{2b}$, where q_{ij}^* is positive if the utility is greater than zero.

Within this basic model, prices and health costs are given, and a single product firm chooses the location x_j. The resulting demand function is: $D_q = \int \max\{q_{ij}^*, 0\}\, dd$, i.e., summing over all consumers and their distance. The situation is exemplified in Figure 2a. $x_j = 0.5$ is an equilibrium choice for a single product firm. However, in Figure 2b, I show that there may be multiple equilibria for sufficiently high prices and/ or health costs. Figure 2 also exemplifies that an increased price or health costs would reduce

Next, I consider a two-product firm, $j \in \{1,2\}$. The positioning on at $x_1 = 0.25$ and $x_2 = 0.75$ is an equilibrium choice for a two-product firm independent of prices and health costs. While I show formal proof in the Appendix, the basic reasoning is the following. The bigger the distance

Figure 2: Single Product equilibrium



(a) Low p_j and/or h (b) High p_j and/or h

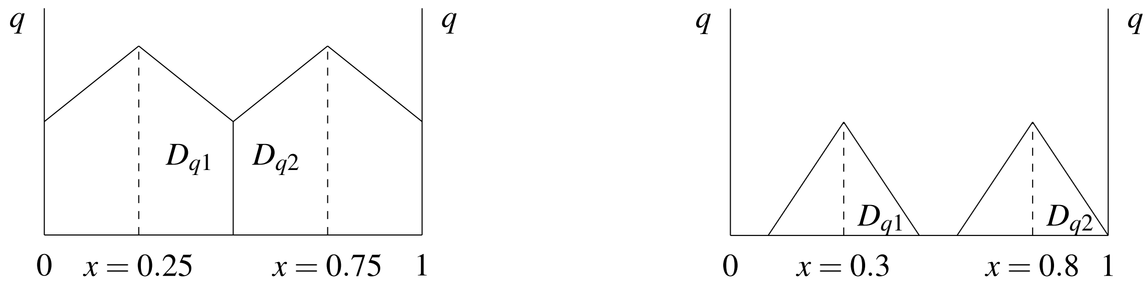
Notes: The Figures show two different single product equilibria. The x-axis refers to the location and preferences of consumers. Along the x-axis consumers are uniformly distributed. The y-axis refers to the quantity demanded by a single consumer. In Subfigure 2a I show a situation with relatively low prices and health costs. A single product locates at the location $x = 0.5$, the unique equilibrium. The area under the function is the demand. All consumers consume a positive amount. In Subfigure 2b, multiple equilibria are possible as high prices or health costs. In this example, independent of the location, a firm cannot locate the product such that all consumers have a positive demand. Thus it may locate at $x = 0.3$.

between a firm positioning and a consumer's preference, the lower the quantity purchased. A company has the incentive to differentiate products to some extent in order to avoid cannibalization. However, full differentiation to the extremes is nonoptimal. I show the case of a two product equilibrium in Table 3. The result extends to a situation where two firms compete. While positioning at $x_1 = 0.25$ and $x_2 = 0.75$ is always an equilibrium, high health costs or prices may extend the possibilities of equilibria as shown in Figure 3b.

Lemma 1: Increasing the number of products increases consumption. Further, some consumers may start consumption in case of high health costs and/or prices.

While I show formal proof of Lemma 1 in the Appendix, the basic intuition is that increasing the number of products reduces the average distance of consumers to their closest product according to their preference location. As a result, we observe a higher number of consumers with large quantity consumption. An additional effect is that some consumers start consuming in case of large

Figure 3: Two Product Equilibrium



(a) Low p_j and/or h

(b) High p_j and/or h

Notes: The Figures show two different multiple-product equilibria. The x-axis refers to the location and preferences of consumers. Along the x-axis consumers are uniformly distributed. The y-axis refers to the quantity demanded by a single consumer. In Subfigure 3a, I show a situation with relatively low prices and health costs. The two products locate at $x = 0.25$ and x=0.75, the unique equilibrium. The area under the function is the demand. All consumers consume a positive amount. In Subfigure 3b, multiple equilibria are possible as high prices or health costs. In this example, independent of the location, a firm cannot locate the products such that all consumers have a positive demand. Thus, it may locate at $x = 0.3$ and $x = 0.8$.

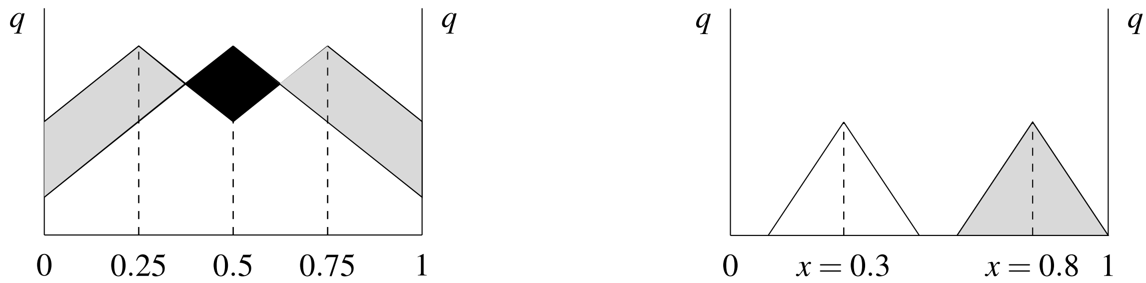
health costs and/or prices. This external margin is based on the possibility of not consuming. High health costs/prices mean that some people have a negative utility from consuming in case of one single product at $x_j = 0.5$ in the market. Thus, they abstain. In case two products are available, and $x_1 = 0.25$ and $x_2 = 0.75$, some consumers that would have abstained start purchasing a positive amount due to a shorter distance in their preference.[7]

Figure 4 shows the extension. In Subfigure 4a, the product extension leads to an increase in aggregate demand, as most consumers have a product closer to their preferences. However, a few consumers consume less (dark black area). There is no external margin as health costs and prices are so low that everyone consumes. In Subfigure 4b, health costs or prices are so high that the demand is not intersecting. As a result, aggregate demand increases and also be consumers that wouldn't have consumed before started consuming.

Lemma 2: Increasing health costs or prices (without changing the margin) increases the incentive

[7]The result is extendable to the situation in which considering two products and introducing a third product, etc.

Figure 4: Single Product equilibrium



(a) Low p_j and/or h (b) High p_j and/or h

Notes: The Figures show two different changes due to a product launch. The x-axis refers to the location and preferences of consumers. Along the x-axis, consumers are uniformly distributed. The y-axis refers to the quantity demanded by a single consumer. In Subfigure 4a, I show relatively low prices and health costs. A single firm locates at $x = 0.5$ while t he two products locate at $x = 0.25$ and $x = 0.75$, the unique equilibria. The grey area is the increased demand due to the product launch, while the black area is the demand from those consumers that consume in the one product but not in the two-product equilibrium. The area under the function is the demand. All consumers consume a positive amount. In Subfigure 4b, multiple equilibria are possible as high prices or health costs. In this example, independent of the location, a firm cannot locate the products such that all consumers have a positive demand. Thus, it may locate at $x = 0.3$ and $x = 0.8$.

of product introduction.

While I show formal proof of Lemma 2 in the Appendix, the intuition is based on the visualization in Figure 4. The higher prices and/or health costs reduce not only the demand of a single consumer but also the number of consumers. As a result, cannibalization due to a second product introduction is less likely. In Figure 4a, low prices and or health costs lead to a mass of consumers that would have consumed the old product in the absence of the entry. The two products in 4b have exclusive demand.

While an additional product will always increase aggregate demand, the relative increase in demand is larger for higher prices and health costs, as cannibalization plays a lower role. I interpret this result as a higher incentive to introduce a new product. Increasing health awareness or increasing prices through taxes incentivizes firms to increase product variety.

3 Institutional Background

Following the 21st Amendment to the United States Constitution, each state has the right to regulate alcoholic beverages individually. Such regulation includes laws on alcohol sales. For example, states such as California allow sales of beer, wine, and liquor in grocery stores, while other states, such as Florida, distinguish between types of alcoholics and solely allow beer, wine, and low-alcohol liquors sold in supermarkets. Finally, in some states, e.g., Delaware, alcohol may be purchased only in a liquor store. Besides the regulation on sales and licensing, states have the authority to regulate the legal drinking age, taxes, distribution, and advertisement.

Despite intense and manifold regulation, the alcohol market remains of high importance in the retail industry. In detail, the alcohol market size is 283.80bn USD in 2023 and is expected to grow further (Statista Research, 20). In this article, I use two specific regulatory changes on the state level that affect the number of available products within a store. In the following I describe each of them seperately.

Deregulation of Liquor Licenses in Washington State

In 2011, Washington State passed a law that ended the state's monopoly on selling liquor. Prior to the law, only state stores and a limited number of private retail outlets were allowed to sell beer and wine. Under the new law, private retailers were allowed to sell spirits. The law also created a new system for licensing and regulating liquor sales, with an increase of the excise tax by 17 percentage points.[8]

One of the immediate effects of the policy change was an increase in the number of retail outlets selling spirits. Prior to the law, there were around 330 retail outlets in the state, but after the law, the number increased to over 1,500. Most of the new retailers have been previous existing grocery stores that started selling liquor (Seo, 2019; Illanes and Moshary, 2020). In this paper, I focus on the affect on assortment in those stores that sold liquor before deregulation and the excise

[8]A license also requires a minimum store size of 10,000 square feet.

tax increase.

Excise Tax Increase in Illinois

In 2009, the state of Illinois increased its excise tax on alcohol. The tax increase was part of the legislation of the "Illinois Jobs Now Act". The revenue generated from this tax increase was intended to be used to fund various state programs, especially infrastructure. The tax increase varied depending on the type of alcohol but generally resulted in higher prices for consumers Gehrsitz et al. (2021). The excise tax on beer increased by $0.08 per gallon, while the tax on wine increased by $0.73 per gallon. The tax on distilled spirits increased by $4.50 per gallon. Thus, the tax increase was especially substantial for liquor and rather small for beer.

4 Data

The article is based on the NielsenIQ Retail Scanner data as well as the Nielsen Consumer Panel. The former includes weekly prices and sales of products on more than 90 retail chains accounting for over 35,000 stores. The data includes large grocery and drug stores, but also smaller liquor and convenience stores. The Nielsen Consumer Panel includes household data of 40,000-60,000 households since 2004 from across the US record all their purchases intended for in-home use. I observe prices, quantities, detailed product categories, and other product information. Purchases are recorded at the household level. Households report demographic data such as household size, composition, and income. Einav et al. (2010) and Zhen et al. (2019) show that that research scanner data is reliable.

The research focuses on the year 2006 to 2019.[9] With Nielsen's retail scanner, I first create a monthly store-level data set on three alcohol categories beer, wine, and liquor. I measure the sales and prices of each category in ethanol equivalent liters of alcohol in each category. Note that I calculate the total quantity of pure alcohol using the following conversions: 0.045 times the

[9] We exclude the first two years of the data, 2004 and 2005, as substantially fewer households are available. Further, we exclude the year 2020 due to strong changes in consumer behavior during the Covid-19 pandemic.

quantity of beer, 0.12 times the quantity of wine, and 0.4 times the quantity of liquor. Table 1, Panel A shows basic summary statistics on the store-month level considering the three categories.

Using the retail scanner, I first identify the availability and assortment of products on the store level by using the retail scanner. As I observe all sales on a weekly level but not the availability, I assume that a product is available if it is at least sold once a year. Thus, I observe a yearly variation of variety across stores.[10] Table 1, Panel A shows the number of available products in the different categories across stores.

We then consider Nielsen's panel data and create a monthly panel of households, their purchases and expenditures of each alcohol category, and their exposure to products. In Table 1, Panel B, I show summary statistics. Note that throughout the article, I consider all households, controlling for household size as well as the presence of children. However, I also consider only single households as robustness checks.

Finally, I am using moving households as part of my identification strategy. I identify moving households that change in their residential zip code. As robustness checks, I also consider changes on the county or state level. As households solely report residence changes yearly, I exclude the year of the move from the analysis. Some households report multiple moves during their time in the panel. In the baseline analysis, I include only those households with a single move. However, I show robustness for multiple moves. Table 1, Panel C shows summary statistics considering only moving households.

5 The Relation of Product Variety and Volume

Within this section, I show descriptives on the relationship between product variety and aggregate consumption patterns at the store level. Consider a store s in a year t selling a set of products with health costs, where sales are $\mathbf{y}_{st}$. Such products can be divided into beer, wine, or spirits.

[10] An alternative specification would be that one identifies the existence of a product if it is purchased once a month. While such an approach would allow monthly rather than yearly variation of assortment, we may measure a bias if some products are still in the assortment but have not been sold.

Table 1: Summary Statistics

	Beer	Wine	Liquor
	Panel A: Store Level Data		
Number of Stores	44,340	40,320	41,908
Number of Retailers	225	217	217
Average Purchases	424.73	287.2	455.19
	(531.72)	(443.54)	(879.48)
Average Number of Products	198.08	460.69	185.27
	(180.45)	(535.88)	(323.75)
Average Prices	9.73	8.31	9.44
	(3.99)	(3.03)	(5.31)
	Panel B: Household Level Data		
Number of Households	183,776	183,776	183,776
Number of Households with Purchase	101,913	103,947	97,653
Average Purchase	2	0.78	0.38
	(10.42)	(4.05)	(2.81)
Average Purchase cond. on Purchase	15.57	6.03	3.94
	(25.15)	(9.73)	(8.3)
Average Purchase of Single Households	1.33	0.65	0.31
	(8.01)	(3.63)	(3.32)
Average Costs	4.46	4.98	3.84
	(20.46)	(23.76)	(19.4)
Average Costs cond. on Purchase	34.61	37.82	40.35
	(46.99)	(55.54)	(49.76)
Average Number of Products Exposed to	327.46	806.34	307.53
	(249.57)	(729.56)	(418.52)
	Panel B: Moving Households		
Number of Households	11,540	11,540	11,540
Number of Households with Purchase	7,909	8,357	7,926
Average Purchase	2.04	0.91	0.38
	(10.17)	(4.31)	(2.2)
Average Purchase cond. on Purchase	15.14	6.23	3.8
	(23.88)	(9.67)	(5.91)
Average Purchase Before Move	2.25	0.95	0.4
	(10.89)	(4.45)	(2.16)
Average Purchase After Move	1.83	0.88	0.37
	(9.41)	(4.17)	(2.24)
Average Costs	4.7	5.85	4.09
	(20.89)	(25.33)	(19.73)
Average Costs Before Move	4.97	5.88	4.17
	(21.57)	(24.91)	(19.73)
Average Costs After Move	4.44	5.83	4.01
	(20.21)	(25.73)	(19.73)
Average Number of Products Exposed to	343.97	862.26	320.72
	(252.02)	(747)	(428.45)
Average Number of Products Exposed to, Before	307.72	828.33	292.92
	(222.55)	(738.39)	(401.79)
Average Number of Products Exposed to, After	380.52	896.47	348.76
	(273.77)	(754.05)	(452.02)

Notes: The Table describes basic summary statistics of the data in the three subcategories beer, wine, and liquor. In Panel A I show summary statistics on the monthly store level. In Panels B and C, I consider the household monthly level. In Panel B I consider the full data set of all households. In comparison, Panel C considers only moving households. A move is defined as a move across a zip code. Average purchases are in ethanol equivalent liters. Price and cost variables are also defined in the costs per ethanol equivalent liter of alcohol. Standard deviations are reported in parentheses.

In all three subcategories, the assortment increased between 2006 and 2018. To investigate and exemplify geographic variation in the changes in assortment and store-level consumption, I first show the following regression evidence. Consider store s in year t offering um_{st} products of spirits,r resulting in y_{st} liter ethanol equivalent liquor purchases. I run the following regressions for each US State between 2006 and 2018:

$$log(Num_{st}) = \alpha + \beta \cdot t + \rho_s + \varepsilon_{st} \tag{1}$$

$$log(Num_{st}) = \alpha + \beta \cdot t + \rho_s + \varepsilon_{st}, \tag{2}$$

where ρ_s are store-specific fixed effects. Thus β measures how many more products or sales of liquor are observed on a store level in a year. Using a logarithmic transformation of the number of products, $log(Num_{st})$ and the ethanol equivalent sales $log(y_{st})$, $\beta \cdot 100$ is the yearly percent changes in both outcome variables on the store level.

In Figures 9 and 6, I show the estimates of $\hat{\beta}$ for each state-specific regression. Within Figure 9, Subfigure 5a shows the effect on liquor variety, and 5b shows the effect on the ethanol equivalent purchases of liquor. In Figure 6 I show the same evidence within a heat map. First, note that the majority of states are characterized by an increase in liquor product variety. In most states, one observes between 0 and 10 percent more products per year between 2006 and 2018. Second, also purchases have increased in most states. However, the increase in purchases on the store level is, on average, slightly lower than the increase in the assortment. Figure 6 indicates a correlation between the effect of increased variety and purchases, with stronger increases for both in the Midwestern United States.

Note that we observe a clear outlier with the coefficients of Washington state. In detail, the variety of liquor has increased by 30 percent per year on the store level, while the purchases of ethanol-equivalent liquor have increased by more than 20 percent. One may rationalize the effect through the liberalization of the liquor market in 2012. Two effects play a role. First, the data includes retailers that obtained a license in 2012 or after; therefore, their sales and product assortment jumped suddenly. Second, following Illanes and Moshary (2020), even retailers with liquor licenses before 2012 have increased their assortment, and consumers increased consumption. In subsection 5.1, I show additional evidence for the latter effect by solely considering retailers who have sold liquor already before the liberalization.

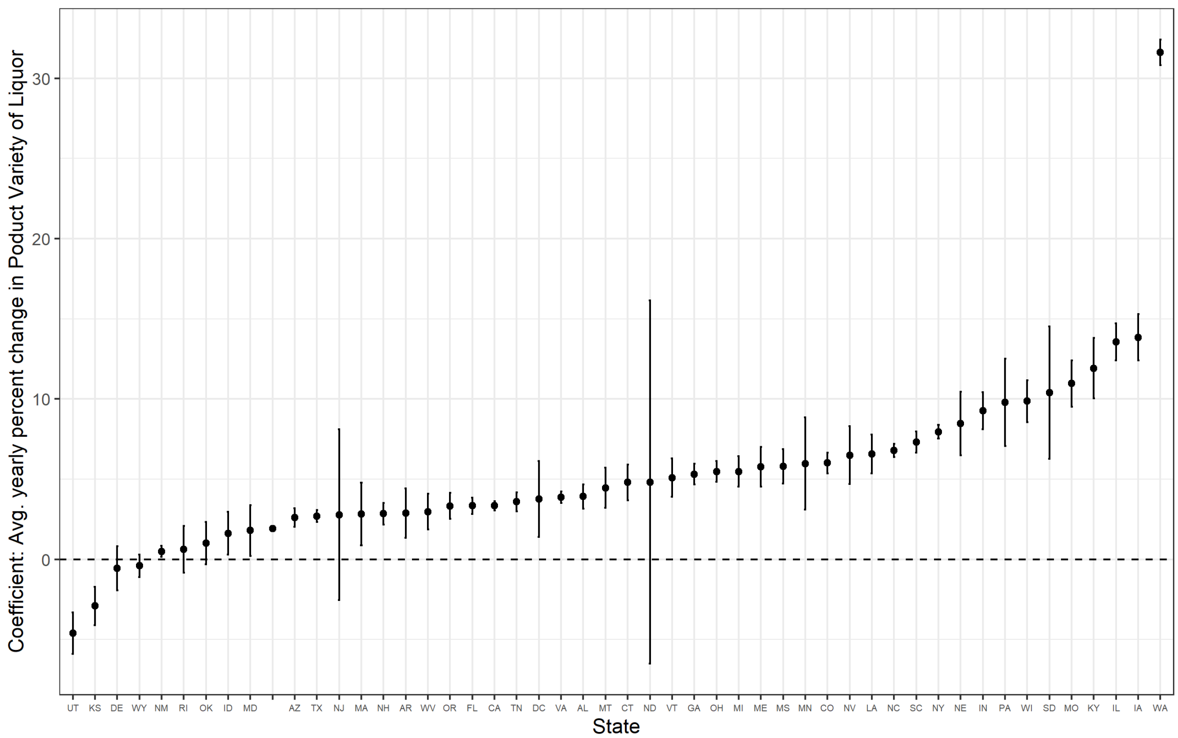
To summarize the correlation between sales and the assortment of products, I show the following regression evidence:

$$log(\mathbf{y}_{skt} + 0.1) = \alpha + \beta log(\mathbf{Num}_{st} + 0.1) + \rho_s + \mu_t \cdot state_k + \xi p_{st} + \varepsilon_{st}, \tag{3}$$

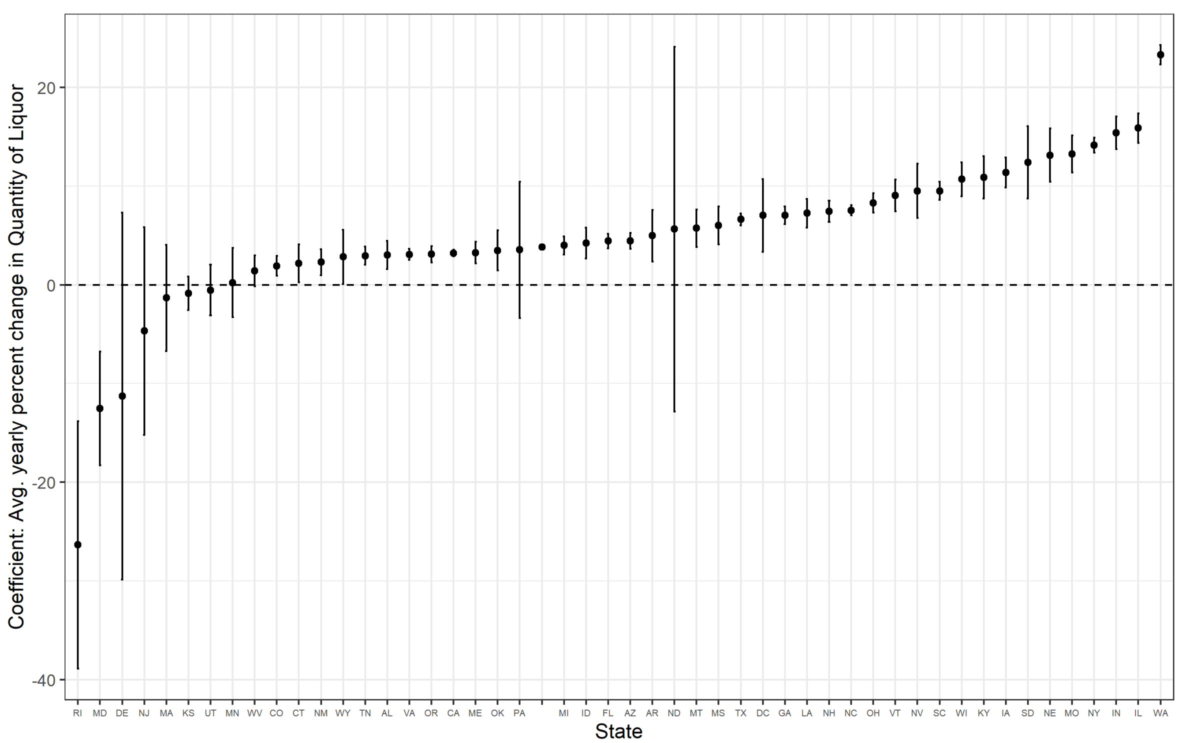
where $\mathbf{y}_{skt}$ are the sales ethanol equivalent alcohol of three alcohol categories (beer, liquor, and wine) within a store s located in state k in a month t $\mathbf{Num}_{st}$ is the product assortment within a category, measured as the number of available products within a year. Within the regressions, I use a logarithmic transformation of the outcomes and the product assortment to interpret $\hat{\beta}$ conveniently. In detail, a one percent change in the number of available products leads to $\hat{\beta}$ percent increase in ethanol equivalent sales. ρ_s and $\mu_t \cdot state_i$ are store and year-store fixed effects, respectively. Given differential alcohol policies within states, time-varying state-fixed effects are essential controls. I further consider models with county-month fixed effects to further control for potential endogenous policy changes on the county level. Finally, I also control for weighted average prices within a store, p_{st}. Running the regression for each alcohol section separately, β measures the effect of the product assortment, the number of products within a category, on the sales within a store. Note that the estimate solely represents a correlative estimate of the relation. Multiple factors that relate to sales may affect the number of products available. For example, a positive economic shock may relate to an increased assortment. Further, the economic shock could positively affect sales within a store through channels other than assortment.

Table 2 shows the results. As an outcome, I consider a logarithm of ethanol equivalent to liters

Figure 5: Regression Evidence: Geographic Variation in Assortment and Sales of Liquor



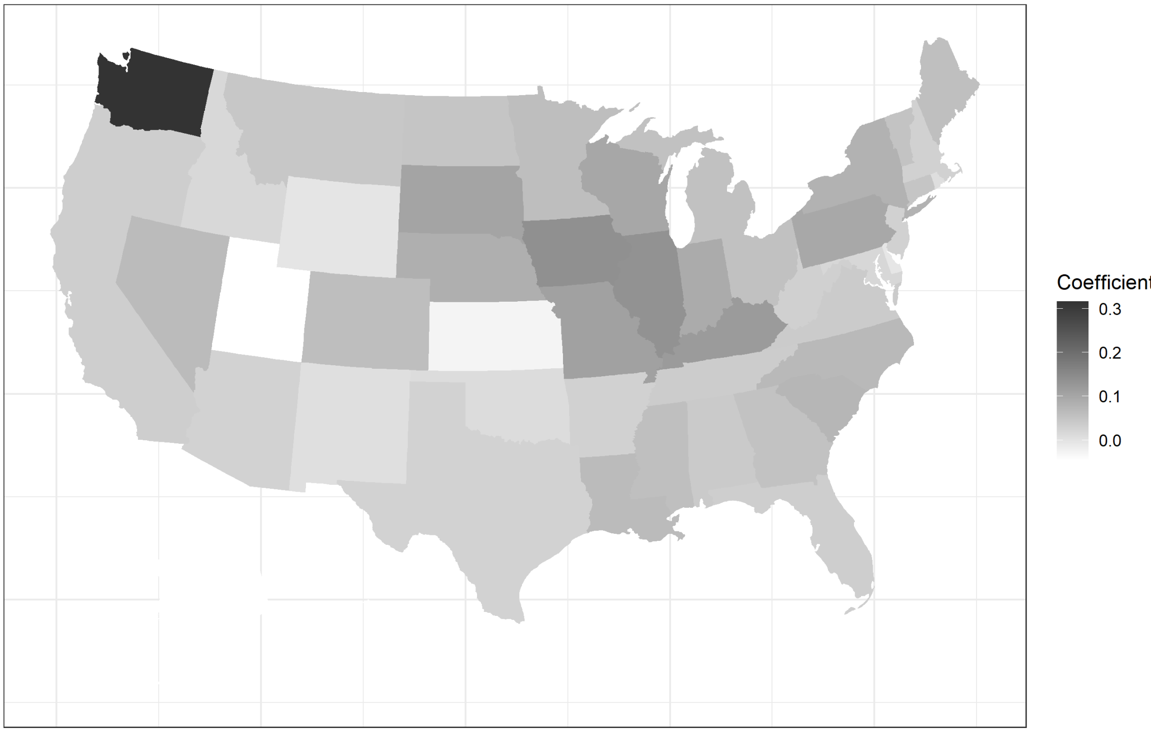
(a) Effect on Product Product variety across States



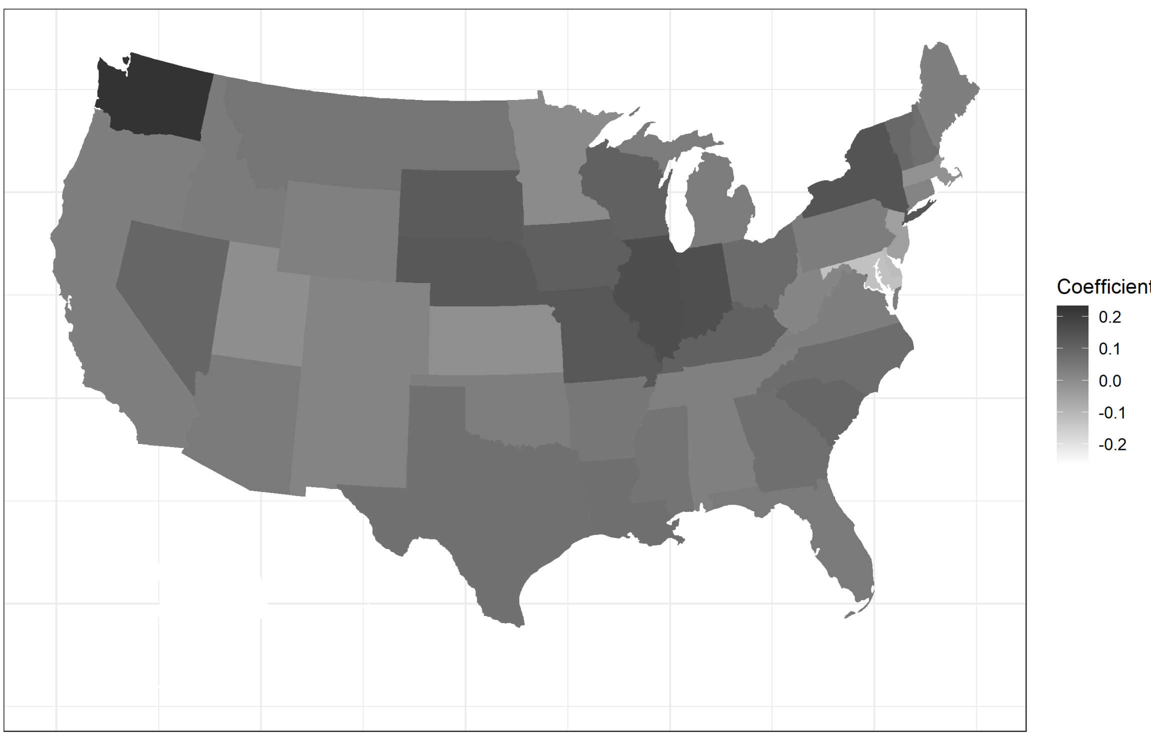
(b) Effect on Quantity across States

Notes: The figure shows regression results of regression equations 1 and 2. Each regression is on the state level and shows the coefficient of an additional year on product variety and quantity sold at the store level. In each regression, I include store-fixed effects. I show 95% confidence intervals, based on standard errors that are clustered at the household level and adjusted for within-cluster correlation.

Figure 6: Regression Evidence in Heat-map: Geographic Variation in Assortment and Sales of Liquor



(a) Effect on Product Product variety across States



(b) Effect on Quantity across States

Notes: The heatmap shows regression results of regression equations 1 and 2. Each regression is on the state level and shows the coefficient of an additional year on product variety and quantity sold at the store level. In each regression, I include store-fixed effects. Standard errors are clustered at the household level and adjusted for within-cluster correlation.

of beer, wine, and liquor. Using store and county-month fixed effects, as well as price controls, I show that a one percent increase in the number of different beer products leads to a 1.06 percent increase in beer sales. For wines and liquor, the effect sizes are slightly lower. A one percent increase in the assortment of wines is correlated with an increase in sales by 0.67 percent, while an expansion of liquor products by one percent relates to a 0.25 percent increase in monthly sales.

Table 2: Correlation between Sales and Assortment

	log(Beer+0.1)			log(Wine+0.1)			log(Liquor+0.1)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
log(N+0.1)	1.43***	1.07***	1.06***	1.23***	0.66***	0.67***	1.24***	0.28***	0.25***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Constant	-1.92***			-2.25***			-0.52***		
	(0.02)			(0.02)			(0.01)		
Store FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
State × Month FE	No	Yes	No	No	Yes	No	No	Yes	No
County × Month FE	No	No	Yes	No	No	Yes	No	No	Yes
Price Controls	No	No	Yes	No	No	Yes	No	No	Yes
N	3,715,546	3,715,546	3,715,442	3,346,274	3,346,274	3,346,186	3,467,985	3,467,887	3,467,887
R^2	0.43	0.94	0.97	0.67	0.95	0.96	0.72	0.96	0.96

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The Table shows regression evidence for equation 3. One observation corresponds to a store within a month. The outcome variable is the logarithm of ethanol equivalent sales of alcohol in three categories. In the first three models, I consider beer sales, the second three models the sales of wine, and the final three models show results for ethanol equivalent sales of wine. To avoid zero sales, I transform the outcome variable to add 0.1 ethanol equivalent liters to each outcome. $log(N+0.1)$ is the number of beer, wine, or liquor products in a store. It varies across years. Given the log-log specification, a one percent change in the number of available products leads to $\hat{\beta}$ percent increase in ethanol equivalent sales. Store FE, State × Month FE, and County × Month FE indicate the inclusion of store, state-month, or county-month fixed effects. Price Controls shows if the model controls for the weighted average price of sales within a category. Standard errors are clustered at the store level, adjusted for within-cluster correlation, and reported in parentheses.

5.1 Deregulation and Excise Taxes

The previous section has exemplified that state-specific alcohol policies could play a large role in explaining the relationship between product assortment and sales of alcohol. In Figure 9, one observes a strong increase in product assortment in the liquor segment in the state of Washington.

Further, sales of liquor grew drastically. Part of the observation is explained by the liberalization of the liquor market in Washington. After the state allowed grocery stores to obtain licenses, the data records an increase in the product assortment. As those stores had not recorded any liquor sales before also, their sales logically increased. With a sample of grocery stores that include partly those without a license before the 2012 reform, the relation between assortment and sales is upward biased.

However, the liberalization of the liquor market that came with an excise tax increas in Washington also allows additional analysis. Illanes and Moshary (2020) show that also among those stores with a license prior to the liberalization, stores increased their assortments by a large margin. Also, Yu et al. (2021) investigate product assortment changes following the liberalization for stores with existing liquor licenses. While Illanes and Moshary (2020) focuses on the question of the number of firms affects product prices and assortment, Yu et al. (2021) shows that the increased product assortment leads to a decrease in price sensitivity. I use the fact of the increased product assortment to evaluate if, indeed, sales increase.

Additionally to the deregulation of the alcohol market in Washington state, I use the large and unexpected excise change of liquor taxes in Illinois in 2009 to evaluate if price through tax changes indeed increases product variety and offsets part of the negative consumption effect. I follow the previous work of Gehrsitz et al. (2021) who use the Illinois excise tax changes and show that (1) prices increase substantially as a one dollar price increase increases prices on average by $1.50 and (2) reduces consumption in the short run by approximately 3.5 percent. I focus on the question posed by Lemma X, i.e., does the increase in price have a second-order effect on consumption through a higher product variety?

In the initial step, I show the relationship between the two shocks and prices, product assortment, and sales. For each of the two shocks, the deregulation of the liquor market in Washington and the excise tax increase, I consider a sample of stores that sold liquor before 2012 and 2009, respectively, to ensure that I solely consider stores that already sold liquor before the shock.[11] Consider the following event study, which considers three outcome variables y_{st} of the store s in month t: (1) The number of liquor products, (2) the sold liters of ethanol equivalent liquor, and (3) the average price of sold ethanol equivalent liter of liquor in USD.

$$\mathbf{y}_{st} = \alpha + \beta \mathbf{I}(t) \cdot Treat_s + \gamma \mathbf{I}(t) + \rho_s +_{st} + \varepsilon_{st}, \tag{4}$$

where $\mathbf{I}t$ are dummy variables for each year from 2006 to 2019, excluding the dummy for the year prior the shock due to multicollinearity. Further, $Treat_{st}$ is a treatment variable that takes the value one if store s is located within a treatment state, i.e., in Washington when considering the liquor deregulation or in Illinois when considering the excise tax increase. Additionally, ρ_s are store fixed effects, and when considering the outcome of sales, I control for weighted average prices of sales, p_{st}. Overall the estimates of $\hat{\beta}$ show the yearly variation on the store level before and after each of the two shocks within a treatment state in comparison to the remaining untreated states.

Figure 7 shows the regression results for the deregulation in Washington, while Figure 8 presents the results of the excise tax increase in Illinois. For each Figure, three Subfigures present regression evidence for different outcome variables: Subfigures 7a and 8a consider the number of liquor products available within a store, Subfigures 7b and 8b show results for the ethanol equivalent sales of liquor, while 7c and 8c present effects on the weighted average price of the sold liquor products. Each coefficient corresponds to the year-specific effect within a treatment compared to a control state controlling for store-fixed effects.

Considering the liquor deregulation in Washington, the regulation resulted in a strong increase in the number of products following the deregulation. The coefficients show a strong and sudden increase in products in 2012, the year of the liquor market liberalization. The results may be rationalized with the reasoning of the existing literature (e.g., Illanes and Moshary (2020)) that argues that the availability of wholesalers and competitive power led to increased assortment pressure.

[11] In detail, I only consider stores that had more than 100 different liquors in stock before new licenses came on the market.

For the aggregate sales on the store level, we see a decrease prior to the deregulation followed by an increase. Finally, prices increase drastically with the deregulation as the deregulation also came with a price increase.

In comparison to the deregulation in Washington, the excise tax hike in Illinois has an immediate positive effect on prices and a negative effect on sales but a delayed and positive effect on the number of products. Further, the delayed increase in the number of products aligns with an increase in sales. Overall, the policy changes show similar behavior in a different time horizons. The deregulation as well as the excise tax indeed increase the product assortment. The increase in product assortment may further affect sales positively.

To generalize the result, I use the two policy changes in an instrumental variable approach to evaluate the effect on store-level sales. To evaluate the effect, consider a model similar to the one in 3 when only considering the outcome of liquor sales of store s in month t:

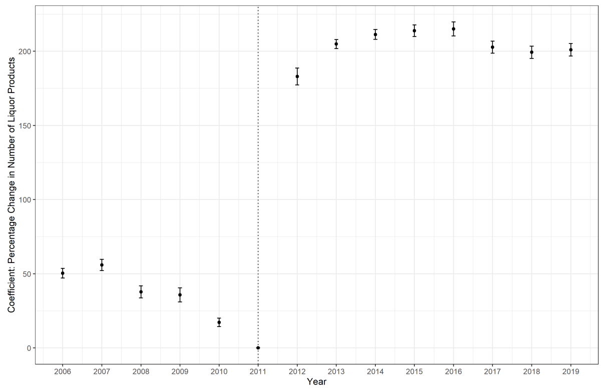
$$y_{st} = \alpha + \beta Num_{st} + \rho_s + \mu_t + \xi p_{st} + \varepsilon_{st}, \tag{5}$$

where $\mathbf{y}_{st}$ is the sales of ethanol equivalent liters of liquor within a store s in month t. $\mathbf{Num}_{st}$ is the product assortment within a store's liquor category. ρ_s and μ_t are store and month fixed effects. Further, p_{st} are weighted average prices of sold liquor products. In the following approach, I use the liberalization of the Washington liquor market and the Illinois excise tax increase as a potential exogenous variation on the assortment to evaluate the effect on consumption. Consider an instrument Z_{st}. In case I consider the liquor store liberalization, Z_{st} takes the value one for those stores with a liquor license in Washington before the liberalization in August 2012 *after* the liberalization. Therefore the treatment group is only those stores that sold liquor before the liberalization. When using the excise tax increase in Illinois Z_{st} takes the value one for stores in Illinois after September 2009.

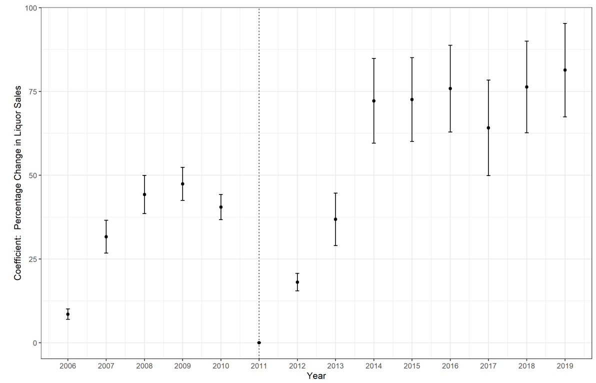
Instrumenting Num_{st} with Z_{st} evaluates on the store level the impact of the increase in as-

Figure 7: Event Study, Liquor Deregulation in Washington

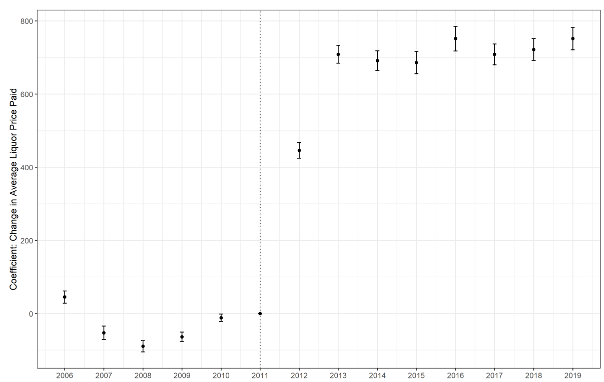
(a) Number of Products



(b) Sales



(c) Prices

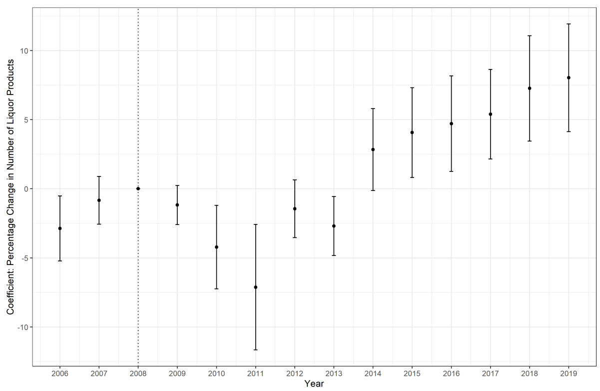


Notes: Results of the event study in Equation 4 on the store level. Each regression solely includes stores that sold liquor products prior to the deregulation in 2012. The Figures show the coefficients $\hat{\beta}_d$, the yearly variation of three outcome variables in Washington in comparison to the remaining states. The three Subfigures correspond to three different outcome variables: The number of liquor products available, the ethanol equivalent sales, and the weighted average price of liquor sales. Each regression includes store fixed effects, and when considering the outcome of sales I control for weighted average prices of sales, p_{st}. The reference level is the year 2011, the year prior the deregulation of liquor in Washington. The error bars represent 95% confidence intervals. Standard errors are clustered at the store level and adjusted for within-cluster correlation.

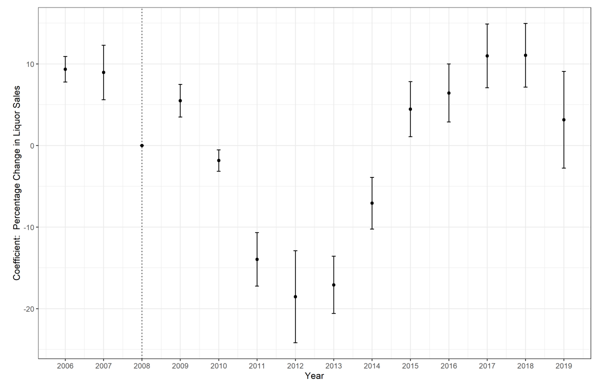
sortment on the store level that correlates with periods after the liberalization. At the same time, the remaining states serve as control states. The exclusion restriction of the approach is that the deregulation and the excise tax increase do not affect the consumption of liquor products through channels other than the number of products. The exclusion restriction in the case of deregulation in Washington may be violated. For example, the deregulation could have impacted the general per-

Figure 8: Event Study, Excise Tax Increase for Liquor

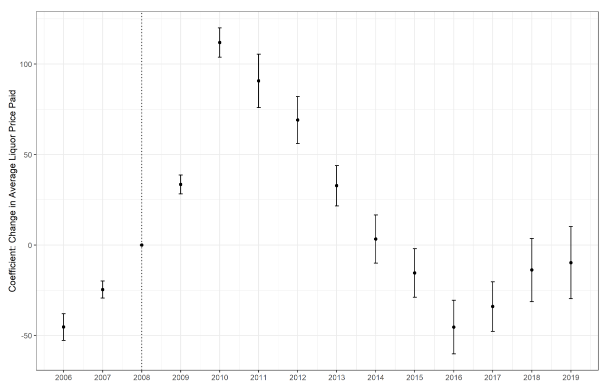
(a) Number of Products



(b) Sales



(c) Prices



Notes: Note: Results of the event study in Equation 4 on the store level. Each regression solely includes stores that sold liquor products prior to the excise increase in 2009. The Figures show the coefficients $\hat{\beta}_d$, the yearly variation of three outcome variables in Illinois in comparison to the remaining states. The three Subfigures correspond to three different outcome variables: The number of liquor products available, the ethanol equivalent sales, and the weighted average price of liquor sales. Each regression includes store fixed effects, and when considering the outcome of sales I control for weighted average prices of sales, p_{st}. The reference level is the year 2011, the year prior the deregulation of liquor in Illinois. The error bars represent 95% confidence intervals. Standard errors are clustered at the store level and adjusted for within-cluster correlation.

ception of liquor and therefore increased consumption. However, the identification strategy offers further evidence about the potential effects of product assortment on consumption through the lens of liberalization and a tax hike, two policies that increased came with higher prices for consumers.

I show the results of the instrumental variable regression in Table 3. In the upper panel of Table 3, I show the result of the first stage. The outcome variable is the logarithm of the number of liquor products in a store. The instrument is a dummy that takes the value one if a store lies within a treatment state after the policy change. I change the control states to only comparable neighboring states in models three and seven.[12] Further, in models three and eight, I delayed the treatment time by two and a half years to allow for delayed treatment effects. Considering the first stage of the deregulation in Washington, the instrument is strong through all models. For the excise tax, the model only is only sufficiently strong when considering a delayed treatment effect. This result is consistent with the graphical evidence shown in Figure 8a.

In the lower panel of Table 3, I show results for the second stage, the impact of the number of products in the liquor category on consumption. Results are consistent, positive, and significant. The coefficients are slightly higher when comparing estimates to the linear least square results in Table 2. For example, model (2) indicates that through the impact of the deregulation in Washington, a one percent increase in liquor products increases the ethanol equivalent consumption of liquor products by 0.309 percent. Overall, the analysis of the reforms shows similar results as the general correlation analysis: An increase in products is related to more consumption at the store level.

6 Empirical Analysis on Household Level

The main empirical strategy is based on household-level data. In the following section, I first show how the correlation between the variety of products a household is exposed to and consumption. I then move to show that changes in product assortment due to residential moves result in similar effects on consumption.

First, consider household i, residing in county c purchasing y_{it} of an ethanol equivalent liters of alcohol within a category (beer, wine, or liquor) in month t. Within the following model, we

[12] for Washington, I follow Gehrsitz et al. (2021) and choose only Oregon as a control state, while I use Wisconsin as a control state for Illinois.

Table 3: Instrumental Variable Approach

	First Stage							
	Outcome Variable: Number of Liquor Products							
	Deregulation in Washington				Excise Tax Increase in Illinois			
	All	All	Control: Neighbors	Delay	All	All	Control: Neighbors	Delay
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Z_{st}	0.297***	1.010***	1.451***	0.704***	0.216***	−0.029**	0.459*	0.081***
	(0.014)	(0.037)	(0.123)	(0.028)	(0.031)	(0.013)	(0.258)	(0.012)
Constant	6.135***				6.093***			
	(0.009)				(0.009)			
Store FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Month FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Price Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
F-statistics	216	3275.6	3838.5	1768.3	24	145	3.1	149
N	789,381	789,381	16,279	789,381	687,225	687,225	44,794	687,225
R^2	0.001	0.905	0.926	0.902	0.005	0.884	0.871	0.884

	Second Stage							
	Outcome Variable: log(Liquor Sales)							
	Deregulation in Washington				Excise Tax Increase in Illinois			
	All	All	Control: Neighbors	Delay	All	All	Control: Neighbors	Delay
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$log(N+0.1)$	1.200***	0.309***	0.682***	0.332***	1.752***	3.263***	0.985***	0.436**
	(0.150)	(0.058)	(0.051)	(0.067)	(0.130)	(1.106)	(0.350)	(0.177)
Constant	−0.484				−3.849***			
	(0.922)				(0.794)			
Store FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Month FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Price Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
N	789,381	789,381	16,279	789,381	687,225	687,225	44,794	687,225
R^2	0.530	0.891	0.906	0.893	0.182	0.520	0.917	0.892

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table shows regression evidence for equation 5. One observation corresponds to a store within a month. In the first panel of the table, I show the first stage result. The outcome variable is the $log(N+0.1)$ is the number of liquor products in a store. The instrument Z_{st} is a dummy that takes the value one if a store lies within a treatment state after the policy change. In the first three models, the treatment state is Washington, and the treatment time is August 2012. In models five to seven, I consider the treatment state Illinois and the treatment time of September 2009. In models three and eight, I delayed the treatment time by two and a half years to allow for delayed treatment. Further, I reduce the sample in models three and seven to solely treatment and a comparable neighboring state. Thus, I only use Oregon as a control state in model three and Wisconsin as a control state in model 7. The second part of the table shows the second stage of the instrumental variable approach. The outcome variable is the logarithm of ethanol equivalent sales of alcohol in the liquor category. To avoid zero sales, I transform the outcome variable to add 0.1 ethanol equivalent liters to each outcome. Given the log-log specification, a one percent change in the number of available products leads to $\hat{\beta}$ percent increase in ethanol equivalent sales. Store FE and Month FE indicate the inclusion of store and month fixed effects. Price Controls show if the model controls for the weighted average price of sales within a category. Standard errors are clustered at the store level, adjusted for within-cluster correlation, and reported in parentheses.

estimate the correlation to the number of products a household is exposed to within a month:

$$log(y_{it}) = \alpha + \beta log(Exposure_{it}) + \xi_i + \rho_{ct} + \phi_{ic} + \delta \mathbf{X}_{it} + \varepsilon_{it}, \tag{6}$$

where $Exposure_{it}$ is the number of products a household is exposed to within a month. xi_i and δ_{ct} are household and month-county specific fixed effects. In part of the regression models, we use household-county instead of household fixed effects ϕ_{ic} to control for effects due to changing residency. Further, I include household time-varying controls, such as household size or composition, in X_{it}. Thus, β measures the impact of being exposed to an additional alcohol product within a month. Given the log-log specification, a one percent change in exposure to products of a category leads to $\hat{\beta}$ percent increase in ethanol equivalent purchases of that category. As an additional outcome variable, I consider the external margin. Therefore I create an indicator variable, $I(y_{it})$, that takes the value one if the purchases in one alcohol category is positive. As a result, in those models, a one percent change in exposure to products of a category leads to $\hat{\beta}$ percentage points higher probability that a household purchases any alcohol of that category.

Finally, I also use the same instrumental variable strategy as in equation 4 on the household level when considering liquor purchases. Consider an instrument Z_{it} that takes the value one for if a household resides within a treatment state after the policy change. For the deregulation of liquor sales in Washington, the treatment state is Washington, and the treatment time is August 2012. When using the instrument for the excise tax hike in Illinois, the value of the instrument variable is one if a household resides in Illinois after September 2009. As the store level regression, instrumenting the exposure of products with Z_{ist} evaluates the impact of the increase in assortment on the individual level that correlates with periods after the liberalization. At the same time, the remaining untreated households serve as controls.

Note that the specification considers the sum of product exposure of a household across different stores within a month. As an alternative, one may consider a household's visit to a store and measure the variation on a store and household level. I show results for the alternative approach in

Appendix **??**.

Table 4: Regression Evidence on Household Level, Beer and Wine

	log(Beer)				I(Beer>0)	log(Wine)				I(Wine>0)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$log(Exposure+0.5)$	0.066***	0.029***	0.029***	0.027***	0.006***	0.099***	0.053***	0.053***	0.046***	0.006***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)
Constant	-3.829***					-4.018***				
	(0.007)					(0.006)				
Household FE	No	Yes	Yes	No	No	No	Yes	Yes	No	No
Month FE	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes
County × Month FE	No	No	Yes	No	No	No	No	Yes	No	No
Household × County FE	No	No	No	Yes	Yes	No	No	No	Yes	Yes
Household Controls	No	No	No	Yes	Yes	No	No	No	Yes	Yes
N	7,008,052	7,008,052	7,008,052	6,565,446	6,565,446	7,008,052	7,008,052	7,008,052	6,565,446	6,565,446
R^2 2	0.003	0.494	0.497	0.498	0.440	0.012	0.479	0.482	0.486	0.418

Notes: The Table shows regression evidence for equation 6. One observation corresponds to a household within a month. The outcome variable is the logarithm of ethanol equivalent sales of alcohol in two categories, beer, and wine, as well as an indicator variable that takes the value one if a household purchases any beer or wine product in a given month. The first five models consider beer, while the last five models refer to wine. To avoid zero sales, I transform the outcome variable and add half the minimum value of the sample beer/wine consumption across observations with nonzero consumption, i.e., $log(Beer+0.1035072)$ *and* $log(Wineamount+0.0015)$. $log(Exposure+0.5)$ *is the number of products a household is exposed to in a month. Given the log-log specification, a one percent change in the number of products leads to* $\hat{\beta}$ *percent increase in ethanol equivalent purchases. Household FE, Month FE, County × Month FE, and Household × County FE indicate the inclusion of household, month, county-month, or household-county fixed effects. Household Controls shows if the model controls for time-varying household characteristics such as household income (income brackets), household size, household composition (relation between household members), the occupation of female and male household heads, employment status, education and age, marital status within a household, the presence and age of kids, and race. Standard errors are clustered at the household level, adjusted for within-cluster correlation, and reported in parentheses.*

I show the results of the household level regression in Tables 4 and 5. While Table 4 shows results for the beer and wine category, Table 5 considers liquor. For beer and wine, the results are stable across all specifications. An increase of exposure of products across shopping occasions significantly increases purchases. The effect size is smaller than in the aggregate regression of 3. A one percent increase in product exposure increases ethanol equivalent beer purchases by 0.027% and wine purchases by 0.046% on average. The smaller effect size can be explained by

Table 5: Regression Evidence on Household Level, Liquor

	OLS					IV: Washington	IV: Illinois
	log(Liquor)				I(Liquor>0)	log(Liquor)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
log(N)	0.103***	0.055***	0.055***	0.052***	0.005***	0.236***	0.067
	(0.003)	(0.002)	(0.002)	(0.002)	(0.000)	(0.031)	(0.173)
Constant		-8.754***					
	(0.011)						
Household FE	No	Yes	Yes	No	No	No	No
Month FE	No	Yes	No	Yes	Yes	Yes	Yes
County × Month FE	No	No	Yes	No	No	No	No
Household × County FE	No	No	No	Yes	Yes	Yes	Yes
Household Controls	No	No	No	Yes	Yes	Yes	Yes
N	7,008,052	7,008,052	7,008,052	6,565,446	6,565,446	6,565,446	6,565,446
R^2	0.005	0.383	0.386	0.384	0.359	0.381	0.384
F-Statistics First Stage						61,902.6	1,173.4

Notes: The Table shows regression evidence for equation 6. One observation corresponds to a household within a month. The outcome variable is the logarithm of ethanol equivalent sales of alcohol of liquor products and an indicator variable that takes the value one if a household purchases any liquor in a given month. The last two models show instrumental variable regression results based on the deregulation of liquor sales in Washington and the excise tax increase in Illinois. The instrument is a dummy that takes the value one if a household resides within a treatment state after the policy change. In model 6, the treatment state is Washington, and the treatment time is August 2012. In model 7, I consider the treatment state of Illinois and the treatment time of September 2009. To avoid zero sales, I transform the outcome variable and add half the minimum value of the sample beer/wine consumption across observations with nonzero consumption, i.e., $log(Liquor + 0.000083)$. $log(N + 0.5)$ *is the number of liquor products a household is exposed to in a month. Given the log-log specification, a one percent change in the number of products leads to* $\hat{\beta}$ *percent increase in ethanol equivalent purchases of liquor. Household FE, Month FE, County × Month FE, and Household × County FE indicate the inclusion of household, month, county-month, or household-county fixed effects. Household Controls shows if the model controls for time-varying household characteristics such as household income (income brackets), household size, household composition (relation between household members), the occupation of female and male household heads, employment status, education and age, marital status within a household, the presence and age of kids, and race. Finally, F-Statistics First Stage refers to the F-statistics of the first stage when using the instrumental variable approach. Standard errors are clustered at the household level, adjusted for within-cluster correlation, and reported in parentheses.*

a large fraction of households that do not purchase any alcoholic beverages, independent of the number of products. However, we also see a significant positive impact of product exposure on the external margin. In detail, a one percent increase in product exposure increases the probability of purchasing any beer product by 0.006 percentage points. The result is the same when considering wine products.

When considering the outcome of liquor in Table 5, results are comparable. A one percent increase in product exposure in the segment of liquor increases ethanol equivalent beer purchases by 0.052% and the probability of purchasing any liquor product at all by 0.005 percentage points. Using the instrumental variable approach, point estimates are more substantial. Considering the deregulation of the liquor market in Washington, the point estimate of product exposure increases to 0.236, while the point estimate in the Illinois tax increase is 0.067 and insignificant. One reason for the insignificance is the delayed treatment time explored in section 5.1.

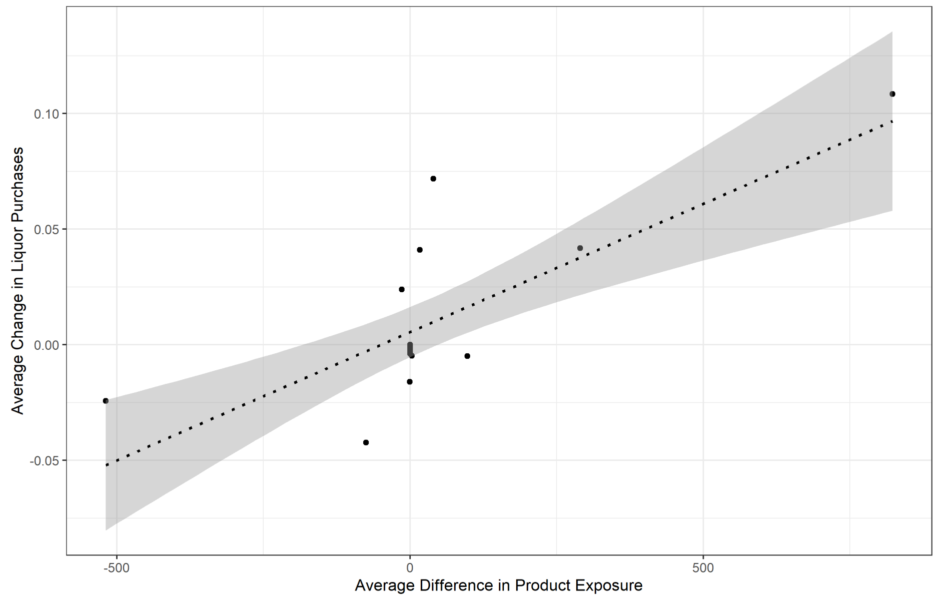
6.1 Movers

I now move to an additional identification strategy by using variation in product exposure due to residence changes. Initially, I consider those households that change their residency within a year between two zip codes.[13] In Figure 9 we show some first descriptive evidence on the relationship between product exposure of households and average changes in liquor purchases. In detail, Figure 9 considers ventiles, ordered by the average difference in product exposure across moving households. I then show average changes in product purchases for each ventile of changes in Product exposures. While Subfigure 9a considers all households, Subfigure 9b excludes those households without any change in product exposure or liquor consumption. The results show a positive relationship. Therefore, exposure to more products after the move correlates with higher purchases.

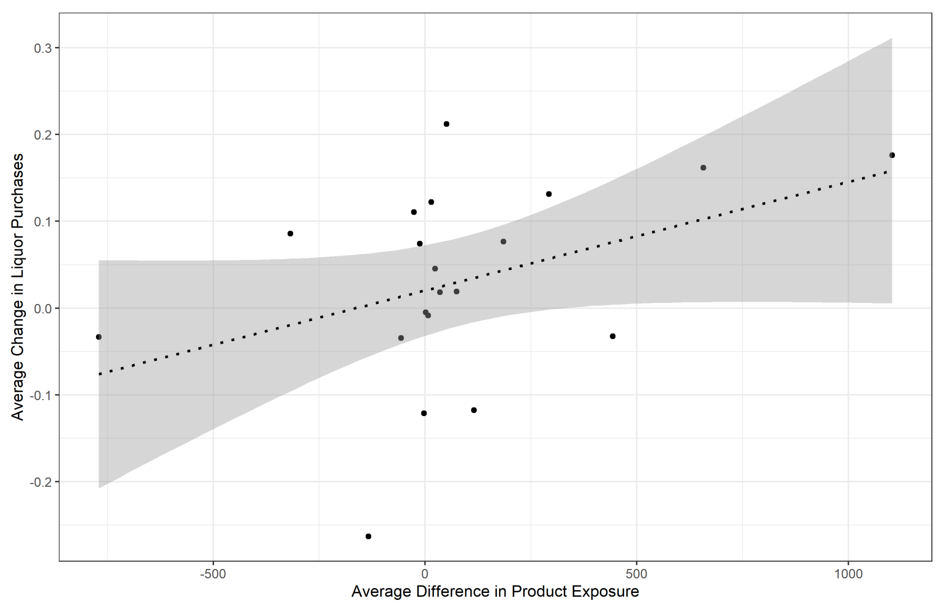
I then consider an instrumental variable approach to use the variation due to movements. Consider a similar model than in 6, where household i, residing in zip code area z purchasing y_{it} of an

[13] In Appendix **??** I explore robustness of alternative definition of moving.

Figure 9: Change in Liquor Consumption by Difference in Product Exposure due to Movement



(a) Including Households Without Change in Product Exposure



(b) Excluding Households Without Change in Product Exposure or Liquor Consumption

Notes: The Figure shows average changes in liquor purchases from before to after a move as a function of the change in product exposure. The average change in liquor purchases is calculated as the difference between average purchases and product exposure during the years before and after the change of residency. We exclude the year of the residence change. These average differences are grouped into ventiles considering the changes in average exposure. Thus for each ventile of the average differences of product exposure, the y-axis shows the corresponding change in liquor purchases, averaged within the ventile. I show an OLS using the 20 data points. Further, I report 95% confidence intervals.

ethanol equivalent liters of alcohol within a category (beer, wine, or liquor) in month t.

$$log(y_{it}) = \alpha + \beta log(Exposure_{it}) + \xi_i + \rho_t + \delta \mathbf{X}_{it} + \mu \bar{y}_{zt} + \phi_{iz}^{Origin} + \varepsilon_{it}, \quad (7)$$

where $Exposure_{it}$ is the number of products within a category, a household is exposed to during their shopping trips within a month. Besides household fixed effects (ξ_i), month fixed effects (ρ_t), and household varying control variables ($\delta \mathbf{X}_{it}$), I control for average consumption of the category in a zip code ($\bar{y}_{zt}$) as well as the origin zip code of a move (ϕ_{iz}^{Old}). In this approach, I use the available products within a zip code for movers after a move, Z_{izt} as an instrument for the exposure of products $log(Exposure_{it})$. Thus, Z_{izt} takes the value of available products of a category within a zip code for moving household *after* a move. For non-moving households as well as for moving households before a move, the instrument takes the value zero.

The exclusion restriction of the instrumental variable approach is that the availability of new products in a new zip code is unrelated to factors affecting consumption except for the exposure to assortment. The new control of average consumption of the category in a zip code ($\bar{y}_{zt}$) is essential in light of the identification strategy. Moving individuals may adapt to a new environment, for example, through spillover effects of behavior (see, for example, Hinnosaar and Liu (2022)). In such a case, the instrument Z_{izt} is correlated to other factors of the environment. Thus, I control for the average monthly consumption within a zip code. Thereby I control if the whole adaption is solely due to adoption to the environment. As a result, the coefficient $\hat{\beta}$ measures the impact of the exposure to products due to the move resulting in a higher assortment conditional on the destination's consumption.

I show results for liquor consumption in Table 6. The OLS regression aligns with the instrumental variable approach in all specifications with the instrumental variable approaches, yielding a higher coefficient consistently. Considering the full sample and all controls in model six, a one percent increase in liquor product exposure due to the movement increases Liquor purchases by

Table 6: Regression Evidence for Movers, Liquor Consumption

	log(Liquor)								I(Liquor>0)	
	Full Sample						Only movers		Full Sample	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
log(Exposure)	0.103***	0.168***	0.053***	0.141***	0.050***	0.109***	0.052***	0.057**	0.005***	0.011***
	(0.003)	(0.023)	(0.002)	(0.035)	(0.002)	(0.035)	(0.005)	(0.029)	(0.000)	(0.003)
Constant	-8.766***	-9.044***								
	(0.011)	(0.100)								
Household FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin Controls	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Household Controls	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
N	6,409,309	6,409,309	6,409,309	6,409,309	6,015,619	6,015,619	524,281	524,281	6,015,619	6,015,619
R^2	0.006	0.003	0.386	0.385	0.405	0.405	0.380	0.380	0.374	0.374
First Stage F Statistics		100,749.5		35,102.6		32,504.3		33,958.7		32,504.3

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: The Table shows regression evidence for equation 7. One observation corresponds to a household within a month. The outcome variable is the logarithm of ethanol equivalent sales of alcohol of liquor products and an indicator variable that takes the value one if a household purchases any liquor in a given month. The models are alternating, showing an OLS and an instrumental variable regression. The instrument takes the value of products available in a zip code if a household has moved. Thus, the instrument takes the value zero for non-moving households. In models one to six and models 9 and ten, I include the full sample. In comparison, models 7 and 8 only include those households that moved during the sample period. To avoid zero sales, I transform the outcome variable and add half the minimum value of the sample beer/wine consumption across observations with nonzero consumption, i.e., $log(Liquor + 0.000083)$. $log(Exposure + 0.5)$ *is the number of liquor products a household is exposed to in a month. Given the log-log specification, a one percent change in the number of products leads to* $\hat{\beta}$ *percent increase in ethanol equivalent purchases of liquor. Household FE, and Month FE indicate the inclusion of household and month fixed effects. Origin Controls indicates if the model includes the zip code-specific average consumption of ethanol equivalent liters of liquor. Household Controls shows if the model controls for time-varying household characteristics such as household income (income brackets), household size, household composition (relation between household members), the occupation of female and male household heads, employment status, education and age, marital status within a household, the presence and age of kids, and race. Finally, F-Statistics First Stage refers to the F-statistics of the first stage when using the instrumental variable approach. In the first stage, the instrument always has a significant positive coefficient. Standard errors are clustered at the household level, adjusted for within-cluster correlation, and reported in parentheses.*

0.11 percent. Also, the external margin increases. In detail, a one percent exposure to products increases the probability of purchasing a liquor product by 0.01 percentage points. Overall, the analysis of movers is in line with the general results.

7 Conclusion

This paper explores the relationship between product assortment and alcohol consumption in the United States. It finds that a higher product variety in retail increases purchases, which may help to explain the gradual increase in alcohol consumption over the past two decades. The initial decrease in alcohol consumption during the 1980s and 1990s could be attributed to increased health awareness about the risks of alcohol, but this led to firms and retailers customizing their product portfolios to appeal to different types of consumers. This customization offsets the negative effect of health awareness on consumption, similar to the impact of taxes.

The paper provides evidence that higher excise taxes increase product variety, which in turn increases consumption. The author suggests that policymakers looking to reduce alcohol consumption could consider using entry regulations, such as licensing requirements for new alcohol products, in conjunction with tax increases or public health awareness campaigns.

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