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Regulation and purchase diversity: Empirical evidence from the U.S. alcohol market

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ABSTRACT

The repeal of the Prohibition Act in 1933 introduced state-level regulations on the retail availability of alcoholic beverages. Recently there has been much debate among industry stakeholders on how changes to these laws will affect consumer choices. We develop an index to measure purchase diversity for alcoholic beverages that considers similarities in product attributes. Following a set of households that moved between regulatory environments during the 2004 to 2016 period, we examine the effect of alcohol availability on purchase diversity. Our key finding shows that consumers further diversify their product selections in states that allow alcohol sales in grocery stores.

1. Introduction

Consumers seek variety for novelty and change (McAlister and Pessemier, 1982). To avoid satiation derived from repeated consumption of products and attributes, consumers do activities to achieve the optimal stimulation level from the behavior itself in the absence of external incentives (Steenkamp and Baumgartner, 1992; Van Trijp and Steenkamp, 1992). Such exploratory behaviors are more associated with psycho-social and feeling-based motivations rather than for rational and economic decision-making reasons (Sharma et al., 2010). However, behaviors in varied consumption are also highly affected by resources and constraints facing consumers. Consumers may choose to maximize their overall utility by increasing the diversity in their choices for goods or services as a response to changes in retail environments (Kahn, 1995; Mohan et al., 2012). Research on demand for variety has examined drivers behind varied choice patterns including convenience (Bronnenberg, 2015) and socio-economic characteristics (Gronau and Hamermesh, 2008; Jekanowski and Binkley, 2000). Our research focuses on how regulation governing the retail availability of alcoholic beverages influences consumer's choice making behavior. We focus on the U.S. market for alcohol given that the retail availability of different beverages varies across states and there are a plethora of choices for beer, wine, and spirits available to consumers.

The regulatory environment for alcohol allows states to establish rules within their borders on the production and distribution of alcoholic beverages. Some states require that alcoholic beverages are sold in specific stores while other states allow alcoholic beverages to be sold in all stores that sell food including grocery stores, convenience stores, big box stores, drug stores, pharmacies, and gas stations. There are 12 states allowing only limited (or no) alcohol sales in grocery stores, 5 states allowing only beer sales, and 16 states that allow the sale of wine and beer in grocery stores. The remaining 18 states allow beer, wine, and spirits to be sold across a wide range of outlets including grocery stores (Rickard et al., 2013; National Alcohol Beverage Control Association, 2016).

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States prohibiting alcohol sales in grocery stores may limit shopping convenience by requiring separate trips and increased travel costs for households (Food Marketing Institute, 2012). For states permitting grocery store sales of alcohol, it generates the utility of one-stop shopping in purchasing both groceries and alcohol in the same store and within the same trip (Seo, 2019).

In recent years, there have been several state legislative proposals to introduce wine and/or beer (and in some cases spirits) into grocery stores. Such bills have generated much debate over how wider availability of alcohol would affect business owners and consumers (Zimmerman, 2016; Asimov, 2009). One side of the argument maintains that expanding the retail availability for alcoholic beverages increases shopping convenience and increase choices available to consumers. Another side contends that greater availability of alcohol in grocery stores would lead to less assortment for consumers and reduce their visits to specialized stores. Byrne and Nizovtsev (2017) examined the effects of retail restrictions on local economy performance and suggested that restrictive retail laws may have moderate effects on the grocery store sector. However, within this debate and within the current literature, much less attention has been given to evaluating how the availability of alcoholic beverages in grocery stores affects purchase diversity among consumers.

In the next section, we provide more background details on the regulation concerning alcohol retail availability in the United States. We describe our household-level dataset and our development of a diversification index that incorporates similarities between distinct products to capture the level of diversification in household purchases over multiple shopping trips. We then provide a conceptual framework that characterizes consumer behavior in the utility maximization problem to understand the purchase diversity pattern for differentiated products considering the implicit travel and search costs associated with alcohol purchases under different regulatory environments. Focusing on a subsample of households that moved across regulatory environments (presumably for reasons not related to alcohol availability laws) enables us to identify the causal impact of allowing wider alcohol availability in retail stores on consumer purchase diversity. Our findings show that there has been greater purchase diversity for beer, wine, and spirits in states that allow alcoholic beverages to be sold in a wider range of retail channels.

2. Background

After the repeal of Prohibition Act in 1933, individual states were granted the authority to regulate the production, distribution and sales of alcoholic beverages. Since then we have observed fairly wide but relatively fixed differences in alcohol laws across states. One piece of U.S. alcohol regulation concerns the retail availability of alcoholic beverages and state-level rules governing which beverages are permitted to be sold in different retail channels, including grocery stores. This regulation varies by alcoholic beverage, or by the strength of alcohol content. Stores allowed to sell wine are also allowed to sell beer; stores allowed to sell spirits are allowed to sell beer and wine.

Legislative proposals to reform alcohol availability laws have been put forth in some states in recent years (National Alcohol Beverage Control Association, 2016). The privatization of the liquor retail market in Washington state in 2012 allowed grocery stores to sell spirits if the store size was at least 10,000 square feet. In June 2016, the state government in Colorado passed a bill that allowed grocers and major retail chains to gradually expand sales of wine, full-strength beer and spirits over the next two decades. Tennessee state lawmakers passed legislation in 2014 that enabled a wine-in-grocery-stores bill to take effect in 2016. In Oklahoma, state legislature passed a bill in October 2016 that permitted grocery and convenience stores to sell wine and beer starting in 2018. In Kansas, starting in April 2019, full-strength beer sales are permitted in grocery, convenience and big box stores based on a legislative bill that passed in 2017. In Pennsylvania, a new liquor law was enacted in August 2016 that allowed grocery stores selling beer to also sell wine.

Figs. 1–3 show the average number of distinct products purchased for wine, beer, and spirits in 2016 across the four retail availability environments. Here, the Universal Product Code (UPC) is used to indicate a distinct product. At a first glance, there appears to be a positive relationship between retail alcohol availability laws and purchase diversity patterns, however, there is significant heterogeneity across states and across alcoholic beverages. In the next section, we describe the data we use to further explore this relationship empirically with detailed household-level purchases between 2004 and 2016.

3. Data and our diversification index

The Nielsen Consumer Panel Dataset entails longitudinal data for a cross-section of households that provide transaction information on their food and beverage purchases using an in-home scanner. The data include shopping trips, date of purchase, UPCs, quantities purchased, total spending, in-store deals and coupon use, and retail chain information. Household demographic and geographical information including the state and county of residence, household size, annual income, presence and the number of child under 18, race, age, education, employment and occupation of the female and male household head are also collected. The UPCs are matched with detailed product characteristics. There are four core attributes distinguishing each UPC: product module, brand, size, and multi-pack. Alcoholic beverages are one of the 10 product departments in the dataset, comprised of three product groups, wine, beer and spirits; product modules further subdivide each of these alcoholic beverages.

Table 1 presents the hierarchical structure of the alcoholic beverages in the Nielsen Dataset and shows the aggregate number of brands and UPCs households purchased under each alcohol product module in 2016. Domestic and imported dry table wine, Ale, Beer, Cordial & proprietary liquors, and Vodka are the modules that have the most brands and UPCs purchased. We use the UPCs to create a quantity-based diversification index that measures the level of diversity in beer, wine and spirits purchases by each household in each year. We construct a dataset by pooling annual cross-sectional Nielsen HomeScan panels from 2004 to 2016.

We drop the observations with total purchase quantities less than the 25th percentile and total expenditures less than the 25th percentile from the distribution of the full sample. For wine, the 25th percentile of the distribution for total annual quantities purchased is 2 bottles (750 ml per bottle) and for annual expenditures is $10.50. For beer, the 25th percentile of the distribution for total annual quantities purchased is 2 six packs (72oz per pack) and for annual expenditures is $15.20. For spirits, the 25th percentile of the distribution for total annual quantities is 2 bottles (750 ml per bottle) and for annual expenditures is $15.30. The rationale for focusing on this subsample is to mitigate the bias stemming from the random and rare purchases by households over a long period of time. Diversity patterns are expected to be high for households with little purchase activity, in either quantity or value, compared to households that have more frequent purchase behavior. We focus our analysis on this subsample of core consumers as they will more accurately reflect the effect of regulations on purchase diversity, rather than the exploratory and intertemporal variations in individual shopping behavior. Also, our sample does not include those

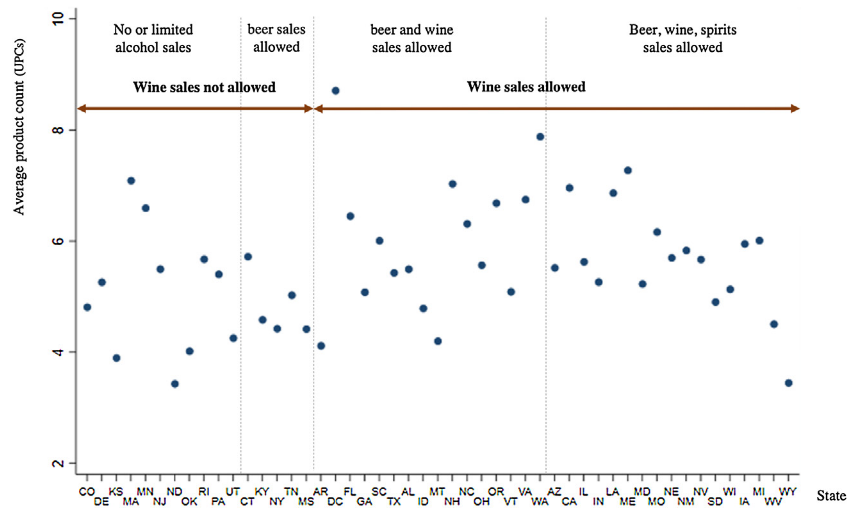

Fig. 1. Regulation of alcohol availability in grocery stores and household purchase diversity for wine, 2016.

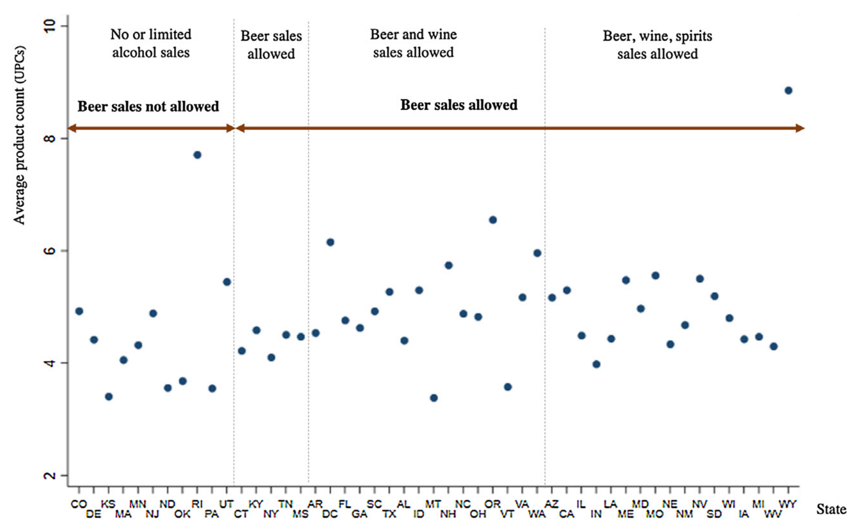

Fig. 2. Regulation of alcohol availability in grocery stores and household purchase diversity for beer, 2016.

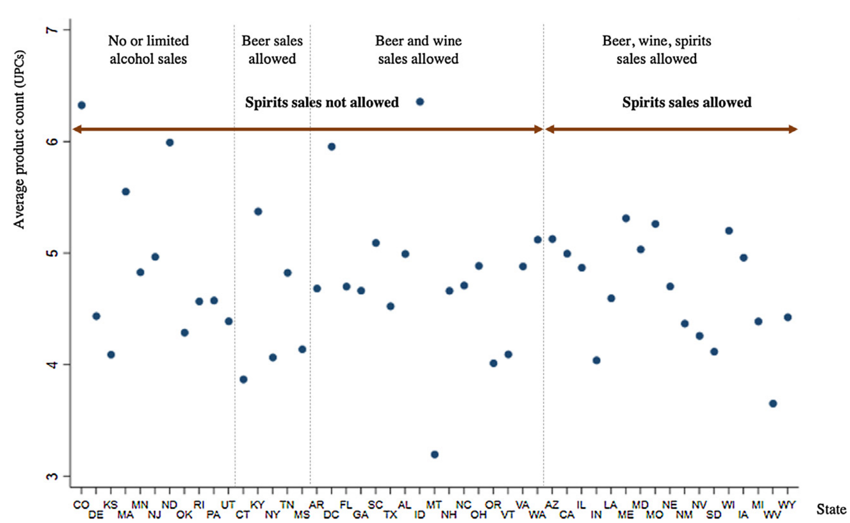

Fig. 3. Regulation of alcohol availability in grocery stores and household purchase diversity for spirits, 2016.

Table 1
Number of brands and UPCs purchased by alcoholic beverage category among U.S. households, 2016.

Wine			Beer			Spirits		
Modules	# of Brands	# of UPCs	Modules	# of Brands	# of UPCs	Modules	# of Brands	# of UPCs
Aperitifs	3	5	Ale	2880	3910	Bourbon-blended	54	126
Dry table – domestic	1960	6013	Beer	1167	2332	Bourbon-straight/bonded	215	613
Dry table – imported	2333	4465	Light beer (low calorie/alcohol)	85	515	Brandy/Cognac	90	265
Flavored/refreshment	407	1040	Malt liquor	31	114	Canadian whiskey	77	321
Kosher table	45	119	Near beer/malt beverage	52	112	Cordial &proprietary liquors	458	1681
Sake	42	104	Stout and porter	413	668	Gin	130	271
Sangria	83	171				Irish whiskey	33	78
Sparkling	364	730				Remaining whiskey	68	155
Sweet dessert – domestic	43	99				Rum	227	905
Sweet dessert – imported	58	132				Scotch	139	320
Vermouth	22	74				Tequila	147	485
Non-alcoholic	35	159				Vodka	386	1819
						Alcohol cocktails	165	642
						Coolers – remaining	132	631
						Fruit and vegetable in alcohol	10	14

Source: Nielsen Consumer Panel Dataset, 2016.

who never buy alcohol, as they exhibit no purchase diversity and it would not be described appropriately by the Entropy Index, which is the measure we use and is explained in more detail below.

The Entropy index has been used to quantify the level of dispersion across attribute levels within a product category in assessing assortment variety in the marketing literature (Van Herpen and Pieters, 2002). It has also been used to measure the degree of diversity of spending across all food and non-food goods in the consumer basket (Theil and Finke, 1983) and the level of variation across different brands or product types (Van Trijp and Steenkamp, 1990). The Entropy index contains both a quantity and a distribution dimension, and therefore it goes beyond a straightforward measure of the number of total variants. The distribution information reflects how total purchases are allocated among different products and the Entropy index increases with a more evenly distributed purchasing pattern.

The Entropy index is defined as:

$$\mathrm{EI} = \sum_{i=1}^{N} s_i \ln\left(\frac{1}{s_i}\right) \tag{1}$$

where s_i is the share of quantity purchased for a UPC, i, out of total purchases of the N UPCs under each product category; the value ranges between 1 and $\ln(N)$. The Entropy index gives more weight to items purchased in smaller quantities and purchased less frequently. A zero purchase would receive a missing value for the Entropy index due to the zero term in the denominator.

Here we modify the Entropy index by introducing a term to reduce the bias resulting from the situation when two products share similarities over certain attributes. Extending the work by Gollop and Monahan (1991) on the Berry Index, we develop a spatially-adjusted Entropy index. It accounts for the UPCs that are vertically close to each other by belonging to the same brand and are horizontally close to each other by belonging to the same module.

For the case with three UPC products purchased in different quantity shares s_i, the level of diversification is:

$$\mathrm{EI}|_{i=3} = s_1 \ln\left(\frac{1}{s_1}\right) + s_2 \ln\left(\frac{1}{s_2}\right) + s_3 \ln\left(\frac{1}{s_3}\right) \tag{2}$$

If two products share a certain attribute group and could be treated as identical, the Entropy index takes the following form:

$$\begin{aligned}
\mathrm{EI}|_{i=2} &= s_1 \ln\left(\frac{1}{s_1}\right) + (s_2+s_3)\ln\left(\frac{1}{s_2+s_3}\right) \\
&= s_1 \ln\left(\frac{1}{s_1}\right) + s_2 \ln\left(\frac{1}{s_2}\right) + s_3 \ln\left(\frac{1}{s_3}\right) \\
&- \left[s_2 \ln\left(\frac{1}{s_2}\right) - s_2 \ln\left(\frac{1}{s_2+s_3}\right)\right] \\
&- \left[s_3 \ln\left(\frac{1}{s_3}\right) - s_3 \ln\left(\frac{1}{s_2+s_3}\right)\right] \\
&= \sum_{i=1}^{3} s_i \ln\left(\frac{1}{s_i}\right) - s_2 \cdot \left[\ln\left(\frac{1}{s_2}\right) - \ln\left(\frac{1}{s_2+s_3}\right)\right] \\
&- s_3 \cdot \left[\ln\left(\frac{1}{s_3}\right) - \ln\left(\frac{1}{s_2+s_3}\right)\right] \\
&= \sum_{i=1}^{3} s_i \ln\left(\frac{1}{s_i}\right) - s_2 \cdot \ln\left(\frac{s_2+s_3}{s_2}\right) - s_3 \cdot \ln\left(\frac{s_2+s_3}{s_3}\right)
\end{aligned} \tag{3}$$

The last two terms in Eq. (3) distinguish an adjusted index from an unadjusted one. Generalizing this example for n variants gives:

$$\tilde{\mathrm{EI}} = \sum_{i=1}^{n} s_i \ln\left(\frac{1}{s_i}\right) - \sum_{A} \omega^A \cdot \sum_{i=1}^{n} s_i \cdot \ln\left(1 + \frac{\sum_{j \neq i}^{m} s_j \cdot z_{ij}^A}{s_i}\right) \tag{4}$$

$$\text{where } z_{ij}^A = \begin{cases} 1 & \text{if } ith \text{ and } jth \text{ products belong to same } Ath \text{ product attribute} \\ 0 & \text{if } ith \text{ and } jth \text{ products belong to different } Ath \text{ product attributes} \end{cases},$$

$A = \{\text{module, brand}\}$ and $\omega^A = [0, 1]$.

The homogeneity term in Eq. (4), $1 + \frac{\sum_{j \neq i}^{m} s_j \cdot z_{ij}^A}{s_i}$, mitigates the upward bias resulting from not differentiating two different UPCs that share the same attribute, A. The term z_{ij}^A represents the similarity indicator for whether two products are in the same attribute space.

In this spatially-adjusted Entropy index, we identify three sources of product similarity, masked within the heterogeneity at the UPC level. First, two products that belong to the same product module but to different brands. Second, two products that belong to same brand but to different modules. Third, two products that belong to the same module and brand but differ by other attributes.[1]

Each UPC represents one distinct product. Although two products could belong to the same module, same brand, or both, any two UPCs would never be the same product sharing exactly all the attributes. We multiply the homogeneity component, $\sum_{i=1}^{n} s_i \cdot \ln\left(1 + \frac{\sum_{j \neq i}^{m} s_j \cdot z_{ij}^{A}}{s_i}\right)$ by weight, ω^A, which is assigned to each source of similarity among products to mitigate any bias from grouping different UPCs into the same product space. Due to the hierarchy within product assortments, we assume $\omega^A = 0.4$ for the case when two products share the same product module (but different brands), $\omega^A = 0.2$ when two products share the same brand (but different modules), and $\omega^A = 0.7$ for products sharing both the same brand and product module. The weight values are chosen to reflect that the extent of similarity between products is greater when compared over certain attributes and over single attribute space relative to multiple attribute space. Two products belonging to the same module (but different brands) will be more similar than two products under the same brand (but different modules). Two products sharing both attributes will be more similar than products sharing only one attribute.[2]

4. Conceptual model

Our primary objective is to understand the impact of regulations concerning the retail availability of alcohol on the breadth of products purchased by consumers. If we observe greater purchase diversity of alcoholic beverages in states that sell those alcoholic beverages in grocery stores, it is plausible that this could be explained by either supply side or demand side considerations.

On the supply side, greater purchase diversity might simply be the result of more variety being offered by certain types of retailers. We expect that grocery stores (and especially large chains) may have greater freedom of contracting with multiple distributors, and this freedom may allow grocery stores to more fully exploit consumer demand for variety. Given the robust competition that exists between grocery stores, we also expect that retailers in this channel are better able to adjust prices more quickly to respond to changes in demand. More competition between retailers could lead to lower prices (Rickard et al., 2013) and perhaps more variety being offered, which could translate into more diverse purchasing patterns by consumers. However, data describing the diversity of alcoholic beverages offered by the different types of retailers are not available. Furthermore, there is some evidence suggesting that the level of variety offered in grocery stores is not substantially different from the variety offered in stores that specialize in selling alcoholic beverages (Seim and Waldfogel, 2013).

The data in the Nielsen Consumer Panel do not describe all the products offered by retailers, but the data can be used to highlight the total number of UPCs purchased across all consumers in the regulated and unregulated environments, and this could be used as a proxy for the number of products offered. In Table 2 we show this information for wine, beer, and spirits in both regulatory environments. Here we see that the UPC count for wine and beer is greater in the unregulated environment yet the UPC count for spirits is higher in the regulated environment. These results for beer and wine suggest that there may be greater variety supplied in the unregulated states (although the large difference observed in the wine category is likely due, in part, to the fact that the major wine-producing states are in the unregulated environment). In Table 2 we also show that the average number of UPCs (by alcoholic beverage) purchased by households annually in each environment is between 3.28 and 5.28. Overall, Table 2 indicates that the supply of alcoholic beverages may be higher in the unregulated states, but it also highlights the degree of diversity that exists in both environments relative to the number of products purchased. Across all beverages in both environments, households on average are purchasing a tiny share of the total products that are available (less than 0.1% in each case).

The absence of data available to describe the supply of UPCs in each regulatory environment coupled with the results in Table 2 showing the tremendous amount of variety that exists in these categories (notably when compared to average annual purchase quantities) lead us to consider demand-side explanations. Greater purchase diversity in states with alcohol available in grocery stores could also be driven by reductions in transaction costs by consumers. The convenience of one-stop shopping for alcoholic beverages at grocery stores would reduce the time requirement needed to travel and search for alcoholic beverages across retailers. One stop shopping is also expected to allow for more time to consider the plethora of choices that exist in the alcoholic beverage categories. Next, we follow this logic and present a formal framework to model the linkages between regulations on alcohol availability in grocery stores and the diversity of purchases by households.

To better understand how regulation might affect consumer's purchase diversity, we provide a framework and a few key hypotheses next. Consumers purchase both groceries (denoted by g) and alcohol (denoted by $l \in \{\text{beer, wine, spirits}\}$) in two types of retail outlets: grocery stores (denoted by G) and/or stores that specialize in selling alcoholic beverages (denoted by L). For grocery purchases, Q^g denotes groceries as a composite good purchased in grocery stores. The terms N^G and N^L indicate the total number of alcohol UPCs purchased in grocery and alcohol stores respectively, where $N = N^L$ if the transactions take place in states prohibiting alcohol sales in grocery stores and $N \in [N^G, N^L, N^G + N^L]$ if transactions take place in states permitting grocery store sales of alcohol.

We assume there are two types of costs when shopping for alcohol. First is the travel time cost (Messinger and Narasimhan, 1997) and the second is the search cost. Visiting different types of stores incurs both travel time cost, t^G and t^L and search cost,[3] d^G and d^L. The travel time and search costs in alcohol stores might also vary by the degree of regulation across different alcohol types. We add w, $w \in [R, U]$, as the subscript in t_w^L and d_w^L to account for the differences in access costs for alcohol in regulated states (R) that restrict alcohol sales in grocery stores and unregulated states (U) that allow alcohol sales in grocery stores. In unregulated states, the travel time cost for both groceries and alcohol occurs in one trip, t^G. For states prohibiting grocery store sales of alcohol, consumers have to make two separate trips, $t^G + t^L$. Search costs could be higher with greater in-store assortment variety because consumers may need to look for the preferred item (Richards et al., 2017). However,

[1] There are data on more product attributes such as flavor, container, type, style, variety, and organic, but not all the products have such corresponding information. These data are not as complete as the product modules and brands for each UPC. We leave the work incorporating more detailed product attributes for alcoholic beverages into a generalized diversity index for future research that could combine the HomeScan dataset and external datasets with more comprehensive product-specific attribute information.

[2] The weights are strictly less than 1 and follow the rule: $\omega^A_{\text{module\&brand}} > \omega^A_{\text{module}} > \omega^A_{\text{brand}}$. We tested this spatially-adjusted Entropy index with a range of plausible weights and found that the general thrust of our results did not change. Although the testing is arbitrary to some extent, it's not possible to estimate the ω without comprehensive information and data on other qualitative and quantitative attributes that define each alcohol product.

[3] Only alcohol shopping is considered in the search cost here. In this framework, we assume the travel cost for grocery shopping t^G is required regardless of the outlet type that consumers shop for alcohol.

Table 2
Purchase diversity across regulated and unregulated states, 2016.

Category	Regulatory status	Total Annual UPCs purchased	Annual UPC purchases per household
Wine	Regulated states	6294	4.24
	Unregulated states	11,276	5.28
Beer	Regulated states	2670	3.28
	Unregulated states	7055	3.95
Spirits	Regulated states	6845	3.72
	Unregulated states	4865	3.85

Notes: Nielsen Consumer Panel Dataset (2016). UPC purchases per household represent the average of annual UPCs purchased by all households in the regulated and unregulated states, respectively.

greater product variety may reduce search costs by increasing the likelihood that a product will meet the consumer's satisfaction or expectation (Oppewal and Koelemeijer, 2005).

The utility function follows the representative consumer model proposed by Anderson et al. (1992), which characterizes consumer's aggregate preference for various products from a differentiated product category.[4]

$$U=\sum_{i=1}^{N}a_i q_i^l-\mu\sum_{i=1}^{N}q_i^l\ln\frac{q_i^l}{Q^l}+Q^g,\quad \sum_{i=1}^{N}q_i^l=Q^l \tag{5}$$

where a_i represents the intrinsic contribution of any specific product i; μ is the diversity parameter where the larger the μ, the greater the extent of choice diversification; Q^l is the total purchase of the differentiated alcoholic beverage product (wine, beer, and spirits respectively) in quantities $q_1^l,\ldots,q_N^l$; l_i is the quantity share, $l_i=\frac{q_i^l}{Q^l}$.

This model embodies two effects: First, the $\sum_{i=1}^{N}a_i q_i^l+Q^g$ expresses the utility derived from the consumption of independent $q_1^l,\ldots,q_N^l$ and Q^g in the absence of the distribution of consumption over all the UPC variants. Second, the term, $\mu\sum_{i=1}^{N}q_i^l\ln\frac{q_i^l}{Q^l}$, entails the entropy-index feature which entails both the variety-seeking preference and the level of purchase diversity across all the product selections. This utility framework generalizes possible shopping scenarios that take place when the retail availability of alcoholic beverages is regulated or not. With p^x, $x\in[l,g]$, denoting the price for groceries and alcohol, consumers maximize utility subject to the budget constraints comprised of income, I, time cost, t_w^r, and search cost, d_w^r, where $r\in[L,G]$, $w\in[R,U]$. The Lagrangian function is written as:

$$\begin{aligned}L=\;&\sum_{i=1}^{N}a_i q_i^l-\mu\sum_{i=1}^{N}q_i^l\ln\frac{q_i^l}{Q^l}+Q^g\\&+\lambda\left[I-P^gQ^g-\sum_{i=1}^{N}p_i^lq_i^l-\left(\sum_{i=1}^{N^G}t^G\cdot 1_{q_i^{l,G}>0}+\sum_{i=1}^{N^L}t_w^L\cdot 1_{q_i^{l,L}>0}\right)\right.\\&\left.-\left(\sum_{i=1}^{N^G}d^G\cdot 1_{q_i^{l,G}>0}+\sum_{i=1}^{N^L}d_w^L\cdot 1_{q_i^{l,L}>0}\right)\right]\end{aligned} \tag{6}$$

where $1_{q_i^{l,G}>0}$ is the indicator function equal to 1 if consumers purchase alcohol in the grocery store and $1_{q_i^{l,L}>0}$ equal to 1 if consumers purchase alcohol in a specialized alcohol store. Solving the consumer problem, the inverse demand follows:

$$p_i^l=a_i-\mu\left(\ln\frac{q_i^l}{Q^l}+1\right) \tag{7}$$

The inverse demand function is multiplied by q_i^l over all purchases N to generate the total expenditure on alcohol purchases:

$$\sum_{i=1}^{N}p_i^lq_i^l=\sum_{i=1}^{N}a_iq_i^l-\mu\sum_{i=1}^{N}q_i^l\ln\frac{q_i^l}{Q^l}-\mu Q^l \tag{8}$$

The budget constraint is rewritten as:

$$\begin{aligned}\sum_{i=1}^{N}p_i^lq_i^l\leqslant\;& I-P^gQ^g-\left(\sum_{i=1}^{N^G}t^G\cdot 1_{q_i^{l,G}>0}+\sum_{i=1}^{N^L}t_w^L\cdot 1_{q_i^{l,L}>0}\right)\\&-\left(\sum_{i=1}^{N^G}d^G\cdot 1_{q_i^{l,G}>0}+\sum_{i=1}^{N^L}d_w^L\cdot 1_{q_i^{l,L}>0}\right)\end{aligned} \tag{9}$$

Based on the state-level regulation, the budget constraint facing consumers can be decomposed into two mutually exclusive scenarios:

$$\begin{aligned}&\sum_{i=1}^{N^L}p_i^{l,L}q_i^{l,L}\leqslant I^L-(t^G+\kappa_R^Lt_R^L)-\nu_R^Ld_R^L \quad \text{(i)}\\&\sum_{i=1}^{N^L}p_i^{l,L}q_i^{l,L}+\sum_{i=1}^{N^G}p_i^{l,G}q_i^{l,G}\leqslant I^L-(\kappa^Gt^G+\kappa_U^Lt_U^L)-(\nu^Gd^G+\nu_U^Ld_U^L) \quad \text{(ii)}\end{aligned} \tag{10}$$

where $I^L=I-P^gQ^g$; κ_w^r represents the parameters associated with the aggregate travel costs incurred when visiting grocery stores, alcohol stores in a regulated state, or alcohol stores in an unregulated state. A higher value for this parameter indicates more alcohol shopping trips are made. Similarly, ν_w^r represents parameters associated with the overall search costs for alcoholic beverages purchased in different stores and states. A higher search parameter value indicates that more time and effort are put into seeking an item.

The above considers scenarios facing consumers in states that allow alcohol to be sold in grocery stores and states that do not allow it. Scenario (i) represents the shopping environment in the states that prohibit alcohol sales in grocery stores, where consumers must buy groceries and alcohol in separate trips and incur the time cost, $t^G+\kappa^Lt^L$. Scenario (ii) represents the environment where grocery stores are allowed to sell alcoholic beverages and where consumers can choose to consolidate their shopping trips for food and alcohol or choose to do multi-stop shopping. One-stop shoppers purchase alcohol only in grocery stores where the overall time and search cost is $\kappa^Gt^G+\nu^Gd^G$.

[4] The utility function U is concave along the domain $\sum_{i=1}^{N}q_i^l=Q^l$, which is assumed to be the definite condition in the model. Second, all the other commodities besides alcohol products belong to the grocery category, denoted by g.

Substituting the derived total expenditure function in the utility maximization equation, we can rewrite the two scenarios as follows:

$$\begin{aligned}&\mu\cdot[\sum_{i=1}^{N^L} q_i^{l,L}\ln(\frac{1}{l_i^L})-Q_R^{l,L}]+\sum_{i=1}^{N^L} a_i q_i^{l,L}\leqslant I^L-(t^G+\kappa_R^L t_R^L)-\nu_R^L d_R^L \quad \text{(i)}\\ &\mu\cdot[\sum_{i=1}^{N^L} q_i^{l,L}\ln(\frac{1}{l_i^L})+\sum_{i=1}^{N^G} q_i^{l,G}\ln(\frac{1}{l_i^G})-Q_U^{l,(L,G)}]\\ &+\sum_{i=1}^{N^L+N^G} a_i(q_i^{l,L}+q_i^{l,G})\leqslant I^L-(\kappa^G t^G+\kappa_U^L t_U^L)-(\nu^G d^G+\nu_U^L d_U^L) \quad \text{(ii)}\end{aligned} \tag{11}$$

Replacing Eq. (11) with a composite diversity function and aggregating terms for the two types of transaction costs:

$$\begin{aligned}&D_R^L(\mu, K_R^L, \tilde{Q}_R^{l,L})\leqslant I^L-(t^G+\mathbf{t}_R^L)-\mathbf{d}_R^L \quad \text{(i)}\\ &D_U^{L,G}(\mu, K_U^L, K^G, \tilde{Q}_U^{l,(L,G)})\leqslant I^L-(\mathbf{t}^G+\mathbf{t}_U^L)-(\mathbf{d}^G+\mathbf{d}_U^L) \quad \text{(ii)}\end{aligned} \tag{12}$$

where $D_w^r(\mu, K_w^r, \sim Q_w^{l,r})=\mu\cdot[\sum_{i=1}^{N^r} q_i^{l,r}\ln(\frac{1}{l_i})-Q_w^{l,r}]+\sum_{i=1}^{N^r} a_i q_i^{l,r}$, $r\in[L,G]$, $w\in[R,U]$ is a diversity function representing the degree of diversification for all the purchased items; $K_w^r=\sum_{i=1}^{N^r} q_i^{l,r}\ln\left(\frac{1}{l_i^r}\right)-Q_w^{l,r}$ retains the entropic form of variants within a differentiated product and $\tilde{Q}_w^{l,r}$ is the weighted total quantities. Diversity within the product selections by a representative consumer is a function of variety-seeking parameter, μ, entropic parameter for overall purchase, K_w^r, and the aggregate consumption of $q_1, \ldots q_N$. The bold terms for t and d represent the aggregate travel and search cost for all alcohol purchases over time; $\mathbf{t}_w^r=\kappa_w^r t_w^r$, $\mathbf{d}_w^r=\nu_w^r d_w^r$.

When we compare the purchase diversity for alcohol across different regulatory environments, two hypotheses are generated. The first hypothesis considers the case when consumers are one-stop shoppers in unregulated states. Diversification in alcohol product choices could be either greater or smaller in unregulated states compared to the level in regulated states:

$$\begin{aligned}&D_U^G(\mu, K^G, \sim Q_U^{l,(G)})\gtreqless D_R^L(\mu, K_R^L, \sim Q_R^{l,L}),\\ &\textit{if}\ \ t^G+d^G\lesseqgtr t^G+t_R^L+d_R^L\end{aligned} \tag{13}$$

For the diversity level to be higher in unregulated states, the cost of grocery shopping in unregulated states, $\mathbf{t}^G$, is less than the total travel cost from separate trips for groceries and alcohol in regulated states, $t^G+\mathbf{t}_R^L$, which reflects the benefits of convenience of shopping for alcohol in grocery stores. It also requires that the sum of travel and search costs in grocery stores is smaller than the sum of search costs in alcohol stores and the separate travel costs to different outlets. Purchase diversity could be smaller in unregulated states when the sum of these two types of costs in unregulated states are greater than that in regulated states. Search costs for alcohol in grocery stores in unregulated states, $\mathbf{d}^G$, might be higher than that in alcohol stores in regulated states, $\mathbf{d}_R^L$, such that the greater search costs outweigh the benefit of convenience from one-stop shopping provided by grocery stores selling alcohol.

The second hypothesis considers the case when consumers are multi-stop shoppers in unregulated states and the purchase diversity level in unregulated states could be either greater or smaller than the level in regulated states:

$$\begin{aligned}&D_U^{L,G}(\mu, K_U^L, K^G, \sim Q_U^{l,(L,G)})\gtreqless D_R^L(\mu, K_R^L, \sim Q_R^{l,L}),\\ &\textit{if}\ \ t^G+t_U^L+d^G+d_U^L\lesseqgtr t^G+t_R^L+d_R^L\end{aligned} \tag{14}$$

In states allowing alcohol to be sold in grocery stores, consumers can choose to purchase alcohol in both grocery and alcohol stores. Purchase diversity is greater in unregulated states only when the total time and search costs occurring for both grocery and alcohol store shopping in unregulated states are sufficiently smaller than both costs in alcohol stores plus the necessary time cost for groceries in regulated states. If both time and search costs for alcohol purchases are smaller than the total costs in both outlets, purchase diversity could be greater in regulated states. This is likely the situation when the search cost for alcohol in both types of stores is greater than that incurred only in alcohol stores in regulated states and when the sum of time costs in both outlets in unregulated states is already greater than that for alcohol stores only.

In the next section, we empirically examine the diversity level of household alcohol purchases across different regulatory environments given a plausible set of shopping routines and transaction costs using the spatially-adjusted Entropy index.

5. Empirical strategy

The key variable of interest in our model is the state-level regulation concerning the retail availability of alcoholic beverages, which by construct does not vary over time since the regulatory environment has remained unchanged across states in our dataset. To identify the effect of allowing alcoholic beverages to be sold in grocery stores on purchase diversity, we examine specific subsamples of households. The first specification focuses on households that have moved between states and whose destination state is under a different regulatory environment allowing us to exploit within-panel variation. The change in the regulatory environment is used to estimate the availability effect on the level of diversity in product choices. This strategy provides a natural experiment in our fixed-effects model. In the second specification, we use a pooled OLS model to estimate the availability effect driven by the differences in retail regulation facing households who either did not move or that moved to another state with the same regulatory environment concerning alcohol availability in grocery stores.

$$D_{hy}=\beta_x\mathbf{X}_{hy}+\beta_R R_{i(state)}+\nu_h+u_{hy} \tag{15}$$

In Eq. (15), D_{hy} is the specially-adjusted Entropy Index described earlier to represent purchase diversity in wine, beer or spirits by household h in year y; $R_{h(state)}$ represents the dummy variable indicating the presence of regulation that limits the retail availability for alcohol type l, where $l\in\{$beer, wine, spirits$\}$, in the *state* where household h resides. The key regulatory variable is used as the proxy for the travel and transaction costs for the households. We assume that grocery store shopping involves less travel costs while liquor stores require higher travel costs, which is also corroborated in one recent study (Seo, 2019). A vector of explanatory variables affecting the diversity in alcohol purchases, denoted as $\mathbf{X}_{hy}$, includes the type or combination of alcoholic beverages purchased and household socio-demographic characteristics; u_{hy} is the idiosyncratic error term. An econometric model is specified for each alcoholic beverage. Household characteristics are included to control for socio-demographic factors that could influence long-run product choices. Year fixed effects are considered in the model to reflect the time-specific variation, such as the price change at the regional or the national level or inventory changes caused by macroeconomic conditions that affect the supply of alcohol products, which could influence the product choices by the consumers across all the states invariantly in specific years.

For the covariates represented by $\mathbf{X}_{hy}$, we include the intensity of two in-store promotion activities, $\texttt{coupon}_{hy}$ and $\texttt{deal}_{hy}$. In-store marketing activities are expected to influence consumers' purchase behavior. External marketing activities such as advertising might lead a habitual buyer to consider a variety-seeking strategy (Adamowicz and Swait, 2013). We create an intensity measure for

Table 3
Descriptive statistics for subsamples by beverages and specifications.

	Within-panel model			Pooled-OLS model		
	Mean	Standard deviation	Median	Mean	Standard deviation	Median
Wine						
Count of UPC	8.56	10.49	5	7.29	8.67	4
Entropy Index	1.43	0.83	1.35	1.31	0.8	1.25
Spatially-adjusted Entropy Index	1.1	0.68	1.04	1	0.65	0.94
Observations		4694			208,424	
Beer						
Count of UPC	4.99	6.08	3	4.53	4.78	3
Entropy Index	1.03	0.71	1.04	0.94	0.68	0.91
Spatially-adjusted Entropy Index	0.77	0.57	0.72	0.68	0.54	0.64
Observations		2600			193,498	
Spirits						
Count of UPC	5.53	5.38	4	4.92	4.52	4
Entropy Index	1.16	0.69	1.1	1.05	0.67	1.04
Spatially-adjusted Entropy Index	0.96	0.6	0.92	0.86	0.58	0.83
Observations		3898			151,099	

coupons and deals for all UPCs in each year for each household. We use the common Herfindahl index to quantify the level of promotional intensity, $H_{hy}^{\text{promo}} = \sum_i^N (s_{ihy}^{\text{promo}})^2$, where promo = {$\texttt{coupon}$, $\texttt{deal}$}; s_{ihy}^{coupon} is the share of coupon value for UPC_i of total coupon value summed over year y in household h and s_{ihy}^{deal} is the share of frequency that UPC_i is offered the deal across total annual deals. We also control for the type of alcohol consumption across three beverages, $\texttt{type}_{hy}$, to isolate the effect from individual preference for a specific category that might affect the purchase diversity for a specific alcohol product. This measure classifies consumers that purchase either only wine, only beer, only spirits, only wine and beer, only wine and spirits, only beer and spirits, or wine, beer and spirits.

6. Results

To specify the regulatory variable in the model, the four different regulatory environments from Figs. 1–3 are redefined as dummy variables to describe the availability of wine, beer, and spirits in grocery stores. For each beverage, the dummy variable with value zero indicates no or limited sales in grocery stores, and one indicates that the beverage is allowed to be sold in grocery stores in that state. Table 3 presents the summary statistics describing purchase diversity measures for the two samples of households. It shows that the households that moved to a state with a more liberal regulatory environment tend to have a more diversified product selection compared to the those who either did not move or moved to states following the same regulation. Out of 213,118 households who purchased wine, 2.2% of them have moved to states with different regulations on retail wine sales. Similar patterns are found for beer and spirits purchases; 1.3% of beer-purchasing households and 2.5% of spirits-purchasing households have moved to states with different regulatory environments.

Table 4 shows the baseline results from three models using three different measures of diversity to estimate the impact of retail regulations for each alcoholic beverage type on purchase diversity: (1) Number of UPCs purchased, (2) Entropy index, (3) Spatially-adjusted Entropy index. The consistent positive effect of alcohol retail availability on purchase diversity provides evidence that allowing alcohol sales in a wide range of retail channels leads to a greater level of purchase diversity among households. The spatially-adjusted Entropy index that accounts for brand and module similarities between distinct UPCs shows a relatively modest effect of alcohol availability in grocery stores on product choice diversity, but it remains positive and statistically significant. Our spatially-adjusted Entropy index also highlights that without considering the attribute similarity between distinct UPCs, the retail availability effect on purchase diversity level would be overestimated. Therefore the subsequent analysis focuses on results using the spatially-adjusted Entropy index.

The estimated effect of greater retail availability on purchase diversity is consistent across wine, beer, and spirits purchases. The level of diversification in beer choices is 0.11 higher in states allowing beer to be available across retail channels, between 0.11 and 0.17 higher for wine product choices in states allowing wine sales in grocery stores, and between 0.041 and 0.076 higher for spirits product choices in states allowing spirits sales in grocery stores.

There is a slight difference in the availability effects on purchase diversity from the two specifications. The availability effect on purchase diversity is greater among the subsample that moved between regulatory environments. Treating the difference in regulation as the natural experiment in the fixed-effects model, the result shows that households increase the level of diversity in their product selections as they reside in the states having wider alcohol retail availability.

When grocery stores sell alcohol and are close to state borders, it may lead to spillover effects and impact purchase diversity patterns in the markets in neighboring states. Consumers in regulated states that are close to counties in unregulated states could shop for alcohol across state borders. To understand whether such spillover effects might confound our estimated availability effect, we include the share of neighboring counties[5] that had strictly less restrictions on the retail availability of alcohol for wine, beer, and spirits. Table 5 shows the results that account for the spillover effects in the neighboring counties and compares them to our baseline results. The effects are slightly smaller in magnitude compared to those in Table 3 in the Within-panel model and slightly greater than those in the baseline Pooled-OLS model. The bordering effect turns out to be insignificant.

To identify the underlying factors driving our main results, we examine how shopping frequency and total alcohol expenditures influence the relationship between retail availability and purchase diversity for the three alcoholic beverages. Table 6 shows the results for four consumer segments based on shopping frequency. There is a pattern across the three beverages types between the two specifications, observed in the highest percentile for wine and beer model

[5] Neighboring county information are based on County Adjacency File, US Census Bureau, accessed at https://www.census.gov/geo/reference/county-adjacency.html.

Table 4
Availability effects on purchase diversity for wine, beer, and spirits.

	Within-panel model			Pooled-OLS model		
	Product count	Entropy index	Spatially-adjusted Entropy	Product count	Entropy index	Spatially-adjusted Entropy
Wine						
Wine sales allowed in grocery stores	2.05***	0.2***	0.17***	1.11***	0.14***	0.11***
(Base: sales not allowed)	(0.40)	(0.0285)	(0.0233)	(0.093)	(0.0078)	(0.0062)
Observations		4663			208,455	
Number of households		1024			68,752	
F value	22.6	14.3	7.14	101.99	757.71	1342.21
Beer						
Beer sales allowed in grocery stores	1.06***	0.15***	0.11***	0.88***	0.17***	0.11***
(Base: sales not allowed)	(0.272)	(0.034)	(0.027)	(0.06)	(0.008)	(0.0065)
Observations		2600			193.498	
Number of households		608			65,701	
F value	2.41	2.46	2.61	61.1	133.5	147
Spirits						
Spirits sales allowed in grocery stores	0.26	0.083***	0.076***	0.098***	0.04***	0.041***
(Base: sales not allowed)	(0.221)	(0.0273)	(0.0236)	(0.045)	(0.006)	(0.0052)
Observations		3690			151,303	
Number of households		924			55,374	
F value	2.86	3.2	3.13	81.6	111.9	125.1

Notes: Robust standard errors in parentheses for fixed-effects estimator; clustered standard errors for OLS estimators. *$p<.05$, **$p<.01$, ***$p<.001$. All models control for household socio-demographic characteristics, promotion intensity, type of alcohol buyers, and year fixed effect.

Table 5
Availability effects considering retail regulatory environment in neighboring countries.

	Within-panel model		Pooled-OLS model	
	Baseline	Bordering effect	Baseline	Bordering effect
Wine				
Wine sales allowed in grocery stores	0.17***	0.16***	0.11***	0.12***
	(0.0233)	(0.0264)	(0.0062)	(0.007)
Retail regulation in neighboring counties		−0.05		0.032**
		(0.0547)		(0.0124)
Observations	4663	4663	208,455	208,455
Number of households	1024	1024	68,752	68,752
F-value	7.14	6.03	1342.2	1322.4
Beer				
Beer sales allowed in grocery stores	0.11**	0.086**	0.11***	0.11***
	(0.0267)	(0.032)	(0.0065)	(0.0078)
Retail regulation in neighboring counties		−0.074		0.002
		(0.054)		(0.013)
Observations	2600	2600	193,498	193,498
Number of households	608	608	65,701	65,701
F-value	2.61	2.48	147	152.6
Spirits				
Spirits sales allowed in grocery stores	0.076**	0.068**	0.041***	0.042***
	(0.0236)	(0.0247)	(0.0052)	(0.0053)
Retail regulation in neighboring counties		−0.067		0.0078
		(0.071)		(0.0096)
Observations	3690	3690	151,202	151,202
Number of households	924	924	55,374	55,374
F-value	3.13	3.26	125.1	123.3

Notes: Robust standard errors in parentheses for fixed-effects estimator; clustered standard errors for OLS estimators. *$p<.05$, **$p<.01$, ***$p<.001$. All models control for household socio-demographic characteristics, promotion intensity, type of alcohol buyers, and year fixed effect.

and in the lowest percentile for the spirits model. The results suggest that the higher level of purchase diversity in states allowing alcohol sales in grocery stores is mostly associated with the segment of high-frequency alcohol shoppers. At the 75th percentile of the distribution of shopping trips from the sample of households in the Pooled-OLS model, the purchase diversity is 0.095 higher in states that permit wine sales in grocery stores, 0.097 higher in states that permit beer sales, and 0.05 higher in states that permit spirits sales. Effects from the Within-panel model are greater for wine only; diversity in product selections is 0.16 higher in states allowing wine in grocery stores. For wine and spirits, a higher level of purchase diversity takes place in regulated states among households who shop for alcohol much less frequently.

Table 7 shows the results for four consumer segments based on expenditures on all alcoholic beverages. These are consistent with the baseline results across three beverages and show that our key finding is mostly linked to the households that spent a relatively moderate amount on total alcohol purchases. Along the distribution of alcohol expenditures by households, it is neither the lowest nor the highest percentile of the sample that are driving the key finding. The availability effect is the strongest and most consistent for wine in both specifications: in the Within-panel model, wine purchase diversity is 0.25 higher (also the highest among the estimates) in unregulated states compared to the level in regulated states for households between the 50th and 75th percentile of the sample distribution. At the 25th–50th percentile of the distribution in the

Table 6
Availability effects on purchase diversity considering alcohol shopping frequency.

	Within-panel model				Pooled-OLS model			
	Less than P25	P25–P50	P50–P75	Greater than P75	Less than P25	P25–P50	P50–P75	Greater than P75
Wine								
Wine sales allowed in	−0.12	−0.008	0.039	0.16***	−0.029***	−0.04***	−0.013	0.095***
grocery stores	(0.0854)	(0.043)	(0.044)	(0.041)	(0.0067)	(0.0066)	(0.0089)	(0.014)
Observations	441	1056	1468	1968	22,834	46,856	64,848	84,459
Number of households	311	556	611	501	16,977	28,699	31,556	27,001
F value	1.79	1.86	1.03	5.56	13.7	25.1	44.6	167.3
Beer								
Beer sales allowed in	−0.11	0.025	0.025	0.096*	0.0041	−0.005	0.016	0.097***
grocery stores	(0.0852)	(0.0520)	(0.048)	(0.049)	(0.0066)	(0.0077)	(0.0096)	(0.014)
Observations	219	515	849	1195	18,591	37,272	59,885	89,249
Number of households	168	283	367	338	14,038	24,168	30,982	28,989
F value	17.85	1.06	0.45	2.77	5.4	20.1	25.8	154.8
Spirits								
Spirits sales allowed in	−0.28*	0.027	−0.002	0.054	−0.046***	−0.0003	0.012	0.05***
grocery stores	(0.109)	(0.0639)	(0.043)	(0.033)	(0.008)	0.0065)	(0.0067)	(0.0085)
Observations	203	597	1250	1919	14,211	28,402	46,939	71,311
Number of households	149	383	564	507	11,171	19,409	25,149	24,440
F value	7.61	1.33	1.79	2.31	10	9.95	26	117.8

Notes: Robust standard errors in parentheses for fixed-effects estimator; clustered standard errors for OLS estimators. *$p < .05$, **$p < .01$, ***$p < .001$. Specifications follow the models in Table 4. For the second column in the within-panel model, it shows the results of less than 50th percentile since there are insufficient observation for percentile less than the 25th. The 25th, 50th, and 75th percentile of household shopping trips for all alcohol is 2, 5, and 13.

Table 7
Availability effects on purchase diversity considering total expenditures on alcoholic beverages.

	Within-panel model				Pooled-OLS model			
	Less than P25	P25–P50	P50–P75	Greater than P75	Less than P25	P25–P50	P50–P75	Greater than P75
Wine								
Wine sales allowed in	−0.071	0.14**	0.25***	0.13**	0.12***	0.12***	0.11***	0.077***
grocery stores	(0.075)	(0.041)	(0.036)	(0.042)	(0.0068)	(0.0057)	(0.0077)	(0.0135)
Observations	301	1181	1567	1884	18,762	56,167	69,388	74,680
Number of households	218	569	607	458	14,109	31,930	32,505	23,368
F value	1.16	1.47	5.11	5.83	25.7	50.01	65.4	156.1
Beer								
Beer sales allowed in	−0.041	0.057	0.088	0.098	0.084***	0.11***	0.1***	0.098***
grocery stores	(0.073)	(0.048)	(0.048)	(0.055)	(0.0067)	(0.0071)	(0.0099)	(0.0149)
Observations	236	629	824	911	23,146	50.931	58,390	61,031
Number of households	175	322	337	252	16,986	29,526	28,316	20,160
F value	2.32	0.5	0.73	2.01	14.8	34.2	54.7	140.6
Spirits								
Spirits sales allowed in	0.054	0.056	0.043	0.037	0.048***	0.062***	0.048***	0.034***
grocery stores	(0.095)	(0.0459)	(0.0388)	(0.0333)	(0.0068)	(0.0055)	(0.0069)	(0.0102)
Observations	233	851	1242	1364	14,558	37,470	47,063	52,212
Number of households	169	471	527	365	11,499	23,657	24,059	17,676
F value	2.44	1.11	1.09	2.9	14	27.8	31.7	105.8

Notes: Robust standard errors in parentheses for fixed-effects estimator; clustered standard errors for OLS estimators. *$p < .05$, **$p < .01$, ***$p < .001$. Specifications follow the models in Table 4. The 25th, 50th, and 75th percentile of household annual expenditures on all alcoholic beverages is $25.8, $91.3, and $305.7.

Pooled-OLS model, the availability effect is the highest compared to other consumer segments for all the wine (0.12), beer (0.11), and spirits purchases (0.062).

7. Conclusion

A number of states have recently implemented legislative changes that allow specific alcoholic beverages to be sold in grocery stores, and other states continue to consider similar proposals. One part of the debate surrounding these legislative changes is the effects on consumers. In this paper, we examine how regulations that restrict alcohol sales in grocery stores affect the breadth of purchase patterns. There is greater level of purchase diversity in states that allow grocery stores to sell alcoholic beverages. The availability effects on purchase diversity are mainly driven by frequent shoppers and those with moderate total expenditures on alcoholic beverages. Furthermore, our results are most clear in the model that focuses on the wine market. This is notable as there has been substantial political pressure to reform the laws concerning the retail availability of wine, relative to other alcoholic beverages, in some states (Rickard et al., 2013).

This paper offers an innovative empirical approach in estimating the impact of time-invariant policies by focusing on a subsample of households that moved across regulatory environments. This framework could be extended to also examine changes in shopping behaviors associated with access to a greater variety of products online and to understand whether the convenience provided by e-commerce increases the variety and diversity in purchases of certain product categories. Also, the spatially-adjusted Entropy index developed in this paper could be used in future research to evaluate how purchase diversity of highly differentiated goods is connected to a range of retail store environmental factors such as promotions, layout, music, aisle space, shelf space, and light (Mohan et al., 2012).

From the marketing perspective, as alcohol becomes more available in retail outlets in more states, the diversified purchase patterns may introduce opportunities for firms developing new products to increase customer patronage and sales. While mass-market brands dominate the current marketplace for alcoholic beverage products, expanding retail availability of alcohol may enable small firms to gain market share and encourage the industry to develop new product offerings. In the long run, the greater availability of alcoholic beverages could help foster the long tail effect where a collective of niche products outweighs the share of a few popular and best-selling products (Anderson, 2004). In addition, a more regulated environment may impede consumer learning during their regular shopping routines. Allowing alcohol in grocery stores may also stimulate curiosity and enable consumers to have more time to make a greater variety of choices during their one-stop shopping trips.

Author statement

Shuay-Tsyr Ho: Conceptualization, Methodology, Software, Validation, Formal Analysis, Investigation, Data Curation, Writing – Original Draft, Writing – Review & Editing, Visualization.

Bradley J. Rickard: Conceptualization, Writing – Review & Editing, Project Administration.

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References

Adamowicz, W.L., Swait, J.D., 2013. Are food choices really habitual? Integrating habits, variety-seeking, and compensatory choice in a utility-maximizing framework. Am. J. Agric. Econ. 95 (1), 17–41.

Anderson, C., 2004. The Long Tail. Wired Magazine, pp. 170–177, Available from: https://www.wired.com/2004/10/tail/ (October).

Anderson, S., De Palma, A., Thisse, J., 1992. Discrete Choice Theory of Product Differentiation. MIT Press.

Asimov, E., 2009. Why Not Wine in Grocery Stores? The New York Times, Retrieved from: https://dinersjournal.blogs.nytimes.com/2009/03/25/why-not-wine-in-grocery-stores/ (25.03.09).

Bronnenberg, B., 2015. The provision of convenience and variety by the market? RAND J. Econ. 46 (3), 480–498.

Byrne, P., Nizovtsev, D., 2017. Exploring the effects of state differences in alcohol retail restrictions. Int. Rev. Law Econ. 50, 15L 24.

Food Marketing Institute, 2012. The Economic Impact of Allowing Shoppers to Purchase Wine in Food Stores, Available from: https://www.fmi.org/docs/gr-state/fmi_wine_study.pdf?sfvrsn=2.

Gollop, F., Monahan, J.L., 1991. A generalized index of diversification: trends in US manufacturing? Rev. Econ. Stat. 73 (2), 318–330.

Gronau, R., Hamermesh, D., 2008. The demand for variety: a household production perspective? Rev. Econ. Stat. 90 (3), 562–572.

Jekanowski, M., Binkley, J., 2000. Food purchase diversity across US markets? Agribus. Int. J. 16 (4), 417–433.

Kahn, B., 1995. Consumer variety-seeking among goods and services: an integrative review? J. Retail. Consum. Serv. 2 (3), 139–148.

McAlister, L., Pessemier, E., 1982. Variety seeking behavior: an interdisciplinary review? J. Consum. Res. 9 (3), 311–322.

Messinger, P.R., Narasimhan, C., 1997. A model of retail formats based on consumers' economizing on shopping time. Mark. Sci. 16 (1–23).

Mohan, G., Sivakumaran, B., Sharma, P., 2012. Store environment's impact on variety seeking behavior? J. Retail. Consum. Serv. 19 (4), 419–428.

National Alcohol Beverage Control Association, 2016. Grocery & Convenience Stores As Alcohol Outlets. NABCA, Available from: https://www.nabca.org/sites/default/files/assets/publications/white_papers/GroceryStoresPaper.pdf.

Oppewal, H., Koelemeijer, K., 2005. More choice is better: effects of assortment size and composition on assortment evaluation? Int. J. Res. Mark. 22 (1), 45–60.

Richards, T., Hamilton, S., Yonezawa, K., 2017. Variety and the cost of search in supermarket retailing? Rev. Ind. Organ. 50 (3), 263–285.

Rickard, B.J., Costanigro, M., Garg, T., 2013. Economic and social implications of regulating alcohol availability in grocery stores? Appl. Econ. Perspect. Policy 35 (4), 613–633.

Seim, K., Waldfogel, J., 2013. Public monopoly and economic efficiency: evidence from the Pennsylvania liquor control board's entry decisions? Am. Econ. Rev. 103 (2), 831–862.

Seo, B., 2019. Firm Scope and the Value of One-Stop Shopping in Washington State's Deregulation Liquor Market. Kelley School of Business, http://dx.doi.org/10.2139/ssrn.2863094, Research Paper No. 16–70.

Sharma, P., Sivakumaran, B., Marshall, R., 2010. Exploring impulse buying and variety seeking by retail shoppers: towards a common conceptual framework? J. Mark. Manag. 26 (5–6), 473–494.

Steenkamp, J., Baumgartner, H., 1992. The role of optimum stimulation level in exploratory consumer behavior? J. Consum. Res. 19 (3), 434–448.

Theil, H., Finke, R., 1983. The consumer's demand for diversity? Eur. Econ. Rev. 23 (3), 395–400.

Van Herpen, E., Pieters, R., 2002. The variety of an assortment: an extension to the attribute-based approach? Mark. Sci. 21 (3), 331–341.

Van Trijp, H., Steenkamp, J., 1990. An investigation into the validity of measures for variation in consumption used in economics and marketing? Eur. Rev. Agric. Econ. 17 (1), 19–41.

Van Trijp, H., Steenkamp, J., 1992. Consumers' variety seeking tendency with respect to foods: measurement and managerial implications? Eur. Rev. Agric. Econ. 19 (2), 181–195.

Zimmerman, L., 2016. The Supermarket Effect: How Wine Selection Differs in Open States. Wine Business Monthly, Retrieved from: https://www.winebusiness.com/news/?go=getArticle&dataid=166371 (18.03.16).