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ABSTRACT

This study explores how product variety affects alcohol purchasing in the U.S., using store-level and household scanner data. By analyzing households that relocate to areas with different product availability and controlling for destination-specific consumption patterns, I document a positive relationship between increased product variety and higher alcohol purchases. I complement the household-level evidence with an analysis of two state-specific policy changes, the 2012 Washington liquor deregulation and the 2009 Illinois excise tax increase, to document that policies that raise prices, particularly the Washington liquor deregulation, are also associated with expanded product variety, which may partially offset the intended reduction in consumption. The results have important implications for public health: policymakers should be aware that alcohol market reforms can inadvertently increase product assortment and thereby stimulate consumption, particularly among the heaviest purchasers.

1. Introduction

Excessive alcohol consumption is a leading cause of preventable death in the United States, resulting in more than 140,000 deaths annually (Centers for Disease Control and Prevention, 2022). In addition, it negatively affects labor market outcomes (Böckerman et al., 2017; French et al., 2011) and educational achievements (DeSimone, 2010). The harmful effects of excessive alcohol consumption extend beyond individual health and economic outcomes. Alcohol is a contributing factor in 40% of violent crimes and almost 40% of all traffic fatalities (National Council on Alcoholism and Drug Dependence, NCADD). Prenatal exposure to alcohol can also lead to long-term negative health and economic outcomes for children (Centers for Disease Control and Prevention, 2022a; Nilsson, 2017).

To reduce excessive drinking and its associated harms, policymakers have implemented various strategies such as alcohol taxes, changes in minimum legal drinking ages, restrictions on alcohol outlet densities, and general restrictions on alcohol sales.¹ Although

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¹ For alcohol taxes, see Chaloupka et al. (2002), Cook and Moore (2002), Griffith et al. (2019), Miravete et al. (2018), and Wagenaar et al. (2009). For drinking age policies, see Carpenter and Dobkin (2009) and Wagenaar and Toomey (2002). For outlet density, see Campbell et al.

these approaches have played a critical role in reducing alcohol consumption from its peak in the 1970s to the early 1990s, per capita alcohol consumption has gradually increased since the late 1990s (see Figure 1a). This increased consumption has received recent attention from the public (see for example, [New York Times \(2021\)](#)).² The increase, accounting for almost 15% of the average alcohol consumption since the 1990s in the US, is particularly surprising given that public awareness of the health risks associated with alcohol has increased ([American Institute for Cancer Research, 2019](#)).

Over the same period, the range of alcohol products available to American consumers widened sharply. The number of operating craft distilleries in the United States grew from fewer than one hundred in 2005 to roughly two thousand by 2019 ([American Craft Spirits Association, 2019](#)), part of a broader shift toward niche products and away from a small set of best-selling brands ([Neiman and Vavra, 2023](#)).³ Figs. 1c and 1d show that this proliferation is also visible in retail scanner data, both as a rise in the number of products on offer and as a fall in market concentration.

This article asks whether wider product variety raises the purchase of a good that carries health costs, and answers it in three steps. First, I present correlative evidence using store-level and household-level scanner data to document a robust positive relationship between product variety and purchases. The correlation is stable and independent of geographic, store-level, or household-level variation. Second, by analyzing residence changes of households, I provide evidence that moving to an area with higher product variety increases purchases, even after controlling for average purchasing levels in the new area of residence. I show that the effect is driven by the top 5–10% of purchasers and is broad-based across liquor subcategories, from vodka to tequila to bourbon, suggesting that it is the breadth of the product spectrum, rather than depth within a single subcategory, that matters. Third, I present descriptive evidence from two state-specific policy changes. The Washington liquor deregulation provides a clear illustration of how market reform can expand product variety, while the Illinois excise tax increase offers a more ambiguous case where variety changes are confounded with national trends.

These findings have implications for policymakers. While increased product customization enhances value for individual households by better satisfying their unique preferences, the proliferation of new products is associated with increased consumption, particularly among those already consuming at elevated levels. Policymakers should be aware of this channel when designing alcohol regulation. Real-world examples of variety regulation exist in U.S. state monopoly systems and Nordic government alcohol monopolies, as discussed in [Section 2](#). Coordinating price policies with attention to product assortment may enhance the effectiveness of alcohol regulation, though such coordination involves welfare trade-offs: restricting variety imposes costs on households that value product diversity.

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 on risky behavior. The most closely related research includes analyses on the impact of the Washington liquor deregulation and the impact of excise tax increases. This article is related to that of [Illanes and Moshary \(2020\)](#), who study the Washington liquor deregulation and show that the deregulation increases liquor store outlets and expands product assortment and consumption. [Illanes and Moshary \(2020\)](#) find that relative to the state monopolist, privatization provides wider product variety but at higher prices, and dramatically expands accessibility. The current paper complements their work by investigating the relationship between product variety and consumption beyond the specific quasi-experimental setting of the Washington reform.⁴ Considering excise tax increases, [Gehrsitz et al. \(2021\)](#) and [Saffer et al. \(2024\)](#) use the Illinois tax increase to show a high pass-through to consumer prices and a considerable negative impact on consumption. I extend the result by focusing on the descriptive effect of prices on product variety.

Second, the mover identification strategy relates to the literature on how moving affects behavior and consumption ([Allcott et al., 2019](#); [Bronnenberg et al., 2012](#); [Hinnosaar and Liu, 2022](#); [Hut, 2020](#); [Finkelstein et al., 2016, 2021](#)). Most closely, [Hinnosaar and Liu \(2022\)](#) show that movers adapt to destination-specific alcohol consumption patterns. I identify product variety as one channel behind this adaptation: households that move to areas with greater product variety increase their purchases, even after controlling for local consumption levels.

Finally, the paper relates to the marketing literature on product assortment, which generally finds that greater variety increases purchases and store visits ([Borle et al., 2005](#); [Brynjolfsson et al., 2003](#); [Sweeney et al., 2023](#)). I contribute by studying product variety in a market where consumption carries health risks, connecting the assortment-demand relationship to public health consequences.

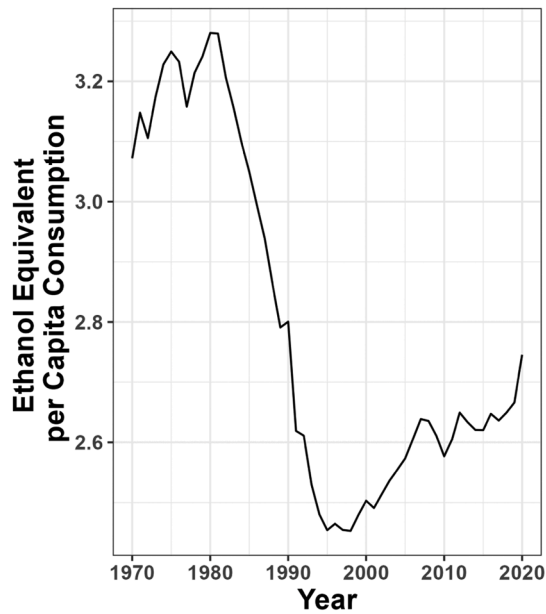
The remainder of the paper is organized as follows. [Section 2](#) provides institutional background on the U.S. alcohol market and the two policy changes. [Section 3](#) describes the data. [Section 4](#) presents correlative evidence at the store and household levels. [Section 5](#) presents the main results using household relocations. [Section 6](#) analyzes the effect of policy changes on product variety. [Section 7](#) concludes. A theoretical framework motivating the empirical analysis is presented in Online Appendix A.

(2009), [Livingston et al. \(2007\)](#), and [Marcus and Siedler \(2015\)](#). For sales restrictions, see [Bernheim et al. \(2016\)](#), [Carpenter and Eisenberg \(2009\)](#), [Chamberlain \(2014\)](#), [Hinnosaar \(2016\)](#), [Kueng and Yakovlev \(2021\)](#), [Norström and Skog \(2005\)](#), and [Seim and Waldfogel \(2013\)](#).

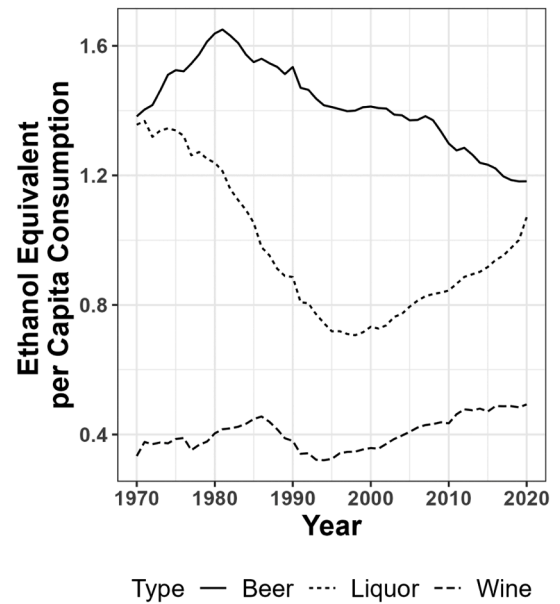
² Experts in the field mention expanded product variety as a specific reason for increased consumption. For example, David Jernigan, professor of health law, policy, and management at the Boston University School of Public Health, stated that “Specific products and product categories were created primarily for females: sweeter, fizzier, and marketed as more ‘feminine’ drinks” ([New York Times, 2021](#)).

³ Within this paper, I follow the general definitions for alcoholic beverages, which include beer, wine, and spirits/liquor ([Slater and Alpert, 2022](#)).

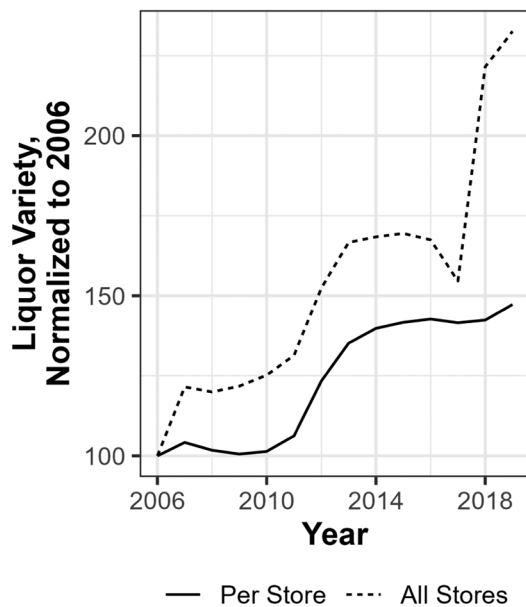
⁴ Further, [Huang et al. \(2022\)](#) evaluate how the deregulation has affected price setting, while [Seo \(2019\)](#) studies the value for consumers and stores due to one-stop shopping. [He \(2022\)](#) estimates the impact of one-stop shopping on consumer behavior. [Aguirregabiria et al. \(2016\)](#) estimate the impact of the deregulation in the Ontario wine retail market. [Yu et al. \(2021\)](#) show that the increased product assortment leads to a decrease in price sensitivity. Lastly, [Conlon and Rao \(2023\)](#) study the impact of post-and-hold regulation.



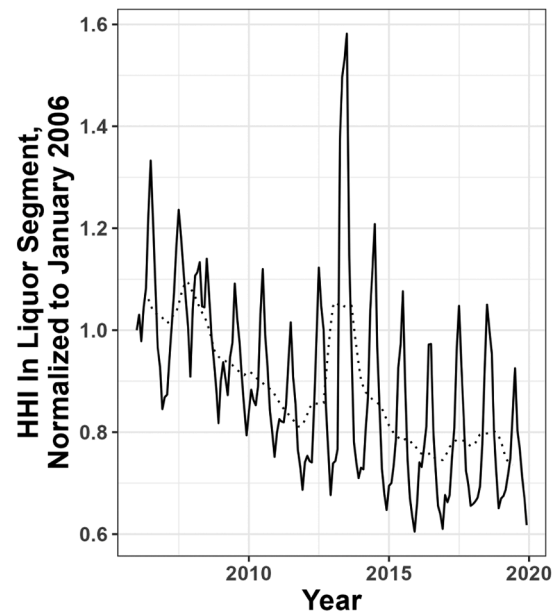
(a) Gallons of Ethanol per Capita



(b) Gallons of Ethanol per Capita by Type



(c) Liquor Variety: Per Store and Total



(d) HHI in the Liquor Market

Fig. 1. Developments in the US alcohol market. Notes: Figure 1a uses data from the National Institute on Alcohol Abuse and Alcoholism (Slater and Alpert, 2022) and reports ethanol consumption in gallons per capita since 1970. Figure 1b differentiates between beer, liquor, and wine. Figure 1c uses the NielsenIQ Retail Scanner data and shows the mean number of distinct liquor products per store among stores present in every year from 2006 to 2019 (a balanced panel of 8032 stores) and the aggregate count across all stores, each normalized to 100 in 2006; the movements in the aggregate series after 2016 reflect changes in the number of stores in the sample, while the balanced panel holds the set of stores fixed. Figure 1d shows the HHI for liquor products, normalized to its 2006 value. The decline reflects falling market concentration as new products enter and erode the share of the best-selling items. I show the HHIs for beer and wine in Online Appendix F.

2. Institutional background

Based on the 21st Amendment to the United States Constitution, each state has the right to individually regulate alcoholic beverages, which includes enacting laws on alcohol sales (Twenty-first amendment, 1933). For example, some states, such as California, permit the sale of beer, wine, and liquor in grocery stores, while others, such as Florida, only allow the sale of beer, wine, and low-alcohol liquor in supermarkets (California Legislative Information, 2021; Florida Department of Business and Professional Regulation, 2021). Meanwhile, in some states, such as Delaware, alcohol can only be purchased in a liquor store (State of Delaware, 2021). Despite the extensive regulation, the alcohol market remains an essential component of the retail industry. The market size for alcoholic beverages was 283.80 billion USD in 2023 and is projected to continue to grow (Statista Research, 2023). This article focuses on two specific regulatory changes at the state level that affect the availability of products in stores.

The variation in state-level regulation creates important differences in the alcohol consumption environment. States with open licensing systems (e.g., California) allow any qualifying retailer to sell all types of alcohol, resulting in widespread availability across grocery stores, convenience stores, and liquor stores, often with extended or 24/7 operating hours. In contrast, monopoly states (e.g., Pennsylvania, Utah) centralize spirits sales through state-run stores that control product listings, store hours, and locations. Between these extremes, many states employ hybrid systems with varying restrictions by alcohol type. These regulatory differences affect not only product variety but also outlet density, accessibility, prices, and store characteristics, all of which may independently influence alcohol consumption. This institutional heterogeneity is important for interpreting the empirical results, as I discuss in Section 5.

2.0.1. Deregulation of liquor licenses in Washington State

Washington State's 2011 reform ended the state monopoly on spirits sales. From June 2012, qualifying private retailers could sell spirits, while beer and wine sales had already been deregulated (Illanes and Moshary, 2020). The law also created a new system for licensing and regulating liquor sales and imposed license fees of 10 percent on distributors' and 17 percent on retailers' spirits revenues. A license also requires a minimum store size of 10,000 square feet (Seo, 2019).

One of the immediate effects of the policy change was a surge in the number of retail outlets selling spirits. Prior to the law going into effect, the state had approximately 330 retail outlets; afterward, the number increased to over 1,500. Most of the new retailers were existing grocery stores that started selling liquor (Seo, 2019; Illanes and Moshary, 2020). In this paper, I focus on the effect on assortment in stores that sold liquor prior to deregulation and the increase in the excise tax.

2.0.2. Excise tax increase in Illinois

In 2009, Illinois almost doubled its excise taxes on spirits, from \$4.50 to \$8.55 per gallon, and wine, from \$0.73 to \$1.39 per gallon, while increasing the beer tax by only about four cents per gallon. The reform reduced spirits and wine sales but increased beer sales, leaving total ethanol consumption nearly unchanged (Gehrsitz et al., 2021).⁵

3. Data

This article draws on NielsenIQ Retail Scanner data as well as the NielsenIQ Consumer Panel. The scanner data include weekly prices and sales of products in more than 90 retail chains accounting for over 35,000 stores nationwide. The data include large grocery and drug stores, as well as smaller liquor and convenience stores. The NielsenIQ Consumer Panel includes household data from 2004 onward for all purchases intended for in-home use in 40,000–60,000 households across the United States. I observe prices, quantities, detailed product categories, and other product information. Purchases are recorded at the household level, and households also report demographic data such as household size, composition, and income. Einav et al. (2010) and Zhen et al. (2019) show that research scanner data are reliable. A more specific concern about scanner data relates to alcohol consumption, as on-premise consumption, such as in bars or restaurants, is not recorded. The NielsenIQ data include a sample of liquor stores but no bars or restaurants.⁶ Industry reports suggest that on-premise consumption is less than 25% of total consumption. Further, Conlon et al. (2022) show that NielsenIQ Retail Scanner data align well with governmental surveys in terms of distribution of household consumption.

For my research, I focus on the years 2006 to 2019.⁷ With the NielsenIQ Retail Scanner data, I first create a monthly store-level data set encompassing three alcohol categories: beer, wine, and liquor. I measure the sales and prices within each category. I measure sales as volume and convert them to ethanol-equivalent liters. Prices are store-month averages of individual product prices, weighted by each product's sales volume.⁸ In addition, I calculate the total quantity of pure alcohol (ethanol) following the literature (see for example Hinnosaar and Liu, 2022), using the following conversions: 0.045 times the 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 at the store-month level for the three categories.

⁵ The tax increase also led to increased cross-border shopping, with Illinois residents traveling to nearby states with lower tax rates to purchase alcohol (Gehrsitz et al., 2021).

⁶ For example, NielsenIQ estimates that half of the liquor sold is due to sales in liquor stores.

⁷ I exclude the first two years of the data, 2004 and 2005, as substantially fewer households are available. Further, I exclude the year 2020 due to strong changes in consumer behavior during the Covid-19 pandemic.

⁸ Variety is measured at annual frequency while sales and prices are monthly. A yearly window gives a more reliable count of available products, since a product can be stocked yet record no sale in a given month. Shelf assortment also changes slowly within the year, so the difference in frequency does not drive the results.

Table 1
Summary statistics.

	Beer	Wine	Liquor
<i>Panel A: Store-Level Data</i>			
Number of Stores	44,340	40,320	41,908
Number of Retailers	225	217	217
Average Purchases	424.73 (531.72)	287.2 (443.54)	455.19 (879.48)
Average Number of Products	198.08 (180.45)	460.69 (535.88)	185.27 (323.75)
Average Prices	9.73 (3.99)	8.31 (3.03)	9.44 (5.31)
<i>Panel B: Household-Level Data</i>			
Number of Households	183,776	183,776	183,776
Number of Households with Purchase	101,913	103,947	97,653
Average Purchase	2 (10.42)	0.78 (4.05)	0.38 (2.81)
Average Purchase cond. on Purchase	15.57 (25.15)	6.03 (9.73)	3.94 (8.3)
Average Purchase of Single Households	1.33 (8.01)	0.65 (3.63)	0.31 (3.32)
Average Costs	4.46 (20.46)	4.98 (23.76)	3.84 (19.4)
Average Costs cond. on Purchase	34.61 (46.99)	37.82 (55.54)	40.35 (49.76)
Average Number of Products Exposed to	327.46 (249.57)	806.34 (729.56)	307.53 (418.52)
<i>Panel C: Moving Households</i>			
Number of Households	11,540	11,540	11,540
Number of Households with Purchase	7909	8357	7926
Average Purchase	2.04 (10.17)	0.91 (4.31)	0.38 (2.2)
Average Purchase cond. on Purchase	15.14 (23.88)	6.23 (9.67)	3.8 (5.91)
Average Purchase Before Move	2.25 (10.89)	0.95 (4.45)	0.4 (2.16)
Average Purchase After Move	1.83 (9.41)	0.88 (4.17)	0.37 (2.24)
Average Costs	4.7 (20.89)	5.85 (25.33)	4.09 (19.73)
Average Costs Before Move	4.97 (21.57)	5.88 (24.91)	4.17 (19.73)
Average Costs After Move	4.44 (20.21)	5.83 (25.73)	4.01 (19.73)
Average Number of Products Exposed to	343.97 (252.02)	862.26 (747)	320.72 (428.45)
Average Number of Products Exposed to, Before	307.72 (222.55)	828.33 (738.39)	292.92 (401.79)
Average Number of Products Exposed to, After	380.52 (273.77)	896.47 (754.05)	348.76 (452.02)

Notes: This table presents basic summary statistics for the three beverage categories: beer, wine, and liquor. Panel A displays monthly store-level statistics, while Panels B and C focus on household monthly data. Panel B includes all households, whereas Panel C is specific to households that have relocated across zip codes. Average purchase quantities are measured in liters, with price and cost variables expressed as cost per liter for each category. Standard deviations are provided in parentheses.

Measuring product variety. I measure product variety at the store level using the number of distinct products (UPCs) with at least one sale in a given year. This measure captures the breadth of the product assortment available to consumers at a particular store. A product is counted as available if it was sold at least once during the year, which provides a conservative measure of shelf availability.⁹

⁹ An alternative specification would be to identify 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, measurement may contain a bias if some products are still in the assortment but have not been sold.

Table 2
Summary statistics by period (Balanced Panels).

	2006–2009	2010–2013	2014–2019
<i>Panel A: Mean Store-Level Sales (ethanol liters/store-year)</i>			
Beer	6208	5685	5576
Wine	3381	3527	3890
Liquor	5145	5355	6545
Total	14,734	14,566	16,011
<i>Panel B: Mean Store-Level Number of Distinct Products (store-year)</i>			
Beer	181	201	244
Wine	560	517	536
Liquor	194	200	233
<i>Panel C: Mean Household Purchases (ethanol liters/HH-month)</i>			
Beer	2.43	2.21	1.88
Wine	0.95	0.94	0.89
Liquor	0.36	0.40	0.41
<i>Panel D: Mean Household Product Exposure (distinct UPCs at visited stores)</i>			
Beer	250	298	398
Wine	778	782	863
Liquor	255	290	375
Stores	17,971		
Households	36,736		

Notes: Means by time period for balanced panels. Panels A–B: 17,971 stores present in all three periods. Panels C–D: 36,736 households present in all three periods. Sales and purchases are converted to ethanol-equivalent liters using standard factors: beer $\times$ 0.045, wine $\times$ 0.12, liquor $\times$ 0.4. Total (Panel A) is the sum of ethanol-equivalent beer, wine, and liquor sales. Product exposure (Panel D) is the number of distinct UPCs available at the stores a household visits, where each store's count is measured over the year (Section 3). Balanced panels ensure that trends reflect within-unit changes rather than entry or exit of stores or households.

I acknowledge that this measure is based on observed transactions rather than direct observation of shelf space. To the extent that products are stocked but never sold during a year, the measure may undercount variety. Conversely, products that sell once and are then delisted would be counted as available. The yearly aggregation provides a considerably better proxy for shelf availability than shorter measurement windows. In the household-level analysis, I define product exposure as the number of distinct products available at the stores a household visits, rather than the number of products the household itself purchases. This distinction helps separate the supply of variety from the household's own demand for variety. Table 1, Panel A shows the number of available products in the different categories across stores.

I then consider the NielsenIQ panel data and create a monthly panel of households, their purchases and expenditures in each alcohol category, and their exposure to products. In Table 1, Panel B, I show summary statistics. When evaluating the purchasing behavior of households, I define the exposure to an alcohol category as the maximum number of distinct products available at any store a household visits within a month. This count is taken regardless of whether the household purchases those products. When a household visits multiple stores, it captures the richest assortment the household had access to. In Section 5, I further construct a supply-side measure based on all stores within a three-digit zip code, which is independent of the household's store choice. Throughout this article, I consider all households, controlling for household size as well as the presence of children.

Finally, I use moving households (i.e., households that relocate) as part of my identification strategy. I identify moving households based on a change in their residential zip code; zip codes are recorded in the NielsenIQ Consumer Panel on a yearly basis. As robustness checks, I also consider changes at 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 moving households only.

Table 2 reports summary statistics by time period for balanced panels of stores and households that appear in all three subperiods (2006–2009, 2010–2013, and 2014–2019), ensuring that trends reflect within-unit changes rather than sample composition. At the store level (Panels A–B), product variety increases for beer (+35%) and liquor (+20%), while total ethanol sales per store increase by 9%, driven by growth in wine (+15%) and liquor (+27%) sales. At the household level (Panels C–D), exposure to product variety increases substantially across all three categories, with liquor exposure rising from 255 to 375 distinct products (+47%). Household liquor purchases increase by 14%, while beer purchases decline, consistent with the well-documented national shift away from beer toward spirits (Fig. 1b). These trends are consistent with the national patterns documented in Fig. 1c and motivate the within-

household identification strategy in Section 5, which is designed to absorb aggregate confounders such as changing preferences and demographics.

Fig. 1c makes this point directly for liquor. Among the stores present in every year, the mean number of liquor products per store rises by 47% from 2006 to 2019, endpoint to endpoint; comparing subperiod averages, as in Table 2, compresses the same growth to 20%. The aggregate count across all stores rises by more than twice as much. The aggregate series therefore overstates the assortment growth that a typical store offers, because part of it reflects the entry of new stores rather than wider shelves in existing ones. The store fixed effects in Eq. (1) isolate this within-store growth.

4. The relation of product variety and volume

I expect more product offerings to be associated with higher consumption. This impact may be observed on two fronts: the internal margin, where existing consumers increase their consumption, and the external margin, where previously inactive consumers become active (the extensive margin). I begin with aggregate store-level data and then turn to household-level data.

4.1. Store-level analysis

Consider a store s in year t selling a set of products with health costs, where sales of pure liters of alcohol are y_{st} . Such products can be categorized as beer, wine, or liquor. In all three categories, the assortment increases 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 Num_{st} products of spirits, resulting in y_{st} ethanol-equivalent liters of liquor, wine, or beer purchases. I run the following regressions for each US state between 2006 and 2018:

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

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

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

In Figs. 2 and 3, I show the estimates of $\hat{\beta}$ for each state-specific regression. Fig. 2a shows the effect on liquor variety, and Fig. 2b shows the effect on the purchases of liquor. In Fig. 3, 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, between 0% and 10% more products become available each year between 2006 and 2018. Second, purchases have also increased in most states. However, the increase in purchases at the store level is, on average, slightly lower than the increase in the assortment. Fig. 3 indicates a correlation between the effect of increased variety and purchases, with stronger increases for both in the Midwestern United States. These maps are descriptive. Because product variety and sales are related outcomes, their geographic co-movement motivates the analysis rather than identifying a causal link. The household relocation design in Section 5 supplies the identifying variation.

Note the clear outlier with the coefficients of Washington state. The variety of liquor increases by 30% per year at the store level, while the purchases of ethanol-equivalent liquor have increased by more than 20%. The effect may be explained by the liberalization of the liquor market in 2012. Two effects play a role. First, the data include retailers that obtained a license in 2012 or after; therefore, their sales and product assortment jumped suddenly. Second, following Illanes and Moshary (2020), I find that even retailers with liquor licenses before 2012 have increased their assortment, and consumers have increased their consumption. In Section 6, I show additional evidence by solely considering retailers who already sold liquor before the liberalization.

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

$$\log(y_{st}) = \alpha + \beta \log(Num_{st}) + \rho_s + \mu_t + \varepsilon_{st}, \quad (3)$$

where y_{st} is the purchases of beer, wine, or liquor in ethanol-equivalent liters in store s in month t . Num_{st} is the number of products within a store's alcohol subcategory, while ρ_s and μ_t are store and month fixed effects, respectively. The coefficient $\hat{\beta}$ is an elasticity that measures the percentage change in sales in response to a 1% change in products. In Table 3, I show the results of the regression.

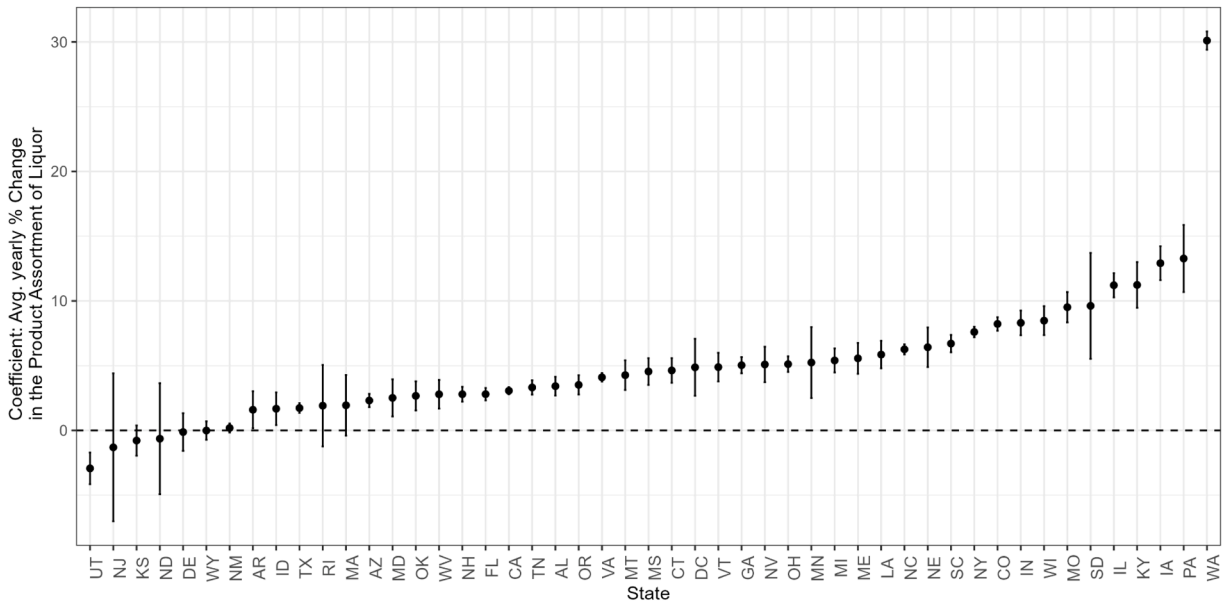
The baseline estimation, which relates sales to the number of products available, documents a clear positive association. With store and time fixed effects and price controls, the elasticities are 1.06 for beer, 0.67 for wine, and 0.25 for liquor (columns 3, 6, and 9).

4.2. Household-level analysis

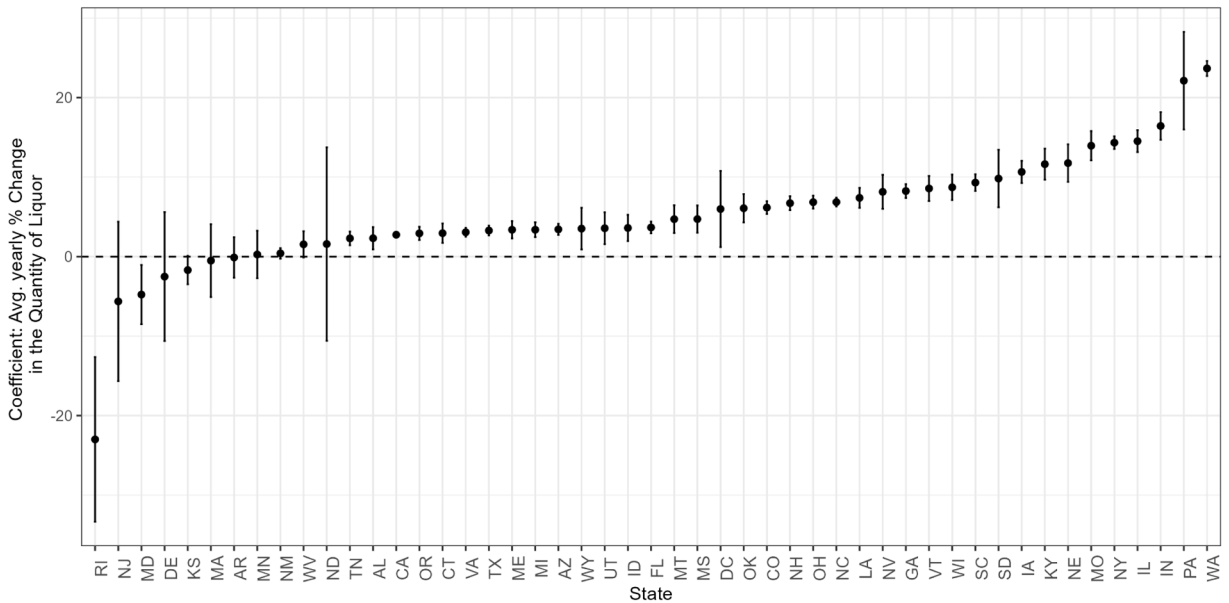
I now move to the household-level analysis, beginning with the correlation between the variety of products a household is exposed to and the household's consumption. Consider household i located in county c purchasing y_{it} liters of pure alcohol (ethanol) within a category (beer, wine, or liquor) in month t . Within the following model, the correlation between purchases and the number of products a household is exposed to within a month is estimated as follows:

$$\log(y_{it}) = \alpha + \beta \log(Exposure_{it}) + \xi_i + \rho_{ct} + \phi_{ic} + \delta \mathbf{X}_{it} + \varepsilon_{it}, \quad (4)$$

where $Exposure_{it}$ is the number of distinct products available at stores visited by household i within a month, and ξ_i and ρ_{ct} are household and month-county specific fixed effects, respectively. In part of the regression models, I use household-county instead of



(a) Effect on Product Variety across States

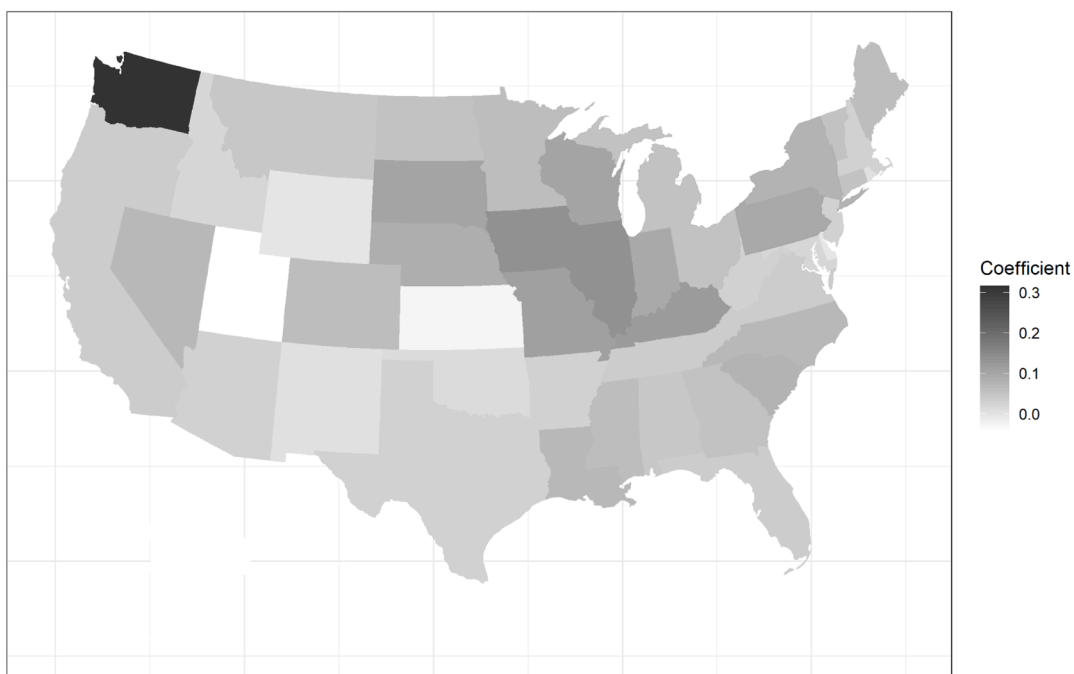


(b) Effect on Quantity across States

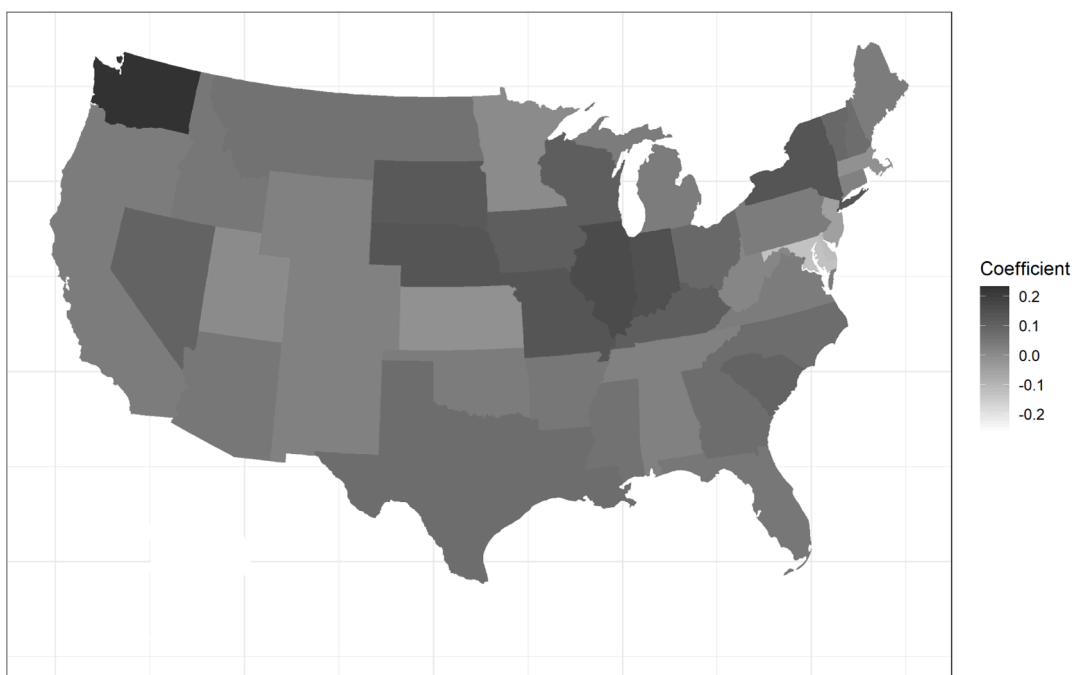
Fig. 2. Regression evidence: geographic variation in assortment and sales of Liquor. *Notes:* Results of regression Eqs. (1) and (2). Each regression is at the state level and shows the coefficient of an additional year on product variety and quantity sold. Store-level fixed effects are included. 95% confidence intervals shown, with standard errors clustered at the store level.

household fixed effects ϕ_{ic} to control for effects caused by changing residency. Further, I include household time-varying controls, such as household size or composition, in X_{it} . Thus, β measures the association between product availability and purchases. Given the log-log specification, a 1% change in exposure to products within a certain category is associated with a $\hat{\beta}$ percent change in purchases of that category. As an additional outcome variable, I consider the external margin and create an indicator variable, $I(y_{it})$, that takes the value of one if the purchases in one alcohol category are positive.

I present the findings of the household-level regression in Table 4. Panel A displays results for the beer category, while Panels B and C show the results for the wine and liquor categories, respectively. The outcomes remain consistent across all specifications.



(a) Effect on Product Variety across States



(b) Effect on Quantity across States

Fig. 3. Regression evidence in Heatmap: geographic variation in assortment and sales of Liquor. Notes: Heatmap of the results of regression Eqs. (1) and (2). Standard errors clustered at the store level.

Table 3
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*** (0.00)	1.07*** (0.01)	1.06*** (0.01)	1.23*** (0.00)	0.66*** (0.01)	0.67*** (0.01)	1.24*** (0.00)	0.28*** (0.01)	0.25*** (0.01)
Constant	−1.92*** (0.02)			−2.25*** (0.02)			−0.52*** (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 Eq. (3). One observation corresponds to a store within a month. The outcome variable is the logarithm of sales in liters of pure alcohol (ethanol) in three categories. In the first three models, I consider beer sales; in the second three models, the sales of wine; and the final three models show results for sales of liquor. To avoid zero sales, I transform the outcome variable to add 0.1 liters to each outcome. $\log(N + 0.1)$ is the number of beer, wine, or liquor products in a store. The number varies across years. Given the log-log specification, a 1% change in the number of available products leads to a $\hat{\beta}$ percent increase in 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.

An increase in exposure to products during shopping occasions significantly increases purchases. The effect size is smaller than in the aggregate regression of Eq. (3), with a 1% increase in product exposure raising beer purchases by 0.025%, wine purchases by 0.042%, and liquor purchases by 0.048% on average. The reduced effect size relative to the store level can be partly attributed to a considerable proportion of households abstaining from purchasing any alcoholic beverages, regardless of product availability. Further, the store-level coefficients aggregate across all consumer preferences and may reflect selection: variety-seeking households may be more likely to visit stores with larger assortments.

Nevertheless, a significant positive impact of product exposure is observed on the external margin. Specifically, a 1% increase in product exposure heightens the probability of purchasing any beer product by 0.006 percentage points. This outcome remains consistent for wine products, although liquor products' external margin is slightly lower.

Cross-category substitution. A natural concern is whether increased variety in one alcohol category (e.g., liquor) merely substitutes for purchases in another (e.g., beer or wine), rather than increasing total consumption. I directly test for cross-category substitution by regressing purchases of each category on the variety of the *other* categories with household and year fixed effects (full results in Online Appendix B, Table B.1). None of the six cross-category coefficients is negative. In fact, all are positive and highly significant: for example, a 1% increase in liquor variety is associated with a 0.27% increase in beer purchases and a 0.25% increase in wine purchases. When all three variety measures are included simultaneously, own-category variety carries the largest coefficient for wine and liquor, and cross-category variety remains positive throughout.¹⁰ These results provide evidence against the substitution hypothesis: variety expansion increases total alcohol consumption rather than reshuffling it across categories.

Interpreting aggregation levels. The analysis proceeds from store-level correlations to household-level regressions with household fixed effects, and then to a mover-based identification strategy. Each level removes specific sources of bias, and the pattern of coefficients is informative about the nature of the variety–consumption relationship.

The store-level elasticities (Table 3) document the aggregate relationship but are subject to two biases that inflate the coefficient: (i) simultaneity: stores in high-demand areas carry more products, and (ii) selection: variety-seeking households sort into high-variety stores. Both biases predict a positive correlation between variety and consumption even absent a causal effect.

The household-level regressions (Table 4) absorb time-invariant household heterogeneity through household fixed effects, eliminating the selection channel. The coefficients fall by an order of magnitude (to approximately 0.025–0.048), consistent with a large share of the store-level association reflecting cross-household sorting rather than a causal effect. However, time-varying confounders remain: changes in income, store availability, or lifestyle may simultaneously affect both product exposure and purchasing behavior.

5. Household relocations and product variety

To move beyond the correlations documented in the previous section, I exploit variation in product exposure arising from household relocations.

¹⁰ The mover IV falsification tests (Online Appendix D, Table D.1, columns 3–4) provide complementary evidence: the liquor-variety instrument does not significantly predict beer purchases, while the wine coefficient is positive and marginal. Beer and wine variety co-move with liquor variety across areas, so the cross-category columns are conservative; the sharper tests are the non-alcoholic categories in Online Appendix D, which show no effect.

Table 4

Regression evidence for product exposure on alcohol purchases at the household level, beer, wine, and liquor.

<i>Panel A: Beer</i>					
	log(Beer)				I(Beer > 0)
	(1)	(2)	(3)	(4)	(5)
$\log(\text{Exposure} + 0.5)$	0.066*** (0.002)	0.028*** (0.001)	0.027*** (0.001)	0.025*** (0.001)	0.006*** (0.000)
Constant	-1.987*** (0.008)				
Household FE	No	Yes	Yes	No	No
Year-Month FE	No	Yes	No	Yes	Yes
County $\times$ Year-Month FE	No	No	Yes	No	No
Household $\times$ County FE	No	No	No	Yes	Yes
Household Controls	No	No	No	Yes	Yes
<i>N</i>	6,878,525	6,878,525	6,878,525	6,419,004	6,419,004
<i>R</i> ²	0.004	0.523	0.527	0.530	0.445
<i>Panel B: Wine</i>					
	log(Wine)				I(Wine > 0)
	(1)	(2)	(3)	(4)	(5)
$\log(\text{Exposure} + 0.5)$	0.099*** (0.002)	0.051*** (0.002)	0.050*** (0.002)	0.042*** (0.001)	0.006*** (0.000)
Constant	-1.987*** (0.008)				
Household FE	No	Yes	Yes	No	No
Year-Month FE	No	Yes	No	Yes	Yes
County $\times$ Year-Month FE	No	No	Yes	No	No
Household $\times$ County FE	No	No	No	Yes	Yes
Household Controls	No	No	No	Yes	Yes
<i>N</i>	6,878,525	6,878,525	6,878,525	6,419,004	6,419,004
<i>R</i> ²	0.010	0.469	0.473	0.478	0.424
<i>Panel C: Liquor</i>					
	log(Liquor)				I(Liquor > 0)
	(1)	(2)	(3)	(4)	(5)
$\log(\text{Exposure} + 0.5)$	0.103*** (0.003)	0.052*** (0.002)	0.050*** (0.002)	0.048*** (0.002)	0.005*** (0.000)
Constant	-1.987*** (0.008)				
Household FE	No	Yes	Yes	No	No
Year-Month FE	No	Yes	No	Yes	Yes
County $\times$ Year-Month FE	No	No	Yes	No	No
Household $\times$ County FE	No	No	No	Yes	Yes
Household Controls	No	No	No	Yes	Yes
<i>N</i>	6,878,525	6,878,525	6,878,525	6,419,004	6,419,004
<i>R</i> ²	0.005	0.388	0.392	0.391	0.365

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

Notes: This table presents regression results for Eq. (4), with each observation representing a household within a month. The outcome variable is the logarithm of household purchases in three categories: beer (Panel A), wine (Panel B), and liquor (Panel C). In the last model, the outcome is an indicator variable equal to one if a household purchases any beer, wine, or liquor product in a given month. To avoid zero sales, the outcome variable is transformed by adding half the minimum value of the sample beer, wine, and liquor purchases across observations with nonzero purchases; that is, $\log(\text{Beer} + 0.1035072)$, $\log(\text{Wine} + 0.0015)$, and $\log(\text{Liquor} + 0.000083)$. $\log(\text{Exposure} + 0.5)$ represents the maximum number of distinct products available at any store the household visits within a month (Section 3). In the log-log specification, a 1% change in the number of products leads to a β percent increase in purchases. Household FE, Year-Month FE, County $\times$ Year-Month FE, and Household $\times$ County FE indicate the inclusion of household, month, county-month, or household-county fixed effects. Household Controls signifies if the model accounts for time-varying household characteristics such as income (income brackets), household size, composition (relation between household members), occupation of female and male household heads, employment status, education and age, marital status within a household, presence and age of children, and race. Standard errors are clustered at the household level, adjusted for within-cluster correlation, and reported in parentheses.

5.1. Identification strategy

I use moving households, those that change their residential zip code, to analyze the effect of product variety on consumption. The key idea is that when a household relocates, it is exposed to a different set of products in its new area. I use this change in exposure as a source of variation to identify the effect of product variety on purchases.

A central concern with this approach is that moving households face many changes simultaneously: different prices, different store types and hours, different regulatory environments, different social norms, and potentially different outlet densities. Product variety itself is a function of these factors; for example, states with open licensing may have both more variety and more accessible alcohol sales. Following [Hinnosaar and Liu \(2022\)](#), I control for average consumption of the category in the destination zip code ($\bar{y}_{zt}$), which absorbs destination-specific factors that affect consumption levels. This control is essential: it ensures that the estimated effect of product variety is not driven by households simply adapting to local consumption norms at their new location.

I further address identification concerns in several ways. First, I include rich household-level controls ($\mathbf{X}_{it}$) that capture changes in household characteristics around the time of the move, such as changes in income, employment, and household composition. Second, I present robustness results restricting the sample to within-state movers, who face the same regulatory environment, tax rates, and alcohol sales laws before and after the move. Third, I construct a supply-side variety measure, the average number of distinct products across all stores within a three-digit zip code, that is independent of the household's endogenous store choice. Fourth, I add environmental controls for outlet density, average prices, and state monopoly status. Fifth, I show results using alternative definitions of relocation (county-level and state-level changes) and allowing for multiple moves.

I acknowledge that this identification strategy cannot fully resolve the endogeneity of product variety. Moving households experience many simultaneous changes, and the destination average consumption control, while absorbing the main destination effect, relies on functional form assumptions. The results should therefore be interpreted as stronger than simple correlations, exploiting within-household variation from relocations and robust to supply-side measurement and environmental controls, but short of a clean experiment.

I consider a model where household i , residing in zip code area z , purchases y_{it} liters from a category (beer, wine, or liquor) in month t :

$$\log(y_{it}) = \alpha + \beta \log(\text{Exposure}_{it}) + \xi_i + \rho_t + \delta \mathbf{X}_{it} + \mu \bar{y}_{zt} + \epsilon_{it}, \quad (5)$$

where Exposure_{it} is the maximum number of distinct products available at any store visited by household i within a month, capturing the store's assortment, not the number of products the household itself purchases (as defined in [Section 3](#)). In addition to household fixed effects (ξ_i), month fixed effects (ρ_t), and household varying control variables ($\mathbf{X}_{it}$), I control for average consumption of the category in a zip code ($\bar{y}_{zt}$). I use the change in exposure of products for movers from before to after a move as an instrument. Z_{it} is the difference between Exposure_{it} and the average exposure in the year before the move. Thus, Z_{it} is positive if a household is exposed to more products. Note that Z_{it} is only non-zero for moving households *after* a move.

5.2. Descriptive evidence

[Fig. 4](#) shows descriptive evidence on the relationship between changes in product exposure and changes in liquor purchases for moving households. I consider ventiles ordered by the average difference in product exposure. I then show average changes in product purchases for each ventile. The results show a positive relationship: exposure to more products after the move correlates with higher purchases.

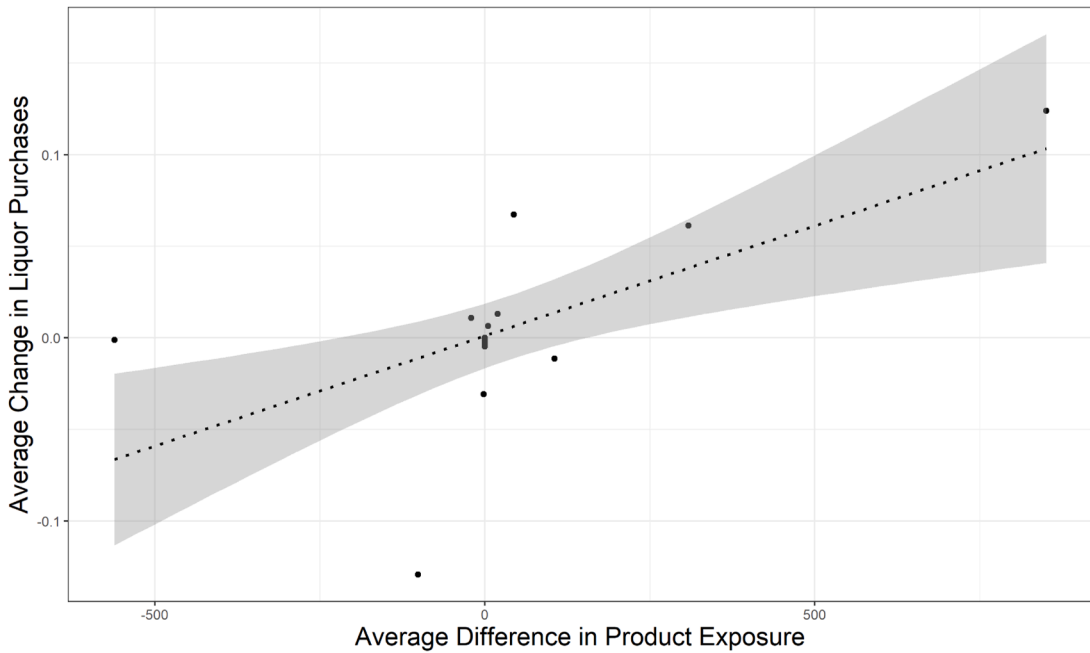
5.3. Main results

I show results for liquor consumption in [Table 5](#).¹¹ The IV estimates consistently exceed the OLS estimates, a pattern that warrants careful discussion. If the treatment effect were homogeneous and simultaneity bias were the only concern, one would expect a larger OLS than IV coefficient. Two mechanisms can account for the observed pattern. First, under heterogeneous treatment effects, the mover instrument recovers a weighted average of responses for households whose variety exposure changes upon relocating. Since these households are exposed to substantially different product environments, with more than half of purchases among the most affected movers, in the later post-move years, accounted for by previously unavailable products ([Figure 5](#)), their response to variety may plausibly exceed the population average. This makes $\text{IV} > \text{OLS}$ possible, though heterogeneity alone does not guarantee this ordering ([Imbens and Angrist, 1994](#)). Second, measurement error, the other natural candidate, plays at most a small role: the area-level variety measure is highly persistent, with a reliability ratio of approximately 0.9, so attenuation of the OLS estimate can account for only a small part of the gap.¹² The gap therefore mainly reflects the stronger response of movers who experience large changes in their product environment.

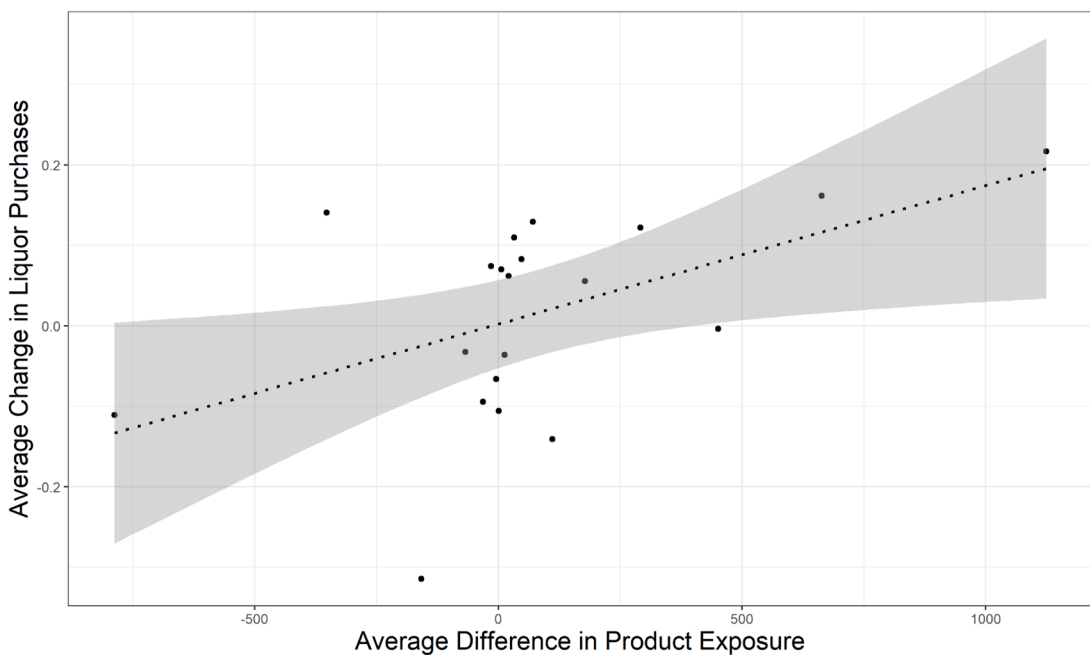
The data show a gradient across specifications: the within-state IV (0.034, [Table 6](#), column 6), the full-sample IV (0.049, column 2), and the household-visit IV (0.078, [Table 5](#)) increase with the magnitude of the variety shock experienced by compliers. This pattern

¹¹ Results for the beer and wine segments are displayed in Online Appendix C.

¹² Measured as the year-to-year correlation of the area-level variety measure within three-digit zip codes (0.90). Correcting the area-level OLS estimate of 0.015 for attenuation at this reliability raises it only to about 0.017.



(a) Including Households Without Change in Product Exposure



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

Fig. 4. Change in Liquor consumption by difference in product exposure due to a household move. *Notes:* Average changes in liquor purchases (ethanol-equivalent liters) from before to after a move, as a function of the change in product exposure. Exposure is the maximum number of distinct products available at any store visited by a household within a month. Average differences are grouped into ventiles. OLS line and 95% confidence intervals are shown.

is consistent with heterogeneous effects, though these estimates come from different samples and measures, so the ordering does not constitute a formal test.

For the full sample and all controls in model (6), a 1% increase in liquor product exposure due to moving increases liquor purchases by 0.08%. The external margin also increases: with each 1% increase in exposure, the probability of purchasing a liquor product goes up by 0.01 percentage points.

Table 5

Regression evidence for movers, liquor purchases.

	log(Liquor) Full Sample						Only movers		I(Liquor > 0) 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*** (0.003)	0.181*** (0.026)	0.050*** (0.002)	0.095*** (0.013)	0.045*** (0.002)	0.078*** (0.013)	0.049*** (0.005)	0.071*** (0.012)	0.005*** (0.000)	0.008*** (0.001)
Constant	-8.752*** (0.011)	-9.088*** (0.110)								
Household FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin/Destination Controls	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Household Controls	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
N	6,471,996	6,471,996	6,471,996	6,471,996	6,047,883	6,047,883	597,584	597,584	6,047,883	6,047,883
R ²	0.005	0.002	0.391	0.391	0.413	0.413	0.396	0.396	0.381	0.381
F-Statistic First Stage		72,169		227,147		204,534		204,041		204,534

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

Notes: This table presents regression results for Eq. (5), with each observation representing a household within a month. The outcome variable is the logarithm of sales for liquor products and an indicator variable equal to one if a household purchases any liquor in a given month. The models alternate between OLS and instrumental variable regression. The instrument takes the value of the change in the exposure of products for moving households after the move in comparison with the average of the year before the move. Exposure is the maximum number of distinct products available at any store the household visits within a month (Section 3). Note that the instrument is zero for non-moving households and moving households before the move. Models 1–6, 9, and 10 include the full sample, while models 7 and 8 only include households that moved during the sample period. To avoid zero sales, the outcome variable is transformed by adding half the minimum value of the sample liquor purchases across observations with nonzero purchases; that is, $\log(\text{Liquor} + 0.000083)$. $\log(\text{Exposure} + 0.5)$ represents the number of liquor products a household is exposed to in a month. In the log-log specification, a 1% change in the number of products leads to a $\hat{\beta}$ percent increase in liquor purchases. Household FE and Year-Month FE indicate the inclusion of household and year-month fixed effects. Origin/Destination Controls signifies if the model includes the zip code-specific average purchases of liters of liquor. Household Controls shows if the model accounts for time-varying household characteristics such as income (income brackets), household size, composition (relation between household members), occupation of female and male household heads, employment status, education and age, marital status within a household, presence and age of children, and race. F-Statistics First Stage refers to the F-statistics of the first stage in the instrumental variable approach, where the instrument consistently has a significant positive coefficient. Standard errors are clustered at the household level, adjusted for within-cluster correlation, and reported in parentheses.

5.3.1. Supply-side variety measure

A concern with the baseline measure of product exposure is that it is based on the products available at stores the household chooses to visit, rather than the total supply of products in the household's geographic area. To address this, I construct a supply-side variety measure, $Variety_{zt}$: the average number of distinct products across all stores within a household's three-digit zip code z in year t , regardless of which stores the household visits. This measure captures the local supply of variety and is not conditional on the household's store choice. I re-estimate Eq. (5) replacing $Exposure_{it}$ with $Variety_{zt}$, using the same instrument (change at the time of the move).

Table 6 presents results using this area-level measure, with paired OLS and IV estimates for each specification. The OLS estimate (column 1) is 0.015, smaller than the household-visit OLS in Table 5 (0.045), consistent with the area-level measure being less precisely targeted. The IV estimate (column 2) is 0.049 and statistically significant, suggesting that the effect is not driven by the household's endogenous store choice. As noted above, measurement error explains little of this gap; the IV captures the response of movers experiencing meaningful variety changes. The true population average effect is uncertain, but the consistency of positive estimates across both OLS and IV specifications is reassuring.

Adding environmental controls for the number of alcohol outlets, average liquor prices, and state monopoly status does not change the estimate (columns 3–4: OLS 0.015, IV 0.048).¹³ When restricting the sample to households that never changed state during the panel period, so that all movers face the same regulatory environment, tax rates, and alcohol sales laws before and after the move, both the OLS and IV coefficients remain positive (OLS: 0.012, IV: 0.034). The within-state IV point estimate is 69% of the full-sample IV, consistent in sign and economically meaningful, but is not statistically significant (column 6). A formal power calculation shows that this subsample has only 33% power to detect the full-sample effect ($\beta = 0.049$) at the 5% level, and the minimum detectable effect at

¹³ Since household fixed effects absorb all time-invariant state-level characteristics, including monopoly status, Sunday sales laws, and grocery store alcohol permissions, the identifying variation comes only from changes movers experience at the time of relocation. The within-state mover specification (columns 5–6) holds the regulatory environment fixed but has limited statistical power; the controls for the move-induced change in the local supply environment in Section 5.3.2 provide a better-powered test of the same concern.

Table 6

Supply-side variety measure: mover regressions, liquor.

	log(Liquor)						I(Liquor>0)			
	Baseline		+ Env. Controls		Within State		+ Retailer FE		Ext. Margin	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
log(Variety)	0.015*** (0.003)	0.049** (0.021)	0.015*** (0.003)	0.048** (0.021)	0.012*** (0.003)	0.034 (0.032)	0.014*** (0.003)	0.048** (0.022)	0.002*** (0.000)	0.005** (0.002)
Destination avg. consumption	0.394*** (0.023)	0.394*** (0.023)	0.394*** (0.023)	0.394*** (0.023)	0.400*** (0.022)	0.400*** (0.022)	0.394*** (0.023)	0.394*** (0.023)	0.034*** (0.002)	0.034*** (0.002)
Zip3 Controls	No	No	Yes	Yes	No	No	No	No	No	No
Retailer FE	No	No	No	No	No	No	Yes	Yes	No	No
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4,850,962	4,850,962	4,836,389	4,836,389	4,704,681	4,704,681	4,850,958	4,850,958	4,850,962	4,850,962
R ²	0.383	0.383	0.383	0.383	0.384	0.384	0.383	0.383	0.352	0.352
F-Statistic First Stage		179,517		176,824		96,631		176,036		179,517

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

Notes: This table presents OLS and IV mover regressions for liquor purchases using the supply-side variety measure: the average number of distinct products across all stores within a household's three-digit zip code (Eq. (5)). The instrument is the change in variety at the time of the move relative to the pre-move average. Columns (3)–(4) add Zip3 Controls: the number of alcohol-selling stores, average liquor prices, and a state monopoly indicator. Columns (5)–(6) restrict the sample to households that never changed state during the panel period, ensuring that movers face the same regulatory environment, tax rates, and alcohol sales laws before and after the move; this restriction reduces both the number of identifying movers and the total sample. Columns (7)–(8) add retailer fixed effects, absorbing all time-invariant characteristics of the retail chain, including pricing strategies, store format, and clientele composition. Columns (9)–(10) use an indicator for any liquor purchase as the dependent variable (extensive margin). To avoid the logarithm of zero, the dependent variable is transformed as $\log(\text{Liquor} + 0.000083)$ and the variety measure as $\log(\text{Variety} + 0.5)$. Household Controls include income, household size, composition, occupation, employment, marital status, presence of children, and type of residence. F-Statistic First Stage refers to the first-stage F-statistic. Standard errors are clustered at the household level and reported in parentheses.

80% power is 0.090, nearly twice the full-sample estimate.¹⁴ The within-state subsample therefore lacks the power to distinguish the full-sample effect from zero; its confidence interval contains both. The within-state OLS (0.012, column 5) remains highly significant, suggesting that even within the same regulatory environment, areas with more product variety have higher liquor purchases. As a further check, columns (7)–(8) add retailer fixed effects, which absorb all time-invariant characteristics of the retail chain, including pricing strategies, store format, and clientele composition. The IV estimate is unchanged (0.048, column 8), suggesting that the variety effect operates through the breadth of products available in the area rather than through the characteristics of particular retailers. Finally, the area-level measure also shows a significant effect on the external margin: a 1% increase in zip-level variety increases the probability of purchasing any liquor by 0.005 percentage points (columns 9–10).

A battery of falsification tests, reported in Online Appendix D, further supports the mover IV. A placebo test replacing the outcome with non-alcohol spending yields a null coefficient (0.003, insignificant), while the actual liquor outcome remains significant (0.048, Appendix Table D.1). A balancing test shows that movers to higher-variety areas are not systematically different in pre-move income, household size, liquor consumption, or total spending (Table D.2). Movers to higher-variety areas show a significantly larger response (0.124) than movers to lower-variety areas (0.035, insignificant), consistent with habit formation or discovery effects (Table D.3). A non-mover placebo using fake “move dates” produces a null coefficient (Table D.3, column 4). There is a monotonic dose-response pattern across terciles of the variety change (Table D.4), no differential pre-trends in an event study around the move date (Table D.5), and dummyTXdummy-(the point estimate ranges from 0.031 to 0.056 when dropping each state in turn (Table D.6).

5.3.2. Robustness to the relocation bundle

A relocation changes many things at once. A household that moves to a higher-variety area may also face a higher outlet density, different store formats, different prices, and a different regulatory environment. If these changes raise consumption and move together with product variety, the mover estimate would overstate the role of variety. I address this concern directly: I control for the change in each of these dimensions at the time of the move, and I hold the retail chain fixed.

Table 7 adds these controls block by block. Controlling for the full local supply and accessibility environment (outlet density, the number of retailers and parent chains, the store-format mix, the liquor-store share, and prices), the estimate is 0.062 and significant

¹⁴ With $SE = 0.032$ and a true effect of $\beta = 0.049$, the expected t -statistic is $0.049/0.032 = 1.53$, below the critical value of 1.96. Power = $\Pr(|t| > 1.96 \mid t_{\text{exp}} = 1.53) \approx 0.33$. At 80% power, the minimum detectable effect is $(1.96 + 0.84) \times 0.032 = 0.090$.

Table 7

The mover IV, the relocation bundle, and the regulatory regime.

	Variety coef.	95% CI	First-stage <i>F</i>
(1) Baseline supply-side IV	0.049	[0.007, 0.091]	179,517
(2) + full supply, density, accessibility	0.062	[0.020, 0.104]	179,729
(3) + excise tax and Sunday sales	0.057	[0.015, 0.100]	174,851
(4) + permission-change indicator	0.053	[0.011, 0.094]	180,838
(5) + bundle, tax, Sunday, and indicator jointly	0.061	[0.018, 0.103]	175,669

Notes: Two-stage least squares estimates of the effect of log area-level liquor variety on log liquor purchases, instrumented by the move-induced change in area variety. All specifications include household and month fixed effects, household demographic controls, and destination average consumption. Each row adds controls for the change a household experiences at the move. Row 2 adds to the baseline in row 1 the full local supply and accessibility environment (outlet density, the number of retailers and parent chains, the store-format mix, the liquor-store share, and prices); row 3 adds, in addition, the excise tax and Sunday sales; row 4 adds to the baseline an indicator for whether the move changed control-state status or a grocery permission for spirits or wine, which itself enters at 0.136 (standard error 0.043); row 5 enters the row 2 supply controls, the excise tax and Sunday sales, and the indicator together, where the indicator's own coefficient falls to 0.100 (standard error 0.047). Among movers whose permissions change at the move, the average absolute change in log area variety is about 1.9, against about 1.2 for other movers, so for the average such move the variety term implies an effect of about 0.10, of the same order as the indicator's own effect. All rows use the full estimation sample ($N = 4,850,962$). The first-stage *F* is reported for each specification. Change controls are measured at the three-digit zip code and state level. Standard errors clustered by household.

(row 2); adding the excise tax and Sunday sales, the dimensions of regulation that change prices and hours but not what stores may legally stock, leaves it at 0.057 (row 3). The variety effect therefore reflects neither the density and accessibility of the destination nor the price-changing dimensions of regulation. Controlling instead for whether the move changed a permission (control-state status or grocery sales of spirits or wine), the effect remains 0.053 and significant (row 4), while the permission change carries its own positive effect; absorbing the incidence of any permission change therefore does not absorb the variety effect. Entering the supply and accessibility controls, the tax and Sunday controls, and the permission indicator together, the variety effect is 0.061 and remains significant, while the indicator's own effect declines (row 5). Online Appendix I lists these variables and the reforms behind them.

I read the result as follows. The non-regulatory components of a relocation do not account for the estimate, and variety raises consumption significantly when I control for whether the regulatory regime changed. Consistent with a genuine role for variety, the response grows with the size of the variety change a household experiences. This gradient appears both in the ventile pattern of Fig. 4 and in the dose-response across terciles of the variety change in Online Appendix D. Among the movers with the largest exposure increases, the share of liquor purchases accounted for by products the household had never been exposed to before the move rises over the post-move years and exceeds half (Fig. 5). I conclude that product variety raises liquor purchases by about 0.05 among movers whose product environment changes.

5.3.3. Which dimensions of variety matter?

To investigate which dimensions of product variety drive the consumption response, I decompose the supply-side variety measure into five components: the number of brands, the number of product subcategories (e.g., vodka, bourbon, gin), product concentration (HHI), the share of niche products, and the share of new products. Each dimension is instrumented separately using the change at the time of the move.

Table 8 presents the results. The strongest predictor of consumption is subcategory diversity: a 1% increase in the number of liquor subcategories available in a zip code increases liquor purchases by 0.20%. Brand diversity also has a significant positive effect (0.10%). Product concentration (HHI) has a significant negative coefficient (-0.26), consistent with the interpretation that less concentrated markets, where no single product dominates, are associated with higher consumption. The share of niche products and new product introductions do not have significant independent effects.

I further estimate the mover IV regression separately for each of the nine largest liquor subcategories. Table 9 presents the results. All nine subcategories show a significant positive effect on total liquor purchases, ranging from 0.033 (scotch) to 0.058 (alcoholic cocktails). The uniformity of these results across diverse subcategories, from vodka to tequila to bourbon, reinforces the conclusion that variety affects consumption through a broad expansion of the product spectrum rather than through any single product type.

5.4. Movers' product choices

The results indicate that more product choices are associated with higher purchases, and new consumers start purchasing alcohol. Considering moving households in particular, I expect that the effect is driven by new, previously unavailable products rather than an increase in the volume of products that a household could have purchased before moving. In Fig. 5, I show that during the years after a move, the share of liquor purchases accounted for by new products that a household has not been exposed to before the move

Table 8
Mover IV regressions: which type of variety matters?.

	log(Liquor)				
	(1)	(2)	(3)	(4)	(5)
log(Brands + 0.5) [IV]	0.097*** (0.022)				
log(Subcategories + 0.5) [IV]		0.204*** (0.034)			
HHI concentration [IV]			−0.263*** (0.081)		
Niche product share [IV]				−0.125 (0.144)	
New product share [IV]					−0.032 (0.090)
Destination avg. consumption	0.394*** (0.023)	0.394*** (0.023)	0.394*** (0.023)	0.394*** (0.023)	0.384*** (0.023)
Household FE	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes	Yes	Yes
N	4,768,969	4,768,969	4,768,969	4,768,969	4,535,528
R ²	0.404	0.404	0.404	0.404	0.402

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

Notes: This table presents mover IV regressions using different variety dimensions measured at the zip3 level. Each column instruments a different variety measure with the change at the time of the household's move. Column (1): number of distinct brands. Column (2): number of product subcategories (e.g., vodka, bourbon, gin). Column (3): Herfindahl-Hirschman Index of product concentration. Column (4): share of niche products (below-median national store presence). Column (5): share of products new to the market within two years. [IV] denotes instrumented variables. Household Controls include income, household size, composition, occupation, employment, marital status, presence of children, and type of residence. Standard errors are clustered at the household level and reported in parentheses.

Table 9
Mover IV regressions by liquor subcategory.

Subcategory	Coeff.	SE	t-stat	Sig.
Alcoholic cocktails	0.058	(0.021)	2.73	***
Canadian whiskey	0.054	(0.014)	3.91	***
Tequila	0.049	(0.013)	3.79	***
Vodka	0.047	(0.012)	3.94	***
Rum	0.045	(0.014)	3.34	***
Gin	0.045	(0.014)	3.22	***
Cordials & liqueurs	0.045	(0.014)	3.13	***
Bourbon	0.036	(0.013)	2.75	***
Scotch	0.033	(0.013)	2.49	**
N	4,556,364 per regression			

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

Notes: Each row reports the IV coefficient from a separate regression of log liquor purchases on log subcategory-level variety at the zip3 level, instrumented by the change in variety at the time of a household move. All regressions include household, time, and demographic fixed effects, and control for destination average consumption. Standard errors are clustered at the household level and reported in parentheses.

rises steadily, exceeding 50% by the sixth year. For the beer and wine segments, moving households are also exposed to more product variety and especially purchase products they have not been exposed to in the past. From the first to sixth year after the move, new beer and wine products account for 22.4%–47.8% and 33.2%–41.2% of purchases.

5.5. Heterogeneity

Purchase distribution. This section investigates heterogeneity in household-level responses to product variety with respect to aggregate alcohol purchases. This analysis is essential for interpreting health costs and other externalities associated with alcohol consumption, particularly excessive alcohol use (Control and Prevention, 2022b).

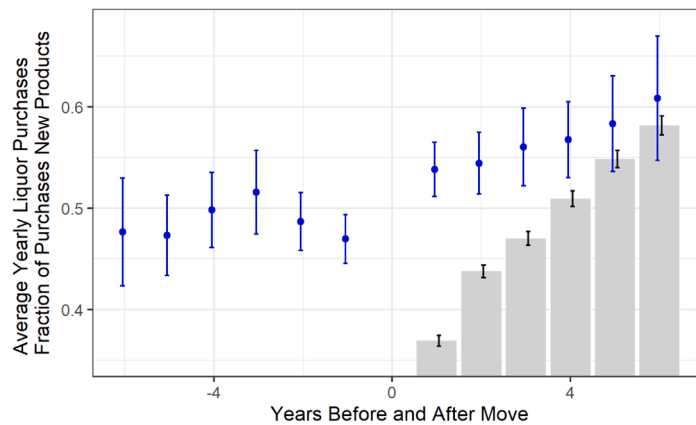


Fig. 5. Liquor purchases and new product share after a household move. *Notes:* Blue coefficients show average yearly liquor purchases before and after a move for households exposed to 107+ more liquor products (top 40% quantile) after the move. Gray bars show the fraction of purchases accounted for by new products not encountered before the move. 95% confidence intervals shown.

Fig. 6 presents results from household-level correlations and the mover identification strategy, considering samples of the top 25%, 10%, 5%, and 1% purchasers per person within a household.¹⁵ While the identification strategy loses statistical power when the sample is reduced, the results reveal a consistent pattern: the top 5% to 10%, not only the top 1%, of households drive the estimate. Thus, among households with alcohol purchases, an inverted U-shaped response is observed in relation to assortment increases.

The results highlight public health consequences. Increases in purchases are not solely driven by low purchasers or the external margin. Instead, households with relatively high purchases further increase their consumption. For example, the largest effect on liquor purchases is observed among households in the 90th to 95th percentile. These households purchase, on average, 0.94 liters of liquor per household member per month.¹⁶ This finding suggests that product variety may contribute to health risks particularly among those already consuming at elevated levels.

To further characterize this heterogeneity, I use the household-level specification from Eq. (4) and estimate an interacted model that allows the variety elasticity to differ across consumption deciles (Figure E.1 in Online Appendix E). The elasticity increases monotonically from 0.004 for the lightest purchasers (D1) to 0.174 for the heaviest (D10). The ratio of the D10 to D5 elasticity exceeds 16 $\times$. This monotonic pattern holds for both liquor and beer and is robust to estimating separate regressions by decile. Rather than addition making heavy purchasers inelastic to variety, the evidence suggests that variety may enable further consumption among those already purchasing at high levels.

The welfare reading of this pattern depends on why heavy purchasers respond to variety. If these households are well-informed and choose alcohol as they would any other good, even a habit-forming one (Becker and Murphy, 1988), then greater variety makes them better off by matching their tastes, and restricting variety would lower their welfare. If instead heavy drinking reflects habit or addiction, so that consumption runs ahead of what households would choose on reflection (Gruber and Kőszegi, 2001), then variety that pushes consumption higher can reduce welfare, and limiting it may help. The data show that variety raises purchases among heavy buyers, but they cannot tell which of these descriptions fits, and the monotone gradient is consistent with both. I therefore frame the policy discussion conditionally: the case for limiting variety rests on the view that consumption among the heaviest buyers carries health costs they do not fully internalize, a question this paper does not settle.

Demographics. In a secondary heterogeneity analysis, Fig. 7 illustrates the effects of product variety on liquor consumption for various demographic subgroups, using both OLS and the mover identification.¹⁷ The power of some results based on movers is diminished due to relatively small sample sizes. Nonetheless, a strong tendency across different subgroups is generally not observed. Households in different income groups respond similarly, and the response does not vary strongly with education. The only notable difference is in household composition: single-male households increase purchases more in response to greater product variety than single-female households.

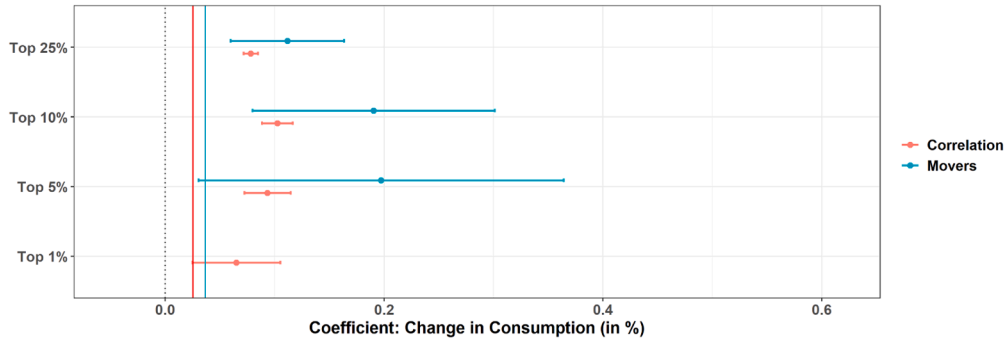
6. Policy changes and product variety

In this section, I analyze how two state-specific policy changes, the Washington liquor deregulation and the Illinois excise tax increase, affected product variety and consumption. Rather than using these policy changes as instruments for product variety (which

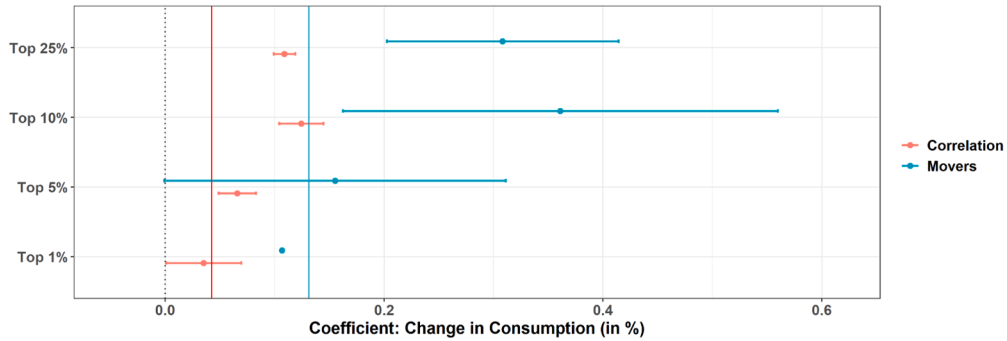
¹⁵ I divide consumption by the number of household members. Robustness analyses are provided in Online Appendix G.

¹⁶ At 40% ethanol, 0.94 liters per month corresponds to approximately 21 standard drinks (14 g of ethanol each), or about 0.7 drinks per day. The CDC/USDA Dietary Guidelines define moderate drinking as up to 2 drinks per day for men and 1 for women. The figure is a household-member average; some individuals within these households likely consume well above guidelines. Scanner data also capture only off-premise purchases and thus understate total alcohol consumption.

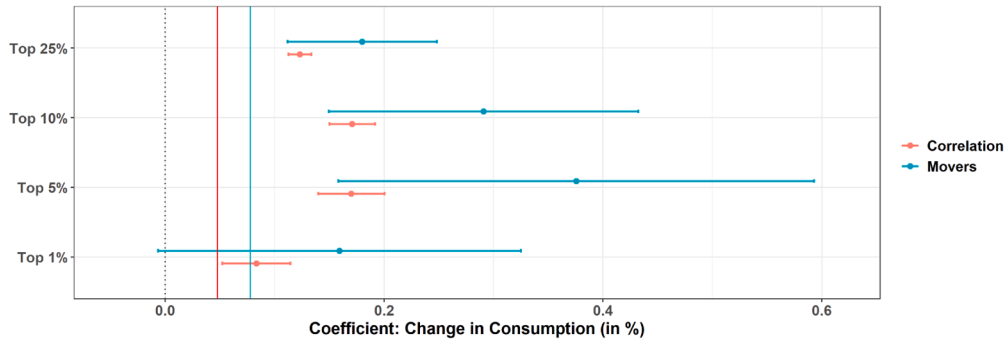
¹⁷ Results for beer and wine can be found in Online Appendix F.



(a) Impact on Beer Purchases



(b) Impact on Wine Purchases



(c) Impact on Liquor Purchases

Fig. 6. Impact of product variety on household purchases, by purchase distribution. Notes: Coefficients from both OLS (Eq. (4)) and the mover IV (Eq. (5)). Vertical lines indicate full-sample estimates. Additional coefficients for subsamples at the 75th, 90th, 95th, and 99th percentile of per-person purchases. Standard errors clustered at the household level.

would require the assumption that they affect consumption only through variety), I present reduced-form event study evidence documenting the effects of each policy on prices, product assortment, and sales. This descriptive approach avoids the strong exclusion restrictions required by an instrumental variable approach while still providing informative evidence on the relationship between policy, variety, and consumption.

6.1. Event study evidence

For each of the two shocks, I consider a sample of stores that sold liquor before the respective policy change to ensure that I solely consider stores that already sold liquor before the shock.¹⁸ Consider the following event study for three outcome variables y_{st} of store

¹⁸ I only consider stores that had more than 100 different liquors in stock before the policy change.

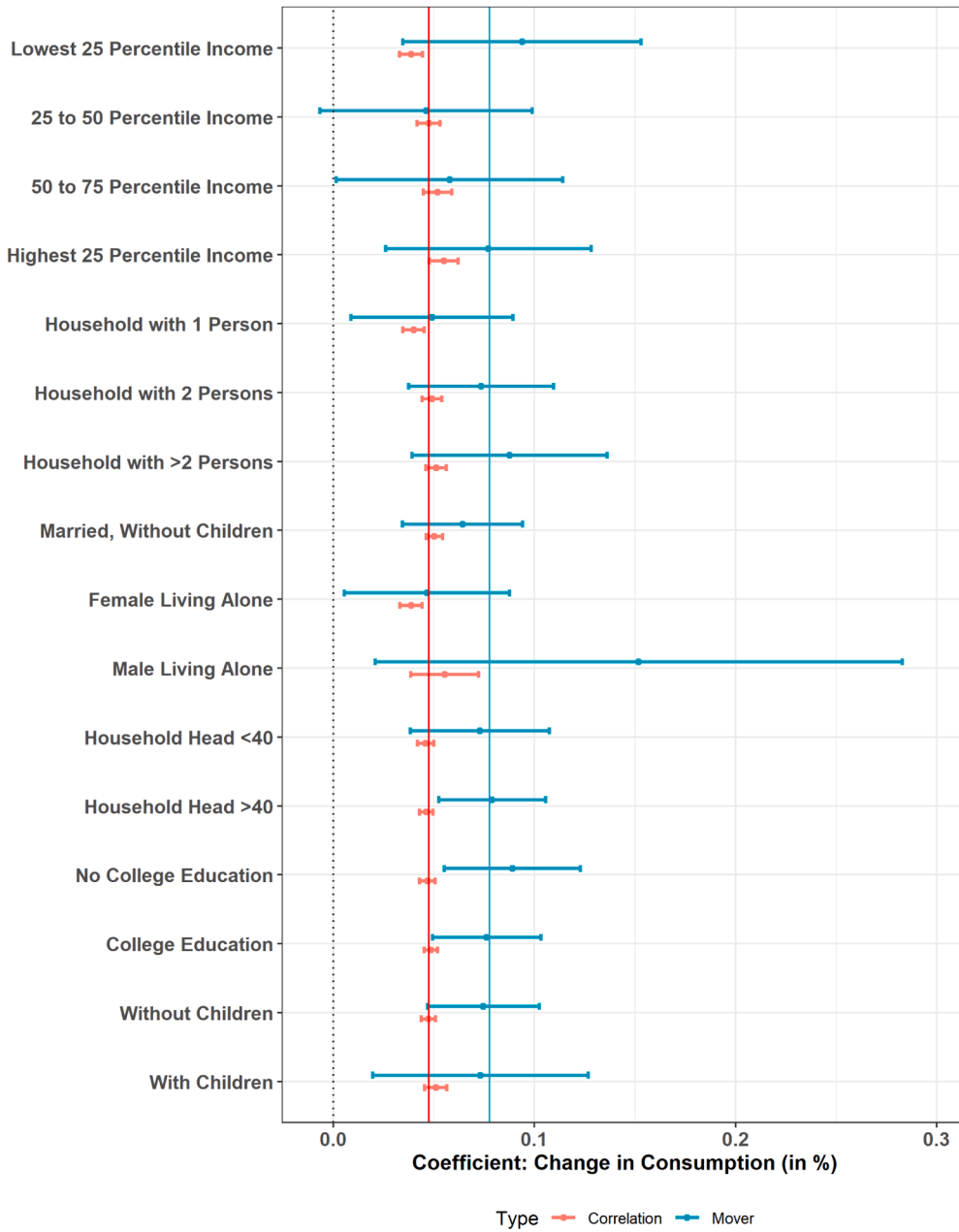


Fig. 7. Impact of product variety on households' Liquor purchases, heterogeneity analysis. *Notes:* Effects of product variety on liquor purchases by demographic subgroups. Coefficients from OLS (Eq. (4)) and the mover IV (Eq. (5)). Vertical lines indicate full-sample estimates. Standard errors clustered at the household level.

s in month t : (1) the number of liquor products, (2) the liters of liquor sold, and (3) the average price of a sold liter of liquor.

$$\log(y_{st}) = \alpha + \sum_{k=2006}^{k=2019} \beta \mathbf{I}(t) \cdot \text{Treat}_s + \gamma \mathbf{I}(t) + \rho_s + \varepsilon_{st}, \quad (6)$$

where $\mathbf{I}(t)$ is a dummy variable for each year, excluding the year prior to the shock. Treat_s takes the value of one if store s is in the treatment state (Washington or Illinois). ρ_s represents store fixed effects. The estimates of $\hat{\beta}$ show the yearly variation on the store level before and after each shock within the treatment state relative to the remaining untreated states.

Fig. 8 shows the results for Washington, while Fig. 9 presents the results for Illinois.

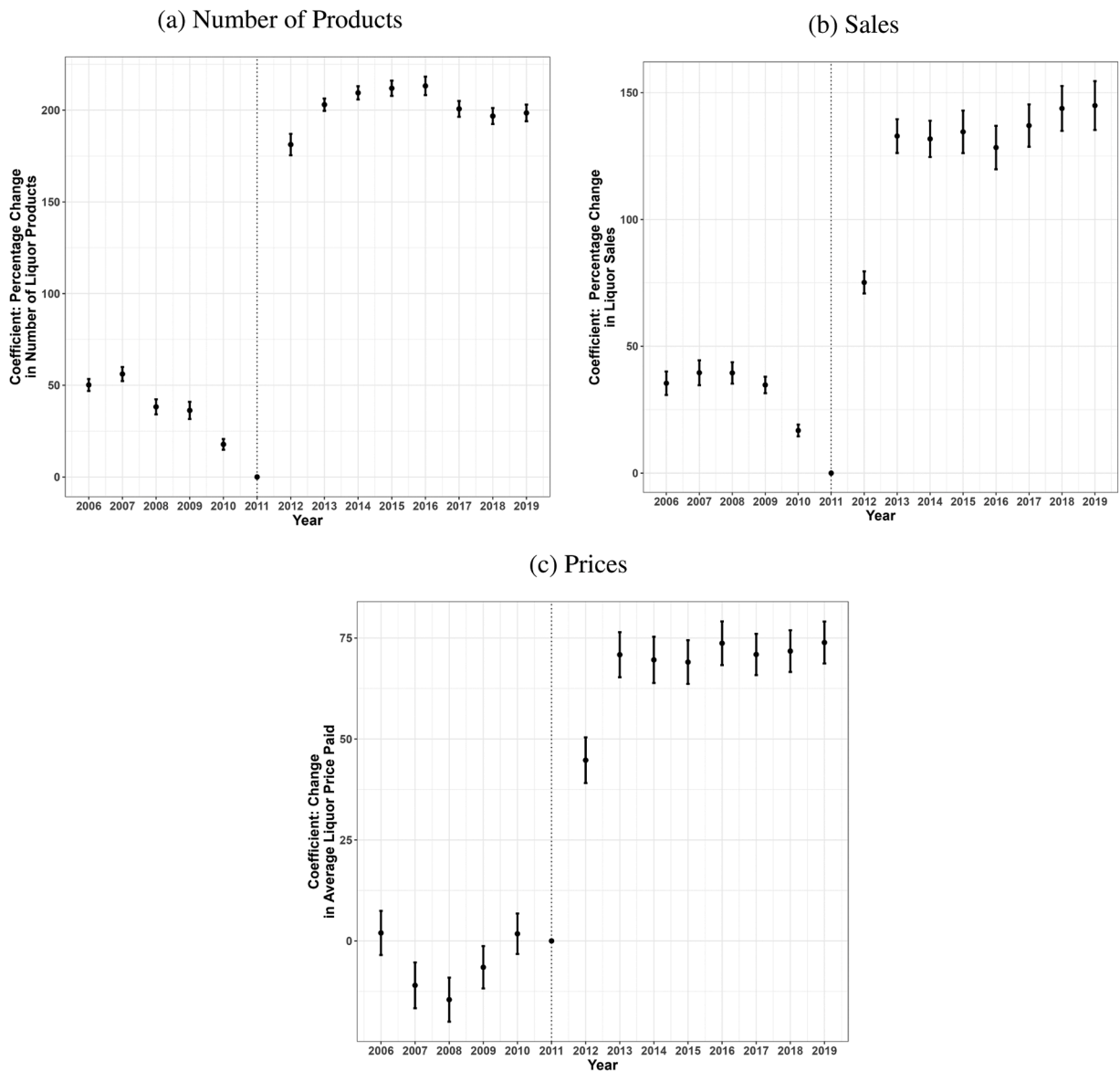


Fig. 8. Event study, Liquor deregulation in Washington. *Notes:* Event study results (Eq. (6)). Only stores that sold liquor prior to 2012 are included. Coefficients show yearly percentage variation in Washington relative to remaining states. Reference year: 2011. 95% confidence intervals; standard errors clustered at the store level.

The liquor deregulation in Washington produced a strong increase in the number of products. The coefficients show a sudden increase in 2012. For aggregate sales, I see a decrease prior to the deregulation followed by an increase. Prices increase sharply with the deregulation, which added license fees of 10 and 17 percent on spirits revenues.

For the Illinois excise tax hike, there is an immediate positive effect on prices and a negative effect on sales, but a delayed and positive effect on the number of products. The delayed increase in the number of products aligns with an increase in sales.

These patterns are consistent with the hypothesis that price increases create incentives for firms to expand product variety. This expansion could come either through competitive pressure (Washington) or through differentiation to mitigate the negative demand effect of higher prices (Illinois). However, the descriptive nature of this evidence means that other explanations cannot be ruled out. In Washington, the deregulation changed many aspects of the market simultaneously, including outlet density, store types, and competitive dynamics, all of which could independently affect both variety and consumption.

The Illinois case deserves particular scrutiny. The event study shows that product variety initially *declined* relative to control states in 2009–2011, consistent with a standard contraction following a tax-induced demand decline. Variety did not begin rising relative to controls until 2012–2014, a full five to six years after the tax increase. This timing coincides with the well-documented national craft spirits boom, during which bourbon, gin, and cocktail products proliferated across the United States. Indeed, control states

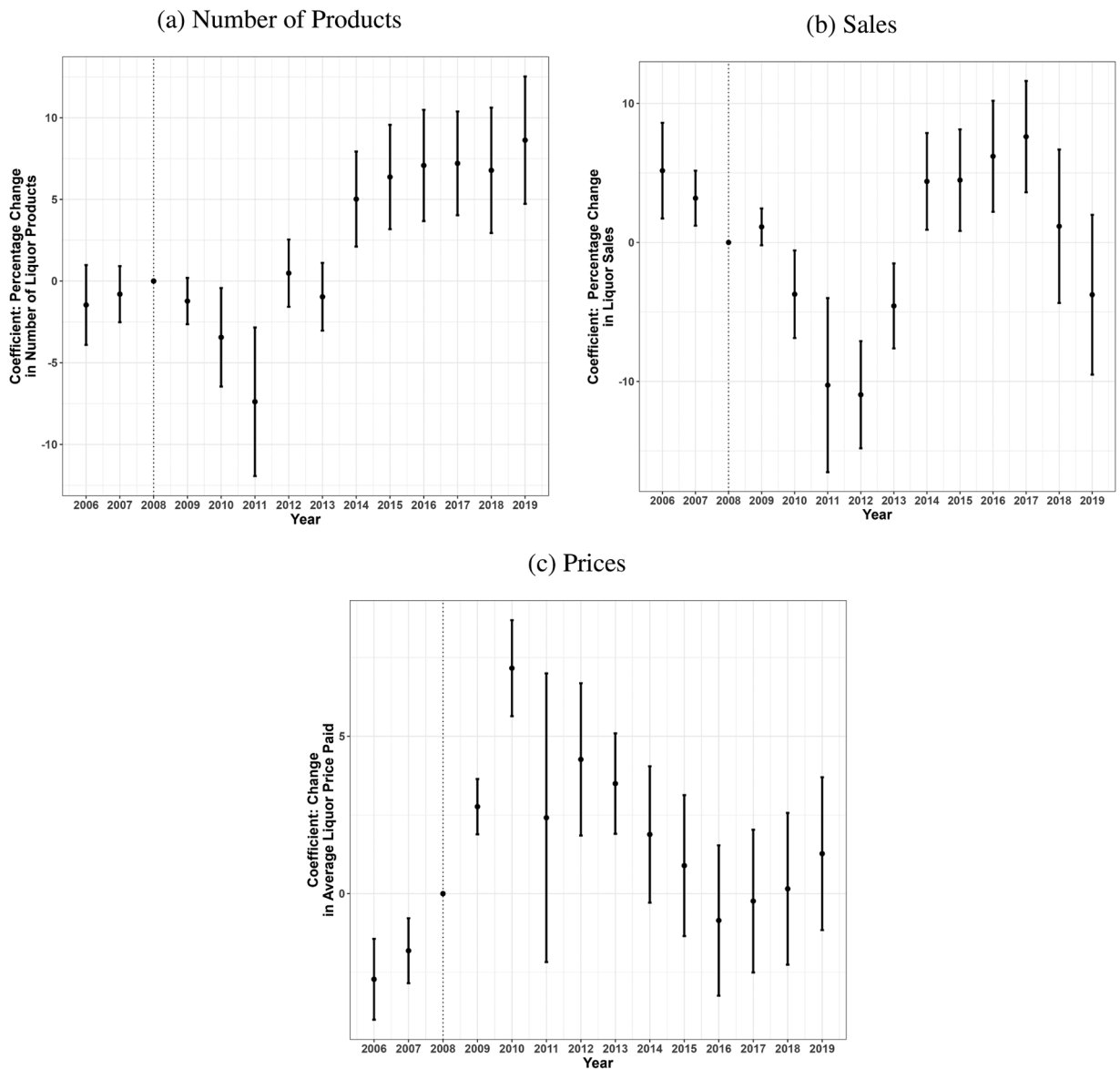


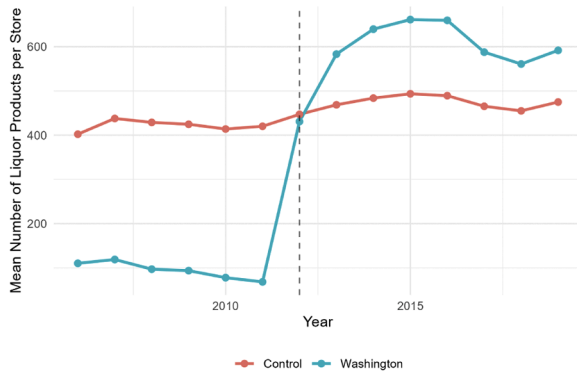
Fig. 9. Event study, excise tax increase for Liquor in Illinois. *Notes:* Event study results (Eq. (6)). Only stores that sold liquor prior to 2009 are included. Coefficients show yearly percentage variation in Illinois relative to remaining states. Reference year: 2008. 95% confidence intervals; standard errors clustered at the store level.

experienced a 15–18% increase in variety over the same period. The number of pre-tax Illinois stores in the sample also declines from 326 in 2008 to 234 by 2015, which may introduce survivorship bias if stores with fewer products were more likely to exit. While the Illinois differential growth exceeds the national trend, the long lag and the plausible confound with national product proliferation make it difficult to attribute the variety increase to the 2009 tax change.

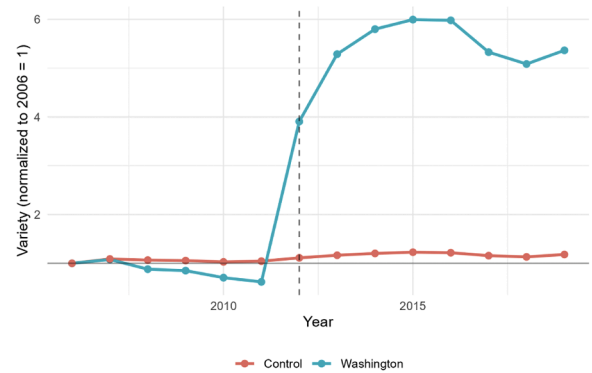
6.2. Variety trends and decomposition

Fig. 10 shows the evolution of product variety in Washington following the 2012 deregulation, considering only the 77 stores that sold more than 100 liquor products before the reform. The deregulation produced a dramatic increase: the average number of liquor products per store jumped from below 100 in the last pre-reform year to over 430 in a single year (panel a). Normalized to 2006 levels, Washington stores experienced a six-fold increase in variety while control states exhibited modest organic growth of approximately 18% over the full period (panel b).

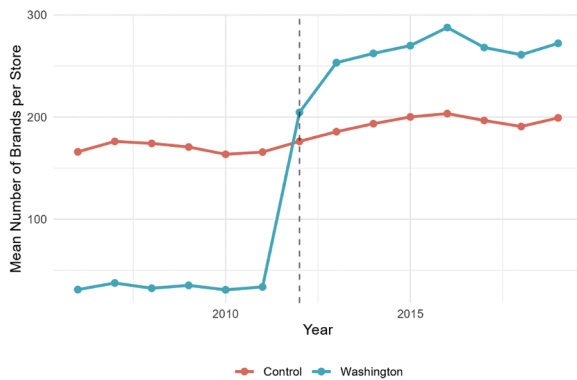
Beyond the total number of products, I decompose variety into the number of brands and product subcategories (e.g., vodka, bourbon, gin). The Washington deregulation expanded both dimensions: the average number of brands per store increased from 31



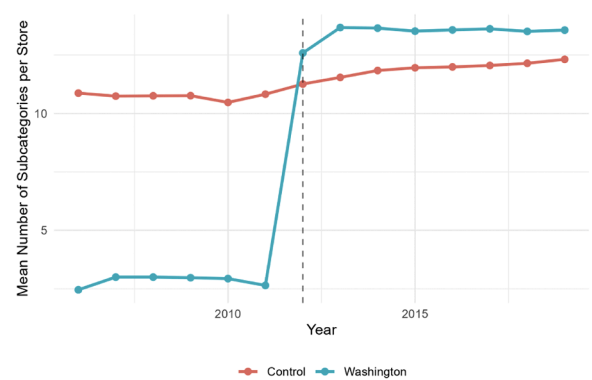
(a) Mean Products per Store



(b) Normalized to 2006



(c) Number of Brands



(d) Number of Subcategories

Fig. 10. Product variety in Washington: trends and decomposition. *Notes:* Only stores that sold more than 100 liquor products before the 2012 deregulation are included (77 stores in Washington). Dashed line: WA deregulation (2012). Control states exclude Washington and Illinois.

to 205 (panel c), and the number of subcategories grew from approximately 2.5 to 12.6 (panel d), indicating that stores transitioned from carrying one or two types of spirits to offering the full range. The expansion reflected the entry of major national brands that had been unavailable under the state monopoly, including Kahlua, Baileys Irish Cream, Bacardi, Pinnacle, Jim Beam, Captain Morgan, Grey Goose, and Patrón, among others. The products-per-brand ratio stayed approximately 2:1 before and after reform, indicating that the variety increase came from new brands entering the market rather than SKU proliferation within existing brands. Analogous figures for Illinois are provided in Online Appendix H.

The mover IV regressions in Section 5 (Tables 8 and 9) suggest that subcategory breadth is a particularly important dimension of the variety–consumption relationship, consistent with the descriptive patterns observed here.

7. Conclusion

In this paper, I explore the relationship between product assortment and alcohol consumption in the US. I find that higher product variety in retail settings is associated with increased purchases, which may help to explain the gradual increase in alcohol consumption over the past two decades. Using household relocations as a source of variation in product exposure, I show that moving to an area with greater product variety is associated with higher alcohol purchases, even after controlling for destination-specific consumption patterns. This effect is concentrated among the top 5–10% of purchasers, suggesting that product variety may exacerbate health risks among those already consuming at elevated levels.

Complementing the household-level analysis, I present descriptive evidence from two state-specific policy changes, the Washington liquor deregulation and the Illinois excise tax increase, showing that policies that raise prices are also associated with increased product variety. While these policy episodes do not identify a causal effect of variety on consumption, they highlight an important and potentially unintended consequence of alcohol regulation: price-increasing policies may stimulate product entry and assortment expansion, which could partially offset the intended reduction in consumption.

These findings have implications for the design of alcohol policy. Policymakers should be aware that market reforms and tax changes can affect not only prices and outlet density but also product variety. Real-world examples of variety regulation exist: state

monopoly systems in the United States (Pennsylvania, Utah, New Hampshire), Canadian provincial boards (the LCBO in Ontario, the SAQ in Quebec), and Nordic government monopolies (Systembolaget in Sweden, Vinmonopolet in Norway, Alko in Finland) explicitly control product listings through centralized procurement processes. While implementing entry regulation in open markets is more challenging, the evidence suggests that coordinating price policies with attention to product assortment may enhance the effectiveness of alcohol regulation. At the same time, variety regulation involves welfare trade-offs: greater product assortment increases consumer surplus by better matching heterogeneous preferences, and restricting variety imposes costs on households that value product diversity. The optimal policy therefore requires balancing the public health costs of increased consumption against the welfare gains from product customization.

Several limitations deserve mention. First, while the mover analysis exploits within-household variation from relocations, it cannot fully resolve the endogeneity of product variety, as discussed in Section 5. Second, I observe only purchasing behavior, not actual consumption, and cannot measure long-term health consequences such as the development of addiction or chronic health conditions. To the extent that product variety fosters habit formation, the long-run effects could be larger than the contemporaneous estimates suggest. Third, the analysis focuses on off-premise purchases captured in scanner data and does not account for on-premise consumption in bars and restaurants. Fourth, product entry is itself endogenous to demand conditions; disentangling whether firms expand variety in response to anticipated demand growth or whether variety expansions stimulate new demand remains a challenge for future research.

Declaration of competing interest

The author declares that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

Supplementary material

Supplementary material associated with this article can be found in the online version at [10.1016/j.ijindorg.2026.103336](https://doi.org/10.1016/j.ijindorg.2026.103336)

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