Intoxicant Consumption Dynamics under Alcohol Prohibition: Evidence from India

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Abstract

This paper examines the effects of a prohibition law in Bihar, India, on intoxicant consumption. We implement a dynamic difference-in-difference estimation strategy using monthly-level longitudinal data exploiting both state-level variation in policy exposure and household-level variation in alcohol usage. We document that alcohol-consuming households in Bihar reduced their spending on tobacco products following the ban announcement, indicating complementarity between alcohol and other intoxicants; however, after its strict enforcement, when alcohol is unavailable, these households gradually increased their consumption of tobacco. We find reallocation in healthcare spending: urgent medical expenses decrease with increased spending towards positive lifestyle changes.

JEL Codes: D10, D12, I10, I18, I19

Keywords: Prohibition, Intoxicants, Consumption, Healthcare Expenditure, Event Study

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1 Introduction

The consumption of alcohol affects individual health and productivity, including overall higher mortality among alcohol consumers (Carpenter & Dobkin, 2009), workplace accidents and absenteeism (Johansson, Pekkarinen, & Verho, 2014; Bassols & Castello, 2018). It also impacts economic and social outcomes, including higher incidence of fatal accidents (Levitt & Porter, 2001; Edlin & Karaca-Mandic, 2006), the prevalence of crime, domestic violence among others (Luca, Owens, & Sharma, 2015; Heaton, 2012; Chikritzhs & Stockwell, 2002). Similarly, smoking tobacco has negative health consequences (Akl et al., 2010; West, 2017); for decades, it has been one of the leading causes of premature deaths, with low and middle-income countries being particularly affected (Lim et al., 2012; Edwards, 2004).

Policies aimed to curb the consumption of one of these goods through higher taxes, restricted sales, stricter age barriers, or complete bans can have the unintended consequence of reducing or increasing the consumption of the others, thereby exacerbating or muting the effectiveness of such a policy. Higher prices for cigarettes lead to substitution towards alcohol (Picone, Sloan, & Trogdon, 2004) and smoking cessation products (Cotti, Nesson, & Tefft, 2016), and reduction in e-cigarette consumption (Cotti, Nesson, & Tefft, 2018)[1]. An increase in alcohol prices leads to substitution towards other forms of alcohol (Gehrsitz, Saffer, & Grossman, 2021), as well as a reduction in smoking participation (Decker & Schwartz, 2000), suggesting complementarity between them. Smoking bans may result in higher (Burton, 2024) or lower alcohol consumption (Picone et al., 2004) but lead to an increase in road accidents due to drunk driving (Adams & Cotti, 2008). An increase in the minimum drinking age can result in young adults substituting for marijuana (DiNardo & Lemieux, 2001; Crost & Guerrero, 2012). Thus, the correct assessment of a policy needs to incorporate the interaction between the type of policy in question and time-varying individual preferences.

In this paper, we analyse the relationship between the consumption of alcohol and other intoxicants such as cigarettes, bidis[2], and other forms of tobacco (referred to as CBT thereafter) by documenting the *dynamic* effects on household consumption in re-

sponse to the complete prohibition of alcohol. We study the Bihar Amendment Act of 2016, initiated in response to widespread protests from women and social activists who demanded prohibition due to alcohol's effect on inciting higher domestic violence. This Act, which prohibited the manufacture, sale, and consumption of all types of alcohol in the state, was announced on November 26, 2015, and was put into effect on April 1, 2016. We use detailed longitudinal monthly consumption data from the Consumer Pyramids Household Survey (CPHS) between January 2015 and December 2017 to study the effects of this policy.

Figure 1a represents the average monthly expenditure on alcohol in Bihar, its neighbouring states of Uttar Pradesh, West Bengal, and Jharkhand, and all states in India, excluding Bihar, between 2015-2017.[3] Initially, the average monthly liquor expenditure in Bihar is approximately 75 Indian Rupee (INR) higher than the All India average and close to 100 INR higher than the neighbouring states. The average household expense on liquor for India shows a steady increase over time; however, we observe a substantial fall in Bihar with the ban announcement. Evidence of the strict implementation can be observed in the data as average liquor expenses in Bihar reduce substantially and ultimately become zero. The curb on alcohol production in Bihar has spillover effects on neighbouring states, as we see a dip in the consumption of alcohol initially, followed by a convergence to a growth rate similar to the rest of India. Figure 1b shows the corresponding average monthly CBT consumption. CBT expense in Bihar, while approximately 100 INR less than its neighbouring states, is comparable to the rest of India during early 2015. We observe almost a 66% decline in CBT expenses in Bihar in the six months between ban announcement and implementation. However, this effect is short-lived; over the months following the ban implementation, CBT expense increases steadily, almost completely reversing the initial decline. Over the entire period, the average CBT expense in the rest of India shows a small increase; for neighbouring states, there is a less than 15% decrease.

We use a dynamic difference-in-difference estimation strategy to study consumption patterns of households in the months leading up to the announcement, between the ban

announcement and implementation, and several months after the implementation. We start our analysis with an interstate comparison to avoid biasing our estimates due to time-varying regional policies, weather, supply shocks, or changing socio-economic characteristics across Indian states, comparing Bihar to its neighbouring states (as opposed to the rest of India). The estimated difference one month prior to the ban announcement is normalised to zero. Since the ban primarily affects the alcohol-consuming households in Bihar (treated), we compare their consumption with similar households in the neighbouring states of Bihar that are not subject to the ban (control). For our benchmark analysis, we define alcohol-consuming households to include those that exhibit some positive levels of alcohol consumption in any of the ten months in 2015 prior to the ban announcement.

The estimated difference in alcohol consumption between Bihar and its neighbouring states fell significantly following the ban announcement and remains low henceforth. Concurrently, the estimated difference in CBT consumption between the same set of households also continued to fall after the announcement; however, almost a year after the ban implementation, the estimated difference started to recover, with the initial decline reversing by the end of our event-study window. We hypothesise that three factors could explain the results that we observe: (i) a complementarity in alcohol and CBT consumption due to which a reduction in alcohol consumption also reduces CBT consumption initially, followed by a substitution towards CBT when alcohol is no longer available, (ii) complementarity in the sale of alcohol and tobacco products, or (iii) societal disapproval associated with all forms of addictive goods following the ban announcement, which simultaneously changes the demand for CBT.

Given the interstate variation in the imposition of the ban, the above-mentioned analysis yields useful results; however, to alleviate possible endogeneity concerns regarding other time-varying state-specific events that may have occurred around the same time, we restrict our sample to compare households within Bihar with differential exposure to the ban. We use an event-study specification to compare households that consume any positive amount of alcohol in the ten months prior to the ban announcement (treated) in 2015 to all households that exhibit zero alcohol consumption (control). The estimated

difference in liquor consumption between the two sets of households gradually disappears after the ban announcement and implementation.

Concurrently, we find the estimated differences in CBT consumption between the treated and control groups to be significant and positive leading up to the ban announcement. Clearly, households that consume more alcohol also consume more tobacco products. After the ban announcement, this estimated difference falls significantly and becomes negative in months following the ban implementation, indicating that alcohol-consuming households reduce their CBT consumption a lot more compared to the control, relative to a month prior to the announcement. This estimate is negative and significant for a substantial time, even after the ban is in full effect, with a slow recovery starting almost a year later. We then observe a gradual increase in the estimated difference, indicating that the treated group starts to increase their CBT consumption. The estimated difference is completely wiped out and becomes positive towards the end of our event-study window, indicating how treated households shift towards CBT consumption more than the control group. The within-state analysis establishes that while supply-side changes or societal disapproval may lead to a decline in CBT consumption by all households, there is evidence of complementarity in the consumption of liquor and other intoxicants, due to which the effect is strongest for those who consume liquor. Once the prohibition policy completely takes effect and liquor is unavailable, these households slowly substitute towards other kinds of intoxicants. Our estimation strategy indicates that it may be difficult to label alcohol and other intoxicants as pure complements or substitutes. The dynamic nature of the change in consumption of one good when the availability of the other changes needs to be noted by policymakers for more effective policy evaluation.

Motivated by the evidence that intoxicant consumption has implications on health, we next investigate the effect of the prohibition policy on household healthcare expenses. We divide health spending into two categories: (a) urgent health expenses related to hospitalisation, medicines, fees associated with doctor visits or physiotherapy, x-rays, and other medical tests, and (b) expenses related to lifestyle changes which include fees asso-

ciated with gym membership, yoga, dietitian, spending on diapers or sanitary napkins, spectacles, lenses or other medical aid. We find that compared to other states, alcohol-consuming households in Bihar experience a decline in urgent health expenses and an increase in expenses related to positive lifestyle changes, thereby showing the benefits of a decrease in alcohol and CBT consumption. In our within-state analysis, relative to non-alcohol-consuming households in Bihar, the treated group experiences a decline and then an increase in urgent medical expenses, thereby mirroring the change in their CBT consumption. They also experience a relative fall in other health expenses as their CBT consumption increases a year after the ban implementation. This provides evidence that while the ban's effect on health is positive through lower alcohol consumption, some of the positive effects are offset by the increase in CBT consumption in the later stages of the analysis.

To the best of our knowledge, our paper is the first to study the impact of an alcohol ban on tobacco consumption and healthcare expenses using detailed household level consumption data.[4]. Papers in this literature often explore the relationship between alcohol and other intoxicants in response to a policy change and show heterogeneity in response across groups. Our analysis highlights that the effective assessment of a policy also needs to account for the dynamic effects on consumption since preferences over these goods can change over time. Gauging the effectiveness of such a policy becomes especially important in a developing economy due to the heightened risks associated with intoxicant consumption. Our two-pronged estimation strategy first uses the interstate variation in the implementation of the policy to estimate the causal impact of the prohibition law. Relative to the literature, we isolate complementarity and substitutability in preferences of different intoxicants from differential market conditions and evolving societal perceptions using our second strategy, looking at a within-state analysis. We are also able to estimate the intensive margin response to an alcohol ban as opposed to only extensive margin changes. We provide novel evidence showing the impact of the alcohol ban and the resulting changes in tobacco consumption on the nature and degree of healthcare spending among households.

The rest of the paper is organised as follows. Section 2 provides background details regarding the liquor ban in Bihar. Section 3 offers a description of the data, while Section 4 contains the main empirical specification. Section 5 illustrates the primary results and discusses some robustness checks. Finally, Section 6 concludes.

2 Background

India is a federal republic comprising 28 states and 8 union territories, where states have autonomy over deciding their liquor policies like minimum drinking age, sale restrictions, and excise taxes.[5]. Bihar, the third most populous state in the country (according to the 2011 Census), has recently been the only state to enforce complete liquor prohibition[6].

Nitish Kumar, the Chief Minister of Bihar between 2005-2014, implemented policies that permitted the operation of a larger number of liquor shops in the state, resulting in a surge in alcohol consumption. As a result, as observed in Figure 1a, liquor consumption in Bihar is higher than the national average before the ban. However, in the run-up to the state elections in 2015, he pledged to ban alcohol if he came to power. This move was in response to protests from women and social activists who demanded prohibition, as higher alcohol consumption was seen as the leading cause behind an increase in cases of domestic abuse and intimate partner violence (IPV). Nitish Kumar fulfilled this promise by announcing on November 26, 2015, just six days after re-election, that there would be a complete ban on alcohol from April 2016. The Bihar Excise (Amendment) Bill 2016 was unanimously passed to implement the ban, which prohibited the manufacture, sale, or consumption of all types of alcohol in the state (Singh, 2020). Strict penalties were imposed if the law was violated, including up to 10 years in prison. Manufacturers and suppliers also faced the possibility of a death penalty if deaths occurred due to the consumption of their spurious liquor. Common people were encouraged to report possession or consumption of alcohol using a toll-free number that was widely advertised in the state (Chaudhuri, Jha, Nilayamgode, & Suryanarayana, n.d.). The police and the excise department worked together to conduct raids and arrests to enforce the law as

strictly as possible.[7]

Given the nature and uniqueness of the policy, some trends in alcohol consumption are clear from Figure 1a. Firstly, due to anticipation regarding this policy, which started during the election campaign, we observe a small decline in average household expenses on liquor in Bihar starting 3 months before the ban announcement. Secondly, we observe a sharp fall between the announcement of the ban in November 2015 and April 2016, when it was legally enforced. Finally, there are potential supply-side spillovers to consumption in some of the neighbouring states, as average liquor expenses in the neighbouring states also undergo a slight fall.

3 Data

We use household-level longitudinal data at the monthly frequency from the Consumer Pyramids Household Survey (CPHS) conducted by the Centre for Monitoring Indian Economy Pvt. Ltd. (CMIE). The data covers over 170,000 households who are surveyed repeatedly over time. Each sampled unit is interviewed every quadrimester about their socio-economic and demographic characteristics, as well as their income and item-wise expenditures in each of the previous four months.

Our data has some unique advantages, which makes it ideal for our analysis. Firstly, this is the only dataset that consistently and comprehensively surveys a representative set of households before, during, and after the imposition of the ban in Bihar. This allows us to compare the state of Bihar (where the alcohol ban took effect) with her neighbours, Uttar Pradesh, West Bengal, and Jharkhand, and also conduct a within-Bihar analysis. Secondly, our database consists of a detailed breakdown of monthly household expenses on 153 category heads with further details embedded for some of them. These include expenses on different food items (including alcohol and other forms of intoxicants), clothing, footwear, cosmetics, appliances, restaurants, utilities, transport, education, health, etc. We also get detailed data on the income of the household and its members collated from different sources. This helps us control for income in our

specification[8].

Since the ban was announced in November 2015 and was implemented in April 2016, we restrict our sample to include observations from January 2015 to December 2017. We observe household expenses up to ten months prior to the announcement of an impending prohibition law, the impact of the announcement, and both the immediate and subsequent effects of the ban[9]. We study detailed expenses under the categories of alcohol and intoxicants, which include cigarettes, bidis, and tobacco (CBT). We also study health expenses, broadly divided into two categories: Health Expenses-I, which includes those that involve urgent expenses such as medicines, fees associated with doctor or physiotherapy visits, x-rays, and other medical tests, and hospitalisation fees, and Health Expenses-II that involves lifestyle changes such as expenses on gym, yoga, or dietician fees, diapers or sanitary napkins, spectacles, lenses, and other medical aid. Table 1 provides some descriptive statistics regarding mean outcomes and demographic characteristics (later used as controls for our regression) for the state of Bihar relative to other Indian states, using both the 2011 Census and the CPHS sample that we use for our analysis[10].

4 Empirical Strategy

We estimate the causal impact of the alcohol ban in Bihar by adopting a dynamic difference-in-difference estimation strategy, where we compare the expenditure patterns of the treated and the control groups over time. The strategy is useful given the staggered nature of the policy change, wherein an impending alcohol ban was announced, followed by its implementation six months later. It also allows us to look at pre-trends and the evolution of treatment effects. We address the challenge of identifying the effects of a state ban on alcohol consumption separately from other policy, secular, and market trends by exploiting the timing of prohibition in both a 'between-state' and 'within-state' scenario. We particularly focus on four sets of consumption outcomes: (i) liquor, (ii) CBT, (iii) Health Expenses-I, and (iv) Health Expenses-II, which have been described in detail in

Section 3 and use the following specification:

$$Y_{it} = \beta_0 + \alpha_d + \alpha_t + \sum_{k=-2}^{-10} \gamma_{\text{pre},k} \cdot 1[D_t = -k] \times \text{Treated}_i + \sum_{k=0}^{20} \gamma_{\text{post},k} \cdot 1[D_t = k] \times \text{Treated}_i + \beta_4 X_i + \beta_5 X_{it} + \epsilon_{it} \quad (1)$$

Y_{it} denotes the consumption of $Y \in$ {alcohol, CBT, Health Expenses-I, Health Expenses-II} by household i in time period t (month-year). $Treated$ is an indicator variable that takes a value of 1 for alcohol-consuming households in the state of Bihar. These include households that exhibited non-zero alcohol consumption between January 2015 and October 2015, that is, up to 10 months prior to the announcement of the ban; thus, these households were directly affected by the ban. Keeping the treatment group fixed, we run this regression for two different control groups. In the first exercise, we conduct an interstate comparison where the control group consists of similar households in the neighbouring states of Bihar (West Bengal, Jharkhand, and Uttar Pradesh). To further control for other state-specific time-varying factors (for example, state elections) that may affect our results, we conduct a second exercise within the state of Bihar, where the control group now comprises all households with zero alcohol consumption between January and October 2015. We control for district-fixed effects, α_d, to account for fixed cross-sectional variation across districts and time-fixed effects, α_t, to account for time-varying factors that affect all households in the given specification at the same time. For the interstate comparison, standard errors are clustered at the state level. For the within-state comparison, since the variation is at the household level, standard errors are not clustered in the benchmark analysis[11].

Our key variables of interest include the vector of estimates given by $\gamma_{\text{post},k}$, represented graphically later in Section 5, which normalises the October 2015 (one month prior to the ban announcement) coefficient to zero. These estimates identify the differences between the alcohol-consuming households in Bihar and the neighbouring states and between alcohol-consuming and non-alcohol-consuming households in Bihar every month following the prohibition law announcement. Here, $\gamma_{\text{pre},k}$ captures the consumption dif-

ferences across the two types of households $k \in (2, 10)$ months prior to the announcement of the ban. This specification allows us to analyse pre-trends and the evolution of the treatment effects over different points in time, with the identifying assumption being that in the absence of an alcohol ban, the consumption differences between households in the treated and control groups would have continued showing the same trends.

We control for other non-time-varying household characteristics (X_i), such as religion, caste, and region, which is particularly important because some religions and castes do not support alcohol consumption. Alcohol consumption patterns also vary in urban versus rural areas. We also control for a vector of time-varying covariates (X_{it}), which include family size, total income, and the education level of the household.[12]. Controlling for income is particularly important since we are using expenditure data and because alcohol consumption (and its unavailability) can affect the productivity of household members, which in turn can impact health and CBT consumption through the income channel (Johansson et al., 2014).

5 Results

We estimate the effect of the alcohol ban on liquor, CBT, and health expenses of households using the event study specification as presented in equation 1 and plot the estimated coefficients, $\hat{\gamma}_{pre,k}$ and $\hat{\gamma}_{post,k}$ for the different exercises.

5.1 Bihar vs. neighbouring States

Figure 2a shows the estimated difference in monthly household liquor expenses in the interstate comparison. As the ban was announced, alcohol-consuming households in Bihar reduced their liquor consumption significantly compared to neighbouring states. Liquor consumption for the treated group fell by 100 INR compared to the control relative to the baseline (October 2015) before April 2016, when the ban was implemented. The strict implementation of the ban can be observed as alcohol consumption in Bihar falls further and remains persistently lower throughout our event-study window.

Figure 2b shows the estimated difference in monthly CBT consumption between Bihar and the neighbouring states. Bihar exhibits higher CBT consumption than the neighbouring states at the start of the analysis relative to the baseline, with the differences being statistically insignificant for three months leading up to the ban announcement. Post-ban announcement, households in Bihar gradually reduced their CBT consumption, with the estimated difference with the neighbouring states falling by 50 INR relative to the baseline, leading up to the ban implementation. After the ban, the differences in CBT consumption remain stable for a year. However, unlike liquor expenses, Bihar households increase their CBT consumption at a higher rate than their counterparts in the neighbouring states, with the initial decline completely reversed a year since the ban.

The dynamic analysis is, therefore, crucial since static difference-in-difference estimates may incorrectly estimate the effectiveness of the policy on overall intoxicant consumption. The decrease and eventual increase in CBT could be explained by three factors: (i) a complementarity channel through which a reduction in alcohol consumption also reduces CBT consumption initially, followed by a substitution towards CBT when alcohol is no longer available, (ii) a complementarity in sale, which leads to lower production of both liquor and tobacco products after ban announcement and (iii) changing societal perception towards addictive goods, which leads to changes in the demand for tobacco products as well.

5.2 Within Bihar comparisons

Interstate comparison using our preferred event-study specification, although useful, cannot distinguish our treatment of interest, the Bihar alcohol ban, from other variations at the same state-time frequency. These include changing market conditions or societal disapproval of intoxicants. To eliminate these plausible threats to identification, we now restrict our analysis to comprise only households *within Bihar*. Our treatment group comprises alcohol-consuming households, as per our definition. The control group consists of all households that did not consume alcohol in the ten months prior to the ban announcement[13]. Thus, we utilize household-level variation in exposure to the alcohol

ban[14].

As illustrated by Figure 3a, monthly expenses on alcohol were approximately 250 INR higher for the treated households than those in the control group relative to the baseline. The estimated difference decreased by 200 INR with the announcement of the ban, even before its implementation. With the ban in place, alcohol consumption reduces completely[15]. The estimated difference in the consumption of CBT between the treated and control exhibits a U-shaped pattern. As seen in Figure 3b, we find that expenses on all forms of tobacco are between 50-70 INR higher for alcohol-consuming households than other households at the start of our analysis, compared to the baseline, showing that these goods are complements in consumption. Following the announcement of the ban, consistent with the complementarity hypothesis, the estimated differences in CBT consumption between the two types of households were reduced by 100 INR over the next year as households also reduced their liquor consumption. However, a year after the ban implementation, the estimated differences begin to rise (by 60 INR by the end of our period of analysis). Results are driven by a higher increase in CBT expense for alcohol-consuming households relative to the non-alcohol-consuming ones[16].

This exercise also allows us to parse out the mechanism explaining the dynamics of CBT consumption. We reconsider the three factors that may explain the results that we observe for intoxicant consumption. The results from Figure 3 indicate that while the supply of CBT products may have decreased or the changes in societal disapproval towards addictive goods may have led to a reduction and subsequent rise in CBT consumption, *both* sets of households would be subject to these changes. The differential fall in CBT consumption between the two types of households in the early part of our analysis indicates that the complementarity channel between alcohol and CBT consumption dominates following the ban announcement. However, approximately a year after the implementation of the ban, CBT consumption in all households increases, with the change being higher again for the treated group. This indicates that households that are predisposed to addictive goods eventually substitute towards other forms of intoxicants, such as CBT, when alcohol is unavailable[17].

5.3 Effect on Health Expenses

Drinking alcohol and smoking any form of tobacco has health implications and thereby impacts healthcare expenses. Therefore, the prohibition law, by influencing changes in liquor and CBT consumption, also impacts the healthcare expenses of households. When households stop spending on addictive goods, they have more resources to spend on other goods, including healthcare. Thus, these could lead to lifestyle changes, which can change long-term health outcomes and corresponding expenses. However, the consumption of alcohol and other intoxicants can have a detrimental effect on health (Carpenter & Dobkin, 2009; Levitt & Porter, 2001); therefore, a ban may positively impact the health levels of households, particularly those that consumed alcohol before the ban. This can result in a decrease in urgent medical expenses associated with diseases and accidents, among others. An alcohol ban can also affect the productivity of household members, which in turn can impact health through the income channel (Johansson et al., 2014). Further, social disapproval towards tempting goods may incentivise households to lead a healthier lifestyle. As discussed before, we categorise these expenses into two groups: Health Expense-I, which pertains to urgent medical needs, and Health Expense-II, which encapsulates lifestyle changes. Figure 4 demonstrates the results of the event study exercises for both interstate comparisons and our analysis within Bihar.

We observe in our interstate comparison a decrease in Health Expenses-I and a slight increase in Health Expenses-II when the ban is in effect. This is suggestive of lower liquor consumption leading to improved health over time due to a decrease in spending on medicines, hospitalisation, etc. However, due to the large standard errors associated with these estimates, the results are not statistically significant. When we compare households within Bihar, we find that overall health expenses for alcohol-consuming households are higher than non-alcohol-consuming households, which could indicate poor health before the ban was announced. The gap, however, decreases over time after the ban comes into effect. However, similar to the change in CBT consumption, the gap in Health Expense-I increases again a year after the ban, while Health Expense-II broadly continues to fall. These results are different from the interstate event study results since the control

group in the other states continues to consume alcohol. Within Bihar, since our control group consists of those who never consumed alcohol, we see urgent health expenses for the treated group mirror the change in their CBT consumption and expenses towards positive lifestyle changes keep going down as CBT expense rises a year after the ban is implemented. Taken together, these results suggest that the effect of alcohol on health seems to dominate over the effect of other intoxicants.

5.4 Robustness Checks

We establish the robustness of our estimates by conducting several checks. Firstly, we modify our treatment group to include only those households that show positive levels of alcohol consumption every month between January and October 2015, which increases our control group by including some alcohol-consuming households. We do not use this as our baseline specification to avoid partial treatment effects on our control group. We reassuringly find that the results are in line with those in Figures 2 and 3. We also use this broader classification of the control group for our interstate comparisons. Secondly, we compare Bihar with the rest of India as the control and repeat the exercise by comparing Bihar to only border-sharing districts of neighbouring states (similar to Baggio, Chong, and Kwon (2020)), and the results hold in all instances. Third, to counter the concern of households choosing to migrate to and out of the state because of the ban, we restrict our sample to households surveyed throughout our study. We do not find our results to be sensitive to this check. We use consumption shares of total expenditure instead of actual expenses in our difference-in-difference estimate to account for the household's optimal budget allocation. Our results go through with slightly narrower confidence intervals. The placebo test uses the timing of the ban to analyse within-state changes in consumption in two other states of India: Rajasthan, and Madhya Pradesh. We do not see the Bihar pattern emerge in any other state[18]. Since our interstate comparison clusters the standard errors at the state level, we try an alternate clustering strategy at the state-time level, and the results retain their significance. We do not cluster our standard errors for the within-Bihar analysis. However, to allow for the unlikely possibility of treatment

being correlated between groups, we cluster our standard errors at the household level, and we do not see different results. Finally, we show in a simple difference-in-difference exercise how CBT prices in Bihar undergo no distinguishable changes or fluctuations in our event-study window that may bias our results. All the results are available in the Appendix.

6 Conclusion

In this paper, we study the evolution of the relationship between alcohol and CBT consumption in the aftermath of the alcohol prohibition law in the Indian state of Bihar in 2016. We use longitudinal data on monthly consumption to conduct a dynamic difference-in-difference exercise where we conduct both an interstate and within-state comparison between households based on their exposure to the ban. Between alcohol-consuming households in Bihar and its neighbouring states, in response to the ban announcement, the estimated differences in monthly liquor expenses fall, whereas, for CBT, there is a fall and a subsequent rise. We find similar results when comparing alcohol-consuming households in Bihar to all other households in the state. We conclude that while supply-side factors and changing societal perceptions toward addictive goods may contribute to this change, the changing preference between alcohol and CBT consumption remains the dominant factor, wherein households perceive alcohol and CBT as complements when both goods are available; however, after the ban takes effect, households substitute to other forms of tobacco-based intoxicants. We also show evidence that suggests the positive impact of an alcohol ban on health outcomes through lower urgent medical expenses and higher expenses on activities and products that indicate a positive change in lifestyle; however, an eventual rise in CBT consumption dampens some of these changes.

Several papers before this work have quantified the relationship between consuming alcohol and different forms of intoxicants through the lens of changing taxes, prices, or changes in the legal age for accessing these commodities. We add to this literature by quantifying the *dynamic* nature of this relationship when a prohibition policy is in place.

We show that the assessment of policy effectiveness should take seriously the evolving nature of household preferences towards addictive goods, which have implications for health outcomes.

Notes

[1]Similarly, the introduction of an abuse-deterrent version of an opioid, OxyContin, led to an increase in substitution towards heroin (Alpert, Powell, & Pacula, 2018)

[2]Bidi is a form of a thin, unfiltered hand-rolled cigarette, commonly wrapped in the leaves of the East Indian Ebony tree held together by a string or adhesive

[3]Neighbouring states here share at least some border with Bihar. These states also have similar social and economic composition, with Jharkhand being a part of erstwhile Bihar up until 2001

[4]Chaudhuri et al. (n.d.) and Dar and Sahay (2018) that study the Bihar alcohol ban, focus on its impact on crime

[5]See Schess et al. (2023) for a review of alcohol policies in India

[6]The Indian state of Gujarat is the only other state to have a complete ban on the sale and manufacture of alcohol in the state. However, this policy was implemented in the mid-1950s, with consumption allowed for foreigners and visitors and U.T. of Diu was also able to sell alcohol. Therefore, it does not serve as a good comparison to Bihar. Some states in North-East India, for example, Nagaland, Manipur, and Mizoram, have had intermittent bans imposed, but with caveats, with widespread illegal consumption quite common.

[7]According to data from the Excise and Prohibition Department of the Government of Bihar, between April 2016 and March 2018, more than 670,000 raids were conducted, and 126,000 arrests were made with respect to alcohol-related violations.

[8]There are two other data sources that measure consumption and some aspects of income in India. The long-running National Sample Survey is a cross-sectional survey. However, the last comprehensive data was released in 2011-12 in the 68th round of study. The latest round in 2022-23 is still not available to the public. The other popular dataset, the Indian Human Development Survey (IHDS), although a panel, is only available for the years 2004-5 and 2011-12.

[9]While data availability in CPHS allows us to extend our analysis further, we refrain from doing so because of two factors. In March 2018, there were communal riots in Bihar, which resulted in the destruction of shops and private and public property. Further, due to changes in the tax structure, we observe large fluctuations in tobacco prices in Bihar between August and October 2018, which may impact CBT consumption. To isolate the effect of the alcohol ban, we restrict our analysis till December

2017.

[10]We winsorise the data to exclude outliers at 1% and 99%.

[11]For robustness, as discussed in the Appendix, we repeat the same exercise by clustering at the household level, with results remaining unchanged.

[12]We use the variable that denotes the education group that a household is classified into, which is a categorical variable constructed by CPHS based on the education levels of all members of the household

[13]The average expenditure on alcohol and CBT over time for both the treated and control group in Bihar are available in the Appendix

[14]Anger, Kvasnicka, and Siedler (2011) finds evidence that smoking bans can have heterogeneous effects on the smoking behaviour of households depending on their exposure to public smoking constraints

[15]There is a slight decline observed in the last couple of months prior to the ban announcement. This could be attributed to the anticipation of an impending ban when the election campaigning was underway, wherein Nitish Kumar promised a ban if he came to power.

[16]We also restrict our analysis to districts in Bihar that do not share borders with neighbouring states to address the concern that households could continue to purchase alcohol from neighbouring states.

[17]We conduct a similar exercise for the neighbouring states, the results of which are discussed in the Appendix. We find a fall in liquor consumption and a subsequent rise in CBT consumption among the alcohol-consuming households in the neighbouring states as well, indicating possible supply-side spillovers. However, the effects are stronger for Bihar

[18]Our choice of these states is motivated by the fact that these states did not have any anti-alcohol drives or planned bans on drinking or smoking

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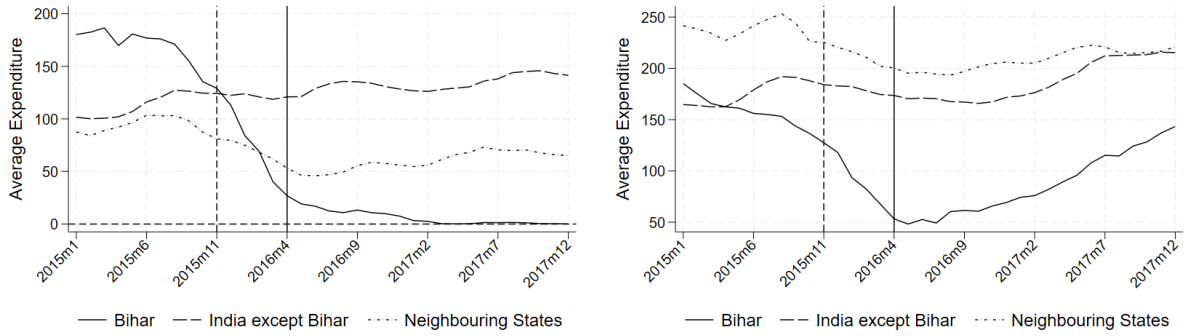
Variable (mean)	Bihar	Neighbouring States	All India	Source
Demographic Characteristics				
Population	104,099,452	324,076,590	1,210,854,977	Census, 2011
Age(%):				
0-18	47.83	42.47	38.98	Census, 2011
19-24	9.08	10.72	10.92	Census, 2011
25-64	38.17	41.25	44.24	Census, 2011
65+	4.51	4.97	5.46	Census, 2011
Family Size	4.393666	4.436544	4.179941	CPHS
Religion and Caste(%):				
Hindu	86.529	85.277	85.103	
SC	19.746	22.695	18.337	CPHS
ST	0.197	2.249	5.101	CPHS
Upper Caste	18.497	35.852	31.002	CPHS
OBC	48.071	24.477	31.103	CPHS
Muslim	13.471	13.861	9.767	CPHS
Region(%):				
Urban	66.087	68.531	70.446	CPHS
Rural	33.913	31.469	29.554	CPHS
Other Economic Indicators:				
Sex Ratio	918	936	940	Census, 2011
Literacy Rate (%)	61.80	70.11	74.04	Census, 2011
Average Monthly Household Consumption (in INR)				
Liquor	146.7215	81.69791	109.0791	CPHS
CBT	136.0652	219.0099	173.6987	CPHS
Health Expenses-1	41.83422	93.88968	68.55887	CPHS
Health Expenses-2	35.21682	57.59393	86.594	CPHS
Total Expense	6808.429	8471.364	9024.207	CPHS
Total Income	9599.63	11086.85	13177.98	CPHS
Sample Observations	75184	316110	1237746	

Notes: The means reported from CPHS are weighted and calculated based on pooled data over ten months, from January 2015 to October 2015, before the alcohol ban announcement was made. Here, the sex ratio is defined as the number of women per 1000 men; the literacy rate is defined by the percentage of the population aged 7 and above who can read and write. CBT is an acronym for cigarettes, bidis, and tobacco. SC, ST, and OBC are acronyms for Scheduled Caste, Scheduled Tribes, and Other Backward Castes, respectively. We winsorise the data to exclude outliers at 1% and 99%.

Table 1: Summary Statistics

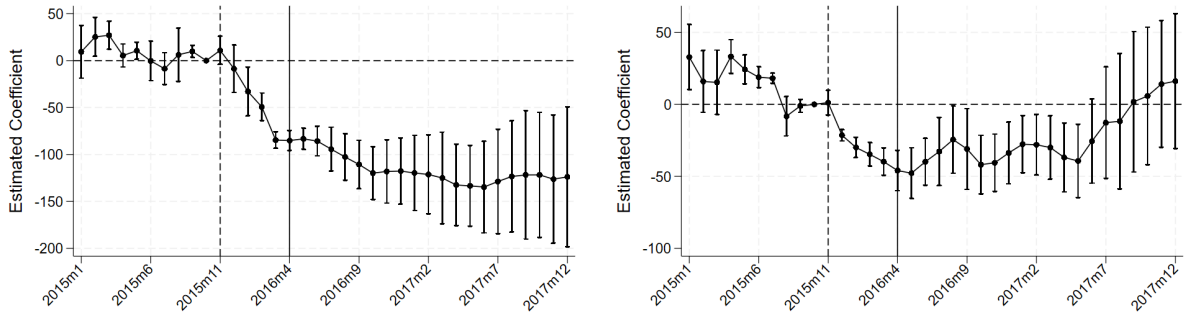


(a) Liquor Expenses

(b) CBT Expenses

Notes: This series comes from the Consumer Pyramids Household Survey (CPHS). Panel (a) plots the average monthly expenses on liquor in the Indian state of Bihar, its neighbouring states, which includes West Bengal, Jharkhand, and Uttar Pradesh, and all Indian states except Bihar (ROI); Panel (b) plots the average monthly expenses on Cigarettes, Bidis, and other Tobacco (CBT) in Bihar, its neighbouring states, and the rest of India. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

Figure 1: Average Monthly Expenditure on Liquor and CBT

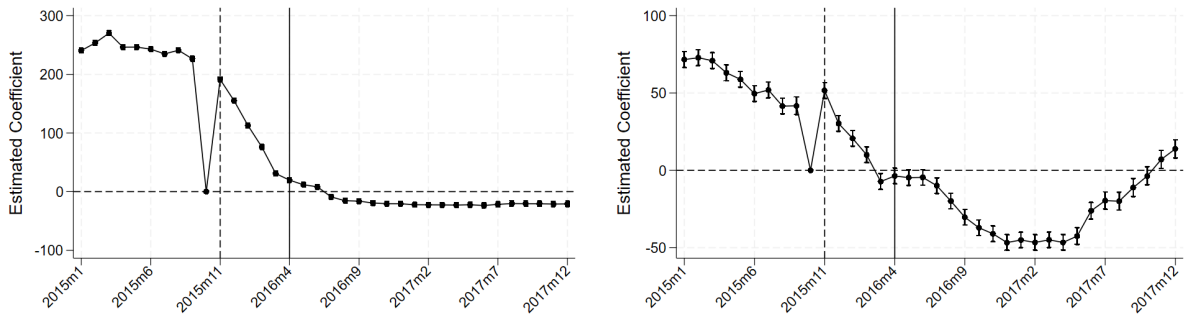


(a) Alcohol Consumption

(b) Cigarettes, Bidis, Tobacco

Notes: Each graph includes point estimates from the event study exercise (normalised to 0 in October 2015) comparing alcohol-consuming households in Bihar with the neighbouring states. Regressions include district fixed effects and time (month × year) fixed effects and are weighted to be representative at the state level. Confidence intervals are at the 95 percent level and are adjusted for state-level clustering. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

Figure 2: Interstate Event Study Results for Intoxicant Consumption

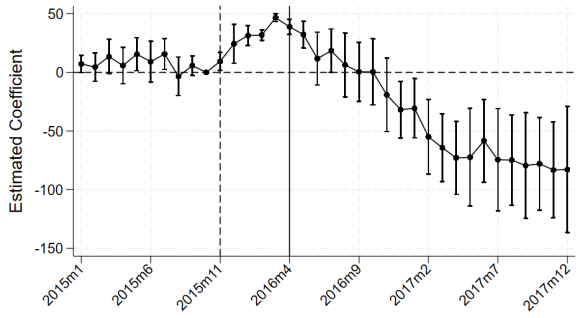


(a) Alcohol Consumption

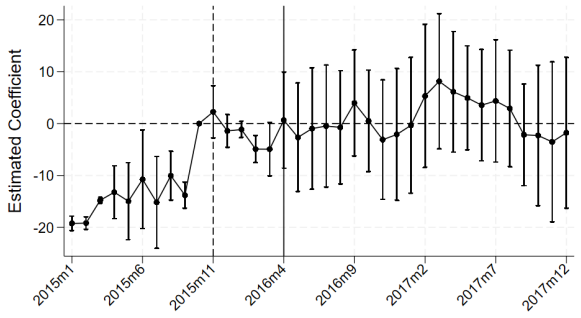
(b) Cigarettes, Bidis, Tobacco

Notes: Each graph includes point estimates from the event study exercise (normalised to 0 in October 2015) comparing alcohol-consuming and non-alcohol-consuming households in Bihar. Regressions include district fixed effects and time (month × year) fixed effects and are weighted. Confidence intervals are at the 95 percent level. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

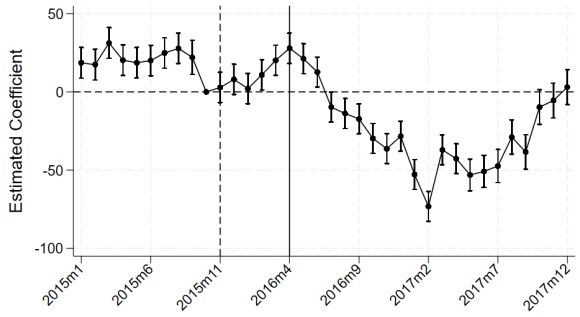
Figure 3: Event Study Results for Intoxicant Consumption within Bihar



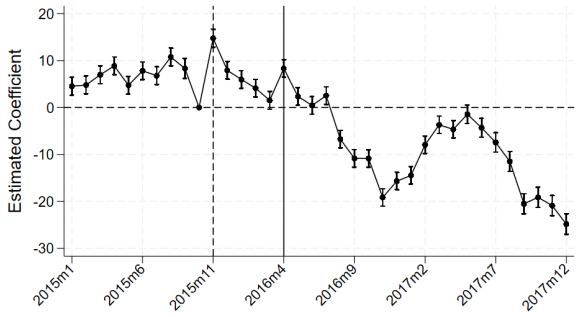
(a) Interstate: Health Expense-I



(b) Interstate: Health Expense-II



(c) Within Bihar: Health Expense-I



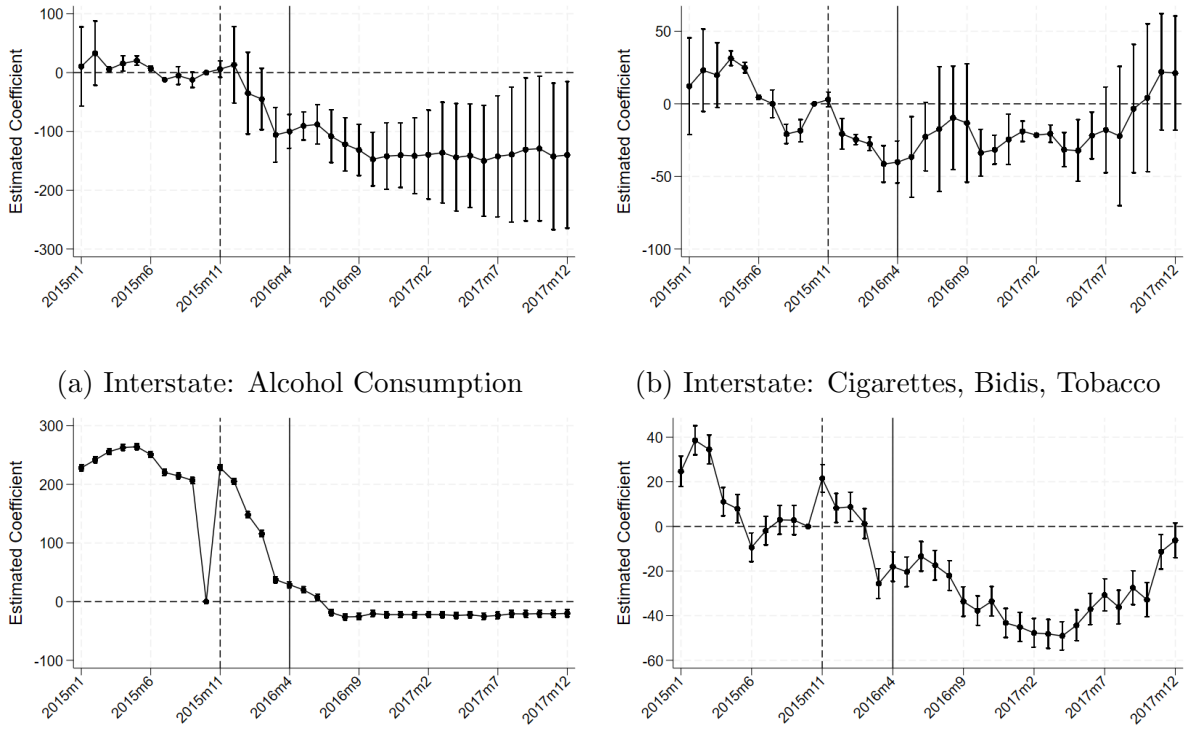
(d) Within Bihar: Health Expense-II

Notes: Each graph includes point estimates from the event study exercise (normalised to 0 in October 2015). Panels (a) and (b) show the interstate comparisons, whereas Panels (c) and (d) show the comparisons between alcohol and non-alcohol consuming households in Bihar. Health Expense-I includes medicines, fees associated with doctor or physiotherapy visits, x-rays, and other medical tests, and hospitalisation fees, and Health Expense-II includes expenses on gym, yoga, or dietician fees, diapers or sanitary napkins, spectacles, lenses, and other medical aid. Regressions include district fixed effects and time (month $\times$ year) fixed effects and are weighted. Confidence intervals are at the 95 percent level. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

Figure 4: Event Study Results for Health Expenses

A Supplementary Analysis

A.1 Definitions of Treated and Control Groups



(a) Interstate: Alcohol Consumption

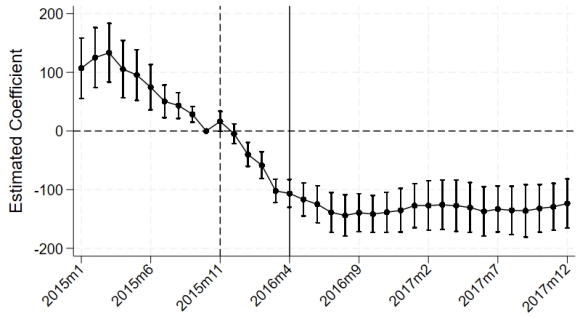
(b) Interstate: Cigarettes, Bidis, Tobacco

(c) Within Bihar: Alcohol Consumption

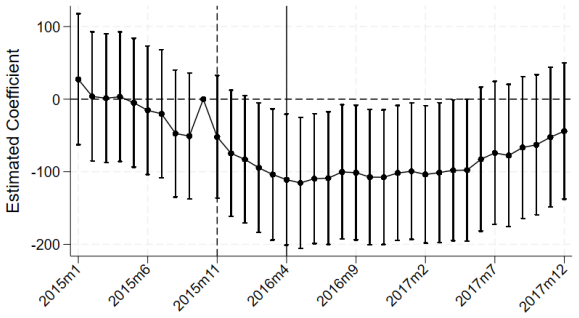
(d) Within Bihar: Cigarettes, Bidis, Tobacco

Notes: We use a *stricter* definition for alcohol-consuming households, to include those that incurred positive expenses on alcohol in *all* ten months prior to the announcement of the alcohol ban (January-October 2015) to validate that our definition of the benchmark exercise is robust. Each graph includes point estimates from an event study exercise (normalised to 0 in October 2015). Panels (a) and (b) show the interstate comparisons between alcohol-consuming households, whereas Panels (c) and (d) show the comparisons between regular alcohol consumers and other households in Bihar. Regressions include district fixed effects and time (month × year) fixed effects and are weighted to be representative at the state level. Confidence intervals are at the 95 percent level and the interstate comparisons are adjusted for state-level clustering. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

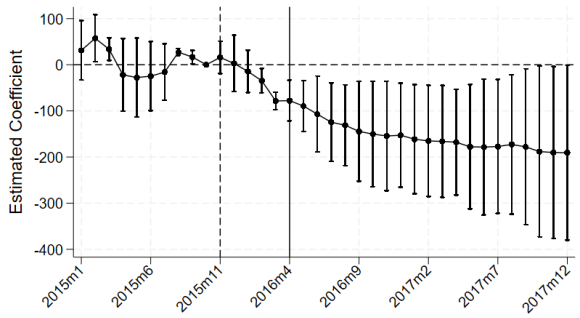
Figure 1: Event Study Results for Intoxicant Consumption: Stricter Definition



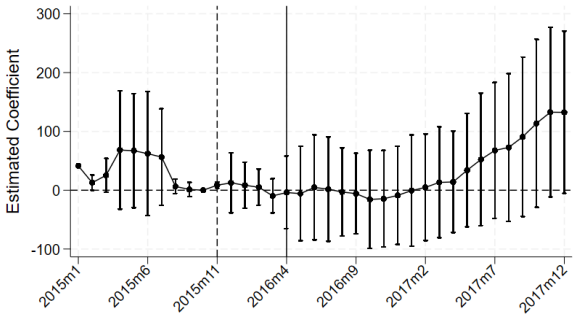
(a) Rest of India: Alcohol Consumption



(b) Rest of India: Cigarettes, Bidis, Tobacco



(c) Bordering districts: Alcohol Consumption

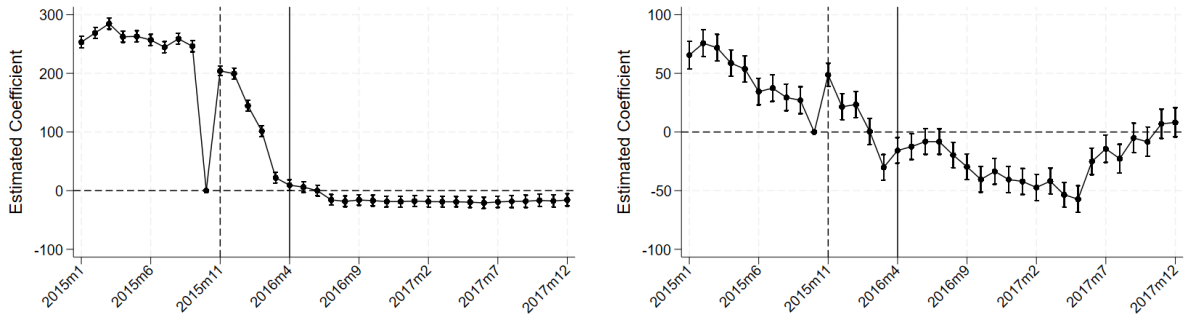


(d) Bordering districts: Cigarettes, Bidis, Tobacco

Notes: We use our benchmark definition for alcohol-consuming households, to include those that incurred positive expenses on alcohol in any of the ten months prior to the announcement of the alcohol ban (January-October 2015). Each graph includes point estimates from the interstate event study exercise (normalised to 0 in October 2015). Panels (a) and (b) show the comparisons between alcohol-consuming households in Bihar relative to all other Indian states, whereas Panels (c) and (d) show the comparisons between alcohol-consuming households in Bihar relative to only the Bihar bordering districts of neighbouring states. Regressions include district fixed effects and time (month $\times$ year) fixed effects and are weighted to be representative at the state level. Confidence intervals are at the 95 percent level and are adjusted for state-level clustering. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

Figure 2: Interstate Event Study Results for Intoxicant Consumption: Alternative Controls

A.2 Balanced Panel



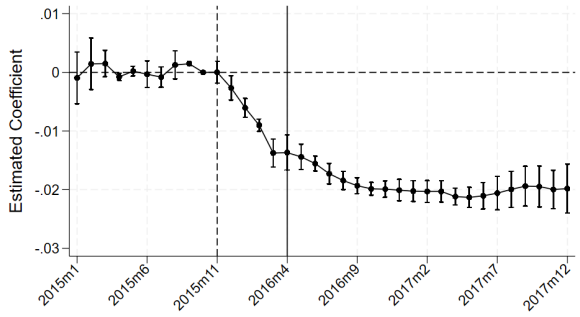
(a) Alcohol Consumption

(b) Cigarettes, Bidis, Tobacco

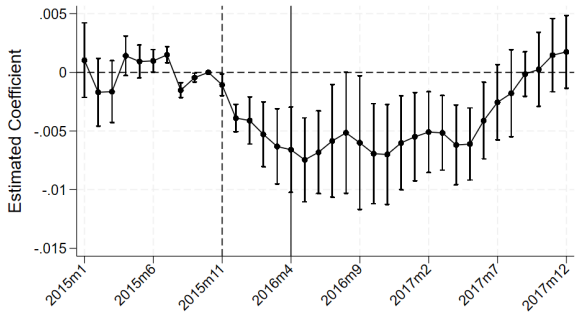
Notes: We use a balanced panel, to control for changing composition of households in our sample due to policy-induced migration. Each graph includes point estimates from the event study exercise (normalised to 0 in October 2015) comparing alcohol-consuming and non-alcohol-consuming households in Bihar. Regressions include district fixed effects and time (month × year) fixed effects and are weighted. Confidence intervals are at the 95 percent level. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

Figure 3: Event Study Results for Intoxicant Consumption within Bihar: Balanced Panel

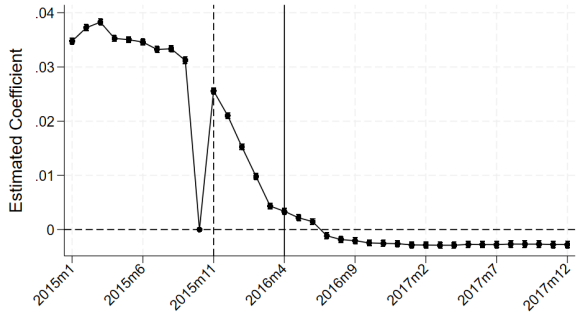
A.3 Consumption Shares



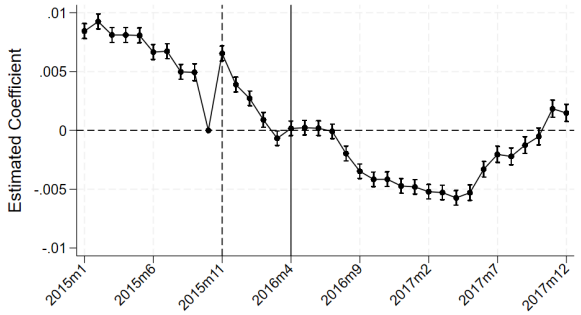
(a) Interstate: Alcohol Consumption



(b) Interstate: Cigarettes, Bidis, Tobacco



(c) Within Bihar: Alcohol Consumption

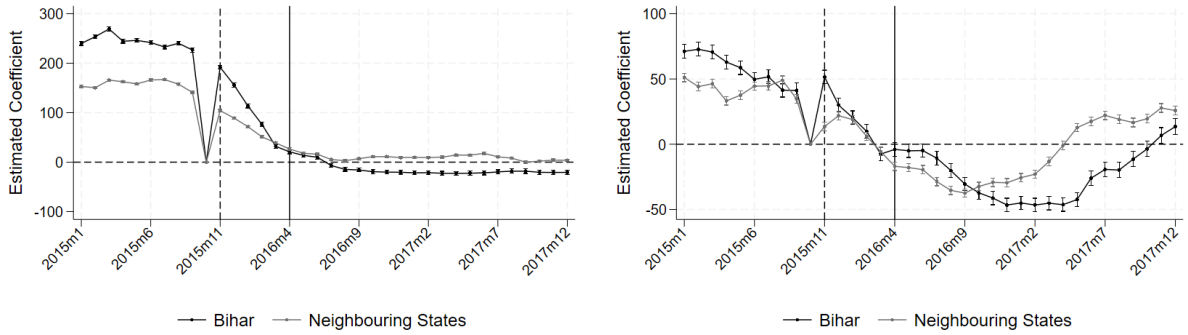


(d) Within Bihar: Cigarettes, Bidis, Tobacco

Notes: To understand how these households optimize and reallocate their resources, we investigate consumption shares instead of monthly expenses. Each graph includes point estimates from an event study exercise (normalised to 0 in October 2015). Panels (a) and (b) show the interstate comparisons between alcohol-consuming households, whereas Panels (c) and (d) show the comparisons between alcohol-consuming and non-alcohol-consuming households in Bihar. Regressions include district fixed effects and time (month $\times$ year) fixed effects and are weighted to be representative at the state level. Confidence intervals are at the 95 percent level and the interstate comparisons are adjusted for state-level clustering. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

Figure 4: Event Study Results for Intoxicant Consumption: Consumption Shares

A.4 Within State Comparisons



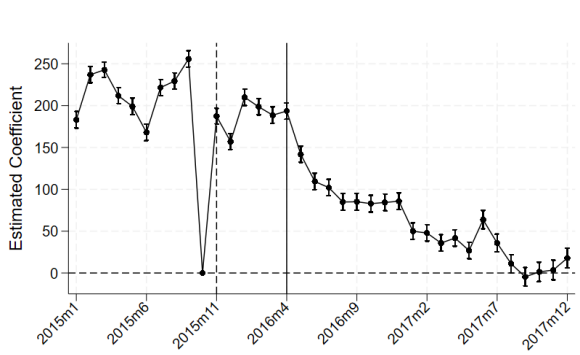
(a) Alcohol Consumption

(b) Cigarettes, Bidis, Tobacco

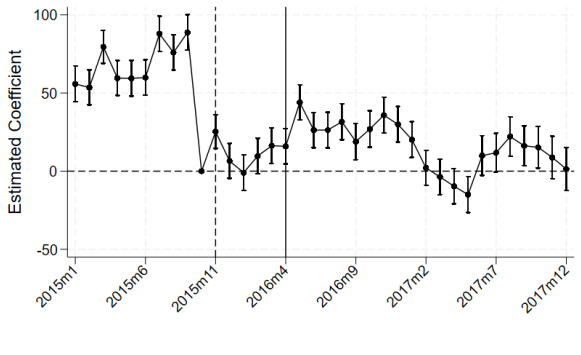
Notes: Each graph includes point estimates from the event study exercise (normalised to 0 in October 2015) comparing alcohol-consuming and non-alcohol-consuming households in Bihar and in the neighbouring states. Regressions include district fixed effects and time (month × year) fixed effects and are weighted. Confidence intervals are at the 95 percent level. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

Figure 5: Event Study Results for Intoxicant Consumption within Bihar: Balanced Panel

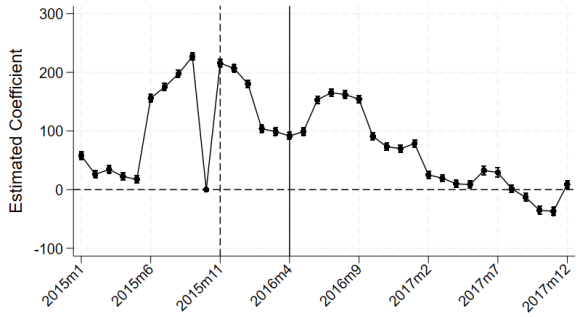
A.5 Placebo Tests



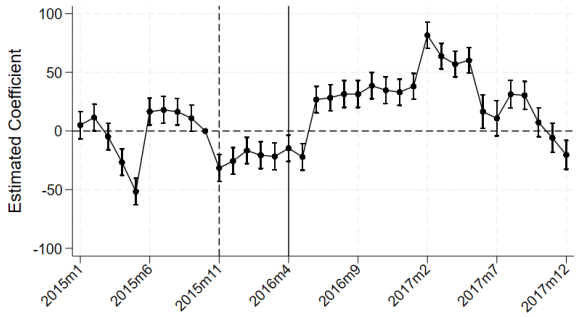
(a) Madhya Pradesh: Alcohol Consumption



(b) Madhya Pradesh: Cigarettes, Bidis, Tobacco



(c) Rajasthan: Alcohol Consumption

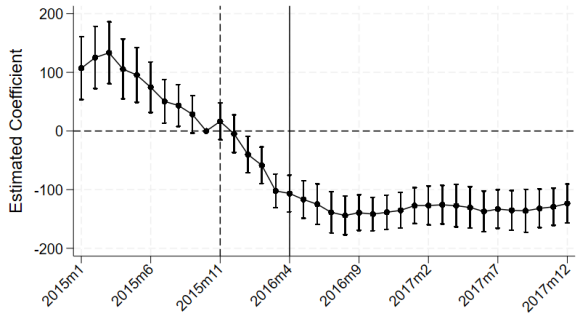


(d) Rajasthan: Cigarettes, Bidis, Tobacco

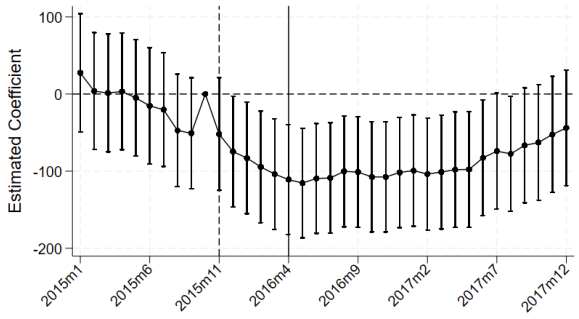
Notes: We conduct placebo tests where, for the within-state comparisons, we compare alcohol and non-alcohol consuming households in the states of Madhya Pradesh, represented by Panels (a) and (b), and Rajasthan, represented by Panels (c) and (d). These are states that have never experienced alcohol or smoking bans, do not share boundaries with Bihar and have a diverse economic and cultural background. Each graph includes point estimates from the event study exercise (normalised to 0 in October 2015) comparing alcohol-consuming and non-alcohol-consuming households. Regressions include district fixed effects and time (month × year) fixed effects and are weighted. Confidence intervals are at the 95 percent level. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

Figure 6: Event Study Results for Intoxicant Consumption within state: Placebo Tests

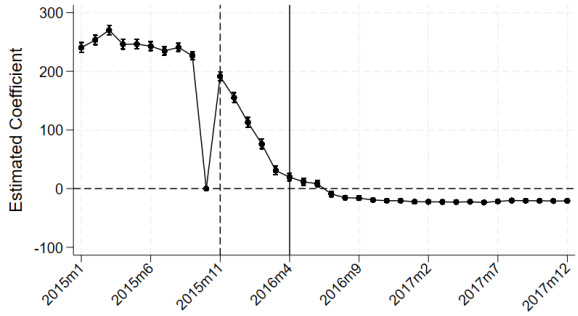
A.6 Clustering



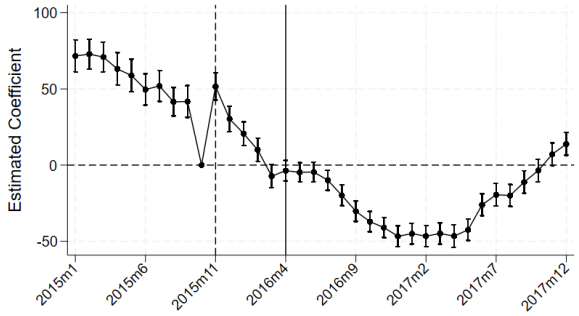
(a) Interstate: Alcohol Consumption



(b) Interstate: Cigarettes, Bidis, Tobacco



(c) Within Bihar: Alcohol Consumption

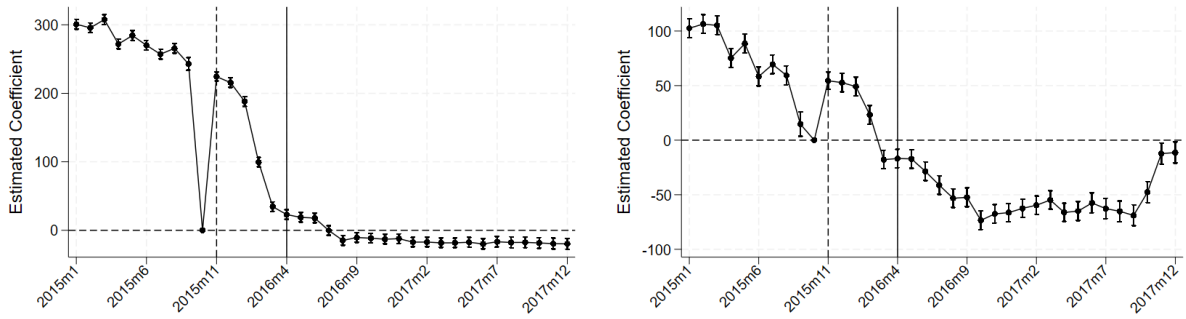


(d) Within Bihar: Cigarettes, Bidis, Tobacco

Notes: We use alternative clustering approaches for robustness. Each graph includes point estimates from an event study exercise (normalised to 0 in October 2015). Panels (a) and (b) show the interstate comparisons between alcohol-consuming households, with standard errors clustered at the *state-time level*; Panels (c) and (d) show the comparisons between alcohol consuming and non-alcohol consuming households in Bihar, with standard errors clustered at the *household level*. Regressions include district fixed effects and time (month × year) fixed effects and are weighted to be representative at the state level. Confidence intervals are at the 95 percent level. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

Figure 7: Event Study Results: Alternative Clustering

A.7 Without border districts of Bihar



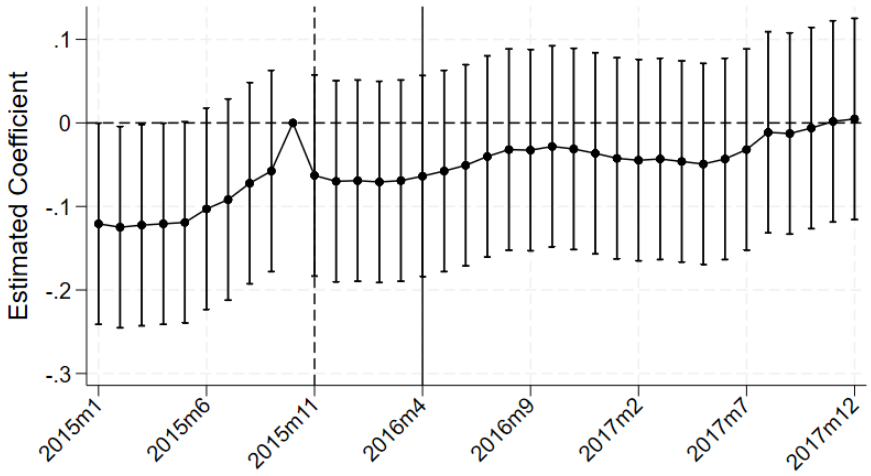
(a) Alcohol Consumption

(b) Cigarettes, Bidis, Tobacco

Notes: Each graph includes point estimates from the event study exercise (normalised to 0 in October 2015) comparing alcohol-consuming and non-alcohol-consuming households in Bihar, excluding those districts that share a border with the neighbouring states of Jharkhand, West Bengal, or Uttar Pradesh. This is done considering that those members who live close to the border of neighbouring states may end up having access to liquor by crossing the border, thereby biasing our estimates. Regressions include district fixed effects and time (month × year) fixed effects and are weighted. Confidence intervals are at the 95 percent level. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

Figure 8: Event Study Results within Bihar: Excluding border sharing districts

A.8 Prices

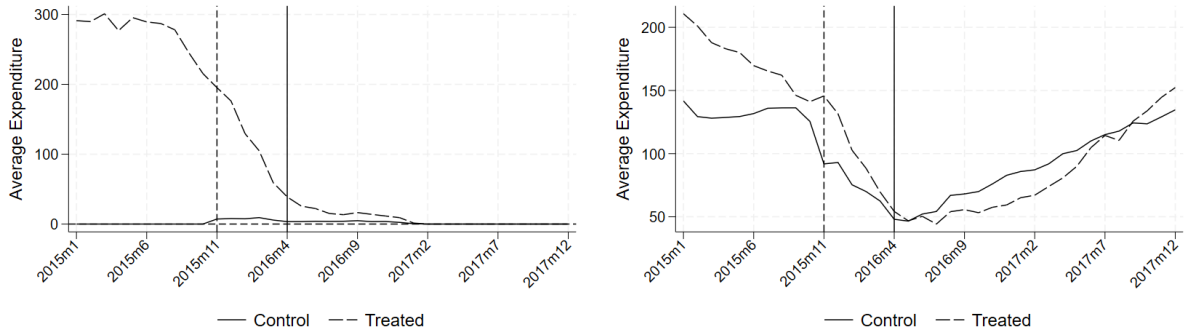


Notes: Each graph includes point estimates from the event study exercise (normalised to 0 in October 2015) comparing Bihar prices for Pan, Tobacco, and Other Intoxicants (treated) to All India (control). Confidence intervals are at the 95 percent level. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively. This series comes from the Ministry of Statistics and Program Implementation, Government of India.

Figure 9: Event Study Results for Prices

B Additional Figures

B.1 Raw trends for Within Bihar



(a) Liquor Expenses

(b) CBT Expenses

Notes: This series comes from the Consumer Pyramids Household Survey (CPHS). Panel (a) plots the average monthly expenses on liquor in the Indian state of Bihar for its alcohol-consuming (treated) and non-alcohol-consuming (control) households; Panel (b) plots the average monthly expenses on Cigarettes, Bidis, and other Tobacco (CBT) in Bihar for the same set of households. The dotted and bold vertical lines represent the months when the ban announcement was made (November 2015) and when it was implemented, April 2016, respectively.

Figure 10: Average Monthly Expenditure on Liquor and CBT within Bihar