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M. Kolosnitsyna, V. Sukhanova[1]

Price elasticities revisited: The effect of price changes caused by taxation on the amount of alcohol consumed

Price elasticity is an important indicator of alcohol consumption. The success of an alcohol policy largely depends on how sensitive the demand is to the price. The purpose of this paper is to determine the effect of vodka price changes on the amount of vodka and pure alcohol consumed by Russian citizens exploiting the variation caused by price regulations, and in particular, taxation. Demand for alcohol is sensitive to its price, as abundant research has shown. However, the price of alcohol, in turn, may depend on demand. To overcome the endogeneity, we used a sharp change in excise tax observed in Russia in 2011 to model the price of vodka using the regression kink design. Based on nationally representative households and individual survey data, we also used the Arellano–Bond method to take into account habit formation. Our results are close to those obtained in other countries but differ from price elasticity values calculated in some work based on Russian data. The results confirm the effectiveness of the tax policy in those years when it increased the real prices of alcohol.

Keywords: alcohol consumption; excise tax; price elasticity; regression kink design; Arellano–Bond method; Russia.

JEL classification: H39; I12; I18; D12.

1. Introduction

Russia is one of the countries with high alcohol intake and the most severe consequences of alcohol abuse. However, in the last decade, there has been a clear trend toward a reduction in the consumption of pure alcohol per capita (APC). Many researchers believe it to be the result of the alcohol policy and call it a 'success story' (WHO, 2017). However, alcohol consumption is influenced by numerous factors. In 2009, Russia faced a decline in GDP, and then a period of economic stagnation, which could reduce alcohol consumption (Rhum, Black, 2002). Also, the group of potential alcohol consumers included new young cohorts refusing alcohol or preferring light drinks (Radaev et al., 2020; Kueng, Yakovlev, 2021). Regardless, Russia remains one of the countries suffering from excessive alcohol consumption and requires alcohol policies to be implemented and correctly evaluated.

[1] **Kolosnitsyna, Marina** — HSE University, Moscow; mkolosnitsyna@hse.ru.
Sukhanova, Varvara — HSE University, Moscow; sukhanovavss@gmail.com.

What is the role of alcohol policy measures in the decline of alcohol consumption observed in Russia? And what is the impact of price measures that experts consider the most effective curbs of alcohol consumption (Wagenaar et al., 2009; Elder et al., 2010; Xu, Chaloupka, 2011; WHO, 2020)? Starting from 2009, the Russian government began to raise the excise tax on alcohol. The tax rate increased unevenly; in some years the growth was rapid, and in other years the tax was "frozen" (Fig. 1), so the dynamics of real alcohol prices turned out to be mixed. This paper is an attempt to disentangle the effect of price policies from other factors which can influence alcohol consumption. Unlike studies that use a thorough narrative analysis (Nemtsov et al., 2019; Neufeld et al., 2021), we rely on econometric modelling to estimate the elasticity of alcohol consumption at its own price.

Numerous studies in different countries have confirmed a significant negative elasticity of demand for alcohol by price (Fogarty, 2006; Gallet, 2007; Wagenaar et al., 2009; Nelson, 2013). However, for Russia, such assessments are few and contradictory. The earliest works of Andrienko, Nemtsov (2006) and Baltagi, Geishecker (2006) on data from the mid-1990s to the early 2000s showed a significant increase in the consumption of alcoholic beverages at the same time as a sharp drop in real prices. More recent work by Goryakin and co-authors (2015) was based on data from 1994 to 2009. Starting from the beginning of the 2000s up until 2009 the real prices of alcohol in Russia did not change a lot (see Fig. 2). Quite predictably, the authors obtained mostly

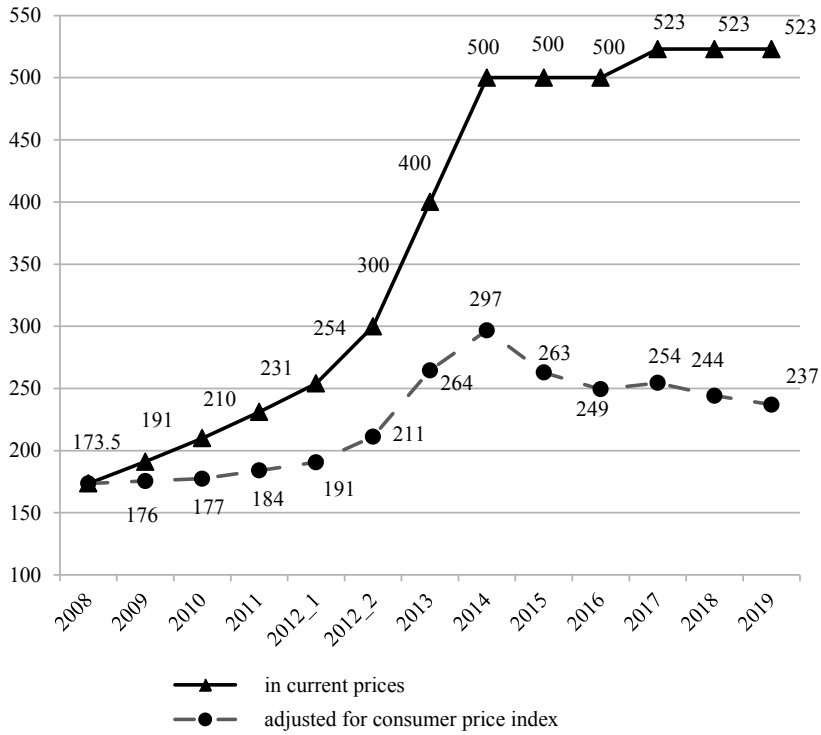

Fig. 1. Excise tax per 1 litre of pure ethanol in vodka, Rubles (in current and real prices), 2008–2019.

(*Sources:* Rosstat, Tax Code of the Russian Federation)

insignificant estimates of the elasticity of demand for different alcoholic beverages. However, there are still no reliable estimates for the price elasticity of amounts of alcohol consumed after 2009.

Data for the most recent years, starting from 2010, allow us to take into account the unprecedented tax increase. Between 2000 and 2010 Russian authorities annually linked the vodka excise tax to the consumer price index (CPI). During the next three years, the tax rate grew at twice the rate of the CPI growth rate. We call it a kink in policy regime, following Yakovlev (2018) who estimated the price elasticity of being a heavy drinker. In our paper, we apply a regression kink design (RKD, Card et al., 2016) to estimate the price elasticity of volumes of alcohol consumed. We use the change in the slope of the excise tax to obtain causal effect estimates around 2011. We explore the data from nationally representative households and individual survey. Along with the prices of alcohol and the socio-demographic characteristics of consumers, we consider habit formation, as is customary in classical models (Becker, Murphy, 1988; Cook, Moor, 2000).

The purpose of this paper is to determine the effect of vodka price changes on the amount of vodka and pure alcohol consumed by Russian citizens exploiting the variation caused by taxation.

2. Studies on price-sensitivity of alcohol consumption

Anderson et al. (2012) mention three meta-analyses where average price elasticity estimates were obtained. Each item of research contained a list of unique papers that were not mentioned in previous meta-analyses. Citing 64 studies from the EU countries, the USA, Canada, Australia, New Zealand, Korea, Japan, and Kenya, Fogarty (2006) reported that the average price elasticity of spirits consumption in these countries was –0.7, while the average spirits intake was 5.5 litres and the average APC 9.4 litres per year. Gallet (2007) based his conclusions on 132 studies from 24 countries and found the price elasticity of spirits to be –0.68. Another meta-analysis of Wagenaar et al. (2009) included 112 studies and reported that the price elasticity of spirits was equal to –0.8. The last two papers also provide estimates for the total price elasticity of alcoholic beverages (–0.5). The studies included both aggregate and individual-level estimates and used different methods of estimation. However, after correction for the publication bias and outliers, Nelson (2013) obtained a new value of average price elasticity of spirits at the individual level equal to –0.55. Overall, the papers mentioned predict that a 1% increase in the alcohol price leads to a 0.5–0.8% decrease in spirits consumption and a 0.5% decrease in total alcohol consumption. These estimates were obtained mostly from data from the EU and USA, and thus cannot be directly applied to the Russian alcohol market.

Most of Russian research on price elasticities of alcohol intake were based on the microdata obtained from the RLMS-HSE — a series of annually nationally representative panel surveys — and used different methodologies. Andrienko and Nemtsov (2006) used 1994–2002 data. In the "myopic" case they assumed a quadratic utility function and a marginal utility of income to be constant. They also included past consumption in the demand function to reflect the addictive nature of alcohol. Using the same assumptions, they ran both myopic and rational addiction models and compared the results. However, they did not find any evidence of rational addiction behaviour among Russian alcohol drinkers. Vodka price elasticity was statistically significant and equal to –1.8. Baltagi and Geishecker (2006) aimed to check if Russian alcohol consumers were following rational addiction behaviour between 1994 and 2003. They made an assumption about the quadratic utility function and also included future consumption in their demand function. The authors

implemented an instrumental variables approach using lagged and future prices as instruments. They found some evidence of rational addiction for men, but not for women. Moreover, they noticed a difference between factors driving male and female alcohol consumption in Russia and proposed to estimate the models separately by gender. Both short-run and long-run price elasticities were not statistically significant for males and females. Hertzfeld et al. (2014) estimated demand for pure alcohol using the data from 1994 to 2005. They paid special attention to selection bias and sample attrition and applied the generalized method of moments. The value of price elasticity of pure alcohol consumption turned out to be –0.10 for the whole sample and varied between subsamples of males/females and young/old respondents. Goryakin et al. (2015) estimated price elasticities of demand for different alcoholic beverages using the data from 1994 to 2009. They estimated a model with regional fixed effects to control for community-level socioeconomic conditions, though ignored the habit formation effect. The authors found an effect of alcohol price changes on its consumption. But for different beverages, the effect was weak and for some of them insignificant. Kolosnitsyna et al. (2015) used more recent data from 2010–2013 and estimated the Tobin model with random effects. They got the statistically significant estimate for vodka consumption price elasticity (–0.01). However, they did not take habit formation into account.

The estimates made on the RLMS data vary significantly, partly due to differences in the research methodology but mainly because of the different periods chosen for analyses. None of these researchers used the kink in the taxation policy regime that happened in 2011 as a source of the exogenous variation, which could help to obtain reliable estimates of alcohol consumption elasticity. Yakovlev (2018) was the first one who applied the regression kink design to estimate the price elasticity of being a heavy drinker using a discrete choice model and the data from 2000–2014. He concluded that a 50% vodka price increase could decrease the proportion of heavy drinkers by 25%. However, he did not estimate the price elasticities of alcohol consumption volumes.

Based on the results of previous studies and the dynamics of alcohol consumption in Russia in recent years, we test the following hypothesis: *The consumption of vodka and alcohol in general in Russia is just as price-sensitive as in other countries*. In particular, in those years when the government consistently implements a price policy by increasing excise taxes on alcohol, we should observe a statistically significant reduction in the consumption of vodka and alcohol.

3. Data and measurements

We used a representative sample of the Russian Longitudinal Monitoring Survey (RLMS-HSE) conducted annually by the Higher School of Economics and ZAO "Demoscope" along with the Carolina Population Center, the University of North Carolina at Chapel Hill, and the Institute of Sociology at the Russian Academy of Sciences[2]. The longitudinal design and repeated sample of this survey make it possible to use panel data; its questionnaires provide rich information on individuals' demographic and socioeconomic characteristics, including alcohol consumption. Survey information is obtained using personal interviews. The RLMS-HSE interviews are conducted annually in 38 out of 85 regions of Russia. People from one to 21 residential areas (communities) are surveyed in each region. New individuals are added to the survey every year due

[2] See https://www.hse.ru/en/rlms/.

to sample attrition. The RLMS-HSE sample is representative of the Russian Federation at the national level (Kozyreva et al., 2016).

The unbalanced panel sample used in this study included respondents aged 15 years and older, who participated in at least one of the seven waves of the study from 2008 to 2014 and answered questions on alcohol consumption. After removing the outliers (the top 1% in alcohol consumption), the sample contained 72504 responses from 7000 to 13000 respondents annually. Every round of the RLMS-HSE includes three main surveys: of individuals, households, and communities. Data used from each survey will be discussed below.

3.1. Individual survey

Individual data included a set of demographic and socioeconomic characteristics: age, gender, marital status, level of education, employment status, and religion. All these characteristics were controlled for as independent variables. Aside from age which was measured in years, all the other variables were dummies. The variable of marital status was equal to 1 if a respondent was officially married or lived with a partner. A dummy for a college degree was created to take the level of education into account. Following Yakovlev (2018), we also created a dummy indicating if the person was Muslim. Another dummy variable indicated if the person lived in a city that is an administrative regional centre (including Moscow and Saint Petersburg).

As a part of the survey, respondents were asked questions about alcohol consumption (in grams), in particular vodka, beer, fortified and table wines, homemade spirits (moonshine), and other alcoholic beverages. The respondents had to say how many times and in what quantities they were drinking each type of beverage during the last month. Overall, 33% of the sample did not drink alcohol at all. However, 47% of the sample had consumed alcohol within the 30 days before the survey. The volume of vodka consumed was calculated based on the frequency and quantity of daily consumption by individuals. All quantities were measured in grams per month.

The alcohol consumption of those who did not consume alcohol at all or within the last 30 days was set as equal to zero. If we removed these respondents, we would only get an effect of prices for current drinkers. Thus, it was important to leave these "zero-consumers" in the sample as we wanted to find an overall effect of the vodka price change on the amount of alcohol consumed. The amount of pure alcohol consumed by an individual within the last 30 days (in grams) was calculated using formula (1). The calculations were based on the data from the RLMS-HSE and Rosstat on the average pure alcohol concentration in various alcoholic beverages:

$$PureAlcohol = 0.4HardDrinks + 0.4Moonshine + 0.18FortifiedWine + \\ + 0.12DryWine + 0.05Beer. \quad (1)$$

Notice that the consumption of moonshine (homemade spirit) is also included in calculations, thus allowing the capture of potential substitution effects. However, each year only 5–8% of the sample reported that they consumed moonshine and the share of moonshine in the total alcohol intake was around 3–5%.

The descriptive statistical data on the individual characteristics of respondents are presented in Table 1. Individuals aged 15 to 90 years are included in the sample. The average age of respondents is 46 years. Females prevail over males. More than a half of the sample is married or lives

together with their partner. In total, 24% have college education and 55% are employed. Overall, 40% of the sample live in the regional centres (including Moscow and Saint Petersburg).

On average, 185 grams of vodka is consumed by an individual within 30 days. These calculations include those who never drink and have zero consumption. Overall, consumption of vodka varies from 0 to 15 litres per month, or 1 bottle (0.5 L) of vodka daily. APC is equal to 160 grams per month, which is equivalent to 1.9 litres per year.

3.2 Household survey

Each individual was attached to a household. Household size varied from 1 to 14 members, but 70% of the households consisted of 2–4 members. Based on the data on aggregate family income and the family size, the average income per family member was calculated and used in further estimations. The average income per family member during the last 30 days before the survey varied from 0 to 140000 Rubles, the mean and median values were 12477 and 10125 Rubles, respectively (in prices of 2010).

Table 1. Descriptive statistics of individual and household characteristics

Variables	Mean (1)	Median (2)	SD (3)	Min (4)	Max (5)
N = 72502					
Age (years)	46.01	46	18.56	15	90
I(Female)	0.584	1	0.493	0	1
I(Married)	0.597	1	0.491	0	1
I(Muslim)	0.0436	0	0.204	0	1
I(College)	0.240	0	0.427	0	1
I(Employed)	0.545	1	0.498	0	1
Income per family member, Rub. per month, 2010 prices	12477	10125	9677	0	140000
I(Regional centre)	0.401	0	0.490	0	1
I(Ever drinks)	0.672	1	0.470	0	1
I(Has drunk in the last 30 days)	0.469	0	0.499	0	1
Vodka consumption in the last 30 days (in grams)	185.3	0	751.6	0	15000
Pure alcohol consumption in the last 30 days (in grams)	160.2	0	459.5	0	8000

Source: RLMS-HSE.

Note. Here and further I(·) is equal to 1, if the respondent is female, Muslim, married, has a college degree, etc. Otherwise, I(·) = 0.

3.3. Community survey

Every year interviewers also collect community-level data including the minimum and maximum prices of goods in local grocery stores they visit in each residential area. Thus, minimum and maximum nominal prices of 1 litre of vodka are available. Maximum prices are not representative for this research, as cheap vodka is the beverage that is mostly consumed in Russia.

Moreover, the average household income per family member is quite low in the RLMS-HSE sample, also making the minimum price more relevant for this study. We used a community-level consumer price index calculated by Yakovlev (2018) to get the real prices of vodka compatible by years. Therefore, we used a logarithm of a real minimum price of 1 litre of vodka in community as the regressor of interest.

3.4. Rosstat data

Region-level data was obtained from Rosstat, a Russian governmental statistics agency. We used average regional prices of vodka as an alternative price variable for sensitivity analysis. Also, regional consumer price indices and unemployment rates provided by Rosstat were used.

Table 2 presents descriptive statistical data on vodka prices and consumer price indices collected both at the community and regional levels.

Table 2. Descriptive statistics of the main regional and community-level characteristics

Variables	Mean (1)	Median (2)	SD (3)	Min (4)	Max (5)
Community (*N = 1043: 149 communities over 7 years*)					
Log (Lowest real price of vodka, Rubles per litre, in community)	0.507	0.520	0.385	–0.927	1.356
Log (Highest real price of vodka, Rubles per litre, in community)	1.497	1.404	0.630	–0.069	3.989
Community-level CPI, %	131.3	127.2	36.9	56.6	347.2
Region (N = 266: 38 regions over 7 years)					
Regional unemployment, %	6.47	6.20	2.28	0.80	17.80
Regional CPI, %	108.5	107.0	3.6	103.8	118.0
Average real price of vodka (Rubles per litre, in region)	304.9	256.8	122.3	149.1	680.6

Source: Rosstat, RLMS-HSE, Yakovlev (2018).

3.5. Data issues

The sample of the RLMS-HSE barely includes wealthy and upper-middle-class respondents. According to Rosstat, the average monthly income in Russia was around 23000–27000 Rubles during the observation period, while the sample average was 12500 Rubles (in 2010 prices). It is important to take into account that elasticity estimates can differ between groups with different income levels. Thus, in this study, we are more likely to get elasticity estimates for people with moderate incomes. Also, the average per capita alcohol consumption in the RLMS-HSE sample is 1.9 litres per year, which is significantly lower than in the country as a whole. According to the WHO data (WHO, 2018, p. 45), the average APC in Russia is about 11–12 litres per year. Since the RLMS-HSE sample is biased in terms of income, it inevitably leads to a bias in the volume of alcohol consumed: those with higher income normally drink more (all other things being

equal). In other words, the RLMS-HSE respondents drink less simply because they are less wealthy. Besides, the individual survey usually does not include those who drink a lot. People could lie about their drinking habits. Some of them choose not to participate in the interview. However, for the purpose of this research, this is not such an issue. We are more interested in finding the relationship between vodka price and alcohol consumption rather than estimating the average amount of alcohol consumed per person.

4. Methodology

The price of vodka is not random. It is defined by many factors such as CPI, demand for and supply of alcohol, excise taxes, and other unobservable factors. So, by including vodka price as a regressor in the model of alcohol consumption, we are likely to face an endogeneity and the final estimates will be biased. A special estimation design is required to avoid this issue.

We use a kink in a state tax policy to find a causal effect of the price change on the amount of alcohol consumed. From 2000 to 2010 Russian authorities annually linked the vodka excise tax to the CPI growth rate. Starting from 2011 to 2014 the growth rate of the tax exceeded the CPI growth rate more than twice. After 2014, the tax was not linked to the CPI anymore; its nominal value stayed almost the same and increased only by 8.8% from 2014 to 2020. Thus, the data after 2014 were not included in the sample.

Figure 2 presents the kink in the policy regime and demonstrates that the average price of vodka in the country moved along the same trajectory as the excise tax. This exogenous modification in a policy regime allows the use of a change in the slope of a policy function to obtain a local average treatment effect around 2011 using a regression kink design (RKD, Card et al., 2016).

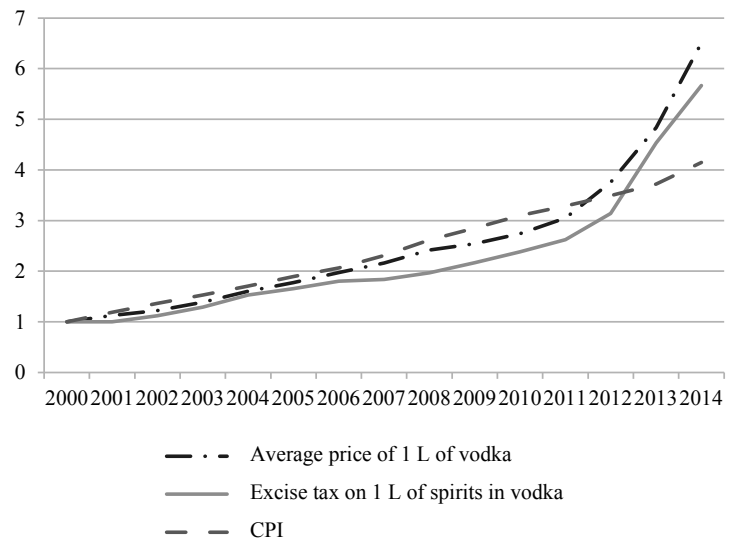

Fig. 2. Excise tax on 1 L of spirits in vodka, average price of 1 L of vodka, consumer price index, 2000–2014 (all the values are set to 1 at year 2000).

(*Sources:* Rosstat, Tax Code of the Russian Federation)

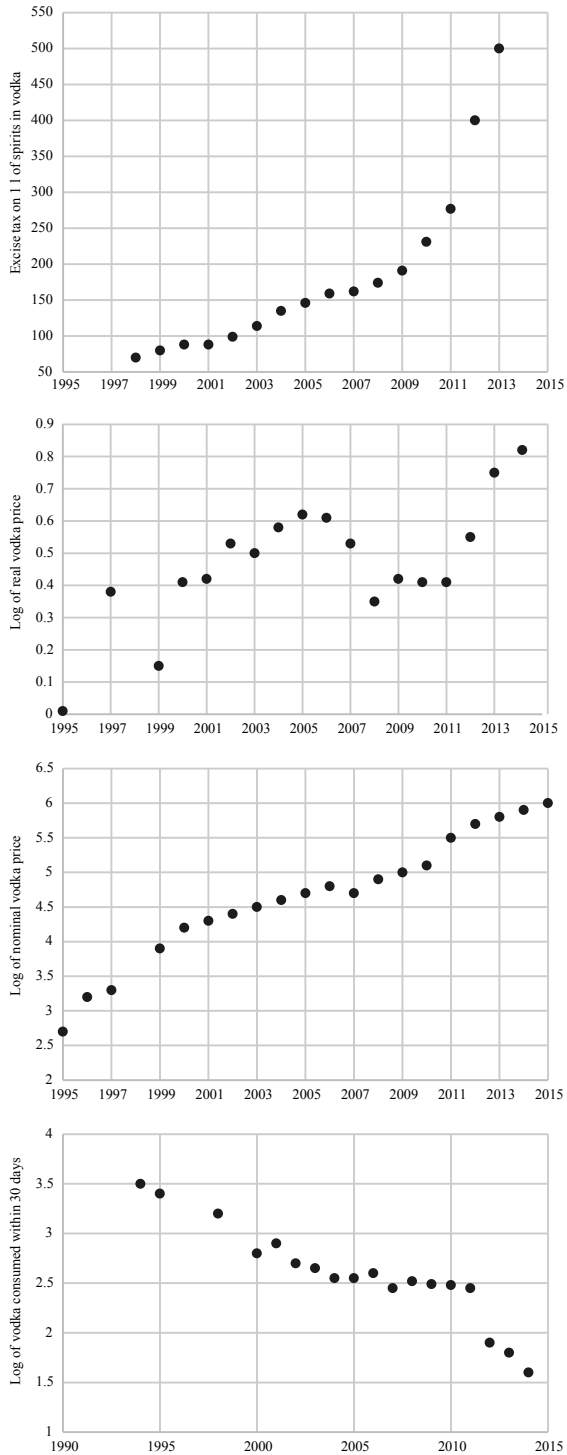

Fig. 3. Averages (by year) of the excise tax on 1 L of spirits in vodka (Rubles), real and nominal prices of vodka, and volumes of vodka consumed within last 30 days (logarithms).

(*Sources:* Tax Code of the Russian Federation; RLMS-HSE 1994–2014)

In the case of the causal relationship between vodka price and consumption, a change in a policy regime that causes a kink in price will lead to a kink in consumption. In 2011, there was a clear kink in the dynamics of real and nominal vodka prices, as well as vodka consumption (Fig. 3). If there is a kink in the price of vodka while all other underlying variables behave smoothly before and after 2011, then we can conclude that the change in the vodka consumption was entirely caused by a kink in a policy. The smooth distribution of other covariates is a main identifying assumption of the RKD. Figure 4 represents the behaviour of three independent variables in time: there was no kink in 2011, so we can proceed using RKD.

To estimate RKD specification, we used a two-stage procedure represented by equations (2) and (3). We assumed a linear RKD, as before 2011 excise tax growth rate was linked to the CPI growth rate and after 2011 it exceeded the CPI growth rate more than twice.

First stage:

$$\log(LowestVodkaPriceReal_{ct}) = \alpha_1 \mathrm{I}\{t \geq 2011\}(t-2011) + \alpha_2 (t-2011) + \\ + \alpha_3 \log(CPI_{ct}) + \alpha_4 \chi_r + \alpha_5 X_{ict} + \xi_{ct}. \quad (2)$$

Second stage:

$$\log Q(Vodka)_{it} = \beta_1 \left(\widehat{LowestVodkaPriceReal}_{ct}\right) + \beta_2 (t-2011) + \\ + \beta_3 \log(CPI_{ct}) + \beta_4 \chi_r + \beta_5 X_{ict} + \varepsilon_{ict}. \quad (3)$$

In the first stage, the local real price of vodka is instrumented by $\mathrm{I}\{t \geq 2011\}(t-2011)$, which allows for the different slopes before and after 2011. $\mathrm{I}\{t \geq 2011\}$ is an indicator that is equal to zero if the year is before 2011 and 1 otherwise. $(t-2011)$ indicates the time before/after 2011. The logarithm of a consumer price index at a community level, $\log(CPI_{ct})$, takes into account that excise tax is linked to the CPI growth rate. Regional fixed effects χ_r are also included in the model. X_{ict} are the demographic and socioeconomic characteristics of the individual *i* in the community *c*. In the second stage, we use the lowest community price estimate obtained at the first stage and the same set of control variables to find an effect of price on individual vodka consumption $Q(Vodka)_{it}$. For individuals who do not drink at all, we set the logarithm of vodka consumption equal to zero. Estimation was done with the *ivreg* STATA function.

From the previous studies, we know that numerous non-price characteristics affect alcohol consumption. Considering the design of this research, we can first estimate the causal effect of price on consumption by simply running a model without any extra control variables. If the exogenous kink in a policy regime is significant and other variables behave smoothly around the cutoff, we should get an unbiased estimate of the elasticity even without control variables. In this situation, adding controls will only improve the goodness of the model's fit, but should not affect the elasticity estimate. However, we cannot be sure if all the underlying variables that affect vodka consumption behaved smoothly; therefore, it is useful to find out how adding control variables will change the elasticity estimate. So, age, sex, marriage status, religion, education, employment status, family income, regional unemployment, and place of settlement were used as controls.

Habit formation is incorporated into our analysis by estimating a dynamic panel data model (DPD). This approach is based on adding the lag of the dependent variable as the independent variable to the model. Thus, we can take into account the effect of previous alcohol consumption on current consumption. The DPD is estimated using the Arellano–Bond model (Arellano, Bond, 1991).

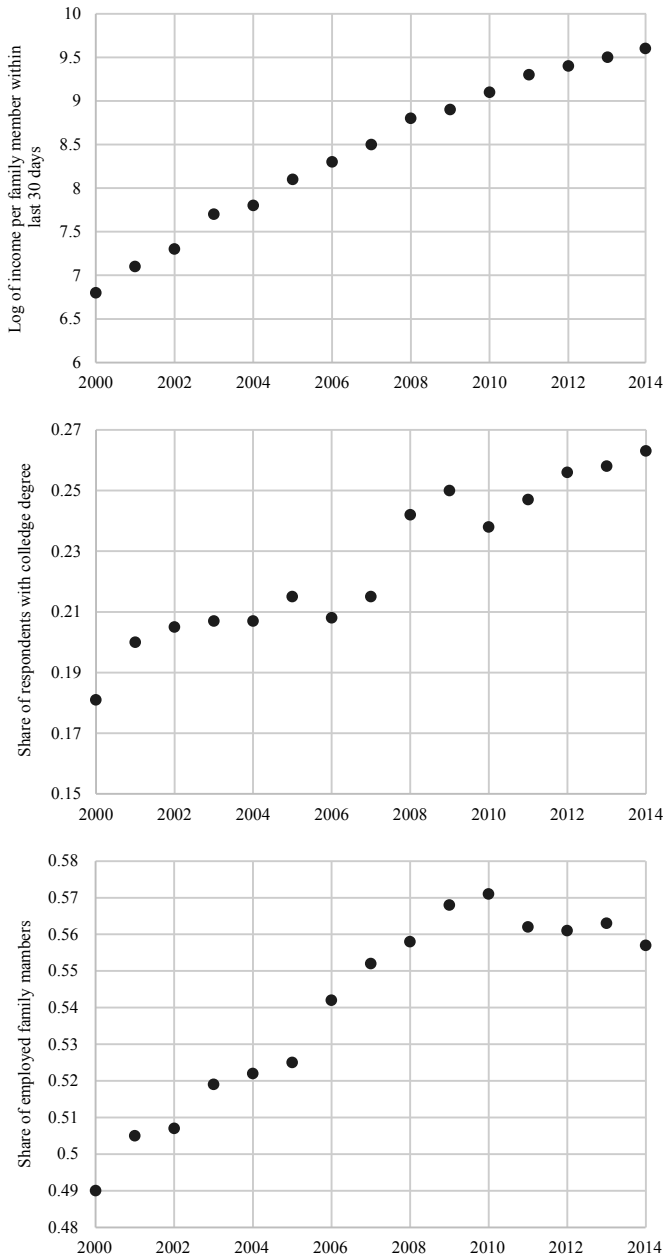

Fig. 4. Averages (by year) of the Log of income per family member within the last 30 days (Rubles, in 2010 prices), the share of respondents with a college degree, and the share of employed members of the family.

(*Source:* RLMS-HSE 2000–2014)

It is estimated in first differences using longer lags as an instrument that does not depend on error term difference. We apply the generalized method of moments that helps to obtain more efficient estimates of the dynamic panel data model.

So, we used three main specifications of the model.

(1) The simple two-stage RKD estimation.

(2) RKD combined with fixed effect (FE) on the second stage of estimation. Thus, we use the panel structure of the data that could increase the share of the explained variance, while not dramatically changing the elasticity estimate.

(3) RKD combined with the Arellano–Bond model. We use the kink in price to tackle endogeneity and include one lag of alcohol consumption to account for habit formation.

All the specifications mentioned were estimated twice: without controls and with controls.

One of the main concerns about rising alcohol prices is a potential substitution effect. Policymakers are worrying that an increase in the price of vodka will make drinkers produce and consume more homemade spirits, causing even more damage to health. So, following the same approach described above, we estimated the effect of vodka price change on the total amount of pure alcohol consumed.

5. Results

Estimating the three specifications of our model, all of them with and without controls, we got six values of vodka price elasticity (full alternative estimates are given in Appendix A). In all the specifications, the price elasticity coefficients were significant and varied from –1.24 to –0.75. Also, all the specifications demonstrated a positive coefficient of the kink variable. Other coefficients did not differ significantly between specifications that can be considered a robustness check.

Table 3 presents the estimate of the third specification (combined RKD and Arellano–Bond models) with controls. We consider this model to be the best. It took into account the changes in policy and the formation of habits. The estimated elasticity of vodka consumption was –1.24. The lag of the previous vodka consumption was significant and had a positive effect (0.12) on current consumption.

If we look at the last two columns of the table in the Appendix A (two specifications including lagged alcohol consumption), the coefficients at last year's consumption volumes are significant and positive, which indicates the influence of habit on current consumption. The coefficients of the price elasticity of consumption are negative, and modulo they are indeed larger than in the other specifications. But taking into account the influence of previous consumption, the total impact of price and habit will be weaker due to the multidirectional nature of these effects. That is, the habit counteracts the influence of the rising price.

Following the same approach, we estimated the effect of vodka price change on the amount of pure alcohol consumed (Appendix B). The control variables' coefficients had the same signs as for vodka consumption and were mostly significant. The price elasticity estimates were lower than for vodka consumption. This conforms to economic intuition. We expect the vodka price regulations to directly influence its consumption, while total alcohol intake can be influenced less due to a potential substitution effect (substitution of beer or home-distilled wine for vodka). However, this effect did not prevail: we still had the negative price elasticity estimate. If the price of vodka increases by 1%, it will cause a 0.5–0.93% decrease in pure alcohol consumption.

Table 3. Estimates of price elasticity of vodka consumption: RKD and Arellano–Bond model with controls

Panel A. First stage	
Dependent Variable — Log of lowest real price of vodka in community	
$I\{t \geq 2011\}(t - 2011)$	0.122***
	(0.003)
Log of community-level CPI	–0.302***
	(0.008)
Time ($t - 2011$)	0.032***
	(0.002)
Constant	1.811***
	(0.046)
Regional dummies	No
Controls	Yes
Method	RKD & Arellano–Bond
Fixed effects	No
Observations	67089
R-squared	0.220
Panel B. Second stage.	
Dependent variable — Log of vodka consumption in the last 30 days	
Log of lowest real price of vodka in community	–1.238***
	(0.288)
Log of community-level CPI	–0.530***
	(0.113)
Time (Year – 2011)	0.022
	(0.061)
Lag of Log (Vodka consumption)	0.119***
	(0.015)
Age	0.086*
	(0.046)
Age squared	–0.001*
	(0.000)
I(Married)	0.135
	(0.098)
I(College)	0.007
	(0.113)
I(Employed)	0.029
	(0.066)
Log of Income per family member	0.068*
	(0.039)
Log of Regional unemployment	0.046
	(0.148)
Constant	0.801
	(2.073)
Region dummies	No
Controls	Yes
Method	RKD & Arellano–Bond
Fixed effects	No
Observations	23954
Number of IDIND	10150

Note. Robust standard errors in parentheses. *** — $p < 0.01$, * — $p < 0.1$.

6. Sensitivity analysis and robustness check

For the sensitivity analysis, we estimated the same models with an alternative price measure, the average regional price of vodka provided by Rosstat. The estimated coefficients are presented in Appendix C. The coefficients for control variables had the same signs as before. The price elasticity estimates were lower by absolute values than in the case of community prices. Rosstat collects prices only in two to four cities from each region and in stores that have a stable supply of all goods. These are large stores that on average have higher prices for alcohol. Prices from the smaller cities and villages are not collected at all. Therefore, the lowest local prices were more likely to provide proper estimates of the consumption elasticity.

For an extra robustness check, we estimated the first specification of the model on a subsample excluding about 8000 respondents who consumed alcohol in restaurants and bars where they were more likely to face higher prices (Appendix D). The results were mostly the same, so we can conclude that the results were robust.

7. Discussion and conclusion

We estimated the effect of vodka price changes on the amount of vodka and pure alcohol consumed by Russians exploiting the variation caused by the kink in a tax policy. This methodological approach allowed us to overcome the possible endogeneity of prices and demand for vodka. RKD in combinations with the fixed effect estimator and Arellano–Bond estimator provided a number of elasticity values. Price elasticities of vodka consumption estimated using the lowest community price varied between –1.24 and –0.75 and were close to the results obtained for other countries (Fogarty, 2006; Gallet, 2007; Wagenaar et al., 2009). Our results also support earlier works that used the data from the years of real price decrease in Russia (Andrienko, Nemtsov, 2006; Baltagi, Geishecker, 2006). However, our estimates differ a lot from the most insignificant results of Goryakin et al. (2015), based on the data from the period of inconsistent price policy.

The elasticities estimated in this study represent a local average treatment effect of government alcohol policy around 2011. The results were quite stable within the sensitivity analysis and robustness checks. As the sample is biased in income, we are more likely to get elasticity estimates for less wealthy people that can differ from overall elasticity. This is by no means a limitation of this research.

However, our estimates allow us to assert the effectiveness of the tax policy to combat alcohol consumption in modern Russia. Critics of alcohol policy often point out that an increase in the price of vodka can lead to its replacement with other alcoholic beverages, including homemade ones. But our estimates showed that a 1% increase in the price of vodka led to a decrease in pure alcohol consumption by 0.5–0.93%. Thus, the price measures of 2011–2014 were effective not only for reducing vodka consumption but also for reducing alcohol intake in general. These measures contributed to the overall decline in alcohol sales and consumption that we observed in Russia in the recent decade.

The hypothesis of the study has been confirmed: the estimates of the elasticity of consumption of vodka and pure alcohol at the price of vodka in Russia were close to the values obtained in other countries. In the years when the government consistently implemented a price policy, we observed a statistically significant reduction in the consumption of vodka and alcohol.

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Appendix A

Alternative estimates of price elasticity of vodka consumption

	Specification (1)		Specification (2)		Specification (3)	
Panel A. First Stage. Dependent variable — Log of lowest real price of vodka in community						
I{$t \geq 2011$}($t - 2011$)	0.118***	0.118***	0.125***	0.122***	0.125***	0.122***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Log of community-level CPI	–0.475***	–0.466***	–0.259***	–0.302***	–0.259***	–0.302***
	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)
Time ($t - 2011$)	0.061***	0.071***	0.038***	0.032***	0.038***	0.032***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	2.709***	2.391***	1.668***	1.811***	1.668***	1.811***
	(0.032)	(0.039)	(0.039)	(0.046)	(0.039)	(0.046)
Regional dummies	Yes	Yes	No	No	No	No
Controls	No	Yes	No	Yes	No	Yes
Fixed effects	No	No	Individual	Individual	No	No
Method	RKD	RKD	RKD	RKD	RKD & Arellano–Bond	RKD & Arellano–Bond
Observations	67089	67089	67089	67089	67089	67089
R-squared	0.447	0.452	0.197	0.220	0.197	0.220
Panel B. Second Stage. Dependent variable — Log of vodka consumption in the last 30 days						
Log of lowest real price of vodka in community	–0.792***	–0.752***	–1.087***	–1.128***	–1.071***	–1.238***
	(0.159)	(0.152)	(0.144)	(0.149)	(0.250)	(0.288)
Log of community-level CPI	–0.463***	–0.424***	–0.400***	–0.456***	–0.441***	–0.530***
	(0.091)	(0.085)	(0.059)	(0.065)	(0.099)	(0.113)
Time (Year – 2011)	–0.006	–0.011	0.031*	–0.039	0.038	0.022
	(0.022)	(0.023)	(0.017)	(0.034)	(0.035)	(0.061)
Lag of Log(vodka consumption)					0.120***	0.119***
					(0.014)	(0.015)
Age		0.133***		0.133***		0.086*
		(0.004)		(0.033)		(0.046)
Age squared		–0.001***		–0.001***		–0.001*
		(0.000)		(0.000)		(0.000)
I(Female)		–1.497***				
		(0.031)				
I(Married)		0.156***		0.029		0.135
		(0.029)		(0.051)		(0.098)
I(Muslim)		–0.227***				
		(0.069)				
I(College)		–0.209***		0.027		0.007
		(0.032)		(0.064)		(0.113)
I(Employed)		0.173***		0.072*		0.029
		(0.031)		(0.038)		(0.066)
Log of income per family member		0.025		0.043*		0.068*
		(0.019)		(0.022)		(0.039)

End of table Appendix A

	Specification (1)		Specification (2)		Specification (3)	
I(Regional center)		0.788*** (0.124)				
Log of regional unemployment		0.126 (0.059)		–0.113** (0.048)		0.046 (0.148)
Constant	3.715*** (0.511)	0.291 (0.521)	3.850*** (0.340)	–0.509 (1.453)	3.894*** (0.572)	0.801 (2.073)
Region dummies	Yes	Yes	No	No	No	No
Controls	No	Yes	No	Yes	No	Yes
Fixed effects	No	No	Individual	Individual	No	No
Method	RKD	RKD	RKD	RKD	RKD & Arellano–Bond	RKD & Arellano–Bond
Observations	67089	67089	67089	67089	23954	23954
R-squared	0.015	0.149	0.010	0.011		
Number of IDIND			21652	21652	10150	10150

Note. Robust standard errors in parentheses. *** — $p < 0.01$, ** — $p < 0.05$, * — $p < 0.1$.

Appendix B

Estimates of price elasticity of pure alcohol consumption

	Specification (1)		Specification (2)		Specification (3)	
Panel A. First Stage. Dependent variable — Log of lowest real price of vodka in community						
$I\{t \geq 2011\}(t - 2011)$	0.118*** (0.003)	0.118*** (0.003)	0.125*** (0.003)	0.122*** (0.003)	0.125*** (0.003)	0.122*** (0.003)
Log of community-level CPI	–0.475*** (0.007)	–0.466*** (0.007)	–0.259*** (0.008)	–0.302*** (0.008)	–0.259*** (0.008)	–0.302*** (0.008)
Time ($t - 2011$)	0.061*** (0.002)	0.071*** (0.002)	0.038*** (0.002)	0.032*** (0.002)	0.038*** (0.002)	0.032*** (0.002)
Constant	2.709*** (0.032)	2.391*** (0.039)	1.668*** (0.039)	1.811*** (0.046)	1.668*** (0.039)	1.811*** (0.046)
Regional dummies	Yes	Yes	No	No	No	No
Controls	No	Yes	No	Yes	No	Yes
Method	RKD	RKD	RKD	RKD	RKD & Arellano–Bond	RKD & Arellano-Bond
Fixed effects	No	No	Individual	Individual	No	No
Observations	67089	67089	67089	67089	67089	67089
R-squared	0.447	0.452	0.197	0.220	0.197	0.220
Panel B. Second Stage. Dependent variable — Log of pure alcohol consumption in the last 30 days						
Log of lowest real price of vodka in community	–0.669*** (0.154)	–0.503*** (0.146)	–0.769*** (0.131)	–0.788*** (0.134)	–0.889*** (0.214)	–0.930*** (0.151)
Log of community-level CPI	–0.267*** (0.089)	–0.164** (0.083)	–0.212*** (0.055)	–0.253*** (0.059)	–0.203** (0.092)	–0.256*** (0.103)

End of table Appendix B

	Specification (1)		Specification (2)		Specification (3)	
Time (Year – 2011)	–0.021	–0.056**	–0.003	–0.084**	–0.003	–0.039
	(0.021)	(0.028)	(0.016)	(0.038)	(0.029)	(0.065)
Lag of Log (vodka consumption)					0.136***	0.138***
					(0.015)	(0.015)
Age		0.105***		0.149***		0.076
		(0.004)		(0.038)		(0.059)
Age squared		–0.001***		–0.001***		–0.001*
		(0.000)		(0.000)		(0.000)
I(Female)		–1.445***				
		(0.032)				
I(Married)		0.269***		–0.058		0.066
		(0.031)		(0.051)		(0.097)
I(Muslim)		–0.322***				
		(0.074)				
I(College)		–0.024		–0.056		0.121
		(0.034)		(0.064)		(0.123)
I(Employed)		0.473***		0.169***		0.135**
		(0.034)		(0.036)		(0.067)
Log of income per family member		0.095***		0.094***		0.121***
		(0.021)		(0.022)		(0.038)
I(Regional center)		0.712***				
		(0.152)				
Log of regional unemployment		–0.058		–0.191***		–0.022
		(0.052)		(0.046)		(0.131)
Constant	3.936***	0.382	3.810***	–1.185	3.509***	0.182
	(0.501)	(0.520)	(0.310)	(1.681)	(0.516)	(2.580)
Region dummies	Yes	Yes	No	No	No	No
Controls	No	Yes	No	Yes	No	Yes
Method	RKD	RKD	RKD	RKD	RKD & Arellano–Bond	RKD & Arellano–Bond
Fixed effects	No	No	Individual	Individual	No	No
Observations	67089	67089	67089	67089	23954	23954
R-squared	0.032	0.189	0.009	0.012		
Number of IDIND			21652	21652	10150	10150

Note. Robust standard errors in parentheses. *** — $p < 0.01$, ** — $p < 0.05$, * — $p < 0.1$.

Appendix C

Alternative estimates of price elasticity using Log of real average regional price of vodka as an explanatory variable. Second stage

	Specification (1)		Specification (2)		Specification (3)	
Dependent variable — Log of vodka consumption in the last 30 days						
Log of real average regional price of vodka	–0.525*** (0.105)	–0.496*** (0.099)	–0.732*** (0.097)	–0.752*** (0.099)	–0.721*** (0.169)	–0.826*** (0.192)
Regional dummies	Yes	Yes	No	No	No	No
Controls	No	Yes	No	Yes	No	Yes
Fixed effects	No	No	Individual	Individual	No	No
Method	RKD	RKD	RKD	RKD	RKD & Arellano–Bond	RKD & Arellano–Bond
Observations	67089	67089	67089	67089	23954	23954
R-squared	0.022	0.155	0.010	0.011		
Number of IDIND			21652	21652	10150	10150

Note. Robust standard errors in parentheses. *** — $p < 0.01$.

Appendix D

Price elasticity estimates in a subsample excluding those who drink in bars and restaurants. Second stage

	Specification (1)		Specification (2)		Specification (3)	
Dependent variable — Log of vodka consumption in the last 30 days						
Log of lowest real price of vodka in community	–0.774*** (0.163)	–0.786*** (0.157)	–1.082*** (0.148)	–1.131*** (0.152)	–1.125*** (0.263)	–1.248*** (0.302)
Regional dummies	Yes	Yes	No	No	No	No
Controls	No	Yes	No	Yes	No	Yes
Fixed effects	No	No	Individual	Individual	No	No
Method	RKD	RKD	RKD	RKD	RKD & Arellano–Bond	RKD & Arellano–Bond
Observations	59941	59941	59941	59941	19810	19810
R-squared	0.014	0.141	0.009	0.010		
Number of IDIND			20182	20182	8617	8617

Note. Robust standard errors in parentheses. *** — $p < 0.01$.