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The Dynamics of Alcohol Consumption in the Russian Federation: Implications of Using Price Related Policies to Control Alcohol Use

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Implications of Using Price Related Policies to Control Alcohol Use

by

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Abstract

This dissertation models the dynamics of alcohol use in the Russian Federation with an emphasis on identifying policy implications most likely to be effective at controlling alcohol use. Utilizing data from The Russian Longitudinal Monitoring Survey, models of alcohol consumption are estimated using both *myopic* and *rational* specifications via ordinary least squares, fixed effects two stage least squares and, the focus of this study, two-step system generalized method of moments. Alcohol consumption is studied both as a composite good and as a distinct beverage category (wine, beer, and hard liquor). Furthermore, equations stratified by gender and rural status are included to better identify effects specific to relevant subgroups of the sample.

Strong evidence of myopic addiction in both the overall sample and the stratified subgroups are identified. Even so, alcohol does seem to follow the law of demand within the myopic specification indicating that consumers will still react to changes in price. No evidence for rational addiction is found in either the complete sample or its subgroups. Results from the sample subgroups (male/female, urban/rural) were consistent with the overall pattern observed in the full sample, but differed in magnitude. This would suggest that, although alcohol consumption in individuals is affected by similar factors, regardless of gender or geography, the extent to which these individuals are affected differs. This reality would lend credence to "targeted" public health interventions for specific subgroups of individuals, rather than a one size fits all approach.

Chapter 1: Introduction

From a public health perspective, it is clear that alcohol consumption plays a major role in morbidity and mortality and imposes extensive private and social costs in a number of countries around the world (Edwards, 1994), (Holder & Edwards, 1995). Policies aimed at increasing the price of alcohol consumption, whether directly through taxes or indirectly through access restrictions are the main tools used around the world to combat these ills. Alcohol control policies, however, yield different results depending on the economic, social, cultural and, political realities of a particular country. This dissertation intends to model the dynamic of alcohol use in the Russian Federation with the intent to identify the viability of using price related policies to affect the level of alcohol consumption in the population as well as any negative side effects that could arise as a result. To further this goal three main tasks will be accomplished.

The first task provides background knowledge on the history of the alcohol problem in Russia and reviews the attempts to solve it by various regimes. Special attention will be paid to the relationship between the legal and underground sectors of the alcohol market and any adverse side effects that resulted from a particular policy. This is done to put any policy implications made as a result of this study into cultural perspective since policies that work well in one country can fail spectacularly in another if care is not taken to adapt them to local realities.

The second task will concentrate on identifying the pattern of behavior exhibited by alcohol consumers in Russia. Modern research identifies two types of economic behavior relevant to the consumption of addictive substances. Under the model of rational addiction, the current standard in the field, a consumer realizes the addictive nature of his activity as well as the resulting negative outcomes. However, he persists in the behavior since, for him, the perceived benefit of consuming the good now outweighs the present value of the expected costs of consumption. This theory implies that current consumption depends linearly on past consumption, future consumption and current prices. A rational consumer reacts not only to the money price of the addictive good today, but also to all the other factors that affect the cost of consumption. In short, higher excise taxes as well as programs aimed to increase awareness of the health and social costs of alcohol use can cause such a consumer to reduce his intake or, in some cases, become an abstainer. The myopic model takes a more conservative view of addiction in that a consumer of an addictive substance is "hooked" on the addictive good so that the only relevant determinant of current consumption is the amount of the addictive good consumed in the past, which by extension represents the strength of the addiction. Myopic behavior implies that excise taxes will be largely ineffective, while educational programs will work primarily through prevention. In short, once a drug addict always a drug addict. This study expects to find that the Russian population acts in a manner consistent with the model of rational addiction.

The third task, which constitutes the primary contribution of this dissertation, will be concerned with identifying the methodological challenges faced by researchers attempting to estimate rational addiction models using panel data and proposing a method

to overcome some of these challenges. A new instrumental variable, twice lagged consumption, not previously used in modeling addictive behavior will be proposed and tested for validity. The standard instrument used in such research, future prices, has a number of shortcomings that have led researchers to question whether useful policy results can be gained from research done on its basis (Gruber & Koszegi, 2001). Since, even with these shortcomings in mind, rational addiction is the standard theoretical framework used in studying the consumption of addictive substances, providing another tool for the estimation of such models will increase the effectiveness of any policy initiatives formed on its basis. The new econometric strategy will then be applied to a dataset on Russian alcohol consumption with an aim to identify health policy implications.

1.1 Russia and Alcohol: A Historical Background

Various countries or regions in the world are known for, or strongly associated with an alcoholic beverage. Germany is famous for its beers, France and California for their wines, and Russia for its vodka. An unfortunate stereotype is of a drunken Russian stumbling around in his "*ushanka*" hat, which is as prevalent and recognizable as the "*matryoshka"* doll or the hammer and sickle. Whether under a Tsarist, Communist or Democratic government, the typical Russian drinking culture was characterized by: "*a predominance of liquors over other beverages, the consumption of large amounts of distilled liquors on one occasion, the disinclination to consume food when drinking, an initial determination to get heavily drunk, and the existence of many drinking traditions* (Zaigraev G. , 2004)". The preference for heavy episodic drinking can be traced to the beginnings of the Russian state. The roots of the problem stem from the fact that for the

majority of its existence, Russia had a primarily rural economy. Holidays and celebrations were few and mostly centered around the agricultural calendar. Consequently, spikes in income corresponded with days of celebration, thus drinking became an episodic phenomenon. As the state urbanized and incomes became higher and more consistent, the restriction of drinking to agricultural holidays and their attendant income spikes was made obsolete, but the habit of excessive drinking on each sitting remained. Complicating the problem was state policy that, since the 15th century, consistently promoted the consumption of distilled high-proof ethyl alcohol at the expense of light alcoholic beverages. So much so, that by the beginning of the 20th century, vodka made up 93% of all beverage alcohol consumed (Zaigraev G. , 2004).

Throughout Russian history, the alcohol market was characterized by three competing, yet often coexisting structures: total monopoly of alcohol sales and production by the state, taxation of privately operating alcohol producers and the "*buy off*" system, which had a noble, wealthy merchant or company buy the right to operate an alcohol related business for a period of time. Ever present alongside these official systems was the problem of home and illicit production. Home production being alcohol produced by an individual for personal use and illicit production being alcohol produced with the intent of future sale. The progress of the State's addiction to alcohol-related revenues and the populace's addiction to alcohol itself can be loosely split into four eras: the Pre-Imperial, Imperial, Communist, and Post-Communist eras.

1.1.1 The Pre-Imperial Era

Before the reign of Ivan the IV (the Terrible), consumption and production of alcoholic beverages in Russia was fairly limited to, wines (imported from Byzantium,

Asia-minor and Europe), grain based beers and *myed* - a locally produced honey based wine. The vodka of the era was not popular and never stronger than 20 percent. Imported wines were expensive, and mostly limited to the feast-halls of the wealthy nobility, while the common people consumed mainly *myed* and beers in special establishments called "*Khorchmas*". A *Khorchma* was a type of a cross between a restaurant, bar and social center which offered food, low alcohol content drinks and entertainment for a given village. Alcohol was mainly consumed on social occasions such as harvests, weddings, and holidays. The manager of the *khorchma* was often elected, and exercised control over drink quality. The norms of consumption, and the clientele (women and children were often banned) were matters decided upon by the entire village. Essentially, "drinking in moderation" was the norm (Golosenko, 1986), (Prizhov, 2009).

In the time period between 1505 and 1681, changes occurred during the unification of the scattered Russian Principalities by the Principality of Muscovy and the formation of the Russian State. The Principality of Muscovy initially, had strict regulations where alcohol was concerned. The common man was allowed to consume alcohol on religious holidays while production of *myed* and grain based beers for domestic use was both limited to special occasions and taxed. To produce, say a bucket[1], of honey-wine you needed to have the following: (a) a reason to do so (wedding or similar holiday would do), (b) pay the appropriate tax and consume the entire volume of beverages produced within an allotted time, usually 3-5 days. In Moscow-City itself,

[1] Appendix B provides the modern equivalents in both metric and imperial.

only foreigners housed in a specially walled off foreign quarter were allowed to drink without restriction. Of course, such draconian control was not present everywhere; for example merchants and nobles would buy the right to operate a *khorchma*, thus contributing to the state's treasury. In addition, monasteries, above state control, often entered into the alcohol business. As the power of Muscovy spread, so did these regulations on private alcohol production and consumption. However, along with the spread of policies aimed against private ownership and operation of *khorchmi*, emerged the state-owned and operated *khorchmi*. This trend accelerated rapidly under the reign of Ivan IV. After the successful (and costly) military campaign against the neighboring kingdom of Kazan around 1552, Ivan the IV banned the production and sale of vodka, opening the first *kabak* (a government owned bar where only high content alcohol drinks are served). Initially there was only one *kabak*, limited to the use by the *opprichniki* (Ivan IV's secret police), but later as the profitability of such institutions became clear, *kabaks* quickly spread throughout the urban centers of the Russian State (Tatishev, 1979), (Prizhov, 2009), (Takala, 2002). Although *kabak*s sold high content alcohol only, many had attached p*ovarni*, which were pubs where grain beer, *myed* and other moderate alcohol content drinks were sold.

Most *kabaks* and *povarni* were directly state-owned and contributed directly to the nation's budget, however, some were owned by monasteries and the nobility either through the system of "buy off" or through grant by the Tsar. As the *kabaks* spread throughout Russia, and their importance to the national treasury grew a series of edicts were enforced. In 1649 *The Edict on Khorchmas* (P. S. Z. R. I., 1830) was passed, outlawing the production sale and storage of alcoholic drinks by private parties, as well

as the purchase of alcoholic drinks from private parties. The edict on *khorchmas* was the first edict to apply to all Russian territories. In 1652, another major piece of alcohol legislation known as *The Sobor o Kabakah* (The Assembly on Kabaks) (P. S. Z. R. I., 1830) was introduced. This piece of legislation established a state monopoly on all alcohol production and sales. All remaining privately owned *khorchmi* and "bought off" *kabaks* were liquidated. The institution of a *kabak* was replaced by a "*kruzhechniy dvor*" (drinking stand) a place where you could buy alcohol to take home or consume nearby. The downside of a *kruzhechniy dvor* as opposed to the *kabak* was that the former did not provide a place to sit and consume the product, and lacked p*ovarni* to provide food and lower content alcohol.

In 1660, this legislation was modified, forbidding the production of alcohol for home use, and stripping monasteries of their rights to produce and distribute alcoholic beverages. By 1681, the government had a complete (100%) monopoly in the alcohol business. Private *khorchmi* were outlawed, monasteries were banned from alcohol production, private production of alcohol for personal use was made illegal and the "buy off" system was liquidated for all intents and purposes. With the elimination of most of the credible competition, government vodka became the only source of high-proof alcohol and a reliable source of income for the government. The state had a simple pricing scheme: alcohol for sale would be priced at twice what it cost to produce and distribute. At these rates, alcohol sales were accounting for approximately 25 percent of the State's annual revenue (Takala, 2002), (Prizhov, 2009). The price of these extra riches was a drastic change in the nature of alcohol consumption. With the suppression of locally managed *khorchmas* in favor of state owned *kabaks*, the consumption of low

strength alcohol with food in a ritual manner was replaced by straight consumption of high strength alcohol. As *kabaks* were replaced by *kruzhechniy dvors,* the prevailing drinking style changed from casual drinking at a table or bar to binge drinking near a *kruzhechniy dvor*.

1.1.2 The Imperial Era

Although the Russian State possessed a complete monopoly on the sale of alcohol, the way in which it was produced was more complex. Production was split between breweries owned outright by the government and territorially tied to a series of points of sale, and private subcontractors, which would produce independently but sell their whole inventory only to the government. Independent contractors had an important advantage over the government run breweries since they were not bound by local demand for alcohol. Taking advantage of economies of scale, they were able to produce larger quantities of alcohol for significantly less than their government competitors, and by 1705, the state run breweries were in crisis. Plagued by inefficiency, corruption, and inability to make use of economies of scale, they were unable to compete with the independent contractors – it was cheaper for the government to buy alcohol for resale, than to produce it for themselves (Takala, 2002). This led Peter the Great, desperately in need of cash to finance his war against Sweden, to reinstate the "buy off" system and move the alcohol industry back into the private sector. Furthermore, in need of maximum returns from alcohol sales, Peter the Great engaged in a crackdown on home production, by confiscating items that could be conceivably used for alcohol production. Orders were issued so that "*in all my kingdom, the high and the low as well as the clerical ranks of all types, at homes and at estates are forbidden to produce wine and*

must buy from Kabaks" (P. S. Z. R. I., 1830). In 1716, in search of yet more money for the treasury, the government devised a new way to profit from alcohol production; home and private production were legalized and heavily taxed. The tax was taken on all items that could be used to produce alcohol, regardless of their actual use. Simultaneously, during Peter's reign the alcoholic infrastructure (*kabacks*, drinking stands, etc…) was drastically increased throughout all of Russia (Takala, 2002), (Prizhov, 2009).

Between 1716 and 1861, the government's alcohol policy fluctuated between state monopolization and use of the "buy off" system, with neither lobby managing to gain the upper hand (Takala, 2002). Eighteen sixty-one however brought in a new era of extracting profit from alcohol sales. After a year's worth of work by a special commission, a report called "*The matter of drinking collections*" (P. S. Z. R. I., 1830) was presented to the government. Based on the findings of that report, a series of reforms was enacted, taking effect in 1863. The "buy off" system was repealed and a three-way excise duty was enacted. Taxes were levied on the following: the means of alcohol production based on capacity, the quality and quantity of alcohol produced, and the amount of alcohol sold. From 1863 on, the government made money by increasing these three taxes, while leaving the alcohol market itself alone. This free market approach led to a boom in alcohol related businesses, spreading previously unrivaled access to alcohol throughout the Empire. This system remained largely unchanged until 1894, when the Russian state enacted a full monopoly on alcohol production, thus becoming the only official seller of alcohol (P. S. Z. R. I., 1830).

Conceived in and provisionally enacted in 1894, the state monopoly on alcohol production took effect on all Russian territories in 1904. The sale of pure alcohol, wine

and strong spirits became the sole domain of the government. Vodka could now be bought only on a carryout basis from special government operated stores. The monopoly did not affect the production of beer, and grape based wine, which continued to use the old tax system. The resale of alcohol also remained legal, as long as an individual purchased supplies from the government stores. Since the monopolization took place under the banner of combating alcoholism through higher prices and an increase in the quality of the vodka consumed, efforts were made to that effect. Alcohol could only be sold from official government stores in standardized containers featuring the official seal of the manufacturer. The price tag had to include separate prices for the alcohol and the container itself. The container could then be redeemed for part of its value. At this point, sales could be conducted only with hard currency, and the practice of purchasing alcohol on credit was outlawed. Sales were to be restricted to the times between 7a.m. and 10p.m., and no earlier than 11a.m. on Sundays and Holidays. Restrictions on sales of alcohol to minors and people under the influence were enacted, and a special police force to oversee and enforce these changes was created. Special social organizations designed to spread educational information on the negative consequences of alcohol, in addition to providing alternative activities were organized as well (Takala, 2002).

The result of the monopolization of the vodka industry was somewhat other than advertised. As an economic measure, it was a partial success. The amount of state revenue generated by alcohol sales increased from 297.4 million rubles in 1884 at the start of the reform to 736.9 million rubles in 1906, two years after taking full effect (Takala, 2002). The domestic economy also benefited. Under the lobbying of D. Mendeleev (Russian chemist, inventor of the periodic table of the elements, and the

formulation of modern Russian vodka), the system of taxes was altered to favor small to medium scale rural alcohol producers, and large urban alcohol factories were outlawed. By 1913, Russia had around 2969 alcohol factories producing an average of 135,846,000 buckets (1,670,905,800 liters or 441,406,614.4831 gallons) of vodka per year (Takala, 2002). However, Mendeleev's stated goal in lobbying for the development of rural alcohol production was to use it as a bridge between agriculture and industry. The resulting increased volume of alcohol was intended for consumption in heavy industry or export to Europe. Although Russia was able to become the world leader in the production of pure alcohol and strong-spirits (vodka), it was dead last in the use of alcohol for industrial needs[2]. Exports were also declining. By 1913 only 7% of total spirits production was used in industrial needs and 4.8% was exported, the domestic consumer consumed the remaining volume (Takala, 2002). Instead of stimulating the rural economy, these policies led to an increase in the prevalence of the ills of alcohol consumption. Street drunkenness became a common sight in Russian cities as the drunks that were previously out of the public sight spilled out into the streets and could no longer be ignored as an insignificant problem.

Despite widespread political rhetoric about the issue, including a 7-year long Duma commission on "the regulatory problems of alcohol," no action of note was taken to combat the problem until the prohibition of 1914 (P. S. Z. R. I., 1830) (Takala, 2002). The 1914 prohibition was enacted to avoid the ransacking of government alcohol stores as happened previously in the mobilization for the Russo-Japanese war in 1905. The

[2] Alcohol can be used as an industrial preservative, solvent or fuel, converted into formaldehyde or ethanoic acid. Other common uses include use as an antiseptic and as an input in many beverages.

state made no secret of the fact that the ban was a temporary measure for the duration of the war, furthermore only the sale of high-content alcohol was forbidden (except in quality restaurants). Otherwise the alcohol market was left untouched. Even so, the effects of this partial ban on the wellbeing of the country were immediately noticeable, foreshadowing the effects of Gorbachev's attempts at prohibition in the Soviet era.

During the first year of the ban, the documented mean alcohol consumption dropped to 0.03 liters of pure alcohol per person per year (Takala, 2002). Surveys conducted during the first few years of the ban identified some interesting effects (Takala, 2002). The saving levels of rural areas had increased by 216.7 million rubles during the first nine months of the ban, compared to the same period in the previous year[3]. This increase in savings could have been caused by the war, and the resulting lack of goods and services on which to spend ones income. However, an alternative explanation could be that the increase in disposable income was due to a decrease in expenditures on alcohol, which beyond the everyday drinking included providing drinks to large numbers of people in situations where social norms required them, such as weddings, being hired for work etc. Furthermore, in rural areas a 27% decrease in work absenteeism was found in several major regions of the country (Takala, 2002).

Not all of the findings were positive. During the second year of the ban, there was a marked increase in the use of surrogate alcohols. In urban areas, restaurants, exempt from the ban, formed a basis for a thriving underground market for alcohol of unknown origin. Markets and drug stores, fielded a large array of medicinal tonics and

[3] During the same time period in the year prior to the ban, rural savings had increased by 6.5 million rubles (Takala, 2002).

self-made beverages of high alcohol content. The consumption of industrial bi-products, such as various polishes and lacquers increased greatly. Moreover, in border areas, contraband flourished. Official statistics revealed that the state lost 22million rubles in gold to illicit alcohol trade with neighboring Manchuria (Takala, 2002). The state budget, which in the 1900-1913 period derived 25-30% of its revenues from the alcohol monopoly, plunged into deficit (Treml, 1975).

1.1.3 The Communist Era

After coming to power as the result of the October revolution, the new communist regime inherited the problem of alcoholism as well as large stocks of alcohol[4]. In addition to large stocks of mass-produced alcohol, a veritable fortune (up of 5 million dollars) of high-grade wine was confiscated within the winter palace (Takala, 2002). Initially the intent was to sell this bounty of alcohol to the West, and measures were taken to secure the alcohol stores. However widespread rioting and persistent attempts to loot the alcohol stores, coupled with the inability of the newly formed communist government to control the situation, led to the decision to destroy all alcohol stocks, and close down all liquor factories in St. Petersburg (Takala, 2002). The situation around the alcohol riots was considered serious enough to appoint a special commissariat for wine affairs to oversee their management. Severe penalties (10 years of hard labor with full confiscation up to and including death) were instituted for a series of alcohol related crimes; indeed drunkards were equated with enemies of the people and treated accordingly. Unfortunately, with the loss of the oil rich regions in the Russian Caucusus (due to the

[4] The equivalent of 70 million buckets (861 million liters) of vodka was confiscated in St. Petersburg alone.

ongoing civil war), the communist government was forced to substitute alcohol for oil as fuel. The automotive park alone required over 24.6 million liters of spirits, while due to the combined effects of the civil war, alcohol riots, and anti-alcohol policy, the supplies of alcohol available to the government was limited to 43.05 million liters (Takala, 2002). To overcome this difficulty, the complete legalization of alcohol was scrapped, the industry was nationalized, and production of alcohol for industrial use was reinstated, though production for private consumption was still illegal. Even at the height of the war, the communist anti-alcohol movement (the slogan of the time was "the dictatorship of sobriety") within the country never approached a true prohibition. The sobriety measures were mostly aimed at protecting grain from being transformed into alcohol, hence making it available as food. The majority of government initiatives of the time was in line with these goals and was aimed both at reducing the potential supply[5] and the demand for strong alcohol[6]. Like the tsarist prohibition before it, the soviet prohibition did not extend to drinks of 12% ethanol or less. A further help to the anti-alcohol effort was the abysmal state of the alcohol industry, which had been reduced to 2.5% of pre-war production in 1920, and 4.2% in 1921 (Takala, 2002).

With the end of the civil war and the introduction of the "New Economic Policy", the situation with alcohol changed once again. To answer the question of how to finance the post-war reconstruction, without the option of outside investment, an internal source of financing was needed, and alcohol sales through a government monopoly was a

[5] Through the illegality of the production of alcohol intended for consumption, severe penalties for moonshining, etc…

[6] Through penalties for being drunk in public and drinking illegally made alcohol.

proposed solution. Although opposed by many high-ranking party members, most notably L. Trotskiy, and publicly decried by official propaganda, and even Lenin by 1923 the drinking ban was, essentially removed (Takala, 2002). The cancellation happened in a series of steps, first legalizing wines of 14% or higher, then allowing the consumption of strong alcohol for workers with hazardous jobs, finally the legalization of production and sale of alcoholic beverages of up to 30% ethanol. Even though the ban was technically still on the books, it was no longer practically enforceable. With these changes came an increase in measured alcohol consumption. The consumption of wines and other alcoholic beverages no stronger than 30% increased from 0.8 million buckets in 1923 to 20.0 million buckets in 1925 (Sheverdin, 1988) (Takala, 2002).

The years immediately after the marginalization of the alcohol ban have been called the "Golden age of Russian Moonshining" (Takala, 2002). The available beverages such as beer, wines and 30% infusions were often relatively expensive, and more importantly unfamiliar to the majority of the population. This latent demand for high potency alcohol combined with the economic policy of "price scissors" created a fertile ground for a flourishing black market. The "price scissors" policy was fairly straightforward, it enforced a large price difference between goods intended for agricultural use (these were kept low) and those intended for industrial use (these were kept high). With this policy in place, it was more profitable for a farmer to convert any surplus grain into alcohol, which could then be sold at a higher industrial good price, or

sold to the local population. The strength of the resulting *samogon*[7] varied from 15-60% on average with some reaching up to 80% (Takala, 2002). Strong punitive measures against moonshiners had little effect; according to official statistics, an average of 10% of all rural households produced moonshine. In certain regions, this reached 36.6% (Takala, 2002). The alcoholism crisis worsened significantly, official reports have cite widespread and persistent drunkenness, corruption, and theft of government funds to purchase alcohol in the local and regional governments, as well as the Red Army. The situation among the urban workers, which was considered satisfactory in 1924, deteriorated equally quickly. The drinking traditions thought obsolete due to the communist revolution returned, and the incidence of drinking at the workplace increased (Takala, 2002).

Faced with this situation the Soviet Government took steps. Using the need to combat moonshining and drunkenness, and overcoming strong opposition to the measures in the Central Committee the Soviet Government enacted a state monopoly on the sale of alcoholic beverages, similar to the one enacted in 1894. In short, alcohol production was legalized for both government, cooperatives and private industry; however all of the produced alcohol had to be sold to the central government, which would then use it to produce alcoholic consumer products. Although the justification for the monopoly was once again the war on alcoholism, and more specifically the war on moonshiners, positive effects were short lived. Initially after the enactment of the government monopoly on August 1925, a decrease in the consumption of moonshine was

[7] *Samogon* or moonshine is a strong alcoholic beverage that varies in color from filmy white to light brown and has alcohol content between 16.5 and 62.2%. (Nuzhnyi, 2004)

observed. The initial price of government vodka was set at 1 ruble per 0.5l and sold fairly well. Two months later the price was increased to 1.5 rubles, which led to a decrease in rural sales and a predictable increase in moonshine use. In July of 1926 the prices were lowered leading to a deteriorating alcohol situation in urban areas, while leaving the rural areas largely unaffected (Takala, 2002). Predictably, an alcohol monopoly so close in structure to the much-criticized Imperial monopoly, led to similar results. Specifically it failed as a way to control both alcoholism and moonshine production. With an average worker's (workers as opposed to farmers had better salaries in the USSR) income of 80r per month, many workers chose to buy moonshine at 0.4 rubles per 0.5 liter rather than government vodka at 1ruble. Many peasants could not even afford the 1-ruble price. Combined with contradictory legal status of moonshining, which since 1926 had been permitted for personal use, while still illegal for sale, this led to the continued thriving of the moonshine black market. According to official statistics by the end of 1928, 34.6% of all rural households produced moonshine for personal use, for a yearly total of 615m liters of moonshine which accounted for 3/4 of total rural alcohol consumption (government vodka accounting for the final fourth) (Takala, 2002).

As a financial instrument, the monopoly proved a much greater success. In the two years following the monopoly, the amount of alcohol producing factories tripled (Takala, 2002). Official statistics recorded the proceeds from alcohol for 1927 at 180 million rubles. Stalin, however, mentioned a sum of 500 million rubles (Stalin, 1954), while the amount budgeted for alcohol proceeds in the five year plan was 900 million. By the end of 1928, alcohol sales accounted for 12% of the state budget (Takala, 2002) an increase of 2% since 1924. The mean per person consumption of pure alcohol rose to

3.5l per person per year. Urban populations drank twice as much as rural ones, with moonshine accounting for 53.7% of consumption, government vodka for 39.1% and beers and wines for the rest. Following a 19% increase in workers incomes' in the periods of 1925-1927 a 40% increase in alcohol consumption and a 12% decrease in cultural goods were observed (Takala, 2002). This nets a 2.11 and -1.05 income elasticity for alcohol and cultural goods respectively.

Following the reinstatement of the monopoly, the Soviet Government fought alcoholism through disciplinary measures only. Strong penalties were enacted for public drunkenness, absenteeism and other alcohol related problems, and a system of mandatory alcoholism clinics was formed to sober up alcoholics. However, nothing was done to curtail the availability of alcohol. The quantity of alcohol produced increased annually, and by 1940 Soviet factories were producing 1,095 million liters of pure alcohol per year (Takala, 2002), distributing it through an ever-growing chain of specialized stores.

The Great Patriotic War[8] turned a new page in the history of alcoholism in Russia. Although no alcohol control legislation was passed until 1948 the peculiarities of the alcohol market in the Soviet Union during the war years appeared to be closely related to the post war boom of alcoholism. The root of the problem could be traced to the 1939 Winter war with Finland, where in light of the extremely cold temperatures and high incidence of frost related deaths in the army, a ration of 100g of vodka (Cognac for

[8] The Great Patriotic War refers to the conflict between the Soviet Union (with allies) and Nazi Germany (with allies) from 1941 to 1945. For the most part The Great Patriotic War ran concurrently with WW2 (1939-1945). However, it started with Germany's attack on the Soviet Union on June 22, 1941 rather than Hitler's Poland Campaign on September 1, 1939. Similarly, it ended after the capitulation of Nazi Germany, May 9, 1945 rather than with the capitulation of Japan later in the year. This is opposed to The Patriotic War, which refers to The Russian Empire's war against Napoleon in 1812.

pilots) and 100g of *salo* (salted pork fat) was instituted to combat the problems. Over the length of the Winter War, the Red Army consumed 10 million liters of vodka and 88.8 thousands liters of Cognac (Takala, 2002). Initially this extra ration was applied to the army as a whole, however in 1942 the policy was restricted to personnel currently assigned to armies in active front duty, however the size of the ration was increased to 200g. Non-frontline units were allowed a lesser ration of 100g on official holidays. This was refined to a more restrictive policy of supplying 100g only to active units after a successfully completed mission later in the year. The wounded were allotted 50g per day on doctors-orders only. Although the individual doses were small, the total amount of alcohol consumed was anything but. In April of 1943, the overall amount of vodka provided to the active fronts equaled 4,450,000 liters (Takala, 2002). Needless to say vodka rations in addition to cigarettes formed a sort of underground economy, vodka rations could be saved, combined, traded and were widely accepted as informal tender. In fact, given the environment vodka often proved to be the most liquid asset available.

Away from the front, the vodka policy differed. In 1941 an edict was issued by Stalin to informally restrict the sale of vodka (i.e. it was legal to sell, it but it was not available in stores). The volume of vodka freed up by this order was channeled to the front and to special reward rations to exceptional workers who produced in excess of the planned amount or workers on special assignments. Since vodka was otherwise unavailable, this served as a strong incentive to work hard. As the war progressed and the amount of special and urgent assignments increased, this system of incentives was expanded and centralized. By the first quarter of 1945, 1,300,000 deciliters of vodka were assigned to motivate a population of roughly 10 million workers (Takala, 2002).

With the end of the Great Patriotic War (World War II - Europe) on May 9, 1945, the above vodka related edicts were annulled.

After the Great Patriotic War, the state policy on alcohol changed little from the pre-war situation. Most anti-alcohol campaigns were targeted at individual drunks, while the quantity of alcohol produced grew. In 1960 the RSFSR was producing 103 million deciliters of vodka alone, this increased to 208 million deciliters in 1980 (Takala, 2002). The annual per person amount of alcohol was 3.9 liters in 1960 while by 1970 this has increased to 6.8 liters (Takala, 2002). Each of the post war soviet leaders engaged in at least one anti-alcohol campaign (Chernenko and Andropov excluded, due to their short reigns): Khrushev in 1958, Brezhnev in 1972, and Gorbachev in 1985. All of these campaigns mirrored previous attempts to solve the alcoholism problem instituted by the Tsars and ended in failure. Although it may not be correct to infer a causal relationship due to heterogeneity, the post-campaign alcohol consumption was typically twice as high compared to its pre-campaign levels (Takala, 2002).

The first post-war anti-alcohol campaign started in 1958. It was supposed to take a long-term community-based approach to combat alcoholism. "*A successful war on alcoholism is possible only under the condition that all of Soviet society engages in this undertaking, if instances of misuse of alcoholic beverages are treated as unacceptable, antisocial occurrences* (Soviet of Ministers of RSFSR, 1968)." Plans were made to involve all relevant parts of the bureaucracy, to participate in nationwide educational measures to combat alcoholism. Price on all alcoholic beverages with the exception of beer was increased by 21% (Treml, 1975) and strong restrictions were placed on the alcohol market. Alcohol was barred from sale in all non-alcohol stores and venues of

public food, excluding restaurants. Alcohol in restaurants was to be subject to an additional 50% price markup and limited to 100g per customer. Vodka was restricted from being sold near to educational and children's venues, factories, medical facilities and places of public recreation. Sale of alcohol to minors was strictly forbidden. At the same time, an increase in beer, wines, and non-alcoholic beverages was added to the production plan. Unfortunately, the execution of this plan was limited to prohibitive measures only, and was not backed up by the required social measures. In essence, this reform once again separated the drinker from food and a controlled environment. Chased out of public parks, cafes and cafeterias, drinkers moved to the streets, and quickly became a familiar and accepted sight. These measures were associated with increased vodka consumption from 551 million liters in 1958 to 921 million liters by 1970 (Treml, 1975). On paper, the planning of the campaign was valid: it restricted the access to vodka, provided substitutes of lesser alcohol content, and backed these actions up by social educational initiatives. In the manner these initiatives were applied it was, unfortunately a failure.

An important achievement of the 1958 campaign was its ability to reduce the market share of strong beverages "*from 76% in 1955 to about 50% by the end of the 1970s*[9] (Treml, 1982)." At the same time the amount of wine consumed increased 4 times and the amount of beer by 70% (Takala, 2002). Although on its face a wholly positive outcome, the real effect of this change in the nature of alcohol consumption on the negative consequences of the same is hard to determine for at least a couple of

[9] (Kolesov & Melnikov, 1988) put the estimate at 56%.

reasons. First, most of the increase in wine consumption was accounted for by low-grade fortified wines containing 17-19% alcohol. Second, "*ethanol used in wine fortification does not have to meet the quality standards of ethanol used in vodka and thus probably contains more toxic impurities* (Treml, 1982)."

The anti-alcohol campaign on 1958 was accompanied by a spike in moonshine production, driven by the combined decrease in access to hard liquor among the population and the liberalization of punishments for moonshine to a maximum of a 30 ruble fine for a first offense (Takala, 2002). In 1958 the amount of illicit alcohol consumed in the rural Soviet Union was estimated to be 825-1076 million liters, by 1970 this range had increased to 1348-1381 million liters (Treml, 1975).

The next notable piece of alcohol related legislation was the "edict on measures for the intensification of the war on drunkenness and alcoholism" of 1972 (CPSU, 1972). The edict repeats most of the long forgotten and unenforced measures of the 1958 campaign, including educational initiatives and a reduction of vodka production, coupled with an increase in the production of non-alcoholic and lower alcohol content beverages, and introducing some new ideas. Along with a crackdown on public drunkenness, the 1972 edict resulted in the formation of an independent narcotics control bureau with a system of narco-dispensaries for the treatment of those addicted to narcotics and alcohol. Starting with 1965 a system of standardized data gathering on the patients receiving narco-based care was instituted and by 1976 useable statistics were made available on the situation with substance abuse in the country, though not released to the public until after the collapse of the U.S.S.R. Again, although the plan was workable in concept, in practice it failed. Similar to the previous 1958 campaign, most of the educational and

social initiatives remained unimplemented for the most part, while the emphasis was put on punitive measures. In 1974, the edict "*On mandatory treatment and re-education through labor of chronic alcoholics*" (RSFSR, 1974) was passed, and a nationwide system of closed clinics was created. An individual diagnosed with chronic alcoholism, could receive up to two years of mandatory treatment in such clinics; the treatment mostly included hard labor, as the clinics were primarily penal in nature and operated by the ministry of the interior rather than the health ministry. By 1980, this system had expanded into 314 clinics with 270,000 beds and around 170,000 yearly clients. According to the available statistics, the one-year recidivism rate reached 85-90 percent (Takala, 2002).

The decrease in production of high content alcoholic beverages proposed in the program was not met, while the increase in the production of lower content alcoholic beverages meant to replace vodka in consumption was met mostly through an increase in production of low quality fruit wines. In summary, the production of vodka increased by 24%, grape wine by 30%, fruit wine by 300% and beer by 24% over the decade of 1970-1980 (Takala, 2002). Even so, vodka's share in total alcohol consumption had decreased over this decade. In 1970, 56% of total alcohol consumption was accounted for by strong spirits. This share had decreased to 51% by 1980 (Kolesov & Melnikov, 1988). However, just like during the previous attempt, most of this reduction was due to a switch over to cheap fruit wines, often fortified by additives, rather than by a switch to healthier grape wines and beers (Takala, 2002). At the same time, social acceptance of alcohol and use of alcohol as informal tender increases greatly. By the 1981-1985 period, alcohol accounted for 169 billion rubles versus 67 billion in the 1966-1970 period (Takala, 2002).

Gorbachev instigated the final anti-alcohol campaign of the Soviet Union in 1985. In essence, it was a rehash of previous plans. It did, however, differ in one important aspect. The goal of the campaign was stated to be complete abstinence, rather than consumption in moderation. Over the three years of the campaign, spirits factories were closed, while wineries and breweries reconfigured for non-alcoholic beverage production. Domestic grape production was reduced and contracts for alcohol imports were cancelled. Alcohol related venues, such as bars and liquor stores, were closed and the number of official alcohol stores was cut back (Takala, 2002).

The main goals of Gorbachev's campaign were to reduce alcohol sales and production and to suppress the manufacture of illicit alcohol. The first goal was achieved, at least on paper. In the period between 1984 and 1987 the amount of alcohol sold by the state decreased by 60.7 percent (Nemtsov A. , 1998). Life expectancy for Russian males increased from 62 in 1984 to 65 in 1987 (Nemtsov A. , 1998) and death from alcohol related causes was cut almost in half[10] (Takala, 2002).

The second goal proved to be harder to achieve. The time of the 1985 anti-alcohol campaign coincided with a drastic jump in the production of illicit alcohol and surrogate use. The 60.7 percent decrease in state alcohol sales was estimated to translate into only a 25% drop in alcohol consumption as consumers made up the shortage of official alcohol from unofficial sources (Nemtsov A. , 1998). During the 1985-1987 period the number of arrests for illicit alcohol production doubled yearly (Nemtsov A. ,

[10] (Stickley, Leinsalu, Andreev, Razvodovsky, Vagero, & McKee, 2007) report rates of alcohol poisoning for Russia as 34.4 per 100,000 in the 1978-79 period and 8.7 per 100,1000 for the 1988-89 period. The second time frame is right after the end of Gorbachev's campaign.

1998) and the per-capita consumption of sugar, the primary ingredient of moonshine in Russia (Treml, 1975), rose to the point of inducing sugar shortages throughout the country (Nemtsov A. , 2000) (Takala, 2002).

The results of the last attempt of the Soviet Union to control its alcohol addiction were lackluster and short-lived. Neither of its stated goals was fully achieved. The decrease in alcohol consumption and increase in life expectancy rebounded to their pre campaign levels by 1991 (Nemtsov A. , 2005). At the same time, the prevalence of moonshining and surrogate use among the population had increased when compared to the pre campaign years (Takala, 2002). Sociological surveys conducted in 1987 showed that 68% of rural and 45% of urban consumers had used illicit sources of alcohol on a regular or episodic basis (Zaigraev G. G., 1992). Finally, the budgetary effect of the campaign was noticeable. Aside from the indirect costs, such as foregone revenues from bars, the cancelation of import agreements, loss of productive capacity and distortions in related markets (i.e. sugar), the state lost 15.8 billion rubles in lost alcohol sales by 1986 and a further 16.3 by 1987 (McKee, 1999).

1.1.4 The Post-Communist Era

The process of political transition, during the years between 1990 and 2001, coincided with widespread social and political troubles. Together with economic decline and a lack of serious legislative attention to the issue, these factors contributed to a rapid increase in alcohol related problems. Alcohol consumption was estimated to have increased by 2.3 liters of pure alcohol per capita per annum between 1990 and 1999 (Nemtsov A. , 2002). This increase has been estimated to account for over 7 million additional deaths between 1990 and 2001 (Nemtsov A. , 2005). In addition, alcohol has

been shown to contribute to increases in the rates of death from alcohol poisoning, accidents, violence, suicides, homicides and cardiovascular failures over the same period. [(Nemtsov A. V., 2003), (Stickley, Leinsalu, Andreev, Razvodovsky, Vagero, & McKee, 2007), (Pridemore, 2002), (Pridemore, 2004), (Nemtsov A. , 2003), (Leon, Chenet, & Shkolnikov, 1997), (Mckee, Shkolnikov, & Leon, 2001)].

After the collapse of the Soviet Union, as the result of several economic reforms, prices on all consumer goods previously set by the government were liberalized. The alcohol market was an exception to the rule and still had its price set by the government. In the presence of a rapidly inflating ruble, alcohol soon became relatively cheap when compared to other goods. Nemtsov (2000) estimates that individual consumption rate of pure alcohol went up from 12.0 liters in 1990 (before price liberalization) to 12.5 in 1991 (after price liberalization). In May of 1992, Yeltsin abolished the long-standing state monopoly on alcohol, transforming it into a private industry[11]. This step brought in a stream of independent alcohol producers, small-scale and large, foreign and domestic, legal and illegal. As a consequence the alcohol market became even harder to monitor and control. From this point on, the government's share in the alcohol market would start to decrease as it was pushed out by increased alcohol sales from foreign and private sources (Levintova, 2007), (Takala, 2002).

In June 1993, the government realized its mistake and tried to restore some control over the market. The act "*On the restoration of the government monopoly on the production, storage, and bulk or individual sale of alcoholic products*" is enacted which

[11] The government still controlled "*RosSpirProm*", which accounted for 65% of total production (Levintova, 2007). (Takala, 2002) provides an estimate of 50% of total production.

gives the government the right to regulate and control the market for alcohol including licensing, advertisement restrictions, production standards and quotas. This time around, the government monopoly primarily took the form of regulation. This law was replaced in 1996 by the act "*On government regulation of the production and circulation of ethyl alcohol and alcohol products.*" This law updated in 1999 and 2006 again stopped short from reinstating the government monopoly but did allow for increased regulation of the alcohol market. Some important aspects of this law included the following:

1. A prohibition on wholesale and retail sales of alcohol without a license. License cost would increase with each modification of the law.
2. The requirement for all alcohol products to carry a visible excise stamp signifying legality for sale within the Russian Federation. Intended to protect against the sale of illicit alcohol, this measure met difficulties with implementation. On one side, the initial excise stamps proved easy to counterfeit and had to be improved with each modification of the law. On the other side, the government failed to provide such stamps to legal producers in a timely manner, leading to shortages of legal imported alcohol.
3. A prohibition of sale of alcohol at child, educational, athletic and cultural facilities as well as public transport.
4. Sale of alcoholic beverages containing more than 15% of alcohol was further restricted. Such beverages were banned from places of large public gatherings such as stadiums, airports, and transit stations as well as wholesale markets and military instillations. Licenses for the sale of such beverages would not be provided to small-scale vendors such as stands, kiosks and mobile stores.

As can be seen, the problem of alcohol control and consumption in the Russian Federation is not a new one. Throughout the history of the Russian State, various regimes tried to balance the tradeoff between the revenues that alcohol brings and the ever more apparent costs it imposes. This balancing act created a situation characterized by rampant large and small-scale illicit production, as well as a populace ready and able to circumvent any restrictive actions taken by the government. It has been estimated that a decrease in Russian alcohol consumption of just 5 or 10 percent could lead to 100,000-200,000 lives saved every year (Nemtsov A. , 2003). In the current social situation, the seemingly simple solution of increasing price and reducing access may backfire into increased rates of surrogate use and underground production, while educational programs are likely to be met with skepticism and apathy. This unique environment makes it critical to understand the interactions between alcohol and society before undertaking any public policy.

1.2 Russia and Alcohol – The Current Day

Russia has one of the world's highest rates of alcohol consumption and a mortality rate that has recently been rising dramatically (World Health Organization, 2011). Since 1990, the mortality rate has increased from 11.2 per thousand to a peak of 16.4 per thousand in 2003 followed by a slight decrease to 14.6 deaths per thousand in 2008 (World Health Organization, 2011). While alcohol is not the sole cause of this increase, it is widely believed to be one of the main contributors (Leon, Chenet, & Shkolnikov, 1997), as the change in mortality rates coincided with both rapid growth in vodka sales, and alcohol-related negative health outcomes. The negative consequences of alcohol consumption are twofold. Short-term effects come about because of individual

inebriation. These include issues like the negative effect of alcohol on automotive and industrial safety or the increase of alcohol related violence (Cook & Moore, 2000). Long-term effects are those that come about over time due to chronic alcohol use such as liver cirrhosis, increased medical care utilization and lost productivity (Cook & Moore, 2000).

When dealing with the consumption of alcohol, "*how*" it is consumed is often more important than "*how much*". Heavy episodic (binge) drinking is one of the most important indicators for negative consequences of alcohol use (Grantand & Litvak, 1996). Defined as drinking at least 60 grams (2.1oz) or more on at least one occasion in the past seven days (World Health Organization, 2011), binge drinking has been shown to be a risk factor for cardiovascular disease and other health problems (Cook & Moore, 2000). In addition, binge drinking tends to eliminate the beneficial effects of moderate alcohol use (Bagnardi & Zatonski, 2008). Russia has the distinction of being one of only two countries[12] (Russian Federation and Ukraine) to score a "5" on the World Health Organization's Pattern of Drinking Score and is in the top category for prevalence of heavy episodic drinking (World Health Organization, 2011).

Governments have a number of tools that can be used in their attempts to reduce alcohol consumption. Restricting the availability and outright prohibition, labeling requirements, limits on advertising and educational efforts are some of the ways that have been tried to restrict the alcohol market. One of the most popular and effective ways for

[12] Although Russia and the Ukraine are the only two nations to score a "5", there are a number of other countries demonstrating dangerous patterns of alcohol consumption. Belarus, Guatemala, Nicaragua, South Africa, Kazakhstan, Moldova, Mexico, Ecuador, Zimbabwe and Belize scored a "4", for example.

reducing alcohol consumption is to increase alcohol prices, usually through taxes. However, even though the basic tenets of the Law of Demand[13] hold for alcohol (Edwards, 1994), it is not clear that this is a wholly effective solution. The widespread production of underground and homemade alcohol, as well as the use of non-beverage spirits and the widespread social apathy toward alcohol abuse could nullify or even reverse any gains expected from a price increase.

Complicating the issue is the lack of consistency in government policy. The relationship between the state and alcohol took form under the influence of two major factors: the increasingly documented negative effects of alcohol consumption, and the dependence on the income stream generated by alcohol sales. There is an inherent conflict of interest in having those responsible for alcohol control being dependent upon revenue generated by alcohol sales. This conflict can be argued to be among the causes of a series of partially implemented or poorly conceived anti-alcohol initiatives discussed in section 1.1.

The problem faced by the Russian state is difficult but not unique. Many developed western countries were at one time faced with the situation where the access to and availability of alcohol was greater than the ability to control its use. For example, during the 1950-1970 period, the per-capita alcohol consumption for the countries of Norway, Finland, and Denmark[14] had doubled. At the same time, rates of negative alcohol-related health outcomes had increased as well. Since then, effective alcohol

[13] As the price of alcohol increases, the amount of alcohol purchased goes down.

[14] Scandinavian countries are provided as an example due to their having the most similar drinking patterns among Western European countries to those found in the Russian Federation.

policies had reduced both the rate of growth of consumption levels and the resulting health problems. Even more, over time, the nature of drinking within these countries changed with consumers switching away from traditional heavy spirits consumption to lighter alcoholic beverages (Karlsson & Osterberg, 2001), (Osterberg & Karlsson, 2002), (Ramstedt, 2002).

In the first chapter of this dissertation, the history of the alcohol problem in Russia as well as the relevant social, cultural, and behavioral factors that contribute to the problems caused by alcohol use today were discussed. Chapter 2 will present an overview of the relevant academic literature in the field both from the point of view of the theoretical treatment of addictive goods and the statistical methodologies used to obtain results. Chapter 3 will provide a description of the data and chosen methodology as well as deal with the specification of the model. Chapter 4 will present the estimation results. Chapter 5 will conclude with a discussion of study implications, limitations, and suggestions for future research.

Chapter 2 Literature Review

2.1 Modeling Addiction: Theoretical Aspect

The relationship between price, purchasing power, and alcohol consumption is an acute point of academic contention. Arguments as to the nature of the relationship, and the consequent policy implications can be traced to at least as early as 1911, with V.K. Dmitriev's "Critical studies on the use of alcohol in Russia". In his book, the author challenges the (at that time) prevailing view on alcohol policy that:

> *"In accordance with the common view, accepted by the majority of learned specialists, the main reason governing the level of per-capita consumption of alcohol in a country is the relationship between the purchasing power of the populace and the price of alcoholic beverages. As the purchasing power of the population in Russia is primarily based on agricultural yields, while the price of alcohol on excise taxes, the proponents of the above point of view insist that the main moments determining the dynamics of per-capita alcohol consumption in Russia are, on one side, the fluctuation in agricultural yields (and by extension the purchasing power of the population) and on the other, the consistent increases in the excise tax. In addition to these two moments the majority recognizes the effects of decreasing the amount of alcohol vendors and the reduction in the welfare of the population over time."* (Dmitriev, 1911)

In essence, the author sets alcohol aside from other products and challenges the idea that:

> *"the demand for alcohol (and, by extension, its consumption), like the demand for the majority of other goods, follows the simplified law of supply-demand, that was in its time identified by classical political economics and that states that demand is always directly related to the purchasing power of the consumers and inversely to the price of the product"* (Dmitriev, 1911)

The results of Dmitriev's study were mixed due to the limitations of the data[15] available and the relative youth of economics as a science. Dmitriev's study resulted in the following findings:

- No evidence was found to support the claim that alcohol consumption reacts to either the size of the excise tax or to agricultural yields.
- The effect of reducing the amount of alcohol vendors, with the exception of removing them altogether, had at best a marginal effect on alcohol consumption.
- Increases in purchasing power, were best measured by industrial cycles and the resultant changes in the urbanized population rather than by the fluctuation in agricultural yields.
- Alcohol use grew in periods of industrial growth and increases in rural to urban transitions. In periods of economic recession and increased urban to rural migration, alcohol use would at least remain constant and sometimes decrease.

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[15] These limitations were realized and noted by the author himself.

- The per-capita consumption of alcohol was found to be highly dependent on the proportion of habitual as opposed to occasional users in the population. Habitual users were found to be more prevalent in urban populations.
- An increase in excise taxes was found to cause urban populations to hold their alcohol consumption constant while reducing the consumption of other luxury goods such as sugar and tea.

Although clearly dated, Dmitriev's study lays some of the groundwork for the understanding of the markets for addictive goods. It illustrates that the simple relationship stipulated by the law of demand (as price goes up, quantity demanded goes down) may not in fact hold for addictive goods in the same manner as it would for any other good. It differentiates between casual and habitual users of the good and identifies a relationship between newly acquired wealth combined with increased levels of social stress (as represented in the rural to urban transition) and alcohol consumption. Nine years later, Marshall (1920) wrote *"… habits which have once grown up around the use of a commodity while its price is low are not so quickly abandoned when its price rises gain"* raising the question of the relationship between price and habit. These early works would eventually result in the defining characteristics of compulsive goods used in most recent formal models of addictive behavior: tolerance, reinforcement, and withdrawal.

Attempts to model the behavior of individuals engaged in the consumption of compulsive goods centered around two models of addiction. One model assumed that addicts would act in a shortsighted or "*Myopic"* manner. Myopic consumers recognize the effects of past consumption of addictive goods on current consumption, but fail to account for the fact that current consumption will affect future consumption.

Houthakker and Taylor (1970) model the demand for alcohol and tobacco by viewing current demand as a function of a "stock of habits" which was used to represent the discounted value of past consumption. Pollak (1976) noted that in the consumption of addictive goods, individuals act in a "*naive*" manner. That is although they recognize the dependence of current consumption of an addictive good on past consumption, they would not see the impact of current consumption on future consumption. This article was based on Pollak's (1970) earlier work, where he modeled the optimal consumption paths of individuals who could revise their consumption during a finite number of fixed points in time. Using mathematics, he found two optimal paths, one of which, the "*naive*" one was for an individual who would make a consumption plan at time *t* without understanding, the fact that he would revise his consumption choice at *t*+1. The other, "*sophisticated*" path modeled an individual who recognized the fact that he would revise his consumption plan at the *t*+1 and adjusted his initial planning accordingly. This split of consumers into the "*naive*" and "*sophisticated*" categories would later aid in resolving some of the criticisms of the Rational Addiction Model.

Winston (1980) proposed a model of consumption that incorporated two of the characteristics commonly exhibited by addictive goods: *"... that a consumer's future choices are affected by current consumption of an addictive commodity."* and *"...that controlling one's own consumption of an addictive commodity regulating or stopping it is typically difficult, involving personal conflict and inconsistent behavior*." In many ways a critique of an earlier work by Stigler and Becker (1977) who claimed that

> "*...if heroin were used even though the subsequent adverse consequences were accurately anticipated, the utility of the user would be greater than it*

would be if he were prevented from using heroin. ...That is, addiction to heroin – a growth in use with exposure – is the result of an inelastic demand for heroin, not, as commonly argued, the cause of an inelastic demand."

Winston's article introduces several new aspects of the problem of modeling preferences for compulsive goods. Winston differentiates between harmful and beneficial addictions, primarily by the presence of "anti-markets" or goods that help an individual not to consume another good. He also introduces the concept of imperfect information feeding into the decision to start consuming a potentially addictive good in the first place and tries to explain the dual nature of an addict: "*...simultaneously wanting to consume the addictive commodity and avoid it.* (Winston, 1980)"

Mulahhy (1985) used a two-part model to estimate the demand for cigarettes using the 1979 National Health Interview Survey dataset. He found strong evidence for Myopic addiction supported by positive, significant coefficients on the coefficient of past consumption. In addition, he found that heavy smokers, were less responsive to changes in price than light smokers.

Baltagi (1986) estimated a dynamic demand for cigarette consumption using data from 46 states. He found further evidence in support of myopic behavior among cigarette

smokers and a strong "bootlegging" effect for over the border changes[16] in cigarette price, demonstrating sensitivity to price among tobacco addicts.

These and other studies using Myopic models have generally found evidence of addictive behavior in the consumption of addictive substances (cigarettes, alcohol) and the susceptibility to price changes of the consumers of compulsive goods. Critics of the Myopic model of addiction made arguments, aimed against the implicit assumption that future implications are ignored when making current decisions.

Pashardes (1986) estimated demand equations for both a "myopic" and a "rational" consumer on data from the British National Income and Expenditures Statistics dataset. The "rational" consumer differed from his "myopic" counterpart in that: "*…current consumption decisions are made with full knowledge of their future cost implications*. (Pashardes, 1986)" The author found strong evidence for rational behavior, that is, future price and other costs of consumption of the addictive good were important determinants of consumer behavior. Cigarette smoking was again, found to be an addictive behavior, but more importantly, the idea that Myopic (backwards looking) behavior is in essence nested in Rational (backwards and forward looking) behavior was introduced.

Two years later, Becker and Murphy (1988) wrote their signature work "A theory of rational addiction". The model presented in this article would eventually become the standard approach to the treatment of addictive goods by economists. In the context of

[16] That is a smoker would drive to a neighboring state to buy cigarettes if he could find a lower price by doing so. This demonstrates responsiveness to price and the fact that addicts will try to circumvent barriers to consumption.

the Becker & Murphy model, "…*rationality means a consistent plan to maximize utility over time* (Becker & Murphy, 1988)". That is, a rational addict will maximize the discounted value of utility over the length of his life, subject to his preferences and a budget constraint. His utility is based on the consumption of a bundle of non-addictive goods, the consumption of the addictive good itself, and an accumulated stock of "*consumption capital*" consisting of past consumption of the addictive good and various life events. This stock of capital is modified by a depreciation rate that varies from individual to individual. The rational addiction model, then, describes addiction by modeling the three central features of addictive behavior (tolerance, reinforcement, withdrawal) within the above framework:

- Tolerance is modeled by allowing the utility gained with the consumption of an identical dose of an addictive good to decrease as the stock of past consumption increases.
- Reinforcement is modeled by allowing the size of the stock of past consumption to increase the amount of current consumption through affecting the marginal utility (additional utility gained with the consumption of an extra dose of the addictive substance) of current consumption. As the stock of past consumption increases, the marginal utility of current consumption increases.
- Withdrawal is modeled by a strong drop in current utility with the cessation of the consumption of an addictive good.

The Becker-Murphy rational addiction framework results in a series of inferences about addictive behavior overall:

- Individuals with a high preference for the present will be more prone to addiction as they will give less weight to the future costs of consuming the addictive good[17].
- Individuals with a high discount rate associated with the stock of past consumption will be more prone to addiction as the future consequences of consuming the addictive goods is not as large for them[18].
- The optimal way to quit an addictive habit is to do it abruptly, "*cold-turkey*"[19]. Such behavior trades in an immediate large loss in wellbeing for an overall lifetime gain in long-run utility that comes about as the result of not incurring the future costs of addiction. A rational addict might even postpone quitting or attempt to quit several times as he tries to find some way of mitigating withdrawal (Becker & Murphy, 1988).
- Consumption of addictive goods exhibits "*adjacent complementarity*[20]." That is, current and future consumption act as complements in demand. Consequently, an anticipated increase in the price of an addictive good would lead to decreased consumption today and vice versa. It is important

[17] However, it can be argued that consumers have incentives to make investments that lower the rate of time preference for the present since the value of present utility becomes higher as the time preference rate decreases (Mulligan 1997).

[18] Causality is not implied as the state of being addicted, in and of itself, could cause the individual to discount the future more heavily and hence become more vulnerable to further addiction.

[19] This occurs since the relationship between the present consumption of an addictive good c and its past consumption S can at some point become discontinuous. See (Becker & Murphy, 1988) Appendix B for mathematical proof.

[20] Any group of goods is complementary if the reduction in price of one of the goods in the group leads to an increase in demand for all other goods of the group. In essence this is saying that alcohol consumption today is a complement for alcohol consumption tomorrow and yesterday.

to note, that this property of addictive goods means that only permanent price increases will affect consumer behavior.

  - The concept of adjacent complementarity leads to the definition of a rational addiction: *"A person is potentially addicted to* c *if an increase in his current consumption increases his future consumption of* c (Becker & Murphy, 1988)*."*
  - Strong adjacent complementarity implies strong addiction.

- Steady-state amounts of consumption are unstable for addictive goods. Furthermore, each individual will have more than one steady state of consumption.

The concept of multiple consumption steady states is a central mechanism in the workings of rational addiction. Steady states can be stable or unstable. Increased levels of adjacent complementarity (a strong addiction) will cause a steady state to become progressively more unstable. Unstable steady states are associated with low levels of consumption of the addictive good, while stable steady states are associated with high levels of consumption. A deviation from unstable steady states could take one of two directions. Falling below the unstable steady state amount would lead to a decrease in the consumption of the good and eventual abstention. Going over the unstable steady state amount would lead to further increases in consumption until a stable steady state is reached.

This model of behavior allows a better explanation for addiction. For example, assume that a high-school student starts by trying out heroin for the first time. Initially, while addiction is weak he is able to keep using low amounts in a recreational manner.

This can be viewed as a low consumption steady state. As his addiction strengthens, the steady state becomes more and more unstable. At this point, a perceived permanent increase in the future price of heroin could cause his current consumption to fall below the unstable steady state amount and eventually lead to abstention. An adverse life event however, could push him above his unstable steady state amount and lead to a more stable, but higher consumption steady state of a heroin junkie. This example shows a possible way to move from moderate, or recreational use to addiction within the rational addiction framework.

The rational addiction model found a lot of support in economic literature. Becker and Murphy (1994) apply their model to the case of cigarettes, using data from 50 States in the period of 1955-1985. Using, what would later become traditional, instrument of future price with fixed effects 2SLS, they found a positive significant coefficient on both past and future consumption. These findings support the basic implications of rational addiction.

Labeaga (1998) tested the Becker-Murphy model on a dataset of 2000 Spanish households between 1977 and 1983. In order to counteract the problem of unobserved heterogeneity Labeaga used an alternative double-hurdle GMM method initially proposed by Arellano & Bover (1988) instead of the customary instrument of future prices. He again found evidence in favor of the rational addiction model.

Grossman (1995) applied the rational addiction model to alcohol consumption among young adults using longitudinal data from the Future Dataset. The study found

evidence that showed that an increase in the price of alcohol reduced the number of alcoholic drinks consumed in the past year.

Douglas (1998) studied the duration of a smoking habit using the *National Health Interview Survey* for 1987. He found that increases in cigarette prices would increase the hazard of smoking cessation and that the quitting hazard rate rises with the habit's duration, a result in line with the expectations of the rational addiction model (Douglas, 1998).

Bretteville-Jensen (1999) tested the existence of stable time-preferences and differences in discount factors among individuals on a survey dataset of Norwegian heroin users. He found that active heroin users had a higher discount rate than former users and a large variation in time preferences between individuals.

Baltagi & Griffin (2001) apply an alternative econometric approach to the rational addiction model and a data set of 46 states from 1963-1992. His results were once again supportive of the rational addiction model.

Baltagi and Geishecker (2006) apply the rational addiction model to alcohol consumption in Russia using eight waves of RLMS data corresponding to the period between 1994 and 2003. Using traditional instruments, they fail to find evidence to support rational addiction among Russian women, and find only limited evidence among Russian men[21].

[21] Note: aside from the conceptual criticism discussed below, the traditional treatment of the rational addiction model has a number of econometric limitations. See Section 2.2

The basic rational addiction model is, however, not without limitations. One criticism states that Becker-Murphy's "rational addicts" are "*…happy addicts, choosing their addiction after careful consideration of the alternatives and never doubting their actions*. (Akerlof, 1991)" The above situation results from the implied assumption of perfect foresight inherent to the rational addiction model. Perfect foresight disallows an individual's ability to become addicted by mistake, and therefore devalues the validity of drug education programs. Orphanides and Zevros (1995) addressed this criticism by introducing uncertainty into the basic rational addiction model, relaxing the assumption of perfect foresight. They propose that

1. Consumption of an addictive good is not equally harmful to all individuals. This proposition is key, as without the appeal of controlled, casual consumption a rational consumer would never risk addiction.
2. Each individual faces uncertainty regarding the future consequences of addiction and possesses a subjective belief structure concerning his potential to become addicted.
3. This belief structure is updated over time with information learned through consumption of the potentially addictive good. As long as an individual fails to observe harmful effects in the course of his experiments, he adjusts the probability of addiction downwards.

Addiction then would result once an individual grew his stock of addictive capital beyond some critical level. Those individuals aware of their critical level would endeavor to not reach this point and in the absence of sudden shocks, would not become addicted. Those unaware of their critical level would attempt to learn it through

experimentation with the addictive good, and either discover it before becoming addicted, or fail to do so and become addicts. Addiction then, is an unintended outcome of experimenting with a good known to provide an instantaneous increase in utility with an unknown probability of harm in the future. Under this framework, getting addicted could happen accidentally, causing regret to the newly minted addict, solving the problem of assuming something as unrealistic as perfect foresight.

An individual who has learned of their critical level of addictive capital - acts according to the model proposed by Becker and Murphy, while those in the process of learning have a tendency for more myopic behavior. An important corollary that can be derived from Orphanides' (1995) modification of the rational addiction model is the importance of educational initiatives in addition to price controls in preventing addiction. Furthermore, it can be deduced that different types of interventions can be more effective in different populations. Young, and/or uneducated consumers may be more likely to respond to changes in price, while their richer, older, more educated counterparts might be more responsive to educational initiatives.

Suranovich (1999) proposed a modification of the rational addiction framework, which incorporated “quitting costs” and changes in perspective that come with age, into the model. Unlike the original rational addiction framework, where the individual plans his consumption over the length of his entire life, Suranovich assumes that the individual can only choose how much of an addictive good he will consume today, even though he still accounts for the future consequences of current consumption decisions. This ‘*boundedly rational*’ individual considers three components of the effect of the consumption of an addictive good on his wellbeing:

1. The current benefits he receives from consumption of the addictive good. This could be euphoria from the substance itself, or perceived social benefits such as fitting in with a group.
2. The present value of the expected future losses in utility that will come about as a result of his consumption.
3. The adjustment, or quitting, costs that arise from the reduction or elimination of the consumption of an addictive good.

Addiction occurs when the individual's addictive capital becomes large enough for quitting costs (withdrawal) to develop.

The presence of adjustment costs inhibits the ability of external shocks such as price increases or educational programs to reduce consumption of the addictive good. They can also be used to explain why addicts tend to need to consume a minimum amount of the addictive commodity (for example, a one pack per day smoker) as consuming less than that amount would lead to a decrease in utility due to the effects of withdrawal. Under Suranovich's framework, a major factor in determining the consumption of an addictive good is the consumer's age. As an individual ages, the discount factor applied to his end-of-life utility (which for an addict, includes the future cost of consumption) rises. This causes the "future loss of utility" component of his utility function to increase. In addition after a certain level of addictive capital is reached, the quitting costs faced by an individual even out in terms of severity. That is, while it would be harder for a 10-yr smoker to quit when compared to a 1-yr smoker, the withdrawal effects that would be felt by 9, 10 and 11-yr smokers would be similar in severity.

If an individual's stock of addictive capital is low, then he will gradually reduce consumption as he ages and his real cost of use increases until he eventually quits. This is made possible because the withdrawal costs under a weak addiction are low. An individual with a strong addiction will also want his consumption to decrease as he ages. However, the high cost of withdrawal will keep him from starting to reduce consumption as the loss of utility he will feel because of withdrawal outweighs the gain in utility from reducing the consumption of an addictive good. This situation would cause the consumer to regret his past consumption choices as his perspective changes with age thus providing an alternative explanation of how rational addicts could be "*unhappy*". Suranovich's model of addictive behavior implies that at the individual level a price increase or educational campaign would not be effective at reducing consumption. However, at an aggregate level, a reduction in consumption levels would be noticed. This occurs because, on the aggregate, individuals exists in many different stages of addiction. Even though a price hike would not cause an individual heavy smoker to quit, it could reduce the amount of potential addicts that start consuming and provide incentives for those who desire to quit to do so sooner.

Gruber and Koszegi (2001) addressed two other problems inherent in the basic rational addiction model: "Is forward-looking behavior possible?", and if so, "Is individual behavior time-consistent?" Using data on tax increases gathered from state legislative histories 1973-1996, they find strong evidence of forward-looking behavior in the consumption of cigarettes, supporting the idea of adjacent complementarity in addictive goods. Citing evidence against the assumption of time-consistent preferences made by the Becker Murphy model [(Prochaska, Crimi, Lapsanski, Martel, & Reid,

1982), (Miller, 1978), (Murray & Hobbs, 1982)] Gruber and Koszegi introduce time-inconsistent behavior into the rational addiction framework. First, a distinction is made between time-consistent and time-inconsistent agents. A time-consistent agent is characterized by being able to follow his utility maximization plan and discounts the future in an exponential manner. He is capable of using quitting aids to help him follow the plan, but would avoid using a self-control device as these would lower the utility received from consuming the planned amount of the substance. Time inconsistent agents, characterized by their hyperbolic discount function, could further be split into two categories of behavior: naïve and sophisticated. Naïve agents are unaware that they will likely change any plan they make today in the future. For example, the line of logic expressed in "I will drink a lot today, tomorrow – I quit", can be looked at as naïve behavior if made by an alcoholic as the individual is ignoring the fact that in the morning, his stock of addictive capital will be higher, and he may decide to alter his consumption plan. Sophisticated agents realize the potential for future self-control issues and make plans with that in mind. This could translate into the use of a self-control device such as an AA meeting to aid in holding to the plan. Gruber and Koszegi's alterations of the rational addiction model resulted in "*…predictions for price changes that are very similar to what are delivered by their (Becker and Murphy) model* (Gruber & Koszegi, 2001)*."*

Although the pure rational addiction model and its modification by Gruber and Koszegi lead to similar results, the policy implication of each is radically different. The pure Becker and Murphy model suggests that optimal taxation for addictive goods should be based solely on the externalities that the consumption of that good imposes on society.

The Gruber and Koszegi extension, however, allows for the inclusion of the harm inflicted by the addictive good on the consumer himself.

The body of literature dealing with rational addiction is quite large. Overall empirical evidence has been supportive of the main implications of the theory based on a variety of addictive substances such as cigarettes [(Chaloupka, 1990, 1991, 1992, 1996, 1998), (Grossman & Chaloupka, 1997), (Sloan, Smith, & Taylor, 2002), (Gruber & Kőszegi, 2004), and others], alcohol [(Moore & Cook, 1995), (Waters & Sloan, 1995), (Bentzen, Eriksson, & Smith, 1999), (Baltagi & Griffin, 2002), and others], drugs [(Van Ours, 1995), (Grossman & Chaloupka, 1998), (Saffer & Chaloupka, 1999)], coffee (Olekalns & Bardsley, 1996) and even milk (Auld & Grootendorst, 2004). Aside from the issues raised by the assumptions made by rational addiction, the main problem noted throughout these studies was that the discount rates estimated by the original rational addiction model tend to be implausible when interpreted.

2.2 Modeling Addiction: Mathematical Aspect

Although the theoretical framework provided by the rational addiction model and its extensions is the current standard for modeling consumption of addictive goods, the mathematical methodologies used to date have a number of shortcomings that have led researchers to question whether useful policy results can be gained from research done on its basis (Gruber & Koszegi, 2001). This section gives an overview of the mathematics of modeling the consumption of addictive goods and illustrates the problems faced by prior research.

A good can be considered addictive if it satisfies three basic properties:

1. Tolerance: The utility[22] gained from consumption of an identical dose of the good today decreases as prior consumption of the good increases. That is, the satisfaction a person receives from consuming any given amount of an addictive substance becomes progressively lower as his past consumption of the same addictive substance increases, requiring the individual to consume progressively higher amounts of an addictive good to achieve the same level of satisfaction.
2. Withdrawal: Cessation of the consumption of a good leads to an instantaneous drop of utility. Essentially, this property refers to any adverse emotional (depression) or physical (insomnia) reaction that occurs because of an abrupt cessation in the consumption of an addictive good.
3. Reinforcement: The marginal utility gained from the consumption of an extra dose of the good today increases as the stock of prior consumption increases. That is, a high level of previous consumption of an addictive good, makes consuming an extra unit of the same good in the current time more appealing[23].

Using this definition, addictive goods can be split into two categories: harmful and beneficial. An addictive good is classified as beneficial if consumption of the addictive good results in an increase in future utility, wellbeing and/or earnings potential. Conversely, it is classified as harmful if its consumption results in a decrease in the same.

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[22] In economics, utility refers to the abstract wellbeing or satisfaction an individual gets as he consumes a good or service.

[23] For example, assume an individual has a background of enjoyable instances of beer consumption. That prior consumption of beer makes drinking a beer today more attractive as the gained benefits are better known and desirable. This is reinforcement. The same individual will need to drink progressively larger amounts of beer to achieve the same state of inebriation as his system gets used to alcohol consumption. This is tolerance. Finally, abrupt cessation of beer consumption will cause this individual some of his wellbeing as at the very least he is giving up the act of drinking itself, which he knows he finds enjoyable. This is withdrawal.

Harmful addictive goods can also be identified by the presence of "anti-markets" (Winston, 1980) such as, nicotine gum and psychological coding sessions. This dissertation will focus primarily on harmful addictions, as the behavior resulting from the consumption of harmfully addictive goods tends to negatively affect both the addict and society at large.

As a consequence of his habit, the individual addict is faced by hardships in the form of internal costs such as adverse health outcomes, higher risk of incarceration or bodily harm while engaged in drug seeking activities, and the opportunity cost of the time spent while indulging the habit. At the same time, society faces an increased burden to enforce drug laws, higher crime rates, and loss of productivity. Modeling the underlying factors that are the cause of such behavior is of interest to anyone concerned with the composition of effective public health policy.

In order to begin looking at the problem of limiting harmful addictive behavior, it would first be helpful to study the mechanism behind the process of addiction. Central is the question of whether or not addicts are capable of taking the future consequences of their habit into account when they are making decisions.

Myopic models of addiction treat consumers as being aware of the dependence of present consumption of the addictive good on past consumption but being unaware of, or choosing to ignore, the effects of current consumption of an addictive good on future utility as they make their consumption choice. In myopic models, consumers have no foresight and irrationally ignore all future physical consequences associated with the

present use of an addictive substance. Essentially, they have an infinite discount rate on future consumption[24].

In myopic models, an individual attempts to maximize a single period utility function, subject to his budget constraint. Mathematically[25] the myopic consumer's problem can be shown as:

$$maxU_t = U(C_t, C_{t-1}, Y_t, Z_t)\ s.t.\ I_t = P_t C_t + Y_t \qquad (1)$$

Where U_t is his current period utility, C_t is his current level of consumption of an addictive good, C_{t-1} is his level of consumption of an addictive good in the preceding time period, $Y_t$is his current level of consumption of a bundle of non-addictive goods[26], Z_t is a vector of life events that affect the individual's preferences, P_t is the price of the addictive good in the current period and I_t is the individual's wealth. Cook and Moore (Moore & Cook, 1995) show that under the assumptions of quadratic utility and a constant marginal utility of wealth, this utility maximization problem will yield the following demand function:

$$C_t = \beta_0 + \beta_1 P_t + \beta_2 C_{t-1} + \beta_3 Z_t + \beta_4 I_t + \varepsilon_t\ where\ \varepsilon_t = \alpha + v_t \qquad (2)$$

Here ε_t is the error term, α is the unobservable, individual specific effect of a consumer's tastes and other time invariant characteristics that affect the consumption of an addictive

[24] A dollar today is worth more than a dollar tomorrow. The discount rate then indicates how much more a dollar today is worth. An infinite discount rate implies that you would rather have a dollar today than infinite riches tomorrow. Similarly, the benefit of a crack-pipe today, outweighs any possible consequences that may happen tomorrow.

[25] Technically there are many myopic consumers, but the '*i*' subscript is suppressed for simplicity.

[26] The price of these goods is assumed to be normalized.

good[27], v_t is a time variant vector of various other unobservable and random determinants of the consumption of addictive goods[28]. In the above equation, the coefficient on the lagged consumption term C_{t-1} measures the presence and strength of the addiction. A strongly significant positive coefficient would suggest that the individual in question is myopically addicted to the consumption of the addictive good. However, the presence of α in the error term would bias any estimates of equation 2, as it would be impossible to differentiate between the effect of past consumption on current consumption and the effect of some unobserved, time invariant determinants of consumption on the same. Essentially, the problem of unobserved heterogeneity, which needs to be addressed when using such models, exists.

The implications of myopic behavior for public policy are straightforward. Since the current consumption of an addictive good is affected by current and past factors only, the best method to control consumption is to increase the price of the addictive good (either through taxes, for legal goods such as alcohol and cigarettes, or through increased enforcement for illegal goods such as heroin and cocaine). Educational initiatives and harsher legal penalties for consumers of the addictive substance would be ineffective as the consumer will not take the consequences his current actions will have in the future (lung cancer, jail time) into account.

Rational models of addiction treat consumers as being farsighted enough to take the effect of current decisions on their future wellbeing into account as they choose what

[27] Note that although α is fixed for an individual consumer, so it does not vary with time, it varies between consumers.

[28] v_t varies over time and consumers

amount of an addictive good to consume. That is they explain addictive behavior within the standard rational utility-maximization framework used in economics in the sense of combining forward-looking maximization with stable preferences. They are based on behavior that maximizes the utility obtained during the total lifetime of the individual thus incorporating dependence between the current, future and past consumption of an addictive good. A rational addict is fully aware of the three properties of an addictive good and considers them when making his consumption choice.

In 1988, Gary S. Becker and Kevin M. Murphy introduced the fundamental theoretical framework behind the "Rational Addiction" model of addictive behavior in their signature article "A Theory of Rational Addiction" (Becker & Murphy, 1988). According to the rational addiction model, an individual's lifetime utility function can be represented by:

$$U(t) = \int_0^T e^{-\sigma t} \mu[Y(t), C(t), S(t)]dt \qquad (3)$$

where U(t) is the discounted lifetime utility, μ is the period specific utility, Y(t) is the consumption of a bundle of non-addictive goods, C(t) is the consumption of a (potentially) addictive good, S(t) is the stock of addiction capital, the natural exponential e is 2.7182 and σ is the time preference rate, or the marginal rate of substitution between present and future utility with the discount factor $1/(1+\sigma)$[29].

[29] Note: the above utility function is assumed to be quadratic, well behaved and separable over time in Y(t),C(t),S(t) but not in Y(t),C(t), alone.

The stock of addiction capital S(t) represents the mechanism through which the past consumption of an addictive good affects the individual's current level of utility. It is a function of previous consumption of the addictive commodity and various life events, such as an automotive accident or marriage, that can affect S(t) in either a positive or negative manner. Addiction capital naturally depreciates at rate δ and its accumulation can be represented by the following equation:

$$S(t) = (1 - \delta)S_{t-1} + C_{t-1} + D(t) \qquad (4)$$

Where D(t) represents expenditures of addiction capital on endogenous appreciation or depreciation (life events). Note that the presence of D(t) implies that even those individuals that have never consumed the addictive good may still have some stock of addictive capital due to adverse life events.

Rewriting the above in a manner more consistent with the treatment of the myopic framework, the rational consumer's problem can be summarized by:

$$max U_t = \sum_{t=1}^{\infty} \left(\frac{1}{1+\sigma}\right)^{t-1} U(C_t, Y_t, S_t)\ s.t.\ I_t = \sum_{t=1}^{\infty} \left(\frac{1}{1+\sigma}\right)^{t-1} (P_t C_t + Y_t) \qquad (5)$$

Observe that equation 5 assumes that the market interest rate and the time preference rate σ of the individual are the same. This assumption implies that the individual has no inclination to shift his consumption into the future or into the past relative to his income flow.

Becker and Murphy showed that an individual acting according to their model generates a demand function for an addictive good of the form (Becker, Grossman, & Murphy, 1994)

$$C_t = \alpha_1 C_{t-1} + (1/(1+\sigma))\alpha_2 C_{t+1} + \theta_1 P_t + \theta_2 I_t + \theta_3 \varepsilon_t \qquad (6)$$

Where α_1 is a measure of the effect of an increase in past consumption on the marginal benefit of current consumption, $(1/(1+\sigma))\alpha_2$ is the effect of an increase in future consumption on the marginal benefit of current consumption, finally ε_t is the effect of measured and unmeasured life cycle events on utility. Rational addiction theory implies a positive value of α_1 and $(1/(1+\sigma))\alpha_2$ and negative coefficient on θ_1. Furthermore, it implies that the short run price elasticity of an addictive good should be smaller than the long run price elasticity of an addictive good since the former holds consumption constant while the latter allows it to vary. Consequently, the price response for an addictive good should grow over time.

As with the myopic addiction model, estimating the rational addiction model through the method of ordinary least squares is problematic. The error term ε_t is likely to contain unmeasured variables such as preferences, marginal utility of wealth and other unaccounted for determinants of demand. These variables are not only likely to be serially correlated but also will be correlated with both C_{t-1} and C_{t+1}causing what is known as the omitted variable bias.

The most common method of solving this problem is by using past and future prices as instruments for past and future consumption and estimating equation 6 through 2SLS however; recently this method has received criticism (Baltagi & Griffin, 2001).

Equation 6 was derived under the assumption that the individual was capable of perfectly anticipating future price and all other variables related to his consumption choice. Any unanticipated change in these variables would cause the individual to revise his consumption plan, therefore C_{t+1}rather than being viewed as the actual future consumption, as is common, should be treated as planned future consumption, which is equal to the actual only if the individual was capable of perfectly predicting future price among other variables at time period t. The fact that available data contains information on actual consumption, rather than the planned consumption leads to measurement error. This leads to the classical error-in-variable problem, which causes attenuation bias. This problem is exacerbated when using panel data (Baltagi & Griffin, 2001). Furthermore, in the presence of measurement error, the error term will be correlated with future prices and other variables whose future value would affect current consumption unless they were perfectly predicted at time t, thus invalidating such variables from being valid instruments for future consumption.

2.3 The Demand for Alcohol

In addition to the mechanics of the consumption of addictive goods, the nature of the demand for alcohol is an important factor in determining properly aimed public policy. It has been shown that factors like national drinking culture and preferred national beverage are important determinants of alcohol consumption (Ramstedt, 2002). This makes it vital to research many individual alcohol markets in order to identify any overall tendencies. Studies aimed at modeling the demand for alcoholic beverages have been conducted with numerous datasets.

Manning (1995) analyzed the effects of heavy drinking on the price elasticity of demand[30] of alcohol. Predictably he found that individuals prone to heavy drinking are less responsive to price than light drinkers. The median price elasticity among all levels of alcohol consumption was found to be -1.2 and increases greatly at higher level of consumption with the 95th percentile implausibly having a slightly positive estimate.

Fogarty (2006) conducted a meta-analysis of 64 alcohol demand studies on a number of different countries and a range of historical time periods. The mean (median) price elasticity of demand differed by alcohol type: -0.38(-0.28) for beer, -0.77(-0.76) for wine and, -0.70(-0.59) for spirits. The elasticity estimates for each alcohol cohort varied widely from country to country. In addition, Fogarty found that "… *within a country, the beverage with the largest market share is the beverage with the most inelastic demand. The opposite also appears to be true* (Fogarty, 2006)*"*. This underlines the importance of considering local characteristics when designing policy interventions.

Gallet (2007) conducted a meta-analysis of 132 alcohol demand studies and found the following tendencies[31] with respect to price and income elasticities[32]. Overall, the price elasticity of alcohol was found to be negative and inelastic, well in line with

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[30] Formally, $\frac{\%\Delta\ in\ Quantity\ Demanded}{\%\Delta\ in\ Price}$ the price elasticity of demand is a measure of the responsiveness of quantity demanded to a price increase. Due to the Law of Demand (as the price of the good increases the quantity demanded of a good must go down) it always takes a negative value. Values below zero but above -1 are called "inelastic" and indicate a relative unwillingness to reduce consumption in the face of a price increase. Common sense would put alcoholics in this category. Values less than -1 are called "elastic" and indicate a relative willingness to reduce consumption should a price increase occur.

[31] Median elasticity for each category is provided in parentheses.

[32] Formally, $\frac{\%\Delta\ in\ Quantity\ Demanded}{\%\Delta\ in\ Income}$, the income elasticity of demand is a measure of the responsiveness of quantity demanded to a change in income. The income elasticity of demand for normal goods is always positive. Values between zero and one indicate a relatively small amount of extra consumption will occur with respect to a change in income. Values greater than one indicate that a relatively large amount of extra consumption will occur with respect to a change in income.

common wisdom on the subject. The short run elasticity (-0.51) was found to be more inelastic than the long run elasticity (-0.81). The demand for beer (-0.36) was found to be more price inelastic than that for wine (-0.7) and spirits (-0.67) and younger individuals (-0.386) were found to be less responsive to price than older individuals (-0.55). The median income elasticities showed beverage type to be an important factor in consumption with wine having the largest income elasticity (1.10), followed by spirits (1.0) and beer (0.39).

These studies provide strong evidence of interdependence between different categories of alcohol and a set of good baseline measure to ensure that estimates make sense within the greater context of the literature available.

The widespread prevalence of several types of illicit alcohol production in Russia complicates any attempt to study alcohol-related questions[33]. On the supply side, the presence of commercially mass-produced "counterfeit" alcohol increases the rate of negative health outcomes and undermines the state's ability to affect the alcohol market through taxes and quotas. Furthermore, the presence of "counterfeit vodka" on the same shelves as legitimately produced vodka is cited by some as a primary reason for consumption of home-made liquor (Nuzhnyi, 2004). On the demand side, the wide availability of non-commercially produced homemade liquor in the rural areas of the

[33] Zaigraev (2004) finds that *samogon* or moonshine was the primary alcoholic beverage for 60 to 70% of rural inhabitants in six regions of the Russian Federation.

Russian Federation provides a nearly perfect substitute for commercially produced liquor at a price that is usually as low as half[34] that of a store bought bottle of low-end vodka.

The supply of illicit alcohol is not homogeneous, rather it falls into seven diverse categories:

> *"(1) commercially produced alcohol that is sold illegally; (2) legally imported quantities of alcohol for personal consumption; (3) illicit importation of commercially produced alcohol; (4) by-products of commercially produced alcohol and commercially produced non-potable alcohol; (5) non-commercial alcohol illicitly produced on a large scale; (6) local small-scale production outside the formal economic system; and (7) production of alcohol at home for personal use."* (Single, 2004)

Each of these sources of illicit alcohol complicates the estimation of the demand for alcohol in its own way. Three are of special interest with regard to the Russian Federation.

1. Alcohol that is mass-produced in an unofficial manner with the intent to sell as a legitimate brand name on the mass market. This type of illicit production is characterized by no quality control and sub-par, occasionally poisonous, inputs. Production can occur either in an underground facility or "off the books" in a legitimate factory; thus, the ability of the illicit product to masquerade as the real thing varies. The estimation of the proportion of the total alcohol market that is made up by this type of product and the

[34] Zaigraev (2004) estimates the cost of producing a 0.5l bottle of *samogon* at 8-10 rubles, about ¼ of the price of a low-end bottle of vodka.

additional health costs borne by consumers of "counterfeit vodka" is beyond the scope of this dissertation. However, since both legitimate and counterfeit brand name alcohol is sold in the same stores, on the same shelves and for the same price no significant effect on an individual's alcohol consumption from the existence of counterfeit products[35] is expected. Furthermore, counterfeit brand name alcohol is expected to be randomly distributed throughout the market as a whole, so no attempt will be made to treat for this category of illicit alcohol separately for the purposes of this dissertation.

2. Alcohol-containing industrial byproducts and other surrogates. This section of the illicit alcohol market includes products not intended for drinking that are available on the free market, such as aftershave, herbal medicine, and antifreeze or at the workplace, including aviation spirits, and medical alcohol, and are used for recreational purposes. These products are characterized by wide availability, high alcohol content (30-97%), and low price. Many come in the traditional Russian drinking sizes (0.1l 0.25l 0.5l) and have bright, colorful labels (McKee, et al., 2005). Discussing the obvious health hazards of consuming products like antifreeze, is beyond the scope of this dissertation, but the presence of these goods creates a difficult problem for any price-based attempt to regulate alcohol consumption. On average, surrogates are cheaper on a milliliter of alcohol per dollar scale than a bottle of store-bought vodka. A sharp increase in the price of store-bought alcohol resulting from something like an excise tax could cause the poorer segments of the population to switch to the consumption of surrogates; this effect

[35] First, any price increase would also increase the price of this category of illicit alcohol, as it is masquerading as the real thing. Furthermore, it should be noted that there is no way to distinguish between this category of illicit alcohol and the genuine product. This is true both for the available data and for the individual wishing to make a purchase in a Russian store.

would likely be greater in urban areas where *samogon*[36] is not as widely available. This effect may not be limited to price-based attempts at market control. An increased level of enforcement of the drinking-age, for example, could also cause those affected to switch to surrogate consumption, as there is no law against minors purchasing antifreeze and the like.

3. Alcohol that is produced on a small scale for domestic or local use with no intent to masquerade as brand name alcohol. In Russia, this type of noncommercial alcohol usually means *samogon* as the production of homemade wines and beers is not widespread (Zaigraev G. , 2004). *Samogon* use is mostly confined to the rural areas of the Russian Federation where it plays three important roles: as a cheap and available substitute for store-bought vodka, as an income subsidy for the rural poor and as a substitute for cash in the provinces (Zaigraev G. , 2004). Unlike counterfeit alcohol, which is indistinguishable from legitimate alcohol until consumed, *samogon* is likely to directly interfere with the price-consumption relationship. Zaigraev (2004) in his study of *samogon* consumption in six economically and geographically diverse regions found that rural Russians drink 4.8 times more *samogon* than vodka. *Samogon* prices were found to be 15-20 rubles per half liter compared to the 50-60 ruble price tag of a store bought bottle of vodka. This was the primary reason cited (60-70% of respondents) for preference of *samogon* over vodka.

This last category of illicit alcohol is of great importance due to a combination of factors in play since the collapse of the Soviet Union. First, the dynamic of alcohol

[36] *Samogon* or moonshine is a strong alcoholic beverage that varies in color from filmy white to light brown and has alcohol content between 16.5 and 62.2%. (Nuzhnyi, 2004)

consumption in rural areas of the Russian Federation have shown an increase in the frequency and volume of alcohol consumption with the attendant spike in alcohol related diseases in all population subgroups (Zaigraev G. , 2004) . Second, the prevailing social apathy towards alcohol related issues provides fertile ground for the production and consumption of illicitly produced spirits. Third, the lack of effective government control, over the production and quality of legitimate alcoholic beverages provide a steady stream of ready consumers for the *samogon* market (Nuzhnyi, 2004). Fourth, the relative poverty of the rural population stimulates the use of *samogon* as a currency substitute. Fifth, the lack of government control over *samogon* production, in terms of education or enforcement makes this a no risk, socially acceptable crime.

Chapter 3 Research Design

3.1 Econometric Methodology

Under the rational addiction framework, the relationship between the price and consumption of an addictive substance is dynamic, that is it exhibits time dependence. Consequently, a large portion of the research dealing with rational addiction involves the use of panel data. Panel data refers to a cross-section that was repeatedly sampled over time. Unlike a pooled cross-section, panel data must gather information on the same cross-section each time-period. Though not without its issues, panel data offers several distinct advantages over the alternatives (Baltagi B. , 1995).

1. It allows for the control of individual heterogeneity and fixed effects (diversity).
2. Has more variability, less co-linearity and more degrees of freedom.
3. It can be used to test more complicated behavioral models and measure effects that are not detectable in pure cross-sections or time-series data.

Over the years, a number of econometric techniques have been applied to the rational addiction model and its extensions. The most common methods used are fixed effects two stage least squares (FE2SLS), two stage least squares (2SLS), Labeaga's

(1999) double hurdle model (LDH) and GMM estimators using a stacked matrix of instruments (AB-GMM)[37]. Assume a generic dynamic panel model of consumption:

$$C_{it} = \beta_1 C_{it-1} + \beta_2 C_{it+1} + \beta_3 P_{it} + \beta_4 X_{it} + \alpha_i + \varepsilon_{it} \;\; where \;\; \varepsilon_{it} = \mu_{it} + v_{it} \tag{7}$$

Where C_{it} is the dependent variable, $C_{it\pm1}$ is the lag/lead of the dependent variable, P_{it} is the current market price of the dependent variable, $X_{it}$is a vector of explanatory variables, and $\alpha_i$is an unobserved effect that is individual specific but time invariant. The error term ε_{it} consists of the unobserved individual specific effect μ_{it}, and the rest of the disturbance v_{it}.

The fixed effects "*within estimator*" obtained through FE2SLS solves the problem of correlation between α_i and the error term. It does so by subtracting the time-averaged model from the original. Unfortunately, this same process also removes the effects of any other time invariant variable. Furthermore, the fixed effects within estimator is consistent only if all regressors are strictly exogenous (Baltagi B. , 1995). Under the standard treatment of the rational addiction model, P_{it} and $C_{it\pm1}$ violate this assumption (Picone, 2005). The assumptions required by 2SLS are not as strict, only requiring contemporaneous exogeneity between P_{it} and X_{it}. However, using this method does not eliminate α_i therefore the endogeneity of $C_{it\pm1}$ is expected to be worse. LDH requires an assumption of strict exogeneity between P_{it} and X_{it} which again, is violated under the traditional rational addiction model (Picone, 2005). The problem stems from the fact that

[37] See (Baltagi B. , 1995) for in depth discussion and examples.

available consumption data provides the actual values of future consumption C_{it+1}. As previously discussed, one of the implicit assumptions inherent in the rational addiction model is perfect foresight on price, P_t and other variables affecting future consumption X_{it}. Consequently, C_{it+1} should be viewed as "planned consumption of the addictive good". Since consumption plans change in response to circumstances, actual C_{it+1} is not equal to planned C_{it+1} leading to measurement error bias. Furthermore, $r_{t+1} = C_{t+1}^{planned} - C_{t+1}^{actual}$ would be correlated with both P_{t+1} and X_{it+1}, unless perfect foresight exists. Consequently, X_{it} and P_t cannot be strictly exogenous.

In light of these considerations, the method of using a first difference GMM estimator with a stacked matrix of instruments as proposed by (Arellano & Bond, 1991) offers the most promise.

Like the within transformation used by FE2SLS, the AB-GMM estimator removes the effects of α_i through a subtracting the lagged model from the original, however it does not require the assumption of strict exogeneity of P_{it} and X_{it}. Applying the first difference transformation to equation 7 leads to:

$$\Delta C_{it} = \beta_1 \Delta C_{it-1} + \beta_2 \Delta C_{it+1} + \beta_3 \Delta P_{it} + \beta_4 \Delta X_{it} + \Delta \varepsilon_{it} \qquad (8)$$

Estimating equation 8 with OLS will still lead to biased and inconsistent results due to the previously discussed problems; however instrumental variable methods can now be used without assuming strict exogeneity between P_{it} and X_{it}.

Instrumental variable methods are used to obtain consistent estimates when the use of OLS is compromised by the considerations discussed above. An instrumental

variable is similar to a proxy in concept. That is, information from a known variable is used to help account for the effect of an unobserved variable, but the assumptions and mathematics differ between the two. An instrumental variable Z cannot be correlated with the unobserved variable and by extension the error term but must be correlated with the variable for which it is intended to be an instrument. In the context of the model a good instrument must be correlated with ΔC_{it-1}, ΔC_{it+1}, and ΔP_{it} and uncorrelated with $\Delta \varepsilon_{it}$. Assuming, $t \geq 3$, past consumption from two and more periods ago would be valid instruments for $\Delta C_{it} = (C_{it} - C_{it-1})$ as it satisfies the above conditions. Assuming it meets both theoretical and practical criteria, this is the recommended instrument for dynamic-panel consumption models (Baltagi B. , 1995), (Picone, 2005). Due to concerns about potential serial correlation of the disturbances, it has been ignored in favor of future prices by most researchers. However, Picone (2005) makes the case that this concern can be overcome by controlling for individual fixed effects and lagged values of the dependent variable. Furthermore, the AB-GMM method allows for testing for the presence of serial correlation directly.

3.2 The Data

This dissertation uses the data provided by the Russian Longitudinal Monitoring Survey (RLMS)[38]. The RLMS is a household based nationally representative survey designed and administered by the Carolina Population Center at the University of North Carolina at Chapel Hill, Paragon Research International and the Russian Academy of

[38] Questionnaires for each wave are available at http://www.cpc.unc.edu/projects/rlms-hse

Sciences. Data drawn from Phase II (rounds V(1994)-XIX(2010)) of the RLMS will be used in the estimation.

In order to ensure national representability, multi-stage probability sampling was used to generate the data for Phase II of the survey. In the first stage, 1850 *rayons* (districts) of the Russian Federation were selected for use as primary sampling units (PSUs). In the second stage, these *rayons* were stratified into three self-representing (SR) and 35 equal sized non self-representing (NSR) strata. One rayon, was chosen at random from each of the 35 NSR strata with the probability of being selected being weighted proportionally to the size of the population. The three SR strata (Moscow city, Moscow District and St. Petersburg city) were selected with a probability of 1, due to their importance. The proportion of the total PSU population accounted for by urban and rural areas was then used in order to distribute the required sample size between these two substrata (For example: 100% of the sample size in Moscow city was drawn from the urban substrata since 100% of Moscow city's population is urban). The resulting sample consisted of 4718 households. The response rate was greater than 80% on the household level and greater than 97% on the individual level (RLMS-HSE).

Information on drinking habits was obtained through a combination of a number of questions. Respondents were asked whether they had consumed any alcoholic beverages during the 30 days before the survey. If so, they were questioned on their frequency of consumption, the types of alcoholic beverages consumed and the usual amount consumed of each (in grams). In addition, the head of each household was asked to report the overall quantity of alcoholic drinks of each type purchased by the household and the expenditures on them during the last week.

Although the study itself is carefully designed, there have been some reported concerns regarding its accuracy. For example, the sample can be biased because it excludes some hard drinking groups of the population, such as migrants, service members, inmates, homeless people and other marginal groups (Nemtsov A. , 2004). Omitting these special groups from the study should not affect the generalizability of the results. These hard drinking groups are not indicative of the average Russian citizen and require separate studies aimed at the peculiarities of such cohorts.

The sample consisted of 4,539 individuals, aged 16 to 100, who had completed at least four consecutive interviews for which price data were available, and had consumed at least one alcoholic beverage of any type during the course of the survey. Figure 1 shows the distribution of sample size over time. Although the available sample starts to rapidly decline after peaking in the year 2000, a relatively large sample size was retained throughout the course of the survey.

The survey was not operational in 1997 and 1999. In August of 1998, Russia went through a major financial crisis. This event is likely to have an effect on alcohol consumption due to increased stress and lower well-being, however since individuals were not observed in the year before and the year after the crisis, the short-term effects of this shock were missed.

3.3 Empirical Specification

The dependent variable used in this study was the amount of alcohol, measured in grams of pure ethanol, consumed by an individual on a daily basis. Alcohol consumption involves a large variety of beverages and surrogates with differing levels of alcohol

content. The Russian Longitudinal Monitoring Survey provides information on an individual's average consumption (in grams) per drinking episode of five categories of alcoholic beverages: beer, dry wine, fortified wine[39], vodka, and homemade liquor. Early waves of data also provided the equivalent in grams of ethanol for each of the above categories. Unfortunately, this data was no longer provided in the later years of the survey. The method of ordinary least squares was used to derive the coefficient used by early waves of the data to convert each alcohol type into pure ethanol. These coefficients were found to be 0.0336 for beer, 0.144 for dry wine, 0.18 for fortified wine and other beverages, 0.4 for vodka, and 0.39 for homemade liquor[40]. These data were combined with information on the average amount of drinking episodes that an individual engaged in over a 30-day period to create the average amount of pure ethanol consumed on a daily basis.

The primary explanatory variables are the average daily amounts of ethanol consumed in waves immediately before and after the current wave. The coefficients on both are expected to be positive if alcohol consumption follows a "*rational*" process.

The price of alcohol was derived in the following manner: RLMS provides the nominal values of the five lowest and five highest prices of the different groups of alcoholic beverages in each individual's local vicinity. This information was used to calculate the average nominal price of each category at the PSU level. Since different

[39] The survey also includes a category of "other alcoholic beverages". From first-hand knowledge of the alcohol market, this would include products like premade cocktails (essentially flavored ethanol) and various infusions. These products are similar in price, alcohol content and lack of quality to fortified wines and have been included in that category when possible.

[40] R^2 and adjusted R^2 for the regressions associated with each coefficient was 1. The derived weights duplicated the information provided in the early waves perfectly.

regions of the Russian Federation have preferences for different categories of alcoholic beverage, the proportion each category contributed to total consumption was calculated for each PSU. Finally, a price index to deflate the nominal prices provided was derived from variables providing information on an individual's real and nominal income. The price of alcohol faced by an individual was then calculated by summing up the products of the mean real PSU price of each category by the proportion that that category contributed to total PSU consumption. A measure for the price of cigarettes was derived using a similar process in order to identify any complementarity or substitution effects between alcohol and tobacco.

Three variables were included to control for unobservable social factors that may influence the decision to consume alcohol:

- Drinking without food and drinking at the workplace are high-risk behaviors likely to lead to strong habit formation and a pattern of alcohol consumption different from that of other consumers. The effects of both behaviors are thought to be persistent over time as such a measure of whether or not an individual has engaged in such behavior over the last two years is included.
- An index of self-assessed prosperity[41] is included as a proxy. The coefficient on self-assessed prosperity should not be interpreted directly. Its primary purpose is to control for unobserved social events that may have occurred. Since self-assessed prosperity is subjective, an individual faced by adverse life events is

[41] The index is on a 9-point scale, the higher the better. This variable is included as part of the RLMS dataset and is not constructed by the author.

likely to lower his prosperity score while an individual going through a problem free stretch of life is likely to increase it.

Other explanatory variables include:

- Gender: Previous research has shown that the majority of alcohol consumption in Russia is done by men. Therefore, men are expected to consume more alcohol than women do.
- Age: The relationship between age and alcohol consumption is expected to be non-linear. Therefore, both age and age squared will be included in the model. Alcohol consumption is expected to increase with age at first but to level out and decrease towards the end of life.
- Income: Increases in income should lead to increased alcohol consumption since alcohol is a normal good.
- Education: A dummy for having completed secondary education will be included. Education is expected to have a protective effect.
- Marriage: Being married expected to have a protective effect on alcohol consumption.
- Employment: Unemployment is expected to increase alcohol consumption.
- Smoking: Being a current smoker of cigarettes is expected to increase alcohol consumption. Other sources of tobacco are not studied.
- Rural status: Living in a rural area should lead to increased alcohol consumption.

In addition to the above, time and regional dummies are included to control for regional differences and temporal trends in alcohol consumption.

Prior research suggests that gender and urban/rural status are likely to be important determinants of alcohol consumption. However, gender does not vary over time and 99.98% of the rural residents in the sample stayed rural for the duration of the study. This lack of within-group variation can potentially reduce the explanatory power of the coefficients obtained with the chosen econometric methodology. To overcome the problem models stratified by gender and rural status in addition to the overall model were included.

Chapter 4 Results

During the study period, the mean level of alcohol consumption varied widely within the sample (See Figure 2). The variation in price over this same period is equally pronounced (See Figure 3). Table 1 reports the summary statistics as well as the within and between variation[42]. A within variation of zero (or 100% if looking at dummy variables) implies that the variable is constant over the sample period. Since the fixed effects and between variation are eliminated by the methodology of this study, the within variation becomes an important source of explanatory power.

The within variations of alcohol price and alcohol consumption are larger than their between variation implying that the variation in these variables due to the passage of time is at least as important as any individual specific effects that may exist. The other explanatory variables have within and between variations of comparable size.

The first step is to estimate the myopic specification of the model using three methodologies: OLS, FE-2SLS, and Two Step GMM (See Table 2 – Table 4) Theory suggests that the OLS, estimate will be biased upwards while the FE estimators will be biased downwards thus giving a range within which a feasible estimate is likely to fall.

[42] Within variation represents the variation within a group over time while the between variation represents the variation between individuals. For example, let a variable "ismarried" have an overall variation of 60%, a within variation of 25%, and a between variation of 58%. This would imply that on average, 60% of the total sample was married, 25% of those married, stayed married over the period of the study, and 58% of the sample was ever married.

This will allow the estimates derived from Two Step GMM, the main focus of this study, to be put into better perspective.

The OLS results show that the explanatory variables are good determinants of alcohol consumption with signs that make theoretical sense. The results of the male/female equations follow the pattern of the overall results but often differ in magnitude and significance. This shows that alcohol consumption between men and women is affected by some of the same factors but with differing efficacy. A similar situation is observed in the urban/rural equations. These differences provide some support for the decision to study the male/female and urban/rural strata in addition to the combined sample.

The 2SLS-FE results look very imprecise and often implausible. With the exception of some of the strongest explanatory variables such as marriage and education, most are insignificant. Of interest is the change on the income variable now strongly positive and significant, as would be expected. The lack of significant coefficients makes it difficult to compare the stratified equations. However, where significant, there is a similar pattern of variables having the same general effect but with a different order of magnitude. The poor results obtained through 2SLS-FE are to be expected due to the limitations of the 2SLS procedure previously described in the research design section.

The main focus of this study are the two-step system GMM estimates since they avoid the problems faced by OLS and 2SLS-FE. The results show that twice-lagged alcohol consumption is a valid instrument for lagged alcohol consumption. The model passes the test for both first and second order serial correlation and the null hypothesis

that the model is correctly specified and that the instruments used are valid as evidenced by the high p-values on the Hansen and Difference in Hansen test is not rejected. The coefficient on lagged alcohol consumption is positive and significant. This can be interpreted to mean that increased levels of alcohol consumption in the past would lead to a higher level of current consumption. That is, alcohol is habit forming. Even so, the coefficient on the price of alcohol is negative and significant implying that the consumer will react to an increase in the price of alcohol by reducing consumption.

The above coefficients in the male/female equations show that the effect of past consumption is stronger for men than for women, however men are also significantly more likely to respond to changes in price. The urban/rural equations finds that price is a much more effective tool in affecting the urban strata than it is in the country.

High-risk alcohol consumption behaviors (drinking at work or without food) are strong determinants of alcohol consumption in all equations. Men are affected to a greater extent than women, rural residents are affected more than urban residents. The effect of unemployment is positive and significant in all equations. However, the significance of unemployment in the male and rural equations is only at a 90% level. As expected, smoking status is strongly associated with alcohol consumption. The size and significance of this effect is fairly constant between all equations. Marriage has a strong protective effect, although primarily for men, while completing secondary schooling was protective for every equation, except in rural settings.

The rational specification of the two-step system GMM model can be found in Table 5. The Hansen and difference in Hansen tests confirm the validity of the

specification of the model and the validity of the instruments. Under rational addiction, positive significant coefficients on both forward and lagged consumption are expected in order to show adjacent complementarity. A negative coefficient on the price of alcohol is expected in order to show adherence to the law of demand. There is no evidence for rational addiction either for the full sample or its stratified components. In these models, the coefficient on price is not significant in all equations. The best results for the coefficients on lag and lead consumption are in the rural equation, however without a significant price effect this is likely saying that an individual will drink more today if he drank more yesterday and will drink yet more in the future since he drank more today: a classic myopic addict.

The effect of high risk alcohol consumption behavior is consistent with the results observed in the myopic specification, with two exceptions: the coefficient on drinking at work, although still positive, is no longer significant in the female and rural equations. The results for smoking are also consistent regardless of model specification. The effect of unemployment on alcohol consumption is still positive across all equations, however under the rational specification the previously weak coefficients on the male and rural equations become much more significant. Education, although still protective is only significant for the overall and male equation, while the effect of marriage is nearly identical between the two specifications.

Drinking behavior may differ based on the type of alcohol being consumed. Therefore, the next models to be estimated separate out the consumption of the three main categories of alcoholic beverages: beer, wine, and vodka. Both the myopic and rational specifications were executed and include measures of the log-price of various

types of alcohol in order to look for possible substitution effects. Once again, even though both specifications pass the tests for specification and instrument the rational model is rejected in favor of the myopic one for all three categories. The results for the myopic[43] specification for beer wine and vodka can be found in Tables 6 – 8.

Beer is shown to be habit forming in all equations. Of primary interest is the rural equation, which boasts the only significant price effect. The coefficient on the price of vodka has a negative and significant effect on beer consumption in the rural stratum. At the same time the rural strata have the only significant coefficient on the drinking at work variable. This provides further evidence for complementarity of beer and vodka in rural populations as beer and vodka are consumed together; episodes of workplace drinking, which are usually associated with hard liquor also have an effect on beer consumption.

In general, males will consume more beer than females; marriage is protective primarily through its effect on males. Social and behavioral effects such as unemployment, education, and high-risk behavior are for the most part insignificant when applied to beer consumption. Smoking has the expected effect in the general, female, and urban equations but does not affect beer consumption among males. There is a small income effect among the male and urban strata suggesting that beer is a normal good.

The equation for wine shows results consistent with what is known of Russian drinking patterns and beverage preferences. Men are likely to drink less wine than women. In fact, the female equation is the only one with a strongly significant

[43] Results for the rational specification are available upon request, but not reported due to their irrelevance.

coefficient on lagged wine consumption. Rural areas are also likely to consume less, likely due to a combination of lesser income, lesser availability and more readily available substitutes. Smoking, social and behavioral variables have very little significant impact on wine consumption. Of interest is the effect of income on wine consumption, especially among the female and urban strata which is stronger than that of any other beverage and a complementary relationship between the amount of wine consumed and the price of vodka among males.

Vodka is shown to be habit forming for all equations with the exception of males. The insignificance of lagged consumption among males is suspect, especially since the male equation has a strong and significant negative effect of vodka price on consumption. No other notable price effects were observed. Men consumed more vodka than women across all equations, an effect consistent with the current body of knowledge on Russian alcohol consumption. Marriage was strongly protective, primarily through its effect on men. Education was weakly protective while unemployment had an adverse effect, especially among men and the rural population. The coefficient on smoking was positive and significant across all equations. Two equations, overall and urban, showed a weak income effect on vodka consumption, with richer individuals being likely to drink more. The effect of high risk alcohol consumption exhibited the same pattern observed in the rational specification of composite alcohol consumption: the coefficient on drinking without food was positive and significant in all equations and drinking at work was positive and significant in all equations except female and rural. Only one cross price effect was observed: fortified wine was a weak complement to vodka in the rural equation, as evidence by a negative, significant coefficient.

In order to try to get a better picture of the relationships between the three beverage categories a series of own-price and cross-price elasticities were estimated for beer, wine, and vodka using a modified version of the myopic model (See Table 9). Specifically, the log-price of each beverage is interacted with a dummy variable to indicate whether an individual has ever consumed that type of beverage. The most promising results are shown by the vodka equation. The wine equation suffers from second order autocorrelation and implausible own-price elasticity[44] while the beer equation fails the specification and validity of instruments tests.

Among those individuals who are willing to drink vodka it is strongly habit forming (a 1% increase in past consumption increases current consumption by 0.09%) but follows the law of demand (a 1% increase in the price of vodka will reduce current consumption by 0.07%). Beer is treated as a substitute with a 1% increase in the price of beer increasing current vodka consumption by 0.075%. A similar relationship exists with cigarette smoking with a 1% increase in the price of cigarettes increasing current vodka consumption by 0.1%. Counter intuitively, wine is treated as a complement with a 1% increase in wine prices decreasing vodka consumption by 0.02%.

[44] Wine has a weakly significant positive price elasticity of demand. This goes against the Law of Demand in economic theory and common sense. This is doubly so, since wine has been shown to be weakly habit forming to the female strata only, so the argument of individuals drinking more wine even as wine prices increase due to the fact that they are addicts does not seem to hold water.

Chapter 5 Discussion and Conclusions

5.1 Discussion of Results

The study findings discussed above indicate that twice-lagged consumption is a valid instrument in both myopic and rational specifications of addiction models at least when applied to data drawn from the RLMS dataset. Alcohol consumption in Russia was found to follow the myopic pattern of behavior in all strata and to be strongly habit forming. Prices were shown to be an effective tool for influencing the male and urban strata while women and rural individuals were shown to be less sensitive to price changes.

Men, the stratum responsible for the majority of alcohol consumption in Russia, were found to be most sensitive to price. However, care should be taken before jumping to conclusions. A short run decrease in alcohol consumption because of an increase in price is both expected and consistent with historical results of previous anti-alcohol campaigns, which featured significant price hikes and resulted in initial drops of alcohol consumption. However, in the long-run these same methods lead to increased consumption of dangerous alcohol substitutes such as varnishes, a switch to more easy to acquire and more cost-effective high alcohol content beverages, and an overall shift to the underground economy as the primary source of intoxicants. Additional support for such an outcome can be found in the estimations for the rural stratum. Specifically, the rural stratum is very resistant to price oriented alcohol control policies. This outcome holds in

both the myopic and rational specification. Furthermore, if the coefficients on lagged and lead consumption are treated indicators of the strength of the habit, then the rural individuals are much more susceptible to adjacent complementarity in alcohol consumption. This is likely due to the fact that rural populations have greater access to homemade alcohol, the price of which is affected solely by input prices rather than government imposed taxes. This implies that any policy aimed at controlling alcohol consumption will need to take into account the differences between urban and rural consumers. Policies that are effective in the cities, where it is much easier to control access to alcohol may fail in the country with its wider availability of easily obtained substitutes. Furthermore, if conditions are such as to stimulate illicit production in the country, eventually this alcohol is likely to find its way into the cities through open-air markets and other hard to control points of sale. A related problem is that a price increase would likely affect low risk alcohol such as wine and beer to a much greater extent than high-risk alcohol such as vodka and moonshine. As previously mentioned the switch from high-alcohol content beverages to low alcohol-content beverages was an important component in the reduction of alcohol related adverse health outcomes in Finland, a country that used to have a drinking profile very similar to the one being observed in the Russian Federation today.

Marriage was shown to be protective to men, the most at risk segment of the Russian population. This relationship can be used to try to improve male health outcomes indirectly, through promoting traditional family values and teaching spouses effective techniques to affect the drinking patters of their significant others.

Study results show that it is important to approach alcohol policy in a comprehensive manner as there are a number of social and behavioral factors that have an effect that is at least as pronounced as that of price. Age affects overall alcohol consumption in a way consistent with both common sense and theoretical expectations. That is, for an average individual, alcohol consumption increases with age up until a certain maximum after which it starts going down. Dangerous alcohol consumption habits such as drinking at work or without food were found to be strong determinants of composite alcohol consumption and vodka. The consumption of vodka at work among men and urban populations targets both the most at risk segment of the Russian population (men) as well as one of the areas where alcohol consumption is especially harmful (work safety). At the same time education was found to be universally protective. A campaign targeted at limiting such behavior among at-risk populations is likely to improve both health outcomes and productivity. Self-assessed prosperity included as a proxy for unobserved social stress factors shows a very feasible relationship with alcohol consumption. Although it should not be interpreted directly as its intent is simply to control for unobservable yet relevant social events, it is significant and shows a negative sign. That is a lower degree of social stress leads to higher self-assessed prosperity, which in turn leads to decreased alcohol consumption. Smoking is positively related to alcohol consumption and harmful in and of itself. This suggests that measures to restrict access to cigarettes and educate the population about the dangers of smoking may lead to indirect improvements in the question of alcohol consumption. However, in beverage-specific equations cigarettes show some substitutability with alcohol. A possible explanation is that individuals who both smoke and drink are trying to achieve a

set “high” as the presence of nicotine in one’s system increases the overall level of intoxication. The addict then would mix and match the proportion of alcohol and tobacco used to achieve his set intoxication goal. An increase in the price of cigarettes would lead to substituting extra alcohol for each smoked cigarette foregone.

The results of the drink specific equations add some interesting details to the overall picture. The equation for beer consumption in the rural strata shows a complementary relationship between beer and vodka. That is an individual is likely to drink both beer and vodka at a sitting. This is likely done to increase the potency of alcohol, as an individual can get drunk in less time by mixing vodka and beer than by drinking vodka or beer alone. The relative lack of access to beer when compared to cheap and easily obtained moonshine in the countryside may have also contributed to this effect.

The consumption of wine poses some additional challenges in interpretation as it includes a wider range of prices and qualities than beer or vodka. The wine consumed by a well-paid Moscow manager is likely to be drastically different from that consumed by a factory worker, as will their reaction to price changes and other stimuli. Furthermore, the relationship between price and quality of wine in Russia is not as straightforward as in those nations where wine drinking is more commonplace. Problems with counterfeit wine and the fact that, areas close to traditional wine producing regions are likely to have access to homemade or contraband wines complicates the problem. These issues may have contributed to the complementary relationship between wine and vodka displayed in Table 9. Another likely explanation could be that since alcohol drinking in Russia is a social activity, alcohol would be purchased in bundles with a set share of primarily male

drinks (vodka) and primarily female drinks (wine[45]). Higher wine prices would then necessitate a reduction in the amount of vodka purchased within the bundle.

5.2 Health Policy Implications

The effect of an increase in the price of alcohol on the negative effects of alcohol consumption is not always straightforward. Mikhail Gorbachev's anti-alcohol campaign, for example, was followed by a decrease in both alcohol consumption and the associated social ills. In the long run, however, it also engendered a number of reactions by alcohol consumers to make it largely ineffectual. The results indicate that even under the myopic specification, alcohol consumption still reacts to price. Therefore as the price of legal alcohol goes up, the average consumer will decrease his consumption, but the underlying want of alcohol is not affected. As a result, the consumer starts looking for ways to satisfy his desire for alcohol. Historically, some switch to dangerous surrogates, while others turn to the illicit alcohol provided by the underground economy. This is consistent with the differences between the urban and rural stratum in the study. Since urban Russian are in many ways limited to using legal sources of alcohol (stores, restaurants), they are more responsive to price changes, while their rural counterparts are more capable of substituting homemade alcohol for that bought in stores. This suggests that anti-alcohol policy should include measures to limit the access of alcohol to legitimate sources. The recent initiatives to ban open-air markets, and forbid kiosks from selling alcoholic beverages are good examples of such measures. To be effective, price-related

[45] Including things not normally identified as "wine" such as martini mixes etc.

policies should be accompanied by measures to restrict the population's access to illicit alcohol, and the availability of hazardous, alcohol-containing surrogates.

5.3 Conclusion

The rational addiction model introduced by Becker and Murphy is the standard framework used to study the consumption of addictive substances. Since its' inception, a large body of empirical literature arose to further extend the basic model and address some of its drawbacks. The customary approach to estimate rational addiction models has been to use future prices as an instrument for future consumption. This method has a number of shortcomings that have led researchers to question whether useful policy results can be gained from research done on its basis (Gruber & Koszegi, 2001). This dissertation provides a way to solve this problem by using twice-lagged consumption, an alternative instrument that does not share the problems faced by future prices.

When applied to a dataset on alcohol consumption within the Russian Federation no evidence of rational addiction was found among both the overall population and the substratum studied. This differs from Baltagi and Geishecker (2006) who found limited evidence of rational addiction among Russian men when using traditional instruments. The lack of a response consistent with the model of rational addiction, coupled with the experience of past anti-alcohol campaigns suggests that the easiest approach to control alcohol consumption, by increasing its price or outright prohibition, is likely to be ineffective at best, and counterproductive at worst when applied to the Russian Federation.

Figures

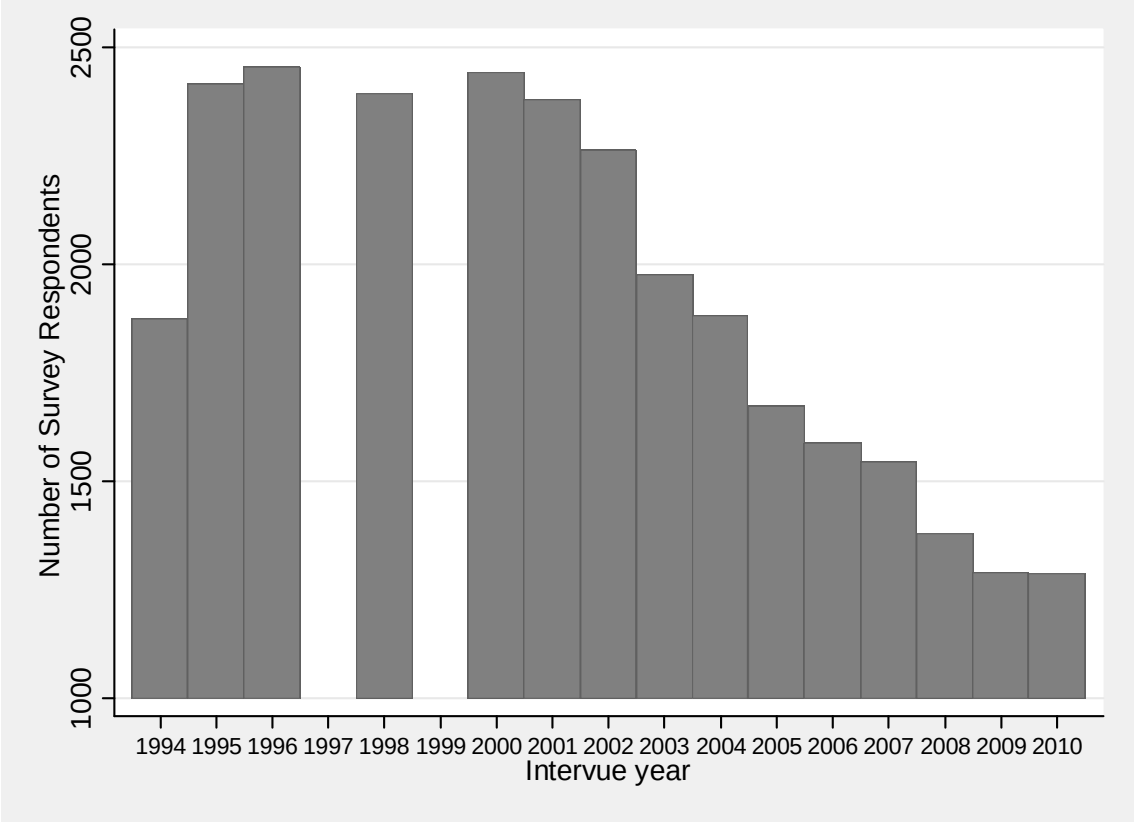

Figure 1: Yearly Response Rates[46]

[46] Figure generated by the author using the RLMS data.

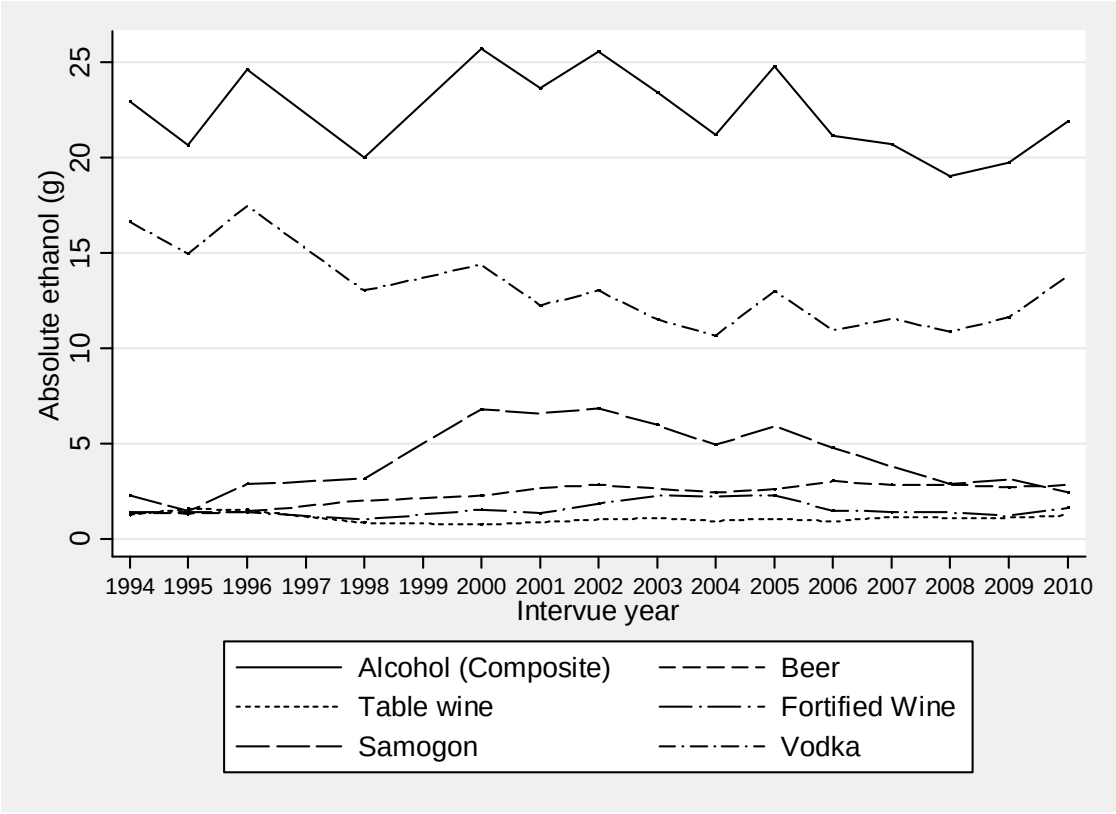

Figure 2: Consumption Trends[47]

[47] Figure generated by the author using the RLMS data.

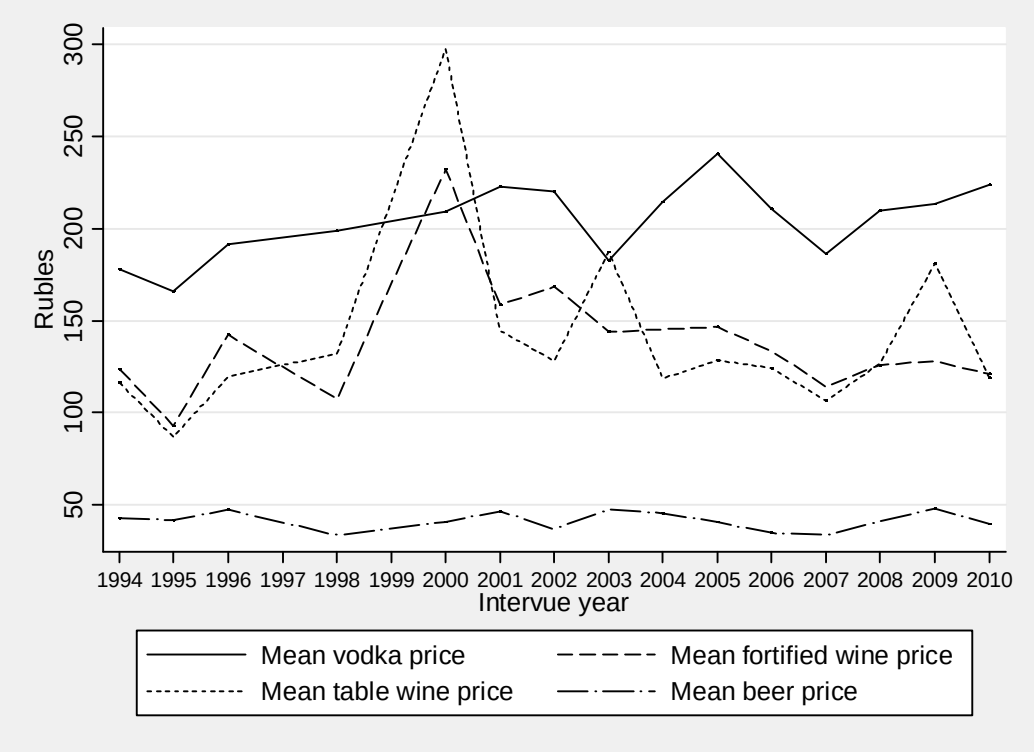

Figure 3: Price Trends[48]

[48] Figure generated by the author using the RLMS data.

Tables

Table 1: Baseline Summary Statistics: 1994-2010

N=4539	Means & Percentages	Overall Variance[49]	Between Variance	Within Variance
Mean Age	47.35	14.13	15.07	4.13
Mean Income	9431.51	12704.5	9283.93	10527.38
Mean Prosperity Index	3.7	1.44	1.08	1.07
Mean Composite Price	149.25	109.44	70.73	87.08
Mean Composite Alcohol Consumption	22.56	56.57	38.19	43.72
% Male	49.34	N.A.	45.27	100.00
% Married	75.15	N.A.	83.81	86.57
% > Secondary Education	90.46	N.A.	89.01	97.04
% Unemployed	34.62	N.A.	63.08	65.68
% Rural	25.96	N.A.	27.23	99.98
% Smokes	38.85	N.A.	42.06	81.8
%Ever Drank Beer	78.88	N.A.	64.55	100.00
%Ever Drank Wine	93.34	N.A.	85.83	10.00
%Ever Drank Vodka	57.71	N.A.	50.5	100.00
% Drank without food during last two years	14.9	N.A.	29.1	38.8
% Drank at work during last two years	16.61	N.A.	33.91	37.79

[49] Within variance represents the variation within a group over time while the between variance represents the variation between individuals. For example, let a variable "ismarried" have an overall variance of 75.15%, a within variance of 86.57%, and a between variance of 83.81%. This would imply that on average, 75.15% of the total sample was married, 86.57% of those married, stayed married over the period of the study, and 83.81% of the sample was ever married.

Table 2: OLS Benchmark - Myopic Specification

Alcohol Consumption (Ca)	**Full Sample**	**Male**	**Female**	**Urban**	**Rural**
Constant	-4.7234	5.0376	7.7157	-12.0785	-0.7149
	(8.4796)	(16.7372)	(5.3289)	(9.0731)	(18.3053)
Age	1.1135	1.8538	0.402	1.1237	1.1102
	(0.1979)***	(0.3703)***	(0.1193)***	(0.2164)***	(0.4485)**
Age Squared	-0.013	-0.0204	-0.0051	-0.0133	-0.0125
	(0.0021)***	(0.0038)***	(0.0011)***	(0.0023)***	(0.0047)***
Male	15.9137			16.0299	15.1847
	(0.9829)***			(1.185)***	(1.6794)***
Married	-4.4551	-10.0997	-0.993	-3.714	-7.095
	(1.0016)***	(2.391)***	(0.6733)	(1.0756)***	(2.39)***
Greater than Secondary Education	-6.3064	-9.4424	-1.1453	-7.6242	-4.7593
	(2.3203)***	(3.6614)**	(0.9326)	(3.2936)**	(3.191)
Unemployed	7.1626	8.4095	4.6372	7.3406	6.8496
	(1.1777)***	(2.1276)***	(0.8219)***	(1.3805)***	(2.26)***
Rural	-0.6596	-1.4693	-0.2438		
	(1.0506)	(1.7851)	(0.7607)		
Smokes	5.5471	4.3971	8.0282	5.7431	5.1633
	(0.9828)***	(1.3802)***	(1.2279)***	(1.1413)***	(1.9717)***
Income (ln)	0.8403	1.2692	0.2604	1.2207	0.3069
	(0.5768)	(1.0198)	(0.4462)	(0.6955)*	(1.0563)
Drank without food during last two years	10.685	11.5107	6.8984	9.5089	14.6068
	(1.493)***	(2.0401)***	(1.6189)***	(1.705)***	(3.0396)***
Drank at work during last two years	5.9286	8.6426	2.4624	5.693	6.6731
	(1.1524)***	(2.0177)***	(0.9077)***	(1.2554)***	(2.7674)**
Self assessed prosperity	-0.6662	-0.9048	-0.3003	-1.1869	0.7547
	(0.3205)**	(0.5631)	(0.2616)	(0.3648)***	(0.6507)
Price of alcohol (ln)	-1.8505	-2.2401	-1.3964	-1.5571	-4.96
	(0.8377)**	(1.4947)	(0.536)***	(0.8787)*	(3.0064)*
Lagged Alcohol Consumption	0.3159	0.3243	0.241	0.3141	0.3155
	(0.0272)***	(0.0293)***	(0.0633)***	(0.0339)***	(0.0411)***

*Year and region dummies are omitted from the results. Significance levels are as follows: 99% - *** 95% - ** 90% - **

Table 3: FE 2SLS Benchmark - Myopic Specification

Alcohol Consumption (Ca)	Full Sample	Male	Female	Urban	Rural
Constant	-16.9911	-25.9783	-36.1762	-95.5242	86.938
	(119.4746)	(149.8381)	(37.7347)	(172.6351)	(138.3939)
Age	2.3982	3.7667	1.1408	3.807	0.8629
	(2.2406)	(2.8171)	(0.7634)	(3.2226)	(2.6822)
Age Squared	-0.0269	-0.0419	-0.0069	-0.0269	-0.0287
	(0.0054)***	(0.0089)***	(0.003)**	(0.0064)***	(0.01)***
Male					
Married	-6.5858	-12.5477	-2.3096	-6.5627	-6.7192
	(2.1233)***	(4.7733)***	(1.6176)	(2.5916)**	(3.6694)*
Greater than Secondary Education	-15.6058	-21.3123	2.1566	-19.9216	-9.726
	(7.3417)**	(9.7933)**	(1.8814)	(11.1894)*	(8.6758)
Unemployed	2.5847	5.4819	-1.3783	2.1495	4.0453
	(2.0686)	(3.3197)*	(2.1081)	(2.5866)	(3.3806)
Rural					
Smokes	1.6688	1.1188	2.8008	-1.3266	12.4889
	(2.5543)	(4.0133)	(2.1804)	(2.778)	(6.149)**
Income (ln)	1.9618	2.7668	0.9914	2.4817	1.1229
	(0.7794)**	(1.3864)**	(0.6215)	(0.9526)***	(1.3676)
Drank without food during last two years	3.0798	2.7818	2.5722	3.9352	0.0492
	(1.9155)	(2.684)	(1.4489)*	(2.1533)*	(4.0766)
Drank at work during last two years	1.5013	2.1875	0.5033	0.9803	3.1576
	(1.2958)	(2.1724)	(1.2717)	(1.4243)	(2.9687)
Self assessed prosperity	-0.8286	-1.3219	-0.2014	-1.2347	0.1194
	(0.4399)*	(0.7306)*	(0.3808)	(0.5065)**	(0.8702)
Price of alcohol (ln)	-1.0193	-1.5004	-0.556	-0.6485	-3.9129
	(1.0792)	(1.9953)	(0.6441)	(1.1286)	(3.7202)
Lagged Alcohol Consumption	0.0071	0.0086	-0.0092	-0.0199	0.075
	(0.0243)	(0.0271)	(0.0448)	(0.0285)	(0.0414)*

*Year and region dummies are omitted from the results. Significance levels are as follows: 99% - *** 95% - ** 90% - **

Table 4: 2 Step System GMM - Myopic Specification

Alcohol Consumption (Ca)	Full Sample	Male	Female	Urban	Rural
Constant	-5.4847	15.3375	4.0626	-2.1155	-1.766
	(8.1681)	(16.0387)	(4.0792)	(9.4737)	(16.4423)
Age	1.2437	1.8148	0.3077	1.091	1.3698
	(0.2217)***	(0.388)***	(0.1153)***	(0.212)***	(0.4075)***
Age Squared	-0.0142	-0.0195	-0.004	-0.0127	-0.0148
	(0.0023)***	(0.004)***	(0.0011)***	(0.0022)***	(0.004)***
Male	18.4332			16.9976	16.234
	(1.229)***			(1.3209)***	(1.8776)***
Married	-5.4447	-9.5128	-0.41	-3.9899	-8.8899
	(1.2367)***	(3.1536)***	(0.4834)	(1.2335)***	(2.6755)***
Greater than Secondary Education	-8.6252	-9.4266	-1.9093	-5.8592	-3.9545
	(2.5968)***	(3.4304)***	(0.9893)*	(2.9597)**	(2.8012)
Unemployed	5.5494	3.7453	3.2033	3.8157	4.2528
	(1.2829)***	(2.2036)*	(0.6775)***	(1.2394)***	(2.2223)*
Rural	0.2798	0.0517	0.4376		
	(1.141)	(1.8934)	(0.5981)		
Smokes	6.5274	5.1121	7.4585	6.2837	6.0104
	(1.1957)***	(1.6301)***	(1.1544)***	(1.2417)***	(2.0179)***
Income (ln)	0.9608	0.5795	0.0698	0.8021	0.5568
	(0.5606)*	(1.015)	(0.28)	(0.6238)	(0.8447)
Drank without food during last two years	8.3833	9.4689	3.1534	7.758	11.6007
	(1.4639)***	(2.121)***	(1.2506)**	(1.6265)***	(2.6746)***
Drank at work during last two years	3.9656	5.5195	1.1769	3.2781	4.4368
	(1.122)***	(1.9777)***	(0.5507)**	(1.0309)***	(2.644)*
Self assessed prosperity	-0.5929	-0.9389	-0.1671	-0.6077	-0.5012
	(0.2836)**	(0.4895)*	(0.1471)	(0.2553)**	(0.5801)
Price of alcohol (ln)	-2.2481	-3.0919	-0.14	-1.7513	-3.3243
	(0.7237)***	(1.2421)**	(0.441)	(0.6639)***	(2.3972)
Lagged Alcohol Consumption	0.0797	0.0962	0.077	0.0782	0.1123
	(0.0355)**	(0.0419)**	(0.0398)*	(0.04)*	(0.052)**
AR(1) p-val	0.000	0.000	0.011	0.000	0.000
AR(2) p-val	0.037	0.035	0.049	0.110	0.179
Hansen p-val	0.332	0.043	0.057	0.398	0.245
Difference Hansen p-val	0.172				

*Year and region dummies are omitted from the results. Significance levels are as follows: 99% - *** 95% - ** 90% - **

Table 5: 2 Step System GMM - Rational Specification

Alcohol Consumption (Ca)	Full Sample	Male	Female	Urban	Rural
Constant	-10.8253	-30.9038	5.0805	-1.6481	0.6485
	(9.9282)	(26.0353)	(5.8302)	(10.0114)	(19.2617)
Age	1.0925	1.6802	0.2084	0.8541	0.9885
	(0.2662)***	(0.4546)***	(0.1633)	(0.2738)***	(0.5486)*
Age Squared	-0.013	-0.0184	-0.003	-0.0104	-0.0109
	(0.0027)***	(0.0046)***	(0.0016)*	(0.0028)***	(0.0054)**
Male	18.2655			16.0655	14.4794
	(1.585)***			(1.5619)***	(2.4467)***
Married	-5.1169	-8.5226	0.07	-3.5441	-4.8496
	(1.4752)***	(3.4651)**	(0.6487)	(1.6253)**	(2.5248)*
Greater than Secondary Education	-6.3393	-7.3275	-1.395	-3.2892	-5.3095
	(2.3581)***	(3.296)**	(1.3277)	(2.7235)	(3.3263)
Unemployed	7.1937	6.1044	3.1943	4.3193	5.5963
	(1.6416)***	(2.7889)**	(1.0392)***	(1.7576)**	(2.7687)**
Rural	1.0952	2.3348	-0.6361		
	(1.277)	(2.0597)	(0.8709)		
Smokes	6.8004	5.8999	7.6728	6.4715	4.5323
	(1.2369)***	(1.6424)***	(1.4419)***	(1.2693)***	(2.4475)*
Income (ln)	1.1348	0.9789	0.3315	0.7276	1.1179
	(0.7383)	(1.2802)	(0.4112)	(0.8164)	(1.1217)
Drank without food during last two years	6.6731	8.1569	2.8047	6.2288	9.7757
	(1.7876)***	(2.3007)***	(1.6445)*	(1.9012)***	(4.2158)**
Drank at work during last two years	3.6754	5.1746	1.205	2.9986	2.8072
	(1.2666)***	(2.1511)**	(0.7871)	(1.2779)**	(3.1393)
Self assessed prosperity	-0.7394	-1.0478	-0.2644	-0.8495	-1.1461
	(0.3511)**	(0.6144)*	(0.1955)	(0.3161)***	(0.7012)
Price of alcohol (ln)	-0.8039	0.0753	-0.6114	-0.787	-1.1479
	(0.7844)	(1.2854)	(0.6404)	(0.7978)	(2.2457)
Lagged Alcohol Consumption	0.0456	0.0396	0.0685	0.028	0.1158
	(0.0349)	(0.0373)	(0.0504)	(0.0385)	(0.0572)**
Lead Alcohol Consumption	0.0426	0.0694	0.0606	0.0772	0.1044
	(0.0239)*	(0.0281)**	(0.0559)	(0.0343)**	(0.0396)***
AR(1) p-val	0.000	0.000	0.029	0.000	0.000
AR(2) p-val	0.036	0.027	0.467	0.113	0.048
Hansen p-val	0.392	0.351	0.145	0.609	0.417
Difference Hansen p-val	0.494				

*Year and region dummies are omitted from the results. Significance levels are as follows: 99% - *** 95% - ** 90% - **

Table 6: Beer Consumption

	Full Sample	Men	Women	Urban	Rural
Constant	2.8215	7.218	2.4627	3.758	3.4217
	(1.3092)**	(3.0557)**	(0.8041)***	(1.5805)**	(2.0635)*
Age	-0.054	-0.019	-0.0328	-0.0488	0.0077
	(0.0227)**	(0.0432)	(0.0155)**	(0.0271)*	(0.0413)
Age Squared	0.000015	-0.0004	0.0001	0	-0.0005
	(0.0002)	(0.0004)	(0.0001)	(0.0002)	(0.0004)
Male	2.0994			2.1243	1.359
	(0.2007)***			(0.2016)***	(0.2843)***
Married	-0.3588	-1.0483	0.0192	-0.407	-0.5001
	(0.1555)**	(0.3655)***	(0.0777)	(0.1697)**	(0.2663)*
Greater than Secondary Education	-0.1439	-0.1364	-0.0434	-0.217	-0.1779
	(0.2068)	(0.3049)	(0.1043)	(0.2498)	(0.2717)
Unemployed	0.1963	0.085	0.2222	-0.0169	-0.0042
	(0.1527)	(0.2623)	(0.0935)**	(0.1908)	(0.2416)
Rural	-0.3409	-0.5724	-0.0229		
	(0.1384)**	(0.2269)**	(0.0782)		
Smokes	0.4791	0.1154	0.9911	0.6482	0.1774
	(0.1572)***	(0.2187)	(0.1604)***	(0.1835)***	(0.2637)
Income (ln)	0.0929	0.2649	0.0074	0.2016	-0.0919
	(0.0818)	(0.1421)*	(0.0406)	(0.0981)**	(0.1234)
Drank without food during last two years	0.6023	0.6882	0.2067	0.4041	0.3438
	(0.2166)***	(0.2684)**	(0.1579)	(0.2417)*	(0.289)
Drank at work during last two years	0.2503	0.3756	0.0472	0.1232	0.6904
	(0.1526)	(0.278)	(0.0886)	(0.1579)	(0.2965)**
Self assessed prosperity	0.0229	0.0118	0.0313	-0.0134	0.02
	(0.0401)	(0.0713)	(0.0206)	(0.0403)	(0.0787)
Price of beer (ln)	0.1336	0.1171	-0.0685	-0.0246	-0.0144
	(0.1322)	(0.2446)	(0.0599)	(0.1374)	(0.2977)
Price of wine (ln)	-0.0319	0.0859	0.0625	0.0662	0.0236
	(0.117)	(0.2126)	(0.0537)	(0.1215)	(0.2172)
Price of fortified wine (ln)	0.0889	0.0874	0.0454	0.031	0.1241
	(0.1142)	(0.2031)	(0.0548)	(0.1174)	(0.2165)
Price of vodka (ln)	-0.0198	0.0281	-0.0097	0.0233	-0.6219
	(0.1242)	(0.2169)	(0.0649)	(0.1237)	(0.2743)**
Lagged Consumption	0.1606	0.1801	0.0864	0.1646	0.2311
	(0.0663)**	(0.078)**	(0.0439)**	(0.0771)**	(0.0776)***
AR(1) p-val	0.000	0.000	0.001	0.000	0.000
AR(2) p-val	0.115	0.248	0.086	0.698	0.015
Hansen p-val	0.160	0.142	0.281	0.292	0.204
Difference Hansen p-val	0.630				

*Year and region dummies are omitted from the results. Significance levels are as follows: 99% - *** 95% - ** 90% - **

Table 7: Wine Consumption

	Full Sample	Men	Women	Urban	Rural
Constant	2.6666	7.1629	0.6102	2.0543	-0.3474
	(1.1029)**	(2.6017)***	(1.0466)	(1.1259)*	(2.6498)
Age	-0.0736	-0.0934	-0.0555	-0.0777	-0.0227
	(0.0225)***	(0.0402)**	(0.019)***	(0.0212)***	(0.0484)
Age Squared	0.0005	0.0007	0.0003	0.0005	0.0001
	(0.0002)**	(0.0003)**	(0.0001)**	(0.0002)***	(0.0004)
Male	-0.5183			-0.5386	-0.3484
	(0.095)***			(0.1107)***	(0.1685)**
Married	0.0954	0.2521	0.0042	0.0445	0.4879
	(0.0876)	(0.1688)	(0.0753)	(0.0974)	(0.2022)**
Greater than Secondary Education	-0.0355	-0.3846	0.0541	0.1475	-0.3572
	(0.1974)	(0.2761)	(0.0969)	(0.1372)	(0.3645)
Unemployed	0.2608	0.2695	-0.071	0.1386	0.2692
	(0.1467)*	(0.2112)	(0.0971)	(0.1429)	(0.4063)
Rural	-0.4741	-0.464	-0.3838		
	(0.11)***	(0.1733)***	(0.0837)***		
Smokes	0.0479	-0.0504	0.1549	-0.0569	0.4042
	(0.0969)	(0.1164)	(0.1406)	(0.1118)	(0.2591)
Income (ln)	0.1618	0.0366	0.2062	0.2113	0.1327
	(0.0606)***	(0.1174)	(0.0539)***	(0.0748)***	(0.1274)
Drank without food during last two years	0.3024	0.2441	0.0304	0.1489	0.9968
	(0.1523)**	(0.1843)	(0.1451)	(0.1613)	(0.4333)**
Drank at work during last two years	0.2168	0.199	0.1271	0.1544	0.2198
	(0.1307)*	(0.2196)	(0.1087)	(0.1261)	(0.3215)
Self assessed prosperity	0.0352	-0.0377	0.0569	0.0264	0.0508
	(0.0332)	(0.0539)	(0.0284)**	(0.0313)	(0.1055)
Price of beer (ln)	-0.1028	-0.1771	-0.0562	-0.087	0.3711
	(0.1093)	(0.1522)	(0.0936)	(0.1009)	(0.3002)
Price of wine (ln)	-0.086	-0.0877	0.0027	-0.0589	-0.1734
	(0.0968)	(0.1475)	(0.082)	(0.1004)	(0.3496)
Price of fortified wine (ln)	-0.0533	0.1256	-0.0036	0.0483	-0.1855
	(0.0758)	(0.0959)	(0.0804)	(0.0707)	(0.2485)
Price of vodka (ln)	0.0295	-0.2365	0.1478	0.0429	-0.0658
	(0.0858)	(0.1407)*	(0.0967)	(0.078)	(0.3639)
Lagged Consumption	0.0534	0.0234	0.1692	0.0639	-0.0155
	(0.0304)*	(0.0338)	(0.0325)***	(0.0369)*	(0.0307)
AR(1) p-val	0.001	0.001	0.078	0.002	0.018
AR(2) p-val	0.694	0.954	0.288	0.320	0.338
Hansen p-val	0.532	0.066	0.471	0.144	0.000
Difference Hansen p-val	0.108				

*Year and region dummies are omitted from the results. Significance levels are as follows: 99% - *** 95% - ** 90% - **

Table 8: Vodka Consumption

	Full Sample	Men	Women	Urban	Rural
Constant	-9.8557	-4.2368	-3.728	-12.0334	1.087
	(5.8175)*	(14.5987)	(3.2987)	(6.6779)*	(12.6963)
Age	0.8056	1.2735	0.2286	0.756	0.7581
	(0.1368)***	(0.2462)***	(0.069)***	(0.1307)***	(0.241)***
Age Squared	-0.0088	-0.0134	-0.0024	-0.0081	-0.0087
	(0.0014)***	(0.0025)***	(0.0007)***	(0.0013)***	(0.0023)***
Male	11.6246			12.035	7.797
	(0.6797)***			(0.7291)***	(1.0993)***
Married	-3.4228	-6.14	-0.4939	-1.9868	-3.579
	(0.7464)***	(1.7828)***	(0.3077)	(0.7277)***	(1.4511)**
Greater than Secondary Education	-3.6384	-4.3261	0.2461	-2.975	-3.2023
	(1.5818)**	(2.244)*	(0.6719)	(1.726)*	(1.9942)
Unemployed	1.8127	0.2417	1.3053	0.7063	3.2534
	(0.7567)**	(1.341)	(0.3971)***	(0.7409)	(1.1619)***
Rural	-0.9809	-2.7314	0.4211		
	(0.7335)	(1.206)**	(0.3476)		
Smokes	4.0765	3.3048	4.6172	3.4757	3.6503
	(0.7447)***	(1.0561)***	(0.8011)***	(0.7489)***	(1.2782)***
Income (ln)	0.5514	0.798	0.0153	0.7303	0.8
	(0.332)*	(0.5875)	(0.183)	(0.3809)*	(0.5147)
Drank without food during last two years	3.3874	4.0437	1.2895	3.3755	5.0626
	(0.837)***	(1.1883)***	(0.6519)**	(0.9457)***	(1.4308)***
Drank at work during last two years	1.7438	3.4021	0.55	1.8677	2.1979
	(0.6849)**	(1.2196)***	(0.3847)	(0.6324)***	(1.3593)
Self assessed prosperity	0.0577	-0.0001	-0.1336	-0.2279	0.4089
	(0.1811)	(0.3224)	(0.0966)	(0.1882)	(0.3123)
Price of beer (ln)	0.3909	0.3277	0.1485	0.1925	1.9152
	(0.4852)	(0.8515)	(0.2942)	(0.4614)	(1.873)
Price of wine (ln)	-0.4308	-0.6939	0.0461	-0.3009	-0.4263
	(0.4024)	(0.7247)	(0.2985)	(0.394)	(1.0017)
Price of fortified wine (ln)	0.3934	1.2079	-0.3499	0.1427	-1.873
	(0.4226)	(0.7558)	(0.2985)	(0.4289)	(1.0591)*
Price of vodka (ln)	-0.9967	-1.4601	0.4185	-0.1818	-2.4719
	(0.5036)**	(0.8654)*	(0.3704)	(0.444)	(1.5935)
Lagged Consumption	0.0628	0.0498	0.0831	0.0625	0.1028
	(0.0253)**	(0.0304)	(0.0369)**	(0.0246)**	(0.0539)*
AR(1) p-val	0.000	0.000	0.068	0.000	0.000
AR(2) p-val	0.002	0.006	0.280	0.009	0.103
Hansen p-val	0.218	0.319	0.000	0.682	0.400
Difference Hansen p-val	0.085				

Year and region dummies are omitted from the results. Significance levels are as follows: 99% - *** 95% - ** 90% - *

Table 9: Elasticities Between Beverage Categories

	Beer	**Wine**	**Vodka**
Own Price Elasticity	0.0335 (0.0396)	0.0028 (0.446)*	-0.0759 (0.0180)***
Crossprice Elasticity Beer		0.1462 (0.194)***	0.0759 (0.0131)***
Crossprice Elasticity Wine	0.009 (0.0105)		-0.0254 (0.0088)***
Crossprice Elasticity Vodka	0.0805 (0.0201)***	0.0674 (0.0161)***	
Crossprice Elasticity Cigarettes	0.1029 (0.0173)***	0.1359 (0.0279)***	0.1032 (0.0153)***
Past Consumption Elasticity	0.0975 (0.0312)***	0.0538 (0.0562)	0.0973 (0.0251)***
AR(1) p-val	0.000	0.000	0.000
AR(2) p-val	0.830	0.744	0.010
Hansen p-val	0.003	0.940	0.231
Difference Hansen p-val	0.018	0.783	0.585

Year dummies and demographic characteristics are omitted from the results. Significance levels are as follows: 99% - *** 95% - ** 90% - *

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Appendix A: Abridged Timeline of Alcohol Regulation in Russia

1649	The "Edict on *Khorchmas*" is enacted.
1652	The "Assembly on *Kabaks*" is enacted.
1660	Monasteries stripped of rights to produce alcohol.
1681	"Buy-off" system liquidated.
1705	"Buy-off" system reinstated.
1716	Private production legalized and strongly taxed.
1863	"Buy-off" system liquidated. Excise system adopted.
1894	Full government monopoly on the sale of alcohol enacted in parts of Russia.
1904	Full government monopoly on the sale of alcohol enacted in all of Russia.
1914	Prohibition of 1914 enacted.
1919	Production and sale of spirits forbidden by the Soviet People's Commissariat of the Russian Socialist Federative Socialist Republic.
1920	Nationalization of alcohol stocks and production facilities.
1921	Production and sale of beer and wine of 14% or lower legalized.
1923	Production and sale of alcoholic beverages 20% or lower legalized.
1924	Production and sale of alcoholic beverages 30% or lower legalized.
1925	Government monopoly on alcohol sale and production enacted. Production and sale of beverages 40% or lower legalized.
1941	Government Defense Committee authorizes vodka ration for the army.
1958	Khrushchev's anti-alcohol campaign begins.
1972	Brezhnev's anti-alcohol campaign begins.
1985	Gorbachev's anti-alcohol campaign begins.
1992	Government monopoly on alcohol abolished.
1993	Law "On the restoration of the government monopoly on the production, storage, and bulk or individual sale of alcoholic products" enacted. The monopoly is regulatory in nature.
1996	Law "On government regulation of the production and circulation of ethyl alcohol and alcohol products" replaces the 1993 law. This law is first proposed in 1995 and modified in 1999 and 2006.

Appendix B: Conversion Rates of Historical Russian Measures

1 liter	0.264 gallons or 33.814 oz.
Mernaya Butilka (Measure Bottle)	1/16 official bucket or 0.77 liters (26.03 oz.)
Kruzhka (Cup)	1/8 official bucket or 1.54 liters (52.07 oz.)
Kazennoye Vedro (Official Bucket)	12.3 liters (415.912 oz.)
Pivnaya Bochka (Beer Barrel)	10 official buckets or 123 liters (4159.12 oz.)
Vinnaya Bochka (Wine Barrel)	12 5/8 official buckets or 155.28 liters (5250.9 oz.)
Mernaya Bochka (Measure Barrel)	40 official buckets or 492 liters (16,636.5 oz.)