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Price Elasticities and Implied Tax Revenue for Alcoholic Beverages

Evidence from Poland, France and Spain

Benjamin Bittschi, Ines Fortin, Sebastian Koch, Richard Sellner, Simon Loretz, Gregor Zwirn

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Abstract

The study estimates the tax revenue effects of changes in alcohol excise taxes for Spain, France and Poland. In addition to excise tax and VAT revenue effects, the price pass-through and the impact on market volumes is estimated. The main parameters – the tax pass-through rate of excise duties to consumer prices and the price elasticities of demand for alcoholic beverages – are estimated via state-of-the-art econometric approaches based a combination of household-levels and macro data. In a first step, the literature survey finds very diverse estimates for price elasticities of alcoholic beverages. We find evidence that excise taxes are typically fully passed onto consumer prices. Using micro data at the household level, we find price elasticities of demand for Spain, France and Poland which are higher (in absolute terms) than those typically found in the literature. This implies that price increases lead to larger drops in sales volume and, thus, tax increases might not result in the expected additional tax revenues. A macro level estimation of the relation between excise tax rates and revenues confirms a Laffer-curve type relationship, i.e., tax revenues cease to increase if excise tax rates reach a certain threshold level. The empirical evidence in this study suggests that the tax rates for beer and wine are well below this revenue maximising saddle point, but the evidence is inconclusive for spirits in the countries in question. Using the simulation tool developed in this study, it is found that a 1 percent increase in the excise tax rates of each alcoholic beverage prevailing in 2017 in each of the countries will have the strongest negative effect on the market volumes of spirits, while for beer and wine these increases translate to by and large higher collected tax revenues. Noteworthily, in some scenarios excise tax increases result in decreases in VAT revenues due to a significant reduction in the higher value on-trade sales.

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Price elasticities and implied tax revenue for alcoholic beverages

Evidence from Poland, France and Spain

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Final Report

Study on behalf of the European Spirits Companies Liaison Group a.s.b.l.

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Executive Summary

In Europe a trend towards higher taxation of alcoholic beverages can recently be observed. Whether it is possible to raise additional tax revenues from the taxation of alcoholic beverages and/or reducing excessive consumption crucially depends on the functioning of the market for alcoholic beverages. A circumstance which deserves attention is that alcoholic beverage types are taxed very differently and, in most cases, spirits drinks are much higher taxed than beer or wine.

The aim of this study is to gather empirical evidence of the impacts of excise tax changes for alcoholic beverages on market volumes and excise and value added tax revenues for the three countries Spain, France and Poland. Methodologically this is done by estimating the main parameters – the tax pass-through rate of excise duties to consumer prices and the price elasticities of demand for alcoholic beverages – via state-of-the-art econometric approaches based on rich datasets covering micro data of consumption at household levels, macroeconomic sales, volume and excise tax data for a panel of European countries and collected excise tax revenues for alcoholic beverages and VAT revenues. These parameters, along with other macroeconomic variables that influence market volume trends in the three countries, are used to predict a benchmark development path for market volumes and tax revenues for each alcoholic beverage in each country. We then developed a user-friendly tax reform simulation spreadsheet tool that can easily be employed for customized scenario analysis. The tool is capable of simulation two simultaneous scenarios in addition to the benchmark and outputs the impacts of the inputted excise tax changes on market volumes and tax revenues.

The main findings of the study are:

- The literature survey finds very diverse estimates for price elasticities of alcoholic beverages.
- We find evidence that excise taxes are typically fully passed onto consumer prices.
- Using micro data at the household level, we find price elasticities of demand for Spain, France and Poland that are higher (in absolute terms) than those typically found in the literature. This implies that price increases lead to larger drops in sales volume and, thus, tax increases might not result in the expected additional tax revenues.
- A macro level estimation of the relation between excise tax rates and revenues confirms a Laffer-curve type relationship, i.e. that tax revenues cease to increase if excise tax rates reach a certain threshold level. The empirical evidence in this study suggest that the tax rates for beer and wine are well below this revenue maximising saddle point, but the evidence is inconclusive for spirits in the countries in question.
- Using the simulation tool developed in this study, it is found that a one percent increase in the excise tax rates of each alcoholic beverage prevailing in 2016 in each of the countries will have the strongest negative effect on the market volumes of spirits, while for beer and wine these increases translate to by and large higher collected tax revenues.
- Another noteworthy result is that in some scenarios excise tax increases result in decreases in VAT revenues due to a significant reduction in the higher value on-trade sales.

1 Motivation and Content of the Study

In Europe a trend towards higher taxation of alcoholic beverages can recently be observed. While it is typically argued in recent years that higher taxation of alcoholic beverages is necessary to curb excessive consumption[1] and its associated health costs (an idea originally articulated by Nordic states in Europe), a tax revenue motive is very often ongoing in the background. The underlying idea of a double dividend, i.e. the possibility of raising tax revenues while reducing socially unwanted behavior, appears to be attractive for many policy makers. Moreover, raising taxes is often described as a cost-effective policy measure for policy makers, meaning introducing taxes generate little costs for governments and should at the same time reduce alcohol related health costs. The latter very much depends on how different consumer groups (different socio-economic status, light, moderate or heavy drinker, etc.) respond to price changes. Unintended consequences, such as a move from the recorded to unrecorded market, need to be considered. Indeed, whether it is possible to raise additional tax revenues from the taxation of alcoholic beverages and/or reducing excessive consumption crucially depends on the functioning of the market for alcoholic beverages. A circumstance which deserves attention is that alcoholic beverage types are taxed very differently and, in most cases, spirits drinks are much higher taxed than beer or wine.

The aim of the study is to shed more light on the functioning of the market for alcoholic beverages and the implied potential to raise tax revenues. The key parameters which determine the impact of taxation on the consumption are the price pass-through of the tax burden and the price elasticity of demand for alcoholic beverages. The price pass-through quantifies the extent to which excise duties and tax increases are passed on to the consumer price, whereas the price elasticity of demand measures the effect of consumer price changes on demand. Additionally, the cross-price elasticity between different types of alcoholic beverages (beer, wine and spirits) as well as non-alcoholic drinks can potentially impact the effects of tax changes on consumption, as some goods are seen as complements while others act as substitute to each other.

In this study, we estimate these main parameters econometrically for a sample of three countries: Spain, France and Poland. Based on the estimated parameters the tax revenue effects for different tax reform scenarios are simulated for each country.

The remainder of the study is structured as follows. Chapter 2 reviews the available international empirical literature relating to estimates of tax pass-through and price elasticities. Chapter 3 outlines the current market situation for alcoholic beverages within the European Union. In chapter 4 the tax pass-through rates are estimated, exploiting information in two different datasets. The resulting estimates are compared to recent changes in excise duties in Poland, France and Spain. The chapter closes with a discussion of the different estimates obtained from the two datasets and the selection of specific parameters for the tax reform scenario simulations. Chapter 5 is devoted to the estimation of the price and cross-price elasticities for alcoholic beverages in the three countries. We first outline possible empirical approaches along with their advantages and disadvantages, along with the choice of two methods based on the availability of data. The following three subchapters contain the summaries of the estimation results for the three countries. The tax revenue simulation of reform scenarios is presented in Chapter 6. We start by outlining the core theoretical concepts behind tax reform simulations with macroeconomic data. Then the choice of the specific model parameters used for the simulation of the tax

[1] The literature review by Wagenaar et al. (2010) found that public policies affecting the price have significant impact on alcohol related diseases and injuries whereas Nelson (2013b, 2015) found almost no effect on heavy and binge drinkers.

reform scenarios are outlined. The chapter proceeds by providing a short user manual for the developed excel tool that permits the simulation of user-specific tax reform scenarios. The chapter then closes with a discussion of the results of a commonly requested tax reform scenario, a one percent increase in excise tax rates for all alcoholic beverages in the three countries.

2 Literature Review

The literature on demand for alcohol is vast and so is the literature on taxation of alcoholic beverages and its impact on prices and quantities sold as well as the literature on empirical price elasticities of alcohol. Hence this short literature review should not provide an extensive overview but rather an indication of how this study compares to previously found results. For a broad and general overview of the issues relating to alcohol and the corresponding literature see also Anderson and Baumberg (2006).

2.1 Price pass-through of excise taxes

Two large studies by Rand Europe (Rabinovich et al. 2009, 2012) analyse the development of the alcohol prices and how excise taxation affects the affordability of alcoholic beverages in the European Union. That said, the affordability of alcohol is only one aspect of the impact of taxation on the market of alcoholic beverages. Even if alcohol becomes generally more affordable, this does not necessarily imply that the consumption of alcohol increases.[2] In general, excise taxation only affects the affordability of alcohol if taxes are passed through to consumer prices. Therefore, Rabinovich et al. (2012) explicitly analyses the **pass-through of excise taxes on prices** for six countries and find a large heterogeneity among countries and beverages. Pass-through rates vary from significantly below unity for Ireland and Finland to strong over-shifting in Slovenia and Latvia. While the authors raise already a number of limitations (endogeneity of tax increases, omission of other factors, use of an average price index) the wide variation in the results can also be due to the econometric approach (regression using first differences) which only exploits the immediate price reactions. There are other academic studies which suggest an over-shifting of excise taxation to price. For example, Young and Bielinska-Kwapisz (2002), Kenkel (2005), and Bergman and Hansen (2017) find evidence for significant over-shifting of excise taxation in the US, Alaska, and Denmark, respectively. On the other hand, Harding, Leibtag and Lovenheim (2010) find an under-shifting of beer taxes. Bergman and Hansen (2017) also find evidence suggesting asymmetric responses to tax cuts and tax hikes: taxes are over-shifted to a larger extent following tax hikes compared to tax cuts. Ardalan and Kessing (2017) find that value added taxes on beer are under-shifted while excise taxes are almost fully shifted to prices, in the European Union. In addition to excise taxation there are numerous further aspects (price changes for inputs, changes in market structure and consumption trends, etc.) which affect the pricing of alcoholic beverages. Therefore, the results from the literature might not be directly applicable for the three countries in this study.

2.2 Price elasticities of alcoholic beverages

To survey the literature on **price elasticities of alcohol** we first report results of meta-studies, which summarize a large number of individual studies and allow to gain further insights into the nature of the demand for different alcoholic beverages. In addition, we discuss studies which estimate different elasticities for subgroups of consumers or different distribution channels. Finally, we also briefly present a few studies, where price elasticities are estimated for France, Spain and Poland.

[2] Affordability does not account for relative prices, and therefore might overlook that other non-alcoholic drinks have become even more affordable. Additionally, a lower price level for alcoholic beverages might also be due to more competitive pressure in a declining market. Furthermore, it is worth noting that the affordability study pre-dates the financial crisis and therefore is largely driven by fast growing income, which may no longer be the case.

2.2.1 Consensus estimates of price elasticities in Meta studies

Recent meta-studies on the demand for alcohol adjust for the precision of individual elasticity estimates, i.e., they weight estimates by estimate precision, and thus allow to analyse the available information in a more efficient way. There are four major recent meta-studies: Nelson (2013), Fogarty (2010), Wagenaar et al. (2009) and Gallet (2007), which report unweighted averages of price elasticities of beer, wine and spirits, see Table 1. All of them report medians except Wagenaar et al. (2009), who report means. In general, the demand for beer is less elastic with respect to price than that of wine and spirits. The price elasticity of beer ranges between -0.32 and -0.46, the price elasticity of wine is between -0.55 and -0.70, and the price elasticity of spirits ranges between -0.67 and -0.80. The simple averages reported in the four different meta-studies are rather similar for a given alcoholic beverage, which can also be seen in Figure 1, and values within these ranges are widely accepted as "consensus" values.

Table 1: Price elasticities for alcohol beverages – unweighted medians/means

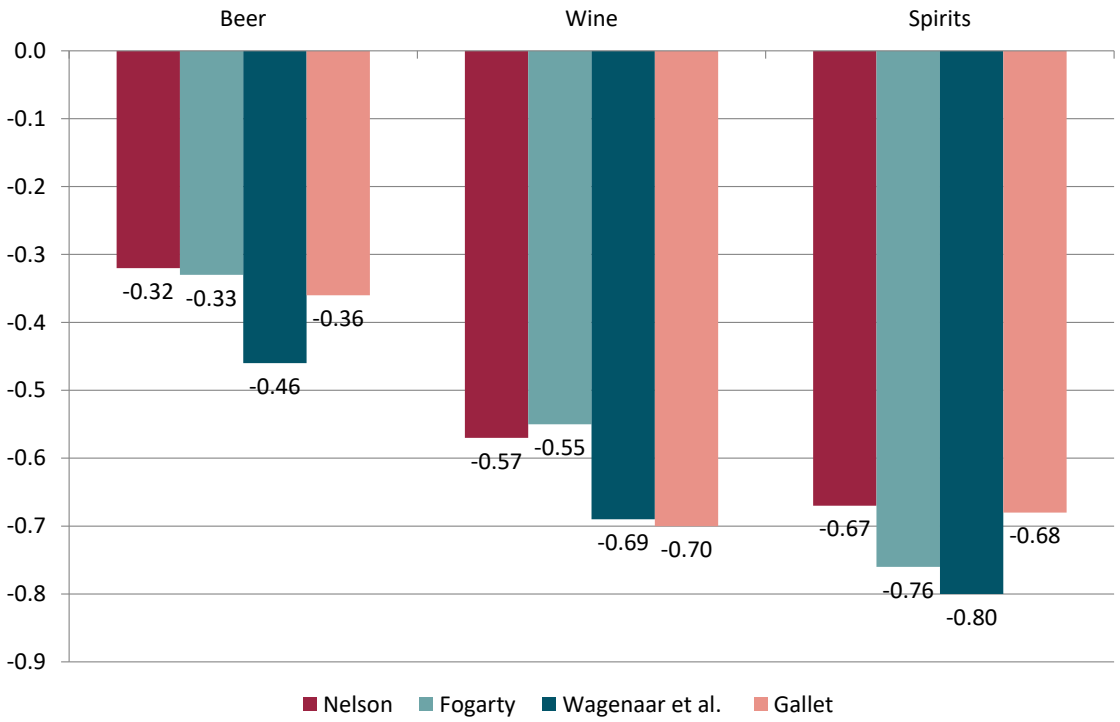
Study	Price elasticity	Number of observations
Nelson (2013) – unweighted medians		
beer	-0.32	191
wine	-0.57	197
spirits	-0.67	202
alcohol	-0.54	117
Fogarty (2010) – unweighted medians		
beer	-0.33	154
wine	-0.55	155
spirits	-0.76	162
alcohol	n.a.	n.a.
Wagenaar et al. (2009) – unweighted means		
beer	-0.46	105
wine	-0.69	93
spirits	-0.80	103
alcohol	-0.51	91
Gallet (2007) – unweighted medians		
beer	-0.36	315
Wine	-0.70	300
Spirits	-0.68	294
Alcohol	-0.50	263

Source: Nelson (2013), Fogarty (2010), Wagenaar et al. (2009), and Gallet (2007).

Meta-analyses often use the precision of study-level estimates to weight these estimates. Fixed-effect models use the inverse variances (standard errors) for weights, with dispersion in estimates only due to sampling error in each primary study. That is, all studies are assumed to estimate a common, or fixed, population elasticity. Estimates with smaller variation (standard error, variance) provide more precise information about the population value and are thus given greater weight. The assumptions underlying the fixed-effect model are quite strong, however, and so one usually considers additional approaches with less demanding assumption. The random-effects model also allows for variation in population values by

estimating a common inter-study variance based on observed variation of estimates, which is added to the study-level variance. Thus, in the random-effects approach the observed variation in estimates is partly due to sampling error and partly due to variation in the underlying population parameters.[3]

Figure 1: Price elasticities for alcohol beverages – unweighted medians/means



Source: Nelson (2013), Fogarty (2010), Wagenaar et al. (2009), and Gallet (2007).

Notes: The graph shows medians except for Wagenaar et al. who report means.

Among the four meta-studies cited above, two weight study-level estimates by estimate precision in their meta-analysis. These are Nelson (2013) and Fogarty (2010). The resulting fixed-effects and random-effects weighted means are given in Table 2. The fixed-effects weighted mean for the price elasticity of beer is -0.26 in both studies and is again smaller (in absolute value) than that of wine and spirits. The fixed-effects weighted mean for the price elasticity of wine is -0.34 and -0.83, as reported in Nelson (2013) and Fogarty (2010), respectively. These are quite different size effects. For spirits the fixed-effects weighted mean is -0.49 (Nelson) and -0.38 (Fogarty). The random-effects approach, which assumes less restrictive assumptions than the fixed-effects approach, shows results that are more similar across the two studies, for all three alcoholic beverages. The resulting means are -0.35 (Nelson) and -0.36 (Fogarty) for beer, -0.58 (Nelson) and -0.57 (Fogarty) for wine, and -0.64 (Nelson) and -0.52 (Fogarty) for spirits. These numbers, and the small difference between the two studies, are shown in Figure 2.

[3] See Hedges and Olkin (1985) and Borenstein et al. (2010) for fixed-effect and random-effects models in meta-analysis.

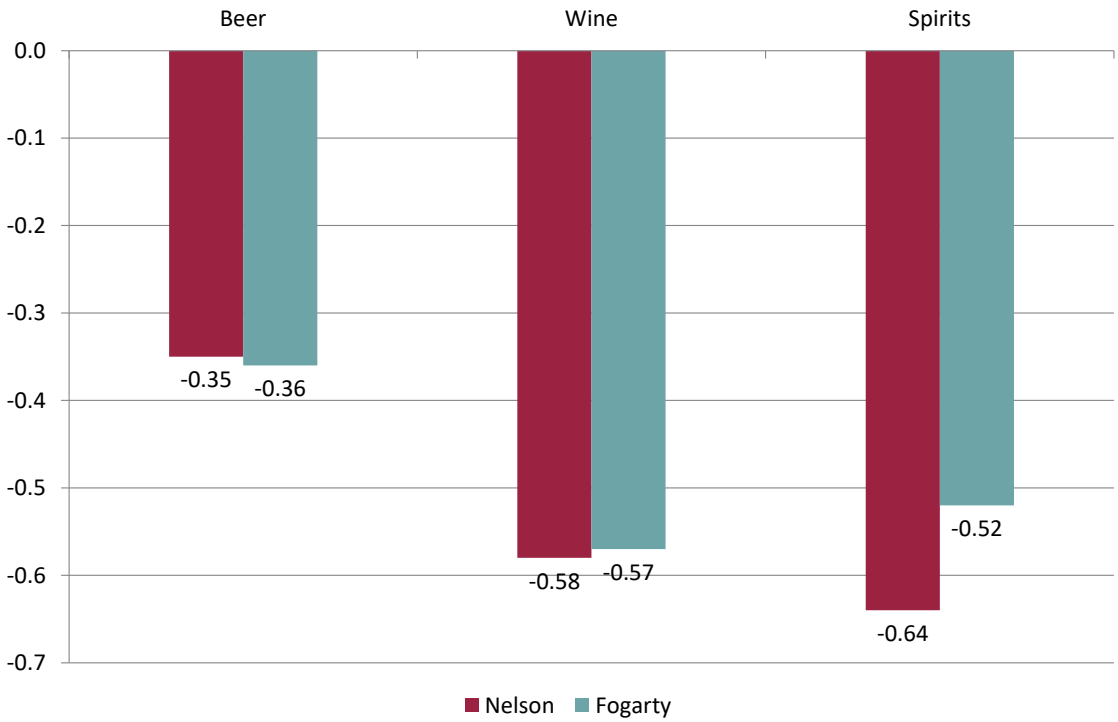
Table 2: Price elasticities for alcohol beverages – weighted fixed-effect and random-effects means

Study	Price elasticity: weighted fixed-effect means	Price elasticity: weighted random-effects means	Number of observations
Nelson (2013)			
beer	-0.26 (0.01)	-0.35 (0.02)	172
wine	-0.34 (0.01)	-0.58 (0.03)	178
spirits	-0.49 (0.01)	-0.64 (0.03)	182
Fogarty (2010)			
beer	-0.26 (na)	-0.36 (na)	74
wine	-0.83 (na)	-0.57 (na)	73
spirits	-0.38 (na)	-0.52 (na)	70

Source: Nelson (2013) and Fogarty (2010).

Notes: Standard errors in parentheses. The samples include only elasticity estimates for which also standard errors are provided. Nelson (2013) reduces this sample further by discarding 2.5% of the largest (smallest) effect-sizes and by discarding 2.5% of the largest (smallest) standard errors. Fogarty (2010) reduces this sample further by considering only Hicksian elasticity estimates.

Figure 2: Price elasticities for alcohol beverages – random-effects weighted means



Source: Nelson (2013), Fogarty (2010).

Fogarty (2010) finds that differences between price elasticities across countries are rather small in general, with the exception of wine consumption in France. In addition, his results suggest a time trend: from 1904 until 1953 the price elasticity seems to become increasingly inelastic while afterwards it seems

to get increasingly elastic. Nelson (2013) finds a publication bias, which is reflected in larger price elasticities.[4]

2.2.2 Heterogeneous elasticities different drinkers and distribution channels

Different types of drinkers characterized by the amount of alcohol consumption may react differently to price changes. Purshouse et al. (2010a, 2010b) estimate the price elasticity of moderate drinkers (adult drinkers with a mean consumption per week of 21/14 or fewer units of alcohol for men/women) and hazardous and harmful drinkers (adult drinkers with a mean weekly consumption greater than 21/14 units of alcohol for men/women) in the United Kingdom.[5] Their findings indicate that moderate drinkers are less price sensitive compared to hazardous and harmful drinkers. This result applies to all alcohol beverages examined, which include beer, wine, spirits, and RTDs. Byrnes et al. (2016) investigate the price elasticity of drinkers at different average consumption levels (i.e., at different quantiles) in the United States, and the authors find a roughly decreasing trend of price elasticity. For the overall population of drinkers the price elasticity of alcohol is -0.96, while for the highest 10% of drinkers the elasticity is -1.26. A US study from 1994, on the other hand, finds rather a U-shaped price response of alcohol consumption, see Manning et al. (1995). The lowest (highest) 10% of drinkers display a price elasticity of -0.53 (-0.49), while the median drinker shows an elasticity of -1.19 and the overall population an elasticity of -0.80. The median drinker is thus more price elastic than the light and heavy drinkers.

Price elasticities in the on-trade and off-trade markets generally differ. On-trade refers to alcohol sold to be consumed on the premises (pubs, bars, restaurants), and off-trade refers to alcohol sold to be consumed off the premises (shops). Meng et al. (2014) and Sousa (2014), for example, find beer to be more price elastic in the off-trade than in the on-trade, while spirits and wine are more price elastic in the on-trade than in the off-trade.[6] The precise numbers for on- and off-trade beer are -0.79 and -0.98 (Meng et al., 2014) and -0.34 and -0.74 (Sousa, 2014), the values for on- and off-trade wine are -0.87 and -0.38 (Meng et al., 2014) and -0.24 and -0.08 (Sousa, 2014), and the elasticities for on- and off-trade spirits are -0.89 and -0.08 (Meng et al., 2014) and -1.25 and -0.45 (Sousa, 2014). Meng et al. (2014) thus generally find beer and wine to be a bit more price elastic than Sousa (2014), while they find spirits to be less price elastic than Sousa (2014). However, all elasticity estimates are within the range of historical estimates.

2.2.3 Country-specific estimates of elasticities in Poland, France and Spain

There are only few studies which investigate price elasticities for France, Spain and Poland at the country level. Those for France report very small elasticities, and thus basically an inelastic demand, for beer, wine and spirits, see Selvanathan et al. (2005a, 2005b) and Labys (1976). For Spain, on the other hand, the price elasticities are considerably larger in absolute value, so the demand is much more elastic, for beer, wine and spirits, see Angulo et al. (2001). A different study finds a somewhat smaller price sensitivity for the

[4] The corrected price elasticities would be -0.29 for beer, -0.46 for wine and -0.54 for spirits, see Nelson (2013), p.8.

[5] Purshouse et al. (2010b) report very detailed tables for own- and cross-price elasticities in the United Kingdom, for beer, wine, spirits and RTDs (for low and high prices for a given beverage), for on-trade and off-trade, and for moderate drinkers and hazardous/harmful drinkers. We present these tables in the appendix, see Appendix A: Detailed own- and cross price elasticities in the UK.

[6] The findings of Purshouse et al. (2010b), who examine price elasticities for on- and off-trade, for moderate and hazardous/harmful drinkers, and for low and high prices of alcoholic beverages, are only partially in line with these results. In the case of beer the above results only apply to moderate drinkers, and in the case of spirits the results only apply to low price spirits. Finally, wine is found to be more price elastic in the off-trade than in the on-trade, which is the opposite with respect to the above results.

consumption of wine, see Labys (1976). Two additional studies consider only young people (aged 14 to 18), see Gil and Molina (2009) and Gil Lacruz (2009), where the first finds wine to be less elastic than beer, which is in contrast to the consensus findings of the meta studies. The second study looks separately at price elasticities of males and females and finds positive, yet insignificant, price elasticities for females. In Poland, only the price elasticity of spirits was found to be negative (-0.62), elasticities for beer and wine are positive, but not significantly so, in the study by Florkowski and McNamara (1992). More recent studies report negative price elasticities for both wine and spirits, which are more or less in line with the meta studies, see Wolak (2015) and Bielinska-Kwapisz and Mielecka-Kubien (2011). Based on all four studies, the demand for beer seems to be either close to zero or insignificant. Table 3 summarizes the price elasticities for France, Spain and Poland.

Table 3: Price elasticities for alcohol beverages for specific countries

Study	Beer	Wine	Spirits
France			
Selvanathan et al. (2005a)	-0.06	-0.05	-0.06
Selvanathan et al. (2005b)	-0.08	-0.09	-0.14
Labys (1976)	na	-0.06	na
Spain			
Gil and Molina (2009)	-0.57	-0.39	-1.04
Gil Lacruz (2009), male	0.39	-1.68	-1.69
Gil Lacruz (2009), female	1.74	0.69	1.28
Angulo et al. (2001), conditional	-1.17	-1.04	-1.04
Angulo et al. (2001), unconditional	-2.44	-1.52	-4.65
Labys (1976)	na	-0.37	na
Poland			
Wolak (2015)	0.16	-0.98	-0.52
Bielinska-Kwapisz and Mielecka-Kubien (2011), conditional	0.03	-0.55	-0.91
Bielinska-Kwapisz and Mielecka-Kubien (2011), unconditional	0.03	-0.50	-0.76
Florkowski and McNamara (1992)	1.28	0.82	-0.62

Source: Wolak (2015), Bielinska-Kwapisz and Mielecka-Kubien (2011), Gil Lacruz (2009), Gil and Molina (2009), Selvanathan et al. (2005a), Selvanathan et al. (2005b), Labys (1976), Angulo et al. (2001), and Florkowski and McNamara (1992).

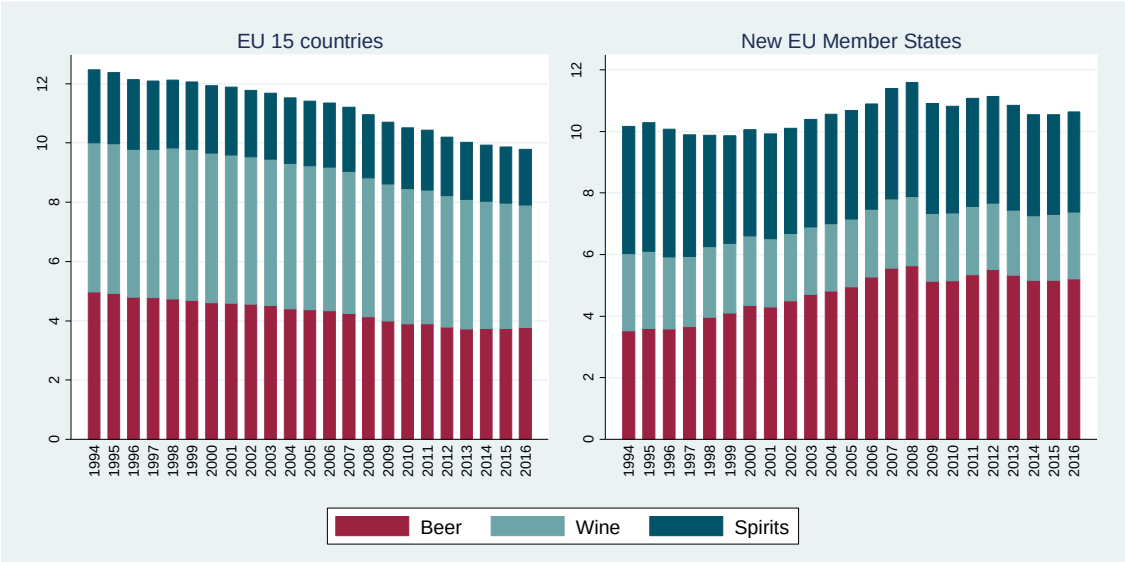
Notes: Wolak (2015), Bielinska-Kwapisz and Mielecka-Kubien (2011), Gil and Molina (2009), and Gil Lacruz (2009) report both Marshallian (uncompensated) and Hicksian (compensated) price elasticities. We show the Marshallian (uncompensated) elasticities, incorporating both the income and the substitution effect (see, e.g., Sousa, 2014, p.21).

3 Background: The market for alcoholic drinks in Europe

The impact of excise taxes on prices and consequently on the demand for the tax commodities cannot be investigated in isolation. The larger economic environment, including general trends in consumer preferences and government regulation set a background, which influences the impact of excise taxation on the demand for alcoholic beverages. Therefore, this background chapter describes the most important developments in the market for alcoholic drinks in Europe in the last two decades. Note, that the data basis for this chapter and for this study in general is recorded alcohol consumption. It is very likely that there is additional unrecorded consumption. That said, unrecorded consumption most likely also remains untaxed and therefore is outside the scope of this study.

The market for alcoholic beverages in many European countries is characterized through stagnant or even declining market volume. Health concerns and a changing lifestyle result in a generally lower demand for alcoholic beverages. These trends are often reinforced through government regulations, including specific excise taxes but also stricter alcohol limits for driving, or restrictions on advertising for alcoholic beverages. That said, the overall downward trend for the average alcohol consumption as depicted in Figure 3 is only clearly observable for the group of EU 15 countries.[7] Starting with an overall consumption of over 12 liters of pure alcohol per adult in 1994 the trend is clearly downward. In 2016 the overall consumption is clearly below 10 liters of pure alcohol per adult.

Figure 3: Development average alcohol consumption in Europe 1994-2016



Source: own calculations based on IWSR data

The reduction in consumption is observable across the three broad categories of alcoholic beverages. For beer and spirits the relative decline is about one quarter, while for wine the decline is somewhat less pronounced with a reduction of approximately one fourth. In absolute numbers the reduction for beer was from 5 liters of pure alcohol per adult in 1994 to 3.8 liters in 2016. Given our assumption of 5% vol. alc. of a typical beer, this represents a reduction from a yearly consumption of 100 liters per adult to 76 liters. In weekly drinks of 0.5 liters this equals a reduction from 3.8 to 2.9. The reduction for spirits was

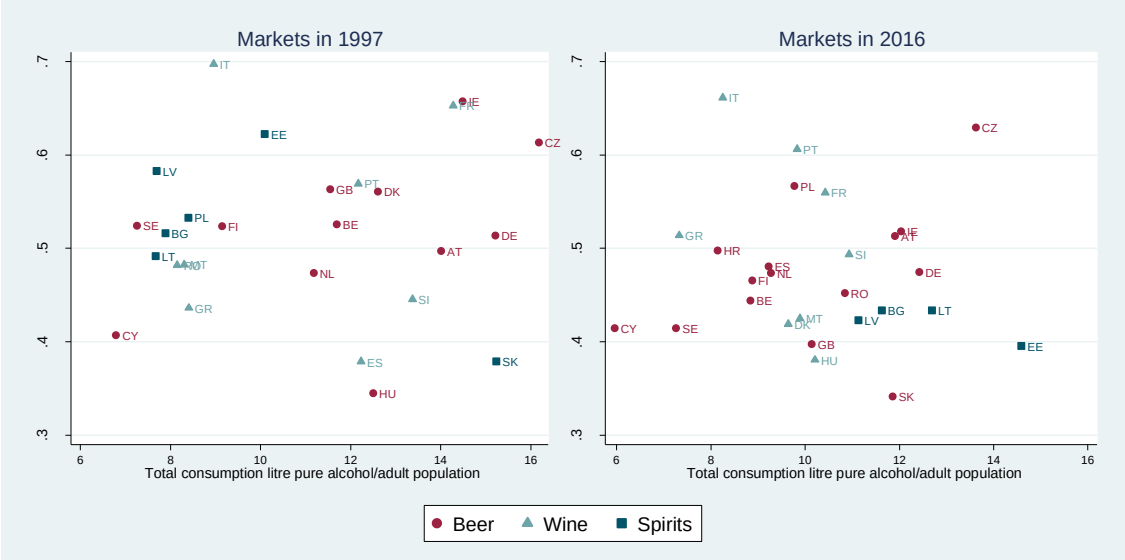
[7] The EU 15 countries are the Member States before the enlargement in 2004, i.e. Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. Data for Belgium and Luxembourg is combined in the IWSR data.

from 2.5 liters of pure alcohol to 1.9 liters. Converted into standard sized drinks (0.02 liters) per week this represents a decline from 5.9 to 4.5 drinks. In comparison the wine consumption declined from 5 to 4.1 liters yearly or from 6.4 glasses (0.125 liters) to 5.3 glasses weekly.[8]

For the new Member States the broad trend is rather different.[9] The overall consumption of alcoholic beverages increases up to 2008 and starts to recede in the latest years. This reflects that in several of the Eastern European countries the markets for alcoholic beverages had to develop after the opening of the markets. The second striking observation is the much bigger share of spirits in the overall alcohol consumption in the new Member States. However, the importance of spirits in the overall consumption of alcohol is clearly declining. While the consumption of pure alcohol per adult in the form of beer has clearly increased from 3.5 liters in 1994 to 5.2 liters in 2016, the consumption in form of spirits receded from 4.1 liters to 3.3 liters. The consumption of wine in the new Member States only changed between 1994 and 2015 only moderately from 2.5 liters of pure alcohol per adult to 2.2 liters.

The marked difference between the EU 15 Member States and the new EU Member States already suggests that there are clear differences between individual countries. Figure 4 highlights these differences by plotting the share of the most popular alcoholic beverages in total alcohol consumption by country in 1997 and 2016. The color coding marks the most popular type; in countries marked through light blue triangles wine is the most popular alcoholic beverage, in countries marked through red dots beer is the most popular drink while the dark blue squares mark countries with spirits as the most popular alcoholic beverages.

Figure 4: Comparison most popular alcohol beverages by country 1997 vs. 2016



Source: own calculations based on IWSR data

In 6 countries (Italy, France, Portugal, Greece, Malta and Slovenia) wine was the most consumed alcoholic beverage in both 1997 and 2016. In 10 countries (Austria, Belgium/Luxembourg, Cyprus, Czech Republic, Germany, Finland, Ireland, the Netherlands, the United Kingdom and Sweden) beer was the most

[8] We use 12 % vol. alc. for a typical wine and 40 % vol. alc. for a typical spirit for these conversions.

[9] The new Member States includes the 13 EU countries which joined the EU in 2004 or later, i.e. Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Latvia, Lithuania, Malta, Poland Romania, Slovenia and Slovakia. Malta prior to 1997 and Croatia prior to 2003 are excluded because of missing or inconsistent data.

consumed beverage and in 4 countries (Bulgaria, Estonia, Latvia and Lithuania) spirits where the most consumed beverage at both points in time. In the remaining countries a change in the most consumed alcoholic beverage has been observed. In Romania and Spain beer superseded wine as the most popular alcoholic beverage, while in Hungary and Denmark the opposite development took place. In the Slovak Republic and Poland beer has been the most consumed alcoholic beverage in 2016 in contrast to 1997 when spirits where the most consumed alcoholic beverages in these countries. Overall, a relative shift away from spirits can be observed, together with a moderate convergence in tastes across countries. This is in line with Bentzen and Smith (2018) finding a long-run overall convergence in drinking patterns in the OECD, which is largely driven by the decline of wine in the traditional wine drinking countries while wine consumption increased in other countries.

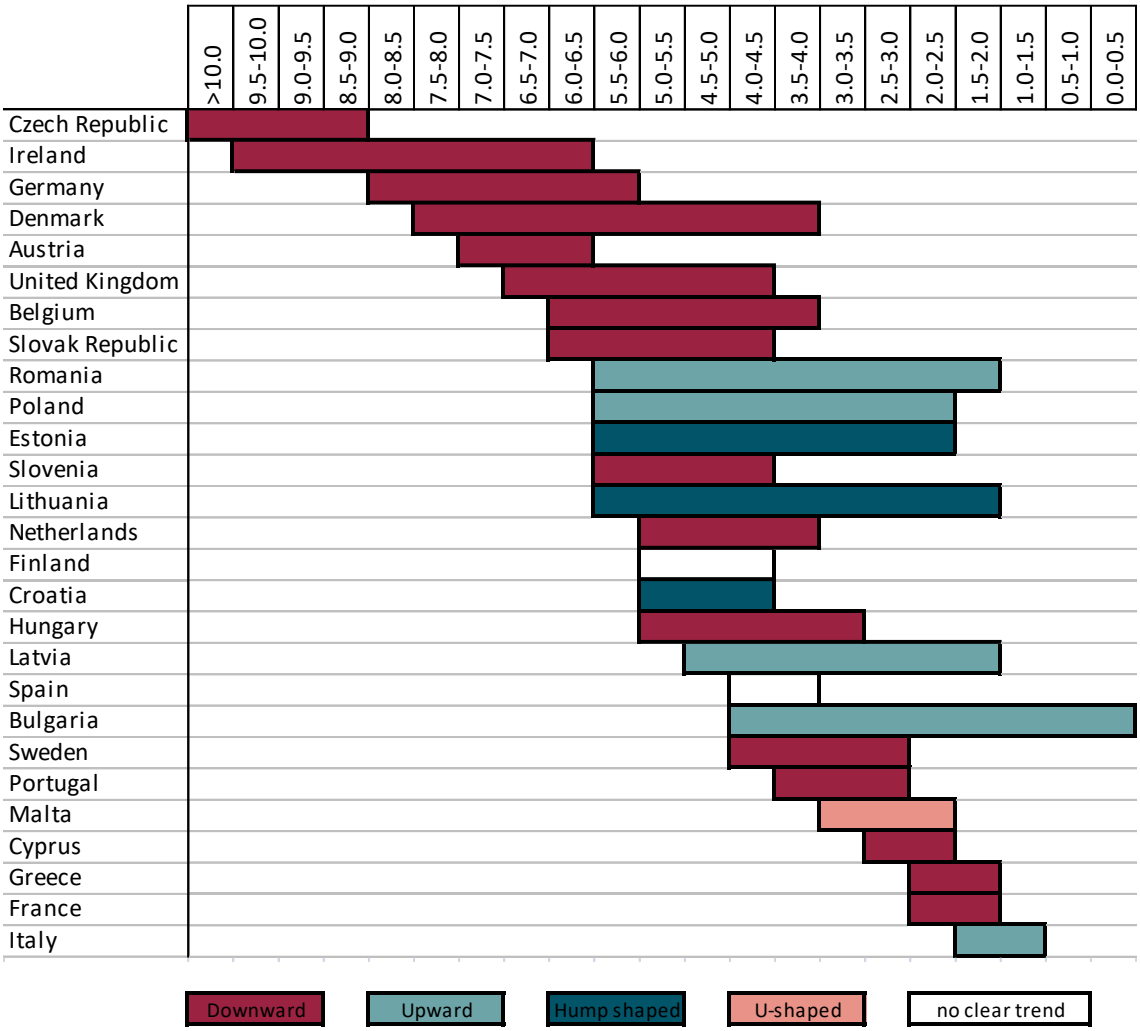
In the following we look at broad trends in the consumption of the three main types of alcoholic beverages over the time period 1994 to 2016 broken down by the individual countries. Figure 5 looks at the consumption of beer, Figure 6 shows the consumption of wine and Figure 7 summarizes the consumption of spirits.

All three figures follow the same logic and color-code the development of over time. Red colored entries describe countries, where the consumption shows a downward trend over time, petrol show countries with an upward trend, darker blue entries show countries with a hump-shaped trend, pink entries describe a u-shape trend and for the countries with non-shaded entries no clear trend is observable.[10] The width of the bars in the figures depict the range of consumption over the years, i.e. the wider the bars the bigger is the change over time. In combination, the graph can be interpreted as following. A wide red bar shows a significant decrease in consumption while a large bar in petrol shows a clear increase in consumption. The entries are ordered according to the maximum per capita consumption in the observed time period. This implies that countries with a downward trend might be further down the ranking in more recent years, with countries with an upward trend (or a less strong downward trend) surpassing them in consumption. For example, the per capita beer consumption in Germany and Denmark is has decreased much more than in Austria, resulting in a higher per capita beer consumption in Austria in 2016.

Figure 5 depicts the consumption of beer by country. Several of the typical beer drinking countries (e.g. the Czech Republic, Ireland, Germany, Denmark, Austria, the United Kingdom and Belgium) have experienced a downward trend in beer consumption the last two decades. In contrast, some of the Eastern European countries (Romania, Poland, Latvia and Bulgaria) have a clear upward trend in beer consumption. For other Eastern European countries like Estonia, Lithuania and Croatia the initial upward trend in beer consumption has turned resulting into an overall hump-shaped trend. Together with the upward trend in the beer consumption in Italy this results in a relative convergence of beer consumption among the European Union countries.

[10] We run two linear regressions on the year variable respectively on the year and year squared variable. The trend is classified as downward (upward) if the t-statistics of the linear regression on the year only is lower than -2.58 (higher than +2.58) and absolutely higher than the t-statistics for the year variable in the regression including the squared term. The trend is classified as hump-shaped (u-shaped), if the t-statistics of the year variable is higher than +2.58 (lower than -2.58) and the t-statistics of the year squared variable is lower than -2.58 (higher than +2.58) and the t-statistics of the year variable is absolutely higher than in the regression including only the year variable. If neither of the regressions have a t-statistic of absolutely more than 2.58 we treat this as no clear consumption trend observable.

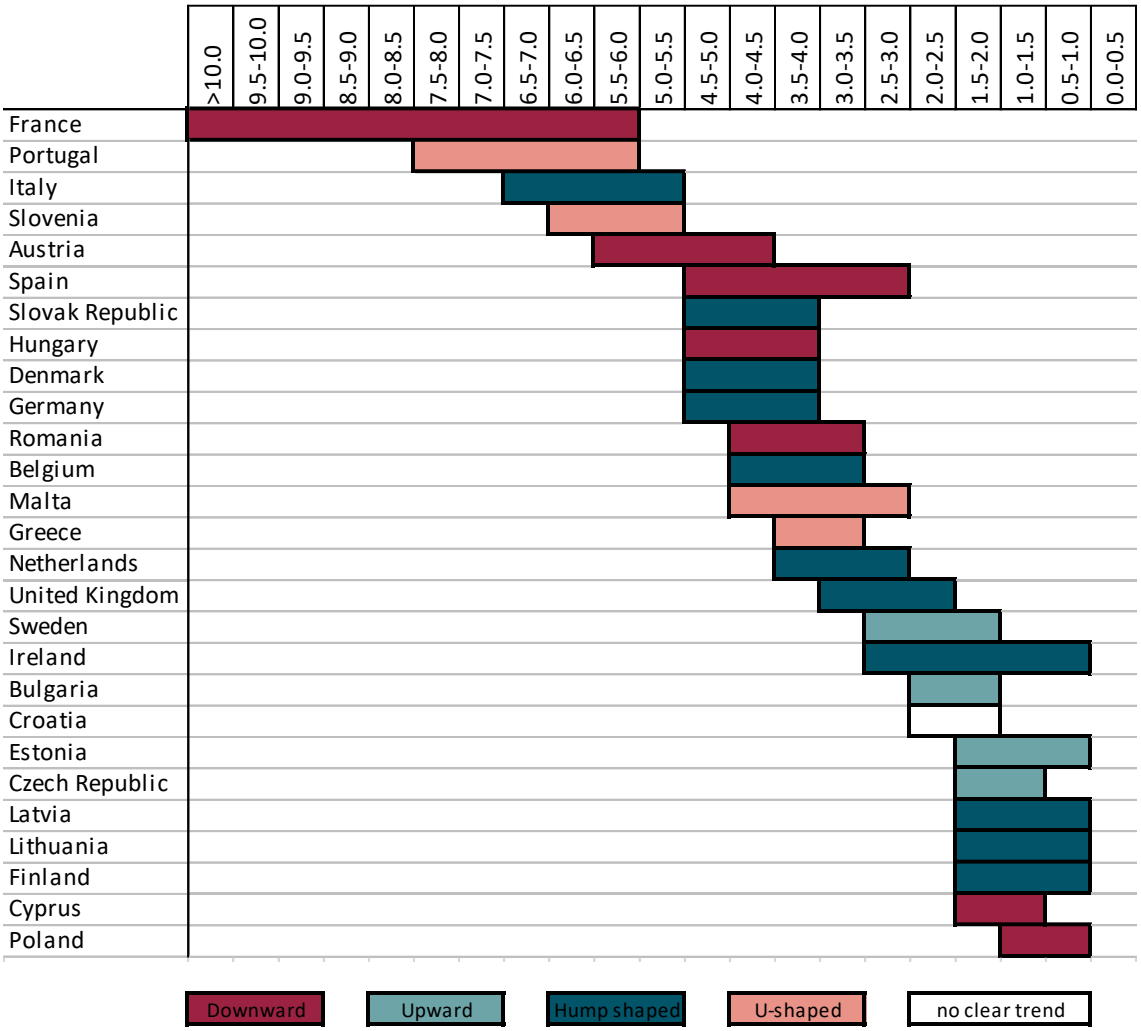
Figure 5: Alcohol consumption by country: Beer 1994-2016



Source: own calculations based on IWSR data

Figure 6 shows the corresponding development in wine consumption. France clearly stands out as the country with the initially clearly highest per capita wine consumption. At the same time a very strong downward trend is observable. For other countries with traditionally high per capita wine consumption the trends are less clear. Portugal and Slovenia have experienced an initial decrease followed by a recovery in per capita wine consumption which results in a u-shape trend, while in Italy the opposite is true. The increase in per capita consumption turned in a recent downward trend resulting in an overall hump-shaped trend. In Austria and Spain, the observable trend is downward. Overall, there is much less of convergence in per capita wine consumption observable, which is also due to countries like Cyprus and Poland where the initially low per capita wine consumption further declined.

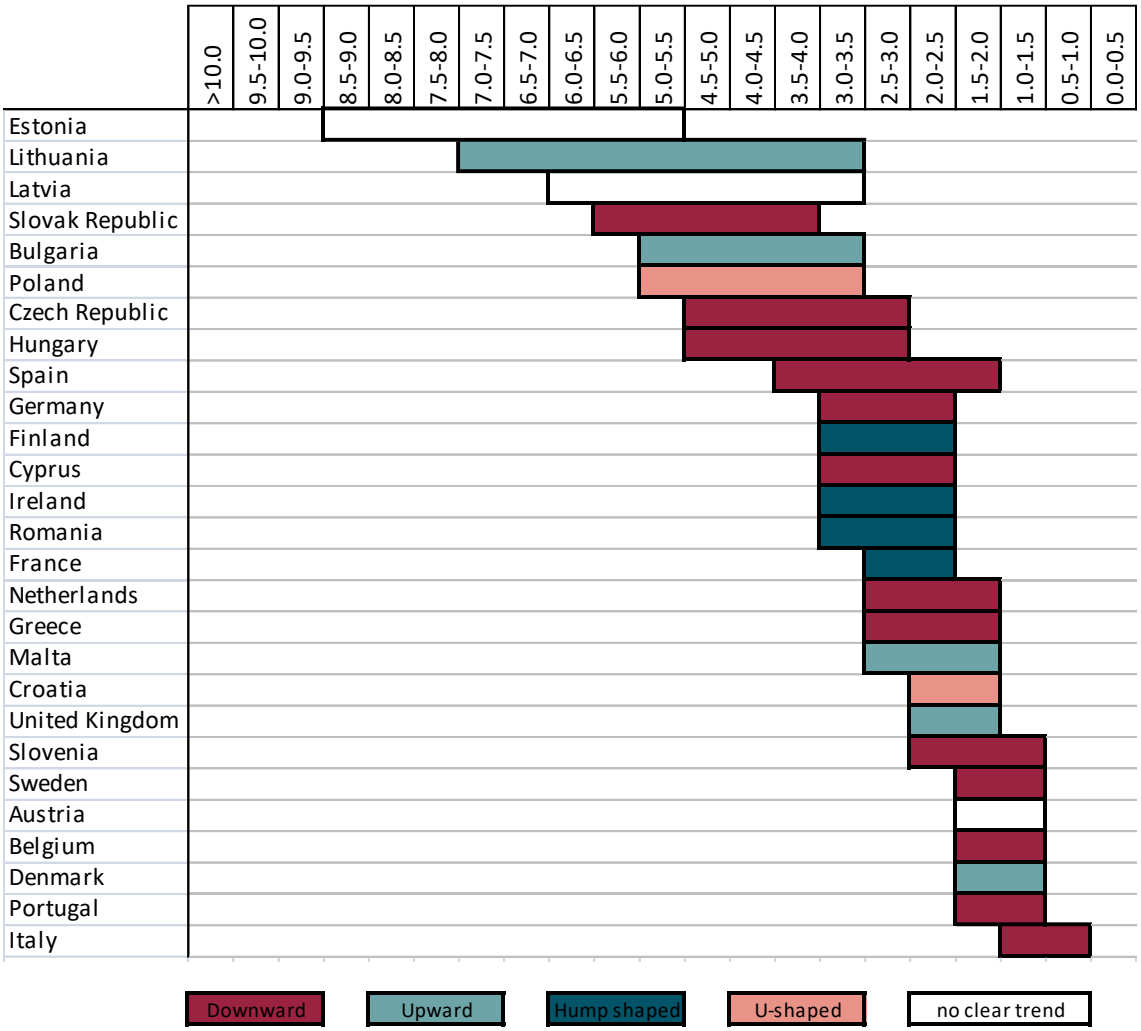
Figure 6: Alcohol consumption by country: Wine 1994-2016



Source: own calculations based on IWSR data

Figure 7 shows the development of per capita consumption of spirits by country. Here the Baltic countries stand out with the highest per capita consumption. The consumption over time is rather volatile – which is reflected by the wide range of the bars in Figure 7 - but apart from Lithuania where a clear upward trend is identifiable no clear patterns over time emerge. Other Eastern European countries also have a relatively per capita high consumption of spirits. Several of them are also characterized with a declining trend. In particular in the Slovak Republic, the Czech Republic and Hungary the per capita consumption of spirits is declining. In Poland, a recent increase in per capita consumption results in a u-shape pattern overall, while Bulgaria is characterized with an overall increase in spirits consumption. Southern European countries are by and large characterized through a declining per capita consumption of spirits. This decline is particularly pronounced for Spain, but also observable for Cyprus, Greece, Portugal and Italy. Overall, there is no clear pattern of convergence observable, but rather a continuing difference between different regions. The Baltic countries and most countries in Eastern Europe remain the countries with a relatively high level of per capita consumption in spirits while several of the Southern European countries are at the other end of the spectrum with a low per capita consumption of spirits.

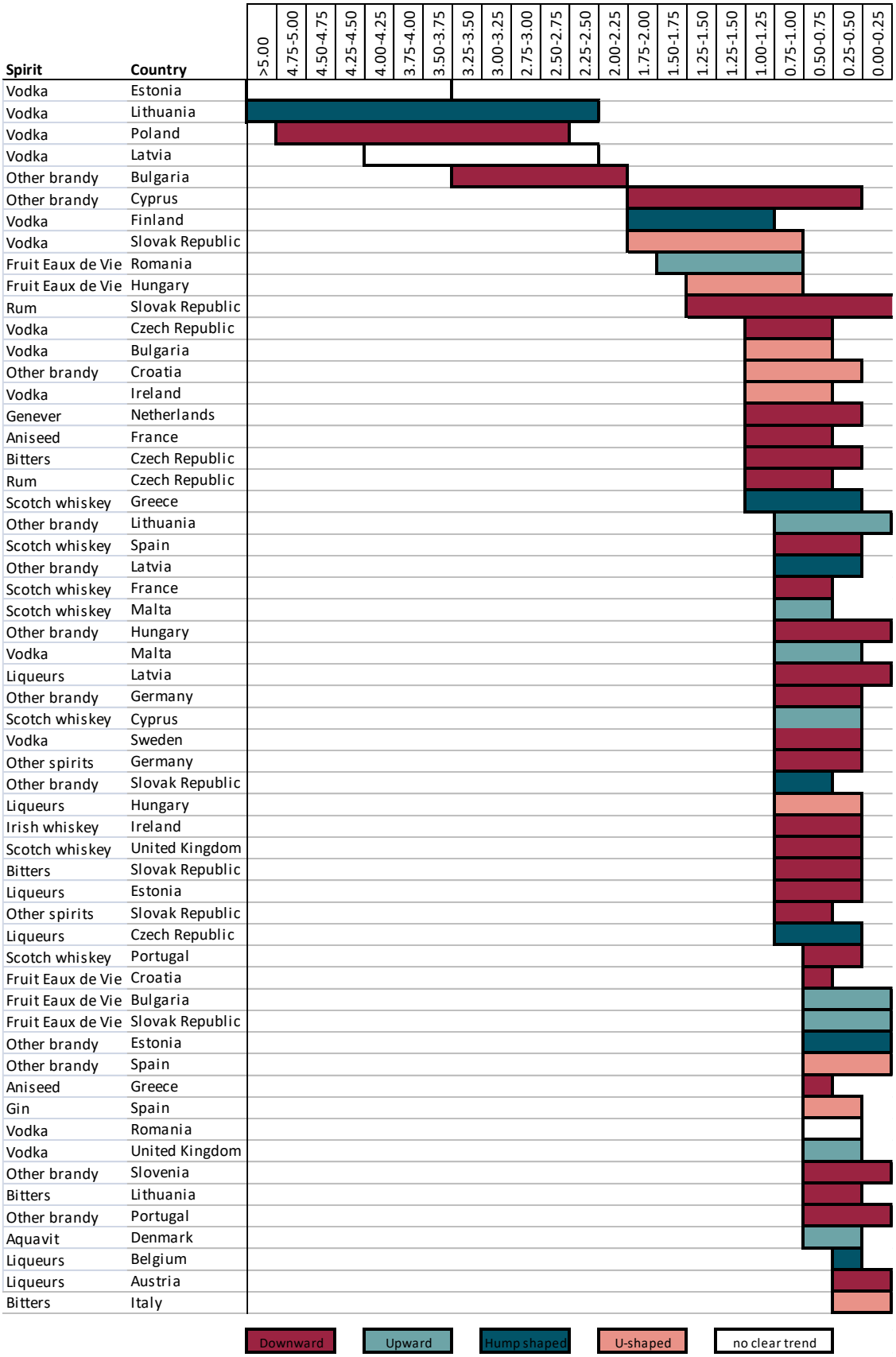
Figure 7: Alcohol consumption by country: Spirits 1994-2016



Source: own calculations based on IWSR data

In Figure 8 we use the detailed information about the consumption of spirits by countries to identify more specific trends in consumer preferences for spirits. Following the exact same logic as in the previous graphs, we show the most consumed spirit types by country. In the Baltic countries and Poland Vodka is predominant. However, the variation over time is substantial and in the case of Poland, there is a strong decline in vodka consumption observable. In Bulgaria, and Cyprus brandy (other than cognac) is the most consumed spirit, but again with a very strong downward trend. In fact, the strong downward trend in typical spirits can be observed in many countries, e.g. for rum in the Slovak Republic, vodka in the Czech Republic, genever in the Netherlands, aniseed in France or for scotch whiskey in Spain. In contrast, there are only a few cases where a clear upward trend in the consumption of specific sprits can be observed. Apart from some cases in Eastern Europe (e.g. Fruit Eaux de Vie in Romania, Bulgaria, and the Slovak Republic and other brandy in Lithuania) where the increase potentially reflects more the transition to a market-based economy, the only observable upward trends are for Scotch whisky in Malta and Cyprus and for vodka in Malta and the United Kingdom.

Figure 8: Alcohol consumption by country: Most consumed spirits 1994-2016



Source: own calculations based on IWSR data

For Spain, Poland and France we additionally draw on micro-level survey data to gain more insights on the recent trends in the respective markets for alcoholic beverages. Two main data sources are available; the household budget surveys (HBS) and the European Health Interview Survey (EHIS). These data sources inform about purchases/consumption at the household or individual level.[11] Table 4 reports the share of households which report purchases of alcoholic beverages in Spain, Poland and France. While the majority of the households in Spain and Poland report some purchases of alcoholic beverages, almost three quarters of the households in France report no purchases of alcoholic beverages. Together with the fact that the latest available dataset is from 2010, the much smaller sample size for France casts some serious doubt on the data quality. Nevertheless, some consistent findings emerge for all three countries. In Spain and France Wine plays a much bigger role than in Poland. At the same time, spirits are much more prevalent in Poland than in Spain or France. Beer plays an important role in Poland and Spain, but much less so in France.

Table 4: Purchases/consumption of alcoholic beverages, Spain, France, Poland (HBS)

	Spain	Poland	France
No alcoholic beverage	40.6%	35.6%	73.2%
Beer only	16.6%	25.8%	5.0%
Wine only	13.6%	4.1%	10.6%
Spirits only	1.5%	5.3%	4.0%
Beer and wine	17.0%	6.5%	2.6%
Beer and spirits	2.0%	13.5%	1.0%
Wine and spirits	1.6%	2.1%	2.7%
Beer, wine and spirits	7.2%	7.2%	1.0%
Sample size (No. Households)	**22,010**	**36,886**	**15,797**

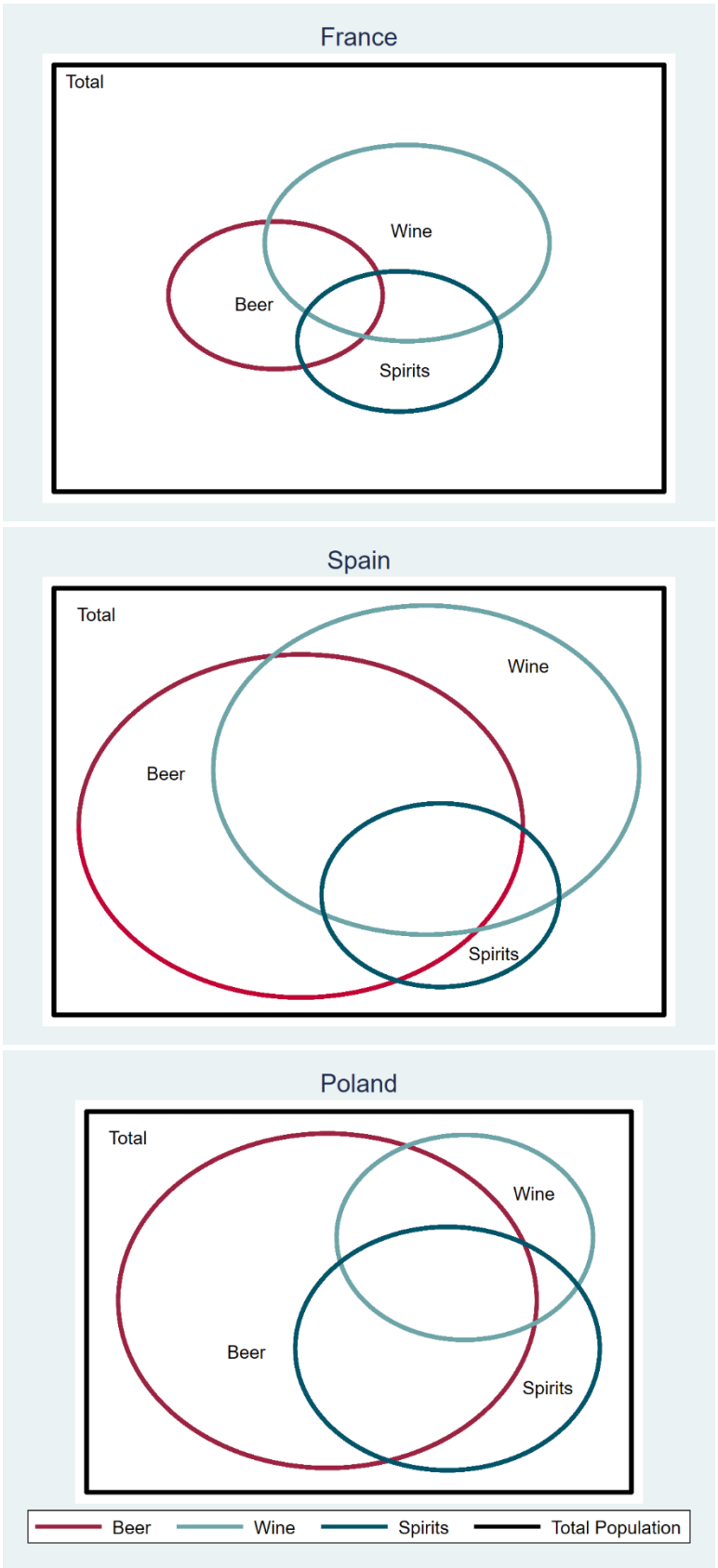
Notes: Data for Spain and Poland from HBS 2016. Data for France from HBS 2010. Percentage values indicate percentage share of sample.

Source: own calculations HBS data

Additionally, Figure 9 graphically illustrates the emerging consumption patterns. The black squares present the total sample and the circles the share of households which consume the three types of alcoholic beverages. The overlapping regions indicate that households consume more than one type of alcoholic beverages. Figure 9 shows clearly, that there is significant overlap in the consumption of alcoholic beverages, especially for the consumers of spirits in Spain and Poland. This is a first indication that substation between the different types of alcoholic beverages can be of importance.

[11] See also Section 5 for a short description of the information contained in the household budget surveys. Furthermore, we use the purchases of alcoholic beverage interchangeably with consumption.

Figure 9: Household consumption patterns France, Spain and Poland (HBS data)



Source: own calculations HBS data

The second important information which can potentially be derived from micro-level data is the frequency and intensity of alcohol consumption. The household budget survey reports the quantity of alcohol purchases. Relating these quantities to the number of individuals over 18 in the households allows a classification of household members into abstainers, light, moderate or heavy drinkers. Table 5 reports the resulting values. For Spain, approximately half of the household members are classified as light drinkers, while for about 3.6 percent of the households the classification of heavy drinkers applies. The picture is quite different from Poland, where more than 60 percent of the household members are classified as light drinkers and only 0.7 percent fall in to the category heavy drinkers. The share of heavy drinkers is highest with 6.3 percent in France, while almost three quarters of the households are classified as abstainers.

Table 5: Households by drinking behaviour, Spain, France, Poland (HBS)

	Spain	Poland	France
Abstained (0g/day)	40.5%	35.6%	74.5%
Light (<20g/day)	47.9%	60.6%	13.4%
Moderate (20-39g/day)	8.0%	3.1%	5.9%
Heavy (>40g/day)	3.6%	0.7%	6.3%

Notes: Data for Spain and Poland from HBS 2016. Data for France from HBS 2010. Percentage values indicate percentage share of sample.

Source: own calculations HBS data

Using the information about the alcohol consumption from previous waves of the household budget survey for Spain and France one can learn that these patterns appear to be changing slowly. In Spain we can observe a shift from moderate drinkers towards abstainers, while for Poland the opposite is true. The tendencies for moderate or heavy consumption are less clear in both countries.[12]

The information about the intensity of the alcohol consumption can be complemented with the information about the frequency of alcohol consumption for the EHIS. Table 6 reports the results for Spain and Poland. In Spain about 16.6 percent of the respondents report daily alcohol consumption. At the same time roughly one third report no alcohol consumption in the last twelve months or respond that they never consume alcohol. This is broadly in line with the share of abstainers found in the HBS data. For Poland a much smaller number of respondents (1.5%) report daily alcohol consumption. The share of reported abstainers is somewhat larger than a quarter (15.9% with no alcohol consumption in the last 12 months and 11.9% with no alcohol consumption). There is, however, also a significant number of interview partners (8.9%) which decline to answer the question on alcohol. It can therefore be assumed that the estimated frequency of alcohol consumption in Poland is a lower bound estimate.

[12] Some caveats remain because of a reporting bias, especially for heavy consumption, which could obscure such tendencies.

Table 6: Frequency of alcohol consumption, Spain and Poland (EHIS)

	Spain	Poland
Every day	16.6%	1.5%
5-6 days/week	1.2%	0.9%
3-4 days/week	3.5%	3.2%
1-2 days/week	15.5%	8.7%
2-3 days/month	9.6%	11.5%
Once a month	7.6%	13.2%
< once a month	11.8%	24.3%
Not in past 12 months	12.8%	15.9%
Never	21.2%	11.9%
Don't know/ refusal	0.2%	8.9%

Notes: Data for Spain and Poland from EHIS 2014. Percentage values indicate percentage share of sample.

Source: own calculations EHIS data

4 Tax Pass-Through

Changes in excise taxation on alcoholic beverages only will affect consumption if they are passed on to consumer prices. Therefore, the extent of the tax pass-through of excise taxes is a key parameter for the estimation of the tax revenue effect triggered by changes in excise taxation. Theoretically, the pass-through of excise taxes can take on any value; immediate and full pass-through to consumer prices, less than full pass-through or over shifting of the tax burden.[13] The main determinants of the pass-through are the relative elasticities of supply and demand. These, in turn, are amongst others depending on the market structure in the industry and its pricing power and the consumer preferences. While it is beyond the scope of the current study to investigate the determinants of the tax pass-through in detail, a general idea of the extent is necessary to model the tax revenue effects. To this end, we estimate the observed tax pass-through based on two independent sources of price data. The starting point is the detailed information from the consumer price index (CPI) available from Eurostat. Additionally, we use the price information, which is implicitly available in the IWSR data. Finally, we sum up the discussion of the tax pass-through by separately investigating the developments in France, Poland, and Spain.

4.1 Estimated tax pass-through based on CPI measures

In the context of the monthly measurement of inflation Eurostat collects detailed information about the price development of goods and services. Based on this data a monthly CPI is calculated for each of the EU countries. The overall CPI is composed of more disaggregated sub-indices, which are harmonized across Europe according to the COICOP classification.[14] We use the development of the sub-indices *CP.02.1.1 Spirits*, *CP.02.1.2 Wine* and *CP.02.1.1 Beer* to investigate the impact of tax changes on the price. The CPI data does only report an index with the base value 2015=100. To relate these price changes to the changes in the tax burden, we convert the excise taxes into a change of tax of a typical product in percent of the price of the product. Therefore, two steps of calculations are necessary. First, we need to convert the excise tax to the tax burden on a liter of typical product. And second, we need a reference price of a liter of the alcoholic beverage.

The conversion of the excise tax uses the same assumptions about the strength of the alcoholic beverages than introduced in the previous section. We take 5 % vol. alc. for a typical beer, 12 % vol. alc. for a typical wine and 40 % vol. alc. for a typical spirit. These assumptions are held constant for all countries and years.

To get the reference prices we use the implicit information about unit prices in the IWSR data. Specifically, we derive the prices for beer, wine and spirits by dividing the reported sales value through the reported sales quantities, both for the year 2015. Additionally, we take the average price of the most consumed variety of spirits (e.g. vodka, scotch whiskey, etc.) as the reference price of spirits in 2015. In Table 7 we report the implied price per liter for all EU 28 countries. The values for the most consumed variety of spirits range from 4.11 Euro in Romania to 43.43 Euro in Sweden. In comparison, the average price all spirits vary slightly less across countries with an average price between 6.82 in Romania and 38.22 in Ireland. Regarding the variety of spirit with the highest sales volume, we can identify a group of 9 countries where vodka is the most consumed variety and the average price of vodka is below the average price for

[13] See also Benedek et al (2015) for a brief summary of the theoretical mechanisms of tax pass-through in the context of VAT changes. For a summary of empirical results see also IFS et al. (2011).

[14] COICOP stands for "Classification of individual consumption by purpose". Eurostat classifies consumption expenditures into 12 main categories which in turn are subdivided into groups of items and so on. See http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=HICP_2000&StrLanguageCode=EN&IntPcKey=&StrLayoutCode=EN for more detail.

all spirits. Another group of 8 countries has scotch whisky as the spirit variety with the highest sales volume and the average price of scotch whisky is above the average price for all spirits in all of these countries.

Table 7: Average prices for 1 liter of spirits in EU 28 countries 2015

		Average price for 1 litre of	
Country	**Most-consumed spirit variety**	**most-consumed spirit variety**	**all spirits**
Austria	Vodka	17.99	19.03
Belgium/Luxembourg	Scotch Whisky	21.47	19.12
Bulgaria	Other Brandy	5.97	7.91
Croatia	Fruit Eaux de vie	13.28	13.52
Cyprus	Scotch Whisky	23.65	20.88
Czech Republic	Scotch Whisky	12.22	13.49
Denmark	Aquavit	25.05	26.98
Estonia	Vodka	15.44	19.05
Finland	Vodka	24.71	29.94
France	Scotch Whisky	18.96	17.60
Germany	Vodka	11.68	13.73
Greece	Scotch Whisky	30.10	22.42
Hungary	Fruit Eaux de vie	14.72	14.02
Ireland	Vodka	33.43	38.22
Italy	Bitters	13.12	15.05
Latvia	Vodka	14.19	17.16
Lithuania	Vodka	11.62	12.71
Malta	Scotch Whisky	26.40	22.80
Netherlands	Liqueurs	16.07	20.19
Poland	Vodka	9.53	10.59
Portugal	Scotch Whisky	20.16	17.30
Romania	Fruit Eaux de vie	4.11	6.82
Slovak Republic	Vodka	10.98	12.82
Slovenia	Bitters	18.63	18.24
Spain	Gin	17.90	14.73
Sweden	Scotch Whisky	43.43	37.70
United Kingdom	Vodka	26.53	29.78

Note: The most-consumed variety is identified as spirit type which has the highest sales volume in Euro in 2015. The average prices are not reported per se, but rather defined as the ratio between the sales volume and the litres sold.

Source: own calculations based on IWSR data

In the next step we combine the 2015 prices with the CPI indices to calculate the reference prices in the other time periods. To avoid the impact of exchange rate changes we convert all values into national currencies using the official exchange rate information as reported by the European Commission in the excise duty tables. Denoting τ_{ijt} as the excise tax per liter of product j (beer, wine, spirits) in the month t in country i and p_{ijt} as the unit price of the same product we then define the tax change as $\Delta\tau_{ijt} = \frac{\tau_{ijt}-\tau_{ijt-1}}{p_{ijt-1}}$.

We use two measures of the inflation rate to see whether these tax changes are passed through. First, we define the year-on-year (YoY) inflation as the change in the CPI for alcoholic beverage j in country i in month t, to the CPI in the same month the year before, hence $\pi_{ijt}^{YoY} = \frac{CPI_{ijt}}{CPI_{ijt-12}} - 1$. This measure eliminates seasonality in the price index because it compares the same months across the years. An

immediate and full pass-through of the tax change will therefore show higher inflation rates for twelve months. After that, the inflation rate returns to its previous level, given no other interacting events occur.

Alternatively, the inflation measure can be based on the month-on-month (MoM) change in the CPI. Then the inflation measure is defined as $\pi_{ijt}^{MoM} = \frac{CPI_{ijt}}{CPI_{ijt-1}} - 1$. In this case, the immediate and full price pass-through should be visible only in the inflation rate of the very same month. Furthermore, one can also investigate a delayed pass-through of the excise taxes by including further lags of the tax changes. We also allow for an anticipated pass-through in the month before the tax change. One additional concern which can affect the MoM inflation rate is seasonality in the CPI measures. To address this issue, we also include month dummies $\boldsymbol{\delta_t}$. More generally, to also take into account other economic developments in the countries we include the general inflation for all goods and services (Π_{it}, defined according to the same logic as the CPI for the alcoholic beverage) as well as country fixed effects μ_i, which capture all time-invariant characteristics of the countries.

The two regression equations are therefore

(1) $$\pi_{ijt}^{YoY} = \beta_1 \Delta\tau_{ijt} + \beta_6 \Pi_{it}^{YoY} + \mu_i + \varepsilon_{ijt}$$

(1') $$\pi_{ijt}^{MoM} = \beta_0 \Delta\tau_{ijt+1} + \beta_1 \Delta\tau_{ijt} + \beta_2 \Delta\tau_{ijt-1} + \beta_3 \Delta\tau_{ijt-2} + \beta_4 \Delta\tau_{ijt-3} + \beta_5 \Delta\tau_{ijt-4} + \beta_6 \Pi_{it}^{MoM} + \boldsymbol{\gamma\delta_t} + \mu_i + \varepsilon_{ijt}$$

where ε_{ijt} denotes the remaining error term.

In Table 8 we present the results of the pass-through estimates for an unbalanced panel of all EU28 countries from 1996 to 2017.[15] The first four columns present the estimates for regression equation (1) with the year-on-year inflation. The tax pass-through is rather similar for beer (0.652), wine (0.696) and spirits (0.679) and somewhat smaller (0.499) if we use the price of the most consumed spirit as reference price. The difference between the two results for spirits is remarkable, since we use the same tax and CPI information for the two regressions. The difference stems purely from the reference price in the year 2015. Specifically, using the average price of the most-consumed variety of spirits results in higher prices (and therefore scales down the tax changes) for 11 countries.[16] For the other 17 countries, the average price of the most-consumed variety of spirits is lower than the average price for all types of spirits and hence the tax changes in these countries will be magnified because they are related to a lower price. Given that there are more countries where the tax change is magnified, a lower tax pass-through is a matter of arithmetics. That said, part of the difference is also due to a higher pass-through in those countries where the most-consumed variety of spirits is less expensive than the average spirit.[17]

The rest of Table 8 presents the results for the pass-through estimates using the month-on-month inflation as specified in regression equation (1'). These specifications allow investigating the time pattern of the pass-through. For all alcoholic beverages we see the lions' share of the pass-through in the first two months. For beer (with an overall pass-through over 5 months of 0.889) and wine (overall pass-through of 0.942) we cannot rule out a complete pass-through of taxes. For spirits the overall pass-through is somewhat lower at 0.797, but the 95% confidence interval still contains full pass-through. Interestingly, we find a moderate anticipation effect of tax changes for the spirits.

[15] The panel is unbalanced because for the Eastern European countries price and tax data are not available for early years. Furthermore, the IWSR data reports Belgium and Luxembourg together. Therefore we use the combined reference prices for 2015 for both countries.

[16] Belgium and Luxembourg, Cyprus, France, Greece, Hungary, Malta, Portugal, Slovenia, Spain and Sweden.

[17] A regression on the split sample confirms this conjecture. The average pass-through for the 17 countries with lower average price on the most consumed variety is 0.71, while for the other 11 countries the average pass-through is 0.62.

Table 8: Estimates of tax pass-through based on CPI price data

	Year on Year Inflation				Month on Month Inflation			
	Beer	**Wine**	**Spirits**	**typical spirit**	**Beer**	**Wine**	**Spirits**	**typical spirit**
Tax change$_{t+1}$					0.003	0.029	0.059**	0.048**
					(0.021)	(0.031)	(0.024)	(0.019)
Tax change$_{t}$	0.652***	0.696***	0.679***	0.497***	0.746***	0.709***	0.527***	0.396**
	(0.211)	(0.197)	(0.174)	(0.205)	(0.179)	(0.080)	(0.141)	(0.164)
Tax change$_{t-1}$					0.165***	0.253***	0.118***	0.080**
					(0.052)	(0.090)	(0.044)	(0.035)
Tax change$_{t-2}$					0.014	0.074	0.039**	0.028**
					(0.028)	(0.045)	(0.016)	(0.013)
Tax change$_{t-3}$					-0.010	-0.102*	0.046*	0.033*
					(0.052)	(0.052)	(0.022)	(0.018)
Tax change$_{t-4}$					-0.028	-0.021	0.008	0.005
					(0.023)	(0.032)	(0.012)	(0.009)
General Inflation$_{t}$	0.715***	0.573***	0.736***	0.737***	0.209***	0.125***	0.113***	0.120***
	(0.089)	(0.077)	(0.128)	(0.129)	(0.052)	(0.032)	(0.048)	(0.049)
Country fixed-effects	✓	✓	✓	✓	✓	✓	✓	✓
Month dummies	×	×	×	×	✓	✓	✓	✓
No. Observations	5,960	5,951	5,951	5,951	5,985	5,976	5,976	5,976
within R^2	0.158	0.150	0.141	0.137	0.143	0.146	0.257	0.234
Combined pass-through					**0.889*** **	**0.942*** **	**0.797*** **	**0.591*** **
					(0.224)	**(0.121)**	**(0.148)**	**(0.198)**

Heteroscedasticity-robust standard errors in brackets. ***,**,* denotes significance at the 1, 5 respectively 10% level. Combined pass-through is the linear combination of the tax change$_{t+1}$ to tax change$_{t-4}$.

Source: own calculations based on Eurostat and IWSR data

Again, using the average price of the most-consumed spirits variety the estimated tax pass-through is much lower (0.591 overall). This lower pass-through is again driven by arithmetics, but also bears the message that pass-through is different depending whether the most consumed variety of spirits is cheaper than the average spirit or not. Interestingly the immediate pass-through is lower in the subsample of 17 countries with a relative cheap variety of most-consumed spirit, while the overall pass-through is higher. Conversely, the immediate pass-through is higher for the other 11 countries, but due to little delayed pass-through in the following months the overall pass-through is lower.[18]

Since the national market for spirits appears to play a crucial role in tax pass-through the next subsection will investigate the pass-through for different types of spirits in more details.

[18] The subgroup of the 17 countries with the higher-priced most-consumed variety has an immediate pass-through of 0.549 and an overall pass-through of 0.742. In contrast the immediate pass-through for the other 11 countries is only 0.441 while the overall pass-through is 0.958. Additionally, there is not anticipation effect observable in these countries.

4.2 Estimated tax pass-through based on IWSR price information

The price information for different varieties of spirits is available from IWSR for 27 countries on a yearly basis for the time between 2000 and 2016. The main advantage is that we have direct information about average prices for all spirits overall and for the different varieties. Therefore, we can directly relate the absolute tax burden on a liter of finish product τ_{ijt} to the average price p_{ijt}.[19] To control for the impact of general inflation or other macroeconomic development we include both the change in the overall consumer price index Π_{it} and the logarithm of nominal GDP Y_{it} . In line with the previous regressions we also capture all time-invariant country characteristics by including country fixed effects μ_i and additionally include year dummies $\boldsymbol{\delta_t}$ to control for common macroeconomic shocks. Hence the regression equations are

(2) $$p_{ijt} = \beta_1 \tau_{ijt} + \beta_2 Y_{it} + \beta_3 \Pi_{it} + \boldsymbol{\delta_t} + \mu_i + \varepsilon_{ijt}$$

where ε_{ijt} denotes the remaining error term. Due to insufficient data we are not able to estimate the pass-through for beer or wine based on IWSR data. Hence, Table 9 only reports the estimates for the pass-through for spirits overall and for the most-consumed spirit variety.

Table 9: Estimates of tax pass-through for spirits based on IWSR price data

	Average price of	
	all Spirits	**most-consumed spirit variety**
Tax change$_t$	0.990***	1.084***
	(0.074)	(0.099)
Log(GDP$_t$)	0.276	-0.755
	(1.573)	(1.870)
General inflation$_t$	0.008	0.026
	(0.086)	(0.098)
Country fixed-effects	✓	✓
Year dummies	✓	✓
No. Observations	392	392
within R²	0.820	0.692

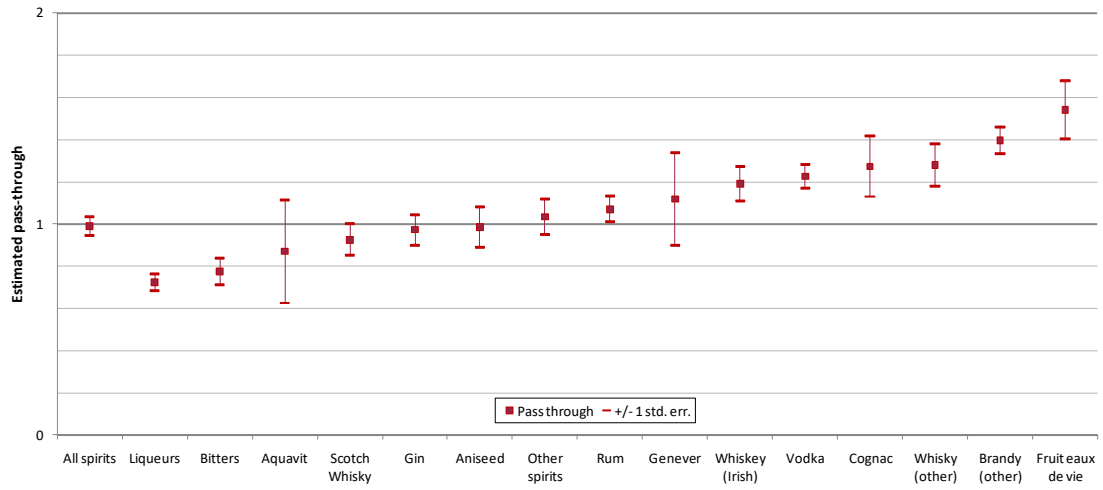
Heteroscedasticity-robust standard errors in brackets. ***,**,* denotes significance at the 1, 5 respectively 10% level.

Source: own calculations based on IWSR data

The pass-through on the price is very close to unity, both for spirits overall (0.990) and for the most consumed variety (1.084). But estimates are not only very close to unity, but also are rather precisely estimated, i.e. the standard error is small. Neither the GDP, nor the general inflation rate, explain any of the price variation. This is mainly due to the country and time fixed effects which already explain a large part of the remaining variation of the average prices.

[19] Note that the index t now denotes the year, and j only stands for spirits and most-consumed spirits.

Figure 10: Estimates for price pass-through for spirits, by types of spirits



Source: own calculations based on IWSR data

In Figure 10 we graphically summarize the estimated pass-throughs for each of the spirit varieties. Starting on the left hand side with the estimated pass-through for spirits overall we then rank the varieties of spirits by the estimated pass-through. For liqueurs and bitters we find a pass-through below unity. For aquavit, scotch whisky, gin, aniseed, other spirits, rum and genever the estimated pass-through is close to unity, while for Irish whiskey, vodka, cognac, other whisky, other brandy and fruit eaux de vie the estimates point towards over shifting of taxes onto prices.

4.3 Development in excise taxes on alcoholic beverages and price development in France, Poland and Spain

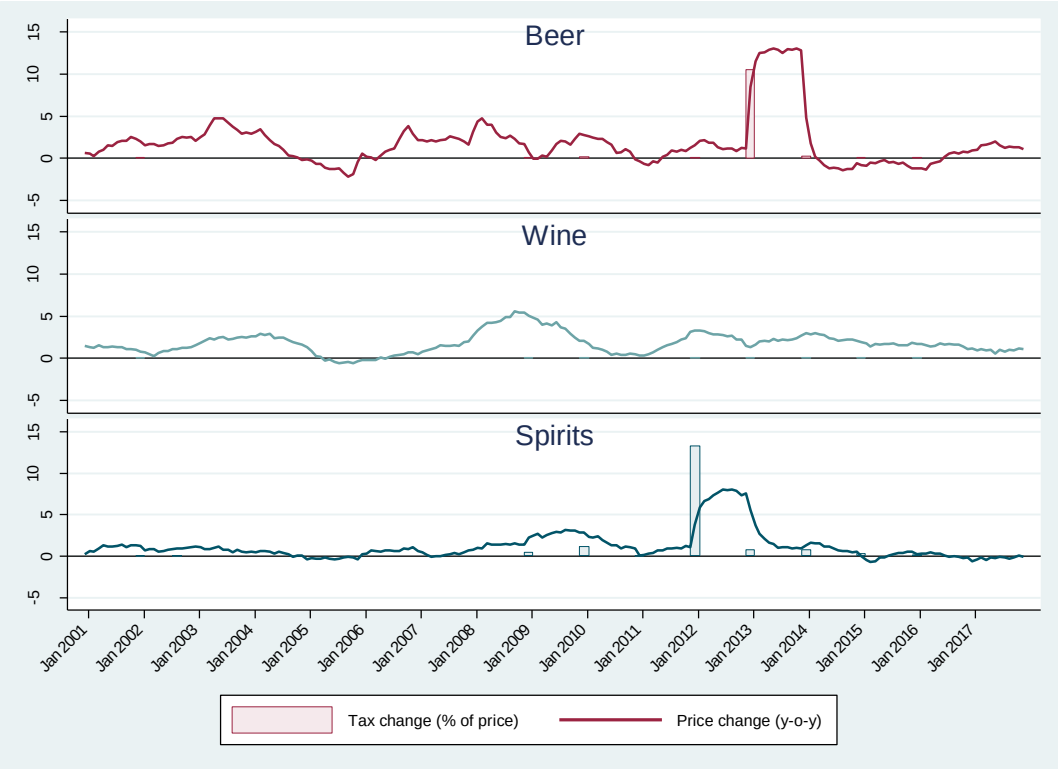
For the three countries which are in the focus of this study, i.e. for France, Poland, and Spain, we received additional price information from Nielsen. Specifically, we have monthly price data for off trade sales in broad drink categories. We use the price values for beer, wine, and the most consumed type of spirits (vodka for Poland, brown spirits for France and Spain) to define the tax change in percent of the price. In Figure 11 we present the development over the time period 2001 to 2017 for France. The upper graph in Figure 11 contrasts the development of the price changes against the changes in excise taxation. The lower graph in Figure 11 compares the development of the price indices to the price index for food and non-alcoholic drinks.

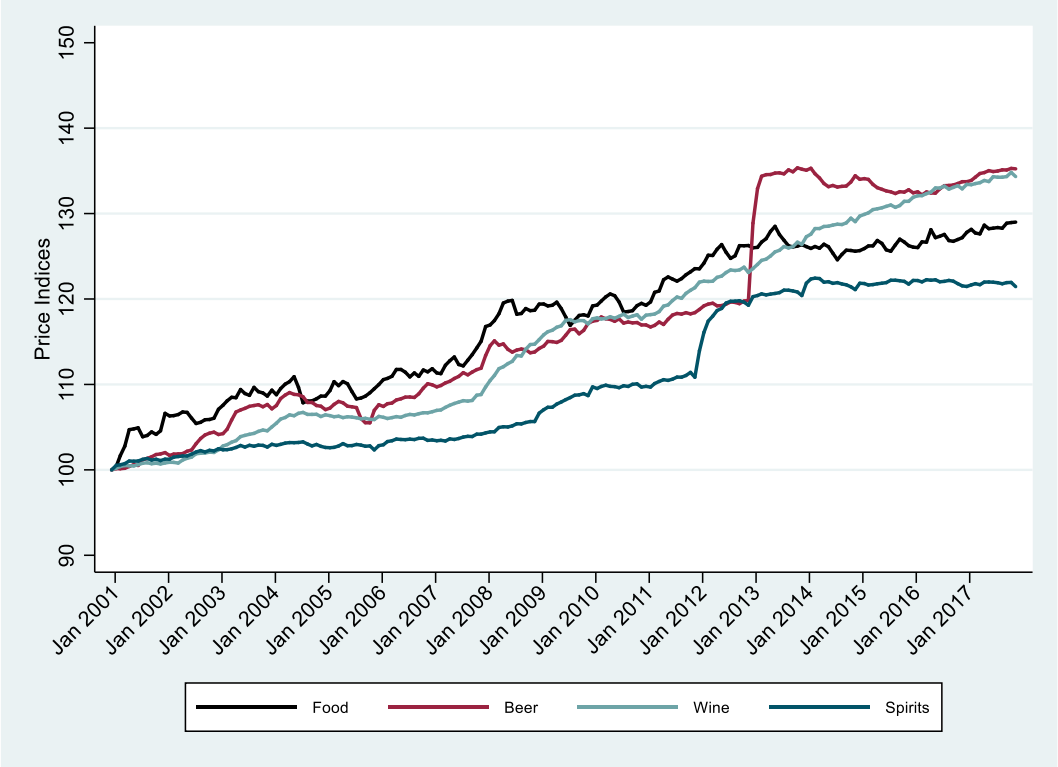
The top part of the upper graph shows the development of the beer price (year-on-year change in the CPI) and the changes in the excise taxation of beer. The substantial increase in the taxation of beer in January 2013 is clearly visible in the inflation rate for the following 12 months and suggests a slight over-shift of the tax burden. The middle part shows the development of the wine price and highlights once more that the excise taxation of wine is negligible in France. The lower part in the upper graph shows the development of the CPI for spirits and the corresponding tax rate changes. The substantial tax increase in January 2012 results in an increased inflation rate for the following 12 months, but it appears that this particular tax increase was not fully passed on to consumers.

The lower graph in Figure 11 compares the price changes of the three types of alcoholic beverages to the change in the price of food and non-alcoholic beverages. Up to 2012 the price index for food in France increased faster than for each of the three alcoholic beverages. The increase in the price index for food levelled off the recent years, while the price index for continued to increase. The prices indices for beer

and spirits both jumped in reaction to the respective tax increases and levelled-off in the following month. Overall, this resulted in a price index above the one for food and non-alcoholic drinks for both beer and wine, while the price index for spirits is below.

Figure 11: Prices and excise tax changes for alcoholic beverages in France

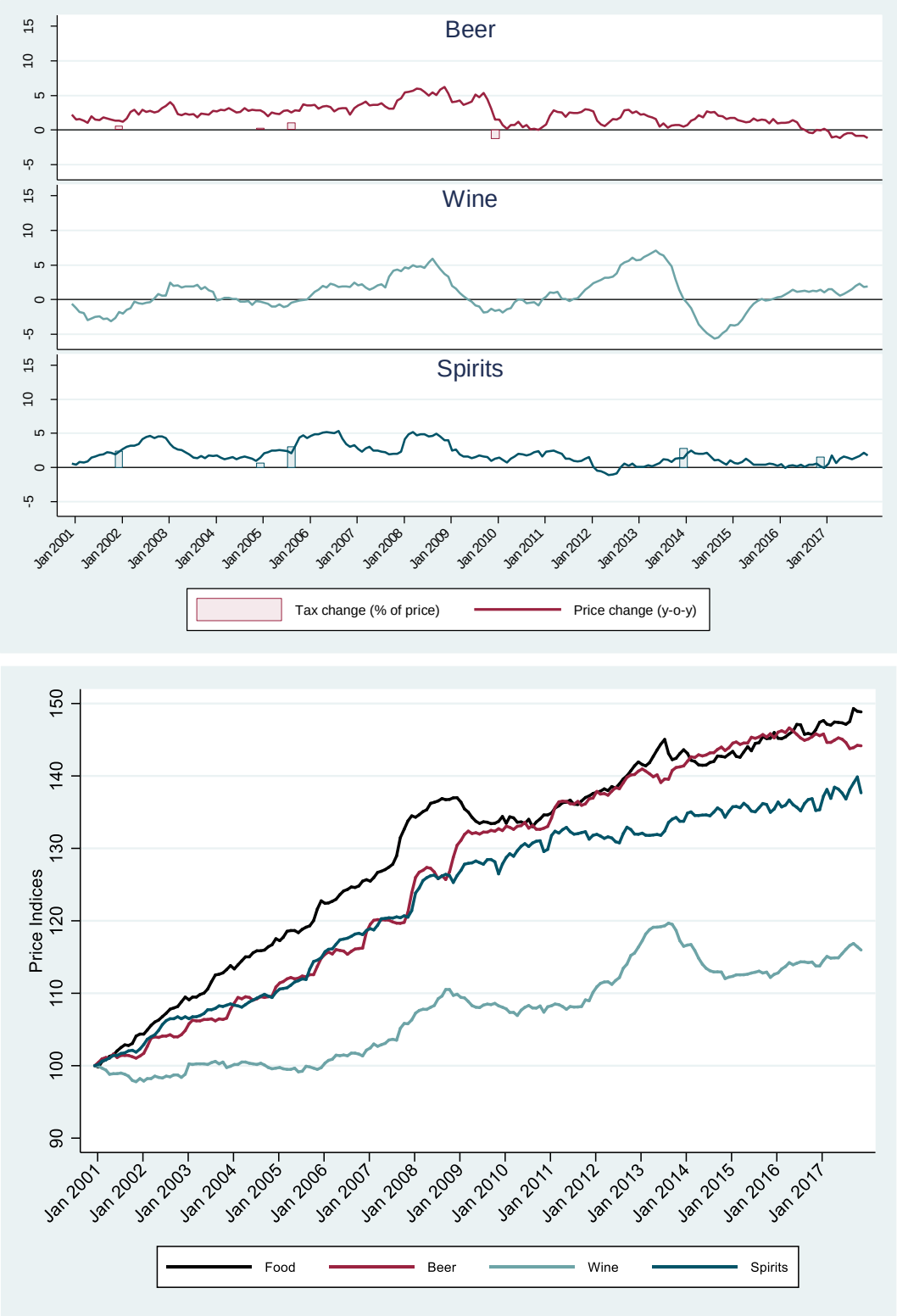




Source: own calculations based on Eurostat data.

Figure 12 repeats this exercise for the development of prices and excise taxation of alcoholic beverages in Spain.

Figure 12: Prices and excise tax changes for alcoholic beverages in Spain



Source: own calculations based on Eurostat data

The taxation of beer remained largely unchanged over the observed period, the slight reduction in January 2010 is followed by lower inflation rates for beer. This period, however, coincides with the recovery of the Spanish economy from the great recession and therefore the low inflation rate could be due to non-tax reasons. In Spain, no tax pass-throughs for wine can be analysed, because Spain levies no excise taxes on wine. The excise tax increases in Spain were less concentrated than in France. Moderate increases can be observed in January 2002, January 2005, September 2005, January 2014 and December 2016. All of these tax increases coincide with an increased inflation rate in the following twelve months, and the larger tax increases appear to have resulted in full pass-through to consumer prices.

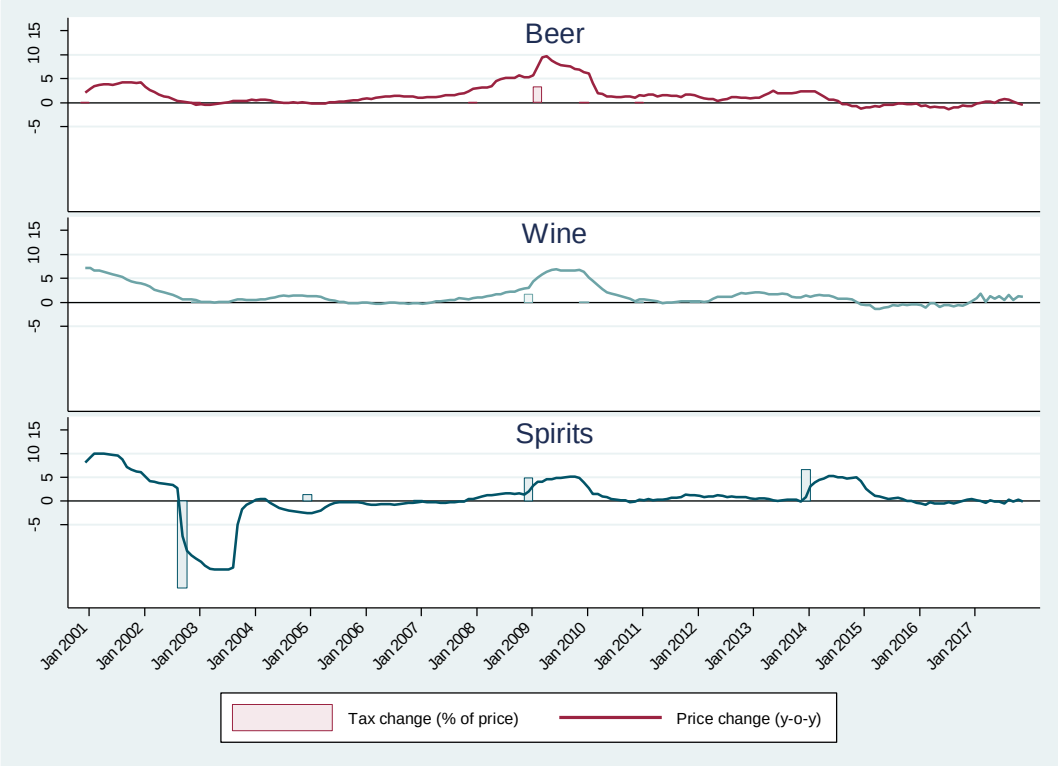
The lower part of Figure 12 compares the price indices of alcoholic beverages to the price index for food in Spain. Food prices increased faster in Spain up to 2009. The financial crisis resulted in a drop in food prices and a less steep increase during the recovery. In contrast, the beer price index continued to increase up to 2016 and only recently saw a moderate decline. Prices for spirits by and large followed the beer prices up to 2009 and then continued to increase at a lower rate. The prices for wine, in contrast, followed a completely different path and did not increase substantially between 2001 and 2007. The price increases between 2007 and 2009 and 2012 and 2014 were not strong enough to bring up the price index for wine to the price indices of food or the other alcoholic drinks. So overall, beer and food prices have increased relatively in Spain in the period 2001 to 2017, while wine has become cheaper compared to spirits.

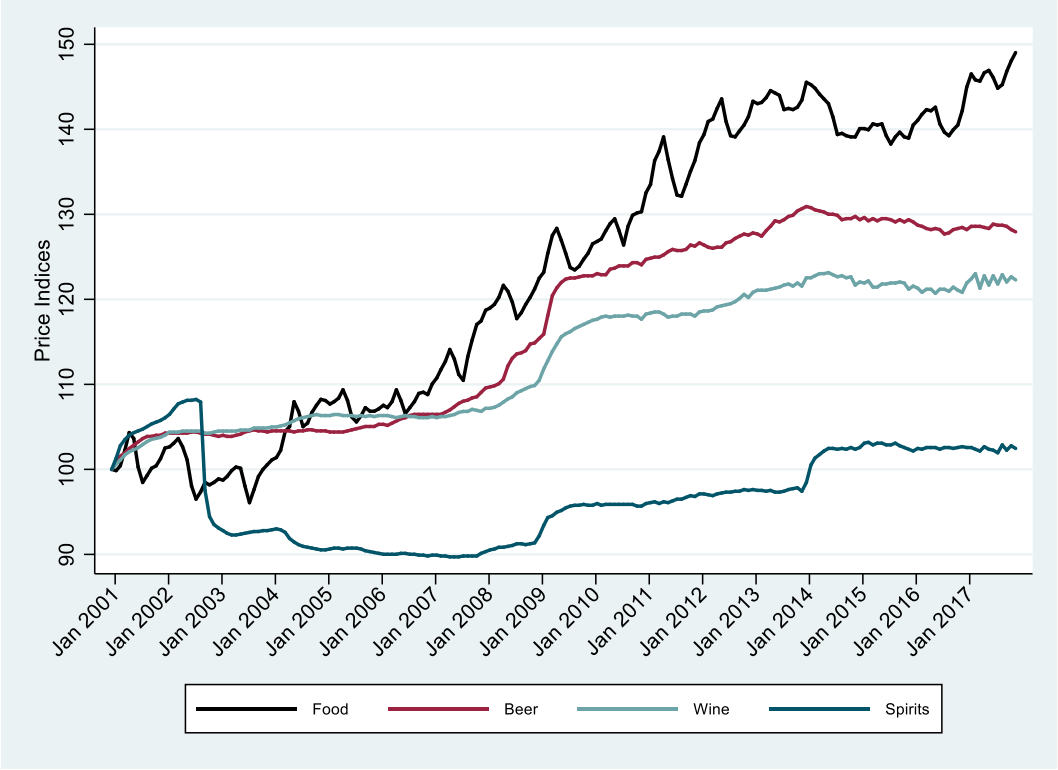
Figure 13 shows the development of prices of alcoholic beverages and their taxation in Poland. For beer and wine, the only relevant tax change was the increase in March, respectively January 2009. Both tax increases resulted in a significant increase in the inflation rate over the coming year, which suggests substantial over-shifting of the tax increase. For spirits there was a significant tax reduction in October 2002, which resulted in a substantial price drop. An incomplete pass-through of a tax decrease is constituent with patterns commonly found in the empirical literature.[20] The moderate tax increase in January 2005 was not passed through to consumer prices while the tax increase in January 2009 results in a price pattern which suggests an immediate and full pass-through. In contrast, the more substantial tax increase in January 2014 resulted in less than a full pass-through.

The lower part of Figure 13 shows that the food price index has increased much faster in Poland than the price index of any of the alcoholic beverages. The price index for spirits drops markedly with the reduction in the excise tax in 2003. Ever since the prices for spirits primarily jumped due to excise tax changes. In contrast prices for beer and wine roughly followed the trend of the food price index up to 2010. Over the last couple of years, the price increases for beer and wine were much lower than for food. So overall, the price indices for alcoholic beverages in Poland suggest that the producers were not able to pass to general inflation on to consumers recently.

[20] See Benedek et al. (2015) for a study on asymmetric pass-through of consumption taxes. Incidentally, the tax decrease in Poland 2002 was conditional on a price decrease of at least 20 %. Given that the drop in excise duty was approximately 30 %, an incomplete price pass-through was sufficient to meet the legal requirement to benefit from the tax decrease.

Figure 13: Prices and excise tax changes for alcoholic beverages in Poland





Source: own calculations based on Eurostat data.

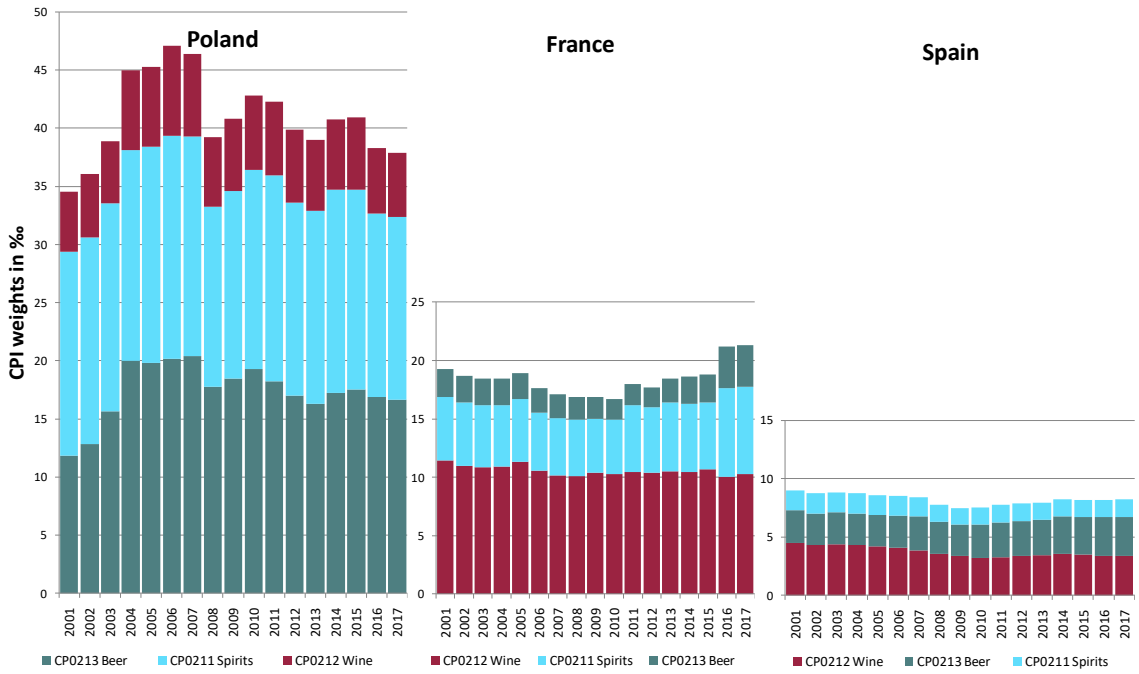
4.4 Towards consensus estimates of price pass-throughs for alcoholic beverages

The estimates for the pass-through of excise taxes seem partly contradictory. Estimates using the CPI price measures suggest a pass-through for spirits of less than 100 percent. In contrast, using the IWSR price data a full pass-through for spirits is found. Hence this subsection aims to reconcile these results. The short literature survey in section 2.1 shows that there is considerable heterogeneity in the results of empirical studies but confirms the tendency that the price pass-through for beer is more likely to be lower than 100 percent. Given the lack of other consistent evidence, the assumption of near perfect pass-through for wine also appears to be innocuous. For spirits, however, there is the issue to reconcile, whether taxes are fully pass-through to prices or not.

Some potential explanations for the finding of an imperfect pass-through can be found in the academic literature. For example, a recent paper by Ally et al. (2014) showed that the price pass-through is not necessarily symmetric, but rather likely varies by price category. Specifically, Ally et al. (2014) find that supermarkets in the UK tended to undershift the tax increases for cheap products, while for the more expensive products an over proportional price increase was found. These findings can be indirectly backed up by the findings from Conlon and Rao (2016) who stress the impact of 'sticky' prices in the context of tax pass-through. Simply put, retail prices are not set arbitrarily but rather at round numbers or at an amount just below the full dollar. This affects the price pass-through since for a small tax increase it may not be feasible to increase the price. However, with a higher initial price level of the alcoholic beverage it is more likely that a price increase to a round number is possible, even for smaller tax increases.

Another explanation for the finding of an imperfect pass-through with the CPI price data is due to composition effects in the CPI measure. Whenever consumers substitute from a product with high price increases to a product with relatively lower price changes, the consumption basket is not adjusted immediately. This bias in measuring the inflation due to this problem is called the substitution bias. However, the weights in the consumption basket are required to be updated on a yearly basis based on recent price changes in order for the HICP to remain representative of consumption patterns. While there are no weights at product or even brand level available, the development of the CPI weights at the alcoholic beverage type level in Figure 14 shows that there is significant variation in the weights over time. Given that the weights are derived from the household consumption surveys, which are executed every five years, and then price-updated based on recent price developments, we can interpret the weights as the expenditure shares.

Figure 14: CPI weights for alcoholic beverages (excl. restaurants and bars) in France, Poland and Spain



Source: Eurostat.

Beginning with Poland, which has the highest absolute expenditure share for alcoholic beverages, we see an increase for all three types of alcoholic beverages in 2004, followed by a clear drop in 2008.[21] Overall the expenditure shares for beer increased while the ones for spirits and wine fell to back to the (or below the) level of 2001. The consequence is that in recent years the expenditures for beer (16.66 ‰ in 2017) surpassed the expenditures for spirits (15.74 ‰ in 2017). In comparison the expenditure for wine in Poland was at 5.47 ‰ in 2017.

In France, wine remained the alcoholic beverage with the highest expenditure share, albeit with a moderate decline in importance from 11.44 ‰ in 2001 to 10.30 ‰ in 2017. In contrast, we can observe a moderate increase in the consumption expenditure for spirits (from 5.46 ‰ to 7.47 ‰) and beer (from 2.37 ‰ to 3.55 ‰). Notably, most of the increase is due to the change in 2011 and 2016.

Spain has the lowest overall expenditure shares for alcoholic beverages which partly reflect the low prices. Both wine (from 4.50 ‰ to 3.38 ‰) and spirits (from 1.73 ‰ to 1.49 ‰) saw a decline in expenditure share, while the expenditure share for beer increased from 2.76 ‰ in 2001 to 3.33 ‰ in 2017.

Combining the results of the estimations with the findings of the literature and the considerations about nominally rigid prices and composition effects in the price measures we aim to get a consensus estimate for the modelling in section 5. These values are collected in Table 10. For beer and wine, we have the main results from Table 8 to start with, namely a pass-through of around 0.9 for beer and roughly 1 for wine. The finding of a slight undershifting for beer is consistent with the literature, while there is not much evidence for price pass-through of excise taxation on wine. The country specific information in Figure 12 additionally suggests that the price pass-through for beer was less pronounced in Spain. Therefore, we

[21] While the weights – representing the share of expenditure – are adjusted yearly, the large changes reflect new rounds of the household budget survey in the respective countries. Especially for an Eastern European country like Poland, these changes in the consumption patterns are more pronounced, because of the recent transition to a market-based economy.

use 0.85 for the price pass-through for excise taxes on beer in Spain, while we use 0.9 for Poland. For France we saw even some overshifting of the large tax increase in 2013. At the same time, all the inflation adjustments in the more recent year were not passed through at all. We therefore also stick to the average pass-through for beer excise taxes of 0.9 for France. Given, we have no any additional information, we use the estimate from Table 8 to approximate the price-pass-through wine for all three countries with the value 1.

For the price pass-through for spirits we have several conflicting estimates. While the CPI based estimates suggests less than full pass-through, the estimates based on the prices derived from IWSR point towards full pass-through. Since the CPI measures can be affected by substitution effects between different drink types and different quality types, we put more emphasis on the IWSR estimates. Starting with the estimate of a full price pass-through we adjust the price-pass-through for France slightly to 0.95. This adjustment accounts for the fact, that the most consumed spirit types in France are Aniseed and Scotch whisky. For both spirit types the estimated pass-through is found to be slightly below 1.

For gin, the most consumed spirit type in Spain, the estimated price pass-through is very close to 1. Therefore, we do not adjust the overall price pass-through for Spain. In contrast, in Poland, the most consumed spirit type is Vodka, where the point estimate for the price-pass-through for Vodka would in principle call for a higher price pass-through. At the same time, the country specific information in Figure 13 does not support significant overshifting of excise taxation. Additionally, the issue of quality upgrading is particular pertinent in the situation of a lower price country like Poland and a potentially lower-priced drink like Vodka. Therefore, we use a price pass-through of only unity for spirits in Poland as well.

Table 10: Consensus estimates for price pass-through in France, Poland and Spain

	Price-pass-through for		
	Beer	**wine**	**spirits**
France	0.9	1.0	0.95
Poland	0.9	1.0	1.0
Spain	0.85	1.0	1.0

Source: own calculations and considerations based on IWSR data.

5 Estimation of price elasticities for France, Poland and Spain

In the empirical literature various econometric methods are used to estimate the elasticities of demand for alcoholic beverages with respect to price. Referring to the meta-study of Fogarty (2010) we may distinguish between

1) log-linear single equation models,
2) system-wide utility-based estimation approaches on cross-section or pooled data,
3) (pseudo-)panel data models,
4) time series models, and
5) selection models on cross-sectional or panel data.

The first method, the simplest and oldest approach, relates the logarithms of demand to the logarithm of price and some controls to obtain an estimate of the price elasticity (see for instance Stone, 1945 or Prest, 1949). However, these simple models have been superseded by the system-wide utility-based approaches, notably the Almost Ideal Demand System (AIDS) or Rotterdam, CBS or NBR models (see Duffy, 2001). These models use data on expenditure shares and prices (or unit values) of different products from household surveys and estimate a restricted demand system derived from economic theory. The main advantage of these models is the solid microeconomic theoretical background, while the major limitations are the data requirements. Since these systems are usually estimated including each product of a more general category (i.e. beverages), the prices and budget shares of all relevant complements and substitutes for each product of that category needs to be available. Based on the results obtained from these models, we are also under the impression that system-wide utility-based approaches yield overly elastic price elasticities. Such models can be estimated on either cross-sectional data, exploiting spatial price variation (see Deaton, 1990 or Chávez, 2016) or using a pool of consumption surveys from several years (see Aepli, 2014). Since the surveyed households change over the years, the resulting pool of data over several years does not result in a panel, where each individual (in this case the household) is observed throughout the years.

This feature of the data has led to the application of pseudo-panels (see Meng et al., 2014), where the individual units are constructed by taking averages over selected time-invariant characteristics (such as year of birth, gender, socio-economic group, etc.). The main advantage of the pseudo-panel approach is that it is easily implemented given data availability and the averaging over the defined stratum eliminates possible measurement errors in unit values used as approximation for prices. Disadvantages included that zero purchases are eliminated via averaging or dropped from the sample beforehand, and that potentially valuable information in the variation of prices and quantities among individual households is lost (see Pryce, 2016).

These shortcomings can be eliminated if proper panel data, i.e. the same individuals or households report their consumption over multiple periods, is available. Examples for studies including such data are Aguiar and Hurst (2007), Sharma, Vandenberg and Hollingsworth (2014) and Harding et al. (2012). They employed the Nielsen Company's HomeScan panel survey data that tracks the product codes of each purchase of a large number of individuals over time along with some fundamental socio-economic data. Such data allows for a proper handling of quality (since unique product codes are available), controlling for unobserved individual characteristics (preferences and behaviour) and common time effects (such as Christmas). The main limitation is that such data is rarely available for research. The authors of this study failed to get access to such a detailed dataset for France, Poland and Spain.

Another method that has become popular with the availability of better data is time series models, such as error correction models (see Johnson et al., 1992). These methods particularly address the problem of spurious correlation, i.e. a significant effect of a variable on another that is mainly driven by a common unobserved trend in both variables. The main limitation of these approaches, besides data availability, is that important control variables such as income are potentially unavailable for higher frequency data (monthly and weekly). For this reason, we decided against this method for estimation of price elasticities, even though time series data from AC Nielsen was available.[22] As shown in the literature review section, estimates of time series models on average point to very inelastic price reactions for alcoholic beverages, especially when compared to system-wide utility-based approaches.

The fifth method comprises all approaches related to household consumption data that control for zero-consumption via one or more selection mechanisms (see Angulo et al., 2001). Famous examples within this family of models include the Heckman Selection model (see Heckman, 1979), the double-hurdle or the infrequent purchase model (see for example Blundell and Meghir, 1987). These models are particularly popular for researchers analysing survey data on consumption of households, where members are asked to record the monetary value and quantity of items they purchased during some period, usually a week or two. Data on such surveys usually contains a large number of observations with zero purchases for particular products. The decision not to purchase might either 1) reflect the fact that there was no desire for that particular product during the one to two weeks where the consumption diary is recorded (infrequent purchase), 2) represent a fundamentally non-economic decision of the household motivated by ethical, psychological or social considerations altering the consumer's preferences (abstainer), 3) or be motivated by economic reasons such as the price of the product or the available income.

5.1 Empirical approach

To estimate the price elasticities of the alcoholic beverages we will rely on the Household Budget Survey of the three countries that are available either annually (Poland and Spain) or every five years (France). The dataset thus consists of a large number of households that are pooled over several years, without an explicit panel structure, since the specific households covered by each survey wave differ. Given this data source the econometric methods available are the system-wide utility-based estimation approaches and selection models. We will apply these two methods for estimating the price elasticities for Spain and Poland. Due to data restriction, we revert to simpler OLS for estimation of French price elasticities.

The advantage of the two-step estimation procedures is that it allows estimating the influence of certain variables and characteristics such as income, gender and education on the decision to consume and the amount consumed separately. Furthermore, the price elasticities for each alcoholic beverage are estimated separately, and the second stage (modelling the amount consumed) is restricted to households with non-zero consumption of the respective alcoholic beverage. By contrast, the demand system jointly estimates the own- and cross-price elasticities of all alcoholic beverages (and soft drinks) on a sample of all households with a non-zero consumption in at least one of the alcoholic beverages. The two methods are thus applied to different samples, with the two-stage procedure yielding estimates on the price elasticity of a specific beverage only for the sub-population of the sample that consumes that specific beverage. The resulting elasticities of the demand system implicitly capture the price effects on households that do not purchase one or more alcoholic beverages. Therefore, if we assume that the price

[22] We estimated a number of time series models (results are not reported), but obtained largely positive or insignificant own-price elasticities.

also exerts an effect at the extensive margin, i.e. the decision to consume a good, we may expect that the QAIDS will result in more price sensitive estimates.

The two-step estimation procedure will be estimated on a number of sub-samples of the data. In a first series of estimations, we estimate the price elasticities for (1) all household, (2) households with up to 3 adults, (3) up to 2 adults, (4) one adult and (5) single households (i.e. adult with no kids). This procedure ensures that we transparently show the effects of the trade-off between a large sample (all households) and the ability of the sample to enable identification of individual price elasticity (one adult households). As can be seen in the result tables below, limiting the sample to households with one adult or singles usually results in a sufficient number of observations for beer and wine, but the sample size rapidly declines for other wines (sparkling, …) and spirits.

In the second series of estimations we divide the sample based on the drinking behaviour of the households. Categorizing light, moderate and heavier drinking is a tedious task, since alcoholic beverages differ substantially in their alcoholic content, even within beverage category (see Dufour, 1999). Furthermore, there is no international consensus[23] on how much grams of alcohol per day is considered moderate. In this study we stick to the definition given in Aepli (2014) that is based on Swiss standards. Hence, we define light drinkers as consumers of < 20 grams, moderate 20-39 grams and heavy >40 grams pure alcohol per person per day. We convert the consumed litres of alcoholic beverage to pure grams of alcohol assuming 86.9 grams pure alcohol per litre for wine, 37.9 grams for beer and 316 grams for spirits. Limiting the sample further to just one adult household in order to get a closer approximation to an individual price elasticity would result in a very small sample size. We therefore decided against a further breakdown of the sample, which means that the definition of light, medium and heavy drinker refer to the average person of a household. For example, being classified as a heavy drinking household in a household with three adults of which two are abstainers, would require the third adult to consume more than 120 grams of pure alcohol per day, while based on an individual definition this third adult would be classified as a heavy drinker when consuming more than 40 grams. Using average household consumption for households of more than one adult to define drinking behaviour should therefore underestimate the proportions of medium and heavy drinkers.

In the third series of estimations, we split the sample into the four income quartiles, using the reported household income, and estimate the price elasticities for each income quartile. Again, we do not further restrict the sample to one adult households due to sample size restrictions.

Household Budget Surveys (HBS)

National Statistical Offices of the member countries of the European Union regularly (annually or every five years) carry out household budget surveys, where the statistical units of interest are a representative number of private households. The aim of the HBS is to provide information about household final consumption expenditure on goods and services (by detailed COICOP classification), as well as information on income, demographic and socio-economic characteristics. One of the prime objectives is to collect information on household consumption expenditure for use in updating the 'weights' for the basket of goods used in the Consumer Price Indices and the harmonised index of consumer prices at an EU level (see Eurostat, 2010). Additionally, the data collected via the HBS gives insights into the living conditions of private households and may be used to study the distribution of income/consumption and poverty.

The HBS unit of observation for expenditures and quantities of specific products is the household, i.e. we cannot identify individual consumption behaviour but only the purchasing decisions taken by all members

[23] For a list of thresholds per country see www.iard.org/policy-tables/drinking-guidelines-general-population/.

of the household. Most countries further collect monthly household income, regional information (NUTS, size of municipality, population density …), and household size, among others. Additionally, to the information recorded at the household level, information on demographics and socio-economic status, such as age, gender, education, employment status, occupation, monthly income, main source of income, etc. are collected for each household member level. In order to link this information to the respective households, we use the data for the "household reference person", that is, the person aged 16 or more who most contributes to the household income (see Eurostat, 2010).

Since the consumption of food and beverages is only recorded during a specific period of between one to two weeks, the HBS usually include weights for each household that may be used to calculate the figure representative for the yearly consumption of that particular household type. Household stratification is usually done via region, household size and some socio-economic characteristics. In the following estimations we will use the consumption a particular household recorded multiplied by the respective temporal weight factor, i.e. for biweekly consumption diaries we multiply the recorded values by 26 to obtain an estimate of yearly consumption.

The goods and services are recorded in the Classification of Individual Consumption by Purpose (COICOP) that allows the identification of the off-trade consumption of beer (including non-alcoholic), still wine, other wine (including Cava, Champagne, Málaga, Moriles, Montila, Oloroso, Amontillado and Moscatel) and spirits and liquors (including non-alcoholic). However, all on-trade consumption of alcoholic beverages is contained within the COICOP groups covering expenditures on restaurants and bars, that does not allow a further disaggregation with respect to alcoholic beverage. Hence, the following estimations only relate to off-trade consumption of alcoholic beverages.

A standard item that is recorded in each HBS and in every wave is the consumption expenditures by households of detailed products and services. However, the HBS in some countries and for some survey waves (especially older vintages) do not contain data on quantities purchased. For instance, our data on Spain and Poland covers quantities in all of the ten years of HBS used, while the HBS of France only started recording quantities (or at least providing the respective files for scientific use) from 2010 onwards. Since we need total expenditures and quantities to derive unit values that can be used as an approximation for the product price, we only employ the cross-section of the 2010 HBS wave of France for the estimations, while we can use the full pooled 10-year HBS waves for Spain and Poland.

Derivation of Prices

The first challenge when using household consumption data is the derivation of unit prices, i.e. in our case the price per litre of beer, still wine, other wine and spirits. Given that the respective HBS contains data on both expenditures and physical quantities, it is possible to divide one by the other to obtain unit values. However, we cannot simply take these unit values for demand analysis for at least two[24] reasons. Most importantly, differences in unit values may reflect different product qualities (see Deaton, 1988), a problem that is particularly severe for wine. The widely adopted empirical approach to remedy this problem is to use the variation in unit values that is unexplained[25] by household and household member characteristics that serve as an approximation for quality (see Angulo, Gil and Gracia, 2001 based on Gao, Wales and Cramer, 1995). Characteristics commonly employed here include the income and socio-economic characteristics such as education or the main source of income, i.e. salary, self-employed, capital income, unemployment benefits, etc. The main shortcoming of this approach is that it only delivers

[24] Another reason not discussed in more detail here includes measurement errors in the reported expenditures and quantities.

[25] This is done via a hedonic price model, regressing the unit values on characteristics

quality-adjusted unit values for households that consume the product in question. Hence, this may substantially reduce the sample size in estimations including cross-price elasticities, since only households that report non-zero consumption for each product considered can be included.

A second approach is to exploit the spatial and time variation of the data and calculate average prices per region-year cell. The assumption underlying this approach is, that geography, transport infrastructure, institutions, the local competitive situation and market structure determine differences in prices within the country (see Deaton, 1988). This assumption is also the main caveat of this approach, since it may be very likely to hold in developing countries but may be violated in developed economies with high quality infrastructure and functioning antitrust agencies. The main advantages of identifying prices via spatial variation are first, that an average price that is also less prone to measurement error and second that it can be applied to each observational unit in the region, without the loss of households with zero consumption on some alcoholic beverages. We will follow this approach as described in Aepli (2014), who estimated alcohol price elasticities for Switzerland.

5.2 Spanish price elasticities for alcoholic beverages

To estimate the price elasticities of beer, wine and spirits in Spain we use data from the Spanish Budget Household Survey for the years 2006-2015. The distribution of prices using the method outlined in Aepli (2014) can be found in Appendix B. In the following we present the summaries of the results of the two-stage Heckman estimations, reporting only the second stage[26] price and cross-price elasticities for beer, still wine, other wine and spirits. Besides the four alcoholic beverages, we also include the price of soft[27] drinks (other beverages, COICOP 01.2.2.2.), since these drinks can be regarded as substitute or complement (for mixed drinks). A description of all variables included and a summary of their impacts in both stages of the decision process is given in Appendix C. Prior to the estimations we discarded observations of households with more than five members aged 18 and above as well as the top and bottom 5% of observations with respect to the quantity of the respective alcoholic beverage consumed per adult. The dependent variable is the logarithm of the quantity purchased per household member aged 18 and above of the respective alcoholic beverage. All prices are included in logarithms as well, to enable the interpretation of the resulting coefficients as elasticities.

The results of the price elasticities using the two-stage Heckman selection model are reported separately for each alcoholic beverage group (beer, wine still, wine other and spirits) per household size, income group and drinking behaviour.[28] Table 11 shows the own price and cross-price elasticities of Spanish beer consumption by household size. Column (1) reports the results when including all Households with up to five members aged 18 and above, which leaves us with approximately 80,000 household-year observations that recorded non-zero amounts of beer (second stage). The own-price elasticity with -1.25 is rather larger compared to the empirical results of the international literature. The only statistically significant cross-price elasticity is that for still wine, which is negative and thus points towards beer and wine being complements rather than substitutes. Columns (2) to (4) repeat this analysis on samples restricted to up to 3, up to 2 and one adult (i.e. aged above 18) Households respectively. Eliminating larger households for one reduces the sample size, but it also eases the interpretation of the resulting price

[26] Detailed estimation results for the first (decision to buy) and second (decision on quantity) are available from the authors upon request.

[27] However, we do not include prices of coffee, tea, cocoa, mineral water, fruits and vegetable drinks as potential complements or substitutes.

[28] Drinking behaviour is defined as total alcohol consumed (sum of alcohol in grams of all alcoholic beverages consumed) per adult person in household per day.

elasticity. Since we only observe the total consumption of alcoholic beverages at the household levels, results on samples with households consisting of fewer members of drinking age, more closely resemble individual price elasticities. The corresponding own-price elasticity of beer declines gradually to a value of -0.68 for one-adult households. Restricting the analysis further to single households (one adult with no kids) results in an elasticity of -0.52.

Table 12 shows the results per drinking behaviour and income group. We do not split up the sample further according to household size as before, since the sample size for the specific strata would be too small for robust inference. The absolute values of the resulting elasticities should therefore not be interpreted at face value, but rather relative to the results of the respective comparison group (i.e. income or drinking behaviour). The results in Columns (1) to (3) would thus indicate somewhat smaller own-price elasticity for heavy drinkers of beer compared to medium and light drinkers. Medium drinkers view spirits as a substitute, while for light drinkers wine acts as a complement. Columns (4) to (7) show the price elasticities by income quartiles, with IncQ1 being the poorest and IncQ4 being the richest income group. Consumption of beer seems to be slightly more unresponsive in the poorest and richest quartile.

The results for Spanish own-price and cross-price elasticities by household size for still wine are summarized in Table 13. Contrary to the own-beer price elasticities, the wine price elasticities are rather stable over different household sizes and amount to between -0.13 and -0.22. Spirits seem to be a complement to wine. The price elasticities for Spanish still wine consumption by drinking behaviour and income group are given in Table 14. Contrary to the beer consumption pattern (see above), only the light drinking households show a significant own-price elasticity of -0.2. For these households, soft drinks are viewed as a substitute. Spirits are a complement and beer seem to be a strong substitute for medium drinkers. The results in Columns (4) to (7) indicate that the price responsiveness of still wine consumption declines with increasing income. While the poorest household quartile shows a statistically significant own-price elasticity of still wine of -0.31, the price elasticity of the richest quartile is statistically insignificant at -0.05. Overall the results suggest that still wine in Spain is consumed along with spirits and that the price elasticity of wine is rather low in Spain. The latter result may stem from the fact that the price of Spanish bottle of wine is relatively low compared to international standards.

Table 15 contains the results of own- and cross-price elasticities for spirits consumed in Spain by household size. The sample size for one adult and single households is very small yielding larger standard errors and partially statistically insignificant results. Focussing on Columns (1) to (3), it can be seen that Spanish consumer respond very strongly to price changes of spirits, with own-price elasticities of between -1.14 to -1.26. The results suggest that beer can be viewed as a complementary drink to spirits. Table 16 shows the results by drinking behaviour and income group. The own-price elasticity of spirits drops from -1.27 for light, to -0.48 for medium and a statistically insignificant -0.28 for heavy drinkers. The results thus suggest that heavy drinkers are essentially unresponsive to price changes when it comes to hard liquor. Compared among different income groups, it is found that the price responsiveness increases, even though not monotonically, with income. Besides beer (see also Table 15), more or less robust and significant substitutes or complements cannot be found for Spanish spirits.

Table 17 summarizes the results of the price elasticities of Spanish consumption of other wines by household size. We focus the discussion of the results on Columns (1) to (3), as the sample size of one adult and single households with non-zero consumption of other wines is too small for robust inference. The own price elasticity of other wines ranges from -0.32 to -0.35 and beer as well as spirits seem to be strong complements with cross-price elasticities of -0.89 to -1.68. The results by drinking behaviour and

income group do not offer strong[29] additional insights. Overall the results suggest that other wines, such as champagne and cava, are usually consumed together with beer and spirits.

The results for the price elasticities of soft drinks are given in Table 48 and Table 49 in Appendix D. To summarize, the own price elasticities of soft drinks lie between -0.38 and -0.64 and beer, wine and to some extent other wines are complements. However, we do not find robust evidence for a complementarity with spirits, as could be expected in case of mixed drinks consumption.

The separate results from the two-stage Heckman selection regressions can be compared to the results of the full demand-system estimation in Table 19. We restricted the sample to households with non-zero consumption in at least one alcoholic beverage. Therefore, the sample just includes households that purchase alcoholic beverage just as in the two-stage estimations, but it also includes households with zero consumption in some of the alcoholic beverages. Thus, the resulting elasticities also implicitly include an extensive margin, i.e. they also depict the impact of price of for instance beer on households that only purchase wine and/or other wines and/or spirits. The own-price elasticities beer, still wine, other wines and spirits are -1.34, -0.71, -0.64 and -1.92, respectively and thus somewhat larger (in absolute values) than the ones from the two-stage estimations, hinting towards the additional negative impact on prices for the decision to consume a specific alcoholic beverage.

The QAIDS estimation results in several significant coefficients on cross-price elasticities. We will focus on those with higher values, i.e. those that are economically more important regarding their impact. Increasing the price of beer by one percent results in an increase of soft drinks by half a percent. Raising wine prices by one percent reduces soft drink consumption by a quarter percent. Beer consumption reduces by around three quarter of a percent for each one percent increase in the price of other wine, whereas wine consumption increases by nearly half a percent. This means that other wine acts as a complement to beer but a substitute to wine. Raising spirit prices by one percent would decrease wine consumption by a bit more than a third of a percent but increases soft drink consumption by more than half of a percent. An increase of the price of soft drinks by one percent will increase beer consumption by half a percent, decrease wine purchases by a third percent and increases spirits consumption by a fifth percent.

The QAIDS estimation results allow the recovery of income elasticities of the alcoholic beverages. These elasticities are respectively 0.83 for beer, 0.93 for wine, 1.34 for other wine and 1.77 for spirits. Hence, the results suggest wealthier households allocate a larger share of their budget on alcoholic beverages to other wine and spirits.

[29] The results may suggest that only light drinkers respond to price changes, since the coefficients on medium and heavy drinkers are statistically insignificant at conventional levels. However, the larger standard errors for the latter two groups may be a result of the smaller sample size.

Table 11: Spanish Beer Price elasticities by Household Size

	(1) All	(2) up to 3 Adults	(3) up to 2 Adults	(4) one Adult	(5) Single HH
Beer own-price	-1.245 (0.0676)***	-1.150 (0.0716)***	-0.994 (0.0805)***	-0.672 (0.148)***	-0.524 (0.140)***
Wine (still) cross-price	-0.208 (0.0281)***	-0.237 (0.0298)***	-0.272 (0.0335)***	-0.117 (0.0634)	-0.0746 (0.0598)
Other wine cross-price	-0.0237 (0.0210)	-0.00948 (0.0222)	-0.0214 (0.0250)	0.0137 (0.0466)	-0.00708 (0.0442)
Spirit cross-price	-0.0163 (0.0422)	0.00153 (0.0447)	-0.0539 (0.0501)	-0.0932 (0.0949)	0.0848 (0.0905)
Soft Drinks cross-price	-0.0820 (0.0751)	-0.216 (0.0794)**	-0.245 (0.0889)**	-0.0181 (0.164)	-0.00521 (0.155)
Observations (1st stage)	190,310	170,812	133,016	30,153	26,404
Observations (2nd stage)	80,698	69,405	49,900	7,370	6,273

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Spanish HBS 2006-2015.

Table 12: Spanish Beer Price elasticities by drinking behaviour and income group

	(1) Light	(2) Medium	(3) Heavy	(4) IncQ1	(5) IncQ2	(6) IncQ3	(7) IncQ4
Beer own-price	-1.153	-1.399	-1.007	-1.161	-1.320	-1.486	-1.039
	(0.0726)***	(0.162)***	(0.252)***	(0.142)***	(0.132)***	(0.131)***	(0.136)***
Wine (still) cross-price	-0.239	-0.101	0.0588	-0.350	-0.187	-0.0982	-0.219
	(0.0301)***	(0.0674)	(0.108)	(0.0598)***	(0.0546)***	(0.0557)	(0.0556)***
Other wine cross-price	-0.0173	-0.0682	-0.0542	-0.0129	0.00945	-0.0568	-0.0444
	(0.0225)	(0.0497)	(0.0792)	(0.0450)	(0.0421)	(0.0414)	(0.0397)
Spirit cross-price	-0.0611	0.694	0.270	-0.144	0.0673	-0.0304	0.0270
	(0.0452)	(0.101)***	(0.158)	(0.0928)	(0.0852)	(0.0818)	(0.0790)
Soft Drinks cross-price	-0.0527	-0.121	-0.893	0.0678	-0.173	0.0668	-0.345
	(0.0805)	(0.179)	(0.279)**	(0.162)	(0.148)	(0.147)	(0.144)*
Observations (1st stage)	171,385	13,317	5,608	47,976	47,787	47,364	47,183
Observations (2nd stage)	68,372	9,036	3,290	15,666	19,775	21,805	23,452

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Spanish HBS 2006-2015.

Table 13: Spanish Wine (still) Price elasticities by Household Size

	(1) All	(2) up to 3 Adults	(3) up to 2 Adults	(4) one Adult	(5) Single HH
Beer cross-price	-0.00681 (0.0668)	-0.0204 (0.0705)	0.0158 (0.0790)	-0.0601 (0.128)	0.0767 (0.119)
Wine (still) own-price	-0.175 (0.0287)***	-0.198 (0.0302)***	-0.227 (0.0338)***	-0.132 (0.0574)*	-0.175 (0.0529)***
Other wine cross-price	0.0449 (0.0205)*	0.0391 (0.0216)	0.0409 (0.0243)	0.0254 (0.0407)	0.0493 (0.0377)
Spirit cross-price	-0.634 (0.0415)***	-0.602 (0.0438)***	-0.554 (0.0492)***	-0.206 (0.0844)*	-0.160 (0.0785)*
Soft Drinks cross-price	0.182 (0.0744)*	0.112 (0.0784)	0.0239 (0.0878)	0.0449 (0.146)	0.231 (0.135)
Observations (1st stage)	191,230	171,694	133,761	30,327	26,494
Observations (2nd stage)	72,614	62,584	45,018	7,082	6,271

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Spanish HBS 2006-2015.

Table 14: Spanish Wine (still) Price elasticities by drinking behaviour and income group

	(1) Light	(2) Medium	(3) Heavy	(4) IncQ1	(5) IncQ2	(6) IncQ3	(7) IncQ4
Beer cross-price	0.0990	1.101	0.308	-0.185	0.267	-0.340	0.160
	(0.0691)	(0.160)***	(0.238)	(0.136)	(0.129)*	(0.132)**	(0.138)
Wine (still) own-price	-0.200	-0.115	-0.0444	-0.311	-0.218	-0.150	-0.0478
	(0.0297)***	(0.0671)	(0.0995)	(0.0585)***	(0.0556)***	(0.0578)**	(0.0580)
Other wine cross-price	0.0324	0.110	0.292	-0.00889	0.117	0.0785	-0.0167
	(0.0211)	(0.0486)*	(0.0767)***	(0.0427)	(0.0402)**	(0.0410)	(0.0400)
Spirit cross-price	-0.627	-0.479	-0.498	-0.582	-0.646	-0.697	-0.600
	(0.0427)***	(0.100)***	(0.146)***	(0.0888)***	(0.0828)***	(0.0816)***	(0.0797)***
Soft Drinks cross-price	0.232	-0.0342	0.371	0.644	0.183	0.188	-0.226
	(0.0770)**	(0.176)	(0.264)	(0.154)***	(0.146)	(0.149)	(0.147)
Observations (1st stage)	171,816	15,182	4,232	48,136	48,059	47,659	47,376
Observations (2nd stage)	58,201	11,372	3,041	14,894	17,888	19,246	20,586

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Spanish HBS 2006-2015.

Table 15: Spanish Spirits Price elasticities by Household Size

	(1) All	(2) up to 3 Adults	(3) up to 2 Adults	(4) one Adult	(5) Single HH
Beer cross-price	-0.578 (0.139)***	-0.611 (0.154)***	-0.454 (0.180)*	-0.515 (0.453)	-0.0130 (0.174)
Wine (still) cross-price	-0.0779 (0.0577)	-0.118 (0.0639)	-0.253 (0.0748)***	-0.336 (0.206)	-0.0799 (0.0765)
Other wine cross-price	0.0553 (0.0417)	0.0855 (0.0463)	0.0572 (0.0550)	0.119 (0.146)	0.0267 (0.0570)
Spirit own-price	-1.259 (0.0850)***	-1.156 (0.0949)***	-1.139 (0.112)***	-0.814 (0.310)**	-0.154 (0.120)
Soft Drinks cross-price	0.432 (0.153)**	0.267 (0.169)	0.167 (0.199)	0.753 (0.522)	0.152 (0.196)
Observations (1st stage)	196,203	175,985	136,643	30,909	27,007
Observations (2nd stage)	28,785	23,174	14,727	1,541	1,218

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Spanish HBS 2006-2015.

Table 16: Spanish Spirits Price elasticities by drinking behaviour and income group

	(1) Light	(2) Medium	(3) Heavy	(4) IncQ1	(5) IncQ2	(6) IncQ3	(7) IncQ4
Beer cross-price	-0.154	-0.261	-0.588	-0.894	-0.0535	-0.853	-0.643
	(0.155)	(0.310)	(0.313)	(0.303)**	(0.279)	(0.264)**	(0.269)*
Wine (still) cross-price	-0.134	0.102	0.121	-0.0550	-0.0301	0.0161	-0.191
	(0.0636)*	(0.129)	(0.137)	(0.130)	(0.115)	(0.112)	(0.107)
Other wine cross-price	0.0690	0.111	0.0592	0.0919	0.00514	0.0248	0.0935
	(0.0453)	(0.0959)	(0.102)	(0.0970)	(0.0853)	(0.0799)	(0.0748)
Spirit own-price	-1.273	-0.477	-0.288	-0.955	-1.121	-1.465	-1.310
	(0.0928)***	(0.197)*	(0.201)	(0.201)***	(0.179)***	(0.161)***	(0.150)***
Soft Drinks cross-price	0.481	-0.0660	0.115	0.823	0.357	-0.0184	0.512
	(0.168)**	(0.347)	(0.351)	(0.349)*	(0.308)	(0.295)	(0.279)
Observations (1st stage)	174,296	15,750	6,157	49,347	49,261	48,942	48,653
Observations (2nd stage)	19,986	6,288	2,511	4,703	6,809	8,141	9,132

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Spanish HBS 2006-2015.

Table 17: Spanish Other wine Price elasticities by Household Size

	(1) All	(2) up to 3 Adults	(3) up to 2 Adults	(4) one Adult	(5) Single HH
Beer cross-price	-0.988 (0.233)***	-0.886 (0.249)***	-0.952 (0.281)***	0.640 (0.826)	0.426 (0.318)
Wine (still) cross-price	0.0384 (0.0964)	-0.0314 (0.103)	-0.128 (0.115)	-0.159 (0.364)	-0.0519 (0.138)
Other wine own-price	-0.321 (0.0722)***	-0.350 (0.0773)***	-0.340 (0.0882)***	0.0156 (0.284)	-0.00857 (0.110)
Spirit cross-price	-1.650 (0.130)***	-1.683 (0.140)***	-1.460 (0.159)***	-0.0696 (0.534)	-0.0638 (0.209)
Soft Drinks cross-price	-0.155 (0.256)	-0.268 (0.274)	-0.276 (0.310)	-0.194 (0.929)	-0.244 (0.353)
Observations (1st stage)	199,195	178,421	138,418	31,375	27,418
Observations (2nd stage)	13,808	11,614	7,965	1,001	889

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Spanish HBS 2006-2015.

Table 18: Spanish Other wine Price elasticities by drinking behaviour and income group

	(1) Light	(2) Medium	(3) Heavy	(4) IncQ1	(5) IncQ2	(6) IncQ3	(7) IncQ4
Beer cross-price	-0.681	-0.913	-0.524	-0.991	0.171	-1.995	-1.003
	(0.263)**	(0.971)	(0.743)	(0.554)	(0.476)	(0.441)***	(0.442)*
Wine (still) cross-price	0.0865	-0.156	0.256	-0.216	-0.161	0.221	0.256
	(0.109)	(0.396)	(0.303)	(0.238)	(0.193)	(0.185)	(0.180)
Other wine own-price	-0.352	-0.0211	-0.294	-0.212	-0.436	-0.271	-0.346
	(0.0808)***	(0.303)	(0.241)	(0.180)	(0.146)**	(0.138)*	(0.133)**
Spirit cross-price	-1.552	-1.735	-0.900	-0.540	-1.641	-1.843	-2.130
	(0.145)***	(0.555)**	(0.466)	(0.316)	(0.273)***	(0.250)***	(0.238)***
Soft Drinks cross-price	-0.388	0.783	-1.445	0.714	-0.322	-0.685	-0.342
	(0.289)	(1.064)	(0.797)	(0.614)	(0.529)	(0.482)	(0.476)
Observations (1st stage)	175,740	15,972	7,483	49,987	50,043	49,706	49,459
Observations (2nd stage)	10,146	2,381	1,281	2,361	3,218	3,817	4,412

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Spanish HBS 2006-2015.

Table 19: Uncompensated price elasticities and income elasticities for Spain

	Beer		Wine (still)		Other Wine		Spirits		Soft Drinks	
Beer	-1.339		0.001		-0.069		0.084		0.492	
	(0.102)	***	(0.053)		(0.031)	**	(0.049)	*	(0.085)	***
Wine (still)	-0.028		-0.708		0.062		-0.023		-0.231	
	(0.049)		(0.052)	***	(0.019)	***	(0.027)		(0.046)	***
Other Wine	-0.770		0.458		-0.649		-0.126		-0.250	
	(0.279)	***	(0.178)	**	(0.150)	***	(0.170)		(0.274)	
Spirits	0.064		-0.378		-0.076		-1.923		0.545	
	(0.206)		(0.124)	***	(0.080)		(0.173)	***	(0.225)	**
Soft Drinks	0.509		-0.322		-0.022		0.203		-1.396	
	(0.098)	***	(0.058)	***	(0.036)		(0.062)	***	(0.136)	***
Income Elasticity	0.831	***	0.929	***	1.337	***	1.767	***	1.028	***
	(0.009)		(0.009)		(0.036)		(0.027)		(0.009)	

Source: Own calculations based on Spanish HBS 2006-2015. Remarks: Sample excludes top 5% (1%) consumption per adult for Beer (Wine, Other Wine, Spirits) and is restricted to households with exactly one Adult (i.e. aged 18 or above) and with non-zero consumption of at least one alcoholic beverage. Number of Observations is 14,358. Robust standard errors are given in parentheses. Own and cross-price elasticities represent uncompensated elasticities; for calculation see Poi (2012). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5.3 French price elasticities for alcoholic beverages

To estimate the price elasticities of beer, wine and spirits in France we use data from the French Household Budget Survey for the year 2010. Availability on Budget Household Survey data for France is quite limited compared to Spain and Poland. France only surveys households every five years and started providing scientific use files for consumption diaries including consumed quantities beginning with the year 2010. Moreover, the HBS for 2015 was not yet available for scientific use for this study, so our dataset for France is de facto limited to the year 2010. Another feature of the French HBS data is that respondents were asked to record their consumption over a period of just one week, compared to two weeks for Spain and one month for Poland. This results in severe under-sampling (compared to the economy wide recorded figures) especially of less frequent consumed but also for more frequently consumed goods such as alcoholic beverages.

As a result of these data limitations, we are left with only small number of observations compared to Spain and Poland and we cannot exploit variation of prices over time, since we are restricted to the year 2010. These restrictions call for methodological flexibility, so we depart from the use of more data intensive two-stage procedures or demand system estimation and revert to simple ordinary least squares regression analysis. As an approximation for the prices of the alcoholic beverages we employ a reduced

version of the approach outlined in Aepli (2014), which is also employed for Spain and Poland, and as an additional method apply the hedonic price adjustment discussed in Angulo et al. (2001). In the first approach we exploit the regional variation over 9 French NUTS1 regions (Zone d'études et d'aménagement du territoire) interacted with a measure of population density of the urban area (<10,000, <100,000 and >=100,000 inhabitants).

In the second approach, we adjust unit values of the alcoholic beverages recorded by the individual households for socio-economic characteristics of the households and their members that may be heavily correlated with the quality of the product. In particular, regarding household characteristics we control for the household type (single, couple with children, …), the total household income, the number of economically active persons, the total expenditures, the budget share spent on restaurants and hotels, the OECD-scale equivalent household size. Additionally, we include as characteristics of the household reference person the highest level of education, nationality, gender and profession.

Table 20 summarizes the results of the two types of regressions. The dependent variable is the logarithm of the quantity per household member aged 18 and above of the respective alcoholic beverage. The first column per beverage reports the results using the method of Aepli (2014) to construct prices from unit values, while the second column reports the hedonic price adjustment. Since the hedonic price adjustment can only be applied to observed unit values, the sample size for this method is even smaller. Within this method, including the price of other alcoholic beverages, to get an estimate of the cross-price elasticity, would even further reduce the sample, since then only households that report consumption in all four alcoholic beverage categories would be included in the sample. We therefore restrict this method to estimation of the own price elasticity only. Due to the small sample size in general, we depart from reporting additional estimates by household size, income group or drinking behaviour as was done for Spain and Poland. In light of the heavy restrictions imposed by the data availability the results seem plausible from an economic perspective and relatively robust and significant from a statistical view.

The estimations result in a beer price elasticity for France of between -0.62 to -0.77. French households respond less to price changes for wine with elasticities of between -0.49 to -0.57. For spirits we receive a positive and statistically insignificant elasticity when exploiting the regional variation of the price in Column (5). The hedonic price adjustment, however, results in a statistically significant spirits price elasticity of -0.38. For other wine, which in France essentially covers sparkling wine such as champagne, a similar picture emerges. Exploiting the regional variation (see column (7)) results in a statistically insignificant, but a reasonable elasticity of -0.16. The small sample size of household reporting non-zero consumption of sparkling wine might be responsible for the larger standard error. When switching to the hedonic price method the results point towards a significant elasticity of -0.18, very similar and thus supportive to the result in column (7). In general, cross-price elasticity are only in one case statistically significant and economically relevant in terms of effect size. Wine seems to be a substitute for spirits with a positive and significant cross-price elasticity of 0.33, meaning that French households switch to wine when faced with increasing prices for spirits.

Table 20: French Price Elasticities, 2010

	Beer		Wine		Spirits		Other Wine	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Beer price	-0.615***	-0.767***	-0.034		0.125		-0.054	
	(0.114)	(0.043)	(0.088)		(0.095)		(0.148)	
Wine price	-0.246*		-0.490***	-0.573***	-0.005		-0.120	
	(0.121)		(0.086)	(0.029)	(0.094)		(0.158)	
Spirit price	0.201		0.327***		0.074	-0.380***	-0.129	
	(0.114)		(0.082)		(0.100)	(0.042)	(0.135)	
Other Wine price	-0.059		-0.012		0.020		-0.155	-0.179***
	(0.067)		(0.052)		(0.054)		(0.098)	(0.043)
Observations	1,503	1,456	2,333	2,293	1,356	1,320	603	585

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Estimation is carried out via Ordinary Least Squares with robust standard errors. Columns (1), (3), (5) and (7) report the results based on prices constructed from regional median unit values (see Aepli, 2014), while columns (2), (4), (6) and (8) price are based on hedonically-adjusted individual unit values. Source: Own calculations based on French HBS 2010.

5.4 Polish price elasticities for alcoholic beverages

To estimate the price elasticities of beer, wine and spirits in Poland we use data from the Polish Budget Household Survey for the years 2006-2016. The distribution of the derived prices can be found in Appendix B. In the following we present the summaries of the results of the two-stage Heckman estimations, reporting only the second stage[30] price and cross-price elasticities for beer, still wine, other wine and spirits. Similar to the analysis for Spain, we also include the price of soft drinks, since these drinks can be regarded as substitute or complement (for mixed drinks). A description of all variables included and a summary of their impacts in both stages of the decision process is given in Appendix C. Prior to the estimations we discarded households with more than five members aged 18 and above as well as the top and bottom 5% of observations with respect to the total quantity consumed per adult for each alcoholic beverage. However, contrary to Spain, this outlier cleaning procedure discards a much larger portion of households at the lowest income quartile than in the other quartiles. Due to this peculiarity, we decided to drop only the largest and lowest 1% of observations with respect to quantity consumed for the results by income group and alcoholic drinking behaviour. The dependent variable is the log quantity per household member aged 18 and above of the respective alcoholic beverage.

As before for Spain, the results of the price elasticities are reported separately for each alcoholic beverage group (beer, wine still, wine other and spirits) per household size, income group and drinking behaviour. Table 21 reports the beer price elasticities for Polish households by household size. Contrary to Spain, the size of the own price elasticity is stable at around -0.43 to -0.48 and are highly significant throughout. Other wines and soft drinks are substitutes, whereas beer consumption reacts more to price changes in soft drinks than in other wines. Table 22 shows the price elasticities by drinking behaviour and income quartile. The consumption of light drinkers (-0.62) seem to be less responsive to beer price than that of medium (-1.65) drinkers, with heavy drinkers being most unresponsive with a statistically insignificant

[30] Detailed estimation results for the first (decision to buy) and second (decision on quantity) are available from the authors upon request.

elasticity of -0.4. Light drinkers regard beer as a substitute for other wines and soft drinks as substitutes and as a complement for spirits, while for medium drinkers beer acts as substitute when faced with increasing still wine and other wine prices. The results by income group suggest the lowest demand sensitivity for the poorest quartile, the highest for the second and then a monotonically decreasing responsiveness.

The price elasticities of still wine by household size are given in Table 23. We find a statistically significant own price elasticity of still wine of between -0.11 and -0.16. For the samples including households with 2 or more adults, columns (1) to (3), we find a statistically significant cross-price elasticity of soft drinks of between 0.15 and 0.2, which suggests that wine acts as a substitute for soft drinks. Table 24 shows the still wine elasticities by drinking behaviour and income group. Statistically significant own-price and cross-price elasticities are only found for light drinkers. Contrary to Spain, the price elasticity of wine does not decrease by income but rather the opposite. The results suggest monotonically increasing price responsiveness from -0.11 to -0.19.

Results for elasticities by household size for spirits in Poland are given in Table 25. The own-price elasticities of spirits for households with 3 and more adults are positive and statistically insignificant. Restricting the sample further to households with less than 3 adults results in negative elasticities but they stay insignificant. While this result does not suggest that Polish households consume more spirits given price increases, it does suggest that consumers in Poland have a very low price responsiveness regarding spirits. Table 26 shows the results by drinking behaviour and income group. Except for medium drinkers, all own-price elasticities for spirits are negative but statistically significant.

A summary of the results of elasticities for other wines by household size is given in Table 27. As with spirits, the results point towards positive own-price elasticities of very small magnitude and with very large standard errors. The results essentially stay the same when dividing the sample by drinking behaviour or income group (see Table 28).

The price elasticities of soft drinks for Polish households are given in Table 50 and Table 51 in Appendix D. The cross-price elasticities of soft drinks with respect to beer are very large, between 0.62 and 0.85, indicating a strong substitutive relationship between beer and soft drinks. Polish Households also substitute other wine and spirits for soft drinks but to a much lesser degree. Moreover, the strong substitutive behaviour seems to be present only for light, and for beer also moderate, drinking households but is present for households of each income group.

Finally, the results of the full demand system are summarized in Table 29. The own-price elasticities are -0.5 for beer, -0.94 for wine, -1.79 for other wine and -0.88 for spirits. Contrary to the findings of the beverage-by-beverage two-step regressions, the QAIDS estimation results in a sizeable negative and statistically significant ow-price elasticity for spirits. The beer price elasticity is in line with the tow-stage estimates, while price changes in wine and other wine respond in much larger changes in consumption patterns according to the estimates of the demand system. Income elasticities are 0.58 for beer, 1.17 for wine, 0.84 for other wine and 1.69 for spirits. Thus, wealthier Polish households spent relatively more on wine and spirits. Concerning the cross-price elasticities, we again only discuss elasticities above a certain threshold in size. A one percent increase in the price of wine lowers beer consumption but increases soft drink consumption by a quarter percent. An increase in other wine of one percent increases beer consumption by 1.27 percent and soft drinks by above a quarter percent but reduces wine consumption by 0.82 percent. Raising spirits prices by one percent reduces consumption of beer by 0.6 percent. Increasing soft drink prices by a percent decreases beer but increases wine consumption by a quarter percent.

Table 21: Polish Beer Price elasticities by Household Size

	(1) All	(2) up to 3 Adults	(3) up to 2 Adults	(4) one Adult	(5) Single HH
Beer own-price	-0.476 (0.0607)***	-0.467 (0.0647)***	-0.426 (0.0741)***	-0.437 (0.155)**	-0.432 (0.164)**
Wine cross-price	-0.0356 (0.0172)*	-0.0368 (0.0184)*	-0.0141 (0.0210)	-0.0189 (0.0440)	-0.0140 (0.0465)
Other wine cross-price	0.0649 (0.00604)***	0.0578 (0.00646)***	0.0479 (0.00744)***	0.0166 (0.0153)	0.0168 (0.0162)
Spirit cross-price	-0.333 (0.0434)***	-0.335 (0.0461)***	-0.365 (0.0526)***	-0.0835 (0.109)	-0.0586 (0.116)
Soft drink cross-price	0.206 (0.0185)***	0.164 (0.0198)***	0.137 (0.0228)***	0.0618 (0.0481)	0.0644 (0.0508)
Observations (1st stage)	313,376	277,181	218,316	53,659	46,288
Observations (2nd stage)	170,710	150,049	117,259	22,128	19,745

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Polish HBS 2006-2016.

Table 22: Polish Beer Price elasticities by drinking behaviour and income group

	(1) Light	(2) Medium	(3) Heavy	(4) IncQ1	(5) IncQ2	(6) IncQ3	(7) IncQ4
Beer own-price	-0.617	-1.647	-0.398	-0.387	-1.076	-0.936	-0.657
	(0.0646)***	(0.288)***	(0.867)	(0.152)*	(0.131)***	(0.125)***	(0.120)***
Wine (still) cross-price	-0.0115	0.309	0.119	-0.110	0.0701	-0.0874	-0.0924
	(0.0183)	(0.0797)***	(0.244)	(0.0428)*	(0.0370)	(0.0351)*	(0.0342)**
Other wine cross-price	0.0796	0.0803	0.0441	0.0955	0.0922	0.0699	0.0563
	(0.00643)***	(0.0291)**	(0.0899)	(0.0152)***	(0.0131)***	(0.0123)***	(0.0120)***
Spirit cross-price	-0.325	-0.504	-0.305	-0.0367	-0.352	-0.407	-0.514
	(0.0462)***	(0.198)*	(0.601)	(0.112)	(0.0952)***	(0.0876)***	(0.0841)***
Soft Drinks cross-price	0.227	0.0556	0.124	0.379	0.337	0.291	0.215
	(0.0196)***	(0.0910)	(0.280)	(0.0451)***	(0.0391)***	(0.0374)***	(0.0382)***
Observations (1st stage)	314,245	8,583	1,248	68,124	81,131	85,871	88,950
Observations (2nd stage)	172,670	7,670	1,070	29,789	42,982	50,805	57,834

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 1% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Polish HBS 2006-2016.

Table 23: Polish Wine (still) Price elasticities by Household Size

	(1) All	(2) up to 3 Adults	(3) up to 2 Adults	(4) one Adult	(5) Single HH
Beer cross-price	0.0410	0.0297	-0.00916	-0.234	-0.274
	(0.0683)	(0.0704)	(0.0746)	(0.124)	(0.132)*
Wine (still) own-price	-0.149	-0.161	-0.148	-0.113	-0.108
	(0.0192)***	(0.0198)***	(0.0210)***	(0.0355)**	(0.0376)**
Other wine cross-price	0.00356	0.00235	-0.00443	0.0123	0.0136
	(0.00713)	(0.00734)	(0.00777)	(0.0129)	(0.0138)
Spirit cross-price	0.128	0.0847	0.0366	-0.134	-0.133
	(0.0481)**	(0.0496)	(0.0523)	(0.0878)	(0.0930)
Soft drink cross-price	0.200	0.191	0.154	0.0726	0.0752
	(0.0215)***	(0.0223)***	(0.0237)***	(0.0403)	(0.0427)
Observations (1st stage)	332,454	294,851	230,768	57,030	49,439
Observations (2nd stage)	54,629	50,987	40,640	8,681	7,711

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Polish HBS 2006-2016.

Table 24: Polish Wine (still) Price elasticities by drinking behaviour and income group

	(1) Light	(2) Medium	(3) Heavy	(4) IncQ1	(5) IncQ2	(6) IncQ3	(7) IncQ4
Beer cross-price	0.0149	0.516	-0.319	-0.0688	-0.253	-0.137	0.187
	(0.0760)	(0.351)	(0.782)	(0.191)	(0.151)	(0.141)	(0.131)
Wine (still) own-price	-0.114	-0.119	0.0371	-0.114	-0.126	-0.135	-0.186
	(0.0214)***	(0.0975)	(0.225)	(0.0538)*	(0.0426)**	(0.0391)***	(0.0367)***
Other wine cross-price	0.00589	0.00833	0.0568	0.0536	0.0131	0.0266	-0.0187
	(0.00793)	(0.0358)	(0.0848)	(0.0206)**	(0.0160)	(0.0145)	(0.0135)
Spirit cross-price	0.133	0.156	-0.591	-0.0530	0.106	0.130	0.117
	(0.0537)*	(0.245)	(0.524)	(0.141)	(0.109)	(0.0982)	(0.0906)
Soft Drinks cross-price	0.252	0.0671	-0.0201	0.157	0.274	0.282	0.323
	(0.0239)***	(0.113)	(0.255)	(0.0582)**	(0.0463)***	(0.0433)***	(0.0427)***
Observations (1st stage)	325,626	9,478	1,933	70,594	84,540	89,726	92,177
Observations (2nd stage)	53,935	4,410	867	6,436	11,151	16,120	25,505

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 1% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Polish HBS 2006-2016.

Table 25: Polish Spirit Price elasticities by Household Size

	(1) All	(2) up to 3 Adults	(3) up to 2 Adults	(4) one Adult	(5) Single HH
Beer cross-price	0.128 (0.0596)*	0.136 (0.0612)*	0.0975 (0.0659)	-0.0644 (0.134)	-0.0726 (0.140)
Wine (still) cross-price	-0.144 (0.0169)***	-0.143 (0.0173)***	-0.102 (0.0187)***	-0.0398 (0.0383)	-0.0343 (0.0401)
Other wine cross-price	-0.0108 (0.00614)	-0.0150 (0.00632)*	-0.0204 (0.00683)**	-0.0246 (0.0135)	-0.0290 (0.0141)*
Spirit own-price	0.0522 (0.0433)	0.0211 (0.0444)	-0.0323 (0.0476)	-0.150 (0.0954)	-0.0637 (0.0997)
Soft drink cross-price	0.175 (0.0185)***	0.129 (0.0192)***	0.0679 (0.0208)**	0.0345 (0.0426)	0.0149 (0.0446)
Observations (1st stage)	326,750	288,618	225,910	55,949	48,343
Observations (2nd stage)	84,509	74,134	56,923	10,531	9,611

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Polish HBS 2006-2016.

Table 26: Polish Spirit Price elasticities by drinking behaviour and income group

	(1) Light	(2) Medium	(3) Heavy	(4) IncQ1	(5) IncQ2	(6) IncQ3	(7) IncQ4
Beer cross-price	0.258	0.648	1.195	0.109	0.0670	0.184	0.191
	(0.0629)***	(0.202)**	(0.587)*	(0.176)	(0.136)	(0.125)	(0.118)
Wine (still) cross-price	-0.134	-0.136	-0.0479	-0.0595	-0.169	-0.211	-0.235
	(0.0178)***	(0.0558)*	(0.167)	(0.0504)	(0.0387)***	(0.0352)***	(0.0331)***
Other wine cross-price	-0.00901	-0.0900	0.0439	0.00629	0.00721	-0.0139	-0.0264
	(0.00649)	(0.0204)***	(0.0640)	(0.0182)	(0.0143)	(0.0127)	(0.0120)*
Spirit own-price	-0.0375	0.252	-0.0940	-0.193	-0.0259	-0.121	-0.0839
	(0.0458)	(0.138)	(0.398)	(0.130)	(0.101)	(0.0901)	(0.0836)
Soft Drinks cross-price	0.115	0.0135	-0.246	0.0933	0.174	0.186	0.311
	(0.0196)***	(0.0639)	(0.186)	(0.0528)	(0.0414)***	(0.0386)***	(0.0379)***
Observations (1st stage)	322,816	9,479	1,283	70,085	83,609	88,636	91,248
Observations (2nd stage)	82,177	8,103	1,057	11,196	19,645	26,284	34,212

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 1% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Polish HBS 2006-2016.

Table 27: Polish Other Wine Price elasticities by Household Size

	(1) All	(2) up to 3 Adults	(3) up to 2 Adults	(4) one Adult	(5) Single HH
Beer cross-price	-0.323 (0.108)**	-0.357 (0.107)***	-0.354 (0.111)**	-0.366 (0.187)*	-0.329 (0.207)
Wine (still) cross-price	-0.0264 (0.0351)	-0.0368 (0.0349)	-0.0114 (0.0358)	-0.111 (0.0649)	-0.112 (0.0705)
Other wine cross-price	0.00387 (0.0155)	0.00194 (0.0153)	-0.0193 (0.0157)	0.0128 (0.0261)	0.00126 (0.0281)
Spirit cross-price	0.198 (0.0926)*	0.145 (0.0920)	0.196 (0.0949)*	0.373 (0.160)*	0.466 (0.176)**
Soft drink cross-price	0.180 (0.0353)***	0.168 (0.0353)***	0.110 (0.0368)**	0.0402 (0.0635)	0.0275 (0.0705)
Observations (1st stage)	340,130	300,071	235,146	58,428	50,717
Observations (2nd stage)	13,859	12,150	9,305	1,496	1,245

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Polish HBS 2006-2016.

Table 28: Polish Other Wine Price elasticities by drinking behaviour and income group

	(1) Light	(2) Medium	(3) Heavy	(4) IncQ1	(5) IncQ2	(6) IncQ3	(7) IncQ4
Beer cross-price	-0.272	-0.788	2.108	-0.587	-0.431	-0.173	-0.157
	(0.124)*	(0.512)	(2.217)	(0.292)*	(0.241)	(0.233)	(0.222)
Wine (still) cross-price	-0.101	-0.194	-0.182	0.0363	-0.235	-0.0989	-0.139
	(0.0406)*	(0.156)	(0.709)	(0.0999)	(0.0826)**	(0.0750)	(0.0684)*
Other wine own-price	-0.00847	0.0997	-0.221	-0.0445	-0.00288	0.0475	-0.0316
	(0.0179)	(0.0681)	(0.304)	(0.0482)	(0.0396)	(0.0326)	(0.0285)
Spirit cross-price	0.469	0.234	1.824	0.558	0.637	0.187	0.417
	(0.108)***	(0.416)	(1.704)	(0.270)*	(0.219)**	(0.198)	(0.181)*
Soft Drinks cross-price	0.217	0.0852	-0.749	0.194	0.196	0.227	0.223
	(0.0407)***	(0.169)	(0.718)	(0.0949)*	(0.0791)*	(0.0745)**	(0.0736)**
Observations (1st stage)	329,072	9,961	2,173	71,100	85,243	90,847	94,016
Observations (2nd stage)	13,699	1,007	229	2,068	3,385	4,240	5,242

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 1% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in litre per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Polish HBS 2006-2016.

Table 29: Uncompensated price elasticities and income elasticities for Poland

	Beer		Wine (still)		Other Wine		Spirits		Soft Drinks	
Beer	-0.498		-0.010		0.077		-0.113		-0.034	
	(0.068)	***	(0.030)		(0.011)	***	(0.056)	**	(0.030)	
Wine (still)	-0.268		-0.943		-0.121		-0.126		0.280	
	(0.076)	***	(0.078)	***	(0.019)	***	(0.072)	*	(0.052)	***
Other Wine	1.270		-0.823		-1.786		0.202		0.293	
	(0.200)	***	(0.141)	***	(0.068)	***	(0.189)		(0.137)	**
Spirits	-0.602		-0.184		-0.001		-0.882		-0.023	
	(0.101)	***	(0.052)	***	(0.019)		(0.106)	***	(0.049)	
Soft Drinks	-0.230		0.232		0.025		0.151		-1.141	
	(0.052)	***	(0.036)	***	(0.013)	*	(0.047)	***	(0.048)	***
Income Elasticity	0.577	***	1.177	***	0.843	***	1.691	***	0.964	***
	(0.004)		(0.009)		(0.031)		(0.007)		(0.006)	

Source: Own calculations based on Polish HBS 2006-2016. Remarks: Sample excludes top 5% (1%) consumption per adult for Beer (Wine, Other Wine, Spirits) and is restricted to households with exactly one Adult (i.e. aged 18 or above) and with non-zero consumption of at least one alcoholic beverage. Number of Observations is 32,448. Robust standard errors are given in parentheses. Own and cross-price elasticities represent uncompensated elasticities; for calculation see Poi (2012). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6 Tax Revenue Simulations

6.1 Direct estimation with macro data

The direct estimation of a revenue effect of a change in the excise tax implies that the demand elasticities estimated in the previous subsection need to be implicitly accounted for. The relationship between the price elasticity of demand and the total revenues has been discussed in various contexts. In microeconomics, the total revenue test of the demand elasticity uses the change in total (sales) revenues to identify whether the price elasticity of demand is elastic or inelastic. In public economics the well-known concept of the Laffer curve discusses the non-linear relationship between the tax rates and tax revenues.[31] These two concepts can be discussed in a common framework. In Figure 15 we illustrate the mechanics in the simple case of a linear demand function. The top half of Figure 15 shows the downward sloping demand curve. A price increase results in a drop of the sold quantity from point A to B. The higher price results in additional revenue for each sold unit, shown as the rectangle with the label 'price effect'. At the same time the higher price also leads to a drop in the quantity sold. This effect is show in the rectangle with the label 'quantity effect'. Depending on which point of the demand curve we are, either one of the effects can be bigger. In the case illustrated in Figure 15 we are in a price range where the demand is elastic. This implies that the quantity effect dominates the price effect and the overall revenues as shown in the lower part of Figure 15 decline as a result of the price increase.

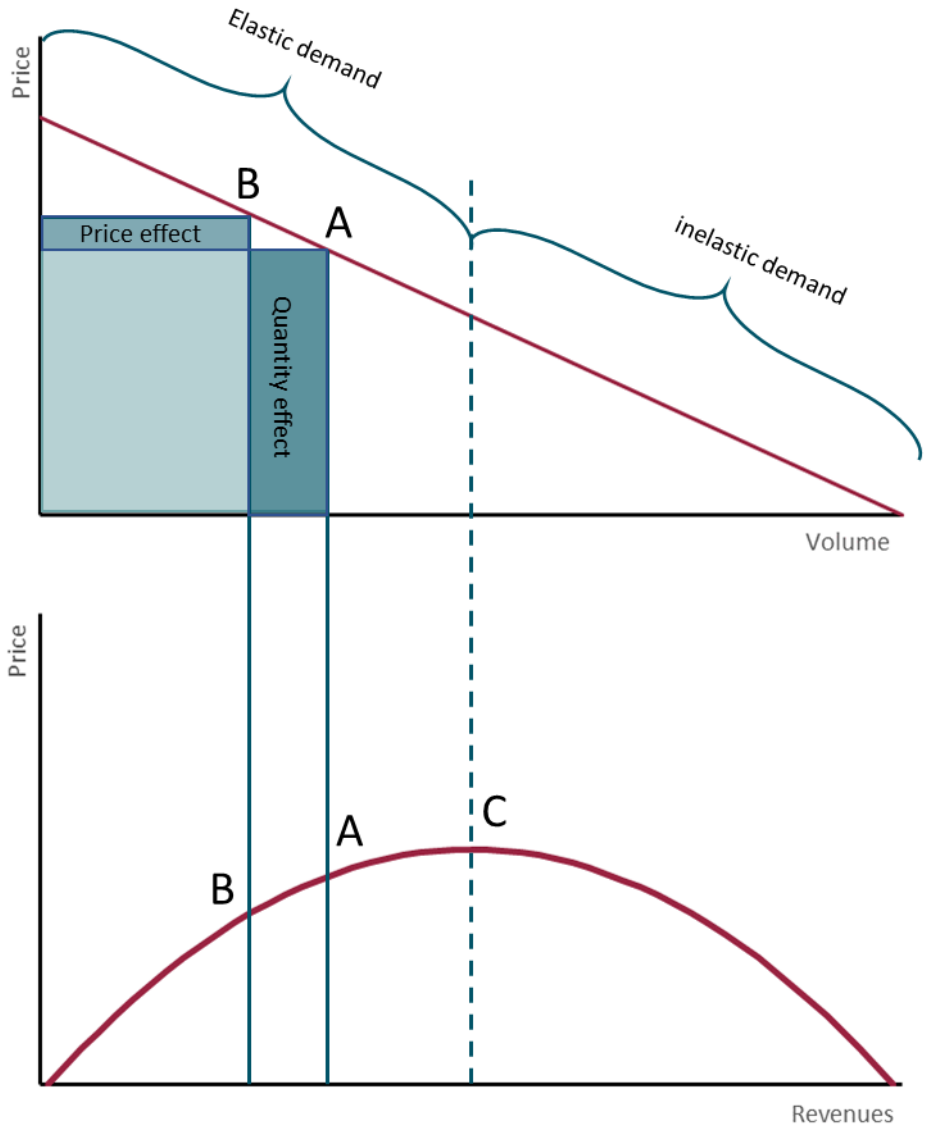
While the description in Figure 15 illustrates the relationship between the price elasticity and the sales revenues it can easily be translated into a Laffer curve setting. Laffer (2004) describes the two competing effects of a tax change as 'arithmetic effect' and 'economic effects'. The arithmetic effect is closely related to the price effect while the economic effect is much like the quantity effect. The combination of these two effects result in the non-linear relationship between tax rate and revenues. The revenue maximising point is illustrated in Figure 15 as point C. At this point the price elasticity is exactly unity, at prices above this point the demand is elastic and at price below this point the demand is inelastic. The key message of the total revenue test is that if the demand is sufficiently elastic a price increase will not increase revenues. Converted to the that Laffer curve concept this implies that if demand is sufficiently elastic, a tax increase will not necessarily increase tax revenues. Additionally, one can imply from the simplified case of the linear demand function, that the price elasticity of demand is likely to be more elastic the higher the prices are. Or in other words, the higher the tax already is, the less likely will a further increase in tax increase the revenues.

The simplicity of the Laffer curve is appealing. If no taxes are levied no revenues are raised. If tax become extremely high, nobody will legally sell any of the good and no more revenues are made. In between, there must be a tax rate which maximises the tax revenues.[32]

[31] The idea of the non-linear relationship between tax rate and revenues and a revenue maximizing tax rate dates much further back, but gained significant public attention when Wanniski (1978) described how the economist Arthur Laffer explained the concept of a revenue maximizing tax rate to Donald Rumsfeld and Dick Cheney. See also Laffer (2004) for a detailed discussion about the origins of the Laffer curve.

[32] It is important to note, that the revenue maximizing tax rate is normally not an optimal tax rate. First there are several other policy goals (health issues, redistribution, stability of employment, etc.) one may want to achieve with taxation. Furthermore, the Laffer curve concept only maximizes revenues of the own tax and does not account for spillover effects on other taxes (e.g. VAT). See for example Diamond and Saez (2011) for a broader discussion of optimal taxes.

Figure 15: Price elasticity and revenues, mechanics of a Laffer curve



Source: own illustration

While there is no dispute about these basic facts, the exact shape of the Laffer curve is unknown. Absent any further information, the simplest way to estimate a Laffer curve is to regress the revenues on the corresponding tax rate and a quadratic term of the tax rate. There are several limitations to the application of the Laffer curve idea to the excise taxation of alcoholic beverages. First, the concept of no revenues at a prohibitively high tax rate does not necessarily hold for a specific tax. In contrast to a case of a 100% income tax rate where any incentive of report income vanishes it is likely that even at very high excise tax rates some consumption will take place. Second, the estimation of a Laffer curve is always necessarily based on past observations. Therefore, there remain some doubts about the validity for later periods. Additionally, difficulties may arise in the estimation of a Laffer curve if there are only few or no observations with very high tax rates. In this case it can be still possible to identify a revenue maximising tax rate, but the empirical backing is only limited. Overall, the use of a quadratic relationship between tax rates and revenues is certainly only a crude approximation to the exact empirical relationship between

the level of taxation and the corresponding tax revenues. That said, it provides easy to interpret results and gives a general idea about the limitations of the tax.

To further reduce the impact of confounding factors we control for all time invariant country characteristics by including country fixed effects. Similarly, we account for general time trends by including year dummies. To further control for general income and growth effects we also include the (logarithm of) nominal GDP in the regression. The resulting regression equation is

$$\log(R_{it}) = \beta_1 \tau_{it} + \beta_2 {\tau_{it}}^2 + \beta_3 \log(\mathrm{GDP}_{it}) + \mu_i + \delta_t + \varepsilon_{ijt} \quad (3)$$

In line with the discussion in Section 3 we define the tax rate τ_{it} as the Euro amount per liter of finished product in country i. The results in Table 30 show the estimates for the overall sample of 28 countries and the time period between 1994 and 2017.[33] For all three types of alcoholic beverages – beer, wine and spirits – the coefficient for the tax rate is highly significant positive and the coefficient for the squared tax rate highly significant negative. Thus, the estimates clearly confirm a Laffer-curve-like relationship between the tax rates and revenues for alcohol excise taxation.

Table 30: Estimates of excise tax revenues from alcoholic beverages based on macro data

	Excise tax revenues from		
	Beer excise taxes	**Wine excise taxes**	**Spirits excise taxes**
Tax per litre finished product$_t$	4.516***	0.803***	0.115***
	(0.188)	(0.219)	(0.014)
Tax per litre finished product$_t^2$	-1.778***	-0.080**	-0.003***
	(0.095)	(0.033)	(0.001)
Log(GDP$_t$)	0.344***	0.694***	0.797***
	(0.059)	(0.187)	(0.066)
Country fixed-effects	✓	✓	✓
Year dummies	✓	✓	✓
No. Observations	525	264	524
within R²	0.688	0.439	0.531
Implied revenue maximizing tax rate	1.270***	4.992***	21.712***
	(0.031)	(0.860)	(2.336)

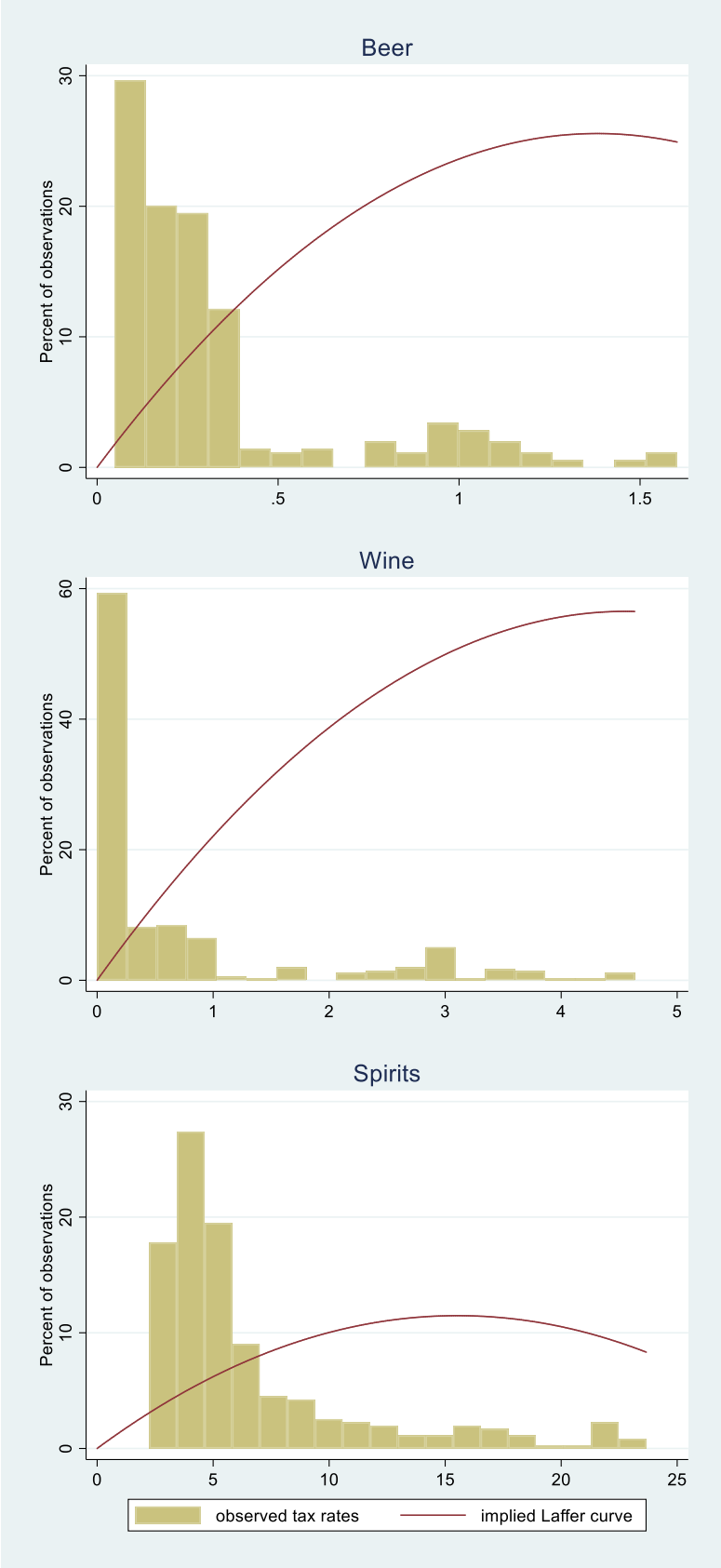
Dependent variable is the logarithm of the excise tax revenue. Heteroscedasticity-robust standard errors in brackets. ***,**,* denotes significance at the 1, 5 respectively 10% level.

Source: own calculations based on data from the European Commission.

The lower part of Table 30 includes the implied revenue maximizing tax rates. In line with the observed values of taxation the revenue maximizing rate is highest for spirits with a rate of 21.71 Euro per liter of finished product. The estimated revenue maximizing rate for wine lies at 4.99 Euro per liter, while the one for beer is at 1.27 Euro per liter. These implied revenue-maximizing tax rates are referring to a more than 20-year period for 28 European countries and therefore are not applicable for each country individually. To get a better idea about the empirical support of the hump-shaped relationship between tax rates and revenues Figure 16 plots the implied Laffer curves against the observed tax rates for the whole data sample.

[33] For wine, we can only use the information of the 16 countries with a positive excise tax rate on wine.

Figure 16: Comparison estimated Laffer curves and observed tax rates



Source: own illustration, based on the results from Table 30

A few things are visible in Figure 16. First, a majority of countries do not levy (a relevant amount of) excise tax on wine. For beer the low excise taxes are also much more common than for spirits. In addition to be generally at a much higher level, excise tax rates for spirits are also more dispersed. The red lines in Figure 16 superimpose the estimated Laffer curves on the histograms. For beer and spirits, we see that some observed excise tax burdens are higher than the revenue maximizing tax rates. In contrast, for wine all of the observed excise tax rates are below the estimated revenue maximizing rate. It should be recalled, that the estimates for the revenue maximizing tax rates are for all countries and the time period 1994 to 2017. They are therefore only a broad approximation for the revenue effects of a tax rate change in the individual countries. For example, if one restricts the sample period to 2005 to 2016 the implied revenue maximizing tax rate for beer increases slightly to 1.36 Euro, for wine it decreases slightly to 4.58 Euro, while for spirits it significantly drops to 15.99 Euro. What remains unchanged, however, is the fact that there is clear evidence for a non-linear relationship between tax rates and revenues. In other words, the data supports the claim that substantially higher tax rates will eventually not lead to even more tax revenues.

To estimate the impact of a tax rate change in an individual country, one needs to set up a model to control for the development of the market of the respective alcoholic beverage. In contrast to the estimation for the EU as a whole it is not possible to control for confounding factors through country or time fixed effects. To still be able to control for a trend in the market volume, we include the one-year lagged tax revenue and a linear trend (T) in the country specific regressions. Income effects are controlled by including the change in nominal GDP. This results in the following regression equations for each country and drinks:

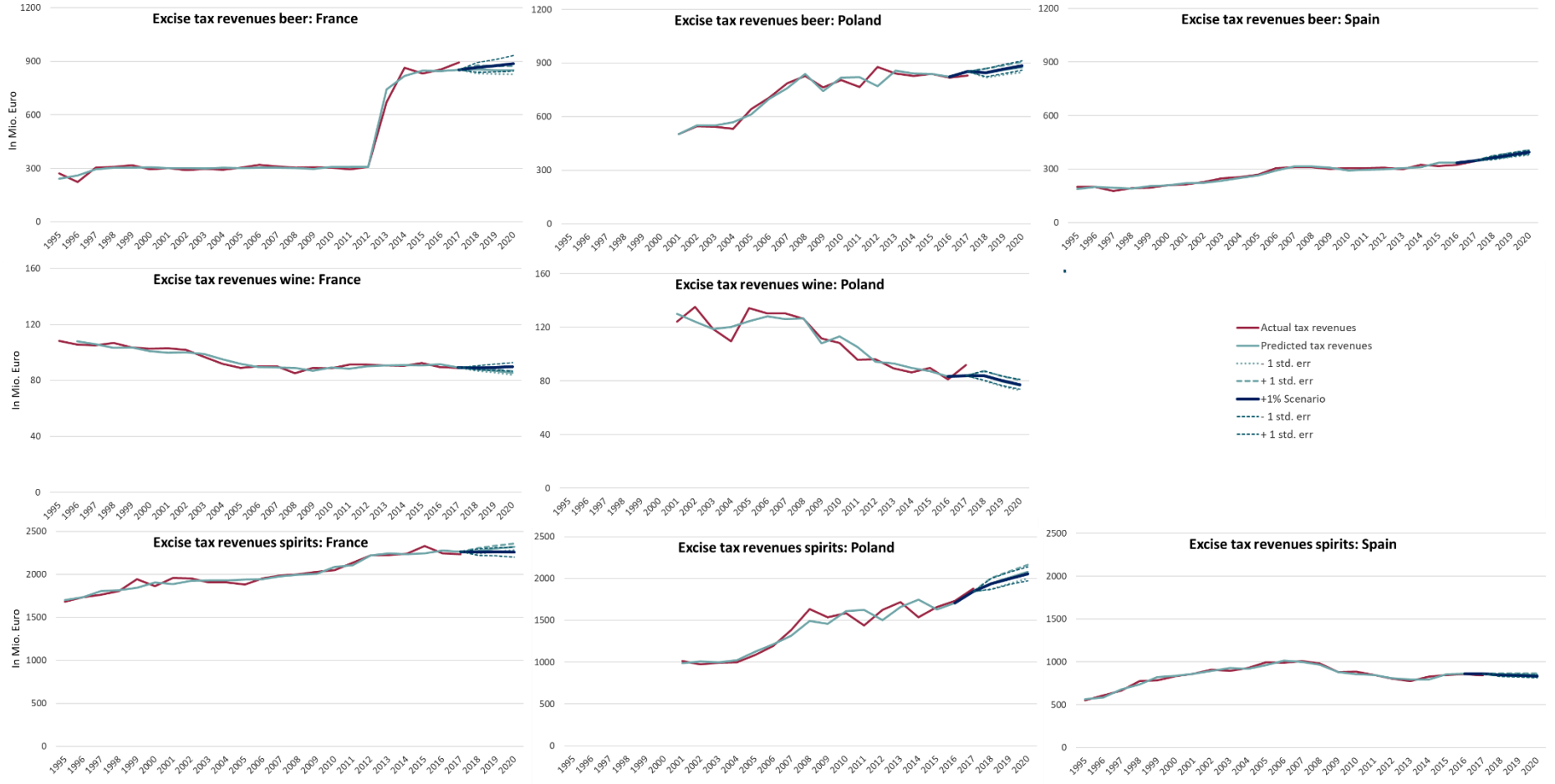
$$(4) \quad \log(R_t) = \beta_1 \tau_{it} + \beta_2 {\tau_{it}}^2 + \beta_3 \, \Delta \, \mathrm{GDP}_t + \beta_4 \log(R_{t-1}) + T + \varepsilon_t.$$

Rather than presenting the regression results for each of the alcoholic beverage in tables, we combine the results in Figure 17. For each of the three countries France, Poland, and Spain and for each for the three main alcoholic beverages we plot the development of the excise tax revenues over the last 20 years against the predicted tax revenues. The top row in Figure 17 compares the development of the beer excise tax revenues. A notable increase in the tax revenues in France in 2013 can clearly be linked to the increase in excise taxation. This sharp increase brings the beer excise tax revenues in France roughly up to the level of Poland.[34] In contrast, in Spain the excise tax revenues from beer have developed much steadier and at a clearly lower level. The middle part of Figure 17 shows the development of wine excise tax revenues. Both for France and for Poland the excise tax revenues have been declining, while Spain does not levy a wine excise tax. In contrast, the lower part of Figure 17 shows that the tax revenues from excise taxes on spirits are increasing in all three countries.

The graphs in Figure 17 plot the observed tax revenues in red against the predicted revenues in light blue. The prediction is extrapolated up to 2020. The dashed light blue lines additionally indicate a confidence interval of the prediction by showing plus/minus one standard deviation. By and large the predictions are most precise for Spain and least precise for Poland. Additionally, the dark blue line indicates an alternative prediction with the excise tax rate increased by 1 % yearly.

[34] It is worth noting, that this absolute comparison does not take into account differences in country size and consumption patterns. Therefore, the differences in tax revenues may not directly be interpreted in differences in tax burden.

Figure 17: Comparison observed and predicted excise tax revenues, incl. prediction to 2020



Source: own illustration, based on the results from regression (4), data from European Commission.

The implied changes in tax revenues in the first year of a 1 % increase in the excise tax rates are also collected in Table 31. A one percent increase in excise tax for spirits appears to lower tax revenues in all three countries. In contrast, for beer and wine an excise tax rate increase implies an increase in tax revenues. However, the estimates are not precise. For all estimates, the reported confidence interval plus/minus 1 standard deviation include both positive and negative values. Therefore, the results from this macro estimates should be taken with caution.

Table 31: Predicted excise tax revenues changes from alcoholic beverages based on macro data

	Beer			Wine			Spirits		
	-1 std.	**estimate**	**+ 1 std.**	**-1 std.**	**estimate**	**+ 1 std.**	**-1 std.**	**estimate**	**+ 1 std.**
Poland	-2,54%	**0,24%**	3,09%	-3,78%	**0,22%**	4,39%	-3,54%	**-0,22%**	3,22%
Spain	-2,69%	**0,02%**	2,81%				-2,32%	**-0,41%**	1,54%
France	-1,85%	**1,32%**	4,59%	-0,55%	**1,12%**	2,81%	-2,42%	**-0,70%**	1,04%

Source: Based on the results from regression (4), data from European Commission

The imprecise nature of the results in The implied changes in tax revenues in the first year of a 1 % increase in the excise tax rates are also collected in Table 31. A one percent increase in excise tax for spirits appears to lower tax revenues in all three countries. In contrast, for beer and wine an excise tax rate increase implies an increase in tax revenues. However, the estimates are not precise. For all estimates, the reported confidence interval plus/minus 1 standard deviation include both positive and negative values. Therefore, the results from this macro estimates should be taken with caution.

Table 31 aside, there are also other shortcomings of the direct estimation approach. First the direct estimation does not present the intermediate result of changes in volume sold and furthermore it does not distinguish between the on and off trade sales. This in consequence also rules out to estimate an additional impact on VAT revenues. To overcome these limitations the next section uses a simulation approach to model the revenue impact of excise tax changes.

6.2 Simulation approach

The simulation approach starts from observed data about tax rates, volumes sold, prices, tax revenues and other macroeconomic development indicators. These inputs are combined in a model with assumptions about the relationship between the observed quantities. This model is then used to derive a path of future development of prices, volumes and tax revenues. Against these benchmark paths we can then evaluate the implied changes in response to an excise tax rate change. In the following we briefly describe the input, structure and assumptions which form the model for the tax revenue simulation.

6.2.1 Input

The first set of input variables includes the tax rates and tax revenues for the different alcoholic beverages. Together with the volume and the value of the respective market these variables provide the outset for our simulation model. Table 32 reports the values for 2017 which is the latest available year with full data coverage.

The second set of input variables includes other general macroeconomic variables which affect the consumption of alcoholic beverages. There are numerous aspects affecting the consumption of alcoholic beverages, but for most of them there are either no reliable data or no well-established prior knowledge

regarding size of the influence available.[35] Therefore, we restrict the number of general macroeconomic variables to two main channels: first, the general income situation, which we measure through the growth rate in nominal GDP, and second the change in demographics, which we measure as the change in adult population. Additionally, we include the general increase in consumer prices in the model. Controlling for overall inflation is relevant to distinguish the increase in income from an increase in purchasing power. Additionally, the general increases in prices also imply higher VAT revenues. Table 33 collects the information about the macroeconomic trends together with the information about the VAT rates.

Table 32: Inputs simulation model: tax rates and revenues, volumes and prices (2017)

	France	Poland	Spain
Tax revenues 2017 (in Mio. €)			
Beer	892	829	345
Wine	89	92	0
Spirits	2,234	1,879	842
Tax rates 2017 (in €/hl of pure alcohol)			
Beer	741	454	199
Wine	34	335	0
Spirits	2,295	1,329	959
Total volumes sold 2017 (in 1,000 hl)			
Beer	22,295	36,620	36,039
Wine	26,227	2,176	9,132
Spirits	3,401	2,799	1,867
Average retail off trade prices for finished product, incl. VAT (2017)			
Beer	3.04	1.26	1.77
Wine	5.89	4.70	4.66
Spirits	18.11	10.96	15.43

Note: Average prices are derived by dividing reported sales volume by the reported quantity sold.
Source: European Commission, IWSR.

Table 33: Inputs the simulation model: macroeconomic trends, VAT rates (2017)

	France	Poland	Spain
Macroeconomic trends (yearly growth rates in %)			
Change in adult population	0.50	0.00	0.30
Change in nominal GDP	2.88	4.93	3.93
Change in consumer prices	1.03	2.08	1.96
Value added tax for alcoholic beverages (in %)			
VAT rate off trade	20	23	21
VAT rate on trade	20	23	10

Note: The change in nominal GDP is for 2018.
Source: World Development Indicators, European Commission.

In addition to the readily available input variables, further input variables are specifically derived for the model. These calculations already require a set of assumptions. Therefore, we discuss them together with the underlying assumptions and the structure of our simulation model in the next subsection.

[35] Aspects that suffer from data availability or lack prior knowledge regarding their impact include for example, the impact of legal restrictions such as bans on advertisement or changes in legal limits for driving.

6.2.2 Assumptions and structure of the model

The first set of assumption collected in Table 34 is concerned with the general trend of the sales volumes in the markets. To get an estimate for the general development of the sales volume we ran linear regressions on the market volumes controlling for the tax rate, the change in adult population and the change in nominal GDP. The resulting coefficient for the linear trend is then used as an input for the model. A quick inspection shows that there is significant variation in the development of the different markets. In Poland all three markets for alcoholic beverages are trending downwards, while beer markets in France and Spain show a moderate growth path. The most pronounced downward trends can be observed for the wine markets in Spain and France and for the markets for spirits in Poland and Spain. Failure to account for these general trends in the market would attribute too much of the changes in aggregate demand to the tax changes.

The middle part of Table 34 contains the derived assumptions about the split between the on-trade and off-trade channel. Two things stand out. First, for wine the share of on-trade is generally lower and second, for Spain the on-trade sector is generally higher.

Table 34: Inputs simulation model: assumptions about trend and split between distribution channels

	France	Poland	Spain
Trend in overall sales volume (in %)			
Beer	1.09	-0.41	0.79
Wine	-1.94	-0.74	-2.41
Spirits	-0.15	-2.17	-4.58
Share of on-trade sales 2016 (in %)			
Beer	34.57	36.27	63.77
Wine	17.57	9.09	36.12
Spirits	25.39	31.23	68.69
Mark up for on trade sales (in %)			
Beer	237.56	237.56[a]	193.79
Wine	225.10	301.05	149.15
Spirits	657.47	571.26	436.89

Note: The assumption about the trend is derived from a linear regression, while the assumptions about the split between the on- and off-trade channel are derived from IWSR data. Assumptions about the mark-ups are derived from Nielsen data. [a] For Poland, no information about the mark-up for beer in the on trade was available, therefore we use the mark-ups of France.
Source: Own calculations, based on data from European Commission, IWSR and Nielsen.

The lower part of Table 34 shows the derived assumptions about the mark up on the price in the on-trade sector. Again, two main observations can be made. First, for spirits the mark up in the on-trade sector is much higher and second, for Spain the mark-up in the on-trade sector is general lower. Since we allow the general income level to have an impact on the consumption of alcohol, we need a set of assumptions on the income elasticity of the alcoholic beverages. In Table 35 we report the assumptions that were derived from a regression model. Specifically, we ran a regression on the full sample of European countries to receive an overall estimate for the average income elasticity for each alcoholic beverage. In a second step we adjust for a country specific factor. Moreover, we make the assumption that off-trade consumption is only 0.6 times as responsive to income changes. Overall, this results in a stronger income elasticity for beer, a moderate one for wine and lower one for spirits.

Table 35: Inputs simulation model: assumptions about income elasticity on- and off-trade channels

	France	Poland	Spain
Income elasticity on-trade			
Beer	0.55	0.57	0.55
Wine	0.31	0.26	0.28
Spirits	0.17	0.18	0.18
Income elasticity off-trade			
Beer	0.33	0.34	0.33
Wine	0.19	0.16	0.17
Spirits	0.10	0.11	0.11

Note: Based on regressions, off trade income elasticity is assumed to be only 60% of on-trade elasticity.
Source: Own calculations.

The next set of necessary assumptions relates to the price pass-through of the excise taxes. Following the discussion in section 4 we use the values collected in Table 10. This implies that tax changes are by and large fully and immediately passed onto end consumer prices, with the slight exception of beer where the tax pass-through is slightly below unity.

The key assumptions for the tax revenue simulation are those made about the price elasticities of demand. Following the estimations in section 5 we have a number of options regarding these assumptions. While we have only one estimate for France, for Spain and Poland we have two sets of elasticities estimates. Since there is clear cut answer to the question which estimates are preferable we use the average between the two-stage selection and uncompensated QAIDS elasticities. For the estimates on the samples with different household sizes, we use the estimate for a household with up two adults. This choice is motivated by a trade-off between large sample size and approximating individual demand choices.

Additionally, we have to make assumptions about the price elasticities for on-trade consumption. Since we are not able to estimate these elasticities from our datasets, we have to obtain these elasticities from other sources. Based on the results in Sousa (2014) we assume that the elasticity for the on-trade consumption is 1.2 times higher than the corresponding off-trade elasticities for wine and spirits and only 0.8 times the off-trade elasticities for beer. The resulting price elasticities are collected in Table 36. The price elasticities are highest for spirits in Spain. Moreover, the own price elasticities are generally much higher than the cross-price elasticities which can be seen as a plausibility check.

Table 36: Inputs simulation model: Assumptions on own and cross price elasticities

	France	Poland	Spain
Own price elasticity on trade			
Beer	-0.61	-0.37	-0.93
Wine	-0.69	-0.65	-0.56
Spirits	-0.46	-0.55	-1.84
Own price elasticity off trade			
Beer	-0.77	-0.46	-1.17
Wine	-0.57	-0.55	-0.47
Spirits	-0.38	-0.46	-1.53
Cross price elasticity off trade			
Beer -> Wine	-0.25	-0.14	-0.15
Beer -> Spirits	0.20	-0.48	0.01
Wine -> Beer	-0.03	-0.01	0.01
Wine -> Spirits	0.33	-0.07	-0.47
Spirits -> Beer	0.13	-0.01	-0.19
Spirits -> Wine	0.01	-0.11	-0.14

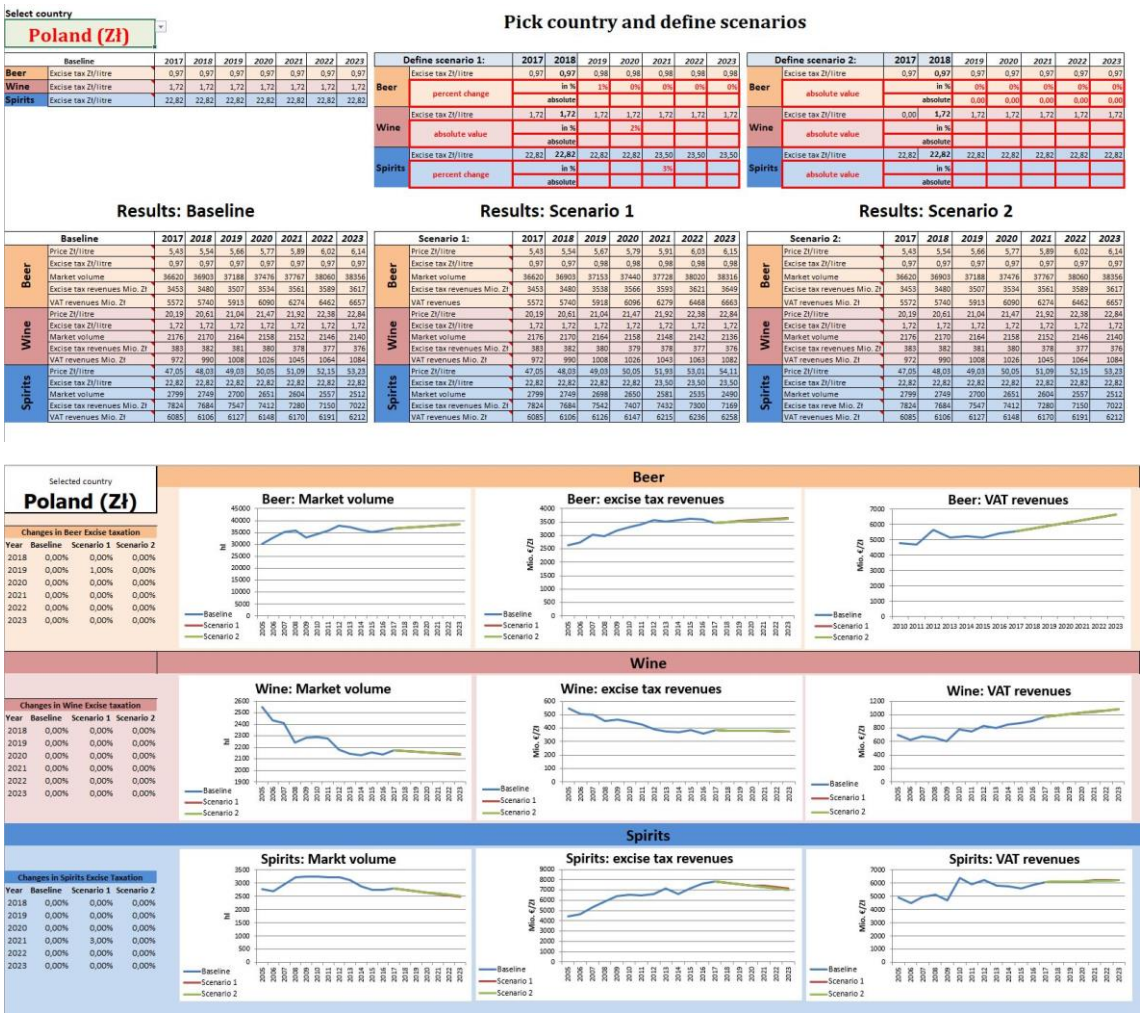
Note: Based on the estimates in section 5. On-trade elasticities are obtained by multiplying with 1.2 respectively 0.8.

Source: Own calculations.

Following Occam's razor, the main structure of the model is kept in the simplest possible form. The observed values of volumes prices are extrapolated with the macroeconomic trends using the corresponding assumptions. These include the impact of the general price inflation, the income growth due to increases in nominal GDP and the change in adult population. This results in a baseline development path of volumes sold and prices. Assuming constant mark-ups and shares in the on-trade sector these volumes can be split into the two distribution channels. The volumes are than multiplied with the corresponding tax rates which gives a benchmark development of the excise tax revenues. We correct this simulated excise tax revenues by the ratio of the simulated excise tax revenues to the observed excise tax revenues for the year 2017. This yields a no-policy change scenario which serves as a benchmark for the tax rate simulations. Additionally, we are able to provide a rough estimate of the VAT revenues by multiplying the sales volume with the corresponding VAT rates.

To facilitate a user-friendly access to the simulation model we developed an Excel-based simulation tool. As can be seen in the screenshots in Figure 18 the user has two Excel spreadsheets.

Figure 18: Interface of simulation model



Source: Screenshots of the Excel-based simulation tool.

The first spreadsheet is the input page, where the user picks the country and specifies two tax rate scenarios for the time period 2019 to 2023. Each tax rate scenario can be defined either as a percentage change of the tax rate or as an absolute tax change. The lower part of the input screen displays the main outcomes: The resulting prices, excise taxes, market volumes, excise tax revenues and VAT revenues. The spreadsheet "Graphs" displays the main results graphically.

Once the two excise tax scenarios are defined, the model in the background first selects the price pass-through assumptions from Table 10 to derive the implied price changes. Using the constant mark-ups from Table 34, the price changes for the on-trade sales are calculated. Together with the own and cross-elasticities from Table 36, the model simulates the changes on both on- and off-trade volumes sold. These new volumes are then used to obtain an estimate of the impact on excise tax revenues as well as VAT revenues.

6.2.3 Results

In principle, the flexibility of the simulation tool allows to find results for all kinds of combinations of tax rate changes. The results of a commonly requested scenario, the impacts of a 1 percent increase in each of the excise tax rates separately, are presented in this section to illustrate the mechanics of the simulation tool.

The top half of Table 37 shows the direct impact of the one percent increase in excise tax rates on the corresponding excise tax revenues. For each of the alcoholic drinks the results imply an increase in excise tax revenue of less than one percent. This result reflects the fact that we find a reduction in volumes as a reaction to a tax increase for all alcoholic beverages. Comparing the results across the three types of alcoholic beverages we see that the increase in revenues is close to one percent for wine, around 0.9 for beer and between 0.48 (Spain) and 0.77 (France) for spirits. Thus, the results suggest a much stronger reduction in market volume for spirits in all countries.

Table 37: Results from simulation model: Direct revenue impact of a 1% increase in excise tax

	France	Poland	Spain
Direct excise tax revenue impact			
Beer	0.89%	0.90%	0.92%
Wine	1.00%[a]	0.94%	n.a.
Spirits	0.77%	0.71%	0.48%
Direct VAT revenue impact			
Beer	0.02%	0.09%	-0.02%
Wine	0.00%	0.04%	n.a.
Spirits	0.32%	0.26%	-0.24%

Source: Own calculations using the simulation tool. [a] 0.995%.

The lower part of Table 37 additionally shows the impact of the 1 percent increase in the excise tax on the VAT revenues. For beer and wine, a one percent increase in excise tax rates results in very moderate increase in VAT revenues. This primarily reflects the fact, that excise tax rates on these two types of alcoholic beverages are relatively low and therefore the corresponding increase in prices does not result in large VAT revenues changes. For spirits, the level of excise taxes is high enough such that a one percent increase in excise taxes results in sizable price changes. Hence, the impact on VAT revenues is also more pronounced. For France and Poland, the VAT revenues increase by roughly 0.3%. This is due to two factors. First, the price elasticities for spirits used in the model are much lower than these two countries than for Spain and the share of the on-trade sales in also smaller. In contrast, the Spanish on-trade sector accounts for a much larger share of the market. Given the importance of the on-trade distribution channel and the much larger price elasticities in Spain, we find that a one percent increase in excise tax rates results in a loss in VAT revenues of -0.24%. This is clearly an extreme result, which rest on the assumption of a very high price elasticity for on-trade spirits consumption. At the same time, the high mark-ups in the on-trade market for spirits and the high share of the consumption which takes place on-trade are not very controversial assumptions. And this combination of parameters results in adverse VAT revenue effects if the consumption is significantly reduced following an increase in excise taxation.

Abbreviations:

COICOP	Classification of individual consumption by purpose
CPI	Consumer Price Index
EHIS	European Health Interview Survey
EU	European Union
HBS	Household Budget Survey
IWSR	International Wines and Spirits Record
QAIDS	Quadratic Almost Ideal Demand System
RTD	Ready to Drink

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Appendix A: Detailed own- and cross price elasticities in the UK

Table 38: Moderate drinkers: Own- and cross-price elasticities for alcohol beverages

Consumption →			Off-trade								On-trade							
			Beer		Wine		Spirit		RTD		Beer		Wine		Spirit		RTD	
Price ↓			Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Off-trade	Beer	Low	-0·4217	0·0044	0·0023	0·0082	0·0011	0·0055	-0·0002	0·0035	0·0131	0·0157	0·0001	0·0020	0·0029	0·0048	0·0004	0·0050
		High	0·0037	-0·4224	0·0027	0·0095	0·0010	0·0037	0·0000	0·0032	0·0130	0·0174	-0·0001	0·0025	0·0033	0·0057	0·0006	0·0055
	Wine	Low	0·0051	0·0063	-0·4127	0·0032	0·0012	0·0028	0·0001	0·0019	0·0115	0·0102	-0·0002	0·0004	0·0033	0·0033	0·0001	0·0038
		High	0·0040	0·0064	0·0012	-0·4612	0·0009	0·0032	0·0000	0·0019	0·0111	0·0155	-0·0002	0·0020	0·0038	0·0042	0·0002	0·0047
	Spirit	Low	0·0030	0·0098	0·0023	0·0097	-0·5129	0·0029	0·0000	0·0018	0·0151	0·0142	0·0003	-0·0006	0·0024	0·0031	0·0003	0·0033
		High	0·0049	0·0056	0·0014	0·0085	0·0007	-0·5242	0·0000	0·0019	0·0124	0·0161	0·0000	0·0017	0·0025	0·0036	0·0003	0·0039
	RTD	Low	0·0118	0·0075	0·0022	0·0010	0·0003	0·0008	-0·3146	0·0009	0·0123	0·0068	-0·0002	-0·0006	0·0017	-0·0080	0·0004	0·0039
		High	0·0059	0·0104	0·0001	0·0053	0·0011	0·0027	-0·0001	-0·3287	0·0083	0·0103	0·0002	0·0016	0·0020	0·0034	0·0004	0·0041
On-trade	Beer	Low	0·0051	0·0067	0·0027	0·0083	0·0010	0·0047	-0·0001	0·0027	-0·3778	0·0259	-0·0003	0·0044	0·0043	0·0082	0·0009	0·0064
		High	0·0060	0·0085	0·0022	0·0091	0·0010	0·0042	-0·0001	0·0032	0·0206	-0·4063	0·0000	-0·0003	0·0051	0·0123	0·0006	0·0075
	Wine	Low	0·0007	-0·0019	0·0009	0·0030	0·0019	0·0016	0·0000	0·0005	0·0148	0·0150	-0·2328	0·0013	0·0010	0·0067	0·0002	0·0060
		High	0·0021	0·0034	0·0010	0·0052	0·0007	0·0031	0·0000	0·0010	0·0121	0·0072	-0·0002	-0·2907	0·0022	0·0053	0·0006	0·0041
	Spirit	Low	0·0017	0·0006	0·0032	0·0101	0·0002	0·0004	0·0000	0·0004	0·0029	-0·0110	0·0001	0·0190	-1·7810	0·0100	0·0023	0·0183
		High	0·0015	0·0011	0·0009	0·0023	0·0002	0·0000	0·0000	0·0007	-0·0038	-0·0060	-0·0011	-0·0102	-0·0005	-0·1891	0·0004	-0·0020
	RTD	Low	0·0016	0·0015	-0·0001	-0·0038	0·0004	0·0005	0·0000	0·0011	0·0075	0·0061	-0·0022	0·0094	0·0414	-0·0149	-0·3304	0·0067
		High	0·0009	0·0019	-0·0004	0·0020	0·0006	0·0020	-0·0001	0·0008	0·0087	0·0012	0·0001	0·0043	0·0050	-0·0087	0·0007	-0·3191

Source: Purshouse et al. (2010b), p.9.

Table 39: Hazardous and harmful drinkers: Own- and cross-price elasticities for alcohol beverages

	CONSUMPTION →		Off-trade								On-trade							
			Beer		Wine		Spirit		RTD		Beer		Wine		Spirit		RTD	
PRICE ↓			Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Off-trade	Beer	Low	-0·5896	0·0086	0·0088	0·0367	0·0041	0·0057	0·0002	0·0006	0·0167	0·0249	-0·0002	0·0041	0·0019	0·0073	0·0002	0·0053
		High	0·0094	-0·5746	0·0098	0·0357	0·0039	0·0033	0·0003	0·0006	0·0136	0·0206	0·0005	0·0032	0·0016	0·0061	0·0004	0·0054
	Wine	Low	0·0198	0·0142	-0·5603	0·0116	0·0024	0·0065	0·0003	0·0043	0·0248	0·0281	-0·0001	0·0007	0·0006	0·0048	0·0005	0·0038
		High	0·0168	0·0151	0·0053	-0·6260	0·0047	0·0062	0·0002	0·0012	0·0280	0·0390	0·0000	0·0025	-0·0001	0·0085	0·0008	0·0037
	Spirit	Low	0·0064	0·0120	0·0041	0·0206	-0·6266	0·0016	0·0001	-0·0001	0·0181	0·0206	0·0006	0·0036	0·0000	-0·0009	0·0003	0·0004
		High	0·0056	0·0042	0·0037	0·0182	0·0017	-0·6459	0·0000	0·0007	0·0205	0·0236	0·0001	0·0025	0·0003	-0·0007	0·0004	0·0009
	RTD	Low	-0·0049	-0·0115	0·0038	0·0178	-0·0047	-0·0013	-0·3816	-0·0005	0·0018	0·0044	-0·0001	0·0006	-0·0012	0·0213	0·0001	-0·0007
		High	-0·0002	-0·0018	0·0135	0·0072	0·0045	0·0057	0·0000	-0·4158	0·0015	0·0077	-0·0001	0·0003	-0·0028	0·0037	0·0001	0·0008
On-trade	Beer	Low	0·0201	0·0175	0·0129	0·0464	0·0052	0·0061	0·0000	0·0024	-0·6161	0·0524	-0·0011	0·0034	0·0039	0·0059	-0·0011	0·0088
		High	0·0201	0·0185	0·0113	0·0415	0·0046	0·0055	0·0002	0·0015	0·0329	-0·6331	-0·0001	-0·0027	0·0048	0·0015	0·0003	0·0026
	Wine	Low	0·0049	-0·0033	-0·0009	-0·0014	-0·0017	0·0123	0·0001	-0·0038	-0·0312	0·0122	-0·3799	0·0004	-0·0022	-0·0069	0·0032	0·0045
		High	0·0097	0·0045	0·0021	0·0121	0·0029	0·0045	0·0002	0·0007	0·0148	-0·0039	0·0001	-0·4106	-0·0028	-0·0050	0·0013	0·0025
	Spirit	Low	0·0176	0·0190	-0·0019	0·0041	-0·0005	-0·0036	0·0000	0·0001	0·0147	0·0128	-0·0012	0·0277	-3·7220	0·0227	-0·0019	-0·0138
		High	0·0066	0·0023	0·0055	0·0179	-0·0006	-0·0018	-0·0003	-0·0026	-0·0048	-0·0181	-0·0003	-0·0015	-0·0006	-0·2861	-0·0002	-0·0043
	RTD	Low	0·0052	0·0042	-0·0046	0·0043	-0·0049	0·0046	0·0003	0·0006	0·0055	0·0119	0·0045	0·0020	0·0679	-0·0299	-0·3925	0·0135
		High	0·0024	-0·0002	0·0048	0·0100	0·0019	-0·0020	0·0002	0·0003	0·0152	0·0022	0·0008	0·0086	0·0019	-0·0053	0·0012	-0·4194

Source: Purshouse et al. (2010b), p.10.

Appendix B: Derived Data on Prices: Spain and Poland

Table 40: Prices in Euro per litre, 2015

	min	q05	q25	median	q75	q95	max	mean	sd
Beer	1.1	1.2	1.3	1.4	1.5	1.5	1.7	1.4	0.1
Wine (still)	1.0	1.4	1.7	2.2	2.3	2.5	3.0	2.0	0.4
Spirits	7.2	8.6	9.1	9.5	10.2	10.9	11.8	9.6	0.8
Other wine	2.3	2.7	3.3	3.8	4.6	5.2	7.8	4.0	0.9

Source: Own calculations based on Spanish HBS 2015.

Table 41: Spanish HBS – Prices in Euro per litre by year

	Beer	Wine (still)	Spirits	Other wine
2006	1.38	2.01	9.46	4.46
2007	1.33	1.79	8.95	4.29
2008	1.36	1.93	10.16	4.28
2009	1.40	1.89	9.76	4.31
2010	1.41	1.82	9.16	4.66
2011	1.34	1.95	8.99	3.63
2012	1.40	1.94	8.95	3.88
2013	1.31	2.06	8.97	4.01
2014	1.36	2.04	9.87	3.79
2015	1.36	2.17	9.50	3.84

Source: Own calculations based on Spanish HBS 2006-2015. Remark: Median price over NUTS1 x Municipality Size x Year.

Table 42: Prices in Złoty per litre, 2016

	min	q05	q25	median	q75	q95	max	mean	sd
Beer	4.39	4.74	4.94	5.00	5.17	5.29	5.46	5.03	0.17
Wine (still)	9.49	14.99	17.32	19.05	20.3	22.86	26.65	18.92	2.48
Spirits	39.98	40.58	42.93	43.98	45.47	47.45	49.98	44.16	1.95
Other wine	6.76	12.94	16.99	19.99	24.16	31.98	59.98	21.15	6.36

Source: Own calculations based on Polish HBS 2016

Table 43: Polish HBS – Prices in Złoty per litre by year

	Beer	Wine (still)	Spirits	Other wine
2006	4.69	15.55	38.34	11.29
2007	4.79	16.25	38.83	12.16
2008	5.00	17.32	39.49	13.00
2009	5.16	17.95	40.00	13.31
2010	5.13	18.21	39.99	13.79
2011	5.13	18.66	39.98	12.84
2012	5.19	18.53	40.00	12.88
2013	5.16	18.29	40.00	19.99
2014	5.05	18.56	42.67	19.99
2015	5.02	18.9	43.74	20.3
2016	5.00	19.05	43.98	19.99

Source: Own calculations based on Polish HBS 2006-2016. Remark: Median price over NUTS1 x Municipality Size x Year.

Appendix C: Summary Results on other variables in Two-Stage Regressions

This appendix summarizes the resulting impacts of the variables used for the first and second stage in the Heckman sample selection regressions for Spain. The first stage results model the probability of a household consuming a particular alcoholic beverage. At least one of these variables should not be included in the second stage regression, which models the amount of consumption. As such variables we chose two dummy variables indicating if the household has expenditures in the consumption categories pork and games of chance. The underlying intuition is that abstaining from alcohol may be due to religious reasons and strongly religious households may also abstain from games of chance and in some religious cultures also from eating pork. Besides these two variables we also included a dummy variable indicating if the household has expenditures in bars and discotheques. As an approximation to the total household income (which is sometimes not reported and thus missing) we include the natural logarithm total consumption expenditures. Furthermore, we include some characteristics of the household representative such as gender (dummy), unemployed (dummy), age and squared age. The latter is included since empirical studies find a U-shaped relationship of alcohol consumption and age, with highest likelihood of drinking in middle age segments.

Table 44: Summary first stage (probability of consumption) results HBS Spain

	Probability of consuming			
	Beer	Wine (still)	Spirits	Other wines
Household characteristics				
Expend. on Pork	+	+	+	+
Expend. on Games of Chance	+	+	+	+
Expend. on Bar and Disco	+	+	+	+
Total expenditures	+	+	+	+
Household Representative				
Female	-	-	-	-
Unemployed	+	+	(+)	-
Age	+	+	+	+
Age²	-	-	-	-

Source: Own calculations based on Spanish HBS 2006-2015.

Table 44 summarizes the results of the first stage regressions. The signs indicate the direction of the effect of the regressions by household size. The parentheses around a sign indicate that the relationship is not robust throughout the different household sizes and blanks indicate insignificant coefficients. According to prior expectations, households with expenditures on pork and games of chance show a higher probability of consuming alcoholic beverages. Furthermore, household that spend money in bars and discotheques show a higher probability of alcohol consumption. The likelihood of consuming alcohol also increases with total consumption expenditures, indicating an income effect on the likelihood of alcohol consumption. Turning to the characteristics of the household representative, household with a female representative tend to be less likely to consume alcoholic beverages, whereas an unemployed household head increases the likelihood of consuming beer or wine. The age profile is also in line with the results of other empirical studies, indicating that the probability of consuming alcohol increases with age until it

reaches a peak and then declines. Using the specific elasticities of beer for single households, for example, the peak probability of consuming beer would be at around age 48. The peak for single households spirits consumption probability is at 55 and the curve for wine is much flatter with a peak at 70.

Table 45 summarizes the impact of the second stage variables, besides the ones already presented in the tables in the main chapter. In addition to the variables used in first stage (except for the excluded variables pork and game of chance), we introduced dummies for the income quartile groups and a dummy that is 1 if the household representative holds a university degree. Overall, the amount consumed increases with total consumption expenditures. Conditional on that, the amount consumed decreases monotonically (except for other wines, which is due to insignificant coefficients) with income quartile. Households with consumption spending on bars and discotheques spend less on other wines. Being married, female, a smoker or having children reduces the consumption relative to the baseline categories unmarried, male, non-smoking and no children. Household heads with a university degree consume less be and more wine. Age has a similar shaped effect on consumed quantity as on probability of consumption. The quantity peaks for all households (up to 5 adults) are at 46 for beer, 74 for wine, and 51 for spirits.

Table 45: Summary second stage (amount consumed) results HBS Spain

	Beer	Wine (still)	Spirits	Other wines
Household characteristics				
Total expend.	+	+	+	+
Expend. on Bar and Disco				-
HH income relative to q1				
q2	less than q1	less than q1	less than q1	less than q1
q3	less than q2	less than q2	less than q2	
q4	less than q3	less than q3	less than q3	less than q2
Household Representative				
Married	-	-	-	-
Female	-	-	-	-
Smoker	-	-	-	-
Children	-	-	-	-
University degree	-	+		
Unemployed	+			-
Age	+	+	+	+
Age²	-	-	-	-

Source: Own calculations based on Spanish HBS 2006-2015.

Table 46 and Table 47 show the results for the respective regressions for Poland. Variables with no significant robust pattern over different household sizes are excluded. Regarding the first stage, expenditures on pork do not seem to be positively correlated with the decision to buy wine. Having expenditures on bars reduces the probability of purchasing other wines. Having a female head of household reduces the probability of consuming beer and spirits but increases the probability of purchasing still wine.

Table 46: Summary first stage (probability of consumption) results HBS Poland

	Probability of consuming			
	Beer	Wine (still)	Spirits	Other wines
Household				
Expend. on Pork	+	(-)	+	+
Expend. on Games of Chance	+	+	+	+
Expend. on Bar and Disco	+	+	+	-
Total expenditures	+	+	+	+
Head of Household				
Female	-	+	-	
Unemployed	-	-	-	
Age			+	+
Age²			-	-

Source: Own calculations based on Polish HBS 2006-2016.

Total consumption expenditures exert a highly significant positive effect on the amount consumed in single and one adult households. Coefficients on income quartiles were very unstable across samples with different household sizes, so no clear statements can be made to that regard. Households with married reference person purchase less beer, still wine and spirits, with the exception of one adult and single households, whose reference person consumes more spirits. Households with female reference persons consume less alcohol on average, with the exception of other wines. Having a university degree reduces average consumption of beer but increases consumption of wine.

Table 47: Summary second stage (amount consumed) results HBS Poland

	Amount consumed			
	Beer	Wine (still)	Spirits	Other wines
Household				
Total expend.	+ for single/one adult			
Head of Household				
Married	-	-	- / + for single and one adult	
Female	-	-	-	+
Children	-	-	-	-
University degree	-	+		
Unemployed	+	+		
Age	+	+		
Age²	-	-		

Source: Own calculations based on Polish HBS 2006-2016.

Appendix D: Results for Price Elasticities of Soft Drinks

Table 48: Spanish Soft Drinks Price elasticities by Household Size

	(1) All	(2) up to 3 Adults	(3) up to 2 Adults	(4) one Adult	(5) Single HH
Beer cross-price	-0.330 (0.0433)***	-0.299 (0.0464)***	-0.198 (0.0535)***	-0.0978 (0.125)	-0.0880 (0.136)
Wine (still) cross-price	-0.0603 (0.0184)**	-0.0659 (0.0196)***	-0.0828 (0.0227)***	-0.0252 (0.0537)	-0.00521 (0.0585)
Other wine cross-price	-0.0463 (0.0136)***	-0.0289 (0.0146)*	-0.0153 (0.0168)	0.0444 (0.0390)	0.0573 (0.0425)
Spirit cross-price	0.0716 (0.0276)**	0.0488 (0.0296)	-0.00372 (0.0341)	-0.182 (0.0808)*	-0.219 (0.0886)*
Soft Drinks own-price	-0.557 (0.0487)***	-0.607 (0.0520)***	-0.643 (0.0599)***	-0.410 (0.138)**	-0.375 (0.152)*
Observations (1st stage)	184,149	164,872	127,989	29,425	26,002
Observations (2nd stage)	134,342	117,519	87,355	16,264	13,792

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in liter per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Spanish HBS 2006-2015.

Table 49: Spanish Soft Drinks Price elasticities by drinking behavior and income group

	(1) Light	(2) Medium	(3) Heavy	(4) IncQ1	(5) IncQ2	(6) IncQ3	(7) IncQ4
Beer cross-price	-0.293	-0.0630	-0.744	-0.107	-0.299	-0.450	-0.538
	(0.0460)***	(0.149)	(0.220)***	(0.0858)	(0.0837)***	(0.0854)***	(0.0924)***
Wine (still) cross-price	-0.0561	0.0480	-0.322	-0.0659	-0.0256	-0.0197	-0.150
	(0.0195)**	(0.0613)	(0.0935)***	(0.0363)	(0.0355)	(0.0368)	(0.0386)***
Other wine cross-price	-0.0509	-0.0137	0.00448	0.0253	-0.0384	-0.122	-0.0556
	(0.0145)***	(0.0456)	(0.0694)	(0.0276)	(0.0268)	(0.0272)***	(0.0274)*
Spirit cross-price	0.0753	0.152	-0.00897	-0.0349	0.0466	0.0827	0.219
	(0.0293)*	(0.0943)	(0.140)	(0.0572)	(0.0546)	(0.0543)	(0.0552)***
Soft Drinks own-price	-0.577	-0.994	0.226	-0.564	-0.519	-0.690	-0.461
	(0.0517)***	(0.165)***	(0.247)	(0.0982)***	(0.0951)***	(0.0967)***	(0.0997)***
Observations (1st stage)	162,924	14,568	6,657	46,297	46,155	45,917	45,780
Observations (2nd stage)	118,400	11,026	4,916	30,942	33,653	34,663	35,084

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in liter per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Spanish HBS 2006-2015.

Table 50: Polish Soft Drinks Price elasticities by Household Size

	(1) All	(2) up to 3 Adults	(3) up to 2 Adults	(4) one Adult	(5) Single HH
Beer cross-price	0.826 (0.0486)***	0.845 (0.0517)***	0.852 (0.0583)***	0.621 (0.133)***	0.656 (0.166)***
Wine (still) cross-price	-0.00164 (0.0138)	0.00299 (0.0147)	-0.00374 (0.0166)	-0.0370 (0.0381)	-0.0322 (0.0474)
Other wine cross-price	0.0602 (0.00489)***	0.0567 (0.00521)***	0.0542 (0.00589)***	0.0266 (0.0134)*	0.0242 (0.0166)
Spirit cross-price	0.332 (0.0352)***	0.285 (0.0373)***	0.237 (0.0419)***	0.153 (0.0956)	0.199 (0.119)
Soft drink own-price	-0.434 (0.0151)***	-0.460 (0.0161)***	-0.481 (0.0182)***	-0.523 (0.0423)***	-0.553 (0.0527)***
Observations (1st stage)	296,286	262,028	205,487	51,183	45,355
Observations (2nd stage)	252,719	221,857	171,899	39,644	34,190

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 5% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in liter per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Polish HBS 2006-2016.

Table 51: Polish Soft Drinks Price elasticities by drinking behaviour and income group

	(1) Light	(2) Medium	(3) Heavy	(4) IncQ1	(5) IncQ2	(6) IncQ3	(7) IncQ4
Beer cross-price	1.005	1.297	0.892	0.882	0.846	1.051	0.969
	(0.0545)***	(0.304)***	(0.683)	(0.112)***	(0.106)***	(0.105)***	(0.106)***
Wine (still) cross-price	0.0219	-0.311	-0.0948	0.0937	0.0640	-0.0478	-0.105
	(0.0155)	(0.0842)***	(0.195)	(0.0316)**	(0.0301)*	(0.0298)	(0.0300)***
Other wine cross-price	0.0791	0.0428	0.0394	0.0643	0.104	0.0918	0.0443
	(0.00547)***	(0.0304)	(0.0742)	(0.0113)***	(0.0108)***	(0.0104)***	(0.0105)***
Spirit cross-price	0.445	0.462	0.520	0.509	0.485	0.510	0.174
	(0.0394)***	(0.210)*	(0.475)	(0.0834)***	(0.0783)***	(0.0750)***	(0.0742)*
Soft Drinks own-price	-0.586	-0.551	-0.618	-0.706	-0.605	-0.537	-0.407
	(0.0169)***	(0.0961)***	(0.218)**	(0.0341)***	(0.0325)***	(0.0322)***	(0.0339)***
Observations (1st stage)	304,165	9,274	1,993	66,113	78,753	83,628	86,938
Observations (2nd stage)	262,208	8,011	1,646	54,424	67,075	72,914	77,452

Remarks: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Only Households with up to 5 members aged 18 and above are included. The observations with the top and bottom 1% of consumed quantities per adult have been removed to correct for outliers. Estimation is carried out via two-step Heckman selection model, with selected second stage results being reported in the table. The dependent variable is quantity in liter per legal-drinking age adult (aged 18 or above). Source: Own calculations based on Polish HBS 2006-2016.