The impact of price changes on volume sales of alcoholic beverages in Sweden, 2006–2013

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We evaluate whether price elasticities on registered alcohol have changed in the last ten years in Sweden, in particular with regard to the investigation by Asplund et al (2007). We also investigate the fiscal effects of such changes. According to our estimates, price elasticities have increased, and these increases may have substantial effects on estimated changes in tax revenues when commodity tax rates are changed. In particular, commodity tax rates on spirits may have reached "Laffer territory" where tax increases may actually lower tax revenues.

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1. Introduction

An important issue with regard to commodity taxation is the extent to which price increases affect the volume of sales. In particular, price sensitivity becomes an issue when it comes to taxes on alcoholic beverages, where tax rates are often high and where therefore changes in tax rates may have substantial effects on prices. To estimate the fiscal impact of tax changes on alcohol, governments rely on estimations of price elasticities, i. e. demand elasticities as well as cross price elasticities. Cross price elasticities become important for alcohol where cross border shopping accounts for a substantial part of consumption. In Sweden, about 50 percent of spirits, 10 percent of wine and 20 percent of beer consumed are non-registered alcohol (Sorad 2012).

A ground breaking study that estimates price elasticities is Asplund, Friberg, and Wilander (2007). The authors estimate price elasticities for sales of Swedish alcoholic beverages for the period 1995–2004, with particular focus on cross price elasticities for cross border shopping. Their study occupies a prominent place in policy discussions on the fiscal impact of alcoholic sales in Sweden. However, their study treats the period 1995–2004, and since then important changes have occurred in the trading environment for private import of alcohol into Sweden. In 2004, the formal quantitative restrictions on cross border shopping of alcohol from the EU were banned. In addition, during the last five years Internet shopping of alcohol has increased. More alternative channels of foreign import as well as quantitative restrictions make it easier to import alcohol from abroad, wherefore domestic sales should become more sensitive to price. One could therefore expect that price elasticities have increased in later years, which would affect the fiscal impact of tax changes on alcoholic beverages.

The purpose of this paper is to update the study by Asplund *et al* (2007), with new data for the period 2006–2013. Have price elasticities changed during the last ten years, and if so, how could this affect tax revenues?

2. Data

We use quarterly data over a period of 8 years (1st quarter 2006 – 4th quarter 2013) and for all 21 Swedish regions (län), which provides us with a balanced panel of 672 observations. Table 1 includes the definition of the dependent and explanatory variables used in our study.

Table 1 Dependent and explanatory variables used in our study.

Variable	Definition
Dependent variable:	
Domestic sales	Swedish sales of alcoholic beverages by quarter and region (natural logarithm, 12-month differences). Sales are from registered channels, i.e sales from the Systembolaget and from restaurants.
Explanatory variables:	
Domestic price	Swedish price of alcoholic beverages by quarter (price index, natural logarithm, 12-month differences).
Foreign price	Foreign price of alcoholic beverages by quarter, by region (price index, natural logarithm, 12-month differences).
Distance to border	Distance to the closest foreign border, by region.
Disposable income	Disposable income per capita, by quarter and region (natural logarithm, 12-month differences).
Number of stores	Number of Systembolaget stores per capita, by quarter and region (natural logarithm, 12-month differences).
Public holidays	Number of public holidays, by quarter (12-month differences).

The dependent variable in our study is the sales volume of alcoholic beverages in Sweden (domestic sales), in liters per capita, by quarter (*t*) and region (*i*). The variable has been included in logarithmic form, for convenience of reading the results as elasticities. As already discussed, we are separately investigating three categories of alcoholic beverages: spirits, wine, and beer. Consequently, quarterly per capita volumes for sales of spirits, wine, and beer in each of the 21 Swedish regions[1] are considered.

To determine the price elasticity of demand we have included the natural logarithm of the price of alcoholic beverages in Sweden, also referred to as domestic price, as explanatory variable. The domestic price is available by quarter (*t*) and region (*i*) and in 12-month differences, to better capture any possible price changes. Following Asplund *et al*, the

[1] In a previous study, Asplund *et al*. (2007) eliminated the municipalities neighboring Sweden's borders with Norway and Finland, but this is where changes in foreign price determine most variation, so we kept them in.

domestic price is included in index format. The foreign price has also been included as explanatory variable. Foreign price is also considered in logarithmic format, for better interpretation of the results, and it is available by quarter (*t*) and region (*i*) and in 12-month differences. By "foreign" we mean the price of alcoholic beverages in the country that is closest, by Euclidean distance, to each of the capital cities of the 21 Swedish regions. The four countries from which prices of alcoholic beverages have been included in the foreign price variable are Denmark, Norway, Finland, and Germany. The foreign prices are also included in index format. Prices are recorded by our three categories considered for analysis: spirits, wine, and beer.

A potential source of error could be that Swedish prices are affected by foreign prices, which would distort results. However, we find little correlation between Swedish and foreign prices, wherefore this effect is disregarded.

Distance to the closest foreign border is the same as the distance used to determine which foreign price is to be considered in the analysis. Each Swedish regional capital has been geocoded (i.e., located on the map) and then the Euclidean (as-the-crow-flies) distance was calculated from each geocoded point to the closest foreign border. The calculations were performed using the Near tool in ArcGIS, a platform that provide tools for complex geographic analysis. Previous studies (e.g., Asplund *et al.* 2007) have considered distance in kilometers by car to Malmö. Their reasoning was that Malmö was the main gateway to lower alcohol prices since there are quick ferry lines from Malmö to both Denmark and Germany and a toll bridge from Malmö to Copenhagen. However, we believe that regions located in the upper half of Sweden (the northern regions) are this way overlooked, since it is more likely that inhabitants of these regions will travel to, e.g., Finland or Norway instead of Denmark or Germany, to replenish their alcohol supplies. Our distances are thus Euclidean distances calculated in kilometers to the closest border. (With regard to Norwegian prices, in practice, Norwegians come to by alcohol in Sweden since alcohol is cheaper there. This does not affect the economic effect on domestic sales from price changes, however.

We have also used a series of control variables in our study, namely disposable income and the number of stores per capita by quarter (*t*) and region (*i*), and the number of public

holidays by quarter (*t*); the reasoning behind the use of these variables is that alcohol sales increase during holidays and thus may impact our quarterly measures, an impact that must be accounted for to eliminate any possible bias. Similarly, alcohol sales in a region may vary with the number of stores located in the respective region. The same reasoning stays behind including the quarterly number of public holidays. It is more likely that people buy higher volumes of alcohol during public holidays. Other control variables initially considered for analysis have been excluded at a later stage, after testing has revealed multicollinearity issues. Among these is the number of Fridays by quarter (*t*). The argument behind using this variable in the study by Asplund *et al.* (2007) was that most of the sales would take place on Fridays until 2003, since the Systembolaget's stores were closed on Saturdays and Sundays. Since our dataset does not include this period of time, the use of the variable loses its validity. Descriptive statistics of the dependent and explanatory variables are presented in Table 2, by the three categories used for analysis (spirits, wine, and beer), where relevant.

Notice that domestic sales of spirits on average decreased during the period, while the sales of wine and beer increased.

Table 2 Descriptive statistics.

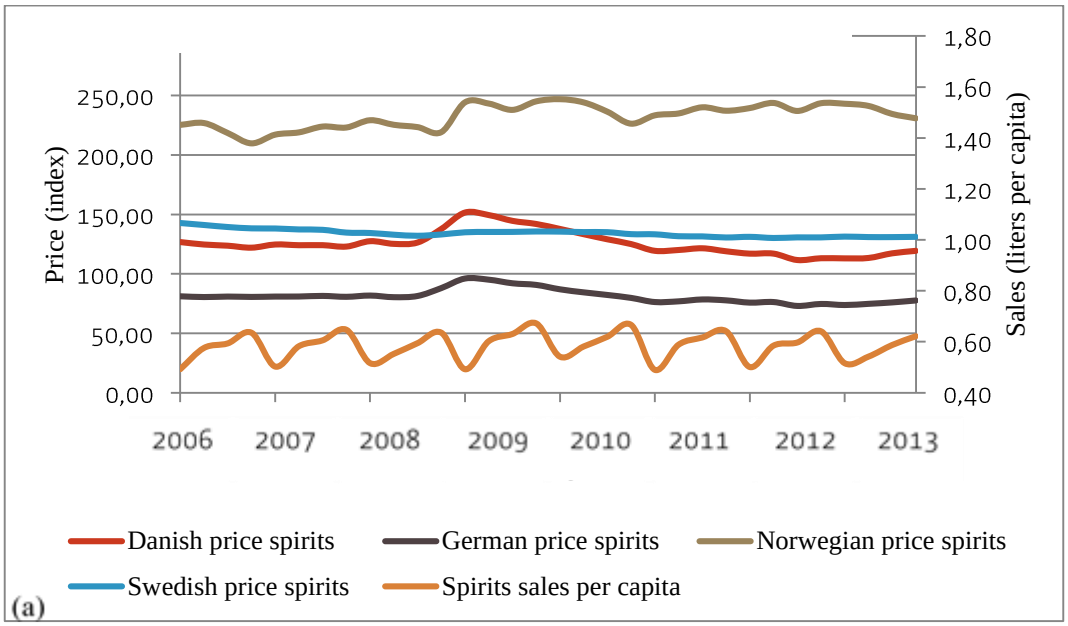
	Mean	Std. Dev.	Min	Max
Domestic sales spirits	–0.003	0.049	–0.132	0.198
Domestic sales wine	0.038	0.042	–0.090	0.215
Domestic sales beer	0.019	0.047	–0.103	0.164
Domestic price spirits	–0.009	0.016	–0.037	0.024
Domestic price wine	–0.004	0.018	–0.030	0.032
Domestic price beer	0.003	0.023	–0.034	0.057
Foreign price spirits	0.009	0.082	–0.143	0.227
Foreign price wine	0.002	0.075	–0.153	0.193
Foreign price beer	0.019	0.085	–0.141	0.268
Distance to border	153.3	73.0	13.4	294.4
Disposable income	–0.015	0.609	–1.640	1.785
Number of stores	–0.003	0.029	–0.284	0.095
Public holidays	0.000	1.000	–3.000	3.000

Note: all variables, except for distance to border, are in 12-month differences. Sales, prices, distance to the border, disposable income, and number of stores are in logarithmic form. Number of stores is per capita.

Sales data and data on the number of stores have been obtained from Systembolaget's own website. Systembolaget is a Swedish government-owned retail monopoly with a network of about 400 stores, and 500 agents that distribute alcoholic beverages all over the country

(Systembolaget 2014). Price indices, both domestic and foreign, have been calculated using Eurostat data (Eurostat 2014). Following Asplund *et al* (2007), domestic prices have been discounted by the consumer price index deflator. Foreign prices have been converted to Swedish kronor by the exchange rate at the period in question, and deflated by the (Swedish) consumer price index deflator. Distance to the closest border has been calculated in ArcGIS, as explained above. The shapefiles of the 21 Swedish regional capitals and those of national borders for the analyzed countries have been obtained from Lantmäteriet (The Swedish Mapping, Cadastral, and Land Registration Authority) and Statistiska Centralbyrån (Statistics Sweden) (Lantmäteriet 2013; SCB 2013). Also, data on disposable income and the number of public holidays have been obtained from Statistics Sweden.

Figure 1 shows Swedish sales of spirits, wine, and beer and the corresponding foreign prices in the analyzed countries, for the time period considered for our analysis.



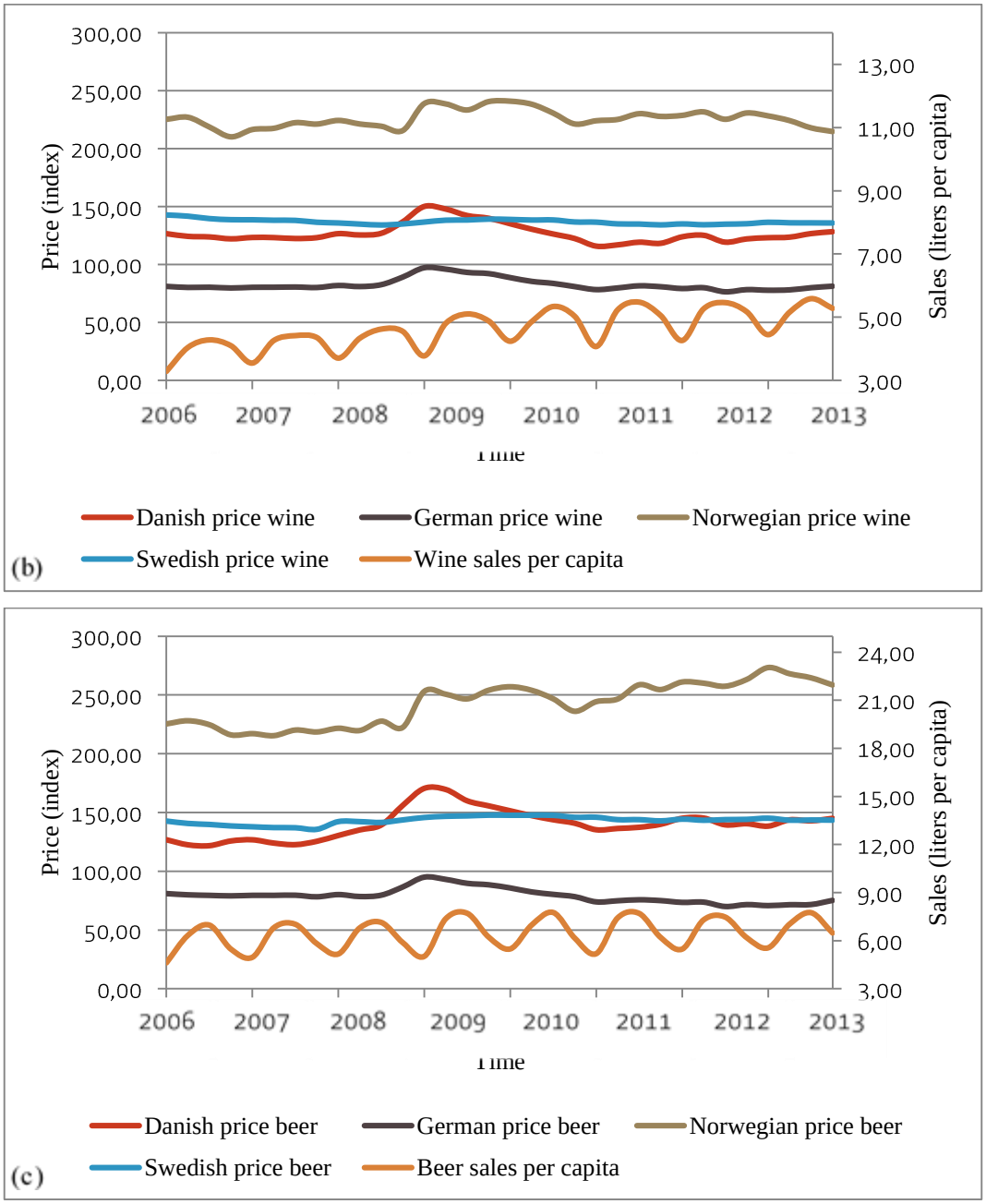


Figure 1. Domestic and foreign prices (index) and volume sales (liters per capita), 2006-2013, for spirits (a), wine (b), and beer (c).

As seen, there is a spike in foreign prices in 2009. This is due to the exchange rate: the Swedish krona lost about 10 percent of its value at this time. Also, alcohol sales are highly seasonal. Beer sales peak in spring, wine in summer and spirits in early autumn.

3. Model and results

3. 1. Model

To determine how demand is impacted by Swedish and foreign prices and also investigate the role of distance to the closest border in this relationship we estimate a double-log econometric model using on Ordinary Least Squares (OLS). Three separate but similar estimations are performed, one for data on spirits, one data on for wine, and one data on beer pieces and sale volumes. The base model is described by equation (1):

$$\Delta_{12} lnq_{t,i} = \alpha + \beta \Delta_{12} lnP^{S}_{t,i} + \gamma \Delta_{12} lnP^{F}_{t,i} + \left(\theta_1 D_i + \theta_2 D_i^2 + \theta_3 D_i^3\right)\Delta_{12} lnP^{F}_{t,i} + \vartheta \Delta_{12} X_{t,i} + \alpha_t + \gamma_i + \varepsilon_{t,i}, \quad (1)$$

where $q_{t,i}$ is the quantity of spirits, wine, or beer sold in Sweden in quarter *t* and region *i*; $P^{S}_{t,i}$ is the domestic price of spirits, wine, or beer, by quarter (*t*) and region (*i*); $P^{F}_{t,i}$ is the foreign price of spirits, wine, or beer, by quarter (*t*) and region (*i*). D_i is the distance from each Swedish regional capital to the closest foreign border. $\left(\theta_1 D_i + \theta_2 D_i^2 + \theta_3 D_i^3\right)\Delta_{12} lnP^{F}_{t,i}$ denotes an interaction term between foreign price and distance from each regional capital to the nearest border. The third-order polynomial function of distance has been included to account for the combined non-linear impact of these two variables on the sales volume of alcoholic beverages (spirits, wine, and beer). Non-linear interaction variables with distance in non-linear format have been previously used (Asplund *et alet al.*2007). $X_{t,i}$ is a vector of control variables (disposable income, number of stores, and public holidays). All variables are calculated as explained in section 2. α is a constant term and Δ_{12} indicates where 12-months differences have been used. β, γ, θ_1, θ_2, θ_3, and ϑ are coefficients to be estimated.

We included a year specific fixed effect, α_t, to adjust for time-variant heterogeneity given by, e.g., business cycles and other nationwide trends. We also included a municipality-specific random effect, γ_i, to control for any region-specific heterogeneity. Finally, a random error term with zero mean and constant variance was included as well (ε_{it}). Following Asplund *et al* (2007), we use OLS variables weighted by population.

3.2. Empirical results

The change in spirits, wine, and beer consumption in Sweden associated with both domestic and foreign price changes are presented in Table 3. The estimated coefficients for all domestic and foreign price variables are significant and have the expected signs. Price elasticities of demand range between –1.01 and –1.63 (–1.36 for spirits, –1.63 for wine, and –1.01 for beer). This means that, with an increase of 1 percent in price, the quantity sold would decrease on average by 1.36 percent for spirits, 1.63 percent for wine, and 1.01 percent for beer, all other variables constant.

Table 3 Changes in regional sales volumes for spirits, wine, and beer.

	Spirits (p-value)	Wine (p-value)	Beer (p-value)
$\Delta_{12} lnP^{S}_{t,i}$	–1.36*** (0.000)	–1.64*** (0.000)	–1.02*** (0.000)
$\Delta_{12} lnP^{F}_{t,i}$	0.26*** (0.000)	0.28*** (0.000)	0.20*** (0.000)
$D_i * \Delta_{12} lnP^{F}_{t,i}$	–1.77e-06 (0.112)	–3.73e-06*** (0.003)	–1.33e-06 (0.186)
$D_i^2 * \Delta_{12} lnP^{F}_{t,i}$	–7.59e-12 (0.382)	8.33e-12 (0.408)	–4.99e-12 (0.540)
$D_i^3 * \Delta_{12} lnP^{F}_{t,i}$	3.58e-17 (0.067)	2.89e-18 (0.901)	2.80e-17 (0.144)
$\Delta_{12}\ln[disposable\ income]$	0.000846 (0.643)	0.00095 (0.636)	–0.0020 (0.29)
$\Delta_{12}\ln[number\ of\ stores]$	0.003022 (0.943)	–0.0097 (0.84)	0.0038 (0.930)
$\Delta_{12}[public\ holidays]$	0.033*** (0.000)	0.021*** (0.004)	0.073*** (0.000)
Observations	580	580	580
R-squared	0.86	0.80	0.84
Adjusted R-squared	0.85	0.78	0.82

*** Significant at the 99 percent confidence level; ** significant at the 95 percent confidence level.

Earlier studies based on data from Sweden and other countries show that the price elasticities for alcoholic beverages typically lie between -0.2 to -1.5 (Baltagi and Griffin 1995; Cook and Moore 2000; Asplund *et al.* 2007). Our estimates are higher than unity and closer to the upper limit of this interval.

As expected, foreign price has a significant impact on the volumes of alcoholic beverages sold in Sweden as well. The results indicate that a 1 percent increase in price in the neighboring countries is associated to an average increase in the quantity sold of 0.26 percent for spirits, 0.27 percent for wine, and 0.20 percent for beer. As mentioned, by

"neighboring" country we considered that foreign neighbor that lies within the shortest distance to each Swedish regional capital. Euclidean (as-the-crow-flies) distances from each regional capital to the closest foreign border have been considered for analysis. The estimated coefficient of $\Delta_{12} lnP_{t,i}^{F}$ indicated the average elasticity of demand for spirits, wine, and beer at the border. The estimated coefficients for the interaction variables indicate how the influence of the foreign price varies with distance from the foreign border.

Most of the interaction variables between foreign price and distance to the closest foreign border are not statistically significant at the 95 percent level. Theory suggests that the influence of the foreign price is decreasing with distance from the foreign border and tapers off behind a certain limit (Asplund *et al.*2007). The lack of significance for the individual coefficients of the interaction variables in our study indicates that distance may not have the importance indicated by previous studies. We also tested for the joint significance of the interaction coefficients (to see if, even if they are individually not significant, they can together have a significant impact on volume sales). The only significant result was given by the wine coefficients. The only significant individual coefficient is also the wine coefficient of $D_i * \Delta_{12} lnP_{t,i}^{F}$; however, the values of these coefficient is very low.

There are three noteworthy results from our study compared to those of the Asplund *et al* study. The difference between our study and Asplund *et al.* are summarized in the following table:

Table 4 Comparison of elasticites, this study and Asplund *et al.* (2007)

	Spirits	Wine	Beer
Own price elasticity (this study)	–1.36	–1.64	–1.02
Own price elasticity (Asplund *et al.*)	–1.29	–0.24	–0.92
Cross price elasticity (this study)	0.26	0.28	0.20
Cross price elasticity (Asplund *et al.*)	0.32	0.17	0.47

First, our point estimates of own price elasticities of demand are higher. Asplund *et al* find a demand elasticity of –1.29 for spirits, –0.92 for beer and –0.24 for wine. By contrast, our estimates are –1.36, –1.02 and –1.64 respectively for spirits, beer and wine. In particular, our estimate for wine is much higher than that of Asplund *et al.*Second, our

at the border cross price elasticities are at about the same level as Asplund *et al* ((in the 0.2–0.3 range, whereas Asplund *et al* are in the 0.2–0.5 range). Third, our estimates of the distance to border effect is much lower than the ones estimated by Asplund *et al*. Distance to border in our study does virtually have no effect on the cross price elasticity of demand.

Out of the three control variables used in our model, only the number of public holidays per quarter produced significant results, while disposable income and the number of stores per region seem not to have a significant role in explaining variation in volume sales of alcoholic beverages in Sweden. The estimated coefficients of public holidays are, as expected, positive. This confirm the hypothesis that, as people buy more alcohol for public holidays such as Easter or Christmas, the presence of such holidays in a certain quarter may positively impact volume sales in that respective quarter. The impact is of 0.03 percent, 0.02 percent, and 0.07 percent increase in sales of spirits, wine, and beer, respectively, for each public holiday in the calendar.

Some of the results in our study, such as the insignificance of the distance coefficients or of control variables such as disposable income and the number of stores per region, may be due to the high level of data aggregation (we worked with only 672 observations[2] – quarterly data during 8 years (2006-2013), from 21 regions, of which 92 degrees of freedom were dropped during the calculations). Data availability has been a problem since Systembolaget declined to provide monthly information at store level to the research team, which would have introduced more variation in our data. Little variation in the dependent variables may lead to large variances of the estimated coefficients; subsequently, it may be difficult to correctly isolate the effect of the explanatory variables on the dependent variables (Doran 1989).

3.3 Effects on tax revenues

As hinted in the introduction, price elasticities affect tax revenues. When calculating fiscal effects of tax changes, it is therefore important to have accurate estimates of elasticities.

[2] Asplund *et al*. (2007) used more than 25,000 observations in their sample.

Here, we give a brief example of differences in tax revenues when different elasticities are used.

In 2013, the Swedish government decided to raise commodity taxes on alcohol, by 7 percent on beer and wine, and 1 percent on spirits. The new tax were to take effect on January 1, 2014. In their fiscal calculus, the Swedish Ministry of Finance implicitly calculates with an own-price elasticity of 0.5, for every type of alcohol (*Beräknings-konventioner* 2014). The ministry also assumes that sales losses on domestic registered alcohol exclusively goes into sales of non-registered alcohol (and not into other types of domestic consumption).

In this section we will estimate the budget effect of the tax increases given our estimated price elasticities. Following an example provided by the Swedish Tax Authority (Skatteverket 2014, p 204), it is assumed that the commodity tax on beer accounts for 36 percent of the sales price exclusive of VAT. For convenience, the sales volume is set to 100. Full pass-through is assumed, that is, the tax increase will be fully incorporated into the price. VAT is 25 percent. Fiscal effects are made for own-price elasticities of 0.5 (Ministry of Finance) and 1.0 (our estimate). The results are shown in table 5:

Tabell 5 Tax revenues from a change in the commodity tax rate on beer of 7 percent, given price elasticities of 0.5 and 1.0.

	Before tax rate	After (el.=0.5)	After (el.=1.0)
Price incl. VAT	16	16,4	16,4
Price excl. VAT	12,8	13,1	13,1
VAT revenue	3,2	3,3	3,3
Commodity tax	4,6	4,9	4,5
Revenue to vendor	8,2	8,2	8,2
Price change	-	2,5%	2,5%
Sales volume	100	98,7	97,5
Tax revenues	780	810	800
Change in tax revenues	-	30	20
Change tax revenues (%)		3,8%	2,5%
Change in tax revenues (el. 1.0) as percentage of change in tax revenues (el. 0.5)			65%

In the example, the change in sales price is 3.8 percent when the commodity tax is raised by 7 percent. This follows when the commodity tax is half of the sales price. The volume decrease in sales of registered alcohol is 1.3 percent given a price elasticity of 0.5, and 2.5 percent given an elasticity of 1.0. Tax revenues increase by 3.8 percent with an elasticity of 0.5, and 2.5 percent with an elasticity of 1.0. Tax revenues with elasticity 1.0 are thus 65 percent of tax revenues with elasticity 0.5.

Now an example with wine (again, following Skatteverket 2014). The example is for a bottle of wine which costs 80 SEK inclusive of VAT, of which 17 SEK is commodity tax. Elasticities are 0.5 (Ministry of Finance) and 1.6 (our estimate).

Table 6 Tax revenues from a change in the commodity tax rate on wine of 7 percent, given price elasticities of 0.5 and 1.6.

	Before tax rate	After (el.=0.5)	After (el.=1.6)
Price incl. VAT	80	81,5	81,5
Price excl. VAT	64	65,2	65,2
VAT revenue	16	16,3	16,3
Commodity tax	17,3	18,5	18,5
Revenue to vendor	46,7	46,7	46,7
Price change	-	1,9%	1,9%
Sales volume	100	99,1	97,0
Tax revenues	3330	3450	3380
Change in tax revenues	-	119	46
Change tax revenues (%)		3,6%	1,4%
Change in tax revenues (el. 1.6) as percentage of change in tax revenues (el. 0.5)			39%

Because the commodity tax accounts for only 25 percent of the sales price (exclusive of VAT) the sales price will be less affected by the tax increase. On the other hand, the price elasticity for wine is higher in our estimate than it is for beer, and thus a given price increase will have larger effect on sales volumes. Given the large difference in price elasticities, the sales loss on registered alcohol will be 0.9 percent and 3 percent respectively, (elasticities 0.5 and 1.6). Change in tax revenues calculated at (el. = 1.6) are now 39 percent of that calculated at (el. = 0.5),

We now turn to an example with spirits. Spirits may be the most interesting case, since the commodity tax accounts for about 73 percent of the sales price (again, example from the Swedish Tax Authority). Here is the calculus (commodity tax is 73 percent of the sales price, elasticities are 0.5 and 1.4 (our estimate), change in the commodity tax rate is 1 percent).

Table 7 Tax revenues from a change in the commodity tax rate on spirits of 1 percent, given price elasticities of 0.5 and 1.4.

	Before tax rate	After (el.=0.5)	After (el.=1.4)
Price incl. VAT	241	242,8	242,8
Price excl. VAT	192,8	194,2	194,2
VAT revenue	48,2	48,5	48,5
Commodity tax	141,8	143,2	143,2
Revenue to vendor	51	51	51
Price change	-	0,7%	0,7%
Sales volume	100	99,6	99,0
Tax revenues	19000	19110	18980
Change in tax revenues	-	110	-20
Change tax revenues (%)		0,56%	-0,11%
Change in tax revenues (el. 1.0) as percentage of change in tax revenues (el. 0.5)			***–19%***

The combination of a high elasticity and the fact that the commodity tax accounts for such a high share of the sales price, makes for a situation where tax revenues may actually decrease when taxes are raised. Instead of tax revenue increases by 0.5 percent calculated at price elasticity 0.5, tax revenues decrease by –0.2 percent when calculated at price elasticity 1.4. *The commodity tax system is in this case in "Laffer territory" where tax increases are actually counterproductive from a fiscal point of view*.

Factual change in tax revenues 2013–2014

It may be of interest to compare the predictions of the previous section with factual and predicted increases in revenues with regard to the increases in commodity taxes on alcohol from January 1, 2014. The Ministry of Finance predicted that they would increase tax revenues by 0.73 billion Swedish kronor from alcohol sales after the tax raises. With factual tax revenues now available, it is possible to compare the outcome with predictions. It turns

out that factual increases in tax revenues were about 60–75 percent of those predicted by the Ministry of Finance, as the following table shows:

Table 8 Factual changes in tax revenues from alcohol sales compared to predictions in Sweden, 2013–2014 (billion SEK).

	Total
Revenues 2013	12,22
Revenues 2014	12,66
Factual increases in revenue 2013–2014 (commodity tax)	0,44
MoF predicted increases in revenues (incl. VAT-effects)	0,73

Source: Statistics Sweden, Ministry of Finance.

Factual increases in tax revenues were 200–300 million SEK lower than those predicted by the Swedish Finance Ministry (the span reflects uncertainty of the VAT effect). A contributing factor to the outcome could well be that actual price elasticities on alcohol are substantially higher than those used by the Ministry of Finance when calculating tax revenues.

3.4 Concluding discussion

The purpose of this paper has been to evaluate whether price elasticities on registered alcohol have changed in the last ten years in Sweden, in particular with regard to the investigation by Asplund *et al* (2007). We also investigate the fiscal effects of such changes in price elasticities. According to our estimates, price elasticities have increased, and these increases may have effects on tax revenues. In particular, with regard to spirits, commodity tax rates may have reached "Laffer territory" where tax increases may lower tax revenues.

The estimated own price demand elasticities are higher than those of Asplund *et al* (1997). This is consistent with the view that prices are more sensitive in the period 2006–2013 than they were in the period 1995–2003. This could be due to a less restrictive trade environment where quantitative restrictions have been abolished and new channels such as the Internet have started to effect purchasing patterns. Higher own demand price elasticities suggest that changes in tax rates should have greater effect on demand than was previously estimated. The fiscal benefits of tax increases, for example, would thus tend to be exaggerated if calculated by the old elasticities.

With regard to tax revenues, our estimates suggest that increases in tax revenues may be lower than is currently believed, given elasticities in current use at the Swedish Ministry of Finance. For beer and wine, "real" revenue increases could be around half to two thirds of those calculated by the Ministry of Finance. Data from fiscal years 2013 and 2014 suggest that tax revenue increases were actually lower than those predicted by the Ministry of Finance. With regard to spirits, tax revenues may actually decrease. This is due to a combination of a high tax-to price ratio and a high price elasticity. If so, this would be an interesting case where Laffer effects would actually occur.

We regret that we were not able to obtain more detailed data from the Systembolaget, since these could potentially have increase the precision of our estimates. Therefore, more studies of this kind (but with finer data) should be a fruitful field of further study.

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		Danish price spirits	Danish price wine	Danish price beer	German price spirits	German price wine	German price beer
2006	jan	126,7	126,7	126,7	81,0	81,0	81,0
2006	apr	124,6	124,4	122,4	80,4	80,1	80,0
2006	jul	123,6	123,9	121,7	80,8	80,3	79,5
2006	okt	122,0	122,2	125,7	80,5	79,6	79,1
2007	jan	124,7	123,4	126,7	80,8	80,2	79,5
2007	apr	124,1	123,3	123,8	80,8	80,3	79,5
2007	jul	124,1	122,5	122,5	81,3	80,5	79,6
2007	okt	122,9	123,3	125,4	80,6	80,1	78,3
2008	jan	127,5	126,7	130,4	81,6	81,8	80,2
2008	apr	125,2	125,6	135,1	80,3	80,9	78,5
2008	jul	126,3	127,0	139,3	81,3	82,5	79,7
2008	okt	137,7	136,9	156,0	87,9	89,1	86,6
2009	jan	151,5	150,1	170,5	95,9	97,1	94,9
2009	apr	149,4	147,9	169,6	95,0	95,9	93,0
2009	jul	144,5	142,3	159,9	91,9	93,1	89,7
2009	okt	141,9	140,0	155,6	90,6	92,0	88,4
2010	jan	137,7	135,2	151,4	86,9	88,6	85,8
2010	apr	133,3	130,5	147,2	84,3	85,4	82,4
2010	jul	129,0	126,4	143,7	82,1	83,6	80,3
2010	okt	125,0	122,5	140,8	79,6	80,8	78,4
2011	jan	119,4	116,0	135,2	76,2	78,2	74,0
2011	apr	120,0	117,1	136,3	76,8	79,7	74,9
2011	jul	121,5	119,4	137,3	78,3	81,5	75,8
2011	okt	119,0	118,4	139,9	77,6	80,7	75,1
2012	jan	117,0	124,0	145,0	75,7	79,2	73,6
2012	apr	117,0	125,3	145,2	76,2	79,9	73,8
2012	jul	111,6	119,4	139,4	72,9	76,4	70,1
2012	okt	113,1	122,2	140,4	74,5	78,2	71,7
2013	jan	113,0	123,2	138,3	73,7	77,7	70,8
2013	apr	113,3	123,7	143,7	74,6	78,0	71,6
2013	jul	117,2	126,8	142,8	75,8	79,9	71,8
2013	okt	119,3	128,4	145,0	77,5	81,2	75,3

		Norwegian price spirits	Norwegian price wine	Norwegian price beer	Finnish price spirits	Finnish price wine	Finnish price wine
2006	jan	225,3	225,3	225,3	168,4	168,4	168,4
2006	apr	226,8	227,1	228,0	165,6	165,8	164,8
2006	jul	218,5	218,7	224,6	164,4	164,5	162,0
2006	okt	209,9	210,3	215,9	161,9	162,1	159,3
2007	jan	217,1	216,5	217,0	163,2	163,8	162,0
2007	apr	219,0	217,6	215,3	163,1	163,4	161,1
2007	jul	223,9	222,4	220,0	163,8	163,8	162,0
2007	okt	223,1	221,2	218,4	161,6	161,5	159,7
2008	jan	229,2	224,3	221,6	181,8	170,1	169,3
2008	apr	225,4	221,3	219,6	179,5	166,6	165,5
2008	jul	223,4	219,4	227,6	181,1	168,2	166,6
2008	okt	219,2	215,7	222,3	196,1	181,7	180,9
2009	jan	244,2	238,8	253,0	228,3	206,1	205,3
2009	apr	243,1	238,5	250,6	224,3	202,2	204,7
2009	jul	237,8	233,3	246,6	216,9	194,2	198,3
2009	okt	245,0	240,5	254,0	227,3	197,8	204,3
2010	jan	246,8	240,9	256,9	218,2	190,8	198,4
2010	apr	244,1	238,2	253,9	210,4	182,4	191,2
2010	jul	236,3	230,6	246,7	206,2	178,1	186,4
2010	okt	226,3	221,3	236,0	200,0	173,1	180,4
2011	jan	233,3	224,1	244,2	191,8	167,0	172,6
2011	apr	234,9	225,2	246,5	192,7	167,8	173,3
2011	jul	240,0	230,1	258,6	195,6	170,5	175,3
2011	okt	237,1	227,8	254,5	193,1	169,9	175,1
2012	jan	239,4	228,7	261,0	199,9	172,9	186,6
2012	apr	243,6	231,7	260,0	200,3	173,3	186,2
2012	jul	237,0	225,3	257,4	191,0	165,0	176,5
2012	okt	243,4	230,7	263,1	195,4	168,2	179,4
2013	jan	243,0	228,2	273,3	195,6	168,0	178,9
2013	apr	241,2	224,2	268,0	196,6	169,5	179,8
2013	jul	234,5	218,0	264,5	199,8	171,8	180,6
2013	okt	230,8	214,8	258,5	203,7	175,1	185,0

		Swedish price spirits	Swedish price wine	Swedish price beer	Spirits volume/ capita	Wine volume/ capita	Beer volume/ capita	Spirits sales per capita	Wine sales per capita	Beer sales per capita
2006	jan	142,8	142,8	142,8	0,5	3,2	5,2	0,5	3,3	4,6
2006	apr	141,1	141,7	140,8	0,6	3,9	6,9	0,6	4,0	6,3
2006	jul	139,4	139,6	139,9	0,6	4,2	7,7	0,6	4,3	7,0
2006	okt	138,3	138,6	138,7	0,6	3,9	6,0	0,6	4,1	5,5
2007	jan	138,2	138,6	138,0	0,5	3,5	5,6	0,5	3,5	5,0
2007	apr	137,4	138,2	137,3	0,6	4,1	7,8	0,6	4,3	6,8
2007	jul	137,1	138,0	137,1	0,6	4,4	8,0	0,6	4,4	7,0
2007	okt	134,7	136,4	135,8	0,7	4,2	6,6	0,6	4,4	5,8
2008	jan	134,4	135,8	142,4	0,5	3,7	6,1	0,5	3,7	5,2
2008	apr	133,0	134,8	142,3	0,6	4,2	7,9	0,6	4,3	6,8
2008	jul	132,1	134,0	141,6	0,6	4,6	8,3	0,6	4,6	7,1
2008	okt	133,2	134,9	143,8	0,7	4,4	6,7	0,6	4,5	5,9
2009	jan	135,0	136,6	145,8	0,5	3,7	5,8	0,5	3,8	5,0
2009	apr	135,3	138,2	146,9	0,6	4,6	8,5	0,6	4,8	7,4
2009	jul	135,3	138,4	147,2	0,6	4,8	8,6	0,6	5,1	7,7
2009	okt	135,7	139,2	147,8	0,7	4,6	7,0	0,7	4,9	6,2
2010	jan	135,6	138,9	147,7	0,6	4,1	6,4	0,5	4,2	5,5
2010	apr	135,2	138,3	147,8	0,6	4,6	8,0	0,6	4,9	7,0
2010	jul	135,1	138,4	147,7	0,6	5,1	8,7	0,6	5,3	7,8
2010	okt	133,4	136,6	146,0	0,7	4,7	6,8	0,7	5,0	6,2
2011	jan	133,3	136,4	146,1	0,5	4,0	6,1	0,5	4,1	5,2
2011	apr	131,7	134,9	144,0	0,6	5,1	8,8	0,6	5,2	7,4
2011	jul	131,6	134,8	144,0	0,6	5,3	8,8	0,6	5,5	7,7
2011	okt	130,7	134,0	143,0	0,7	4,7	7,0	0,6	5,1	6,2
2012	jan	131,2	134,9	144,4	0,5	4,1	6,4	0,5	4,3	5,5
2012	apr	130,2	134,2	143,5	0,6	5,0	8,5	0,6	5,3	7,3
2012	jul	130,7	134,7	144,1	0,6	5,2	8,4	0,6	5,5	7,5
2012	okt	130,7	135,1	144,3	0,7	4,9	7,0	0,6	5,2	6,2
2013	jan	131,4	136,4	145,2	0,5	4,3	6,6	0,5	4,4	5,5
2013	apr	131,0	135,9	143,6	0,6	4,9	8,1	0,5	5,2	7,0
2013	jul	131,0	135,8	143,7	0,6	5,4	9,1	0,6	5,6	7,8
2013	okt	131,2	135,7	143,6	0,7	5,1	7,5	0,6	5,3	6,5

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