Discussion Papers
Department of Economics
University of Copenhagen

No. 11-28

Do Taxes Produce Better Wine?

Martin Ljunge

Øster Farimagsgade 5, Building 26, DK-1353 Copenhagen K., Denmark
Tel.: +45 35 32 30 01 – Fax: +45 35 32 30 00
http://www.econ.ku.dk

ISSN: 1601-2461 (E)

Do Taxes Produce Better Wine?

Martin Ljunge[1]

October 14, 2011

Abstract

Theory predicts that unit taxes increase the quality consumed in a market since unit taxes reduce the relative price of high quality goods. Ad valorem taxes, on the other hand, have no effect on relative prices and should not affect product quality. The hypothesis is tested empirically in the US wine market. I find that the market share of high quality wine is significantly increased by unit taxes and that there is no significant effect of ad valorem taxes, in accordance with the hypothesis and previous empirical studies.

JEL codes: D12, H31
Keywords: Quality Choice; Unit Tax; Tax Distortion.

1. Introduction

Taxation gives rise to shifting behavior on many margins. Barzel (1976) put forth the idea of quality shifting from taxation. His hypothesis is that unit based taxes, like excise taxes, would increase the quality of goods consumed in a market. One argument for this is that unit based taxes reduce the relative price of high quality, inducing a substitution effect towards high quality. Unit based taxes only apply to one dimension of the good, the quantity, while it leaves the quality untaxed. Ad valorem, or value based, taxes apply both to the quantity and quality of the good and leave relative prices unchanged. Thus, ad valorem taxes should have no effect on the quality in a market.

[1] Department of Economics, University of Copenhagen, Øster Farimagsgade 5, DK-1353 Copenhagen K. e-mail: martin.ljunge@econ.ku.dk. I acknowledge financial support from the Wallander grant and Riksbankens Jubileumsfond.

The unit tax causes an additional source of deadweight loss due to induced quality shifting. In the standard case the deadweight loss is in terms of the quantity of products not consumed and produced. If the tax system induces quality shifting, there is another margin that must be included when computing the deadweight loss, i.e., to what extent people change the quality of goods consumed. Given that the hypothesis is true, there are people buying a higher quality of the good than they would have in the absence of the tax. Hence they consume goods that are too good, money they would rather spend differently had there not been a tax. Also, production is shifted in relative favor of higher quality goods, and the social resources are used less efficiently. Furthermore, quality shifting in response to unit taxation has consequences for tax revenues. Increasing the unit tax will not only make some people not buy the item, it will also shift the demand in favor of higher quality goods. These concerns may be important when formulating tax policies.

The idea of quality shifting extends well beyond the effect of unit taxes. Any good that is available in different qualities and where the price involves a per unit component would be affected. The per unit component could involve monetary costs, like title and registration fees for automobiles,[2] or time costs, like shopping around at different stores to find the best deal. Another related area is trade where shipping costs and tariffs constitute fixed costs similar to unit taxes. The hypothesis has implications for a wide range of activities, and the welfare consequences are potentially large.

The validity of Barzel's hypothesis is an empirical question. In this paper I test the hypothesis with data from the wine market, which expands the existing literature to a

[2] The effects of taxes on demand of automobiles are studied in Fershtman, Gandal, and Markovich (1999).

new market. I find evidence consistent with quality shifting from low to high quality consumption due to unit taxes while ad valorem taxes seem to have no such effect.

Previous tests of Barzel's hypothesis have focused on the cigarette market. The first papers tested the effect of taxes on cigarette prizes. Barzel (1976) and Johnson (1978) found support for the hypothesis, while Sumner and Ward (1981) rejected it. A different test of the hypothesis is explored in Sobel and Garrett (1997). They test how the market share of premium cigarettes is affected by unit and ad valorem taxes. They find that unit taxes significantly increase the premium market share, while ad valorem taxes have no significant effect. They conclude that their results support Barzel's hypothesis. Recent evidence from the beer market in Rojas and Shi (2010) find support for quality shifting based on one change in the federal excise tax and differences in transportation costs across brewer and market pairs. Hummels and Skiba (2004) use detailed trade data and find support for the quality shifting hypothesis based on differences in transportation costs and tariffs.

The contribution of this paper is two-fold. First, I outline a simple model for analyzing quality shifting through which the empirical estimates can be interpreted. The second, and main, contribution is to empirically test for quality shifting using data from the wine market, data that have not been explored before. The test uses the market share and the results are similar to what is found in the cigarette market.

The literature on how taxes affect the quality of goods consumed is small. This might be somewhat surprising since public policy has the potential of affecting quality in many areas. One study is Goolsbee (2003). He examines how depreciation allowances

to firms affect investment in equipment. Another related area is international trade where quotas and tariffs may shift the quality of traded goods.[3]

The paper is organized as follows. The next sections outline the model and the method, which is followed by a section describing the data. Then the section with the empirical tests is presented. The conclusions are discussed in the subsequent section.

2. Model

The two main predictions in Barzel (1976) are that unit based taxes will induce shifting towards higher quality of a product, and that ad valorem taxes have no effect on the product quality.

One motivation for how unit taxes increase average market quality is based on relative prices. Suppose there are two quality categories of a product, high and low with respective prices P_H and P_L, $P_H > P_L$. Introducing a unit tax of t reduces the relative price of high quality since $(P_H + t)/(P_L + t) < P_H / P_L$. The reduction in the relative price of high quality from the unit tax induces a substitution effect toward the high quality category. Introducing an ad valorem tax does not affect the relative prices, and should have no effect on the product quality.

As pointed out in Sobel and Garrett (1997), a test consistent with the hypothesis can be conducted by examining how the market share of the high quality good varies with unit and ad valorem taxes. To formalize this argument consider the following model[4].

[3] See for example Falvey (1979), Rodriguez (1979), Krishna (1987), Feenstra (1988, 1993, 1995).
[4] The model is chosen to exhibit the properties from the intuition regarding the market share used in the previous literature, which put some restrictions on the set of models.

Let demand for a good, Q_i, be represented by

$$Q_i = h(1+s)\cdot g^i\left(P_i + t, \frac{P_i + t}{P_j + t}\right) \qquad (1)$$

Where s is the proportional sales tax rate and i=H, L and j≠i. The i represents the quality level of the good, which is either high or low. The first argument of $g^i(.)$ determines how demand responds to price of that good, and the second argument determines how the own price relative to the price of the other quality affects demand.

The first derivatives of g are assumed to be continuous and non-positive for both the first and second arguments. Partial derivatives will be denoted by subscripts, so $g_1^i \leq 0$ and $g_2^i \leq 0$. The model will exhibit quality shifting if relative prices affect demand, that is, if $g_2^i < 0$.

The market share of the quality levels can be constructed using the demand model (1). Let MS_H denote the market share of the high quality good in terms of physical quantities. Then

$$MS_H = \frac{g^H\left(P_H + t, \frac{P_H + t}{P_L + t}\right)}{g^H\left(P_H + t, \frac{P_H + t}{P_L + t}\right) + g^L\left(P_L + t, \frac{P_L + t}{P_H + t}\right)} \qquad (2)$$

From the expression of the market share we see that $\delta MS_H/\delta s=0$, so the sales tax has no effect on the market share. The second prediction is that higher unit taxes will increase the high quality market share, that is, $\delta MS_H/\delta t>0$. For this to be true we need that the elasticities for demand of quality i with respect to the unit tax t are ordered as $\varepsilon_{Qt}^{L} < \varepsilon_{Qt}^{H}$.[5] In words, the requirement on the model is that the demand of low quality goods is more elastic to the unit tax than the high quality demand.

Testing quality shifting using market share data rests on two assumptions. First, the function h(.) needs to be the same for both the high and low quality markets. Second, an assumption regarding the ordering of demand elasticities is needed to get a positive relationship between the market share and the unit tax. The market share test is essentially a test of the ordering of the elasticities.

The model outline here is very simple but captures Barzel's main prediction. The model essentially states some conditions under which the prediction will hold. It is of course possible to write down more complex models under which the prediction is ambiguous, such as Rojas and Shi (2010). At the end of the day, however, it is an empirical question to determine if there is quality shifting due to unit costs in real markets, which is the main focus of this paper.

3. Empirical Method

As a test of quality shifting, I apply the empirical strategy based on the market share similar to Sobel and Garrett (1997). I use a pooled linear regression model where the

[5] Note that the elasticities are in real terms. The condition is derived in Appendix 1.

market share of high quality wine is regressed on unit and sales taxes, state and time fixed effects, and additional controls. The additional controls are combinations of personal income, unemployment, and population growth. Barzel's hypothesis would predict that the coefficient on unit taxes is positive and significant, and that the coefficient on sales tax is insignificant.

The empirical model for examining the market share is

$$\%\text{High Quality}_{st} = \alpha + \beta*\text{Unit tax}_{st} + \gamma*\text{Sales tax}_{st} + \delta*X_{st} + \mu_s + \pi_t + \varepsilon_{st} \quad (3)$$

where $\%\text{High Quality}_{st}$ is the market share of high quality table wine in state s and year t, Unit tax_{it} is the cents per gallon unit tax on wine with less than 14% alcohol content in state s and year t, and X_{st} is a set of control variables for state s and year t. State fixed effects are represented by μ_s and time fixed effects by π_t.

From Barzel's hypothesis, the coefficient on unit tax β is expected to be positive and significant and the coefficient on sales tax γ is expected to be insignificant. The regression is estimated using ordinary least squares and robust standard errors are computed. The identifying assumption is that the tax rate variation is exogenous conditional on the control variables. It is reasonable to assume, I believe, that tax rate changes are enacted independent of individual demand changes with respect to the quality of the good demanded. Since state fixed effects are included it is allowed that both the level of taxes and the high quality share vary systematically across states, since the parameters of interest are identified from variations around the state specific means. The interpretation that tax changes cause changes in the fraction of high quality is, as in all the empirical papers, conditional on the exogeneity assumption

being true.[6]

4. Data

The available data are on the quantity of domestic and imported table wine consumed per year and state in the United States.[7,8] The quantity data is used to construct market shares and conduct a test of quality shifting based on the market share of high quality wine.

There are two groups of US states with regard to wine sales. 32 states and the District of Columbia are License States, which impose wine excise taxes at the state level and the distribution and sales of wine is decentralized. The remaining 18 states are Control States where the sales of wine is directed by the government and distributed through a centralized network. They use a combination of mark-ups and taxes in their pricing and it is hard to disentangle what really is a tax. Both the market structure and the data are problematic for the Control States. Therefore the License States are used in the study, which leaves 33 jurisdictions per product and year. Unit taxes range from 10 to 246 cents per gallon of wine, and the average is 71 cents per gallon. The states with the highest taxes are Florida and New Mexico. The lowest taxes are found in Louisiana and New York. There are two sources of variation in the taxes, states that change the tax and inflation. There are on average 3 states per year that change their unit tax on wine. The tax rates are transformed into real terms using the CPI.

[6] The exogeneity assumption is fundamentally untestable.
[7] Source: Adams Wine Handbook. 'Table wine' is the label for wine with an alcohol content of less than 14%.
[8] It would be preferable to have more detailed data on consumption, for example by label or vintage. Such data is, however, not available at the state level.

The wine data are, as mentioned, divided into the two categories domestic and imported. Imported wine is classified as the high quality category and domestic wine is the low quality category. The top 5 brands in the respective category are presented in Table 1 along with their market shares and average prices. The top domestic wines are primarily sold in boxes, big bottles, and jugs. These wines are the budget alternatives on the market. The top imported brands are all sold primarily in 75 cl bottles and have a significantly higher price. Price is a good indicator of quality since consumers would not pay more for a product if it did not deliver a higher value.[9] Price per quantity then provides a measure of a good's perceived quality. The most popular imported wines have an average price of 140% above the domestic wines. The categories are not perfect since there are a number of more expensive domestic wines. However, the consumed quantity of domestic wine is dominated by the low quality brands. Furthermore, among the top imported wines there are no brands selling in big boxes or jugs as the top domestic brands. Another argument for the quality classification is the Alchian-Allen theorem.[10] It states that given constant transportation costs, relative prices will be tilted to favor imports of higher quality goods.

The classification of imported wine as high quality does not mean that every bottle of imported wine is preferred over any bottle of domestic wine by most people. It does not mean that pair wise comparisons of imported wine versus domestic wine given a

[9] One might imagine other definitions of quality, for example based on taste ratings from the Wine Spectator. There are however several problems with such definitions. First, those ratings are very subjective and may not reflect the opinion of most consumers. Second, the taste is only one part of the product's quality (you may pay a premium to have an Italian wine with your Italian meal just because the wine is Italian). Third, such ratings only cover a subset of the market. It would be hard to control for substitution into and out of unrated wines. Fourth, the available data does not allow for such a study.

[10] See Borderching and Silberberg (1978).

certain price even in most cases come out in favor of the imported wine. The distinction does not imply that professional wine tasters would give imported wine a higher grade. The crucial distinction is that consumers pay more for the average bottle of imported wine. By paying more for imported wine they reveal that they value imported wine higher than domestic wine, on average. The higher price paid for imported wine characterizes its higher quality. It does not matter if the higher price can be explained by custom duties, transportation costs, or higher production costs. Consumers have still revealed that they value the imported wines more by paying a premium for them.

As seen in the table the domestic wine market is much more concentrated to a few brands. As a further comparison the top 25 domestic brands have a market share of about 75% while the top 25 imported brands have a market share of 50%.

Table 1. Top Wine Brands in 2000.

Domestic				Imported			
Brand	Volume	Market share	Avg. Price (75 cl)	Brand	Volume	Market share	Avg. Price (75 cl)
Franzia Winetaps	20166	12.3%	$1.60	Concha Y Toro	1972	5.0%	$4.35
Carlo Rossi	10500	6.4%	$2.00	Riunite	1802	4.6%	$4.45
Almaden	9380	5.7%	$2.20	Lindemans	1750	4.4%	$8.20
Livingston Cellars	9150	5.6%	$2.50	Rosemount Estate	1335	3.4%	$9.90
Sutter Home	7200	4.4%	$4.70	Casarsa	1210	3.1%	$4.55
Top 5 average			$2.60	Top 5 avg.			$6.29
Share of total		34.3%				20.4%	

Note: Volumes are measured in thousands of 9-liter cases. Market share refers to the share of respective category. The top 5 average price is unweigthed. Source: Impact Databank and Adams Wine Handbook.

The data are used to construct one dependent variable, the market share of high quality wine, as imported wine's share of the total market. The two main controls in the regressions are unit taxes for table wine and general sales taxes for the different states and years. Additional control variables considered are personal income,

unemployment, and population growth. All monetary variables are deflated using the CPI. The data span 6 years, 1995 through 2000, which adds up to 198 observations. The quality measures and dependent variables are assumed to exhibit no more than classical measurement errors. Table 2 presents a summary of the data.

Table 2. Data summary statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Market share of high quality Wine, %	198	16.9	6.1	5.0	33.2
Unit tax, cents per gallon	198	70.9	49.9	10.6	246.0
Sales tax rate	198	4.7	1.7	0	7
Personal income, $	198	26735	4314	19831	40046
Unemployment, %	198	4.6	1.3	2.3	8.9
Price, low quality	198	3.44	0.38	2.38	4.35
Price, high quality	198	5.19	0.53	3.85	6.36

5. Results

This section presents the empirical analysis of the market share of high quality wine. The results from the regressions are presented in Table 3. The estimates in the table are consistent with Barzel's hypothesis. In all specifications there is a positive and significant effect of unit taxes and the effect of sales tax rate is never significantly different from zero.

Table 3. Dependent variable: Market Share of High Quality Wine.

	1	2	3	4	5
Unit tax	0.0198	0.0187	0.0188	0.0188	0.0168
	(.0075)	(.0072)	(.00728)	(.00702)	(.00665)
Sales tax rate	0.320	0.420	0.411	0.312	0.294
	(.564)	(.49)	(.495)	(.482)	(.496)
Income		0.00019	0.000527	0.000214	0.000199
		(.000097)	(.00047)	(.000098)	(.000098)
Income squared			-4.95E-09		
			(7E-09)		
Unemployment				0.1396	0.1225
				(.105)	(.111)
log Population					-7.94
					(2.52)
State Fixed Effects	yes	yes	yes	yes	yes
Year Fixed Effects	yes	yes	yes	yes	yes
Observations	198	198	198	198	198

Note: In brackets are robust (Huber/White/sandwich) standard errors.

The first specification only includes the unit and sales tax rates, in addition to the state and year fixed effects. The state fixed effects mean that the only variation used to identify the estimates is within states across time. The positive estimate on unit tax is hence due to the market share for high quality wine being higher during years when the unit tax is higher than usual. The year fixed effects account for any aggregate effects on the market share of high quality wine. The point estimate on the unit tax is positive and strongly significant, consistent with the quality shifting hypothesis. The estimate on the sales tax rate is positive but insignificant, which is also in line with the hypothesis.

Although state and year effects capture many potential confounding factors there may be some time varying factors that drive the market share for high quality wine. One such candidate is income, which is included in the second specification. The point estimate is positive, so higher income is associated with a higher share of high quality wine. The estimates on the unit and sales tax rates remain very similar to the previous specification. The third specification allows for non-linear effects of income by

including the square of income. The point estimate is negative but insignificant, and the term is not included in the remaining models. Another moment of the income distribution is captured by the unemployment rate, which is included in specification 4. The point estimate is positive but insignificant. In the last specification of Table 3 the log of the state population is included. As state fixed effects are included, the estimate on the log population is identified from population growth. The negative point estimate, which is significant, tells us that the market share for high quality wine decreases when population in the state increases. In all these specifications the point estimate on the unit tax remains positive and strongly significant, while the estimate on the sales tax rate is always insignificant. Both these results are consistent with Barzel's hypothesis of quality shifting.

The effect of unit taxes on the product quality is 1.35 percentage points evaluated at the average, that is, the product quality in the wine market is 1.35 percentage points higher solely due to the unit taxes. The average effect of unit taxes is smaller compared to Sobel and Garrett's (1997) study of the cigarette market. One explanation for this may be that taxes relative to the product price are smaller in the wine market.

The results in Table 3 provide support of Barzel's hypothesis and they are consistent with the previous study in the cigarette market in Sobel and Garrett (1997). The evidence from the wine market also line up with Rojas and Shi (2010) study of the beer market.

5.1 Alternative Stories: Interaction results

It may be argued that the wine market is segmented into a high quality and low quality part. The responses found could then be interpreted as the low quality segment being more sensitive to price. When taxes increase it pinches the low segment more and they shift out of the market. If this is true we would expect low quality consumers with higher income to be less responsive to the tax. This could be tested by interacting unit tax with income and including it in the regressions.

Another concern may be that agents don't purchase the wine in the state they live, but rather cross the state line. Agents in high tax states would be more prone to do so. To test for this I use two different interactions. They are unit tax interacted with population density or state size. The argument for the tax-population density variable is that small states tend to have larger population density and that it is easier to cross the state border in a small state. For the tax-state size interaction the argument is that large states have longer borders, which makes it easier to cross them.

None of the interaction terms come up significant in the regressions. The point estimate of the tax-income interaction even has the unexpected sign. It seems like the data do not support any of these alternative stories.

It may be argued that the wine market is special. One argument would be that there is a fraction of the market that is ultra premium where prices are not set in a competitive way. However, the quantity of wine in this category is negligible compared to total wine consumption. The situation is not unlike other markets like, for example, clothing and automobiles where exclusive designer fashion or extreme performance cars demand a hefty price premium. That there is a very high quality niche in a market

is rather common.

6. Conclusion

In this paper I have empirically tested Barzel's hypothesis, which asserts that unit taxes shift consumption to higher quality and that ad valorem taxes have no effect on the quality consumed. I find that unit taxes significantly increase the market share of high quality goods and that ad valorem taxes have no effect on the market share. The results are consistent with the hypothesis.

The results indicate that the quantitative significance of quality shifting is limited in the US wine market. The influence of unit taxes on the quality consumed and produced does not seem to produce large distortions of the quality composition in the wine market. This implies that the welfare loss from unit taxation, as compared to ad valorem taxation, may be relatively limited. This could be due to particulars in the wine market, for example that taxes constitute a smaller share of the total price in the wine market compared to the cigarette market.

Nevertheless, it is important to learn that quality shifting may be present also when excise taxes are not a major part of the products cost for the consumer as it provides evidence that the effect is present across markets. Quality shifting could of course be quantitatively important if the taxes are a major of the total price of wine, as is the case in several Scandinavian countries. It would hence be very interesting to see evidence from such countries.

References

Barzel, Yoram, (1976). "An Alternative Approach to the Analysis of Taxation," Journal of Political Economy 84 (December): 1177-97.

Borderching, Thomas and Eugene Silberberg (1978). "Shipping the Good Apples Out: The Alchian and Allen Theorem Reconsidered," Journal of Political Economy, 86(1): 131-138.

Falvey, R., (1979). "The composition of trade within import-restricted product categories," Journal of Political Economy 90 (5), 1142–1145.

Feenstra, Robert (1988). "Quality Change under Trade Restraints in U.S. Autos," Quarterly Journal of Economics 103: 131-146.

Feenstra, Robert (1993). "Measuring the Welfare Effect of Quality Change: Theory and Application to Japanese Autos," NBER Working Paper #4401.

Feenstra, Robert (1995). "Estimating the Effects of Trade Policy," in Gene Grossman and Ken Rogoff, Eds. Handbook of International Economics, Volume III (Elsevier, Amsterdam).

Fershtman, Chaim, Neil Gandal, and Sarit Markovich (1999). "Estimating the Effect of Tax Reform in Differentiated Product Oligopolistic Markets," Journal of Public Economics**,** 74(2): 151-170.

Goolsbee, Austan, (2003). "Taxes and the Quality of Capital," Journal of Public Economics.

Hummels, David, and Alexandre Skiba 2004. "Shipping the Good Apples Out: An Empirical Confirmation of the Alchian-Allen Conjecture," Journal of Political Economy, 112, 1384-1402.

Johnson, Terry R., (1978). "Additional Evidence of the Effects of Alternative Taxes on Cigarette Prices," Journal of Political Economy 86, no.2, pt. 1 (April): 325-28.

Krishna, K., (1987). “Tariffs versus quotas with endogenous quality,” Journal of International Economics 23, 97–117.

Nesbit, Todd M., (2005). “Excise Taxation and Product Quality: The Gasoline Market,” Mimeo, West Virginia University.

Rodriguez, C., (1979). “The quality of imports and the differential welfare effects of tariffs, quotas, and quality controls as protective devices,” Canadian Journal of Economics 12, 439–449.

Rojas, Christian and Tianji Shi (2010). "Tax Incidence when Quality Matters: Evidence from the Beer Market." Working paper.

Sobel, Russell S., Thomas A. Garrett (1997). “Taxation and Product Quality: New Evidence from Generic Cigarettes,” Journal of Political Economy 105, Issue 4 (August): 880-887.

Sumner, Michael T., and Ward, Robert (1981). “Tax Changes and Cigarette Prices,” Journal of Political Economy 89 (December): 1261-65.

Appendix 1. Conditions for $dMS_H/dt>0$

This section derives the condition to get dMS/dt>0. Recall that the market share of high quality consumption is

$$MS_H = \frac{g^H(P_H + t, (P_H + t)/(P_L + t))}{g^H(P_H + t, (P_H + t)/(P_L + t)) + g^L(P_L + t, (P_L + t)/(P_H + t))}.$$

Then,

$$\frac{\partial MS_H}{\partial t} = \frac{\left[g_1^H + g_2^H \frac{P_L - P_H}{(P_L + t)^2}\right] g^L - \left[g_1^L + g_2^L \frac{P_H - P_L}{(P_H + t)^2}\right] g^H}{\left[g^H + g^L\right]^2}$$

which is greater than zero if and only if

$$\frac{g_1^H + g_2^H \dfrac{P_L - P_H}{(P_L + t)^2}}{g^H} > \frac{g_1^L + g_2^L \dfrac{P_H - P_L}{(P_H + t)^2}}{g^L}.$$

Multiply this expression by t and we get the condition

$$\varepsilon_{Qt}^H > \varepsilon_{Qt}^L$$

since the demand elasticity with respect to the unit tax is

$$\varepsilon_{Qt}^i = \frac{g_1^i + g_2^i \dfrac{P_j - P_i}{(P_j + t)^2}}{g^i} t \qquad i = H, L \quad j \neq i.$$