

Do Taxes Produce Better Wine?¹

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Abstract

Theory predicts that unit taxes increase the quality 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 a previous empirical study. However, this test is indirect and does not identify the theoretical prediction. The paper develops and performs direct tests of the hypothesis. The direct tests find no evidence of quality shifting.

JEL codes: D12, H31

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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

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valorem taxes should have no effect on the quality in a market.

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 if there were no 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 automobiles³, or time costs, like waiting in line at the ice cream parlor. 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 will test the

hypothesis with data from the wine market. The data is sufficiently detailed to perform direct tests of the hypothesis, which the previous literature has not been able to perform. This paper also extends the empirical analysis to a new market. I find that the effect of quality shifting from low to high quality consumption seem to be small at most.

Previous tests of Barzel's hypothesis have considered 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.

The contribution of this paper is two-fold. First, I outline a model for analyzing quality shifting. It shows that the market share can only provide indirect evidence on quality shifting. However, direct implications of quality shifting can be obtained by analyzing demand. Second, I empirically test for quality shifting using data from the wine market, data that has not been explored before. The first test uses the market share and the results are similar to what is found in the cigarette market. Although consistent with Barzel's quality shifting hypothesis this test does not identify the hypothesis. I have direct data on quantities of high and low quality goods, which allows me to perform direct tests of the hypothesis. Using these explicit tests, it is hard to find evidence of quality shifting. Though indirect tests of quality shifting find support for the hypothesis as in the cigarette

³ The effects of taxes on demand of automobiles are studied in Fershtman, Gandal, and Markovich (1999).

market, the direct tests provides no significant evidence of quality shifting.

The literature on how taxes affect the quality of goods consumed is small. This is 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 goods⁴.

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 sections with the empirical tests are presented. First the results of the indirect market share tests are discussed, followed by the direct market size tests. The conclusions are discussed in the subsequent section.

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

⁴ See for example Falvey (1979), Rodriguez (1979), Krishna (1987), Feenstra (1988, 1993, 1995).

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. Let demand for a good, Q_i , be represented by

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

Where s is the sales tax rate and $i=H, L$ and $j \neq i$. The i represents the quality level of the good, which is either high or low. The first argument of $g^i(\cdot)$ 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

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

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 to assume that elasticities of demand of quality i with respect to the unit tax t are ordered as $e_{Q_i}^L < e_{Q_i}^H$ ⁵. In words, the assumption 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 $h(\cdot)$ 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. More importantly, the effect of the unit tax on the market share does not provide direct evidence of quality shifting. A positive relationship between MS_H and the unit tax provides evidence on the ordering of the

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

elasticities, $e_{Q_t}^L < e_{Q_t}^H$. The ordering may be the result of the low quality demand being more elastic to price, not that low quality consumption is shifted into high quality consumption through a change in relative prices. Higher unit taxes may shift consumers out the low quality market altogether, and thereby increase the market share of high quality. Examining the market share we may interpret this behavior as quality shifting, which is incorrect. In terms of the model, the test does not identify if the effect of the unit tax works through the first or the second argument of the $g^i(\cdot)$ function. To obtain direct evidence of quality shifting we need to establish that the unit tax affects demand through the second argument of the $g^j(\cdot)$ function.

These concerns can be addressed by examining the demand for high and low quality goods directly. The objective of the direct tests is to examine if whether $g_2^i < 0$, that is, if relative prices affect demand. Consider how demands respond to changes in the unit tax.

$$\begin{aligned} \frac{\partial Q_H}{\partial t} &= \left[g_1^H + g_2^H \frac{P_L - P_H}{(P_H + t)^2} \right] \cdot h \\ \frac{\partial Q_L}{\partial t} &= \left[g_1^L + g_2^L \frac{P_H - P_L}{(P_L + t)^2} \right] \cdot h \leq 0 \end{aligned} \tag{3}$$

Demand for low quality will unambiguously decrease (weakly) as the unit tax increase, since both derivatives are non-positive. The effect on high quality demand is ambiguous since $P_L - P_H < 0$. The derivative will be positive if the first term in the bracket, the price effect, is smaller than the second term, the substitution effect. One direct test of quality shifting is to examine if higher unit taxes are associated with higher consumption of high

quality goods, that is

$$\frac{\partial Q_H}{\partial t} > 0. \quad (4)$$

This would provide evidence of a substitution effect towards high quality induced by the unit tax. Furthermore, consumption of low quality goods should decrease with the unit tax.

The test of quality shifting using the relation between unit taxes and demands is fairly powerful. If the test comes through there is certainly evidence of quality shifting. On the other hand there may be quality shifting that the test fails to capture. The chances of rejecting the null hypothesis of no quality shifting when the null is true are quite limited with this test.

For a second implication of the theory consider how price affects demand, holding relative prices constant.

$$\frac{\partial Q_i}{\partial P_i} = g_1^i \cdot h \quad i = H, L \quad (5)$$

This allows an ordering of the responses of demand to price and unit tax, respectively.

For the high quality good we obtain

$$\frac{\partial Q_H}{\partial P_H} < \frac{\partial Q_H}{\partial t}. \quad (6)$$

For the low quality good the relation is reversed,

$$\frac{\partial Q_L}{\partial P_L} > \frac{\partial Q_L}{\partial t}. \quad (7)$$

The implications produced by the model for demand rely on fewer assumptions than the test based on market share. When examining demand directly there is no need to assume that the $h(\cdot)$ function is the same for both goods, nor is there any assumption regarding elasticities. The functional form of the demand can also be allowed a great deal of flexibility⁶. Furthermore, the implications presented for demand also hold for the log of demand.

In summary, the model has shown that the tests based on the market share of high quality goods can provide indirect evidence of quality shifting at best. Tests using the demand can, however, provide direct evidence of quality shifting. Both approaches will be considered in the methodology section.

Method

⁶ In particular, there is no need to have a separate function for the sales tax s . It can be incorporated into the $g(\cdot)$ function in several ways.

As a first indirect test of quality shifting, the empirical strategy based on the market share will be applied. I use a pooled linear regression model where the 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 market share is

$$\%High\ Quality_{st} = \alpha + \beta * Unit\ tax_{st} + \gamma * Sales\ tax_{st} + \delta * X_{st} + \epsilon_{st} \quad (8)$$

where %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. 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.

To provide direct evidence of the effect of unit taxes on the demanded quality I run a second set of regressions. I want to investigate how the size of the low quality and high quality markets vary with the unit tax, price, and other exogenous controls. The purpose is to estimate the effects of changes in unit tax and price on demand, and examine if the results correspond to the sign in equation (4) or the orderings in equations (6) and (7). One approach is to run regressions of the form

$$u(\text{Quantity}_{st})=v(\text{Unit tax}_{st}, \text{Price}_{st}, Z_{st}) + \varepsilon'_{st} \quad (9)$$

where $u(\cdot)$ is either a linear function or the logarithmic and $v(\cdot)$ is an additively separable linear or logarithmic function, and Z_{st} is a set of control variables. The model is estimated for both the low and high quality markets. Quantity in these regressions is measured as liter of wine per 1000 capita over 20 years of age.

It may be argued that the price of the good is an endogenous variable, and requires instrumenting. For each price variable there will be two instruments. First, the lagged value will be used. Second, the price of a different good for which prices for low and high quality are available will be used. This good is gas. The price of regular gas will be an instrument for low quality price, and the price of premium gas will instrument for the price of high quality. The instruments are correlated with the price variables and, by assumption, uncorrelated with the error terms in the market size regressions.

Data

The available data is on the quantity of domestic and imported table wine consumed per year and state in the United States⁷. The quantity data will be used to construct market shares and conduct an indirect test of quality shifting based on the market share of high quality wine. Furthermore, since there is direct data on quantities, which previous studies in the cigarette market did not have, the quality shifting hypothesis can be tested directly. The quantity data will be used to perform new tests on the size or quantity of the markets.

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, which adds variation in some functional specifications.

The wine data is, 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

⁷ Source: Adams Wine Handbook.

pay more for a product if it did not deliver a higher value. 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 theorem⁸. It states that given constant transportation costs, relative prices will be tilted to favor imports of higher quality goods.

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				Concha Y			
Winetaps	20166	12.3%	\$1.60	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				Rosemount			
Cellars	9150	5.6%	\$2.50	Estate	1335	3.4%	\$9.90
Sutter Home	7200	4.4%	\$4.70	Casarsa	1210	3.1%	\$4.55
Top 5 average			\$2.60				\$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 average is unweighed. Source: Impact Databank and Adams Wine Handbook.

The data is 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 market

⁸ See Borderchning and Silberberg (1978).

share 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 price data on wine is based on price levels of wine in urban areas in the four Census regions, as collected by the BLS. The price spread between high and low quality wine follow the national price spread reported by the Impact Databank. The data on gas prices used as instruments are also collected by the BLS. The data spans 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
Low quality market, per 1000 capita	198	7397	3781	2501	18637
High quality market, per 1000 capita	198	1548	1240	228	7729

Market Share

This section presents the empirical analysis of the market share model. 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 (.0075)	0.0187 (.0072)	0.0188 (.00728)	0.0188 (.00702)	0.0168 (.00665)
Sales tax rate	0.320 (.564)	0.420 (.49)	0.411 (.495)	0.312 (.482)	0.294 (.496)
Income		0.00019 (.000097)	0.000527 (.00047)	0.000214 (.000098)	0.000199 (.000098)
Income squared			-4.95E -09 (7E-09)		
Unemployment				0.1396 (.105)	0.1225 (.111)
log Population					-7.94 (2.52)
Constant	yes	yes	yes	yes	yes
State Fixed Effects	yes	yes	yes	yes	yes
Year Fixed Effects	yes	yes	yes	yes	yes
R-squared	.99	.99	.99	.99	.99
Observations	198	198	198	198	198

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

The average effect of unit taxes on the product quality is 1.35 percentage points, 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 indirect support of Barzel's hypothesis and they are consistent with the previous study in the cigarette market. However, the findings are not direct support for the hypothesis. The next section provides direct tests of the quality shifting hypothesis through comparison of the effect of unit tax and price on market size.

Market Size

In this section I investigate directly how consumption is affected by unit taxes. This is

enabled by the availability of better data on wine consumption compared to previous studies. The tests in the section are based on a less restrictive model than in the previous section, although the main benefit is that the model produces direct implications for quality shifting.

The market quantities need to be put in terms comparable across states. The market size variable is constructed as liter of wine consumed per 1000 capita above 20 years of age. The controls used are similar to those in the previous section. Consider a linear version of equation (9).

Table 4. Market size regressions (IV). Dependent variable: Per 1000 capita wine consumption.

	Low Quality	High Quality
Unit tax	-7.27 (2.63)	-0.743 (.924)
Price	0.95 (2.93)	-0.41 (.65)
Sales tax rate	292.8 (271.9)	-42.7 (95.4)
Income	0.033 (.354)	-0.205 (.099)
Income squared	-1.10E-06 (5.57E-06)	3.97E-06 (1.55E-06)
Constant	Yes	Yes
State Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
R-squared	.99	.99
Observations	165	165
Reject Unit tax = Price?	No	No

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

Unit taxes have a significant negative effect on the low quality market. The effect of unit taxes on the high quality quantities is not significant. There is, at a minimum, evidence of a reduction of the low quality market as the unit tax increases.

Next focus on the point estimates on unit taxes. Though not significantly different from zero in the high quality regressions, the point estimates are nevertheless the best estimates of how variables vary with each other. The first direct test of quality shifting is if unit taxes increase high quality consumption, as seen in equation (4) above. In table 4 it's estimated that the unit tax has a negative effect on consumption of high quality. This result does not support quality shifting.

Indeed, it may still be argued that there is some quality shifting. The reason it can't be detected in the regressions is that at the same time as people are shifting from low to high quality there are some shifting out of high quality altogether due to the higher prices induced by higher taxes. There are two forces at work and the net effect is zero.

One observable implication of this story is that in the low quality market the unit tax elasticity is *smaller* (in real value) than the price elasticity. The unit tax induces two kinds of shifting in the low quality market, quality shifting into high quality and shifting out of the market due to the higher price. Both these effects work to increase the unit tax elasticity. The higher price only induces shifting out of the market. Similarly, in the high quality market the unit tax elasticity should be *larger* than the price elasticity. The higher price induces consumers to shift out of the market. The unit tax has two opposing effects. It induces shifting out of the market due to the higher cost but at the same time unit taxes induce quality shifting into the high quality market.

Now consider how the effects of unit tax and price on consumption are ordered in table 4. The last line in the table tests the hypothesis that the coefficients on unit tax and price are equal at the 5% level. The estimates are not significantly different in either market, so there is no significant evidence of any ordering. Next turn to the point estimates. In the low quality market the ordering is as suggested by quality shifting, the coefficient on unit tax is smaller than the coefficient on price. The prediction is, however, not verified in the case with high quality consumption where the model would have predicted the unit tax estimate to be smaller in real value than for price if there was quality shifting. The predictions of the model concern both the low and high quality markets. Since one of the markets, in this case high quality, does not verify the prediction I can't interpret the results as support for quality shifting even if we only consider the point estimates.

One criticism of the results in table 4 may be that it is something particular with the linear specification. To address this concern the model is estimated in logs. It provides a robustness check of the results obtained above. The dependent variable is log of wine consumption and the controls are in logs.

Table 5. Market size regressions (IV). Dependent variable: Log of per 1000 capita wine consumption.

	Low Quality	High Quality
Log(Unit tax)	-0.052 (.018)	-0.030 (.019)
Log(Price)	-0.001 (.11)	-0.02 (.12)
Sales tax rate	0.052 (.052)	-0.006 (.051)
Log(Income)	1.544 (.791)	2.158 (.812)
Income*Log(Income)	-4.62E -06 (2.27E-06)	-6.83E -06 (2.35E-06)
Constant	Yes	Yes
State Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
R-squared	.99	.99
Observations	165	165
Reject Log(Unit tax) = Log(Price)	No	No

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

In table 5 the effect of unit taxes on the low quality market is negative and significant. In the high quality market the unit tax is insignificant and the point estimate is negative. The sales tax rate is insignificant in all specifications, as is the price variable. The income variables are only significant in the high quality market. Semi-log specifications provide similar results.

The results are similar to Table 4. The effect of unit tax on high quality is negative, though not very significant, and it does not support quality shifting. The point estimates of unit tax and price have the same ordering as previously, although there is no statistically significant evidence of the ordering. The ordering in the low quality market supports quality shifting while it is contradicted in the high quality market.

These two direct tests of Barzel's hypothesis challenge the indirect support for quality

shifting reported in table 3. The results in table 5 are as challenging to Barzel's hypothesis as is table 4. The effect of unit taxes on the low quality quantities is negative and significant. It is however hard to see any positive effect on the high quality. The estimates on unit taxes are negative even after adding one standard deviation.

Though the indirect evidence in support of quality shifting reported in table 3 was consistent with previous evidence the direct evidence could not support the hypothesis. In tables 4 and 5 I examine if the effect on the market share is driven by a shift from low to high quality consumption. Even when inspecting the data looking for evidence for quality shifting it is hard to find much. The findings are robust to functional specification. There are many other specifications not presented here which provide the same results. The results are also robust to allowing serial correlation of the error terms within states.

The indirect test of quality shifting using market shares may support the hypothesis as seen in the previous section. This section has shown that the indirect test may be misleading. There is no evidence of quality shifting when examining the direct implications of the hypothesis.

Alternative Stories: Interaction results

It may be argued that the wine market is segmented into a high and low 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 will 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 wrong sign. It seems like the data does 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 by competitive markets. 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.

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 data allows for analysis of high and low quality consumption separately. Using the direct data on consumption I find that the effect of quality shifting is small, at most. When relying on the significant results there is no evidence of quality shifting.

The results in this paper point at the importance of looking at the mechanism of quality shifting. Just looking at the market share of high quality consumption can be misleading. To find empirical support for Barzel's hypothesis it is important to find evidence of the specific mechanism, which is consumption shifting from low to high quality. This paper has developed a framework for testing quality shifting directly, but I have not been able to find such evidence.

The results indicate that the quantitative significance of quality shifting is small at most. The distortion of unit taxes on the quality consumed and produced seems relatively small. This implies that the welfare loss from unit taxation, as compared to ad valorem taxation, is negligible.

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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,

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

which is greater than zero if and only if

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

Multiply this expression by t and we get the condition

$$e_{Q_i}^H > e_{Q_i}^L$$

since the demand elasticity with respect to the unit tax is

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