

# The Price of Unique

Estimating Own-Price Elasticities of Demand for Collectible Beer and Wine

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### **Abstract**

High-end, collectible beer are increasingly prevalent in the United States; however, analysis of the demand for these age-worthy beers is absent from the literature. This paper uses a unique dataset of online auctions of Stone Brewing Co.'s Vertical Epic series of ales. The characteristics of this series allow for a straightforward estimation of own-price elasticity. This estimate is then compared to an own-price elasticity of collectible wine using a similar dataset. In this analysis, demand for collectible wine is found to be more elastic than collectible beer.

# 1. Introduction

The collectible beer market is long established in the beer cultures of Belgium, France, and England. For example, Westvleteren 12, one of the rarest beers in the world, regularly fetches prices upward of \$100 per six-pack on eBay. Thomas Hardy Ale, from England, is said to improve in quality over the course of three decades. However, this market is new to the United States, stemming from the recent “craft brewery” movement, with its beginnings in the 1970s. Increasing alcohol by volume (ABV) levels in commercially available beer (higher alcohol means longer aging potential) signifies that fermented beverages meant to be aged for years are no longer limited to wine. Prominent examples in the US include Boston Beer Company’s Samuel Adam’s Triple Bock, Avery Brewing’s Demonic Trilogy, and, the subject of this paper, Stone Brewing Co.’s Vertical Epic series. Further, bottles released by craft brewers of “wood-aged” beers are fetching higher and higher prices (Avery Brabant, retailing for over \$10 for a 12 ounce bottle, is already sold out after its release a month ago; Odell Brewery’s Woodcut Series retails for over \$25 per 22 ounce bottle and sells out in less than a week). These anecdotes suggest a growing demand for high-end beer, a demand that persists despite high prices.

These beers are fetching even higher prices on the secondary market, with the most prominent marketplace being eBay. However, analysis of the collectible beer market falls prey to the same issues as the collectible wine market: the product is, by its very nature, unique, thus the construction of a demand curve for it is difficult. Only one point on a demand curve can be observed.

Most recent advancements in alcohol elasticity estimates use “system-wide” estimation techniques (Fogarty 2008), but the helpfulness of a system-wide estimation of collectible beers or wines is itself unclear. This category is defined by small-scale production and difficulty in acquisition, so the relevant metric

may instead be of one particular collectible beer, since it is this elasticity that a potential producer will face. Each producer can't do more than produce a small amount per label without 'producing' itself out of the market and removing the beer from the 'collectible' category. The nature of the analysis should be determined by the research question at hand: given tiny production figures of hard-to-find beers, isn't it a question of specific prices and quantities, for which a log-log regression equation would be most applicable?

Previous own-price elasticities for beer concentrated mostly on ethanol content and comparable consumption of wine and spirits. Own-price elasticities for specific beer brands have previously been placed at around -4, suggesting high substitutability for individual brands. Initial demand estimates of beer as a category in the US produced an elasticity of -1.3 (Hausman et al. 1994). A recent review has placed the own-price elasticity of beer in the range of 1.28 to -3, as well as identifying beer as, on average, a necessity good, while spirits are a luxury good, and wine is a middle case (Fogarty 2008). The meta-analysis in Fogarty's working paper places the US own-price categorical demand for beer at -0.42.

The rest of the paper is structured as follows: Section 2 discusses Stone Vertical Epic and its "natural experiment"-like production and marketing structure; Section 3 describes data and analysis for Stone's series as well as first-growth Bordeaux; and Section 4 reviews the results and concludes.

## **2. The Stone Vertical Epic Series**

The Vertical Epic series of beers from Stone Brewing Co. is collectible by design. Stone released the first beer in the series on February 2, 2002. They then release subsequent installments one day, one month, and one year after the previous one, so the second beer was released on March 3, 2003, the third April 4, 2004.

The final beer will be available for purchase on December 12, 2012. Stone has brewed each beer so that on this date, every vintage should be opened side-by-side, for a ten vintage vertical tasting. The first beer, the 02/02/02, will have aged for almost 11 years, the 03/03/03 for 10, etc. Since they age for different times, their recipes differ from year to year, sometimes dramatically, so that each beer hits its peak on the same date.

These beers are highly sought after among beer collectors, selling out almost immediately upon release. The average eBay winning bids of these vintages are displayed below in Table 1, with the 02/02/02, the rarest of the series, selling for on average over \$400 for a single 22 ounce bottle.

The central assumption of this paper's analysis is that the differences in equilibrium prices of these different vintages should arise only from different levels of production. This assumption stems from three separate aspects of the Vertical Epic series: freely available homebrewing recipes, the constant consumption date across vintages, and their intended consumption as a complete set.

Each year, as Stone releases the next installment in the series, they also release their recipe for its production. The brewers at Stone strive to make these recipes as straightforward as possible, although they are all-grain, high gravity recipes. For any particular vintage, a curious beer drinker can make a virtually unlimited amount, at a price per bottle less than one-tenth of the initial release price (and for an even smaller fraction of eBay prices). Since recipes are available for every vintage, the differing style of each release shouldn't affect a collector's demand for it. Such differences in style would affect other collectible beers, e.g. Fuller's Vintage Ales, all of which have slightly different recipes that are unavailable to the public.

Although vintages will ultimately be aged for vastly different durations, at the particular time of an auction, every beer will have to be aged for the exact

same amount of time before consumption. Thus, at the time of purchase in the secondary market, each beer requires the same patience and time invested. Furthermore, these beers are meant to be drunk as a complete set, side-by-side. There is no a priori reason why a 03/03/03 is more desirable than a 04/04/04, since they are both one element of a set; collectors will try to have as many as possible, and there is no intrinsic reason that missing an 03/03/03 is any better or worse than missing an 04/04/04. Therefore, their relative rarity alone should be the motivation behind any price differential that arises, where it is assumed that this rarity is proportional to the initial production figures of each vintage. Each vintage can then be seen to be a separate point on the same demand curve, a curve describing the demand for an element of the Stone Vertical Epic set. Since every vintage sells out within weeks of release, it's clear that there isn't a surplus of Vertical Epic. Because separate vintages are on one demand curve, we have a mapping from quantity demanded (i.e. the amount produced in the absence of any surplus) to market price, from which we can calculate an elasticity of demand.

### **3. Data and Analysis**

#### **Stone Vertical Epic**

Beer auction data was collected from eBay over a two month period in August and September of 2008. There is a history of demand curve estimation based on online auction data; as an example, economists at the Federal Trade Commission have used eBay auction data to estimate own-price elasticities and provide insight into anti-trust cases for telescopes (Adams and Bivins 2003). For this paper, 52 separate single-bottle auctions ended with a successful winning bid (a bid that cleared the reservation price of the seller, had more than one bidder,

and wasn't a "buy-it-now" purchase). Case production figures were acquired from the producer, Stone Brewing Co. Figure 1 shows the outlines of a demand curve, matching mean winning bid for each year with its respective case production figure. Again, the following analysis does not require that the actual number of beers available on eBay is equal to the original case production for that vintage; instead, it assumes that the currently available number of beers per vintage is proportional to the original production. This constant of proportionality, in a log-log regression, is then subsumed into the constant without biasing the elasticity coefficient.

The log-log regression equation is:

$$\ln(\text{price}) = \alpha + \beta_0 \ln(\text{production}) + \beta_1 X + \epsilon$$

where  $\alpha$  is a constant,  $X$  is vector of control variables (in the case of the Stone Vertical analysis, there is no  $X$ , while in the wine analysis, these include Parker scores and vintage dummy variables), and  $\epsilon$  is the error term. Since the standard errors are bootstrapped, there are no parametric priors assumed about the error term's distribution. Lastly, the  $\beta$  on the log-production variable is the inverse of the own-price elasticity:

$$\beta_0 = \frac{1}{\text{elasticity}}$$

An overall log-log regression with bootstrapped standard errors, regression (1) in Table 2, provides an initial estimate of the own-price elasticity. Here, it is slightly inelastic with a point estimate of -0.91 but is not statistically significant from a unitary elasticity.

The next regressions in Table 2, (2) through (4), exclude individual vintages for robustness. Regressions are only reported for the exclusion of ales 02/02/02 to 04/04/04, since excluding later vintages does not change results significantly

or substantially from regressions (3) and (4). These results show that when the 2002 vintage is included in the regression, the coefficient skews toward elasticity, revealing that the demand curve around the low case production level of 2002 is more elastic than around the larger production levels. Figure 2 presents the log-log demand curve fit from the data, from which it is clear that the curve is more inelastic when 2002 is excluded from the estimation.

When, instead of actual production figures, case numbers fit to a line, with 2002 excluded, are used as the exogenous variable, the resulting elasticity is unchanged from previous estimates that exclude 2002, as shown in regression (5).<sup>1</sup> These “trended production figures” may correspond more closely to the market’s perception of steadily increasing production, vintage after vintage. The demand curves in Figures 1 and 2 show that production of the 05/05/05 Vertical Epic was lower than that of the 04/04/04, a fact that Stone Brewing Co. itself was unaware of until they found and forwarded the data.

The elasticities from this analysis show that the demand curve for Stone Vertical is, on average, inelastic, and once production figures and prices move away from the extremely low production level of the 2002 ale, demand becomes even more inelastic. Such inelastic estimates contrast with previous single-brand estimates of beer, which were, generally speaking, very elastic (above 3 in absolute value).

## **First-Growth Bordeaux**

However, previous estimates often use scanner data and system-wide elasticity estimation techniques, rendering direct comparability of estimates difficult, especially given the eclectic nature of this paper’s estimation approach. In particular, at least one previous study has suggested that elasticities based on

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<sup>1</sup>Including 2002’s data in a trended production regression merely lessens 2002’s influence of elasticity on the data.

auction data exhibit more elasticity than equivalent choice-based data (Lusk and Shroeder 2006). An analysis of the own-price of elasticity of collectible wine using similar methodology and data follows in order to put the collectible beer estimates from above in context.

Data from the online wine exchange LIV-EX is used to estimate elasticity of high-end, collectible Bordeaux. This website allows subscribers to sell and buy wine in an exchange environment. Furthermore, information is available on high, low, and average bids per month for previous years, and, when applicable, critical reviews of wines are included for each wine. The analysis below uses data on first-growth Bordeaux, which have historically been, and continue to be, some of the most age-worthy and sought-after wines for collectors.

Data were collected for the five Left Bank Bordeaux's, derived<sup>2</sup> from the 1855 Classification: Chateaux Haut-Brion, Lafite Rothschild, Latour, Margaux, and Mouton Rothschild. Data was also used from the two Right Bank First Growth Class A Bordeaux from the 1955 Classification of St. Emilion: Chateaux Ausone and Cheval-Blanc.

Wine Spectator reviews provided case production figures for these wines, with data available for vintages ranging from 1988 to 2005. Mean price information was calculated from two years of average monthly exchange prices for cases of these wines, and scores from Robert Parker, acquired from the LIV-EX websites dedicated to each wine, were added to the dataset.

Parker scores, easily observed by each wine investor when viewing a wine before purchase or sale, carry with them anecdotal evidence of large influence on price. Such anecdotes include the remarkably high prices charged for 2000 Bordeaux after they received high Parker scores, as well as Chateau Quinalt's price increase after a favorable Parker score (see Wikipedia entry for Robert M. Parker, Jr.). For now, such information will be assumed to capture much

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<sup>2</sup>Albeit with the significant 'ascension' of Mouton from second to first growth

of the quality variation between Bordeaux, especially for investors looking for quick information on quality,<sup>3</sup> but we will test this assumption later. The final dataset has 49 observations, complete with full 2 year price histories, Parker scores, and case production information.

With this data, log-log regressions were calculated, with vintage dummy variables and the wine's Parker score, thus controlling for these a priori differences between wines. Specifically, these controls assume again that proportionality to initial production holds within vintages, but across wineries. Dividing the wines into separate cells by vintage and Parker scores versus vintage cells and controlling for Parker as a continuous variable produced no significant differences in coefficients. Furthermore, the assumption that Parker scores influence prices is confirmed by its inclusion in the regression explaining almost 35% of variation (adjusted R-squared, reported in regression (3) of Table 3; a similar regression using Wine Spectator scores explained only an additional 8% of variation, suggesting Parker scores influence prices much more strongly).

Initial results, reported in regression (1) of Table 3, demonstrate that demand for these high-end wines are very elastic, with a point estimate of almost -5.5, and a range from -15.55 to -3.32 (again, standard errors are calculated using 1000 repetition bootstrapping). When regressions include only wines with Parker scores 95 and over in regression (2), this elasticity falls to -4.41, as would be expected given the lack of substitutes for these ultra-high-end wines. However, demand for these wines is still elastic and significantly different from unitary elasticity. The point estimates are unchanged even when any single winery is excluded from the analysis; bootstrapped standard errors, however, grow large enough to include positive elasticities. A caveat to this wine analysis: the variation in case production stems mostly from Left Bank versus Right

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<sup>3</sup>Recent events aside, Parker scores may operate as a sort of wine exchange Moody's rating system

Bank differences and the results are not robust to keeping with only the 1955 or 1855 classifications, since there simply isn't enough variation in case production within these regions.

## 4. Conclusion

The above analysis concentrated on two specific examples of collectible alcohol: Stone Brewing Co.'s Vertical Epic series of ales and first-growth Bordeaux wine. Through a "natural experiment"-like setup in the production and marketing of Stone's series, a straightforward log-log regression was used to estimate own-price elasticity of demand for this ale series. Using eBay auction data, these estimates showed an inelastic demand curve, which contrasted largely with previous brand-specific own-price elasticities of non-collectible beer.

To put this estimate into a context allowing easier comparison, data from an online wine exchange was used to estimate the own-price elasticity of first-growth Bordeaux wine, perhaps the quintessential collectible wine. Controlling for vintage and Parker scores, a log-log regression, similar to the beer analysis, was carried out. The results showed a highly elastic demand significantly different from the estimates for Stone's series, even when only those wines scoring 95 Parker points and above were used. These wines are the most collectible of the quintessentially collectible wine, and yet demand for them was still elastic. Since the own-price elasticity of demand for a product fundamentally depends on the number of substitutes available, this paper provides evidence that there are more substitutes for collectible wine than for collectible beer.

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**TABLE 1**

Mean Winning Bids for Stone Vertical Epic

Vintage	Mean Winning Bid
02/02/02	409.18
03/03/03	98.79
04/04/04	49.90
05/05/05	34.87
06/06/06	19.69
07/07/07	12.56
08/08/08	3.57

Table 2

Regression-derived Own-Price Elasticity Estimates of Stone Vertical Epic

	Log of Winning Bids				
	(1)	(2)	(3)	(4)	(5)
Log of Cases	-1.097 (0.09)	-1.609 (0.15)	-1.059 (0.08)	-1.123 (0.08)	-1.781 (0.14)
Constant	12.71 (0.74)	17.17 (1.23)	12.29 (0.68)	12.79 (0.67)	18.67 (1.21)
Corresponding Elasticity	-0.91	-0.62	-0.94	-0.89	-0.56
95% Range of Elasticities	[-1.09, -0.78]	[-0.76, -0.53]	[-1.12, -0.82]	[-1.04, -0.78]	[-0.48, -0.67]
Observations	52	46	43	42	46
R-squared	0.82	0.78	0.83	0.86	0.85
Bootstrapped standard errors in parentheses (1000 repetitions)					

**Table 3**

Regression-derived Own-Price Elasticity Estimates of First-Growth Bordeaux

	Log of Average Price		
	(1)	(2)	(3)
Log of Cases	-0.183 (0.06)	-0.227 (0.78)	-0.211 (0.11)
Parker Score	0.13 (0.02)	0.21 (0.04)	
Constant	-2.65 (2.16)	-9.18 (3.83)	10.23 (1.01)
Corresponding Elasticity	-5.48	-4.41	
95% Range of Elasticities	[-15.55, -3.32]	[-13.61, -2.62]	
Observations	49	25	49
R-squared	0.85	0.93	0.51

Bootstrapped standard errors in parentheses (1000 repetitions)

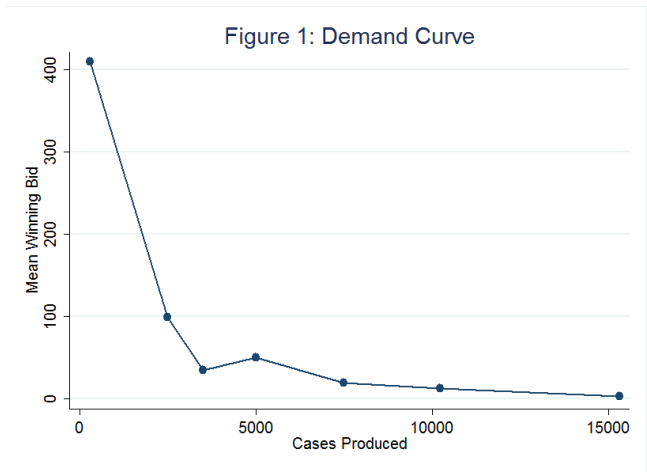


Figure 2: Demand Curves, Including and Excluding 2002

