Understanding the Law of Demand

Utilizing demand analysis can provide winemakers with greater insight into the market and lead to more profitable decision-making.

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In the January 2006 issue of *Wine Business Monthly*, **Christopher Sawyer** reports that "**Kendall-Jackson Wine Estates** repositioned its top brand Vintner's Reserve Chardonnay by increasing the price by a dollar to $12 per bottle and reducing production from 2.3 million to two million cases." The move by Kendall-Jackson illustrates one of the most fundamental theorems in all of economics: The law of demand.

When Kendall-Jackson decided to raise the price of its Chardonnay, it was the law of demand that lead them to reduce the number of cases produced. However, to determine exactly how many fewer cases should be produced, more rigorous demand analysis must be performed. Demand analysis answers the question, how many units should I produce if I want to maintain a specific price? In addition, demand analysis can answer questions such as: What will happen to units sold when I change the price of my wine? What will happen to revenue when I change the price of my wine? What will happen to my sales when my competitors change the price of their wines? And how sensitive are my sales to changes in the purchasing power of consumers?

In this article, we show how the combination of economic theory, data and modern econometric methods provide answers to these and other questions. We believe that the tools presented in this paper can provide winemakers with a greater insight into the market for their wines and lead to more profitable decision-making.

The law of demand

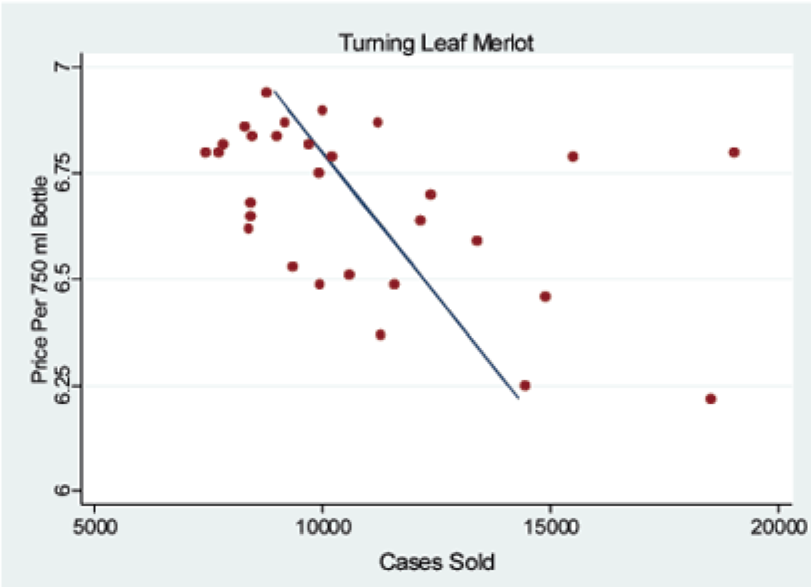
We begin with the very simple but fundamental theorem: The law of demand. In the context of the wine industry, the law of demand states simply that as the price of a bottle of wine increases, fewer cases will be sold. The inverse is also true: as the price of a bottle of wine decreases, more cases will be sold. In textbooks, the law of demand is usually represented by a downward sloping "demand" curve. To illustrate the law of demand, we use scan data on the average price of 750ml bottles of wine as well as a number of nine-liter case equivalents sold to estimate the demand for one of the top-selling wines in the $3 to $7 price point: **E&J Gallo**'s Turning Leaf Merlot. We use a multiple regression equation and the method of ordinary least squares (OLS) to estimate a demand function of the following form:

$\mathbf{Q^D} = f(\mathbf{P}_{own}, \mathbf{P}_{competitor}, \mathbf{I})$, where $\mathbf{Q^D}$ is the quantity demanded of wine measured in cases, $\mathbf{P}_{own}$ is the own price of a 750ml bottle of wine, $\mathbf{P}_{competitor}$ is the price of the nearest competitors, and $\mathbf{I}$ is a measure of aggregate income.

The regression results are shown in **Table 1** and the estimated demand equation is shown in **Figure 1**. As can be seen from Figure 1, our estimate of the demand for Turning Leaf Merlot is consistent with economic theory, and results in a standard downward sloping demand curve.

Despite a few outliers, our estimated demand curve fits the data fairly well, explaining over 60 percent of the variation in the quantity sold of Turning Leaf Merlot.

Estimated demand curve based on scan data



Above, the estimated demand curve of Turning Leaf Merlot illustrates the inverse relationship between price and quantity.

As simplistic as the demand function appears, it does more than just quantify the inverse relationship between price and quantity. The demand function provides winemakers a powerful tool for planning and decision-making. For example, from actual sales data, we know that at a price of $6.25 per 750ml bottle, Gallo sold 14,421 cases of Turning Leaf Merlot. Suppose that Gallo wanted to know the effect on cases sold of raising price to $6.75. The law of demand tells us only that fewer cases of wine will be sold at a higher price. For planning purposes, however, what is needed is an estimate of *how many* fewer cases will be sold. The estimated demand equation provides the tool necessary to estimate the unit sales generated from each price.

Based on the estimated demand function shown in Table 1, sales are predicted to fall by 10,027.06 cases for every $1 increase in price. For a price increase of $.50, sales are predicted to fall by 5,069.35 cases to 9,351.65 cases sold when price rises to $6.75. The actual number of cases sold at $6.75 was 9,908, a difference of 556.35 cases or about 5 percent. Although not perfect, most wineries would gladly accept a forecast with a 5 percent margin of error. More accurate forecasts provide better information for planning, staffing and resource decisions.

In addition to forecasting unit sales, the estimated demand function also provides a powerful pricing tool. For example, suppose instead that Gallo sets a goal of selling 20,000 cases of Turning Leaf Merlot. We know from the law of demand that to sell more units you need to lower price. However, what winemakers would like to know is exactly what price is necessary to achieve this goal. The estimated demand function provides the answer. Gallo would have to set a price of approximately $5.75 per 750ml bottle to achieve their goal of 20,000 cases sold.

Estimated demand functions provide another useful tool to winemakers. For example, if your primary concern is on the revenue generated from sales, the law of demand tells you only that a price increase will result in fewer units sold, and a price decrease will result in more units sold. The law of demand says nothing about the effect of a price change on revenue. Revenue can increase, decrease or stay the same. In essence, without more information, you have a one in three chance of actually increasing revenue when you change price. To examine the effect of a price change on revenue, we turn to the microeconomic tool called the "own-price elasticity of demand."

own-price elasticity of demand

The own-price elasticity of demand measures the responsiveness of consumers to changes in price, and thereby tells you the effect on revenue of a price change. To derive the own price elasticity of demand, we re-estimate the demand for Turning Leaf's Merlot using a double logarithmic specification, which allows us to interpret the estimated regression coefficients as elasticities. The results are shown in **Table 2**.

When examining own-price elasticities, the critical value to observe is -1. An own-price elasticity of demand less than -1 indicate that consumers are relatively sensitive to price changes. In this case, raising price will decrease revenue. When the own-price elasticity of demand is greater than 1, consumers are considered relatively unresponsive to price changes. If consumers are unresponsive to price changes, then raising the price will increase revenue.

From Table 2, we can see that the estimated coefficient on own-price for Turning Leaf Merlot is -5.7, indicating that for every 1 percent increase in price, quantity demanded will decrease by 5.7 percent. With an own-price elasticity of demand less than -1, consumers are relatively sensitive to price changes, so increases in price will result in a *decrease* in revenue. A highly negative own-price elasticity of demand for Gallo's Turning Leaf Merlot is consistent with what one would expect in the highly competitive fighting varietal price point. However, a high elasticity is not necessarily bad news. If consumers of a particular wine are sensitive to price increases, they are also sensitive to price decreases, so lowering price will increase revenue.

cross-price elasticity of demand

While the own-price elasticity of demand tells you how sensitive consumers are to changes in the price of the good, it is also important to know how sensitive consumers are to changes in the price of competing goods. To analyze the effects on the demand for your product, resulting from changes in the price of your competitors' product, we again turn to economic theory and the concept of cross-price elasticity of demand. The critical value for cross-price elasticity is zero. If two goods have a positive cross-price elasticity of demand, the two goods are viewed as substitutes by consumers. From the perspective of producers, a positive cross-price elasticity of demand identifies competing products: the higher the cross-price elasticity, the greater the degree of competition between the two goods.

For Turning Leaf's Merlot, we examined the effect of three of the top competing brands in the $3 to $7 price point: Woodbridge Merlot, Woodbridge Cabernet, and Sutter Merlot. From Table 2, you can see that the demand for Turning Leaf Merlot is most sensitive to changes in the price of Woodbridge's Merlot. The cross-price elasticity between Turning Leaf and Woodbridge Merlot is 5.76, indicating that a 1 percent decrease in the price of Woodbridge Merlot would result in a 5.7 percent decrease in the demand for Turning Leaf Merlot. What the cross-price elasticity of demand represents is the willingness of consumers to switch from one brand to another in the face of price changes.

Positive income elasticities

Finally, we consider another important factor when analyzing the demand for a product. The income elasticity of demand tells you how the demand for your product responds to changes in the income of consumers. Positive income elasticities indicate that as consumer incomes increase, consumers buy more of your product. For example, Cuellar and Lucey (2005) estimate the income elasticity for all wines to be approximately .825, indicating that every 10 percent increase in income results in a 8.25 percent increase in wine consumption. Goods with an income elasticity of less than 1 are considered "income inelastic" or insensitive to income changes, while goods with an income elasticity greater than 1 indicate a high degree of sensitivity to changes in income. The estimated income elasticity for all wines of .825 indicates that as income rises, wine consumption rises, but not proportionately. Again, this is not necessarily bad since it also means that as income falls, wine consumption will not fall at the same rate.

However, although the income elasticity for wine consumption as a whole may be positive, the income elasticity of wines in each price point will vary in sign as well as magnitude. For example, consider the lower price point represented by Turning Leaf Merlot. The income elasticity of demand shown in Table 2 is -3.57, indicating that a 1 percent increase in income will result in a 3.57 percent decrease in quantity demanded. This is consistent with what you would expect from wines in the lower price points.

As wine consumers earn more, they will be expected to decrease consumption of inexpensive wines and move into higher price points. We would expect that while wines in the lower price points will have negative income elasticities, wines in the upper price points will have positive income elasticities. To test this hypothesis, we compare the income elasticity of Turning Leaf's Merlot with a wine in one of the upper price points. We chose one of the top-selling wines in the $20 to $30 price point: Sterling Vineyard Merlot. Recall that Turning Leaf's income elasticity of demand is -3.57. From **Table 3** you can see that the income elasticity for Sterling's Merlot is 1.76, which differs in both sign and magnitude from Turning Leaf's Merlot.

Again this is consistent with what is expected. Wines in this price point are considered luxury goods and are generally very sensitive to income changes. In this case, a 1 percent increase in income results in a 1.76 percent increase in demand for the Sterling Merlot. Given the two price elasticities, we can expect each wine, Turning Leaf's Merlot and Sterling's Merlot to behave differently given the same economic change in consumer income. As consumer incomes rise, consumers will consume more Sterling Merlot and less Turning Leaf Merlot.

In the modern world of business, decisions are often based on metrics designed to reduce the probability of error. Unfortunately, in the wine industry, metrics representing the law of demand are often misrepresented or absent. This is unfortunate because pricing and quantity decisions are at the heart of all businesses, including wine.

A more complete understanding of demand can help wineries large and small decrease operating costs, increase revenue and increase profits. Whether using scan data for large off-premise brands or in-house data for brands primarily focused in the direct channel, the proliferation of data provides the opportunity to put the theories of microeconomic demand analysis into practice. Combined with modern econometric methods, skilled analysts can gain valuable insights into the demand for their products. This article provides a glimpse of the wealth of information available when the confluence of economic theory, data and econometric methods meet. **wbm**

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