Economic Hysteresis in the Californian Vineyard Industry: A Real Options Analysis of Entry and Exit

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Abstract

Over a 30 year period the pattern of vineyard investment and grape production in the Californian wine industry appears to show delayed or limited response to grape price fluctuations, ultimately resulting in perceived cycles in grape prices. From 1976 onward there are at least three periods (1983-1991, 1994-2002 and 2004 onward) where, due to shortages in grape supply, grape prices increased substantially for several years, to be followed by a period of stagnant prices, and an apparent oversupply of grapes. Figure 1 provides a graph of average Cabernet Sauvignon grape prices for 1976 through 2008 in California, indicating the periods of grape shortage and price increases.

Figure 1. Napa County Weighted-Average Cabernet Sauvignon Grape Prices ($/Ton), 1976-2008

Although the periodic lack of grape supply may partly be due to the three to five year period required for new vineyards to be commercially producing, an analysis of non-bearing acreage (Malone, 2008) would indicate a delay in the establishment of new vineyards relative to what traditional investment analysis would suggest. This deferment of investment may be characteristic of economic hysteresis, observed in many areas of economics and usually the result of market risks and sunk costs.

Brennan and Schwartz (1985), McDonald and Siegel (1985, 1986) and Majd and Pindyck (1987) were the first to model the real asset investment and abandonment decision using financial option theory, commonly known as real options analysis. The explicit application to the theory of industrial entry and exit, or investment hysteresis was subsequently developed by Dixit (1989 and 1991) and Dixit and Pindyck (1994). The approach recognizes that the investment or disinvestment decision, effectively requiring irreversible financial commitment in the face of
uncertain returns, results in the creation of options. In particular, the opportunity to invest can be characterized as a call option, whereas the potential to abandon an investment, a put option on the value of the project. Given the typical option pricing framework, the “value matching” and “smooth pasting” conditions, relating to the call option to invest and put option to abandon, result in an equilibrating system of four nonlinear equations. From this system, the critical entry and exit prices for which the options to invest and abandon may be rationally exercised, can be solved for simultaneously. The exit and entry prices are typically higher and lower than what traditional investment analysis would suggest, resulting in a perceived delay of response to price changes.

Recent applications of the real options approach to agricultural production investment include Tauer (2006) and Luong and Tauer (2006) in the case of dairy farming and Vietnamese coffee growing. The issue of hysteresis is particularly relevant, however, in the case of vineyard or orchard endeavors, which require relatively large fixed investment and long lead times before a commercial crop is produced. Consequently, the focus of the current paper is to couch the decision to invest in California vineyard operations within a real options framework, using Cabernet Sauvignon grape production and the Napa Valley as an empirical example. The Napa Valley represents the prime wine grape producing area of California and the Cabernet Sauvignon grape, one of the major red wine grape varieties produced in the region. Additionally, market conditions in Napa Valley are different in several key ways from most other agricultural markets that have been studied using a real options framework. In Napa Valley there is a relative scarcity of land suitable for vineyard development which is partly reflected in high land prices. Further, the market for Napa Valley Cabernet Sauvignon grapes itself is heterogeneous, with significant differences in prices paid at the top of the market versus the bottom (e.g., in 2008 the 90th percentile price was $6,492, the 10th percentile price was $2,800 and the weighted average price was $4,727).

Employing investment and variable costs for average vineyard operations in the Napa Valley, we estimate critical entry and exit grape prices for the years of 1979 through 2007. A comparison of the entry and exit grape prices to market prices provides a potential explanation for the cyclical pattern in vineyard investment and grape supply.

References


