Assessing the Economic Viability of Wine Grape Production in the U.S. and Possibilities for Robotic Technology Development

I want to submit an abstract for:
Conference Presentation

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Keywords
wine grapes, stochastic simulation, robotic technology development

Research Question
Given current technology, production methods, and changing dynamics in the U.S. wine grapes industry, are wine grape vineyards economically viable?

Methods
Using production budgets developed with grower panels in five states, a stochastic financial statements simulation model was developed to assess the economic viability of wine grape vineyards in the U.S.

Results
Stochastic results focus on projected financial statements and economic viability of the representative vineyards over the 10-year planning horizon under current production methods, and price and yield risk.

Abstract
Objectives
The motivation for this study centers on the labor-and cost-intensive nature of wine grape production, and the potential opportunities for robotic technology to augment those production tasks that are manual labor-intensive. The objectives of this study are to: 1) develop cost of production budgets for 5 major growing areas in the U.S.; 2) assess the economic viability of wine grape production in each region under current operating conditions; 3) evaluate labor costs by production task; and 4) identify common production challenges and tasks that could be augmented with robotic technology development.

Background

In 2014, the U.S. produced an estimated 4.2 million tons of wine grapes. Wine grape acreage in the leading wine grape-producing states has increased from an estimated 521,000 acres in 2005 to 641,000 in 2014, an increase of 19 percent. There are approximately 25,000 wine grape vineyards in the U.S (The National Association of American Wineries, 2014). California led the U.S. in wine grape production with 3.89 million tons produced on 565,000 acres. Washington was the second leading state with 2.27 million tons on 48,000 acres, followed by Oregon with 58,000 tons (19,000 acres), New York with 44,000 tons, Pennsylvania with 17,600 tons, and Texas at 6th with 8,650 tons on 4,400 acres (NASS, 2014).

Grapes are among the most intensively managed fruit crops, requiring a great deal of manual labor to complete many production tasks including vine training, pruning, canopy management, and harvest. Scarcity of skilled labor has been identified as an increasing challenge for the grape industry and has constrained continued expansion (MKF Research, 2007). A reduction in the availability of skilled labor generally leads to production quantity and quality issues, higher production costs, and decreased competitiveness in global markets. With a push for stricter border reform in the U.S., there is cause for vineyards to be concerned about skilled labor availability and rising production and harvesting costs.

Machines have been developed to reduce most of the previous season’s growth, remove leaves, position shoots, and thin fruit. However, these machines do not perform any of these tasks with the selectivity that many premium wine grape producers require.

Robotic technology has made significant contributions over the last decade and offers the potential to duplicate the efficacy of skilled human labor for vineyard tasks requiring selective activity. Today’s industrial robots have dexterity, strength, reliability, speed and precision that is unparalleled by human workers. Wine grape production is primed for robotic technology as it faces a variety of production and labor issues that could affect long-term competitiveness. Mechanization will be a key factor for achieving vineyard efficiencies within the production process, as robotics can potentially allow for selective pruning, thinning, training of vines and canopy, and crop estimation.

Data and Methods

Using a grower panel process, this project includes the development of six representative wine grape vineyard budgets in the following five states: California (1), Washington (1), New York (1), Oregon (1), and Texas (2). The panels consist of 3-5 wine grape growers from a major wine grape growing region within each state. Each state has one grower panel, except for Texas which has two panels; one for a medium-size vineyard and another for a large-size vineyard. Using a consensus building process, each panel provided budget information on the size of the vineyard (acreage), wine grape variety produced, cost of production, fixed costs, budgeted yield, yield distribution, budgeted price and price distribution, equipment compliment and replacement strategy, other assets, and loan terms and balances. Labor costs for various production tasks are of particular interest. The panels also provided input on the production tasks that they feel would be the most useful in terms of new technology being developed.

Using the data from the representative budgets, a 10-year projected income statement, cash flow statement, and balance sheet have been developed for each representative vineyard. These baseline scenarios reflect the
representative vineyards’ current production and operating practices, projected over a 10-year planning horizon. Long-range, annual projections of inflation rate indices for input prices, labor costs, equipment prices, and interest rates by the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri form the basis for vineyard expense projections (FAPRI U.S. Baseline Briefing Book, 2015).

In order to assess the effects of price and yield risk on the projected financial statements, a stochastic simulation model was developed using Simetar®, a simulation program designed for risk analysis in Microsoft ® Excel. To simulate stochastic yields and prices, a multivariate probability distribution was developed for each representative vineyard based on panel input.

Results

Given the wide variation in climate, agronomic conditions, and production systems across the five states, the results first summarize and compare the production budgets, highlighting areas of the budgets where there are notable differences in production costs. The results from the stochastic model are then presented, focusing on the projected financial statements and assessing what the next 10 years may look like for these representative vineyards under current production methods, and anticipated production and price risk. Of particular interest is the extent to which the representative vineyards are economically viable over the 10-year planning horizon under current operating methods and the inflation parameters used in the model.

After discussing the future economic health of the representative vineyards, the labor costs associated with each production task are presented and discussed in relation to feedback received from the panels regarding production constraints, labor issues, and production tasks where new technology would be most useful. Together, these results suggest opportunities to strengthen vineyard profitability and long-term viability using robotics.