Co-opetition for the Diffusion of Resistant Innovations: A Case Study in the Global Wine Industry using an Agent-based Model

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Abstract

This study explores whether and how competitive cooperation, also known as co-opetition, can be utilized to speed the rate of diffusion of resistant innovations, which are defined as products that consumers are reluctant to adopt. We investigate a specific innovation, screwcaps on fine wines, as a case study. We explore the extent to which wineries embrace co-opetition strategies through a coordinated marketing campaign. We model both demand-side and supply-side diffusion within the context of a conjoint simulation. In this ABM simulation, each agent is modeled as either a utility-maximizing (consumers) or profit-maximizing (firms) agent. Both consumers and firms interact, share information, and/or react to decisions by other agents. The underlying data consist of international surveys of over 2,800 consumers, including conjoint analyses, in Australia, New Zealand, and the US coupled with over 20 in-depth interviews of wine producers in the US. In particular, we endow a sample of consumers with preferences based on the conjoint analyses and allow them to interact with one another and with wine producers. Wine producers are rational profit-maximizing agents who decide whether or not to produce wines with Stelvins based on the amount they can sell at (endogenously) chosen characteristics, price, and advertising levels. Because profits and sales depend upon the industry structure and consumer choices, we are able to examine the sensitivity of diffusion to such structures.[1]

[1] The model runs in Netlogo (1999) freeware. Our model is open-source and available.

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1. Introduction

Supporting and accelerating the adoption and diffusion of innovations through a consumer population has been a common theme for agent-based modelers (Janssen and Jager 2001, Young 1999). Research using agent-based models (ABMs) has shown that network structure can significantly impact diffusion rates (Garcia, Zhao, and Calantone 2001, Goldenberg, Libai, and Muller 2003). One commonality across these studies is the assumption that all innovations eventually diffuse through a population. Some innovations, however, are 'resistant' to diffusion. Resistant innovations (Krackhardt 1997, Molesworth and Suortfi 2002, Ram and Sheth 1989) cause a discontinuity in the existing market or technology base because benefits of an innovation are unrealized by the adopting party. Examples of resistant innovations have been ATMs, hybrid electric automobiles, and fluoridation of city water. All these new products experienced slow initial adoption because consumers were skeptical of their usefulness.

Ram and Sheth (1989) recommend several marketing strategies to overcome consumer resistance to innovations. Their prescriptive guidelines suggest following traditional marketing and communication strategies. Although these normative guidelines can be used with success with many innovations, our case study suggests that these rules may not apply in all industries/countries. In this study, we seek to extend the diffusion of resistant innovation theory by introducing competitive cooperation, also called co-opetition, as an alternative strategy.

Co-opetition is a form of a strategic alliance in which two or more interorganizational firms in the same industry, who normally compete against each other, cooperate on some actions to accomplish a specific goal (Brandenburger and Nalebuff 1996, Gomes-Casseres 1996, Harbison and Pekar 1998). Firms have embraced co-opetitive alliances in order to (a) exchange patents and other knowledge, (b) undertake collaborative research and development activities, (c) build market alliances for setting new standards, and (d) establish collaborative agreements to integrate existing businesses (Garraffo 2002). By working together co-operating firms can maximize resources, stimulate knowledge development and utilization, and expand market opportunities (Jorde and Teece 1989). We explore co-opetitive strategies can be used to diffuse resistant innovations.

The aim of this study is to investigate the role of cooperation among competing firms with the intent of speeding the diffusion of a resistant innovation. We employ an agent-based model (ABM) to evaluate our research questions. With an ABM we can model heterogeneous agents who interact with each other; in this case agents are both firms and consumers. Consumers make choice decisions on whether to adopt a resistant innovation, and conjointly, firms make separate choice decisions whether to offer the resistant innovation. We explore markets in which there is no competition and markets in which there are varying degrees of cooperation among firms on whether or not to offer the innovation. (Firms remain free to compete on price.) An ABM allows us to model these separate but interdependent networks to determine the influence they may have on each other, such that;

Consumer Adoption = *f (individual preferences, consumer network effects, firm adoption, advertising)* (1)

Firm Adoption = *f (innovativeness, firm network effects, consumer adoption)* (2)

We examine the impact of micro-level firm strategies (i.e., advertising effects, network ties) on global, macro-level effects, including diffusion. We use the results of a conjoint study of more than 2800 consumers to instantiate the model with empirical data to drive the choice decisions of the consumers. We use ethnographic results from interviews with more than 20 related firms to drive the choice decisions of the firms. The research questions we explore are:

1. When (and what type) of a co-opetition strategy is more profitable than a competitive strategy (acting alone) in the diffusion of resistant innovations?

2. What is the impact of different network structures of consumers on firms' decision to join the marketing cooperative?

3. What size of network alliances between firms is most beneficial on a micro-individual level? On a macro-marketplace level?

1.1 Case Study

We base our model on a case study set within the global wine industry. Quality natural cork closures for wine have been in limited supply due to the few localities worldwide where cork can be grown and harvested. Screw caps (also called Stelvins) were developed and tested for feasibility as an alternative wine closure in the late 1950s and early 1960s. In the late 1970s, Stelvins were introduced to the Australian marketplace by local wine producers. But by 1984, these wineries had stopped using the Stelvin because of consumer resistance to accept a screw cap closure for premium wines. However, the innovation did not completely die out with this failed introduction. Wine producers found that screw caps eliminate wine oxidation that leads to rapid aging, discoloration and loss of fruit flavors due to air leakage that can occur with other types of closures. The technical superiority of Stelvins over other closures, including the traditional cork closure, caused its resurgence in 2000 with great success in Australia and New Zealand.

A strategy of co-opetition was used in these wine markets to diffuse the Stelvin. Driven by the superiority of screw caps over cork closures, a group of 15 winemakers from the Clare Valley of Australia selected the Stelvin for closing their premium Rieslings in 2000. Gaining insights from the failures twenty years previous, the collaborative of wineries jointly launched a marketing campaign, 'Riesling with a Twist' in which they communicated to the media, consumers and retailers the quality aspects of the seal. The success of the Australian launch motivated 27 New Zealand wineries to form the New Zealand Wine Seal Initiative in late 2001 (www.screwcap.co.nz/). By 2004, sales of screw capped wines outnumbered wines with cork closures in New Zealand and Australia (Sogg 2005).

Figures 1 and 2 illustrate some of the marketing of Stelvins in the US. Despite the marketing efforts of several wineries in the US, screw caps have not gained popularity with the American consumer – less than 5% of wineries in the US bottle use screw caps. Screw caps on mid-to-high-end wines

appear to be 'resistant' innovations in the United States. The mainstream US wine consumer is either not accepting or has not heard of the benefits of the screw cap.

Figure 1. Screw Capped Offering by 3 Loose Screws Winery

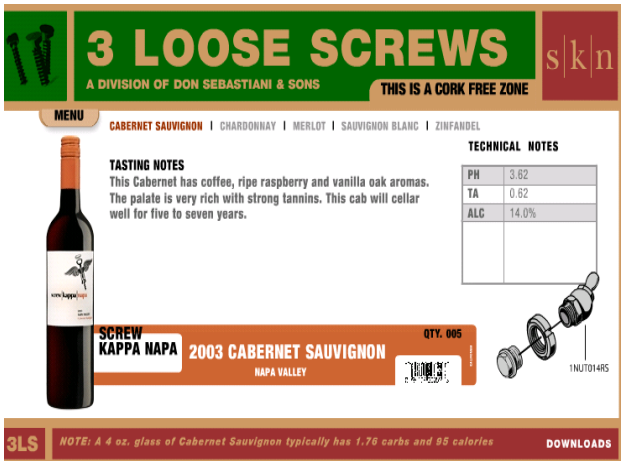


Figure 2. Web page for Hogue Cellars Screw Capped Offering

1.2 Empirical Calibration of the ABM Model

We use an iterative three step approach to build our model: Model/Theoretical Foundation – Empirical Data – Simulation (Figure 3) based on Madey, et al (2002). In the iterative design, six tasks are conducted: ***test, structure, develop, enrich, instantiate,*** and ***replicate.***

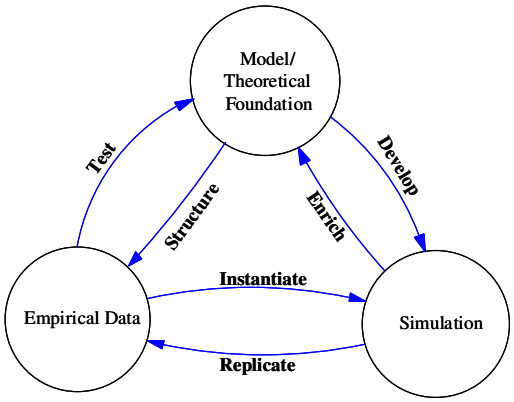
We start with model development based on the theoretical foundations of co-opetition and diffusion of innovations as previously discussed. We models word-of-mouth and advertising as positive influences on consumers' awareness of and preference for Stelvins. The former is endogenous to the network and a function of prior adoption. The latter is a control variable of profit-maximizing firms. We then use the ABMs to explore whether:

P1. A co-opetition strategy between wineries will speed the diffusion of the screw cap, a resistant innovation in the wine industry.

P2. Co-opetition strategy will have greater impact on speed of diffusion of the screw cap compared to word-of-mouth and advertising effects.

P3. A co-opetition strategy will be more profitable to cooperating firms as opposed to competitive strategies in the diffusion of the screw cap.

Figure 3. Framework for Empirical Calibration of ABMs (based on Madey, et al 2000)



These research questions guide simulation algorithm ***development*** (noted as ***develop*** in Figure 4). A generalized causal model, shown in Figure 4, demonstrates how the two types of agents, wineries and consumers, interact with each other. A six-step process summarizes the rules in which the agents follow:

Step 1. Agents (wineries and consumers) initialized with heterogeneous characteristics.

Step 2. Wineries evaluate the utility of joining an alliance of wineries, which jointly market wines with Stelvin closures. Each winery strives for profit maximization.

Step 3. Wineries 'produce' wine based on market demand and membership in the alliance. (Alliance membership dictates that only Stelvin closures are used on product offerings; prices are set independently.) Firms choose their prices by maximizing expected profit. Each firm acts unilaterally in price based on the observed demand from the previous period.

Step 4. Consumers choose wineries to evaluate their preference for the winery's products based on market offerings (winery production), personal 'network' with other consumers (word-of-mouth) and winery advertisements.

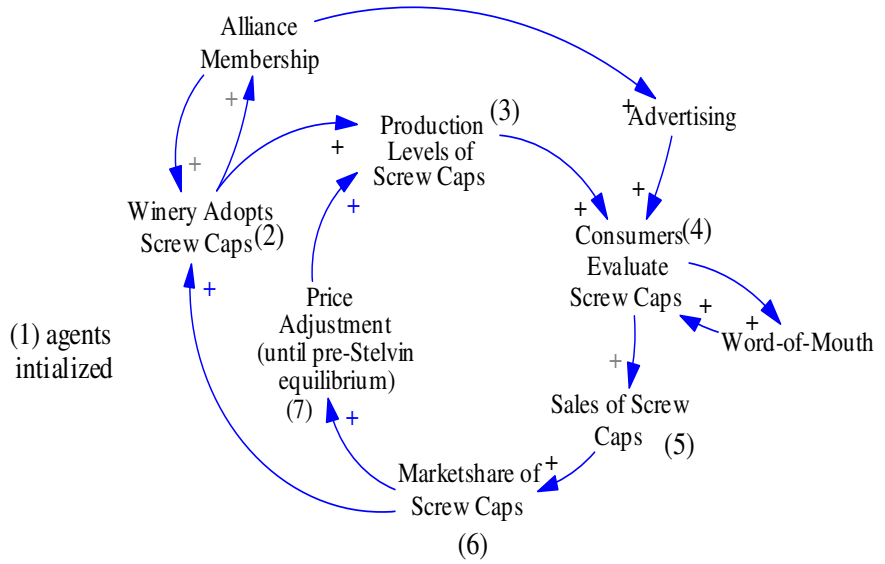
Step 5. Consumers 'purchase' a wine based on maximization of their utilities. If this choice is a Stelvin closure, the consumer has 'adopted' the innovation. If no wine is found that provides sufficient utility, the consumer does not purchase.

Step 6. Firms record sales and store any unsold wine. Stored wine is available for future periods but incurs an inventory cost. Firms cannot change the closure type on unsold wine, but they can change the price.

Step 7. Market share (re)calculated. Repeat starting with Step 2.

The theoretical foundation and propositions jointly drive the ***structure*** of the data collection for exploring the impact of competition and cooperation. Having observed the extreme differences in marketplace acceptance for screwcaps across the three countries (US, Australia, New Zealand), we seek to gain an understanding of the impact of changing consumer preferences for wine in these three countries. To instantiate the model, we conducted a conjoint-based study in order to understand consumers buying preferences for different types of closures

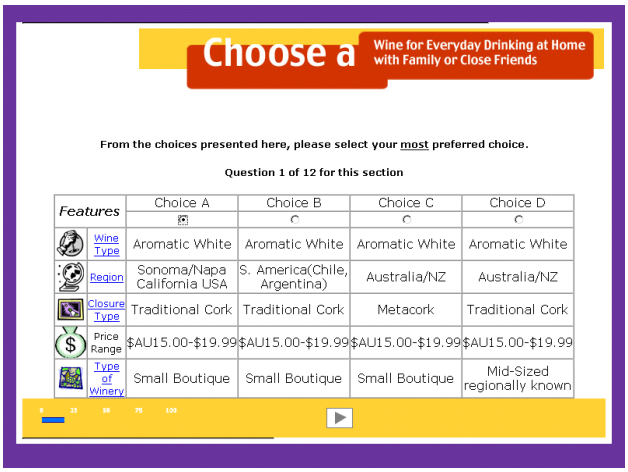
Figure 4. Causal Model



We recruited 2,825 subscribers of a wine-related e-newsletter to complete a conjoint-based survey; these included 1097 from Australia, 385 from New Zealand, and 1343 from the US. Methodology and detailed results of this study are reported in Toubia, et. al. (2005). The conjoint design included five features at four levels each (see Figure 5) :

- closure type: traditional cork, synthetic cork, Metacork™, screw cap
- type of wine: dry white, aromatic white, dry red, blush red
- origin of wine: Australia/New Zealand, France, Sonoma/Napa, Chile/Argentina
- vintner type: small boutique, mid-size region winery, large nationally recognized winery, international conglomerate winery
- price: $7, $12, $20, $25 in the respondents' currency (e.g., Australian dollars)

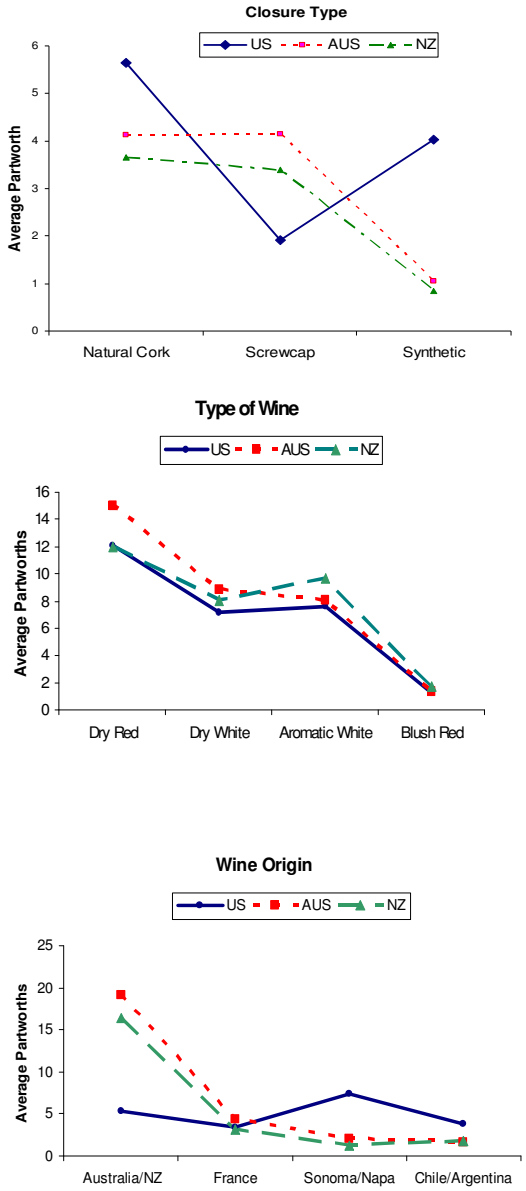
Figure 5. Conjoint Design (from Toubia, et. al. 2005)



Not surprisingly, the conjoint results suggest that Australians (AUS) and New Zealanders (NZ) prefer Stelvin closures more than Americans (Figure 6). In regards to overall closure preferences, AUS and NZ consumers appear indifferent between Stelvins and natural cork closures. In the United States, respondents prefer corks to other types of closures, with Stelvins the least preferred. Interestingly, little difference, besides this preference for closure types, was found between the

Australian and US consumers. On average, respondents preferred red wines over white wines and they preferred wines from regional and boutique wineries over international conglomerates. Respondents relied on wine-related periodicals and wine-related functions to gather knowledge about wines, although New Zealanders and American went to more wine-related functions than Australians.

Figure 6. Conjoint Partworths (from Toubia, et. al. 2005)



To understand firm behavior, we initiated qualitative data collection focused on the wineries themselves. Key decision makers in the wine industry were contacted in both New Zealand and the United States to give their 'story' behind this resistant innovation for their product offerings. We also collected secondary quantitative data about market place information regarding different types of wine, average prices of wine, current market share for Stelvins, and other industry-related data using our industry contacts. These qualitative data help to set the rules set for the 'winery' agent.

After collecting the quantitative and qualitative data our next step was to use the empirical data to ***instantiate*** a baseline ABM. Tesfatsion (2005) refers to this as input validation, where the modeler ensures "that the structural conditions, institutional arrangements, and behavioral dispositions incorporated into the model capture the salient aspects of the actual system"). Consumer agents are assigned partworths from the conjoint results representing preferences for winery types (boutique, regional, national, international), red wine/white wine, price levels ($7, $12, $20, $25) and closure type (screw cap/cork).

ABM sensitivity analyses are conducted. An important distinction is noteworthy at this time; a baseline ABM model is used in these tests. The baseline model is set with minimal interdependencies between agents and with elimination of exogenous shocks to the system. In the baseline model here, we exclude alliance memberships, advertising and word-of-mouth impacts. This allows us to calibrate the model using sensitivity analyses by setting the micro variables (agent characteristics driven by the empirical data) constant and observing how well the macro-environmental variables match the true

market place (for example, market share for Stelvins, red wines, white wines, etc. When the simulations do not ***replicate*** the known facts about the macro system as revealed in the empirical data, adjustments of the model parameters are required. Fagiolo et al., (2004) refer to this as the replication of 'stylized facts'. They suggest that first the stylized facts must be identified, then the micro conditions must be set as close as possible to the 'real world' and then parameters and initial conditions are established that statistically replicate the stylized facts.

Because we allow price (and advertising) to be set endogenously by rational agents (wineries) in response to economic decisions by consumer agents (buy what and from whom), we begin with a burn-in period until prices reach a pre-Stelvin equilibrium. In oligopolistic competition, wineries make profit-maximizing, but myopic, decisions to introduce Stelvins. They adjust prices to the new market conditions. It is only after we have reached both a price and product equilibrium do we introduce network effects (both consumers and wineries) and advertising effects.

Consumer agents can communicate with one another based on a small world structure (Watts and Strogatz 1998), thus aiding (or inhibiting) the diffusion of Stelvins. Co-opetition is manipulated by the degree to which wineries cooperate on Stelvin production and advertising. Early results of this model indicate that the size of the alliance (number of firms committed to screw caps) can significantly impact the rate of diffusion of the screw cap. This supports the qualitative data collected from the both the New Zealand and Australian wineries which have stated that at least a dozen committed wineries were necessary to 'get the ball rolling'. This was due to advertising expenditure, media and retail education and bottling costs. Our model also suggests that too large of an alliance results in lower profits for the firms in the alliance because consumers are not 'ready' to accept the innovation and sales go to the wineries which stayed committed to cork closures. Later the wineries not in the alliance can free-ride on the Stelvin-coalition's initial investments. Our early results enable us to refine and ***enrich*** our theoretical foundation. Continuing analyses are planned to explore the profit impact of competition vs. co-opetition.

2. Summary

In summary, this study explores whether and how organizations interested in diffusing resistant innovations may be able to utilize competitive cooperation to speed the rate of diffusion. An international survey showed that wine consumers in three countries are similar in their approach to the purchasing process with the exception of preferences for wine bottle closures. Endogenous decisions by wineries have led to differing adoption rates of screw cap closures among countries. We explore the extent to which this difference is due to the willingness of wineries in Australia and New Zealand to embrace co-opetition strategies through a coordinated marketing campaign. Insights from the model enable us to predict the impact of any potential co-opetition in the US wine market.

Acknowledgements

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