Canopy Management: Economics and Consumer Willingness-to-Pay

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From Vine to Bottle: Making Decisions about Canopy Management
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Outline

- REVENUES… Consumer willingness-to-pay analysis for sensory and 'green' attributes
- COSTS… Economic analysis incorporating yield effects and management costs
- NET RETURNS… Does CM pay?

WTP Motivation

- Predicting consumer demand for new food products and developing informed marketing strategies is incomplete without incorporating both **sensory and monetary evaluations**
- Consumer demands are encouraging the investigation and adoption of alternative practices that can reduce the reliance on chemicals and **promote more environmentally friendly products.**
- Increasing trend towards the **use of eco-labels** suggests consumers can be induced to differentiate between products purely based on their production processes, even if they do not ultimately lead to any discernible physical differences between the final products.
- Order and type of information received can result in **asymmetric effects** on WTP.

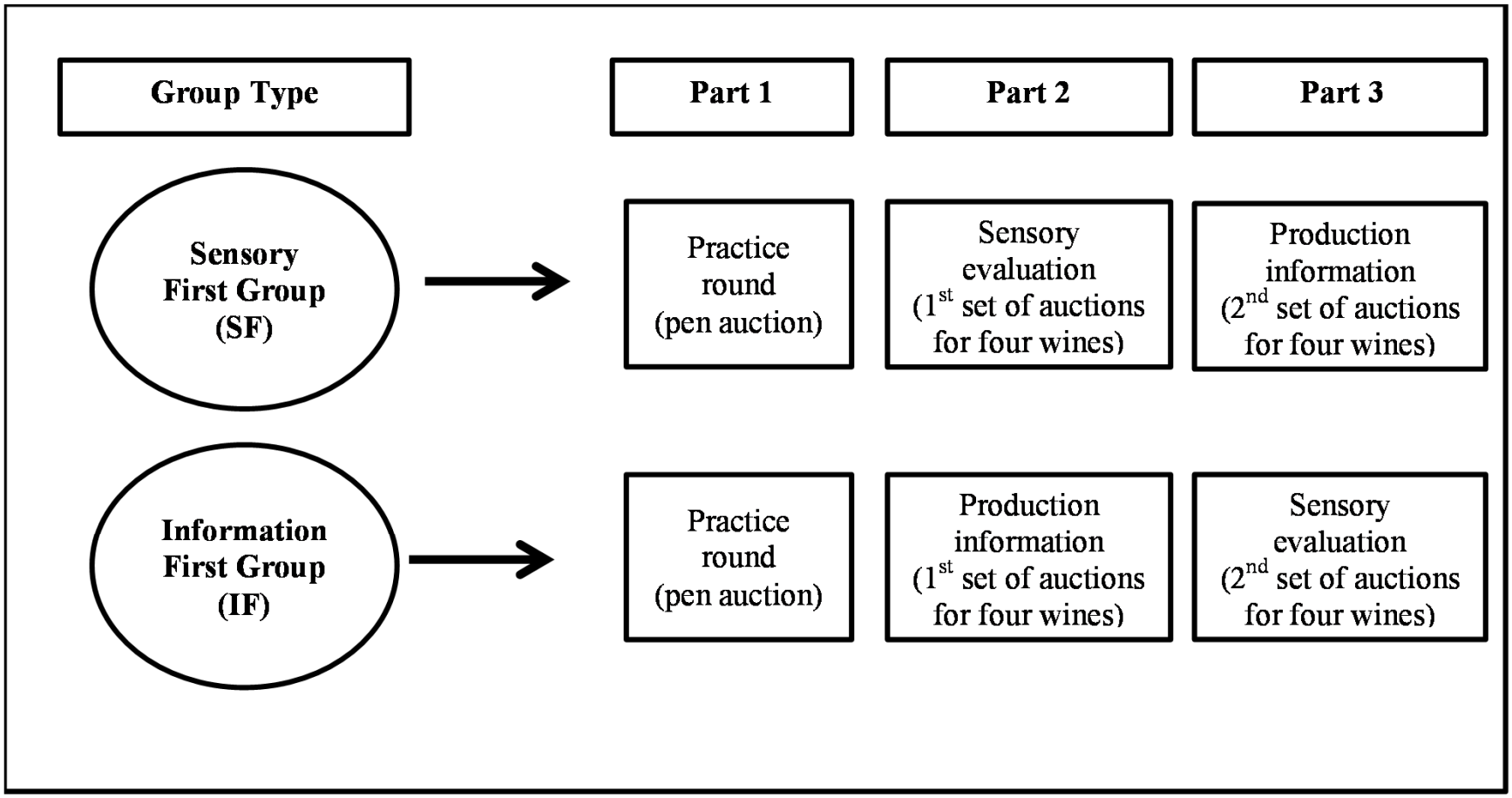
WTP Experiment

- **Examine if consumers (untrained) can detect differences in wines by CM production treatment**
  - How does this effect their WTP?
- **What is the impact of consumers being informed of the CM practices employed and expectations on fungicide use and fruit quality?**
  - How does this effect their WTP?
- **172 participants, 'regular' white wine consumers (at least 1x/month)**
  - Panelists receive $30 for participating, one per session 'buys' wine
  - Panelists provide WTP for each wine
  - Two separate rounds of bidding (order of information varies)
- **Use regression analysis to quantify:**
  - Differences in WTP by CM treatment
  - Account for ordering effects
  - Control for differences in demographic characteristics

Types of Riesling Wines (semi-dry)

1. **Control (*CON*):** recommended industry practices for premium quality grape and wine production are followed;
2. **Shoot Thinning (*ST*):** recommended industry practices for premium quality grape and wine production are followed, along with shoot thinning early in the growing season to five shoots per canopy foot;
3. **Leaf Removal (*LR*):** recommended industry practices for premium quality grape and wine production are followed, along with leaf removal in the fruit zone (80%) late in the growing season; and
4. **Shoot Thinning and Leaf Removal (*STLR*):** recommended industry practices for premium quality grape and wine production are followed, along with shoot thinning and leaf removal practices as described above.

Parts of Experiment



CM Information - Grape Production

- Increased disease protection efforts are needed during humid growing seasons like those experienced in New York State (NYS).
- Riesling grapes are particularly susceptible to funguses such as powdery mildew and botrytis (bunch rot).
- These fungal diseases generally do better in wet, cool climate conditions such as those experienced in NYS.
- Dense & shaded canopies can be problematic (high levels of vine growth with clusters hidden by several layers of leaves) since this increases the incidence of these diseases & promotes uneven ripening.

• As a result, grapes have to be <u>sprayed multiple times</u> throughout a growing season to prevent infection, often every 10-14 days depending on the weather.

CM Information – Practices

- University research indicates that growers can enhance their disease management programs by using **Canopy Management (CM)** practices.
- CM practices such as **shoot thinning & leaf removal** are used to develop more open canopies that improve air circulation & sun light exposure.
- CM practices are considered more **environmentally-friendly** since they reduce fungal pressure by decreasing the duration of wetness events and improve the penetration and efficacy of chemical applications.
- It is expected that implementing CM practices will result in:
  1. **Reduced total fungicide use** with a more open canopy & cleaner fruit, AND
  2. **Improved fruit composition** from increased light interception and more even ripening by grape clusters.

Econometric Model

- A random effects Tobit model was used to account for the panel nature of the data; i.e., each subject submitted multiple bids for different wines in multiple rounds:

$$WTP^{*}_{jtim} = \alpha + \boldsymbol{\beta} W_j + \boldsymbol{\gamma} W_j G_m + \delta R_t + \theta R_t G_j + \boldsymbol{\varphi} \mathbf{X_i} + e_{jtim} + u_i$$
$$WTP_{jtim} = max\left[0, WTP^{*}_{jtim}\right]$$

- In words, model how consumer WTP is affected by:
  - **W**ine type (CON, ST, LR, STLR),
  - **G**roup Type (Sensory first, CM Info first)
  - **R**ound (condition on information)
  - **D**emographic variables (***X***)

WTP Regression Results - 2009 wines

Variable	Estimate
ST	-0.399
LR	-0.912 ***
STLR	-0.480
ST*InfoFirstGroup	1.262 ***
LR*InfoFirstGroup	0.777 *
STLR*InfoFirstGroup	1.307 ***
ROUND2	-0.014
ROUND2*InfoFirstGroup	-0.528 *

*,**, and *** represent 0.10, 0.05 and 0.01 levels of statistical significance, respectively

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Marginal WTP estimates for the CM wines based **ONLY on their combined sensory characteristics** relative to the control wine for round 1

No statistically significant differences for ST and STLR wines from control

BUT LR had a MINUS 91 ¢/bottle (14%) premium!

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Adding information about environmentally friendly CM practices after sensory **DID NOT** affect original valuations.

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Subjects **were willing to pay for environmentally friendly practices** in general, however.

Positive and significant marginal WTP estimates for all CM wines relative to the sensory first group in round 1

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Positive and significant marginal WTP estimates for all CM wines relative to the sensory first group in round 1

Total premiums for **only** environmentally friendly attributes are the sum of both:
ST = 0.863 (14% premium)**
LR = -0.135
STLR = 0.827 (13% premium)**

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Negative sensory response reduces WTP by 53 ¢/bottle. The positive premiums for ST and STLR based on environmental attributes are distinguished with the addition of (negative) sensory feedback

Cost Analysis of CM Practices on Riesling

- Assess differences in costs for alternative CM practices:
  - Labor costs
  - Fungicide costs (quantity, spray frequency (labor), equipment O&M/depreciation)
  - Yield effects
- Utilize field trial data and other sources of information to parameterize the model.
- Estimate minimum change in grape prices to offset higher unit costs of production.
- Make template updatable for grower/user personalization.

Table 1. Cost Analysis of Canopy Management Practices on Riesling

Yield and Cost Variables	Supplemental Parameters	Treatment			
		Control	ST	LR	ST/LR
Yield (ton/acre)		4.70	4.16	4.70	4.03
Percentage Change			-11.4%	0.0%	-14.3%

Note: Control = no shoot thinning, no leaf removal; ST = shoot thinning, LR = leaf removal (late), ST/LR = shoot thinning and leaf removal (late). Cells in yellow are input cells.

Sources: White 2011; Preszler 2012; Author calculations

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Variable Costs					
Fungicide Materials, Labor, Equipment		$ 602	$ 602	$ 602	$ 602
Percentage Change			0.0%	0.0%	0.0%

Note: Control = no shoot thinning, no leaf removal; ST = shoot thinning, LR = leaf removal (late), ST/LR = shoot thinning and leaf removal (late). Cells in yellow are input cells.

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Percentage Change				0.0%	0.0%	0.0%
	Hours	$ per Hour				
Shoot Thinning	3.5	$ 12.00		$ 42		$ 42
Leaf Removal	4.5	$ 12.00			$ 54	$ 54

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Leaf Removal	4.5	$ 12.00			$ 54	$ 54
Other Growing Costs			$ 1,713	$ 1,713	$ 1,713	$ 1,713
	Rate					
Interest on Operating Capital	4.0%		$ 93	$ 94	$ 95	$ 96
Machine Harvesting			$ 240	$ 240	$ 240	$ 240
Total Variable Costs ($/acre)			$ 2,648	$ 2,691	$ 2,704	$ 2,747
Change in Variable Costs ($/acre)				$ 44	$ 56	$ 100

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	Price ($/ton)					
Net returns over variable costs (NROVC)	$ 1,537		$ 4,576	$ 3,709	$ 4,520	$ 3,443
Change in dollars per acre				-867	-56	-1133
Percentage change in dollars per acre				-18.9%	-1.2%	-24.8%

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Grape price for constant NROVC ($/ton)			$ 1,537	$ 1,745	$ 1,549	$ 1,818
Change in price per ton				208	12	281
Percentage change in price per ton				13.5%	0.8%	18.3%
	Bottles/ton grapes					
Change in price per bottle	443			$ 0.47	$ 0.03	$ 0.64

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Conclusions

- Environmentally friendly attributes were important to consumers, with premiums ranging from 83-86 ¢/bottle.
  - But (negative) sensory effects dominated environmental attribute effects
  - Positive premiums for environmental attributes realized only if consumers' sensory expectations are satisfied.
- Management costs (47-64 ¢/bottle) within range of WTP environmental premiums → *potential* for improved returns.
  - Variation in yield effects evident over time; close monitoring of cost effects important.
  - More information on sensory (quality) effects and fungicide management needed.