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The Welfare Impacts of Demand-Enhancing Agricultural Innovations: The Case of Honeycrisp Apples

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UNIVERSITY
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Introduction

Motivation

The agricultural sector in the United States (U.S.) has introduced thousands of new products to the food market over past decades. Specifically, in the period of 2011 to 2016, a total of 3,523 new varieties of fruit and vegetables are sold in the grocery stores with an annual increase ranging from 446 to 710 (USDA 2017). These new agricultural products cope with the contemporary challenges of food security and public health. The continuous introduction of new agricultural products, fueled by the investment in agricultural research and development (R&D), contributes to social welfare. Quantifying economic returns from new agricultural products, therefore, is of interest to all stakeholders from producers (e.g., State Agricultural Experiment Station, universities, farmers, and retailers) to consumers.

For a number of reasons, the apple market adequately serves the purpose of this research: (1) apples are the second most valuable fruit in the United States, (2) the growth of apple industry is rooted in the success of the breeding programs in the land grant universities (e.g., Cornell Univ., Washington State Univ., and Univ. of Minnesota), and (3) a large number of newly patented varieties are under development.

Research Question

This study investigates the welfare impacts of a new apple variety and bring insights into the market benefits from the investment in agricultural R&D.

Apple Industry in the U.S.

Variety

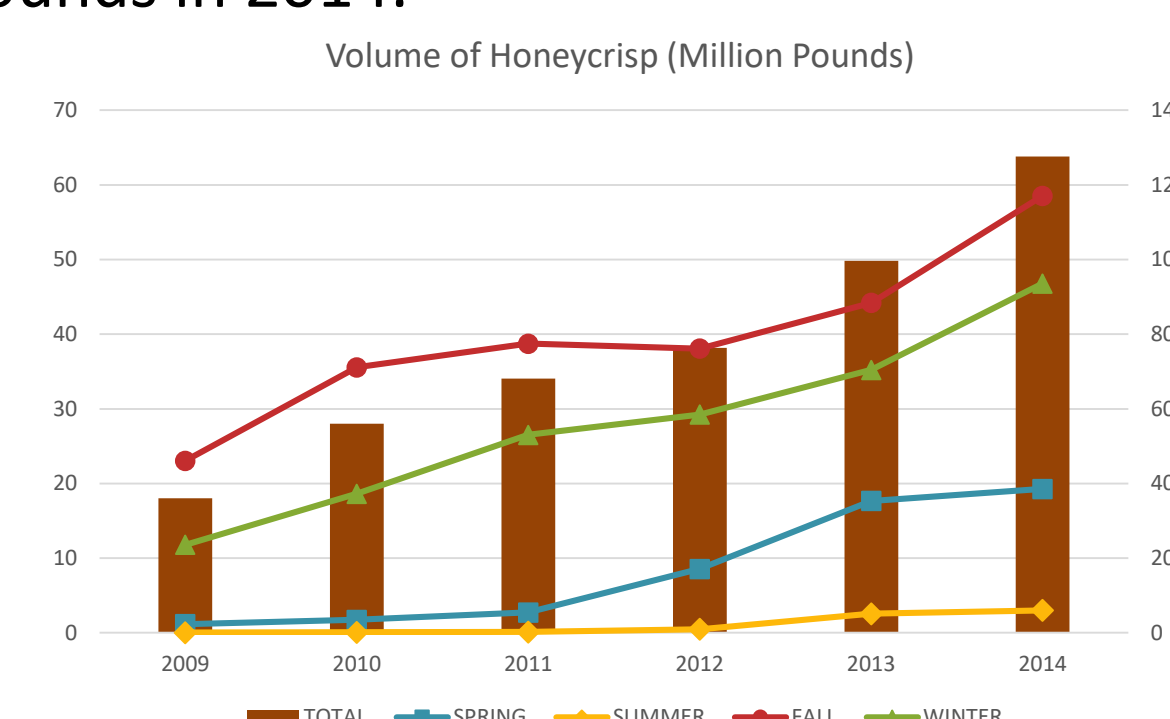
- Apples are marketed by variety
- 7,500 over the world, 2,500 in the United States, and more than 100 sold in retail stores

Production and Consumption

- Apples are grown in all continental states but commercially produced in 32 states, led by WA, NY, MI, and PA.
- Second most consumed fruit
- 70% of total production are sold in the market of fresh fruits
- Average annual consumption per capita 14.3 pounds in 2009, and 16.6 pounds in 2014.

New Variety

- Higher price
- Honeycrisp
 - 1960s: developed by the University of Minnesota
 - 1991: Introduced to the market
 - 2006: State Fruit
 - 2008: Patent Expired



Analytical Framework

Consumer Utility and Demand

The random utility framework is employed to motivate the discrete choice model of demand using market level data (e.g., Nevo 2001).

Supply and Pricing Conditions

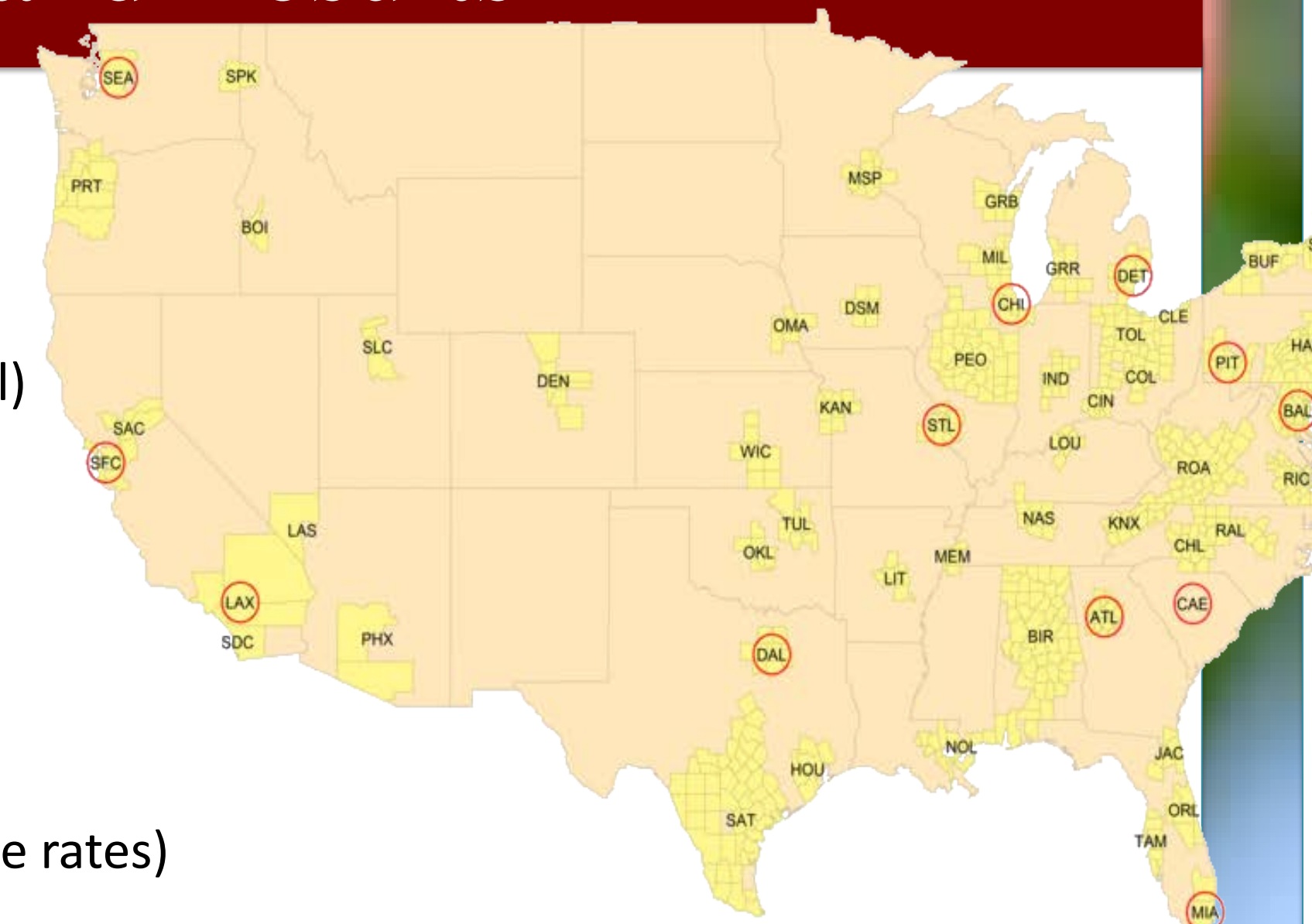
In the retail apple markets, retailers compete in a Bertrand-Nash fashion by choosing optimal prices for differentiated apples in their stores (e.g., Petrin 2002).

With the estimated demand and the pricing conditions, we can simulate the equilibrium outcomes of a counterfactual scenario in which Honeycrisp was removed from the market.

Data and Results

Data

- IRI Store Scanner Data from Mar 2009 to Feb 2015 (Weekly) Sales quantities and prices
- American Community Survey (Annual) County level population statistics
- USDA Agricultural Marketing Service (Monthly) Terminal market prices in 15 markets
- BLS Occupational Employment Statistics (OES) Survey (Annual) State level cost information (i.e., wage rates)



Price Elasticities

Variety	Own-price		Cross-price	
	Mean	Same (Yes)	Same (No)	Average
Braeburn	-3.958	0.040	0.026	0.031
Fuji	-3.855	0.052	0.053	0.053
Gala	-2.802	0.050	0.043	0.045
Golden Delicious	-6.466	0.093	0.061	0.072
Granny Smith	-3.737	0.063	0.053	0.056
Honeycrisp	-5.584	0.030	0.021	0.024
Pink Lady/Cripps Pink	-5.639	0.050	0.027	0.035
Red Delicious	-2.961	0.033	0.022	0.026
Retailer category				
Local	-4.243	0.072	0.026	0.043
Small regional	-5.925	0.076	0.023	0.041
Regional	-4.560	0.036	0.030	0.032
Nationwide	-3.377	0.026	0.064	0.050

Selected References

- Nevo, Aviv. 2001. "Measuring Market Power in the Ready-to-Eat Cereal Industry." *Econometrica* 69 (2): 307–42.
- Petrin, Amil. 2002. "Quantifying the Benefits of New Products: The Case of the Minivan." *Journal of Political Economy* 110 (4): 705–29.

Welfare Analysis

Changes of Market Shares (Percent) and Revenues (Million Dollars)

Year	Numb. of Markets	Numb. of IRI Cities	Change in Market Size			Change in Sales Revenues		
			Honeycrisp	Others	Total	Honeycrisp	Others	Total
2009	42	29	3.36	-0.92	2.43	12.58	-1.81	10.77
2010	61	38	3.38	-0.95	2.43	17.77	-2.94	14.84
2011	78	39	3.82	-1.04	2.78	22.71	-3.85	18.86
2012	82	38	3.50	-1.09	2.41	28.17	-5.34	22.83
2013	107	43	3.64	-1.16	2.47	36.13	-6.72	29.41
2014	111	43	3.88	-1.09	2.79	42.46	-7.05	35.41
Average			3.59	-1.04	2.55	26.64	-4.62	22.02

Decomposition of Average Consumer Welfare (Cents per Pound)

Total Change at Average in Consumer Welfare ($E[CV_i]$)	Change from Observed Characteristics ($\delta_j + \mu_{ij}$)	Change from Logit Error (ϵ_{ij})	
Market Shares of Honeycrisp \geq 1 percent (481 Markets)	3.14 (100.00%)	1.87 (59.55%)	1.27 (40.45%)
Market Shares of Honeycrisp \geq 5 percent (96 Markets)	4.49 (100.00%)	3.18 (70.82%)	1.32 (29.18%)

Total Welfare Changes (Million Dollars)

Year	Numb. of Markets	Numb. of IRI Cities	Introduction Effect	Price Effect	Total Change in Consumer Welfare
2009	42	29	2.76 (91.09%)	0.27 (8.91%)	3.03 (100%)
2010	61	38	4.42 (92.28%)	0.38 (7.72%)	4.79 (100%)
2011	78	39	6.73 (92.45%)	0.54 (7.55%)	7.28 (100%)
2012	82	38	7.05 (91.56%)	0.66 (8.44%)	7.70 (100%)
2013	107	43	10.04 (91.11%)	0.98 (8.89%)	11.02 (100%)
2014	111	43	13.91 (91.51%)	1.29 (8.49%)	15.20 (100%)
Average			7.49 (91.66%)	0.69 (8.34%)	8.17 (100%)

Conclusions

- For selected markets in the analysis, the total sales revenue of all included apples increases from 10.77 million dollars in 2009 to 35.41 in 2014, whereas the associated welfare for consumers increases from 3.03 million dollars in 2009 to 15.20 in 2014.
- Honeycrisp consumers benefit from extending the marketing season of Honeycrisp and non-Honeycrisp consumers enjoy the low prices of other cultivars due to the increasing competition in the market.
- Honeycrisp drives downwards the prices of existing apple varieties, and the extent of price decline is positively associated with the market share of Honeycrisp.
- These findings indicate that the increment of consumer welfare owing to the presence of Honeycrisp, an example of the return to demand-enhancing agricultural R&D, is large.