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


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Goat Meat Consumption in Oklahoma: A Quantitative Assessment of Potential Consumer Demand

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Abstract

Although goat meat is one of the significant meat protein sources around the world, it is a minor consumption item in the United States. However, with dynamic demographic integration throughout the country, consumption has increased in recent years, while domestic goat meat supply has not kept pace with consumer demand. Using a Qualtrics survey, the study assesses potential factors influencing the demand for goat meat consumption in Oklahoma. The results indicate that gender, education, income, price specials, and safety assurance measures influence goat meat demand. These findings will help execute an effective market expansion strategy for goat meat in Oklahoma.

Keywords: goat meat, consumer survey, marketing strategies, probit model, marginal effects

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Introduction

Goat meat is a vital source of protein for meat consumers in the world marketplace. According to the United States Department of Agriculture (USDA) food composition database (USDA-NAL, 2019), goat meat is lean meat, which is relatively healthier in nutritional qualities than other red meat. Recently, the demand for goat meat has increased in the United States. According to USDA statistics, the total goat inventory in the United States in January 2023 was 2.51 million goats, a 2% decline from 2022 (USDA-NASS, 2019). Based on available data, the United States does not produce an adequate supply of goat meat to satisfy local demand (Ekanem et al., 2013). This shortage leads to a relatively high price for goat meat in the United States. The U.S. imports goat meat mainly from Australia to fill the supply gap (USDA-ERS, 2020).

Several studies show that the main driving forces for the increased demand for goat meat in the United States are the increased consumption from ethnic groups and the rising awareness about healthy dietary habits (Knight et al., 2006; Ibrahim et al., 2017). As ethnic diversity is highly associated with goat meat consumption, it will eventually lead to unique preferences among U.S. meat goat consumers. In addition, previous studies found the demand for goat meat among the target consumers to be inelastic (Pinkerton, David, and Pinkerton, 1992). Ibrahim et al. (2017) report that the majority of goat meat consumers in the United States have cultural ties with the Middle East, Latin America, the Caribbean, and Asia. As the population of ethnically diverse Americans is projected to increase by 17% in 2040 (Colby and Ortman, 2015), the demand for goat meat in the United States will increase as the population increases, *ceteris paribus*.

At the production level, Oklahoma ranks fourth in meat goat inventory in U.S. goat production (USDA-NASS, 2019). However, goat producers in Oklahoma are constrained by marketing issues and seasonality in goat meat prices (Jones and Raper, 2017). This uncertainty will lead to yield, marketing, and other risks to producers and the market.

As with other commodities, meat goat production and marketing are highly correlated. Pinkerton, David, and Pinkerton (1992) emphasized insufficient marketing information on seasonal demand, consumer opinions, and consistent quality (Knight, 2005). In this scenario, understanding the dynamics of goat meat consumption and its implications is vital for producers and marketers in better responding to consumers' tastes and preferences. A practical question involves identifying the factors that will increase the consumer's willingness to pay for and consume goat meat. Specifically, what are the product attributes and demographics responsible for shaping consumers' willingness to consume and pay for goat meat? On the other hand, assessing consumers' willingness to consume and pay for goat meat helps to determine investment and production capacity planning, production allocation, and sales by building marketing strategies for expanding the goat meat market in Oklahoma. In addition, the outcome of this identification is vital in advertising and promotional activities to increase the display of goat meat in supermarkets.

A promising feature of goat meat is its source of nourishing benefits. Goat meat provides less saturated fat, lower calories, and less cholesterol than traditional meats, including chicken, beef, pork, and lamb. Regarding saturated fat, goat meat contains 0.79 saturated fat per 3 ounces when

compared to a similar serving size of chicken (1.7g), pork (2.9g), beef (3.0g), and lamb (2.9g). While goat meat provides 122 calories per 3 ounces, beef and pork provide 179 calories and 180 calories for a similar serving size (Niyigena, 2020).

These nutrition attributes represent an opportunity to expand the market for goat meat in the United States. As consumers become more aware of the health benefits of goat meat, the demand for low-fat red meat will eventually rise.

Our paper investigates the product attributes and consumer characteristics that affect the likelihood of goat consumption in Oklahoma. Specifically, the study attempts to identify the numerous product characteristics and the consumers' demographics and socioeconomic factors influencing consumers' willingness to consume and their buying decisions across different counties in Oklahoma. The study also identifies helpful market strategies for marketers, grocers, and retailers that can attract goat meat consumers for their meat products.

Previous Studies

This section provides a brief overview of the changes in the U.S. goat meat market, consumer attitudes and preferences, and potential factors contributing to the rise in the demand for goat meat. Few studies have been conducted focusing on goat meat consumption. Ibrahim et al. (2017) explore the factors affecting the potential demand for goat meat in Georgia. The authors use a binary logit model to estimate the willingness to consume goat meat and find that the education, gender, and household size of the respondents are statistically significant determinants of the willingness to consume goat meat. Importantly, this study shows that around 56% of the respondents who did not previously consume goat meat stated that they would purchase goat meat if they could find goat meat products from nearby grocery stores. Their study also finds that the freshness attribute is statistically significant in increasing the likelihood of consuming goat meat, and 94% of respondents expressed that freshness is an important feature of purchasing decisions. This result implies a better positioning for local goat production over imported and frozen goat meat products. According to the survey results, nutritional qualities, including leanness and cholesterol content, are also shown to be very important in consumer choices.

Ekenem et al. (2013) studied the profiles and goat meat consumer preferences using the data from face-to-face interviews administered in Tennessee. The survey identified that 62.2% of the interviewed meat consumers were immigrants, and 83% of the participants purchased goat meat. In addition, their analysis reported that 32.1% of the consumers stated they were willing to pay a higher price for goat meat, but 85% of the buyers responded that price was an important determinant in purchasing decisions. Moreover, the results showed that taste, package, and nutrition instruction were also important factors, with 84%, 75%, and 58% of participants choosing them as essential attributes.

McLean-Meyinnse (2003) investigated the socioeconomic, demographic, and geographic characteristics that result in the willingness to try and purchase goat meat products using the data across states in the United States. The study employed binary logit and ordered probit models to

estimate the factors affecting prior consumption and the probability of willingness to consume goat meat from non-goat meat consumers, thereby providing valuable estimates on future buying decisions of consumers for different goat meat products. Their results indicated that goat meat consumption was at the top for older customers, households consisting of more than three members, African Americans, non-Caucasians races, men, and Texas households. The study's findings also illustrated those women and residents, including Arkansas, Florida, Kentucky, Louisiana, North Carolina, South Carolina, Oklahoma, and Virginia, would be more likely to eat goat meat in the future. The study further concluded that age, race, household size, religion, gender, and residence affected goat meat consumption.

Another study by Harrison et al. (2013) implied that meat cuts, source of meat, and price were comparatively more critical than the goat meat color. This analysis used survey data from 2,000 general respondents and 2,000 goat meat consumers. For the live goat buyers, the slaughtering method and the goat's age were also more significant compared to the price and sex of the goat. The study concluded that various marketing opportunities would be available for goat meat producers in selling goat meat products and live goats.

Degner and Lin (1995) examined consumer perceptions and preferences by analyzing the willingness to consume goat meat at different locations through a blind taste test. Consumers were questioned about various sociodemographic features and about consuming at home and in a restaurant. The study emphasized consumers' views and attitudes toward goat meat. Consumers responded that if goat meat was prominently advertised, there was a higher probability that those consumers would order goat meat at restaurants. Among the selected socioeconomic and demographic factors, income, gender, and household size were identified as statistically significant factors for goat meat consumption in this study. The study further found alternative product names for goat meat products, cooking techniques, and meal attributes of the whole pack provided by the food outlet.

Research conducted by Knight et al. (2006) detailed the sociodemographic factors on goat meat consumer preferences. According to this study, among the age categories, individuals between the ages of 45 and 64 are the most likely to have consumed goat meat in the past, while younger consumers stated that they would like to consume it. In addition, males are more likely to express the desire to buy goat meat than females. The research focused on three categories: non-consumers (consumers who are unwilling to consume goat meat), potential consumers (consumers who are willing to consume goat meat), and current consumers (consumers who consume goat meat). Results reported that Hispanics were more likely to eat goat meat compared to Black Americans in all three categories. The findings also suggest that consumers with professional or graduate degrees are more likely to purchase goat meat. The same study also found that lamb consumers were more likely to consume goat meat. Several studies (Worley et al., 2004; Ibrahim et al., 2008; Fisher et al., 2009) reported that consumers were willing to add goat meat in place of lamb. The findings of Knight et al. (2006) further indicated that consumer attitude about goat meat is a significant obstacle in deciding their choices regarding goat meat. The findings revealed that consumers whose views toward goat meat were positive were more likely to be classified as goat meat consumers. Although there has been considerable demand for goat meat due to the rise in

ethnic variety, the study emphasized that increasing supply is necessary to fulfill the increasing demand. Considering that this study demonstrates that there is no difference in the willingness of Black and White purchasers to consume goat meat, it would be important to expand into new and existing markets outside of the non-Hispanic and non-Black markets. Additionally, Knight et al. (2006) also highlighted the importance of raising consumer awareness of goat meat's health and nutritional benefits; therefore, educational information can positively impact consumer decisions.

Liu, Nelson, and Styles (2013) investigated potential factors affecting the purchasing decisions of goat meat consumers and showed a considerable possibility of increasing the demand for existing consumers. The study also identified latent demand for new consumers and a seasonally adjusted demand. According to the study, older consumers and ethnicity were significant determinants of goat meat consumption, and age significantly affected willingness-to-purchase decisions.

Finally, Martin (2021) addressed the effect of consumer perceptions and demographic factors on their willingness to purchase goat meat. This research used a national survey to illustrate the impact of the various consumer attributes on grass-fed, locally produced, and organically raised goat meat. The results implied that the meat quality and freshness variables significantly affected consumers' willingness to buy goat meat. Furthermore, the analysis suggested that there is a possibility for a good market potential for fresh goat meat products.

Methodology

Data Collection: Survey

Data were collected using consumer surveys across 77 counties in Oklahoma to characterize and understand consumer preferences for goat meat and identify other potential factors that influence goat meat demand. The sample was identified through Qualtrics Panels, LLC, and was also used to conduct the survey. Potential respondents were contacted via email by Qualtrics and provided the opportunity to participate in the online survey. The survey was approved by Langston University's Human Research Protection Program. The electronic survey was administered between July and August 2021, and a total of 508 households responded. The survey instrument gathered detailed information on several categories of questions, including sociodemographic, economic, and other factors potentially influencing goat meat consumption from participants 18 or older from the 77 counties in Oklahoma. The primary research question of the survey questionnaire was to determine the consumers' willingness to consume goat meat.

Data Description

This study is based on the reviewed literature, and prior research indicates that the probability of purchasing goat meat is influenced by a variety of factors, including gender, age, education, household income, ethnicity, price specials, safety measures, and specific meat cuts. Tables 1 and 2 present the selected profiles of goat meat consumers and important survey responses of consumer buying behaviors. Table 1 also summarizes the sociodemographic information. Hence, we learn from the survey that 68.1% of the respondents are female, 70.4% are white, 9.4% are African

American, 5.8% are Hispanic, and 10% of the survey respondents identified themselves as multiracial.

Table 1. Selected Profile of Goat Meat Consumers

Demography	Percent	Count	Demography	Percent	Count
Gender			Education		
Male	31.89%	162	High school or less	38.38%	195
Female	68.11%	346	Some college	32.48%	165
Age			College graduate	22.44%	114
18–29 years	42.32%	215	Postgraduate/prof	6.69%	34
30–49	43.50%	221	Household Income		
50 years and older	14.17%	72	Less than \$10,000	13.19%	67
Race			\$10,000–\$24,999	16.73%	85
White	70.40%	352	\$25,000–\$49,999	28.35%	144
African-Amer/black	9.40%	47	\$50,000–\$99,999	28.15%	143
Black	2.80%	14	\$100,000 or more	2.95%	39
Hispanic	5.80%	29	Prefer not to answer	5.91%	30
Asian	1.60%	8			
Multiracial	10.00%	50			

There were six categories of educational achievements, with 38.3% of the respondents having either a high school diploma or lower, 32.48% having some college education, and nearly 6.7% having a postgraduate degree. Among the 508 participants, 73.3% said they would purchase goat meat if it were accessible in their grocery stores, and 26.7% responded that they were not interested in the product. While 24.6% of those surveyed had previously consumed goat meat, 75.4% had not. Among the participants who had already consumed goat meat, those between the ages of 18 and 29 expressed the most willingness to eat goat meat again, and those in the age category of 30 to 39 were the next highest willingness group among those who have consumed goat meat. On the other hand, among those who had eaten goat meat, participants who were 50 and 59 years old said they were most unlikely to consume goat meat again. Additionally, 48% of participants stated that cooking instructions are important, while 49% replied that prepackaged cuts are vital in their buying decisions.

Consumer Buying Behaviors, Opinions, and Specific Cut Preferences

Table 2 reports some important information on consumer buying behaviors along with attitudes and preferences for goat meat. According to the survey, 38.4 % responded that the participant or any member of the participant’s household had purchased goat meat, whereas 61.6% answered they had not. At the same time, 72.2% of the participants preferred purchasing specific goat meat cuts, including chops and cubes, and 11.8% expressed buying live goat (to be slaughtered). When considering specific cuts, most consumers preferred chops—approximately 39.9%—while 12.5%, 5.9%, and 4.7% of the respondents stated that they purchased cubes, whole carcasses, and half carcasses, respectively. When questioned about how much they preferred each cut of meat, 47.2%

of participants selected “very much” for chops on a scale that ranked consumer opinions and perceptions of the specific meat products. Approximately 43.2% of the consumers were likely to travel less than 1 mile from home to the farm where they buy live goats. Regarding where the respondents purchase goat meat, 17.82% bought it from the farm.

In this study, we aimed to identify the potential factors influencing the decision to purchase goat meat from Oklahoma consumers. Both socioeconomic and demographic factors were identified, and various goat meat product attributes of consumers’ buying decisions were also assessed.

The dependent variable in this study is a “yes” or “no” response to whether consumers are willing to consume goat meat. Therefore, we apply a discrete choice probit model for the dichotomous binary variable to provide a detailed analysis of the consumers’ behavioral responses to the consumer preferences questions regarding goat meat consumption.

Table 2. Some Information about Consumer Buying Behavior

Information	Percent (%)
Purchased goat meat	38.4
Specific cuts	
Chops	39.9
Cubes	12.5
Whole carcass	5.9
Half carcasses	4.7
Consumer opinions for specific cuts	
“Very much” for chops	47.2
“Very much” for cubes	13.8
Travel distance to purchase goat meat	
Less than 1 mile from home to the farm	43.2
Purchasing location	
Farm	17.8
Buying goat meat if it is available in food stores	73.3
Cooking instructions are important	48.0
Prepackaged cuts are important	49.0

The larger the value of y_i^* , the greater the individual’s utility received from choosing the option $y_i = 1$; the greater the probability of choosing the option. The researcher does not observe y_i^* but observes the choice according to the following expression:

$$y_i = 1 \text{ if } y_i^* > 0 \quad (2)$$

$$y_i = 0 \text{ if } y_i^* \leq 0,$$

A description of the explanatory variables can be seen in Table 3.

Table 3. Probit Model Variables and Description

Variant	Variable name	Description
Gender	GENDER	1 if female, 0 otherwise
Age	AGE1	Ages 18 to 29 (omitted category)
	AGE2	Ages 30 to 39
	AGE3	Ages 40 to 49
	AGE4	Ages 50 to 59
	AGE5	More than 60
Education	EDU1	Less than high school (omitted category)
	EDU2	High school diploma
	EDU3	Associate's/technical degree
	EDU4	Some college
	EDU5	College graduate
	EDU6	Postgraduate/professional
Decision to purchase goat meat Price specials	PRVIM	1 if very important
	PRIM	1 if important
	PRNIM	1 if not important (omitted category)
Safety assurance	SAFTY1	1 if very important
	SAFTY2	1 if important
	SAFTY3	1 if not important (omitted category)
Ethnicity	BLACK	1 if Black, 0 otherwise
	HISP	1 if Hispanic, 0 otherwise
	WHITE	1 if White, 0 otherwise (omitted category)
Household income	HH1	Less than 10,000 (Omitted category)
	HH7	\$75000 to 99,900
	HH10	\$200,000 or more
	HH11	Prefer not to answer

According to Greene (2017), we express the probit model:

$$\begin{aligned}
 p_i &= \text{prob}[Y_i = 1|X] \int_{-\infty}^{x_i'\beta} (2\pi)^{-1/2} \exp\left(-\frac{t^2}{2}\right) dt & (3) \\
 &= \Phi(x_i'\beta)
 \end{aligned}$$

where Φ is the standard normal cumulative distribution function. The maximum likelihood estimation is employed to obtain the parameter estimates of the binary probit model. In addition, the marginal effect provides the change in the probability or measures the change in probability

due to a unitary change in one of the explanatory variables under the *ceteris paribus* condition. The marginal effect of a variable x_k is given (Greene, 2017):

$$\frac{\partial p_i}{\partial x_{ik}} = \phi(x_i' \beta) \beta_k \quad (4)$$

where ϕ denotes the probability density function of the standard normal variable.

Empirical Results and Discussion

The fully specified empirical model for this analysis is based on Equation 1. Table 4 provides the results of the binary probit model with the estimated coefficients, standard errors, and marginal effects with other goodness of fit statistics. According to the study's results, respondents' education, gender, household income, price specials, and safety assurances, such as USDA inspections of goat meat, significantly affect consumers' willingness to purchase goat meat. On the other hand, our results show that age and ethnicity variables have no statistically significant effect on the consumers' goat meat consumption.

In the model, the gender variable has a positive and statistically significant effect on the probability of purchasing goat meat. In addition, the marginal effect indicates that males are 13% more likely to consume goat meat than females. On the other hand, the variable for the education level of college graduates is positive and significant at the 10% level. The marginal effect of education implies that individuals with a university/college degree are 14.6% more likely to buy goat meat than individuals with less than a high school-level education. This finding is likely because education increases individuals' awareness of healthy food and nutritional values. Our findings align with Knight et al. (2006), who reported statistically significant and positive coefficients for the education variable for willingness to consume goat meat.

Table 4. Empirical Results from the Willingness-to-Consume Goat Meat

Binary Probit Model				
Parameter	Estimate	Standard Error	Pr > ChiSq	Marginal Effects
Intercept	-0.8681	0.3268	0.0079	-----
GENDER	-0.4394**	0.2010	0.0288	-0.1337
AGE2	-0.2903	0.2219	0.1907	-0.0883
AGE3	-0.3302	0.2759	0.2314	-0.1004
AGE4	0.0711	0.4087	0.8619	0.0216
EDU2	0.0133	0.1420	0.9254	0.0040
EDU3	-0.0963	0.3289	0.7697	-0.0293
EDU4	0.2159	0.2693	0.4227	0.0657
EDU5	0.4819*	0.2790	0.0842	0.1466
EDU6	0.1737	0.4136	0.6745	0.0529
PRVIM	1.0027***	0.2629	0.0001	0.3051
PRIM	0.4327***	0.1359	0.0015	0.1316
SAFTY1	0.5597**	0.2327	0.0162	0.1703
SAFTY2	0.2234*	0.1232	0.0698	0.0679
BLACK	0.0836	0.1627	0.6072	0.0254
HISPANIC	0.1220	0.0879	0.1652	0.0509
HH7	-0.3879	0.2741	0.1570	-0.1608
HH10	-0.4596*	0.2649	0.0828	-0.1180
HH11	-0.5737	0.3830	0.1342	-0.1398
HH1	-0.5285	0.3885	0.1737	-0.1745

Note: Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% level.

Moreover, the results indicate that household income level variable (HH10) for the income level of \$200,000 or more is a statistically significant factor in the analysis. The probit model results show that household income negatively influences the willingness to consume goat meat. Hence, the respondents with more than \$200,000 annual household income are approximately 12% less likely to buy goat meat than consumers who earn an income less than \$10,000. This finding illustrates the lower willingness of buyers to consume goat meat as household income increases, suggesting a negative income elasticity of demand. Further, it is possible, given that other things

are equal, people tend to substitute their consumption of goat meat with other closely related goods when their income increases.

Another important result is the significance of price specials in increasing the likelihood of consuming goat meat. In effect, there are 30% more chances to buy goat meat when individuals view the price specials as very important than those who think price specials are unimportant. According to the responses from the consumer survey, 13.75% of the participants answered that goat meat is more expensive than other traditional meat. The study illustrates that price specials are essential to meat purchasers and would increase their likelihood of trying goat meat, given that it is expensive compared to other meat types. Among the buyers, 30% are more likely to rank price specials as a “very important” strategy than the shoppers who viewed them as “not important.” Overall, around 43% are highly likely to believe price specials are helpful promotional tools to enhance goat meat consumption when the consumers view price specials as “very important” and “important” compared to who did not answer price specials as “not important.”

Finally, safety assurance is one of the critical determinants affecting consumers’ buying decisions. The study’s findings reveal that safety assurance, such as USDA inspection, is a significant factor in purchasing goat meat. The mean marginal effect of safety assurance suggests that the probability of buying goat meat increases by 17% when consumers view safety assurance as very important, and by 6% when they rank it as “important.” This is an increase over those consumers who did not answer that safety measures were important.

Conclusion

The demand for goat meat has increased in the United States, indicating potential for market expansion. This study was conducted to identify the socioeconomic factors that affect consumers’ willingness to consume goat meat. Understanding the dynamics of goat meat consumption and its implications is critical to assessing the potential economic impact on Oklahoma’s goat meat marketing and production sector.

The study found that socioeconomic factors, such as education, gender, price specials, and safety measures, influence goat meat consumption and purchasing decisions. To expand the goat meat industry, providing educational information is helpful as there is a higher probability of more informed buyers consuming goat meat. Our survey results revealed that consumer awareness of the nutritional value of goat meat was low. Although goat meat is high in protein, low fat and low cholesterol, and has other health benefits, many people are misinformed about these attributes. Therefore, informational campaigns would be essential to enhance the consumption of goat meat. Higher educational levels increase individuals’ decision making and likelihood of consuming highly nutritional foods to mitigate health concerns. As indicated by Knight et al. (2006), it is crucial to increase consumer understanding of the health and nutritional benefits of goat meat, and educational information may positively influence consumer decisions.

The study found that the probability of purchasing goat meat is higher for males than for females. Females are the primary shoppers in family grocery spending, mainly concentrating on the price

and quality of food and meals (Chopra, 2014). Therefore, marketers can promote goat meat using those strategies to attract female customers. Consumers show positive reactions toward price specials; this variability increases the probability of goat meat buying decisions. Therefore, offering price specials would be a crucial marketing strategy. Thus, food stores and marketers may provide various price specials during the year to influence buying decisions. According to the survey respondents, goat meat is more expensive when compared to other traditional meats. Hence, a price special that reduces the unit price may lead to an increase in quantity demanded by an amount greater than the reduction in the unit price, resulting in a rise in overall sales and revenues.

Although previous research suggests that Blacks and Hispanics are the major goat meat consumers, this study found that ethnicity did not significantly impact goat meat consumption. Therefore, the goat meat industry should also focus on non-Black and non-Hispanic markets as there is no difference in the willingness of Black and White consumers to consume goat meat. This result may reflect the increasing integration of ethnic groups into the mainstream demographics of Oklahoma and the United States, suggesting that marketers should focus on all consumers and all ethnic groups, which could create opportunities to explore the entire goat meat market beyond ethnic populations. Consequently, the study suggests that market expansion is possible. The goat meat industry should focus on an educational campaign about all aspects of the product, without regard to demographic groups. Additionally, if goat meat products are sold as prepackaged cuts with cooking instructions and promoted as a healthy alternative to other meats, consumers will likely be encouraged to purchase them regularly.

Marketers and producers can use the results of this study to understand their consumers better and the characteristics consumers desire in goat meat, which will help increase the markets for goat meat in Oklahoma. Additionally, this research emphasizes the requirement for further research into how consumer comprehension of the nutritional value of goat meat could lead to higher consumption. Marketing strategies focusing on goat meat's nutritional value and health benefits may facilitate market expansion.

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Measuring Brand Equity on Amazon.com: The Case of Starbucks

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Abstract

This study uses novel data to estimate the price and sales rank premium for Starbucks ground coffee on Amazon.com and compares this premium with that of other major ground coffee brands. We find that the price premium for Starbucks ground coffee is 13%–42%, which is higher than the price premium for Dunkin' Donuts, Folgers, and Lavazza brands. We also find that Starbucks commands a sales rank premium of 52%–64%, but the other three premium brands challenge it as the top-selling ground coffee. These results show that Starbucks differentiates itself among major coffee brands, even on Amazon.com.

Keywords: Amazon, brand equity, hedonic analysis, price premium, Starbucks

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Introduction

In retailing, having an online presence is increasingly vital, and there is no other place that is more important to establish that presence in the United States than on Amazon.com. Amazon is the largest e-commerce platform in the world, with \$220 billion in revenue in 2022 (Amazon, 2023). Many food companies recognize this, but there is limited evidence of how these brands perform on e-commerce platforms. Amazon and other e-commerce platforms feature metrics that are visible to consumers, such as sales rankings for brands, which are highly influential to customers (Ahmad and Guzman, 2021). The economic and managerial implications of these e-commerce metrics remain largely unexplored. However, a growing body of empirical research uses data from e-commerce platforms to measure factors such as returns to reputation (Fan, Ju, and Xiao, 2016) and hedonic pricing (Carlucci et al., 2014).

Moreover, the transparency of prices in e-commerce allows for estimating price premia relative to other brands. Li (2022) used data from the Chinese e-commerce platform Taobao to investigate the role of place-of-origin claims in determining price premia. Wang (2018) used data from Amazon.com to study the price premia of used books. We contribute to the broader literature on price dispersion by highlighting brand-level price premia as a factor that helps explain price variation within product categories.

As a case study, we focus on Starbucks coffee. Starbucks began operating in Seattle in 1971. Since then, the company has grown exponentially, and as of May 2022, it operates more than 34,000 stores in 84 countries (Starbucks, 2022). The success of Starbucks has aroused widespread interest in the performance of the Starbucks brand. For example, Starbucks owners, partners, and investors often question the relative strength of their brand compared to its past performance and major competitors and how that strength translates across markets and countries (Aaker, 1996; Schultz and Gordon, 2012). Starbucks has not enjoyed the same level of success in all regions it has entered (Patterson, Scott, and Uncles, 2010); the reasons for lack of success are poorly understood. To help understand the determinants of brand-level performance, we measure the price and sales rank premium of Starbucks ground coffee on Amazon.com and compare our estimates with those of other major ground coffee brands.

Due to its global reach and reputation, we expect Starbucks coffee to sell at a price premium compared to other brands. However, few studies have attempted to measure this premium. An example is the work of Vishwarath and Harding (2000), who alluded to the Starbucks Effect in the coffee industry of the United States, arguing that the company's tremendous growth led to a chain of investments and innovations that spanned the U.S. economy. For example, Starbucks has been reported to have a positive cachet effect on the coffee industry and a positive spillover effect on neighboring real estate markets (Zillow, 2018; Vishwarath and Harding, 2000). But despite this exciting insight, Vishwarath and Harding stopped short of providing an exact price and sales premium for the Starbucks brand. Vachon (2022) focused on the store experience, comparing the price of a cup of Starbucks coffee relative to its major competitors, and found that drip coffee prices averaged 20%–27% higher than those at Dunkin' Donuts and 8%–15% higher than those at Caribou. Although physical stores are the main component of Starbucks' revenues, we focus on

online ground coffee markets. We test if price and sales premiums for cups of Starbucks coffee are held for its ground coffee on Amazon.com and contribute to the literature on measuring brand equity.

We adopt a straightforward technique for estimating price and sales rank premia using e-commerce data. Applying our methods to a sample of 23,145 observations from Amazon.com, we find that Starbucks commands a price premium of 13%–42%, which is higher than the price premium of other major ground coffee brands. Starbucks' major competitors in the ground coffee market on Amazon.com are Dunkin' Donuts, Lavazza, and Folgers, and the price premium for Starbucks is higher than those of these competing brands. Despite the high price premium for Starbucks, we also find that the brand commands a significant sales rank premium of 52%–64%, relative to the three major premium brands, and is the top-selling ground coffee brand. We conclude that Starbucks has succeeded in differentiating itself even in the online ground coffee market. Starbucks' high price and sales rank premium suggests that the in-store experience translates into the online markets, a testament to customer loyalty and the company's reputation.

Our study contributes to the literature strand that focuses on using web-scraped data for economic analyses, which is becoming an integral component of the more extensive literature of the broader field of economics. Edelman (2012), in a highly influential article, predicted the possible boom of using web-scraped data for economic analyses. He noted that government agencies and large institutions dominate traditional methods of collecting economic data, which are often very expensive. He also recognized that researchers usually collect their data mainly because of the Internet. Edelman's insights have provided the foundation for many economic studies (Cavallo and Rigobon, 2016; Cavallo, 2017; Hillen, 2019; Etumnu and Noumir, 2023). For example, Cavallo (2017) and Cavallo and Rigobon (2016) used web-scraped data from a project that aimed to collect over 1 billion price observations from the Internet across the globe. A few studies using web-scraped data exist in agricultural and applied economics. Volpe (2011) used web-scraped data on two supermarket chains to evaluate intrastore price competition among national brands and private labels. Hillen (2019) provides a step-by-step approach to carrying out web scraping for research and provides the pros and cons of doing so. Hillen (2021) used a similar strategy to study food prices during COVID-19. Etumnu et al. (2020) also used web-scraped data to study the effect of online consumer ratings on ground coffee sales ranks. We apply web-scraped data to a novel purpose as we study the brand equity of major coffee brands, notably Starbucks, using data from Amazon.com.

Data

The dataset used in the study was collected from Keepa (www.keepa.com)—a subscription-based company that scrapes Amazon websites around the globe. The process by which Keepa collects data is also feasible using Python or other tools such as Octoparse (www.octoparse.com) and Parsehub (www.parsehub.com). Using Keepa is advantageous for this study for at least two reasons. First, Keepa was explicitly developed for Amazon, making it one of the best data sources for products sold on its marketplaces. It is also available for Amazon's website in the United States and across the globe, including Canada, Mexico, the United Kingdom, France, Germany, and many other countries. Thus, it is an essential source of comparable data for Amazon research. Second,

Keepa users are not expected to be programmers unless they want to access the website's application programming interface. For this study, we downloaded the data that we needed from Keepa's website as we needed it. Despite these two advantages, Keepa has limitations, such as missing data, data cleaning challenges, and a lack of important Amazon product variables, such as answered questions.

We collected product listing data for five months, from October 2021 to February 2022. The dates we collected the data were as follows: October 7, 2021; November 11, 2021; December 13, 2021; January 12, 2022; and February 9, 2022. For each day, we selected ground coffee products from Keepa's website following this channel: www.Keepa.com—Data—Category Tree—Grocery & Gourmet Food—Categories—Beverages—Coffee—Ground Coffee. Then, we used the search button to view and download up to the 10,000 allowable ground coffee products. Each download contains hundreds of variables, from which we selected the following: brand, sales ranks, BuyBox price,¹ seller type, stockout rate, ASIN, item weight, average star rating, and number of ratings. A summary of these variables is shown in Table 1.

Table 1 reports the summary statistics of 23,145 observations from 4,629 products in 5 panel periods. Among the variables reported in Table 1 are the sales ranks and BuyBox price, the dependent variables used in the study. The average sales rank is 78,715, with a minimum of 11 and a maximum of 340,456. However, lower sales ranks imply higher sales performance and vice versa. The average BuyBox price is \$25.51, with a minimum of \$3.38 and a maximum of \$519.99. The key independent variable in the study is the Starbucks brand, representing 1% of the sample. The proportion of other major brands, such as Dunkin' Donuts (1%), Lavazza (1%), and Folgers (2%), is like that of Starbucks. We chose these three brands mainly because of two reasons. First, in several assessments, these brands are listed as one of Starbucks' main competitors (Bhasin, 2023; Pereira, 2023). Second, these brands appear to have similar relative frequencies in our data. Specifically, the sample size of Starbucks (301), Dunkin' Donuts (275), Folgers (385), and Lavazza (313) products in our data are not too distant apart. In addition, our control variables are summarized in Table 1. These control variables include average rating, with a mean of 4.33; number of ratings, with a mean of 1,288; stockout rate, with a mean of 2%; and item weight, with a mean of 22 ounces. We standardized the prices and weight to obtain the price per ounce variable, with a mean of \$2.61/ounce. We also have an indicator variable for seller type (Amazon, FBA, and FBM sellers), with a mean of 1.86. Although these control variables are not the focal point of our research, their associations with the dependent variables will also be examined.

¹The BuyBox is the box-like feature on the top right side of Amazon product pages where customers can add products to their cart and where further information is provided. This information might include the BuyBox price, whether the product is eligible for Amazon Prime, Subscribe and Save, in Stock, delivery date, add to cart feature, and who the seller is. Interestingly, the BuyBox price and the listing price are the same most often. Hence, our decision to choose the BuyBox price was not arbitrary. It was borne out of the relevance of knowing who the BuyBox seller is and the importance of the BuyBox in the successes of Amazon and its third-party seller. Some estimates suggest that about 80% of Amazon's sales go through BuyBox (Vamanan, 2023).

Table 1: Variables and their Descriptive Statistics

Variable	Description	Mean	Std. Dev.	Min	Max
Sales rank	Best sellers rank of the product	78,715.951	7,3833.818	11.0000	34,0456
Log sales ranks	Natural logarithm of best sellers rank	10.4600	1.7254	2.3979	12.7380
BuyBox price (\$)	Unit price in dollars in BuyBox	25.5084	20.6606	3.3800	519.990
Log buybox price	Natural logarithm of BuyBox price	3.0476	0.5829	1.2179	6.2538
Item weight (ounces)	Per product weight in ounces	22.3181	29.8475	0.1058	1279.9876
Price per ounce (\$/ounce)	BuyBox price per item weight	2.6074	11.6923	0.0372	283.7784
Log price per ounce	Natural logarithm of price per ounce	0.2428	0.8647	-3.0604	5.6482
Average rating	Average star rating per product	4.3733	0.5160	0	5.0000
Number of ratings	Number of ratings per product	1288.4604	3673.8583	0	59,300
Stockout rate	Average 90-days out-of-stock percentage	0.0187	0.0749	0	1
Sellers	1 = Amazon, 2 = FBA seller, 3 = FBM seller	1.8608	0.7805	1	3
Starbucks	Dummy variable for the Starbucks brand	0.0130	0.1133	0	1
Dunkin' Donuts	Dummy variable for Dunkin' Donuts brand	0.0119	0.1084	0	1
Lavazza	Dummy variable for Lavazza brand	0.0135	0.1155	0	1
Folgers	Dummy variable for Folgers brand	0.0166	0.1279	0	1
Month	1 = Oct 21, 2 = Nov 21, 3 = Dec 21, 4 = Jan 22, 5 = Feb 22	3.0000	1.4100	1	5
Observations	Number of observations	23,145			

Figure 1 provides a comparison of the average prices of the major brands. The figure shows each major brand's average BuyBox prices per ounce over time. Specifically, it shows that Starbucks's average price per ounce is the highest, followed by the price per ounce of Lavazza, Folgers, and Dunkin' Donuts. The margin between the price per ounce of Starbucks and the other brands is also vast. This suggests that the expected price premium for Starbucks would be higher than those of the major brands. However, the comparison does not consider the possible correlations of the control variables and how that could affect the price premia, which warrants further empirical analysis.

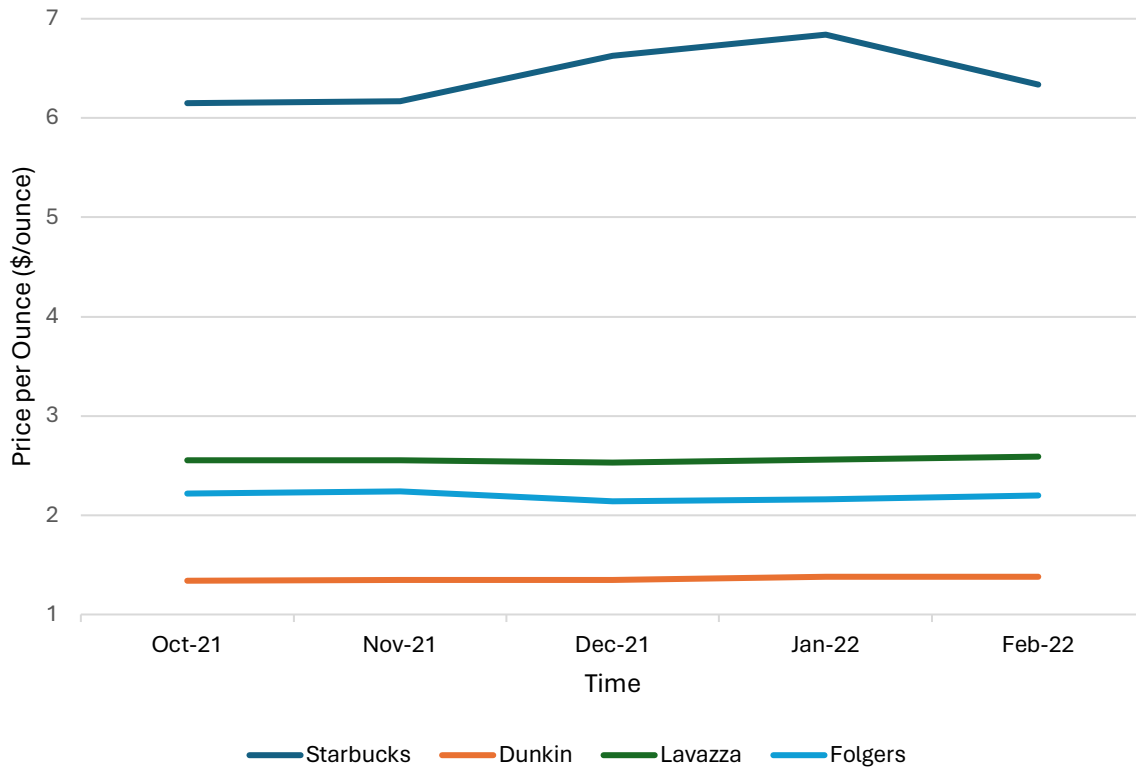


Figure 1: Price per Ounce of Major Brands over Time

Empirical Strategy

To estimate the price premium for Starbucks and compare the premium with that of other major brands, we estimate a hedonic regression model following Roheim, Asche, and Santos (2011):

$$\ln(\text{Price}_{it}) = \alpha \text{Starbucks}_i + \beta \mathbf{X}_i + \gamma \mathbf{Y}_{it} + \delta \mathbf{Z}_{it} + \varepsilon_{it} \tag{1}$$

where $\ln(\text{Price}_{it})$ is the natural logarithm of price per ounce for product i in period t , Starbucks_i is a dummy variable indicating whether the product brand is Starbucks, \mathbf{X}_i is a vector of other major brands, including Dunkin' Donuts, Folgers, and Lavazza, \mathbf{Y}_{it} is a vector of product attributes such as the number of ratings, average rating, stockout rate, and \mathbf{Z}_{it} is a vector indicating the type of seller for the products—Amazon, FBA sellers, or FBM sellers. We hypothesize that α is

positive, which shows that Starbucks commands a price premium on Amazon.com. We also hypothesize that each of the parameters in β is positive, suggesting that the other major brands command a price premium. Finally, because we believe that Starbucks' offline reputation translates into premium prices online more than the other major brands, we also hypothesize that α is greater than or equal to the parameters of each of the other brands.

Despite the plausibility of using the hedonic price method in economic analysis, several challenges emerge. Some of these challenges were highlighted by Graves et al. (1988). They include the selection and treatment of variables, the function form of the models, measurement error, and error distribution assumptions. Each of these challenges could bias our results, so we took steps to justify how we navigated the challenges. First, we carefully selected the variables in the study to have both economic and practical relevance. For example, our focal variables are the four major brands we considered (dummy variables for Starbucks, Folgers, Dunkin' Donuts, and Lavazza brands) and our dependent variable—ground coffee BuyBox prices per ounce. We also carefully selected meaningful control variables in the study, such as types of sellers, number of ratings, average ratings, and stockout rates. Second, we selected the log-linear functional form because it normalizes the distributions of variables, and prices are often one such variable that becomes better distributed through logarithmic transformation. An additional advantage is that the Interpretation of our estimated coefficients becomes more intuitive with natural logarithms of price. With log-linear models, we can now interpret the coefficients as percentages and easily compare them among the four major brands. Third, we carried out the regression analysis stepwise, including the Starbucks variable first, Starbucks and the other major brands, and finally including Starbucks, the major brands, and the control variables. This stepwise analysis allows us to focus on how the coefficient of Starbucks changes with additional variables. Minor changes in the Starbucks coefficient are more desirable than sporadic coefficient changes. We believe these three steps minimized the possibility of biases in our hedonic price models.

To ascertain whether Starbucks commands a sales premium, we also estimate the following regression using sales ranks as a proxy for sales due to data limitations following Etumnu (2022b):

$$\ln(\text{SalesRank}_{it}) = \theta \text{Starbucks}_i + \vartheta \mathbf{X}_i + \pi \mathbf{Y}_{it} + \omega \mathbf{Z}_{it} + \mu_{it} \quad (2)$$

where SalesRank_i is a number assigned to actively selling products by Amazon, which shows their relative sales level at a particular time t . The independent variables remain the same as in Equation 1, but their coefficients have different meanings and interpretations. For example, we hypothesize that the coefficient of Starbucks (θ) is negative, suggesting that Starbucks commands a sales rank premium relative to the other ground coffee brands. We also hypothesize that each of the parameters of the other major brands (ϑ) is negative, suggesting that the other major brands command a sales rank premium. Our final hypothesis is that the absolute value of θ is greater than or equal to the absolute values of each of the parameters of the other major brands. This hypothesis suggests that Starbucks's sales rank premium is higher than the sales rank premium of the other major brands.

The expectations for the signs of coefficients for Starbucks and the other major brands are ambiguous. Recall that sales ranks are assigned such that 1 represents the highest sales performance for a given product, and higher incremental numbers represent lower sales performance relative to the number 1. This ranking style suggests that the sales rank is inversely related to sales. However, a relationship between sales ranks and sales has been established in the literature (Schnapp and Allwine, 2001; Chevalier and Mayzlin, 2006). Specifically, the natural logarithm of sales ranks is linearly and inversely related to the natural logarithm of sales plus a constant. This relationship has enabled several researchers to use sales ranks as a proxy for sales in economic literature (Sun, 2012; Reimers and Waldfogel, 2017; Etumnu et al., 2020; Reimers and Waldfogel, 2021; He, Reimers, and Shiller, 2022; Etumnu, 2022a; Etumnu, 2022b).

We estimate equations 1 and 2 with time-fixed effects using the Stata command `reghdfe`, developed by Correia (2017a; 2017b), to control time trends, seasonality, and inflation. However, we do not include product fixed effects because the brand variables are time-invariant. Hence, we do not claim that the relationship between the brand variables and our price and sales rank dependent variables that we estimate are causal. However, we argue that the estimates provide precise estimates of the price premia and sales rank premia for the major ground coffee brands. This conviction leads to our discussion of the results in the next section.

Results and Discussion

This section presents the study's results. The first part focuses on Table 2, which reports the price premia of Starbucks and the other major ground coffee brands. The second part focuses on Table 3, which reports the sales rank premia of Starbucks and the major brands. Each table also reports the associations of the control variables, prices, and sales ranks and discusses how the results relate to and contribute to the literature.

Table 2 reports the price premium for Starbucks in three log-linear regressions. The first regression is that of log price per ounce on the Starbucks brand only (column 1). The second regression is that of log price per ounce on the four brands—Starbucks, Dunkin' Donuts, Lavazza, and Folgers (column 2). The third and final regression reported in Table 2 is that of log price per ounce on the major brands and the control variables. By carrying out these three stepwise regressions, we pay close attention to how the coefficient of Starbucks varies. Because the coefficient of Starbucks is stable in the three regressions and the third regression includes the control variables, we focus our reporting on this regression. Hence, in column 3 of Table 2, the coefficient of Starbucks is 0.23, which is highly significant. The 95% confidence interval of the coefficient is 0.12 to 0.35.² Transforming the coefficient implies that the average price premium for the Starbucks brand is 26%, with a range of 13% to 42%.

² To obtain precise estimates of the premium values, we adopted a simple transformation of the coefficients because of the log-linear form of our regression models. Thus, the exact percentage premium for Starbucks in both regression models is given by $100 * (e^{\text{coefficient}} - 1)\%$ (Roheim, Asche, and Santos, 2011).

Table 2: Estimation of Price Premia with a Focus on Starbucks

	(1)		(2)		(3)	
	Log Price per Ounce		Log Price per Ounce		Log Price per Ounce	
Starbucks	0.3141***	(0.0547)	0.3122***	(0.0548)	0.2349***	(0.0580)
Dunkin' Donuts			-0.1502***	(0.0395)	-0.2768***	(0.0330)
Lavazza			0.2209***	(0.0526)	0.2112***	(0.0532)
Folgers			-0.1865***	(0.0495)	-0.2427***	(0.0501)
Average Rating					-0.0144	(0.0108)
Number of Ratings					0.0000***	(0.0000)
Stockout Rate					0.0763	(0.0778)
Amazon					-0.7659***	(0.0154)
FBA Seller					-0.2401***	(0.0161)
Constant	0.2388***	(0.0057)	0.2407***	(0.0058)	0.6787***	(0.0502)
<i>N</i>	23,145		23,145		23,145	
<i>R</i> ²	0.0018		0.0038		0.1341	

Note: Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels. We transformed the coefficients of the dummy variables to their exact percentage values. $(100 * e^{coefficient} - 1)\%$.

The estimated Starbucks price premium is higher than those of other major brands. Following the same procedure, column 3 of Table 3 also shows that the average price discount for Dunkin' Donuts is 24%, with a range of 19%–29%. For Lavazza, the average price premium is 24%, with a range of 11%–37%, whereas for Folgers, the average price discount is 22%, 13%–29%. The average price premia and their ranges for each of these major brands is lower than that of Starbucks, which suggests that Starbucks has succeeded in differentiating itself even on Amazon.com. These findings also indicate that Starbucks has substantial brand equity in online markets, which may be an extension of the customer loyalty associated with the in-store experience cultivated over time. Given the reputation and longevity Starbucks enjoys in the coffee market, these estimates conform to our expectations and verify that applying equation (1) to prices in e-commerce is a valid approach for measuring price premia for brands.

The control variables also have essential associations with product prices per ounce, which lead to managerial implications and motivate future work. For example, the coefficient of average rating is negative and insignificant, whereas the coefficient of number of ratings is positive and significant. This result suggests that an increase in consumer perception of product quality is associated with lower prices per ounce. In contrast, the product's visibility is associated with higher prices per ounce for the products. Although several strands of the economic literature have examined price-quality relationships (Shapiro, 1983; Bagwell and Riordan, 1991; Jin and Kato, 2006; Li and Hitt, 2010; Luca and Reshef, 2021), the associations between prices per ounce of ground coffee and average rating and number of ratings are unexplored. It seems intuitive for a higher number of ratings to lead to higher product prices per ounce. After all, a higher rating signals to a consumer that a product is popular with other consumers, and the seller can then capitalize on that perceived value to raise product prices. However, in another scenario, a product with higher or higher average ratings also becomes more visible to the seller's competitors, potentially resulting in price wars that lead to lower prices. That said, because of our non-experimental or non-quasi-experimental settings, we are cautious about making any causal claims about our estimated relationships.

Another control variable included in the regression model is the stockout rate. The stockout rate ranges from 0 to 1, with 0 indicating 100% availability and 1 representing 100% unavailability. A 1-unit increase in the stockout rate is associated with an 8% increase in ground coffee prices per ounce. This sizable association corresponds with the marketing literature on stockouts (Anderson, Fitzsimons, and Simester 2006; Aastrup and Kotzab, 2010). Other control variables, such as the seller type, also significantly correlate with the product prices. Table 2 also shows that relative to FBM sellers, Amazon and FBA sellers' products are cheaper. Specifically, Amazon's products are about 54% cheaper than FBM products, whereas FBA sellers' products are 21% cheaper than FBM sellers' products. These price differences have been examined by Reimers and Waldfogel (2017), who suggest that Amazon sold books at meager prices. A later study (Etumnu, 2022b) also found that Amazon and FBA sellers sold ground coffee and red wine much cheaper than FBM sellers.

Table 3: Estimation of Sales Rank Premia with a Focus on Starbucks

	(1)		(2)		(3)	
	Log Sales Ranks		Log Sales Ranks		Log Sales Ranks	
Starbucks	-1.2703 ^{***}	(0.1521)	-1.3044 ^{***}	(0.1521)	-0.8817 ^{***}	(0.0781)
Dunkin' Donuts			-0.9185 ^{***}	(0.1384)	-0.3213 ^{***}	(0.0663)
Lavazza			-1.2546 ^{***}	(0.1295)	-0.3020 ^{**}	(0.1313)
Folgers			-0.3504 ^{***}	(0.0856)	-0.4845 ^{***}	(0.0610)
Log Price per Ounce					-0.0578 ^{***}	(0.0118)
Average Rating					-0.3252 ^{***}	(0.0201)
Number of Rating					-0.0003 ^{***}	(0.0000)
Stockout Rate					0.2659 ^{**}	(0.1201)
Amazon					-0.8090 ^{***}	(0.0219)
FBA Seller					-0.6299 ^{***}	(0.0181)
Constant	10.4765 ^{***}	(0.0113)	10.5107 ^{***}	(0.0113)	12.8803 ^{***}	(0.0892)
<i>N</i>	23,145		23,145		23,145	
<i>R</i> ²	0.0083		0.0192		0.5747	

Note: Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels. We transformed the coefficients of the dummy variables to their exact percentage values. $(100 * e^{coefficient} - 1)\%$.

Although the control variables ensure that brand price premia are precise, a significant and sizeable price premium on Amazon.com may not be profitable or sustainable for a brand if it comes at the expense of its sales. Hence, we also report the sales rank premia for the major brands. Table 3 shows regressions like Table 2 but with a natural logarithm of sales rank as the dependent variable. Column 1 of Table 3 shows a regression of log sales ranks on the Starbucks brand. Column 2 includes other major brands alongside the Starbucks brand, while column 3 includes the control variables. Because the regression with controls has highly significant variables, our report focuses on that regression. Interestingly, we find that Starbucks commands an average sales rank premium of 59% on Amazon.com relative to every other brand in our sample, with an estimated 52% to 64% range. These findings indicate that Starbucks has significant brand equity across channels, which allows it to enjoy a premium sales rank relative to competing brands.

The sales rank premium for Starbucks is also higher than that of other major brands. Table 3 shows that the average sales rank premia for Dunkin' Donuts is 27%, ranging from 17% to 36%. Lavazza's average sales rank premium is 26%, with a range of 4%–42%. Finally, for Folgers, the average sales rank premium is 38%, ranging from 31% to 45%. The average sales rank premia suggests that the sales performance of the Starbucks brand is much higher than those of the other brands. The higher sales rank premium for Starbucks seems undeterred by its premium prices. This is incredibly insightful, given that the Starbucks Experience is mainly appreciated in its stores (Michelli and Hill, 2007; Schultz, 2012; Schultz and Gordon, 2012). It is, therefore, safe to assume that the Starbucks Experience has also been transmitted to the e-commerce market. Besides, the other major brands also command sales rank premia in the e-commerce market, which shows that these brands are doing well even in the presence of Starbucks.

All the control variables also have significant correlations with the sales ranks. For example, the relationship between price per ounce and sales ranks is negative, suggesting that higher prices per ounce sell more than products with lower prices per ounce. A higher price per ounce could signal higher perceived value, which translates into better sales ranks. This result contributes to previous literature (Koenigsberg, Kohli, and Montoya, 2010; Yonezawa and Richards, 2016; Etumnu et al., 2020; Çakır et al., 2021; Reimers and Waldfogel, 2021), which examined the relationship between product prices, package sizes, and sales. Aside from price per ounce, consumer ratings are associated with improved sales performance (Chevalier and Mayzlin, 2006). Furthermore, an increase in stockout rates is associated with poor sales performance, as expected (Anderson, Fitzsimons, and Simester, 2006). Finally, relative to FBM sellers, the products of Amazon and FBA sellers are associated with improved sales performance (Etumnu, 2022b).

Managerial Implications

Our results suggest that Starbucks and the major brands command both price and sales rank premia, which has implications for brand managers. Each ground coffee brand we examined can be considered a premium brand, which requires marketing strategies tailored to the premium market segment. However, all the major brands are already successful on Amazon based on our sales rank metrics, raising only the question of how to sustain and improve their successes. One key finding of our study is that Starbucks commands both price and sales rank premia, demonstrating that it is

not necessarily the most competitively priced brand that sells the most in e-commerce. Brand reputation, healthy inventory levels, effective advertising, and presence across marketing channels can allow sales to exceed those of competing brands without engaging in price wars.

We argue that Starbucks and the major brands selling on Amazon should constantly evaluate their use of Amazon advertising, the FBA program, and how to improve metrics in our control variables, such as consumer ratings and stockout rates. Given the size of these companies, marginal changes to their operations could be pivotal for their future. For example, while our results do not measure the effect of individual stockouts on performance, we demonstrate that the cost of stockouts online should be internalized by companies, measured carefully, and should include impacts on sales rank premia.

We also argue that the success of Starbucks on the Amazon platform is at least partially a function of the brand's reputation and notoriety in the brick-and-mortar channel. This argument suggests that other food and beverage brands have yet to expand to e-commerce platforms but likely have latent demand that could be capitalized upon. Moreover, it is worth considering if the reverse effect can be identified, in that food and beverage brands with success in e-commerce could leverage their exposure to increase their sales on supermarket shelves or in food service outlets, and vice versa. For example, McDonald's recently unveiled CosMc's as a potential rival to Starbucks' dominance in the coffee industry (Wiener-Bronner, 2023). However, whether such rivalry will enter the online retail market and topple Starbucks will be interesting.

Conclusions and Future Work

This study estimates the price and sales premia for Starbucks and several competing brands on Amazon.com. We find that Starbucks commands a price premium of 13%–42% and a sales rank premium of 52%–64%. The price and sales rank premia are higher than those of other major competing brands such as Dunkin' Donuts, Lavazza, and Folgers. These results contribute to the research that measures brand equity in online markets (Aaker, 1992; Aaker, 2009). Our methods can be applied to any brand for which price and sales rank information is available online, and future research may investigate other brands and product categories. Our study also contributes to the literature on using web-scraped data for economic analysis (Edelman, 2012). We show how to use data from Keepa—a subscription-based company that scrapes Amazon's websites across the globe. However, studies focusing on retailers like Walmart and Kroger can use other web scraping tools like Octoparse and Parsehub.

Our study is not without limitations. We cannot observe actual sales and use sales ranks as a proxy. Our measures of price premia are not intended to measure markups relative to cost but rather price differentials among competing brands. Moreover, our findings are exploratory and intended to demonstrate how empirical insights can be drawn from publicly available e-commerce data. We do not assign causality to the price or sales rank premium for Starbucks or any other brand. A more formal analysis is called for to understand the variation in premia across brands, which controls for additional factors of importance, including costs, total sales, marketing, and more.

Brand-level pricing and sales research for food and beverage products is typically conducted using store scanner data. Such datasets are usually costly and subject to restrictions regarding the identification of brands. We argue that future research is warranted to assess how the findings drawn from e-commerce data corroborate those drawn from analyzing store scanner data. To the extent that findings are qualitatively similar, it may be possible to significantly expand our understanding of brand performance, the impacts of brand introduction, and the determinants of brand exit within product categories. We also hypothesize that Starbucks' online brand equity is a function of its reputation and customer loyalty in brick-and-mortar establishments, and it would be fascinating to study the association between these factors across companies and industries. Finally, it would be interesting to calculate price and sales rank over more extended periods for brands and compare these numbers to data available from earnings reports for publicly traded brands. Particularly during food price inflation in the United States, there is a strong interest in the associations between prices and performance, and our empirical approach facilitates this analysis.

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Willingness to Pay for Alternate Merchandising Strategy of Beef Top Round

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Abstract

Whole top round steaks can lack color uniformity between the deep and superficial cuts, leading to changes in consumers' willingness to pay (WTP), potentially leading to wasted meat products or loss in revenue. A choice experiment was used to elicit consumers' preferences and WTP for alternate merchandising strategies of whole beef top round steaks. Using a two-stage model, results show heterogeneity in the purchase decision across steak and respondent characteristics with differences in purchase likelihood and WTP. Results indicate that consumers may be open to alternative merchandising strategies in markets that struggle with excessive margin losses, increased labor demands, or meat waste.

Keywords: meat merchandising, willingness to pay, beef, top round

Introduction

Food quality attributes are primary factors in consumer willingness to pay for beef products. Tastes and preferences are often led by appearance and perceived palatability by the consumer, and if a product is perceived to be less desirable or has a limited shelf-life, monetary losses for retailers, and potential meat waste can occur. Consumers consider leanness, tender appearance, and freshness of beef steak as primary factors in purchasing beef and beef products (Gao and Schroeder, 2009; Khan, Jo, and Tariq, 2015; Morales, Ehmke, and Sheridan, 2022). Bright red coloring in beef, determined by the amount of myoglobin (the protein that gives meat its red coloring), is considered an indicator of freshness and wholesomeness (Hunt et al., 2004; Holman et al., 2017), and consumers rely on the color as an important criterion for quality judgement (Seideman et al., 1984; Felderhoff et al., 2020; Morales, Ehmke, and Seridan, 2022). Discolored beef or beef with more grey hues is considered less fresh and is generally marketed in reduced-value form or would need to have value added, such as aging, to be marketed with a premium (Faustman and Cassens, 1990; Felderhoff et al., 2020). For example, top round has mixed colors compared to top sirloin and would command a lower price in comparison. Discolored meat may be ultimately marked down or discarded in markets. Discarded products have been found to have caused \$1 billion of losses to the U.S. beef industry (Suman et al., 2014). Whole top round steaks can lack color uniformity due to both a deep and superficial portion of the meat, which varies the myoglobin, leading to discounts or loss as consumers' willingness to pay is reduced. To mitigate profit losses and meat waste due to discoloration of top round steaks, an alternate merchandising strategy can be used to drive sales and provide retailers a strategy in the face of market losses and meat waste. The alternative marketing strategy for top round is to separate the whole beef top round steak into a deep portion and superficial portion. By cutting top round into smaller portions, a more red, superficial cut could be marketed as a steak, and the darker deep cut could be marketed alternatively in ground meat or aging to add value to the product. These alternative strategies may make these cuts more sellable and appealing to buyers who are concerned about the steak appearances and preferences on freshness. We compared the deep portion, superficial portion, and whole beef top round steaks using a choice experiment to determine consumer willingness to pay and preferences for the cuts to determine whether consumers would purchase the individual cuts and at what price.

Findings from this study provide a more comprehensive view of consumers preference and choice in the American beef market and help beef retailers better market their product and reduce meat waste from discolored whole top round.

Background

Various studies have analyzed the factors affecting willingness to pay for beef steak. Quality attributes of steak, marbling and Warner-Bratzler shear force, the country-based origin of steak, information on the beef husbandry system, and type of feed (corn feed versus grass feed), are some of the factors that affect consumers' willingness to pay for steak (Umberger et al., 2002; Platter et al., 2005; Gao and Schroeder, 2009; Lim et al., 2013; Risius and Hamm, 2017; Morales, Ehmke, and Sheridan, 2022). In general consumers prefer a tender cut of meat, such as top loin, which rates highly in consumer acceptability (Martinez et al., 2017). Demographics can play a role in preferences, where sex, age, and socioeconomics affect purchase behavior (Reicks et al., 2011). Contrarily, top round has the highest Warner-Bratzler sheer force (least tender) of steaks tested and is consistently ranked lower on preferences (Martinez et al., 2017; Gonzalez and Phelps, 2018).

Because visual presentation of beef is paramount in consumers' purchase decisions (Morales, Ehmke, and Sheridan, 2022), beef cuts that are less favorable are often discounted or disposed of if they cannot sell. Aging of top round is one solution to market the product to reduce markdowns related to discoloration and tenderness, but the impact of aging differs by size of carcass (Lancaster et al., 2020; Lancaster et al., 2022). Ramanathan et al. (2022) found that, on average, 2.55% of kg of beef (across cuts) sold are discarded due to discoloration. Consumers prefer bright red coloration and as the meat ages on the shelf, it loses this preferred color, leading to either discounts or meat waste (Killinger et al., 2004; Holman et al., 2017; Ramanathan et al., 2022). Top rounds are tougher than other cuts and tend to rank lower in consumer preferences (Gonzalez and Phelps, 2018). This toughness is coupled with discoloration, or more accurately, mixed coloration, in whole top round cuts because of the muscle structures of top round and the respective pH levels of the different muscle tissues (Lancaster et al., 2022). McKenna et al. (2005) demonstrated that beef muscles can be classified based on color stability. They categorized the semimembranosus (Top Round) as being a "moderate" color stability muscle when aged for 3 days and subjected to 5 days of retail display. Colle et al. (2016) noted that top round color decreases rapidly after 21 days of aging. They also found that top round steaks were less uniform in color (more two-toning) than bottom round steaks. When shopping, consumers compare top round steaks to a top sirloin steak with consistent coloring and a more tender Warner-Bratzler sheer force, leaving the top round wanting. Estimated sales losses related to discoloration account for 194.7 million kg of beef or \$3.73 billion annually for all beef cuts (Ramanathan et al., 2022). Alternative marketing strategies may be used to reduce meat waste and retail losses and capture more of the true market value of beef cuts.

Methodology

A choice experiment was used to elicit consumers preferences and WTP for alternate merchandising strategies of whole beef top round steaks. Two analyses were estimated, including

the propensity to purchase the alternative steak cut and how the WTP was affected by buyer characteristics (demographics and purchasing behavior). This approach allows for an understanding of whether these cuts are acceptable to consumers as an alternative to the current market choices and if it is equal to WTP.

Choice Experiment

A choice experiment is a survey implement that allows for consumers to consider hypothetical market scenarios and make tradeoff decisions between product attributes. For this experiment, USDA Choice top round steaks were purchased from a commercial meat distributor and aged between 21 and 24 days from their pack before breaking them down into the semimembranosus (SM) muscle and then dividing them into five steaks per top round. These whole beef top steaks were cut proximally to distally and assigned a day-of-retail display from 0 to 4 days (D0, 1, 2, 3, or 4). Each steak was displayed in a glass-fronted retail display case at 3°C until the day assigned. The steak was then unpackaged, placed on a white background, and a photograph (Sony Cyber-shot DSC-H300, New York, NY) was taken at 15 inches above the steak. The whole steak was then separated into a superficial and deep portion (approximately 5 cm from the steak's superficial edge), and photographs were taken of both the deep and superficial portions. These images were used to create a choice experiment developed and distributed online through Qualtrics. The University of Idaho Institutional Review Board certified this project as exempt. A link to the survey was sent to the Cattlemen's Association and various University of Idaho newsletters, administered on December 2020, and was open for 16 weeks. A limitation of this survey design is the variance in color between monitors and consumers; however, all steaks were photographed in the same lighting so any differences would be consistent across the full set of steak choices. Future work could replicate this study and include in-person responses to limit differences in viewing settings and monitors.

Based on survey length, and to ensure a representative across the different cuts, age days, and steaks, respondents were presented 18 individual randomized images and were asked if they would purchase each steak. Respondents selected from one of four possible responses, "definitely would not," "probably would not," "probably would," or "definitely would." Utilizing a payment card, a follow-up question asked respondents to select their willingness to pay for the steak shown. Prices presented on the payment card included \$2.58/pound, \$3.58/pound, \$4.58/pound, \$5.58/pound, and \$6.58/pound. These prices were selected to provide a range of prices around the current average market price for top round steak from a local retail grocery store in Idaho at the time of the study (\$4.58/pound). If the decision to purchase was "no," they were asked the reason for this decision, which included the following options: amount of trim, toughness, color, and amounts of marbling. Meat purchasing behavior and demographic information were also collected to account for respondent heterogeneity. A total of 265 consumers completed the survey, and 3,375 hypothetical purchase decisions were made, with 56.8% responding they would purchase the presented steak.

A summary of the responses is presented in Table 1. The respondents were predominantly female (69.9%) from the Northwest United States (Idaho, Montana, Oregon, and Washington) (81.4%)

with even proportion of household income levels across the sample. This sample has a slightly higher female population compared to the United States as a whole (50.8%) (Blakeslee et al., 2023). Consumers reported purchasing steaks across multiple outlets with the most frequent being grocery stores (80.5%) and least frequent being community-based retailers (44%), such as a local retailer. Steaks were purchased frequently as defined by at least every other shopping trip 32.1% of the time, as opposed to infrequently and never purchasing steaks (22.0% and 6.8%, respectively, not reported).

Table 1: Select Summary of Responses for Alternative Top Round Choice Experiment

Variable	Description	N	Mean	Std. dev.	Min	Max
Lower Bound	Lower Bound of Price Selected	2,331	4.595	0.930	2.58	6.58
Upper Bound	Upper Bound of Price Selected	2,637	4.133	0.981	2.58	5.58
Age	Age of Respondent	3,284	38.818	17.476	18	84
Day	Display Day of Steak	3,375	1.991	1.399	0	4
Binary Variables¹	Description	N	Percent of Observations			
Buy	Purchase decision	3,375	56.8%			
Deep steak	Steak cut is deep portion	3,375	33.8%			
Superficial steak	Steak cut is superficial portion	3,375	33.9%			
Whole steak	Steak cut is whole top round steak	3,375	32.3%			
Grocery store	Purchase beef products at grocery store	3,366	80.5%			
Specialty meat store	Purchase beef products at specialty meat store	3,366	23.5%			
Directly from producer	Purchase beef products directly from producer	3,366	44.1%			
Community-based retailer	Purchase beef products from community-based retailer	3,366	9.5%			
Frequently	Purchase steak at least every other shopping trip	3,266	32.1%			
Female	Respondent identified as female	3,375	69.9%			
Northwest ²	Respondent from northeast USA 2	3,432	81.4%			
HHI: \$29,999 or Less	Household income \$29,999 or less	3,342	27.1%			
HHI: \$30,000 to \$69,999	Household income \$30,000 to \$69,999	3,342	22.1%			
HHI: \$60,000 to \$99,999	Household income \$60,000 to \$99,999	3,342	26.0%			
HHI: \$100,000 or More	Household income \$100,000 or more	3,342	24.8%			

Notes:¹All Binary Variables defined as 1 as described, 0 otherwise.

²Northwest as defined as Idaho, Montana, Oregon, and Washington.

Econometric Modeling

The WTP questions were asked only to those responding positively to the willing-to-purchase question. As such, the data are truncated. The economic analysis of the choice experiment used a two-stage, selection correction estimation, with the first stage estimating the purchase decision (probit model) and the second the WTP estimation (interval regression), accounting for the truncation in the data for WTP. To estimate the consumer purchase decision, probit was used, capturing the consumer's propensity to purchase the alternate steaks across the different choices presented. The empirical probit model is detailed in Equation 1 as:

$$Purchase_i = \beta_k S_i + \gamma_l C_i + \varepsilon_i \quad (1)$$

where the binary purchase decision is a function of steak-specific factors (S) and consumer-specific factors (C) for the i -th steak selection, with β_k and γ_l representing the estimated coefficients. Standard errors (ε_i) were clustered to account for respondent correlation between steak selections.

To account for the sample selection in the WTP estimates, where only the observations of respondents positively responding to the purchase decision, were asked how much they were willing to pay, an inverse Mills ratio (IMR) was calculated. The IMR accounts for a truncated sample of those responding positively to the purchase question. It is included in the second step to adjust the sample and account for sample selection bias as proposed by Heckman (1979). The IMR is calculated using the ratio of the probability distribution function of the standard normal distribution (ϕ) to the cumulative distribution function (Φ) as shown in Equation 2 (Heckman, 1979).

$$IMR = \frac{\phi(x)}{\Phi(x)} \quad (2)$$

The IMR is calculated for each observation and is used in the second stage of the analysis. The selection correction works well with linear models such as the interval regression estimated.

The WTP for the different steak cuts were estimated using interval regression, which is a generalized tobit model for observable intervals. Respondents were presented a list of prices for choosing the one that closest represented their WTP. This method implies the ranges in which the true WTP lies. For example, if a respondent chose \$3.58, it can be inferred that the true WTP is at least \$3.58 and less than \$4.58. Using the ranges as presented in Table 2, an interval regression is calculated using the log likelihood in Equation 3 (Cameron and Trivedi, 2010; StataCorp, 2021),

$$\begin{aligned} \ln L = & -\frac{1}{2} \sum_{i \in \text{Uncensored}} \left\{ \left(\frac{y_i - x_i \beta}{\sigma} \right)^2 + \log 2\pi\sigma^2 \right\} + \sum_{i \in \text{LeftCensored}} \log \Phi \left(\frac{y_{LB,i} - x_i \beta}{\sigma} \right) + \\ & \sum_{i \in \text{RightCensored}} \log \left\{ 1 - \Phi \left(\frac{y_{UB,i} - x_i \beta}{\sigma} \right) \right\} + \sum_{i \in \text{IntervalCensored}} \log \left\{ \Phi \left(\frac{y_{UB,i} - x_i \beta}{\sigma} \right) - \right. \\ & \left. \Phi \left(\frac{y_{LB,i} - x_i \beta}{\sigma} \right) \right\} \end{aligned} \quad (3)$$

Where the true value lies within the given censored intervals using the upper bound (UB) as the limit for left-censored data, lower bound (LB) for right-censored data, and both for interval-censored (i.e., $y_{LB,i} \leq Y_i \leq y_{UB,i}$) data. Effects of specific steak attributes (cut and day) and respondent attributes (age, sex, household income, region, and typical purchasing behavior) were accounted for in the modeling. Standard errors were clustered to account for respondent-correlated effects between steak selections.

Table 2: Intervals Used in Estimations Based on Choice Price Selections

Observed Selection	Lower Bound	Upper Bound	Percent of Purchasers
\$2.58	\$2.58	\$3.57	15.50
\$3.58	\$3.58	\$4.57	29.65
\$4.58	\$4.58	\$5.57	30.12
\$5.58	\$5.58	\$6.57	18.48
\$6.58	\$6.58	No upper limit	6.23

Results and Discussion

The results are separated into the purchase decision and the WTP results, both presented in Table 3.

Purchase Decision Results

For the choice experiment, 56.8% of respondents said they would purchase the steak presented. Results from the purchase decision analysis showed heterogeneity in the decision to purchase the steak across choice and respondent characteristics. All things held constant, respondents were 8.6% less likely to elect to purchase the deep steak portion than the whole steak portion. In contrast, respondents were 7.0% more likely to purchase the superficial steak portion, which indicates a preference by consumers for the superficial portion. While whole steak portions are sold in many markets capturing the value for the whole cut, indicating that consumers may be open to alternative merchandising strategies in markets that deal with excessive margin losses, increased labor demands, or meat disposal. The deep portion could be sold as is, ground and sold as ground beef, or even seasoned to add value.

Other factors that drove steak preferences to purchase a steak included where respondents typically shopped for steak. Respondents who typically purchased direct-from-producer were 10.8% less likely to purchase any of the steaks in general. In comparison, respondents who purchased from community-based retailers were 1.9% more likely to purchase the steak presented, all else being equal. This finding may indicate some heterogeneity based on retail market choice and collective preferences for steak appearance and perceptions of freshness and taste.

In terms of consumer heterogeneity, there were no significant sex differences. The age of the consumer affected willingness to purchase so that each additional year in the cross-sample increased purchases by 0.4%, possibly showing generational consumption differences. Regionally, respondents from the Northwest were 8.6% more likely to purchase the steak. Overall, 81.4% of respondents were from the Northwest, and future work could expand the sample to be more nationally representative and focus on regional preferences in steak purchases.

Willingness to Pay Results

For steaks that had a positive purchase decision, the interval regression results show the marginal effect on respondent WTP. There were no significant differences in WTP for the three cuts. This result implies that the WTP for the deep steak portion (the least desirable) is not lower than the whole or superficial cut, even though it is not the desired cut. For retailers with high discounts or product waste who wish to separate the whole steak into the two portions, they could grind the deep steaks and the rest could be alternatively marketed at the same rate per pound. There would be additional labor costs, but currently these retailers are paying additional labor to markdown, grind, or age the whole top round. The marginal changes in costs are not considered in the present study, but it should be noted that a change in strategy could affect the labor costs. Contrarily, this factor also means that there is not a premium for superficial steak. This alternative marketing strategy may not be effective or beneficial to retailers able to sell their steaks with only limited discounts but may be useful in driving volume sales where a whole steak may have previously been rejected and create opportunities for converting customers to the other two portions.

Respondents shopping at specialty meat stores had a \$0.04 higher WTP for steak. This preference can be driven by a perception of quality at these stores. Baltzer (2004) and McCluskey and Loureiro (2003) reported a positive relationship between quality food and higher WTP. In this case, these customers may be used to paying a premium for their meats from these types of stores, which helps in understanding the market perceptions and price perceptions at different formats.

While respondent heterogeneity impacted the purchase decision, it was less of a driver of WTP. Sex, age, and location had no significant impact on WTP. However, results show that consumers with an upper-middle-level annual income (\$60-99 thousand) had a \$0.45 per pound higher WTP than the lowest income level. This finding is plausible because consumers with higher annual income have more purchasing power and may place a premium on steak in their diet. This was not the case for the highest level of income.

Table 3: Results for Purchase Decision and Willingness to Pay for Alternative Top Round Steak Cuts

	Purchase Decision Results		WTP Results
	Probit Coefficients	Average Marginal Effects	Interval Regression Coefficients
Deep steak	-0.228*** (0.059)	-0.086*** (0.022)	-0.039 (0.070)
Superficial steak	0.188*** (0.063)	0.070*** (0.024)	0.043 (0.065)
Day	-0.020 (0.017)	0.007 (0.006)	0.009 (0.019)
Frequently buy steak	-0.006 (0.108)	0.002 (0.041)	0.0164 (0.150)
Grocery store	-0.035 (0.156)	-0.013 (0.059)	0.0171 (0.207)
Specialty meat store	-0.198 (0.130)	-0.074 (0.049)	0.042** (0.166)
Directly from producer	-0.289** (0.134)	-0.108** (0.050)	0.167 (0.167)
Community-based retailer	0.503** (0.204)	0.019** (0.076)	0.098 (0.175)
Female	-0.028 (0.121)	-0.011 (0.045)	-0.217 (0.161)
Age	0.014 (0.023)	0.004*** (0.002)	-0.008 (0.024)
Age*age	0.000 (0.000)		0.000 (0.000)
Northwest	-0.230* (0.131)	0.086* (0.049)	0.208 (0.198)
HHI: \$30,000 to \$69,999	0.022 (0.164)	0.008 (0.061)	0.133 (0.237)
HHI: \$60,000 to \$99,999	-0.201 (0.159)	-0.076 (0.059)	0.447* (0.237)
HHI: \$100,000 or More	0.10 (0.164)	0.004 (0.061)	0.306 (0.229)
Inverse mills ratio			-0.008 (0.012)
Constant	0.137 (0.425)		4.931*** (0.489)
Log Pseudolikelihood	-2030.298		-2450.241
lnSigma			-0.000
Wald	88.22***		36.77***
Observations	3,100	3,100	1,709
Average Predicted Value	0.568*** (0.020)		5.08*** (0.070)

Note: Robust standard errors, clustered by respondent presented in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Negative Purchase Decision

For those choosing “no” for each steak purchase decision, respondents were asked a follow-up question to provide a rationale for their choice. The breakdown of respondents’ reasons is provided in Table 4, disaggregated by steak type. Based on purchase decision results above, we know that the deep steak was the least preferred, having a lower likelihood of being purchased and lower WTP. This is reflected in the percent (46%) of choice set that respondents chose not to purchase, which were deep steak options, followed by whole steak (30%), and superficial steak (22%). Deep steaks have a greyer hue than the superficial steak, which supports the preferences in the literature

indicating that a more red color is associated with freshness and quality (Seideman et al., 1984; Hunt et al., 2004). These colors were measured instrumentally (Puga 2019), but the discussion of color is based on consumer comments and their perceptions of quality and WTP.

Overall, the perceptions of toughness (56.9%), lack of appropriate marbling (59.3%), and coloring (43.8%) were the largest drivers of negative purchase response across all steaks. However, the factor importance varies by the steak portion. While perception of toughness was the largest reason for choosing whole steak, a significant difference was found in the top response for superficial and deep steaks. This result is interesting in that the two components individually are not perceived as tough as the full whole steak, or as a larger driver for a negative purchase response. This is the only response category where this holds. Across all other reasons, the whole steak and deep steak portions are not statistically different from one another.

The main differences in negative purchase responses were demonstrated through the comparison of whole and deep to superficial steaks. Insufficient marbling is the largest response for the superficial steak (72.7%), which is significantly different than whole or deep steaks. Superficial steaks are redder in color but also lack the fat profile of the deep portion, which is consistent with the perceptions of being off color as a large driver of respondents' preferences for whole (54.7%) and deep (46.9%) steaks, but not for superficial steak (23.6%). The smallest response across all three steaks was too much marbling, consistent with consumer surveys on beef tenderness and beef portions (Martinez et al., 2017; Gonzalez and Phelps, 2018).

Table 4: Reported Reasons for Negative Purchase Response

Reason [†]	Whole Steak			Superficial Steak			Deep Steak		
	N	Mean	St. Dev	N	Mean	St. Dev	N	Mean	St. Dev
Amount of trim	148	0.155 ^A	0.364	110	0.382	0.488	226	0.186 ^A	0.390
Looks tough	148	0.662	0.475	110	0.464 ^A	0.501	226	0.553 ^A	0.498
Off color	148	0.547 ^A	0.499	110	0.236	0.426	226	0.469 ^A	0.500
Not enough marbling	148	0.500 ^A	0.502	110	0.727	0.447	226	0.584 ^A	0.494
Too much marbling	148	0.027 ^A	0.163	110	0.018 ^A	0.134	226	0.018 ^A	0.132

Notes: *Means in each column may sum to more than 100 as respondents could choose more than one reason for negative purchase response.

[†] Means sharing a letter across row are not significantly different at the 5% level.

Conclusion

Meat waste and lost marketing opportunities lead to losses in the beef industry annually. Alternative marketing strategies aim to provide a solution to less desirable products. The beef top round is a large muscle that varies in color and tenderness. This variation results in less appealing steaks that end up being discounted at the retail store. By separating a whole top round into two portions (i.e., a deep and superficial portion), a retailer with high losses or discounted product can drive more sales and better cater to customer preferences. Specifically, these findings would guide retailers to sell the superficial portion as a steak and either grind or season the deep portion. This would reduce the amount of or product reduced for quick sale. Further research should be

conducted to expand beyond the Pacific Northwest region and compare rural versus urban purchasing decisions.

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China's Emerging Market for Maple Syrup: Opportunities and Challenges for U.S. Exports

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Abstract

While China's maple syrup imports have increased steadily since 2009, from 2.85 metric tons in 2009 to 219.96 metric tons in 2020, the share of U.S. maple syrup in China's imports has been less than 9%. This study reviews the development and trends of China's maple syrup imports, assesses the strengths, weaknesses, opportunities, and threats of U.S. maple syrup in China, and derives recommendations for expanding U.S. exports to China. The U.S. maple industry needs to incorporate Chinese consumer preferences and market characteristics in its product development, trade negotiation, and market promotion to capture the opportunities in the Chinese market.

Keywords: U.S. maple syrup, maple syrup exports, China, SWOT analysis

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Introduction

As a large country that does not produce maple syrup, China's maple syrup imports increased steadily from 2.85 metric tons (mt) in 2009 to 219.96 mt in 2020 and then dropped to 157.01 mt in 2022 (United Nations Comtrade Database [UNCD], 2023). While China's limited maple syrup imports in the early years were used primarily to serve the demand of foreigners visiting or living in China, the significant increase in its imports in recent years has made maple syrup more widely available to Chinese consumers, mainly through online platforms. China as an emerging market for maple syrup may provide significant opportunities for the U.S. maple syrup industry, which has achieved remarkable growth in production volume since the early 1990s but has experienced a downward trend in its producer price since 2008 (USDA, 2023).

As shown in Figure 1, following an increasing trend in both production and average nominal producer price from 1992 to 2008, U.S. maple syrup production continued the increasing trend after 2008, except for the significant drops in 2020 and 2021 due to poor sugaring weather. On the contrary, the average nominal producer price has shown a downward trend since 2008, except for 2020 and 2021. The downward trend in average producer price since 2008 is more apparent when the nominal price is converted into the real price in 2008 dollars. For example, when the nominal producer price dropped from \$40.74 per gallon in 2008 to \$34.70 per gallon in 2022, the real producer price in 2008 dollars declined from \$40.74 to \$25.52 per gallon over the same period. Figure 1 further suggests that the average producer price tended to increase in the years with lower productions and decrease in the years with higher productions. This pattern is consistent with the economic principle of how market supply and demand work together to determine the market price.

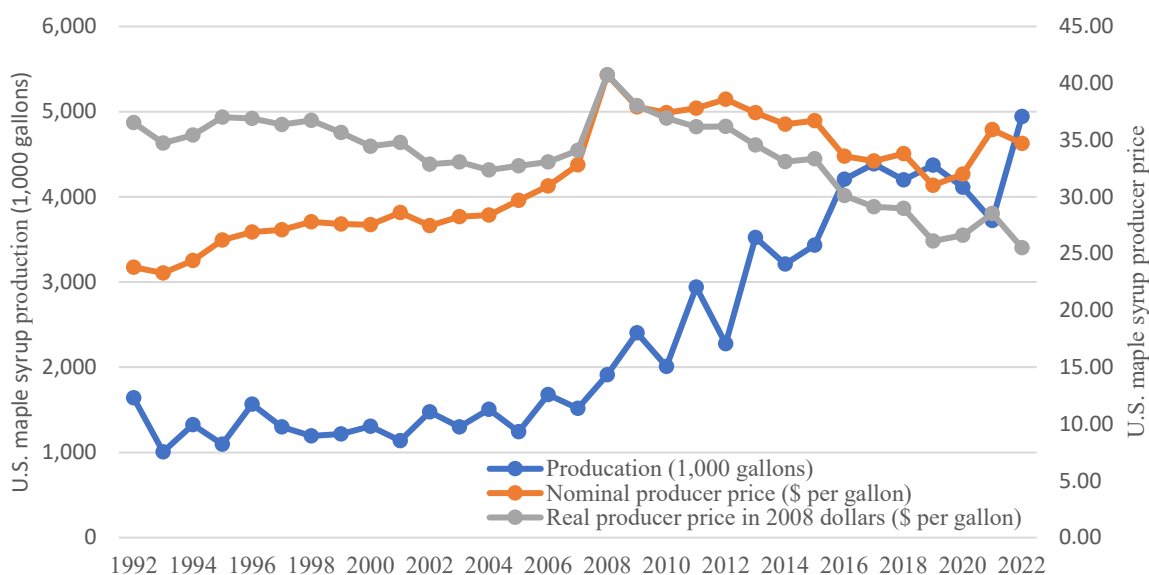


Figure 1. U.S. Maple Syrup Production and Average Producer Price, 1992–2022

Data sources: Production and nominal price data were from USDA NASS (1992–2023) and real price was calculated from the nominal price and consumer price index (CPI) from U.S. Federal Reserve Bank of Minneapolis (2023).

As U.S. maple syrup production is likely to maintain the increasing trend, a major challenge for the industry is to increase the demand in the domestic and foreign markets to reverse the downward trend in producer price as well as to reduce its fluctuations over time (Farrell and Chabot, 2012; Gabe, 2014; Becot et al., 2015). This study is motivated by the growing need for information on foreign demand for U.S. maple syrup and the potential opportunities in China's emerging market for maple syrup.

With a long history of an integrated food production system of grains, fruits, vegetables, nuts, livestock, seafood, etc., China's regional food consumption patterns have historically been determined by its regional food production. For example, rice has been a major staple food in Southeast China and wheat has been a major staple food in Northwest China, predominantly due to the product availability and relative prices. However, as a result of China's ongoing transition from a centrally planned economic system to a market economic system since the early 1980s, the dependence of food consumption on local food production in China has significantly and steadily declined for two major reasons. First, the transportation of food products, including both staple and non-staple food products, from production regions to consumption markets in China has improved remarkably in terms of costs and efficiency due to the development of transportation infrastructure, such as highway and train systems, and the reduction of government interventions in food transportation and distribution (Huang and Tian, 2019). Second, China's food imports have increased significantly since the early 1990s, particularly since China joined the World Trade Organization (WTO) in 2001 (Cao et al., 2021; Liu and Zhou, 2021). China has emerged as a large importer of many food and feed products, such as soybeans, vegetable oils, powdered milk, frozen pork, whey, and alfalfa (USDA, 2020; Wang and Zou, 2020; Ren et al., 2021). China's food self-sufficiency rate, calculated using data on calories from 54 major food products, decreased steadily from 94% in 2000 to 83% in 2010 and reached a record low of 76% in 2020 (Hadano, 2022).

China has gradually emerged as a large importer of many food products. Its maple syrup imports increased rapidly from 2.85 mt in 2009 to 219.96 mt in 2020 and then dropped to 157.01 mt in 2022 (UNCD, 2023). Canada and the United States, as the world's two largest maple syrup producers and exporters, have both made efforts to introduce maple syrup to Chinese consumers and increase their exports to China. For example, the Canadian government provided \$2.2 million to help maple syrup producers in the province of Quebec expand and diversify their exports to the United States, United Kingdom, Germany, Japan, and China (Desjardins, 2019). In the United States, the USDA has funded a number of educational, research, and Extension projects for promoting the maple syrup industry and exploring new market opportunities for U.S. maple syrup in the United States and abroad. As the largest maple syrup producer in the United States, the state of Vermont has made efforts to introduce and promote its maple syrup in Australia, the Republic of Korea, Japan, China, and several other nations. For example, the Vermont Chamber of Commerce maintained an office in Shanghai, China's largest city, to increase the visibility of Vermont's products, including maple syrup, in China for many years until the start of COVID-19.

Although China has emerged as a large market for maple syrup and significant efforts have been made by both government agencies and the maple industry in the United States and Canada to promote maple syrup in China, there is a dearth of information and many unanswered questions

about the Chinese market for maple syrup. For example, how is maple syrup imported and sold in China? What maple syrup attributes are important to Chinese consumers? Why has U.S. maple syrup had a very limited market share in China? How can we enhance Chinese consumer acceptance and preferences for U.S. maple syrup? What are the traditional Chinese foods and recipes that may complement or include maple syrup? This study is motivated by the growing need for information and answers to the above questions about maple syrup in the Chinese market. Specifically, this paper reviews the development and trends of China's maple syrup imports, analyzes Chinese market characteristics and consumer feedback on their purchase of maple syrup, and derives recommendations for the U.S. maple syrup industry to expand its maple syrup exports to China. This is likely the first or one of the first studies on China's maple syrup market.

China's Maple Syrup Imports

Maple syrup trade data used in this study are from the UNCD (2023). For China's annual maple syrup import, the searchable database provides data on the import quantity and value reported by China as well as by the exporting quantities and values reported by the exporting nations. Although the import quantity and value reported by China for each year should theoretically be equal to the corresponding sums of export quantities and values reported by the exporting nations, there are significant differences for all the years of the study period. Furthermore, the data reported by the exporting nations seems to contain more errors. For example, the maple syrup export quantity to China reported by Myanmar for 2020 and 2021 were significantly greater than China's total import quantity reported by China, and there is no supporting data that Myanmar has been a large maple syrup producer or exporter. Due to the concern about the quality of data reported by the exporting nations, this study uses the import data reported by the importing nations.

The trade data of "China" in the UNCD includes "mainland China" only and does not include Hong Kong and Macau. Although Hong Kong and Macau have been special administrative regions of China since 1997 and 1999, respectively, they are listed separately from China in the UNCD. Also, Taiwan is included in the database under "Other Asia, not elsewhere specified" (UN Statistics Division, 2023). It is beneficial to examine and compare the development and trends of China's maple syrup imports to that of Hong Kong, Macau, and Taiwan due to their similar culture, food consumption patterns, and consumer characteristics. The experience of Hong Kong, Macau, and Taiwan with significantly higher per capita income than that in mainland China may shed light on China's future demand for maple syrup.

Maple syrup imports of mainland China, Hong Kong, Taiwan, and Macau from 2009 to 2022, reported in Figure 2, suggest three major findings. First, their total maple syrup imports increased significantly from 41.14 mt in 2009 to 383 mt in 2020 and then dropped to 312.77 mt in 2022, resulting in an average annual growth rate of 16.89% from 2009 to 2022 and 24.50% from 2009 to 2020. The rapid growth suggests that this region has emerged as a significant import market for maple syrup in Asia. Second, mainland China accounted for most of the increase in this region's total imports of maple syrup over the study period, as its share increased from 6.93% in 2009 to 57.44% in 2020 and then dropped to 50.20% in 2022. Third, Macau's maple syrup imports have been limited, and its annual imports never exceeded 1 mt over the study period.

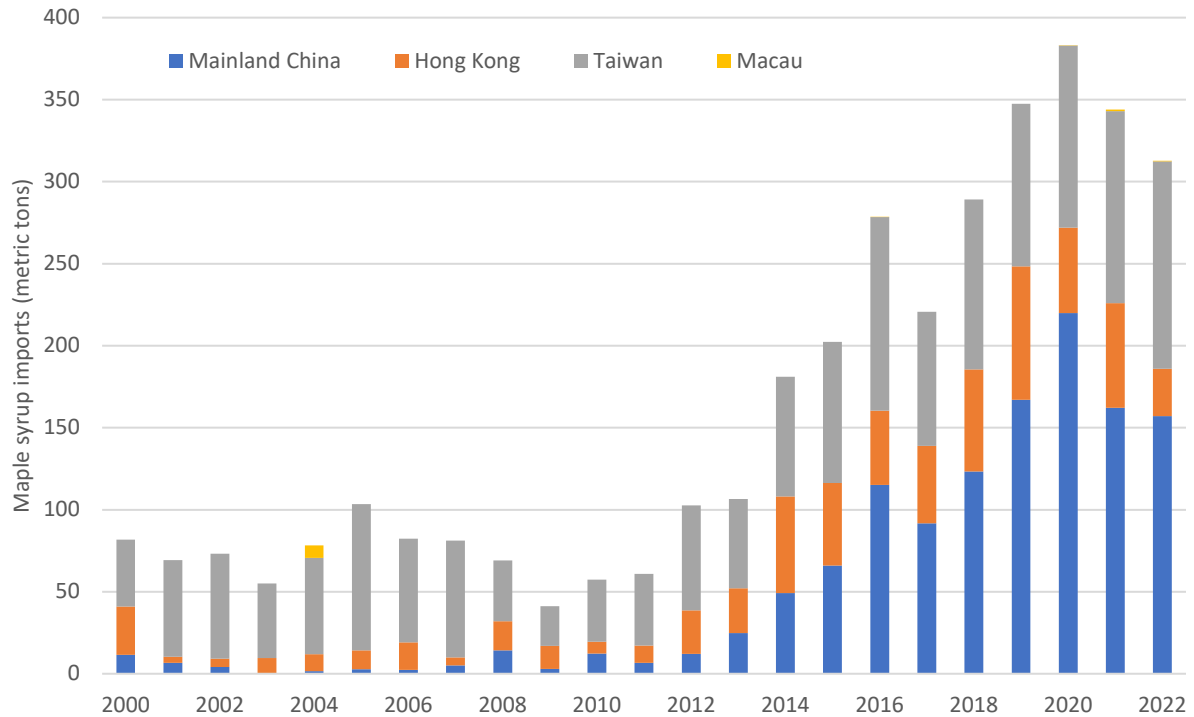


Figure 2. Maple Syrup Imports of Mainland China, Hong Kong, Taiwan, and Macau, 2009–2020

Data source: United Nations Comtrade Database (2023).

While data from the UNCD (2023) suggests that both Hong Kong and Taiwan exported maple syrup to China (i.e., mainland China) during the study period, there is no information on whether the exports of maple syrup from Hong Kong and Taiwan to China were included in China's total imports reported by the Chinese government. As discussed earlier in this section, there are significant differences between the data reported by the importers and those reported by the exporters in the database. A preliminary analysis of the import and export data of Taiwan and Hong Kong over the period of 2005 to 2022 indicates that likely about 10.93% of Taiwan's maple syrup imports were exported to China and about 11.62% of Hong Kong's imports were exported to mainland China.

The development and trends of Hong Kong and Taiwan's maple syrup imports in relation to their populations may indicate the preferences of Chinese consumers for maple syrup as well as foreshadow the market potential in mainland China due to their similar consumer characteristics and food consumption patterns. According to the 3-year average data from the UNCD for 2020 to 2022, Hong Kong and Taiwan imported an average of 6.57 and 4.95 grams of maple syrup per capita per year, respectively, but the corresponding value for mainland China was only 0.13 grams per capita over the same period. If the per capita import of mainland China reached 10% of Taiwan's per capita import, its total import would increase to 920 mt.

In addition to Taiwan and Hong Kong, Japan and the Republic of Korea's maple syrup import trends may also foreshadow the future growth of China's maple syrup market due to their similar food consumption and dietary history and patterns. Data from UNCD (2023), presented in Figure 3, suggest three major findings. First, Japan's maple syrup imports have increased significantly since 2000, from 1,352.76 mt in 2000 to 3,022.79 mt in 2022. Japan was the sixth largest importer of maple syrup in 2022, with a share of 4.8% of the global import. Second, the Republic of Korea's maple syrup imports increased dramatically from 39.70 mt in 2000 to 1,037.20 mt in 2022, resulting in an average annual growth rate of 15.99% over the period. Third, although the total maple syrup imports of mainland China, Hong Kong, Taiwan, and Macau increased significantly from 2000 to 2022, their total imports were much less than the imports of Japan and the Republic of Korea, especially in relation to their populations. For example, in terms of the average annual per capita import from 2020 to 2022, it was 23.80 grams for Japan and 19.42 grams for the Republic of Korea, but only 0.24 grams for the Greater China region (i.e., mainland China, Hong Kong, Taiwan and Macau) and 0.13 grams for mainland China.

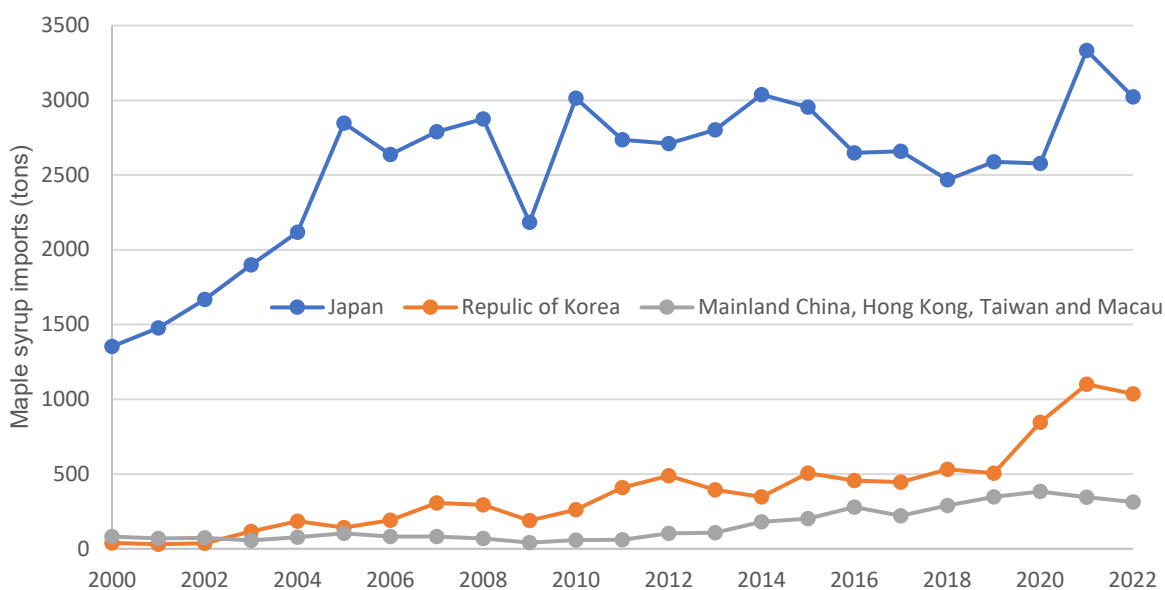


Figure 3. Maple Syrup Import Quantity of Japan, Republic of Korea, and Mainland China, Hong Kong, Taiwan, and Macau, 2000–2022

Data source: United Nations Comtrade Database (2023).

China's rapid growth in maple syrup imports in recent years and the experience of Taiwan, Hong Kong, Japan, and the Republic of Korea over the past two decades suggest that Chinese, Japanese, and Korean consumers likely have a strong acceptance of and preference for maple syrup as a foreign product when the product is available to them. The maple syrup market trends of Taiwan, Hong Kong, Japan, and the Republic of Korea, regions and countries possessing many food consumption and dietary characteristic similarities to that in mainland China, may also foreshadow the great potential of mainland China's imports of maple syrup in the future. On the other hand, with significantly lower per capita income and more government interventions in food imports as compared to Japan, the Republic of Korea, Taiwan, and Hong Kong, mainland China's future

growth in maple syrup imports will be determined highly by its income growth and trade policies, especially the trade policies with Canada and the United States. In recent years, there has been an increase in trade disputes between China and the United States as well as Canada and Taiwan.

Major Characteristics of China's Maple Syrup Market

Due to the lack of information and literature on China's maple syrup market, this study has collected primary data from media reports, retailers' websites, and our visits to supermarkets and import food stores in five large Chinese cities (Beijing, Shanghai, Wuhan, Xian, and Changchun) in the summer of 2021. Data collected through this study suggests three major findings. First, maple syrup products sold in China are not packaged and labeled for the Chinese market, but many Chinese retailers have added a label with information in Chinese. Figure 4 shows two maple syrup products sold at a Carrefour supermarket in Beijing in August 2021. The label in Chinese generally includes the brand name translated into Chinese, weight or volume, the country of origin, production and expiration dates, importer and/or distributor names and their addresses and phone numbers, and nutritional information.



Figure 4. Two Maple Syrup Products Found in a Carrefour Supermarket in Beijing

Data source: Photos of the authors' research team.

Second, according to data collected on maple syrup products with importer information that were sold online or in stores in China, maple syrup products were primarily imported by small importers with none of them being imported by a well-recognized large food importing company in China. Third, the major marketing channels of maple syrup in China are online sales and small grocers that specialized in imported food products and consumer goods in large cities. For online sales, Taobao.com and jd.com, China's two largest online retailers, offer more than 1,500 maple syrup listings each. The number of stores specializing in imported food products has increased rapidly in Shanghai and other large cities in recent years. These stores are generally owned and managed by franchise owners and most of them are located in neighborhoods with relatively high average income or more foreign residents. Data from China's 2020 Census indicated 845,697 foreigners were living in China in 2020, reflecting an increase of 42.41% from 593,832 in 2010 (National Bureau of Statistics of China, 2022). Foreigners living in China play an important role in introducing and popularizing foreign food products like maple syrup to Chinese consumers.

Among the 50 supermarkets we visited in Beijing, Shanghai, Xian, and Wuhan in the summer of 2021, only four carried maple syrup products. Further, a search of “maple syrup” in Chinese from the top 10 chain supermarkets’ websites in China (China Resources Vanguard, RT-Mart, Yonghui, Walmart, Lianhua, Freshhema, Wu-Mart, Carrefour, Jiajiayue, and Hyper-Mart) did not yield any results. Most of the large international and national chain supermarkets in China do not sell maple syrup, likely because their estimated demand quantity is not large enough to warrant shelf space. On the other hand, most of the large chain supermarkets in China have started to dedicate a section of shelf space for imported food products, including beer, wine, coffee, chocolates, snacks, and baby formulas. This could be a potential platform for maple syrup as an imported food product to be introduced to Chinese consumers through large supermarkets.

To assess the preferences and feedback of Chinese consumers who had purchased maple syrup products online, the top 200 maple syrup products listed at Taobao.com, China’s largest online retailer, were reviewed in December 2021. These were the top 200 listings of maple syrup products as ranked by the number of sales. Similar to Amazon.com and other online retailers, one vendor could have multiple listings, and the same product could be listed by multiple vendors. The review results, reported in Table 1 and Figure 5, suggest four major findings. First, maple syrup products listed at Taobao.com in China are dominated by products from Canada (79%), and only 7% of them were from the United States. These data were based on the country of product origin, not the country of the food manufacturer is located. For example, Kirkland maple syrup products were listed as Canadian products although Costco as the owner of the Kirkland brand is a U.S. company with its headquarters located in Seattle, the United States. The top six brands (Kirkland, Aodi, Kojo, NOW Foods, Maple Joe, and Taichuang by a Taiwanese company) accounted for 60% of the 200 reviewed listings.

Table 1. Characteristics of Maple Syrup Products Listed on Taobao.com

Country of origin	Canada (79%), the United States (7%), Japan (5%), and other nations (9%)
Brand	Kirkland (28%), Aodi (10%), Kojo (10%), NOW Foods (4%), Maple Joe (4%), Taichuang (4%), and all other brands (40%)
Container	Plastic (59%) and glass (41%)
Unit	Milliliter (ml) (43%), liter (35%), gram (12%), ounce (6%), and kilogram (kg) (4%)
Listing information	Price and weight or volume (100%), photos (95%), sale (discount) price (90%), recipe (85%), shipping and return policy (85%), customer feedback (80%), and video clips (40%)
Promotion	Price discount for current purchase (90%), price discount for future purchase (80%), free shipping (60%), free return (50%), and donation to charities (40%)

Note: See Figure 5 for Customer Feedback. Data source: Primary data collected by the authors’ research team.

Second, all the maple syrup products sold in China, except the brand of Taichuang, made by a Taiwanese company, were not packaged or labeled for the Chinese market. For example, the units that are listed in ounce, milliliter, and liter are not familiar to many Chinese consumers. Although China uses the metric system, most Chinese consumers, especially elder consumers, are more familiar with the weight units like the traditional unit of Jin (one Jin equals 500 grams), kilogram and gram for liquid products. For example, honey, as a likely competing product of maple syrup, has always been sold by weight, such as Jin, kilogram, or gram, not by volume, in China. Labeling maple syrup products by metric weight or by using both volume and weight may help many Chinese consumers better assess and compare the unit price between maple syrup and other related products, such as honey.

Third, most online retailers provide a large amount of information about their maple syrup products, but some of them may not be relevant to Chinese consumers. For example, 85% of the retailers provide maple syrup recipes like pancakes, waffles, and French toast, but none of these recipes are adapted for Chinese cooking. There is a great need for the further development of maple syrup recipes for Chinese consumers.

Fourth, for the 200 listings of maple products on Taobao.com we reviewed, each listing provides several key words, such as “delicious,” “sweet,” “healthy,” “nice color,” etc., based on the feedback from the customers who had purchased the product. The frequency of the top 18 key words across all 200 listings is presented in Figure 5. “Delicious” was the most frequent descriptor, followed by “sweet,” “great packaging,” “fresh,” and “affordable.” It is an encouraging finding that a large percentage of online consumers who had purchased maple syrup considered maple syrup to be affordable. Note that this finding is based on feedback from Chinese consumers who had purchased maple syrup online, and their income and characteristics are likely to be very different from that of average Chinese consumers.



Figure 5. Chinese Consumer Comments on Their Online Purchase of Maple Syrup

Data source: Primary data collected by the authors' research team.

A SWOT Analysis of U.S. Maple Syrup in the Chinese Market

SWOT analysis is a strategic planning and management technique used to help a business or organization identify strengths, weaknesses, opportunities, and threats of a new product, a new market, or a proposed organizational change (Benzaghta et al., 2021). A SWOT analysis was conducted to assess these four aspects of maple syrup as a relatively new foreign product in China, and the findings are summarized in Table 2.

Maple syrup as a new foreign product in China has several potential strengths in the market.

Table 2. A SWOT Analysis of U.S. Maple Syrup in China

Strengths	Weaknesses
Has been introduced as an all-natural sweetener enjoyed and appreciated by people in many countries	Limited recipes with maple syrup for typical Chinese food preparations
Delicious taste, beautiful color and good smell	Limited introduction and promotion of maple syrup in China
Has been introduced as a healthy food product in China	Limited information on Chinese consumers' preferences for maple syrup
The process of collecting sap from trees to boiling the sap into syrup is attractive to Chinese consumers	No maple syrup product has been developed, packaged or labeled for the Chinese market yet
Has been introduced as a western food in China, similar to coffee and wine	Relatively expensive as compared to honey and other syrups
Opportunities	Threats
China does not produce maple syrup and the demand must be met from imports	Maple syrup is not part of the Chinese diet and cuisine
Excellent customer reviews and feedback in China	Language and cultural barriers for maple syrup as a relatively new foreign product
China has emerged as a large importer of many food products	Ongoing China-U.S. trade war and retaliations
China will likely import more foods from the U.S. to reduce its huge trade surplus	Competition of Canadian maple syrup
China does not produce maple syrup and the demand must be met from imports	Increasing international transportation costs since 2000
Excellent customer reviews and feedback in China	Almost no growth in per capita sugar consumption in China since the mid-1980s
China has emerged as a large importer of many food products	Ongoing public health campaign of reducing sugar intake to prevent diabetics and obesity in China
China will likely import more foods from the U.S. to reduce its huge trade surplus	Lack of enforcement for trademark protection and punishment for fake products in China

Although maple syrup has been introduced in China for only a short period, it has been introduced as a natural, healthy, safe, and luxury Western food product. The taste, color, smell, and production process, from collecting sap from trees to boiling the sap into syrup, has been well received in China. As a result of the ongoing globalization and rising income, Chinese consumers, especially young and educated consumers, have developed strong preferences and demands for products like beer, wine, coffee, lobsters, and cheese that were traditionally not present in the Chinese diet and cuisine. For example, China's beer production was extremely limited until the 1980s, but has now

emerged as the world's largest beer market since 2002 (Wang et al., 1997; FAO, 2022). Similarly, as a country culturally and historically attached to tea, China's coffee consumption has increased by more than 600% between 2006 and 2020. Furthermore, Chinese consumers, especially those in their 20s to 40s or with relatively higher income, have proven themselves to be connoisseurs of fine wines from Italy, gourmet cheeses from France, freshly caught abalone from New Zealand, fresh Bing cherries from Chile, and live lobsters from Canada or the United States. It seems reasonable to predict that maple syrup will be added to the refined list of foreign foods for many Chinese consumers.

The rapid growth in maple syrup imports in the greater China region in the past decade suggests that their imports are likely to continue to grow at a significant rate. The increase in maple syrup imports of Japan and the Republic of Korea, with similar food culture and consumption characteristics to China, also confirms that many Asian consumers will presumably enjoy maple syrup when it is available and affordable (Atlantic Cooperation, 2019; Korea Business Services, Inc., 2020).

Regarding weaknesses, maple syrup has not been a traditional part of the Chinese diet and cuisine, hence, there is a limited number of Chinese food recipes that include maple syrup. Most consumers in China have never tried maple syrup, and therefore do not know the best ways to consume it or use it as an ingredient. The maple industry needs to improve its efforts in studying Chinese food culture and developing new products and recipes for Chinese consumers. Furthermore, in comparison to honey and other syrups that are readily available in China, maple syrup is more expensive, less widely available, and is not packaged or labeled for Chinese consumers. There is limited information provided to Chinese consumers regarding maple syrup and its uses and there is also limited knowledge within the industry at large of Chinese consumers' preferences for maple products. The maple syrup industry, especially the exporters, need to collaborate more effectively with Chinese importers to ensure that maple syrup is more affordable and accessible to Chinese consumers.

There are many opportunities for increasing maple syrup exports to China. First, China does not produce any maple syrup, which means that all of the demand for the product must be met from imports. China has emerged as a large importer of many food products and will likely increase its imports of U.S. food products to reduce its trade surplus with the United States (USDA, 2020). Many American food products, such as baby formula, vegetable oil, and frozen pork, have earned an excellent reputation in quality and safety among Chinese consumers (USDA, 2020). Second, the rising income of Chinese consumers makes maple syrup affordable for more and more people. Third, since luxury food products are often purchased as gifts for parents, relatives, and friends in China, maple syrup as a foreign product with a beautiful color has the potential to be one of these gifts. Fourth, because both bakery goods and baking at home have become popular in China, especially within urban areas, there are increasing opportunities for maple syrup to be used as a complement to baked goods. Fifth, the number of foreigners who live, work, or study in China and the number of Chinese people who study, visit, or work abroad have increased rapidly in the past two decades. Such activities and movements could help introduce maple syrup in China.

There are potential threats to the expansion of maple syrup exports to China. First, maple syrup is not a part of the Chinese diet or cuisine and there are language and cultural barriers that exist in regard to maple syrup as a relatively new foreign product in China. Second, there are ongoing trade disputes and retaliations between China and the United States, as well as rising tensions between the two nations in their political and economic relations. Third, China is a large sugar producer, consumer, and importer, but there has been almost no growth in per capita sugar consumption in China since the mid-1980s. China also has an ongoing public health campaign of reducing sugar intake to prevent diabetes and obesity. Fourth, there is a lack of enforcement for trademark protection and punishment for fake products in China. This could be a potential threat to maple syrup as a luxury, expensive, and imported product in China.

Conclusions and Recommendations

As a pioneering study focused on China's emerging maple syrup market, this paper has reviewed the development and trends of China's maple syrup imports, examined the market characteristics with a focus on distribution channels and consumer preferences and feedback, and assessed the strengths, weaknesses, opportunities, and threats of maple syrup in the Chinese markets. Such information is expected to be useful to maple syrup producers, processors, exporters, policy makers, educators, Extension specialists, and other stakeholders of the maple industry.

This study suggests four major conclusions and recommendations. First, as a large country that does not produce maple syrup, China's maple syrup imports are likely to continue to grow at significant rates because of increasing average income, ongoing urbanization, and growing consumer demand for imported food products. The North American maple syrup industry should begin to include China in its export strategies and promotion efforts. As maple production in the United States and Canada continues to increase, the Canadian maple industry, with support from the Quebec Maple Producers Association (PPAQ), has made great efforts in increasing its exports. On the other hand, the U.S. maple industry is loosely organized in promoting its exports. For example, early attempts by the Vermont Agency of Agriculture, Food and Markets to advance international maple syrup export research were met with skepticism. This reaction suggests that the U.S. maple syrup industry needs to work to better develop an identity for its maple syrup as a global specialty sweetener.

Second, the maple syrup products available in the Chinese market are not developed, packaged, or labeled for the Chinese market. It is of the utmost importance to rectify these marketing issues. In addition, new maple syrup products and recipes must be developed with consideration for Chinese cooking and food culture. Maple products for the Chinese markets should be labeled in Chinese, using units that are familiar to Chinese consumers, and marketed as luxury food products according to Chinese custom. While China is a large country with significant variations in food consumption patterns and preferences across regions, it is important to incorporate such differences in product and recipe development, introduction materials, and marketing strategies.

Third, while U.S. agricultural exports to China increased sharply in the past two years, reaching a record high of \$36.4 billion in fiscal year 2022 (USDA, 2023), the exports have been concentrated

in soybeans, corn, sorghum, cotton, alfalfa, beef, pork, powdered milk, and other bulk products. This study suggests that maple syrup, as a unique product mainly produced in Canada and the United States, has great market potential in China and should be included in agricultural trade negotiations with China. Maple syrup may also serve as a pilot study to assist in understanding Chinese consumer preferences for imported food products with the end goal of expanding the exports of high-value and regional products to China.

Fourth, while there are extremely limited information and studies on Chinese consumer preferences for maple syrup and its attributes, there is a growing need for the maple industry, government agents, and researchers to work together to understand Chinese consumer preferences and willingness to pay in order to incorporate such information in product and recipe development and market promotion efforts. While maple syrup has nostalgic significance for many producers, distributors, retailers, and consumers in North America, industry leaders have begun to acknowledge the opportunity to expand sales into non-maple-producing regions in North America and beyond to market the ever-increasing supply of syrup. With this acknowledgment, the maple industry has begun adopting new marketing strategies that place a greater emphasis on product quality, flavor, and positive environmental attributes. These adjustments aim to expand awareness of maple products to consumers in broader geographic regions and demographic profiles. More research in China is vital to understand consumer preferences and inform effective product promotion, packaging, and placement to further develop this emerging market.

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Factors Impacting Growers’ Adoption of Genetically Modified and Gene Edited Crops

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Abstract

To gain insights into how genetically modified (GM) or gene edited (GE) crops’ benefits affect growers’ willingness to grow, we conducted a survey with 111 Minnesota growers. We found growers are more familiar with GM crops than GE crops. Compared to a GM or GE crop without

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specified benefits, growers are more willing to grow GM or GE crops that are healthier for consumers. Growers who perceive the benefits of GM or GE crops as outweighing the risks are attracted to multiple benefits, including healthier for consumers, lower production costs, higher yield, enhancing disease or pest resistance and reducing pesticides.

Keywords: specialty crops, benefits, risks, new technology

Introduction

By 2050, the world population is projected to reach 9.2 billion. To feed this population, global food production needs to increase by 70% (Clarke and Daniell, 2011). Many researchers believe that the cultivation of genetically modified (GM) crops can play a pivotal role in alleviating food insecurity (Huang, Pray, and Rozelle, 2002; Ali and Rahut, 2018). On one hand, genetic modification can enhance crop yields (Qaim, 2003; Finger et al., 2011). On the other hand, the cultivation of GM crops can bolster farmers' food security by increasing their income (Ali and Rahut, 2018). For instance, Qaim and Kouser (2013) found that the cultivation of GM cotton increased Indian farmers' household income, subsequently improving their calorie and nutritional intake. In addition, GM crops also have several important traits, such as herbicide tolerance and resistance to plant viruses and insect damage (U.S. Food and Drug Administration, 2022). With such beneficial traits, the global cultivation area of GM crops surged from 1.7 million hectares in 1996 to 190.4 million hectares in 2019 (International Service for the Acquisition of Agri-biotech Applications, 2017; International Service for the Acquisition of Agri-biotech Applications, 2020).

However, extensive cultivation of GM crops has raised many safety concerns. Many people and institutions worry about potential negative health impacts of GM crops, such as toxicity, allergenicity, antibiotic resistance, cancer, nutrition loss, or immune reactions (The Cornucopia Institute, 2009; Bennett, et al., 2013; Center for Food Safety, 2016). Given these concerns, GM crops have not gained widespread acceptance among consumers and growers. Gene editing technology is different from genetic modification technology in that it can swiftly and precisely alter specific DNA sequences to manipulate traits for crop improvement without introducing transgenic genes from other species or organisms, which may make gene edited (GE) crops much more readily accepted by growers and consumers (Muringai, Fan, and Goddard, 2020).

Given the diverse range of traits, widespread cultivation, and stakeholders' varying perceived risks associated with GM and GE crops, public perceptions of GM and GE crops are a complex yet widely studied issue. Muringai, Fan, and Goddard (2020) conducted a choice experiment to examine Canadian consumers' attitudes toward GM and GE potatoes. Their results suggest that consumers are more accepting of GE potatoes compared to GM potatoes. Consumers are willing to pay a premium for GM or GE crops that provide improved health benefits over environmental benefits. Pruitt, Melton, and Palma (2021) examined whether physical activity can influence consumers' acceptance of GE foods and whether consumers are willing to pay a premium for GE foods relative to GM foods. Although they found no effect of physical activity on consumer acceptance of GE foods, they did find evidence of price premiums for GE foods.

While there is a substantial body of literature on consumer attitudes and willingness to pay, there is limited focus on growers' perspectives. Most studies related to growers investigate the potential benefits GM and GE crops have on their business. For instance, using a dataset for corn, soybeans, and cotton cultivation in the United States, Gardner, Nehring, and Nelson (2009) estimated the labor time savings associated with adopting a GM crop and found significant household labor savings for GM soybean cultivation. Another example is the aforementioned study by Qaim and Kouser (2013). They identified the economic benefit from the cultivation of GM cotton,

particularly increased household income. A meta-analysis of the agronomic and economic impacts of GM crops cultivation by Klümper and Qaim (2014) concluded that, on average, the cultivation of GM crops reduced chemical pesticide usage by 37%, increased crop yields by 22%, and increased farmer profits by 68%. Although there are some studies on growers' acceptance of GM and GE crops, such as Keelan et al. (2009), that examined how grower demographics affect their acceptance of GM crops, there is less attention given to how the beneficial traits of GM and GE crops affect growers' acceptance. We aim to address this gap in knowledge. Additionally, our findings provide implications for policy makers or marketing decision makers on how to promote GM and GE crops. Our findings also shed light on the most important beneficial traits researchers should focus on when improving crops using GM or GE technologies. For example, relevant decision makers can emphasize the beneficial traits when promoting the crops to growers, thereby increasing product adoption. Researchers can focus on improving these traits to better align with growers' needs to increase the growers' willingness to grow such crops.

Survey Design

Our online survey was developed and programmed into Qualtrics software, and Minnesota farmers who completed the survey received a \$10 Visa gift card. We obtained Institutional Review Board approval for our survey. The survey was comprised of questions aimed at understanding participating growers' willingness to grow (WTG) GM and GE crops with different benefits, their familiarities with GM and GE crops, and their attitudes toward the risks and benefits of GM and GE crops. Information about the characteristics of their farms and their demographics was also collected.

To gauge growers' WTG, we asked them to indicate the extent to which they were likely to grow a GM or GE crop with a specific benefit using a 5-point Likert scale, ranging from "very unwilling" to "very willing." Our questions covered seven potential benefits of GM or GE crops: enhanced disease or pest resistance, reduced use of pesticides and herbicides, higher yields, reduced greenhouse gas emissions, healthier crops for consumers, lower production costs, and increased consumer willingness to buy. For each benefit, growers were asked to choose their WTG for GM crops with that benefit and GE crops with that benefit, respectively. For example, when addressing the benefit of enhanced disease or pest resistance, growers were asked to indicate their levels of agreement with the following two statements: "I am willing to grow GM crops if they are more disease or pest resistant" and "I am willing to grow GE crops if they are more disease or pest resistant." We also asked growers to indicate their WTG for GM and GE crops in general (without specifying any benefit), which were used as a control group for model estimation.

Participants were also asked to choose their level of familiarity with GM or GE crops, with response options ranging from "not familiar at all" to "extremely familiar." Growers were asked to provide their opinions on how benefits compared to risks for GM and GE crops, using a 5-point Likert-scale that ranged from "risks strongly outweigh benefits" to "benefits strongly outweigh risks."

Regarding farm characteristics, growers were asked to identify the top five crops cultivated on their farms. In terms of demographics, the survey included questions related to growers' gender, age, education level, race, and income from their farm operations, among other factors.

Model

We employed Ordered Probit Models to assess the impact of the benefits associated with GM and GE crops on growers' WTG. The dependent variable is a discrete variable measuring the extent to which a grower is willing to grow GM or GE crops with specific benefits ("very unwilling" = 0; "somewhat unwilling" = 1; "neither willing nor unwilling" = 2; "somewhat willing" = 3; "very willing" = 4).

In the basic model, the independent variables include four groups. The first group includes the dummy variables of seven benefits, where each dummy variable equals 1 if GM or GE technology enhances the crop in a specific way (e.g., the dummy variable for increased disease or pest resistance = 1 if GM or GE makes the crop more disease or pest resistant; = 0, otherwise). The second group includes grower demographics, and the third group consists of the variables measuring farm characteristics (i.e., the indicators of main crops grown by the grower) and growers' familiarity of GM and GE crops. The fourth group consists of a single dummy variable indicating whether the benefits are from GE crops (= 1, if the benefit is from GE technology; = 0, if the benefit is from GM technology). The last three groups are control variables. Definitions and descriptive statistics for these variables are shown in Table 1 and Table 2.

Table 1. The Meaning of the Indicator Variables Used in Probit Models

Indicator	Meaning of the Indicator
GM	The crop is genetically modified; 1 = yes, 0 otherwise.
GE	The crop is gene edited; 1 = yes, 0 otherwise.
Resistance	GM or GE crops have enhanced disease or pest resistance; 1 = yes, 0 otherwise.
Reducing_pesticide	GM or GE crops have reduced use of pesticides and herbicides; 1 = yes, 0 otherwise.
Higher_yield	GM or GE crops have increased yield; 1 = yes, 0 otherwise.
Reducing_greengas	GM or GE crops have reduced greenhouse emissions; 1 = yes, 0 otherwise.
Healthier	GM or GE crops are healthier to consumers; 1 = yes, 0 otherwise.
Reducing_cost	GM or GE crops have reduced production cost; 1 = yes, 0 otherwise.
Purchase	GM or GE crops have higher consumer willingness to purchase; 1 = yes, 0 otherwise.
No_specified_benefit	GM or GE crops do not specify any specific benefits; 1 = yes, 0 otherwise.

Table 2. Summary Statistics of Variables Used in Probit Models (Sample Size = 111)

	Mean (S.D.)	Percent (in %)
Dependent variable		
WTG (the extent to which the grower is willing to grow the GM or GE crop)	2.33 (1.38)	
1 = Very unwilling		16.89
2 = Somewhat unwilling		10.19
3 = Neither willing nor unwilling		18.41
4 = Somewhat willing		31.64
5 = Very willing		22.86
Demographics		
Male	0.71 (0.45)	
1 = the grower is male		71.17
0 = otherwise		28.83
Age (the age of the grower)	47.42 (12.45)	
Education (the education level of the grower)	2.95 (0.94)	
1 = High school diploma or equivalent		9.91
2 = Some college, but no degree		17.12
3 = College degree		41.44
4 = Graduate degree		31.53
Experience (years of experience as a grower)	13.74 (8.03)	
2.5 = Less than or equal to 5 years		14.41
8 = 6 to 10 years		22.52
13 = 11 to 15 years		27.93
18 = 16 to 20 years		17.12
23 = 21 to 25 years		9.91
28 = 26 to 30 years		1.80
33 = More than 30 years		6.31
Ethnicity	0.15 (0.36)	
1 = the grower is Hispanic or Latino		15.32
0 = otherwise		84.68
White	0.90 (0.30)	
1 = the grower is white		90.09
0 = otherwise		9.91
Income		
Income_low	0.29 (0.45)	
1 = the grower's income from farming is less than \$49,999		28.83
0 = otherwise		71.17

Table 2. (cont)

	Mean (S.D.)	Percent (in %)
Income_middle	0.38 (0.49)	
1 = the grower's income from farming is between \$50,000 and \$249,999		37.84
0 = otherwise		62.16
Income_high	0.33 (0.47)	
1 = the grower's income from farming is higher than \$250,000		33.33
0 = otherwise		66.67
Familiarity with GM or GE crops		
Familiarity (grower's familiarity with the crop)	2.17 (0.99)	
0 = Not familiar at all		4.50
1 = Slightly familiar		20.27
2 = Moderately familiar		37.39
3 = Very familiar		29.73
4 = Extremely familiar		8.11
Indicators of the crops that growers mainly grow		
i_largescale	0.59 (0.49)	
1 = the grower mainly grows large-scale agricultural crops		58.56
0 = otherwise		41.44
i_ornamental	0.29 (0.45)	
1 = the grower mainly grows ornamental crops		28.83
0 = otherwise		71.17
Indicator of grower's attitude towards GM or GE crop		
i_benefit	0.69 (0.46)	
1 = the grower believe that GM (or GE, if the indicator of GM = 0) crops' benefits overweigh their risks		69.37
0 = the grower believe that GM (or GE, if the indicator of GM = 0) crops' risks overweigh their benefits		30.63

In the basic model, let WTG_{ijp} be the dependent variable, indicating the extent to which a grower is willing to grow a GM or GE crop with a specific benefit. $Benefits_{ijp}$ is the vector of benefit indicators. $Controls_{ijp}$ is the vector of control variables (encompassing the last three groups of independent variables). I denotes grower, j represents the type of crop (GM or GE), and p represents the specific benefit (increased disease or pest resistance, reduced pesticide and herbicide use, higher yields, reduced greenhouse gas emissions, healthier for consumers, lower production costs, increased consumer willingness to purchase, or unspecified benefits). Assume that the value of WTG_{ijp} is determined by grower i 's evaluation V_{ijp}^* of crop j with benefit p . The evaluation is

affected by crop’s benefit (**Benefits**_{ijp}), the control variables (**Controls**_{ijp}), and a standard normal distributed error term e_{ijp} . Hence, the evaluation V_{ijp}^* can be defined as, for any i, j and p ,

$$V_{ijp}^* = \alpha' \mathbf{Benefits}_{ijp} + \beta' \mathbf{Controls}_{ijp} + e_{ijp} \tag{1}$$

Then, assume that, for any i, j and p ,

$WTG_{ijp} = 0$ (“Very unwilling”), if $V_{ijp}^* \leq v_0$;

$WTG_{ijp} = 1$ (“Somewhat unwilling”), if $v_0 < V_{ijp}^* \leq v_1$;

$WTG_{ijp} = 2$ (“Neither willing nor unwilling”), if $v_1 < V_{ijp}^* \leq v_2$;

$WTG_{ijp} = 3$ (“Somewhat willing”), if $v_2 < V_{ijp}^* \leq v_3$;

$WTG_{ijp} = 4$ (“Very willing”), if $v_3 < V_{ijp}^*$;

Equations 2–6 define the probability of a growers’ willingness to cultivate a GM or GE crop with a specific benefit at levels 0, 1, 2, 3 and 4.

$$\begin{aligned} \Pr(WTG_{ijp} = 0 \mid \mathbf{Benefits}_{ijp}, \mathbf{Controls}_{ijp}) &= \Pr(V_{ijp}^* \leq \\ v_0 \mid \mathbf{Benefits}_{ijp}, \mathbf{Controls}_{ijp}) &= \Pr(e_{ijp} \leq v_0 - (\alpha' \mathbf{Benefits}_{ijp} + \\ \beta' \mathbf{Controls}_{ijp}) \mid \mathbf{Benefits}_{ijp}, \mathbf{Controls}_{ijp}) &= \Phi[v_0 - (\alpha' \mathbf{Benefits}_{ijp} + \\ \beta' \mathbf{Controls}_{ijp})] \end{aligned} \tag{2}$$

$$\begin{aligned} \Pr(WTG_{ijp} = 1 \mid \mathbf{Benefits}_{ijp}, \mathbf{Controls}_{ijp}) &= \Pr(v_0 < V_{ijp}^* \leq \\ v_1 \mid \mathbf{Benefits}_{ijp}, \mathbf{Controls}_{ijp}) &= \Phi[v_1 - (\alpha' \mathbf{Benefits}_{ijp} + \beta' \mathbf{Controls}_{ijp})] - \\ \Phi[v_0 - (\alpha' \mathbf{Benefits}_{ijp} + \beta' \mathbf{Controls}_{ijp})] \end{aligned} \tag{3}$$

$$\begin{aligned} \Pr(WTG_{ijp} = 2 \mid \mathbf{Benefits}_{ijp}, \mathbf{Controls}_{ijp}) &= \Pr(v_1 < V_{ijp}^* \leq \\ v_2 \mid \mathbf{Benefits}_{ijp}, \mathbf{Controls}_{ijp}) &= \Phi[v_2 - (\alpha' \mathbf{Benefits}_{ijp} + \beta' \mathbf{Controls}_{ijp})] - \\ \Phi[v_1 - (\alpha' \mathbf{Benefits}_{ijp} + \beta' \mathbf{Controls}_{ijp})] \end{aligned} \tag{4}$$

$$\begin{aligned} \Pr(WTG_{ijp} = 3 \mid \mathbf{Benefits}_{ijp}, \mathbf{Controls}_{ijp}) &= \Pr(v_2 < V_{ijp}^* \leq \\ v_3 \mid \mathbf{Benefits}_{ijp}, \mathbf{Controls}_{ijp}) &= \Phi[v_3 - (\alpha' \mathbf{Benefits}_{ijp} + \beta' \mathbf{Controls}_{ijp})] - \\ \Phi[v_2 - (\alpha' \mathbf{Benefits}_{ijp} + \beta' \mathbf{Controls}_{ijp})] \end{aligned} \tag{5}$$

$$\begin{aligned} \Pr(WTG_{ijp} = 4 \mid \mathbf{Benefits}_{ijp}, \mathbf{Controls}_{ijp}) &= \Pr(v_3 < V_{ijp}^* \mid \mathbf{Benefits}_{ijp}, \mathbf{Controls}_{ijp}) = \\ 1 - \Phi[v_3 - (\alpha' \mathbf{Benefits}_{ijp} + \beta' \mathbf{Controls}_{ijp})] \end{aligned} \tag{6}$$

In the equations, $\Phi(\cdot)$ denotes the cumulative distribution function (CDF) for standard normal distribution. Additional details for Ordered Probit Models can be found in Chapter 26.10 of Hansen (2022).

With equations (2)–(6), the log-likelihood function of the Ordered Probit Model can be written as equation (7).

$$\log L(\alpha; \beta) = \sum_{i=1}^n \sum_{j=1}^2 \sum_{p=0}^7 \sum_{x=0}^4 \mathbf{1}\{WTG_{ijp} = x\} \log [Pr(WTG_{ijp} = x | \mathbf{Benefits}_{ijp}, \mathbf{Controls}_{ij})] \tag{7}$$

In equation (7), $\mathbf{1}\{WTG_{ijp} = x\}$ equals 1 when $WTG_{ijp} = x$; otherwise, it equals 0.

By the Maximum Likelihood Estimation, we can get the Ordered Probit estimates $(\hat{\alpha}; \hat{\beta})$ satisfying

$$(\hat{\alpha}; \hat{\beta}) = \operatorname{argmax}\{\log L(\alpha; \beta)\} \tag{8}$$

$\hat{\alpha}$ is a vector of the estimated coefficients of benefit indicators and $\hat{\beta}$ is the vector of the estimated coefficients for control variables.

In addition to the basic model, we conducted estimations using two other Ordered Probit Models. First, we added interactions between each of the eight benefit indicators and an attitude indicator reflecting whether the grower believes GM or GE crops' benefits outweigh risks. These interactions aim to assess whether the effects of benefits from GM or GE technology on growers' WTG change based on their attitudes toward GM or GE technologies. Second, we added interactions between demographics and the attitude indicator into the model.

Results and Discussion

Comparison between Sampled Growers' Demographics and Census Data

In total, 111 growers completed all the questions used in this study. The summary statistics of our grower sample are shown in Table 1. The sample used in this study is a subsample of the study of Abbey et al. (2024). Several observations were dropped due to incomplete answers to the questions of interest in this research. Our sample's gender distribution closely mirrors the census data (US Department of Agriculture, 2019), with approximately 71% of participants who were male compared to approximately 70% in the census data. The growers in our sample tended to be relatively younger, with an average age of 47 years old, compared to the census data, which averages 57 years old. When considering years of farm operation experience, our sample showed 14% with 0–5 years, 23% with 6–10 years, and 63% with 11 or more years of experience. On the other hand, the census data reports 11% with 0–5 years, 10% with 6–10 years, and 79% with 11 or more years of experience. But the median years of experience of our sample is the same as the census data (both have 11 or more years of experience). Our sample included a higher percentage of growers with Hispanic, Latino, and Spanish origins (15%) compared to those in the census data

(0.5%). Our sample had a lower percentage of White growers (90%) compared to those in the census data (99%). Furthermore, our sample had slightly higher income compared to those in the census data. Given these differences, the extrapolation of our findings to the whole population of Minnesota growers or growers in other states or regions should be done with caution.

Growers' Familiarities with GM and GE Crops

Table 3 presents the distributions of participants' familiarities with GM and GE crops. For both GM and GE crops, the largest share corresponds to the option "moderately familiar" (42.34% and 32.43% for GM and GE, respectively). Compared to GE crops, participants exhibited greater familiarity with GM crops, as evidenced by the larger share of participants who selected "very familiar" (34.23%) and "extremely familiar" (10.81%) for GM crops. The difference may be attributed to the longer history of GM crops.

Table 3. Growers' Familiarities with GM and GE Crops (Sample Size = 111)

Familiarity	GM Crops (in %)	GE Crops (in %)
Not familiar at all	0.90	8.11
Slightly familiar	11.71	28.83
Moderately familiar	42.34	32.43
Very familiar	34.23	25.23
Extremely familiar	10.81	5.41

Growers' Attitudes toward the Risks and Benefits of GM and GE Crops

Table 4 displays the distributions of participants' responses regarding how benefits are compared to risks for GM and GE crops. Notably, 18.92% of participants believe that GE crops' benefits strongly outweigh risks, while only 10.81% of participants think that GE crops' risks strongly outweigh benefits. This finding suggests a greater receptiveness among growers toward GE crops. However, for GM crops, 19.82% of participants believe that benefits and risks are about the same, while only 14.41% participants hold this view for GE crops. Additionally, compared to GM crops, more participants think that GE crops' risks somewhat outweigh benefits. Nevertheless, these results alone do not conclusively indicate a higher level of acceptance for GE crops among growers.

Table 4. Growers' Attitudes toward the Risks and Benefits of GM and GE Crops (Sample Size = 111)

	GM Crops (in %)	GE Crops (in %)
Risks strongly outweighs benefits	17.12	10.81
Risks somewhat outweighs benefits	11.71	21.62
Benefits and risks are about the same	19.82	14.41
Benefits somewhat outweigh risks	34.23	34.23
Benefits strongly outweigh risks	17.12	18.92

The Impact of GM or GE Benefits on Growers' WTG: The Role of Growers' Attitudes

Table 5 presents the results of three Ordered Probit Models. The first (Column 1) includes the benefit indicators and control variables. The second (Column 2) is the Ordered Probit Model with the interactions of the attitude indicator and benefit indicators. Compared to the second model, the third model (Column 3) includes additional interactions of the attitude indicator and demographic variables.

Table 5. The Impact of Benefits on Growers' WTG of GM or GE Crops: The Role of Growers' Attitudes (Sample Size = 111)

Variable	(1) Ordered Probit Model	(2) Ordered Probit Model with Interactions for Benefit Indicators	(3) Ordered Probit Model with Interactions for Benefit Indicators and Demographics
Resistance	0.036 (0.102)	-0.135 (0.191)	-0.146 (0.193)
Reducing_pesticide	0.075 (0.101)	0.017 (0.189)	0.016 (0.191)
Higher_yield	0.051 (0.102)	-0.097 (0.191)	-0.107 (0.193)
Reducing_greengas	-0.030 (0.101)	0.205 (0.188)	0.216 (0.190)
Healthier	0.174* (0.101)	0.352* (0.188)	0.380** (0.190)
Reducing_cost	0.085 (0.102)	-0.085 (0.191)	-0.093 (0.193)
Purchase	0.074 (0.101)	0.123 (0.188)	0.126 (0.190)
Resistance*ibene		1.472*** (0.165)	1.003** (0.447)
Reducing_pesticide*ibene		1.326*** (0.163)	0.846* (0.446)
Higher_yield*ibene		1.444*** (0.165)	0.972** (0.447)
Reducing_greengas*ibene		0.898*** (0.160)	0.397 (0.446)
Healthier*ibene		1.005*** (0.161)	0.498 (0.445)
Reducing_cost*ibene		1.484*** (0.165)	1.013** (0.448)
Purchase*ibene		1.178*** (0.161)	0.695 (0.446)

Table 5. (cont)

Variable	(1) Ordered Probit Model	(2) Ordered Probit Model with Interactions for Benefit Indicators	(3) Ordered Probit Model with Interactions for Benefit Indicators and Demographics
No_specified_benefit*ibene		1.228*** (0.163)	0.741* (0.447)
Male	0.269*** (0.064)	-0.089 (0.068)	0.098 (0.117)
Age	-0.012*** (0.003)	-0.010*** (0.003)	-0.005 (0.005)
Education	0.100*** (0.032)	0.078** (0.033)	0.087 (0.064)
Experience	0.008* (0.005)	0.006 (0.005)	-0.032*** (0.007)
Ethnicity	0.464*** (0.083)	0.381*** (0.084)	-0.340 (0.248)
White	0.041 (0.095)	-0.044 (0.096)	-0.413* (0.220)
Income_middle	0.374*** (0.076)	0.410*** (0.077)	0.124 (0.127)
Income_high	0.409*** (0.093)	0.535*** (0.095)	1.243*** (0.165)
Male*ibene			-0.314** (0.149)
Age*ibene			-0.012* (0.006)
Education*ibene			-0.003 (0.074)
Experience*ibene			0.066*** (0.009)
Ethnicity*ibene			0.994*** (0.265)
White*ibene			0.503** (0.245)
Income_middle*ibene			0.435** (0.169)
Income_high*ibene			-0.789*** (0.181)
Familiarity	0.034 (0.029)	0.046 (0.030)	0.080*** (0.030)
i_largescale	0.138** (0.069)	-0.122* (0.072)	-0.329*** (0.081)
i_ornamental	0.219*** (0.066)	0.205*** (0.067)	0.245*** (0.069)

Table 5. (cont)

Variable	(1) Ordered Probit Model	(2) Ordered Probit Model with Interactions for Benefit Indicators	(3) Ordered Probit Model with Interactions for Benefit Indicators and Demographics
GM	-0.039 (0.053)	-0.100* (0.054)	-0.103* (0.054)
v_0	-0.388* (0.201)	-0.109 (0.230)	-0.562 (0.397)
v_1	0.002 (0.200)	0.371 (0.230)	-0.052 (0.396)
v_2	0.548*** (0.200)	1.006*** (0.230)	0.617 (0.396)
v_3	1.461*** (0.202)	2.006*** (0.233)	1.662*** (0.398)
Log likelihood	-2621.3981	-2428.7787	-2359.7759

Note: Standard errors in parentheses (** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Based on our likelihood ratio test results (see Table A in the Appendix), the third model has the best goodness of fit. In Column 3 of Table 5, most coefficients of benefit indicators are not statistically significant, except for “healthier for consumers.” This suggests that, for participants who believe that GM or GE crops’ risks outweigh the benefits (hereafter referred to as “risk growers”), the benefits of GM or GE crops are insufficient to increase their WTG. However, five out of eight coefficients of the interaction terms for benefits indicators (including enhanced disease or pest resistance, reduced pesticide and herbicide use, higher yields, lower production costs, and no specified benefit) are positive and statistically significant. This finding implies that, compared to “risk growers,” participants who believe that GM or GE crops’ benefits outweigh the risks (hereafter referred to as “benefit growers”) are more likely to grow GM or GE crops and are more easily to be attracted by the associated benefits. The second model reveals similar conclusions.

When considering the demographic variables in the third model, it becomes apparent that “risk growers” with more farming experience who are White are significantly associated with a lower WTG GM or GE crops. Besides, “risk growers” with high income levels are more likely to adopt GM or GE crops. The results of the interaction terms for demographics suggest that, compared to the “risk growers,” “benefit growers” are more inclined to adopt a GM or GE crop when they have more farming experience, are Hispanic or Latino, White, or have middle-level income; whereas, when they are a male and older, or have high-level income, “benefit growers” are less likely to adopt GM or GE crops.

Familiarity with GM or GE crops has a significantly positive coefficient in Column 3, indicating that participants who are more familiar with GM or GE crops are more willing to grow them. Both

indicators for participants' main crops have significant coefficients, suggesting that participants' WTG and attitudes toward GM and GE crops are affected by their primary crops. The coefficient for the indicator of large-scale agricultural crops (e.g., corn, soybeans, wheat, oilseeds, etc.) is significantly negative, which indicates that growers primarily involved in growing large-scale agricultural crops are less inclined to adopt GM or GE crops. Conversely, the coefficient for the indicator of ornamental crops is significantly positive, likely because ornamental crops are not typically used for foods, and growers may believe GM or GE ornamental crops are more easily acceptable to consumers. Therefore, participants are more willing to grow GM or GE ornamental crops. Besides, the indicator of GM has a negative significant coefficient, indicating participants are more willing to grow GE crops compared to GM crops, possibly due to the perception that GE crops are more natural or healthier than GM crops.

Conclusions

To understand how GM or GE crops' benefits impact growers' WTG, we conducted a survey with growers in Minnesota, with 111 growers participating. We employed ordered Probit Models on the survey data, leading to several key findings. First, compared to GE crops, growers are more familiar with GM crops. Second, growers who believe that GM or GE crops' risks outweigh the benefits can still be attracted by the "healthier for consumers" benefit. Third, compared to growers who believe that GM or GE crops' risks outweigh the benefits, growers who believe that the benefits outweigh the risks are more likely to grow GM or GE crops. They are particularly drawn to the benefits of enhanced disease or pest resistance, reduced pesticides and herbicides used, higher yield, and lower production cost offered by the GM or GE technology.

We can draw several implications from our findings. First, the growers' varying levels of familiarity with GM and GE crops suggest a need for targeted education initiatives to enhance understanding of these technologies. Efforts should focus on providing comprehensive information about the differences between GM and GE crops and their potential benefits and risks to ensure that growers are well-informed when making decisions about crop selection and adoption. Second, growers prioritize factors that directly impact yield and production costs. This finding suggests that initiatives promoting the economic advantages of GM or GE technology, such as potential savings on inputs and increased profitability, may be effective in encouraging adoption among growers. The emphasis on benefits such as reduced pesticide and herbicide usage indicates growers' recognition of the potential environmental benefits associated with GM or GE crops. It underscores the importance of promoting the environmental sustainability aspects of GM or GE technology, such as reduced chemical inputs and conservation of natural resources, to align with growers' priorities and promote adoption. Policy makers and GM and GE marketers can leverage public information platforms, such as social media, to effectively communicate the appealing benefits of GM and GE crops to growers. Lastly, growers' responsiveness to the benefits offered by GM or GE technology reflects a willingness to embrace agricultural innovation to address their challenges. It suggests opportunities for further research and development in biotechnology to continue delivering solutions that meet the evolving needs of growers. Researchers can work on improving the GM or GE crops' benefits that matter most to growers to increase the adoption rate and success of GM and GE crops.

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Appendix

Table A. Likelihood Ratio Test for three Ordered Probit Models

Assumption	Likelihood Ratio Test Statistics	P-value
“Ordered probit model” nested in “ordered probit model with interactions for benefit indicators”	385.24	< 0.001
“Ordered probit model” nested in “ordered probit model with interactions for benefit indicators and demographics”	523.24	< 0.001
“Ordered probit model with interactions for benefit indicators” nested in “ordered probit model with interactions for benefit indicators and demographics”	138.01	< 0.001