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Teaching and Educational Commentary

Agribusiness Study Abroad Programs and Their Potential for Fostering a More Inclusive Climate

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JEL Codes: A22, Q10, Q13
Keywords: Agribusiness, cultural competence, diversity, inclusivity, study abroad

Abstract
Study abroad programs can make meaningful contributions to undergraduate agribusiness education and can be designed and executed to effectively contribute to a campus and departmental culture of diversity, equity, and inclusion (DEI). To be most effective in furthering goals of inclusive excellence, program faculty should understand the unique challenges and opportunities associated with agribusiness-focused study abroad programs and common barriers to participation of underrepresented minority (URM) students. This article describes the experience of faculty and staff during the program design, scholarship fundraising, and student recruitment for an "Agribusiness in Mexico" program at California Polytechnic State University (Cal Poly). This case shows how insights and evidence from the literature on inclusivity in study abroad programs relate to the needs of agribusiness industry employers for improved cultural and linguistic competency among their workforces. The article offers specific conclusions and recommendations for program development related to location and topic of study, securing industry involvement and financial support for the program, and establishing scholarship and program timelines that minimize barriers for students with financial need.

1. Introduction

Attracting diverse student populations and developing a culture of inclusive excellence are priorities of many agribusiness and agricultural economics programs, as well as the colleges in which they reside. To be successful in diversity and inclusivity efforts, it is important to expand our focus beyond broad, objective diversity metrics, such as the demographics of the student body and disparities in time-to-degree-completion for different student segments. In addition to these measures, college and departmental leadership and faculty should be making efforts to ensure that all students are represented, feel valued, and have access to the extra and co-curricular activities that have been shown to significantly impact educational outcomes and students' personal and professional development (Sweeney 2013).

Study abroad programs are widely recognized as high-impact educational experiences and have gained popularity because of the personal and professional value that they provide students (Vernon, Moos, and Loncarich 2017). While there are some examples of successful study abroad programs that focus on agribusiness management in an international context (e.g. Ames and Houston 2001; Gibson et al. 2012; Beseli et al. 2016), agribusiness and agricultural economics are not common topic areas of study abroad programs at U.S. universities. Given the continuing trends of internationalization in the agriculture industry, there is strong potential for study abroad programs to make meaningful contributions to agribusiness programs at the undergraduate level, and agribusiness faculty have an opportunity to design these programs in a way that also furthers university and departmental goals of inclusive excellence. In this context, it is important that educators and administrators that are working toward greater inclusivity in agribusiness education understand the unique opportunities and challenges involved with study abroad programs.

This short article describes the efforts and lessons learned by faculty and staff at California Polytechnic State University (Cal Poly) in San Luis Obispo, CA, during the development of the "Agribusiness in Mexico" faculty-led study abroad program. The Agribusiness Department at Cal Poly, like many others across the country, provides undergraduate students with a curriculum and co-curricular programming that is industry-relevant and creates value for both students and industry employers. In the context of California agriculture, this increasingly requires exposure to international business operations, particularly food and agriculture production and distribution operations in Latin America. This case highlights the intersection between insights from the literature on inclusivity in study abroad programming and calls from industry stakeholders for stronger cultural and linguistic skills among agribusiness graduates. By creating study abroad programming with greater diversity, equity, and inclusion (DEI) as an explicit goal, objectives related to both DEI and industry relevance can be achieved.

2. The Agribusiness in Mexico Faculty-Led Study Abroad Program

As with many of the agribusiness-focused international programs across the country, Cal Poly's Agribusiness in Mexico program was developed in response to the growing internationalization of the agriculture industry and the calls to better educate students in international agribusiness operations (Wolf and Schaffner 2000; Gillespie and Bampasidou 2018; Urban, Navarro, and Borron 2018). These trends of internationalization are particularly strong in the specialty crops sector, and with respect to integration of the agricultural supply chains of the United States and Mexico. From 2008 to 2020, the share of U.S. consumption that comes from imports has increased from 26 percent to 43 percent in the case of vegetables and melons, and from 36 percent to 51 percent in the case of fruits and tree nuts (U.S. Department of Agriculture, Economic Research Service 2022). Canales, Andrango, and Williams (2019) shows that imports of specialty crops from Mexico to the United States have seen tremendous growth in the past 20 years, as has foreign direct investment in Mexico's agricultural sector. Avocados and berries have been key areas of growth in imports from Mexico (Canales et al. 2019), both of which are dominated in the United States by California-based firms that are major employers of Cal Poly agribusiness graduates.

The Cal Poly Agribusiness in Mexico program was designed as an 8-week faculty-led program during the summer term, to be based in Santiago de Querétaro, Mexico. Students were to take a Spanish course, taught by local instructors at a partner institution, along with courses in global agribusiness logistics and the world food economy taught by the Cal Poly faculty leader. A key focus of the program was the opportunity for close interaction between students and leading agricultural firms from California that have major operations in Mexico. As a UNESCO world heritage site known for its beautiful historic central city and low crime rate, Santiago de Querétaro provided easy access to production and processing facilities of the industry partners and is also an attractive place to live and learn more about Mexico and its people. The intent of the program was not only to provide Cal Poly students with exposure to the Latin American operations of California-based agricultural firms, but also to help students develop the linguistic and cross-cultural skills that these firms increasingly seek in employees. An early focus during the development of the Agribusiness in Mexico program was fundraising for student scholarships. Industry support was strong, and more than $35,000 was raised from partner firms to fund scholarships for students with high financial need.

The first Agribusiness in Mexico trip was scheduled for an 8-week period from late June to mid-August 2020. An inaugural student cohort of 13 students was successfully recruited in late 2019 and early 2020 through a combination of classroom visits by the program leader, participation in a study abroad fair, and promotion through the campus study abroad office. Although recruitment went well and student targets were met, all university-sponsored international programs were canceled in March 2020 in response to the COVID-19 pandemic. Given the continuing uncertainty regarding COVID-19,

recruitment was not attempted in 2021. Recruitment for the Agribusiness in Mexico 2022 program was attempted in late 2019 and early 2022, but the program was ultimately cancelled due to low student enrollment, which was in part driven by continuing COVID-19 restrictions and safety concerns. While some of Cal Poly's study abroad programs did take place in spring and summer of 2022, student applications were down overall relative to pre-pandemic numbers. Despite the disappointing outcome for this program in 2020 and 2022, the several years of program development and student recruitment and feedback has led to some important lessons for the role that study abroad programs can play in DEI efforts in agribusiness and agricultural economics programs in the United States.

3. Minority Students Come to These Programs from a Position of Strength

Perhaps the most notable observation from several years spent discussing the Agribusiness in Mexico program with students is that the program seemed to resonate strongly with Latino/a students. DEI was not a primary focus of this program when development began in 2018, but a disproportionate number of Latino/a students responded with enthusiasm and great interest when introduced to the program through presentations to their classes or other occasions. In many cases, students that had been rather quiet and reserved in class became more animated and excited in discussions about studying abroad in Mexico. The program's messaging emphasized the value of linguistic and cultural competency skills in the agribusiness industry and this served to communicate that the department and university valued the contributions and skills that many of these students bring to the table from their personal lives. Unfortunately, students from immigrant families, or who are the first in their families to attend college, often feel like they are coming from outside of the dominant culture of the institution. In this context, the foundational premise of the Agribusiness in Mexico program, that some of the largest agricultural firms in the state seek managers that can work across cultures, languages, and borders, must seem particularly affirming.

Indeed, underrepresented minority (URM) students that are used to navigating across cultures, and particularly heritage language learners in their heritage language-speaking country, come to programs like the Agribusiness in Mexico program from a position of strength. The literature on study abroad education has found that students with existing cross-cultural skills often become leaders in the context of international travel (Marijuan and Sanz 2018), and may find program activities and industry engagement during the trip more meaningful (Davidson and Lekic 2013).

Communicating the value of linguistic and cultural skills to students can have significant impacts on the perceived inclusiveness of an academic program, thus furthering stated DEI goals. While there is no firm evidence that the existence and promotion of the Agribusiness in Mexico study abroad program improves the attractiveness of the Agribusiness Management major among URM students, it is clear that URM students, and Latino/a students in particular, are disproportionally drawn to this study abroad program. In Fall 2021, 19 percent of the Cal Poly student body identified as Hispanic or Latino/a, and 53 percent identified as White. Consistent with national trends, White students are overrepresented in Cal Poly study abroad programs, making up 68 percent of all participating students in the 2018/2019 academic year. In the same year, Hispanic or Latino/a students made up only 8 percent of study abroad students. In contrast, more than half (56 percent) of the applicants to the Agribusiness in Mexico program in 2020 and 2022 were Latino/a and only 39 percent were White.

4. There Are Barriers to Success, and Departments and Universities Need to Be Committed to DEI Goals

Although there appears to be strong potential for industry and career-focused study abroad programs to further the internationalization and inclusivity goals of agribusiness and agricultural economics programs, there are also barriers to success. The challenges discussed in this section were identified through conversations with students and campus international programs staff over several years of program development and recruitment, along with written feedback solicited from students that applied to the program in 2020 and 2022.

First, the direct and indirect costs of participation in an 8-week faculty-led study abroad program in the summer are significant[1] and are often cited as a barrier to participation. While students of all demographic groups cite the cost of the Agribusiness in Mexico program as a challenge, low-income students are most likely to be discouraged from attending because of financial constraints. The feedback from students interested in the Agribusiness in Mexico program is consistent with the literature on barriers to study abroad participation generally, which shows that cost is the most significant barrier to international study (Whatley and Raby 2020), and that minoritized students likely face the strongest financial challenges (Taylor and Turk 2019). Moreover, given that much of the appeal of the Agribusiness in Mexico program is the promise of industry interaction and career-relevant courses on international food and agricultural supply chains, the students that are attracted to this program are likely among the most driven to pursue summer internships or other paid industry work, which increases the opportunity cost of program participation. For many students, the relevance of the courses and ability to use the summer program to speed their time to degree completion was a strong selling point, although that limits appeal somewhat to students majoring or minoring in Agribusiness Management that need these courses to satisfy degree requirements.

Second, while the location of Cal Poly's Agribusiness in Mexico program (Querétaro, Mexico) is often cited as a positive program attribute by students with a family connection to Mexico, it also seems to be considered less attractive than other study abroad options by many students. It has been frequently observed in the study abroad literature that European destinations are preferred by many students (Garver and Divine 2007) and receive more study abroad students from the United States than all other regions combined (Institute of International Education 2022). Although industry-relevant international programs may be attractive to agribusiness students, and URM students in particular, the locations of these programs may limit their broader appeal. This could be problematic if the financial viability of the program is dependent on high enrollment numbers.

A third barrier to success for career-focused study abroad trips designed with URM students in mind is that recruitment may be more challenging and labor intensive than for more traditional study abroad programs. Simon and Ainsworth (2012) explain that some of the racial and class disparity in study abroad participation can be explained by a lack of familiarity and comfort with the study abroad process within the students' social and family networks. Indeed, recruitment for the Agribusiness in Mexico program appeared to be more time consuming than for other programs at Cal Poly, with more individual conversations with interested students before an application was submitted. This might have been due to a higher number of prospective program participants that had little existing knowledge of the study abroad process or fewer people within their networks of friends and family that have themselves participated in a study abroad experience. It might also have to do with the fact that the program did not have an established history on campus, and there were no past student participants available to share information. In any event, to ensure that these programs are truly accessible to students that do not have the guidance and financial resources of parents and other mentors with their

[1] The program fee for the 8-week Agribusiness in Mexico program, including room and board, group travel while in country, and tuition for three courses, was projected at roughly $8,500 in 2022.

own college study abroad experiences, international program staff and faculty leaders must be willing and able to provide greater levels of predeparture support.

5. Suggestions for Successfully Developing and Executing an Inclusive Study Abroad Program

We learned several lessons over the course of developing and recruiting students for Cal Poly's Agribusiness in Mexico program that may help other faculty develop inclusive, industry-relevant study abroad experiences. First, if interested in making study abroad programs inclusive and more representative of campus demographics, program leaders should focus on designing programs to address the needs of URM students rather than relying on targeting them with promotion of existing programs. In terms of the four "Ps" of marketing, too much emphasis is often placed on "promotion" of study abroad experiences rather than design of the "product." The experience at Cal Poly illustrates the importance of program design. Despite the fact that no special effort was made to promote the Agribusiness in Mexico program to Latino/a students, the program received many more applications from this group than most other programs on campus, suggesting that the program addressed an unmet demand.

Designing a study abroad program for inclusivity might involve reconsidering the timing of the program to accommodate the needs of students with fewer financial resources. Cal Poly's Agribusiness in Mexico was planned for the summer term, originally for the sake of convenience for the faculty leader and ease of scheduling. It became apparent during recruitment efforts that this was a mistake, and that students who cite cost as a primary barrier to participation also seem to be more likely to prioritize work during the summer months. Moving a program to the spring or the fall could potentially increase the number of URM students that are able to participate. This is an area that should be explored further on a case-by-case basis given the potential impact on time-to-degree completion.

The second lesson learned relates to successful fundraising from industry sponsors. When initially approaching industry connections for support, program leaders should be able to articulate a clear vision for how the partner firm can help the program in a nonfinancial way. In the case of Agribusiness in Mexico, we asked firms, most of which had existing relationships with Cal Poly's Agribusiness Department, if they would be willing to host students for a tour of their Mexican facilities or engage with students on projects related to the structure of the firm's North American supply chains. This in-country industry interaction was critical to the design and educational mission of the program, but it was also central to attracting prospective students and showing that the program was relevant to their career. Moreover, once firms had already considered interacting with students on the trip, they were much more receptive to subsequent requests for student scholarship funding. This industry support seemed to build on itself when industry leaders heard that others in the industry were planning on hosting students and/or providing scholarships funds.

Third, while the direct support for students with financial need is important, the scholarship system should be designed in a way that reduces the risk and uncertainty involved in the students' decisions to participate in the program. In the case of the Agribusiness in Mexico program, the faculty leader and international programs staff did not determine scholarship awardees until the final program applications were due, mostly for the sake of administrative convenience. While this system was easy to manage, it did not provide students with clarity on their cost of participation while discussing the program with their families and considering other options for the summer. As a result, some students that would have been top candidates for financial support may have been discouraged from moving beyond the initial stages of information gathering. If administratively possible, it would be preferrable to have an early scholarship application and award process, allowing students to consider programs with

full information about costs, similar to the example provided by Tolan and McCullers (2018).[2] If such a scholarship system were adopted, it would have the secondary benefit of providing program leaders with more information on the number of applicants with financial need, which could help in raising additional funds from industry sponsors.

The final suggestion is that program leaders should make efforts to demonstrate to URM students that they are likely in a strong position to benefit both personally and professionally from study abroad programs. While faculty leaders can communicate this to students, it may be more convincing when these messages come from their peers that have already participated in study abroad experiences (Tolan and McCullers 2018). If past program participants are not available, as will necessarily be the case with new programs, recent graduates working in international agribusiness roles may be able to speak in general terms about the value of international experience and cultural competence. It is particularly important that these "ambassadors" are able to relate to URM students through shared experience or a shared cultural background so that all prospective participants feel that they are welcome, and that the program is designed with their personal and professional well-being and growth in mind.

6. Conclusion

The goal of this article is to share the experiences from the development of a study abroad program focused on the international agribusiness industry and located in Central Mexico. While aspects of this process have been challenging, this program and programs like it have the potential to further curricular goals related to the internationalization of agriculture, and also the DEI goals of agribusiness and agricultural economics departments. The article advocates for the design of agribusiness study abroad programs with an intentional focus on accessibility of programs for student populations that are typically underrepresented in many undergraduate programs in agribusiness management, and in study abroad programs generally. The key insight is that many of the design decisions involved in the development of an international study abroad program, including location, topical focus, and approach to program marketing and recruitment, can create an environment that is more welcoming and attractive to URM students.

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[2] The University of Texas–Austin has a program in which first-generation college students are eligible for a $3,000 award that can be used toward any of the university's approved study abroad programs. The award is granted after the student's first semester on campus and can be used at any point during their time at the university.

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Research Article

Awareness and Usage of Extension and Outreach Programs

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Abstract
Extension takes many forms, with a common thread to provide scientific information to a diverse audience on a variety of topics. This research examines awareness and use of Extension-related information from different entities (e.g., state Departments of Agriculture, private businesses, and other public entities), overall experience with Extension output from different entities, and use of different types of Cooperative Extension programming (e.g., youth development, food safety, and animal production). Using data from a 2021 survey of around 4,000 U.S. residents, most respondents were aware of or used information from a variety of sources and were not limited to their own state Extension and outreach sources. Depending on the program area, around 30–40 percent of respondents were interested but not using or attending Extension or outreach programming. Several demographic factors were associated with higher or lower awareness and use including age, race, gender, political affiliation, urbanicity, and connection to agriculture. Respondents found information and Extension agents to be somewhat reliable to extremely reliable. Finding ways to motivate

1 Introduction

Cooperative Extension (Extension) and other university outreach programs have had a long history of bringing academic research to the local communities they serve. Extension began with a focus on agriculture and rural communities in 1914. When Extension was founded, more than 60 percent of the population in the United States lived in rural areas, and 40 percent were engaged in some form of agriculture (Lusk 2016). In the first 5 years after its formal founding, Extension helped the U.S. war effort during World War I. During this time, Extension supported shifts in acreage, encouraged food preservation and processing, and helped farmers at home address labor shortages due to the draft (U.S. Department of Agriculture, National Institute of Food and Agriculture 2014). Today, Extension serves both rural and urban communities, as only about 2 percent of the population is actively involved in farming today (U.S. Department of Agriculture, Economic Research Service 2021), and approximately 85 percent of the population lives in urban areas (Dobis et al. 2021). Extension offers programs on childhood development; gardening; 4-H; science, technology, engineering, and math (STEM); and much more, in addition to the traditional agriculture Extension services.

With the shift from a traditionally rural audience to an audience across the entire urban-rural spectrum, there may be opportunities for increased awareness of and impact from Extension programming. This study investigates respondent awareness and use of Extension programs and other outreach services. In particular, how aware are people of Extension and other Extension information providers (e.g., state Departments of Agriculture, private businesses, etc.), how many have used Extension or other outreach services, or attended Extension or other outreach programs, and what are the potential factors that drive this awareness and use? A nationwide survey was conducted that assessed general residents' awareness and use of Extension and outreach services through various providers (e.g., in-state universities, out-of-state Departments of Agriculture, and industry associations) and across different topic areas (e.g., crop production, animal production, youth development, etc.).

A multinomial logit (MNL) regression is used to assess the importance of different sociodemographic drivers of awareness and use. The results suggest several sociodemographic factors are important in assessing awareness and use of different entities' Extension and other outreach efforts that include age, race, political affiliation, education, and income. The impacts are relatively consistent (i.e., have the same sign) across different entities. By program area, awareness, interest, and use are affected by location within the United States, age, gender, education, household income, and other factors. Again, the results are relatively consistent across program areas. These results suggest that there are different segments of the public that Extension and other information providers can target to reach a broader audience. For instance, rural respondents, younger (Millennial and younger), and households with higher incomes are more likely not to be aware of Cooperative Extension in their state (or more likely to be aware and use). Given this, opportunities exist to increase awareness to these groups as they have a higher probability of using Cooperative Extension if they are aware.

2 Background

The Morrill Act of 1862 enabled the establishment of a group of postsecondary institutions focusing on the education of the public in the "agriculture and mechanical arts" (Croft 2019). It was followed by a second act, the Morrill Act of 1890, that further secured financial support for these institutions, as well as creating 19 historically black college and university land-grant institutions. More than 100 years later, the Equity in Educational Land Grant Status Act of 1994 rounded out the legislation concerning land-grant universities by bringing 36 tribal colleges and universities into the land-grant system. These groups are often referred to as 1862, 1890, and 1994 institutions, respectively. All three waves of land-grant institutions are tied to the three-fold land-grant mission: teaching of students within the university, research to further our collective understanding, especially in the realms of agriculture and engineering, and outreach to the general public to bring the knowledge gained in research out for use by the public (Croft 2019).

While the land-grant acts of 1862, 1890, and 1994 established a place for education of students and research, there was a need for more research dissemination among the general population, especially those involved with agriculture. Thus, the Hatch Act of 1887 established the funding and organization of agricultural experiment stations, with the main directive to help diffuse new research findings to the public and look into areas of research relevant to the general agriculture community (Croft 2019). These agricultural research stations prompted a wave of legislation in regard to the organization of land-grant institutions. The Smith and Lever Act of 1914 further ensured the mission of extension of research to the general public in the land-grant mission through a combination of federal, state, and local funding and formally established the Extension system currently used today. It should be noted that the two above acts excluded 1890 and 1994 institutions from funding. This was remedied by the Evans-Allen Act in 1997, which established funding for the 1890 schools, and the Agricultural Research Extension, and Education Reform Act (AREERA) of 1998, which provided funding for 1994 institutions (Croft 2019).

Several studies have attempted to determine the impact of Extension, but passing of program informational content to nonparticipants via word of mouth or other unobserved means makes it difficult to fully quantify the impacts (see Israel 1992 for sampling methods). Studies often focused on only one part of the Extension service such as the impact of youth programs (Edwin, McKinley, and Talbert 2010), the impact of Extension on lifelong learning (Van Tilburg 1989), or one specific area, such as social impacts (Borron et al. 2019).

Warner et al. (1996) provides some insight into public perception of Extension and its programs. The authors conducted a telephone survey in 1982 and 1995 asking potential Extension users their awareness and use of Extension programs, in an attempt to track the impact of Extension more fully. The combined awareness of Extension overall decreased by 2 percent between 1982 and 1995, with the

largest area of decreased awareness in community development and 4-H, both an 8 percent decrease over the study time periods. Twenty-six percent of the sample in both 1982 and 1995 indicated that they had used Extension services at some point. However, the percentage who used Extension programs dropped by a third, from 12 to 8 percent, between 1982 and 1995. The greatest geographical area of usage was the Midwest and Southern regions, while demographically those living on farms and those with higher incomes and educational levels used Extension programming more often. The lowest level of usage demographically were people living in cities, young people, and those with lower incomes and educational levels. These usage trends carried over between both rounds of the survey.

Warner et al. (1996) also asked about current funding levels for different programs (i.e., 4-H/youth development, family development/management, natural resources/environment, community economic development, nutrition/health, agriculture production/marketing, and leadership/volunteer development) in 1995. Across all programs, a majority of respondents in their survey indicated that funding should be kept the same or increased. Areas including 4-H/youth development, family development and management, and natural resources and the environment were areas in which more than half of respondents said to increase spending. Around half of respondents said that spending on the agriculture production and marketing area should remain the same. These funding preferences varied across different sociodemographic factors such as race, gender, age, and income.

Yang et al. (2009) surveyed Adams County, Colorado, residents about the importance of thirty-seven issues. Using principal component analysis, the authors identified six principal issue areas (i.e., helping vulnerable children/youth, agricultural education and sustainability, strengthening families, chronic diseases, and environmental threats). The residents identified helping vulnerable children and youth as the most important, and agricultural education and sustainability as the least important. Yang et al. (2009) found that several demographic factors affect the relative importance of these different principal issue areas, including gender, age, and household size. Moreover, the authors found that 71 percent of the survey respondents were unaware of Extension. Twenty percent were aware but did not have any contact with Extension. Last, 9 percent had interacted with Extension within the last 3 years.

More recently, Narine, Ali, and Hill (2020) surveyed Utah residents about thirty-two issues and how much effort Extension should place on each issue. The authors narrowed these issues into four priority issue areas using principal component analysis. The most important priority issue area according to Utah residents was environmental quality, followed by conservation capacity, community development, and agriculture and food safety. Individual issues that received higher effort ratings centered on the environment and food health and safety.

These studies suggest that there may be differences in awareness, interest, and use across different program areas. Additionally, these studies suggest that sociodemographic factors may be important considerations affecting awareness, interest, and use. Our study builds on past studies by examining awareness of not only traditional Cooperative Extension, but also Extension information coming from entities outside Cooperative Extension. Further, our study examines overall experience with Cooperative Extension as well as use and interest in different types of Extension programming.

3 Data

During January 2021, an online survey was implemented to obtain a representative sample of the U.S. population. The purpose of the survey was to better understand perceptions of agriculture within the United States, specifically preferences and perceptions about production practices in the greenhouse industry. Furthermore, the survey examined awareness, experience with, program use, and investment levels in Extension and other outreach services.

Respondents were recruited from the online panel of Toluna, Inc. A random set of panelists were emailed by Toluna, Inc., asking if they would like to participate in the survey. (Toluna is from Wilton, CT, and maintains a panel database and utilizes various data quality checks, including eliminating duplicate

responses, speed-checks, etc.). Panelists agreeing to participate were directed to the survey where they were presented with the Institutional Review Board consent form. After consenting to take the survey, respondents completed the survey. The only requirement to participate was that a respondent be 18 years of age or older. A total of 3,931 respondents completed the survey questions of interest to this paper.

The sample is relatively representative of the U.S. population with respect to age, race, region of residence, and household income. Table 1 presents descriptive statistics and a comparison to U.S. Census Bureau estimates as appropriate. The estimated median U.S. age is 38 years while the sample median age is 42 (U.S. Census Bureau 2019a). The sample age is higher given the U.S. Census estimates include persons under 18 years of age—our sample only included respondents 18 years of age or older. U.S. Census estimates the race makeup of the U.S. population as 76 percent Caucasian, 13 percent African American, and 11 percent another race (U.S. Census Bureau 2019b). In comparison, the sample is 82 percent Caucasian, 9 percent African American, and 9 percent other. The U.S. Census estimate of median household income is $62,843 (U.S. Census Bureau 2019b), which is similar to the sample median household income of $62,501. Regions are defined using criteria defined by the Bureau of Economic Analysis, with each region being represented in a similar manner as the population. The Mideast and Far West are slightly different from U.S. Census estimates. The sample is disproportionately women compared to men (62 percent female compared to 51 percent male estimated by the U.S. Census), which could impact the results. Results are generalizable to the overall U.S. population to the extent the sample is representative of the population as a whole.

Prior to answering the Extension-related questions, respondents were told that "Extension is providing formal and informal education to clients." The questions of interest for this paper are:

1) How aware are you of the Extension efforts provided by the following entities ...? (See Table 2 for different providers of Extension information.) The choices included: Not aware, Have heard of but not used, Have used information but not attended an in-person/online event, Have attended an in-person/online event, and Have used information and attended an in-person/online event.
2) Overall, what has been your experience with the following entities (listed in Table 2) with respect to providing education programming, information, workshops, etc.? (0–100 scale, 0 = Extremely Negative, 50 = Neither Negative/Positive, and 100 = Extremely Positive)
3) What types of information commonly provided by your state's Cooperative Extension have you used or would use to better your life/business? (See Table 3 for program areas.) The choices included: Have used, Have attended an in-person/online event, Have attended an in-person/online event and used information, Not used but interested in accessing information, Not used but interested in attending an in-person/online event, Not used but interested in attending an in-person/online event and accessing information, and Not interested.)
4) How reliable do you perceive the information that you have seen from your state's Cooperative Extension? (0–100 scale, 0 = Not reliable, 50 = Somewhat reliable, and 100 = Extremely reliable)

Table 1: Descriptive Statistics of Demographics and Other Variables of Interest

Variable[a]	Mean	Census Estimates
Region[b]		
Far West	14%	17%
Rocky Mountains	3%	4%
Southwest	11%	13%
Plains	5%	7%
Great Lakes	14%	14%
Mideast	19%	15%
New England	5%	5%
Southeast	28%	26%
Age (median years)	42	38
Age: Generation[c]		
Millennial and younger	41%	
Generation X	29%	
Baby Boomers and older	30%	
Race		
White/Caucasian	82%	76%
African American	9%	13%
Other	9%	10%
Gender: Male	38%	49%
Political Affiliation		
Democrat	43%	
Republican	29%	
Independent	23%	
Other	6%	
Education		
High School or Less	15%	38%
Some College or Associate's Degree	32%	28%
Bachelor's Degree	31%	22%
Higher than Bachelor's Degree	22%	13%
Urbanicity		
Metropolitan	25%	
Suburban	53%	
Rural	22%	
No. Children in Household	0.8	
No. Adults in Household	2.2	
Household Income (median $)	$62,501	$62,843
Primary Food Buyer in Household	94%	
Primary Plant Buyer in Household	86%	
Connection to Agriculture, Personal or Parental[d]	35%	
No. Observations	3,931	

[a] Reference categories for categorical variables are as follows: Region = Southeast, Generation = Baby Boomers and older, Race = White/Caucasian, Gender = Female, Political Affiliation = Democrat, Education = Bachelor's Degree, Urbanicity = Metropolitan, Primary ___ Buyer in Household = Not the primary ___ buyer.

[b] States are divided into regions using definitions from the Bureau of Economic Analysis (Abadi 2018).

[c] Baby Boomers—born 1964 or prior, Generation X—born between 1965 and 1984, Millennial—born in 1985 or after

[d] A respondent has a connection to agriculture if the respondent or their parents have either grown up on a farm or have worked on a farm, or the respondent has worked or are working another non-farm agricultural job.

Table 2: Entities Evaluated for Awareness and Use/Attendance of Extension (or Extension-Like) Programming
Entities
Your state's Department of Agriculture
Your state's Cooperative Extension
Your state's universities
Departments of Agriculture in other states
Cooperative Extension in other states
Universities in other states
Private businesses
Other public entities in your state
Other public entities in other states

Table 3: Program Areas Evaluated for Attendance and Use/Attendance
Program Areas
Animal production (for food)
Animal production (non-food)
Crop/plant production (for food)
Crop/plant production (non-food)
Environment and natural resources
Youth development (e.g., 4-H)
Money, family, and home
Food safety and health
Timely and trendy topics
Other

4 Empirical Model

Questions 1 and 3 are of main interest for this paper. With respect to Question 1, the choices are divided into three categories: (i) Not aware of, (ii) Have heard of but not used, and (iii) Used or attended, or both, in order to better understand awareness and use. Given the categorical nature of the data, a MNL model is utilized to examine sociodemographic factors impacting responses that provides Extension information (Table 2). The model is specified as (Greene 2012):

$$P(R_i = j) = \frac{e^{\boldsymbol{\beta}_j' \boldsymbol{x}_i}}{\sum_{v=0}^{2} e^{\boldsymbol{\beta}_v' \boldsymbol{x}_i}} \text{ where j = 0, 1, 2} \quad (1)$$

where the $P(R_i = j)$ is the probability that the ith respondent (R_i) chose the j^{th} option; $\boldsymbol{x}$ is a set of respondent characteristics (Table 1); and $\boldsymbol{\beta}$ is a vector of parameters. These respondent demographics are selected to provide a breadth of demographics (e.g., age and race), psychographics (e.g., political affiliation), and behaviors (e.g., primary food or plant buyer) that may be associated with a person's awareness or use of Extension or outreach programming. Others in the literature have also used these variables when asking similar questions. For example, Yang et al. (2009) compared respondent program priorities across gender, age, urbanicity, education, income, household size, and other demographic variables. Marginal effects are estimated because they are more readily interpretable than the MNL coefficient parameters using log-odds. The marginal effect for a continuous variable represents the increase/decrease in probability of being in a category given a one-unit change in the explanatory

variable. Categorical variable marginal effects represent the change in probability given a change from the explanatory variable's base category. Standard errors of the marginal effects are estimated using the delta method (Stata n.d.).

With respect to Question 3, respondent choices are aggregated into three categories: (i) Not interested, (ii) Not used but interested, and (iii) Used or attended. A MNL model is analyzed for each Extension program area described in Table 3. The structure of the MNL model is similar to Equation 1, except that the options are now not interested, not used but interested, and used or attended for a particular program area. Average marginal effects are calculated in the same way as with respect to Question 1. The average marginal effect for a continuous variable estimates the change in probability of being in a response option given a one-unit change in the independent variable. Categorical variable average marginal effects are estimated as the change in probability of being in a category given a change in the categorical variable from a base category. As before, the standard errors of these marginal effects are estimated using the delta method.

5 Results

Due to the large number of programs considered in this paper, the results start with an overview of awareness of outreach programs as a whole. Then the results of the estimated MNL models are presented. Next is a more detailed look at respondents who stated they are aware of outreach programs and the results from the second series of MNL models (for survey Question 3 of interest) regarding interest and use of various Extension programs. Full estimation results are available as a downloadable supplementary appendix accompanying this paper.

5.1 Entity Awareness and Use

Figure 1 presents the results of awareness and use by potential outreach providers. In all but one case, a plurality of respondents to the survey are aware of outreach programs by different entities. However, use tended to be at around 30 percent across all entities. Approximately, 65 percent of respondents are aware that a university in their own state offers Extension programming, while around 60 percent are aware of Extension programming at universities in other states. Extension has around 30 percent use, with around another 25 percent hearing about programming from Extension.

These results are somewhat similar to Warner et al. (1996); however, direct comparison is difficult because of differences in terminology. Awareness may have increased since 1995 when Warner et al. (1996) found that around 45 percent of respondents were aware of the Cooperative Extension Service by name. In the current study, around 55 percent of people are aware of or use Cooperative Extension. Warner et al. (1996) found that around 26 percent of respondents had ever used Extension programming. These results suggest use has increased since 1995.

Around 23 percent of respondents have heard of, but have not used, their state's or another state's Extension or services provided by other public entities. In contrast, around 27 to 29 percent of respondents are aware of, but have not used, Extension services of universities and state Departments of Agriculture. Thirty-seven percent of respondents are both aware of and use or attend Extension or other outreach programs provided by the land-grant university in their state, and 32 percent are aware of and use Extension or other outreach programs provided by other states' land-grant universities. Thirty-two percent of respondents use or attend their own state's Extension and outreach information or programs, but only 28 percent do the same for Extension and outreach in another state.

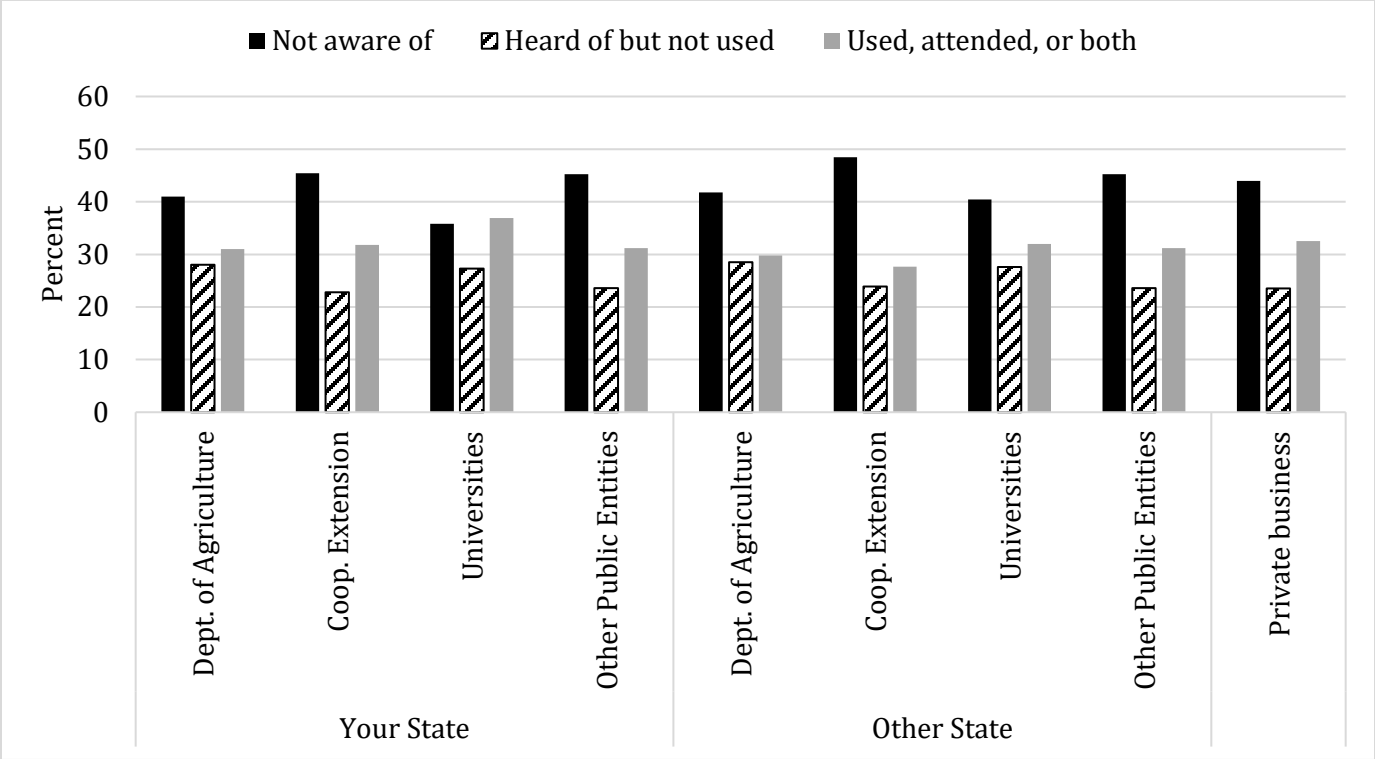

Figure 1: Respondent Awareness by Entity and Level of Awareness

MNL models examining factors influencing awareness and use of programs or services for different entities (providers) separated by the providing entity result in several interesting findings. The range of marginal effects for each explanatory variable across entities and the direction of any significant marginal effects are presented in Table 4. Marginal effects for all entities are available from the authors upon request. Generation X and younger are more likely to be aware of and use Extension programs in comparison to older generations (e.g., Baby Boomer and older). From Table 4, Generation X is between 4.1 and 15.7 percent more likely to have used, attended a program, or done both, compared to the Baby Boomer and older generation. This points to a potential generational break in awareness of Extension and other outreach entities.

African American respondents are more likely to use/attend Extension information across different entities compared to Caucasian respondents. Male respondents are also more likely to be aware of and use Extension and outreach programs. This has one of the largest impacts on the probability of awareness or use. Respondents who identify as Republican are more likely to be aware of Extension and other outreach programs, but are less likely to use them as compared to Democrats. Education also plays an important role in awareness and use of Extension and outreach programs. Respondents with an education level below a bachelor's degree are more likely to be unaware of Extension and outreach programs. This may be due to many of the Extension programs running out of universities, where college students have a higher chance of exposure to Extension and other programs and services. Respondents with education levels above a bachelor's degree are more likely to be both aware of and use Extension programs and services. This again may be due to an increase in the possibility of exposure to outreach programs and services while pursuing multiple degrees.

Households with more adults and those with more children are more likely to be aware of and use Extension services, as are households with higher incomes. Suburban respondents are more likely to be unaware of and therefore less likely to use Extension programming, whereas rural respondents are more likely to be aware of Extension, compared to urban respondents. This may be due to availability and ease of participation in programs in rural and suburban areas. In terms of the impact of having a

Table 4: Multinomial Logit Regression Marginal Effects of Entity Awareness, Range across Different Entities, and Significance Direction (if significant)[a]

Variable	Not aware of			Heard of but not used			Used, attended, or both		
	Low	High	Significant Direction[b]	Low	High	Significant Direction	Low	High	Significant Direction
Region									
Far West	-0.005	0.065	+	-0.058	0.006	-	-0.028	0.018	
Rocky Mountains	0.034	0.121	+	-0.055	0.046		-0.097	-0.014	-
Southwest	-0.004	0.036		-0.054	0.005	-	-0.020	0.026	
Plains	-0.022	0.048		-0.046	0.039		-0.030	0.031	
Great Lakes	-0.010	0.020		-0.020	0.034		-0.024	0.017	
Mideast	-0.020	0.014		-0.047	0.002	-	-0.012	0.036	+
New England	0.040	0.102	+	-0.097	-0.022	-	-0.049	0.030	
Generation									
Young	-0.102	0.056	+/-	-0.137	-0.078	-	0.054	0.180	+
Generation X	-0.084	0.015	-	-0.110	-0.056	-	0.041	0.157	+
Race									
African American	-0.041	0.003		-0.055	0.001	-	0.002	0.072	+
Other	-0.029	0.012		-0.033	0.050	+	-0.021	0.035	
Gender: Male	-0.187	-0.143	-	-0.002	0.030	+	0.136	0.176	+
Political Affiliation									
Republican	-0.016	0.002		0.010	0.055	+	-0.045	-0.008	-
Independent	0.007	0.048	+	0.022	0.053	+	-0.084	-0.052	-
Other	0.031	0.114	+	-0.058	0.022	-	-0.067	-0.038	-
Education									
High School or Less	0.046	0.118	+	-0.024	0.007		-0.119	-0.026	-
Some College	0.052	0.080	+	-0.036	0.017	-	-0.089	-0.026	-
Higher than Bachelor's Degree	-0.086	-0.060	-	-0.024	0.023		0.052	0.101	+
Urbanicity									
Suburban	0.019	0.036	+	0.001	0.029		-0.061	-0.037	-
Rural	-0.041	0.036	-	0.025	0.074	+	-0.079	-0.019	-
No. Children in Household	-0.048	-0.027	-	-0.013	0.006	-	0.033	0.046	+
No. Adults in Household	-0.025	-0.007	-	-0.008	0.011		0.007	0.019	+
Household Income[c]	-0.009	-0.003	-	-0.007	0.001	-	0.007	0.010	+
Primary Food Buyer in Household	0.016	0.078	+	-0.023	0.026		-0.056	-0.017	

Table 4 continued.

Variable	Not aware of			Heard of but not used			Used, attended, or both		
	Low	High	Significant Direction[b]	Low	High	Significant Direction	Low	High	Significant Direction
Primary Plant Buyer in Household	-0.123	-0.083	-	-0.023	0.046	+	0.062	0.109	+
Connection to Agriculture	-0.207	-0.155	-	-0.014	0.038	+	0.158	0.196	+

Note: Significance is at the 10% level. Full marginal effect and coefficient results are available from the authors in a supplemental appendix.

[a] Entities include: Your state's Department of Agriculture, your state's Cooperative Extension, Your state's universities, Department of Agriculture in other states, Cooperative Extension in other states, Universities in other states, private businesses, other public entities in your state, and other public entities in other states.

[b] Significant direction looks across all entities and assesses whether the sign direction is positive or negative for any significant variables. For instance, if all significant marginal effects were all positive for a variable, then the significant direction column would have a "+", if the significant marginal effects were all negative for a variable, then the significant direction column would have a "-", and if there were positive and negative effects then the significant direction column would have a "+/-". Exact marginal effects are available from the authors upon request.

[c] The marginal effect for household represents a change in the probability given a $10,000 increase in income.

connection to agriculture, an increased connection to agriculture leads to increased likelihood of awareness and use of Extension.

Some of these results match with previous literature, while others are different. The findings regarding education, income, and connection to agriculture are directionally similar to Warner et al.'s (1996) findings. However, our results on age, race, and rurality differ. Warner et al. (1996) found that whites made more use of Extension programming. However, we find that African Americans are more likely to use or attend Extension or outreach programs. Similarly, Warner et al. (1996) showed that those in cities and those that are younger have lower use rates. Our results are in direct contrast to this.

Figure 2 contains the experience ratings of each entity by respondents who indicate they have used information from that entity or have attended an event put on by the entity, or both. Average experience ratings are relatively close to one another, ranging from 68.5 to 72.7 on a 100-point scale (0 = Extremely Negative, 50 = Neither Negative/Positive, and 100 = Extremely Positive). The respondents' own state Departments of Agriculture, Extension, and universities received the highest ratings, while private businesses and other public entities received the lowest ratings. These results suggest that residents have a positive experience with the entities in their state that are traditionally associated with providing outreach and less so with other states' providers and private businesses. Table 5 contains the reliability of Extension information and personnel. These reliability scores are given on a 0–100 scale with 0 being not reliable, 50 being somewhat reliable, and 100 being extremely reliable. These are similar to each other at approximately 74. This suggests that users find the information from Extension reliable. Additionally, respondents find that the people they interact within Extension are reliable.

Table 5: Perceived Reliability of Cooperative Extension Information and Personnel, 0–100 scale[a]

Reliability of Element Evaluated	Obs.	Mean	Std dev.
Information	1,298	73.8	21.6
Extension agents or other personnel you get information from	1,289	74.1	21.2

[a] 0 = Not reliable, 50 = Somewhat reliable, and 100 = Extremely reliable

Note: This sample is limited to those respondents that indicated they used information from their state's Extension, attended an online or in-person event by their state's Extension, or did both of those things.

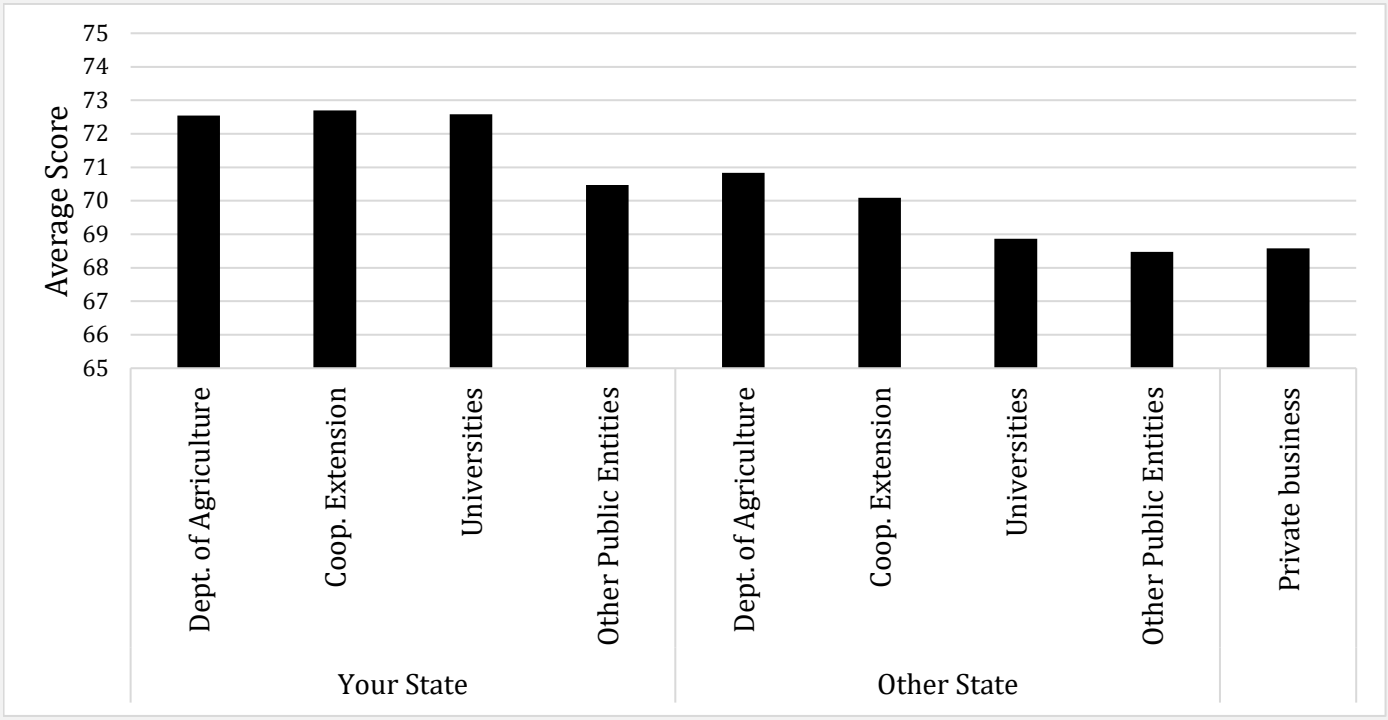

Figure 2: Average Respondent Experience by Entity, 0–100 Scale

5.2 Program Area Awareness and Use

Breaking down the utilization of outreach programs and services by program area separate from the entity providers can give a better picture of which programs respondents are not interested in compared to those they are interested in, compared to those they have actually used. These percentages are presented in Figure 3. Most program areas have about 30 percent of respondents utilizing them, with the food safety programs having the highest percentage of usage at approximately 33 percent and "other" programs having the lowest at around 24 percent.

The percentage of respondents who are interested in using but not currently using or attending programs is larger than the percentage of users across all program areas. This indicates there is a large portion of current non-users who would like to be users but are currently not reached by Extension programs either via lack of knowledge in how to participate or a lack of means to participate. The percentage of interested non-users is highest for environmental (42 percent) and food safety programs (41 percent). These results are somewhat similar to the results by Yang et al. (2009), who found that helping families, children, and the environment are important areas of interest. However, our findings suggest environmental issues may be more interesting with youth development being less interesting to respondents today compared to 2009. These are also similar to those found by Narine, Ali, and Hill (2020), who found that environmental issues were important areas of focus. However, direct comparison is difficult because the program areas are not identical.

The percentage of respondents who are aware of various programs but not interested ranges from 26 percent to 44 percent, with the lowest level of disinterest in food safety programs and the highest for the other category. The high level of disinterest in the "other" category may be due to consumers preferring to participate in outreach programs for particular subjects.

Another series of MNL regressions are used to examine the impact of various demographic variables on use and interest by program area. The range of marginal effects for each variable across program areas and the directions of significant marginal effects are presented in Table 6. Marginal effects for all program areas are available from the authors upon request. Region plays a larger role in interest and participation; all regions are more likely to be uninterested or neutral, and less likely to use

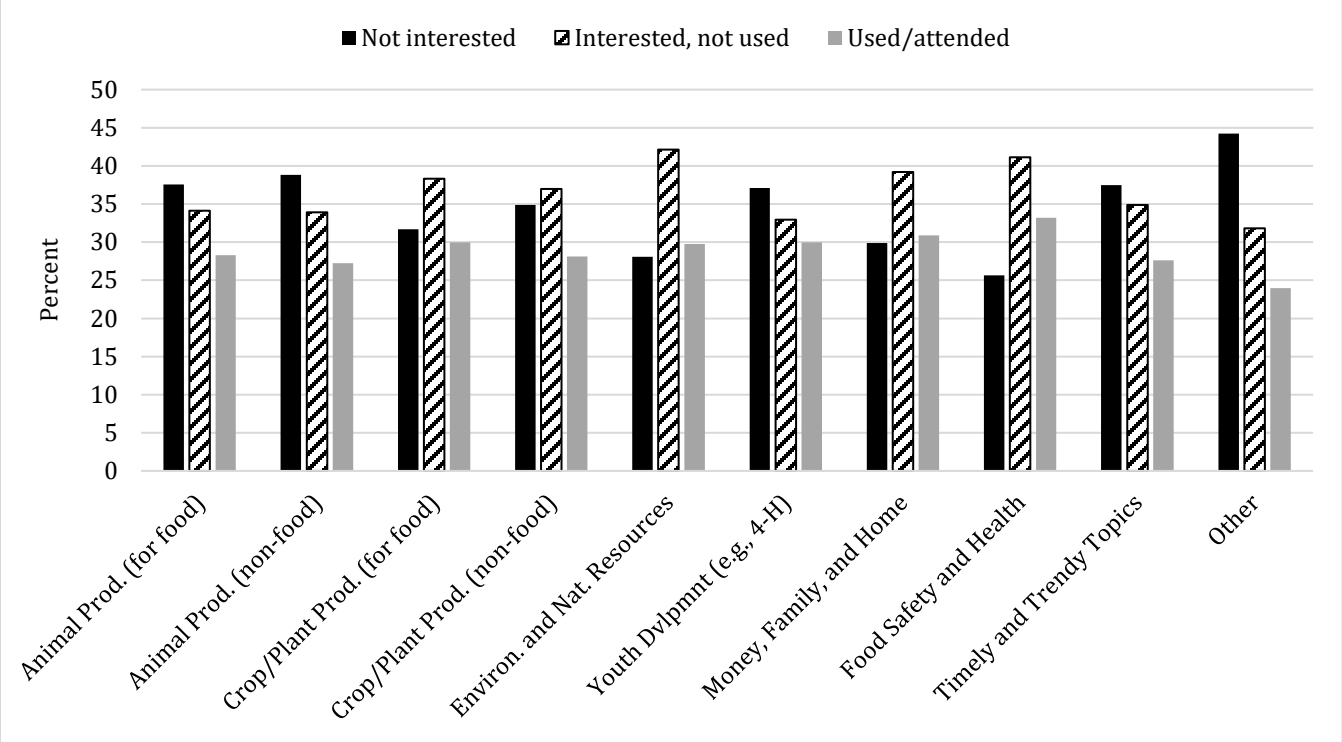

Figure 3: Respondent Use by Program Area

and attend relative to the Southeast (the reference region). Generation X and younger, and male respondents are more likely to be interested and use outreach programs as compared to older generations. Young generations are more likely to be interested in and have attend programs and are less likely to be uninterested when compared to older generations. However, different generations seem equally likely to be interested, but are not using programs as older generations. This breakdown is program dependent and may be the result of accessibility, timing, alternative information sources, or cost of programs. For example, younger generations have a higher likelihood to use information about animal production than to use information about food safety and health. Non-white respondents are not only more likely to be interested in but also more likely not to use programs. This may be due to accessibility issues

Male respondents are more likely to be interested in and use outreach programs as compared to their female counterparts. These results are fairly consistent at around a 10 percent higher probability of using an outreach program compared to females. They are equally likely to be interested in, but not use Extension programs, based on the program. All other individual demographics except for education are more likely to be uninterested, and more likely not to have used Extension programs, compared to their base categories. Respondents with educational levels lower than bachelor's degree are more likely to be either uninterested or interested but are non-users as compared to the base category of those with a bachelor's degree. Specific areas of disinterest includes environmental topics, timely and trendy topics, and food safety. This again may be due to a lack of knowledge on how to participate in programs or a lack of means to do so. Warner et al. (1996) found an association between lower education levels and lower use. Respondents with higher than a bachelor's degree education are more likely to be both interested in and use programs. Their higher use is significant across all program areas. Households with more adults and households with more children are more likely to be interested and use programs, as are households with higher incomes. Those households with more children have a relatively consistent higher likelihood of currently using or attending programs across all areas. However, interest (without use) is less widespread. Those with more children are more likely to be interested but are not currently using youth development programs, animal production programs, timely and trendy topics,

Table 6: Multinomial Logit Regression Marginal Effects of Program Area Use, Range across Program Areas, and Significance Direction (if significant)

Variable	Uninterested			Interested but Not Using			Interested and Using		
	Low	High	Significant Direction[a]	Low	High	Significant Direction	Low	High	Significant Direction
Region									
Far West	0.007	0.043	+	-0.029	0.011		-0.028	0.008	
Rocky Mountains	0.075	0.136	+	-0.085	-0.003	-	-0.075	-0.028	-
Southwest	0.000	0.038		-0.058	0.005	-	-0.018	0.024	
Plains	0.059	0.100	+	-0.062	-0.004		-0.074	-0.013	-
Great Lakes	-0.001	0.033		-0.048	0.013	-	-0.028	0.017	
Mideast	-0.030	0.012		-0.007	0.045	+	-0.038	0.002	-
New England	0.001	0.061	+	0.011	0.053		-0.088	-0.031	-
Generation									
Young	-0.158	-0.015	-	-0.051	0.036	+/-	0.065	0.163	+
Generation X	-0.134	-0.036	-	-0.017	0.049	+	0.046	0.127	+
Race									
African American	-0.113	-0.043	-	0.003	0.086	+	0.000	0.061	+
Other	-0.090	-0.046	-	0.027	0.099	+	-0.032	0.033	
Gender: Male	-0.134	-0.054	-	-0.046	0.044	+/-	0.087	0.127	+
Political Affiliation									
Republican	0.033	0.098	+	-0.052	-0.002	-	-0.047	-0.008	-
Independent	0.034	0.082	+	-0.039	0.019	-	-0.063	-0.013	-
Other	0.105	0.153	+	-0.110	-0.043	-	-0.074	-0.025	-
Education									
High School or Less	-0.007	0.073	+	-0.026	0.044	+	-0.069	-0.011	-
Some College	-0.004	0.030	+	-0.017	0.042	+	-0.046	-0.010	-
Higher than Bachelor's Degree	-0.079	-0.047	-	-0.017	0.013		0.051	0.087	+
Urbanicity									
Suburban	0.015	0.052	+	0.024	0.063	+	-0.082	-0.054	-
Rural	0.029	0.098	+	-0.028	0.026		-0.070	-0.027	-
No. Children in Household	-0.077	-0.033	-	-0.005	0.033	+	0.031	0.048	+
No. Adults in Household	-0.021	-0.012	-	-0.006	0.012		0.008	0.022	+
Household Income[b]	-0.009	-0.001	-	-0.009	0.000		0.007	0.010	+
Primary Food Buyer in Household	-0.070	-0.001	-	-0.002	0.077	+	-0.054	0.028	

Table 6 continued.

Variable	Uninterested			Interested but Not Using			Interested and Using		
	Low	High	Significant Direction[a]	Low	High	Significant Direction	Low	High	Significant Direction
Primary Plant Buyer in Household	-0.138	-0.090	-	0.037	0.066	+	0.037	0.079	+
Connection to Agriculture	-0.184	-0.144	-	0.019	0.075	+	0.088	0.135	+

Note: Significance is at the 10% level. Full marginal effect and coefficient results are available from the authors in a supplemental appendix.

[a] Significant direction looks across all entities and assesses whether the sign direction is positive or negative for any significant variables. For instance, if all significant marginal effects were all positive for a variable, then the significant direction column would have a "+", if the significant marginal effects were all negative for a variable, then the significant direction column would have a "-", and if there were positive and negative effects then the significant direction column would have a "+/-". Exact marginal effects are available from the authors upon request.

[b] The marginal effect for household represents a change in the probability given a $10,000 increase in income.

and other areas. Suburban and rural respondents are more likely to be uninterested and less likely to utilize outreach programs.

For particular program areas, participants with a connection to agriculture are significantly more likely to have used or attended programs for all program areas than their non-agriculture counterparts. Those with a connection to agriculture are also less likely to be uninterested in any program area and more likely to be interested but have not used the program for all areas but youth programs, as compared to those without a connection.

6 Conclusions

Extension and other outreach programs are currently at a crossroads of growth. The push for virtual programs and databases has allowed new users to fully access outreach programs they would not normally have access to or awareness of. With food safety and other programs also coming into the public eye more than before, outreach programs could see a swell of interest and growth of users. Knowing how to engage these potential new users and maintain the current ones is extremely important to fully capturing this peak in interest. Using survey responses and MNL regressions, insight has been gained into which consumers are already aware of outreach programs, which consumers are actually using the programs, and what are their perceptions about their experiences. With these insights, Extension and other entities can better increase their name recognition, program recognition, and the number of users by engaging in programing that is of interest to current non-users. For instance, rural consumers are more likely to be aware of but not use Extension programming; thereby, increasing programming in rural areas could lead to increased use in these areas. For rural residents, this awareness cuts across all public entities. However, they are less likely to be of interest across program areas compared to those living in metropolitan areas. Therefore, alternative programming and different messaging may be needed to garner interest in Extension and outreach programs in these areas.

There is room to market and expand usage, especially to urban and suburban users, users with lower incomes, women, and users with lower education levels. These users may not be aware that Extension and outreach programs apply to more than agricultural programs, especially those who live in urban areas. For example, more programing in urban school systems could improve name recognition as well as improve usage across demographics since schools are not exclusive to one specific demographic. This could also help reach those at any education level, not just those with a college education. To attract those with lower income levels, providing no-cost or low-cost programming would seem to be essential. Other program delivery modes may also be warranted due to additional constraints (e.g., internet access or time of program delivery). As noted by Rader (2011), people are not keen to find Extension

information online, which motivates the notion that other alternative methods of program delivery are warranted.

Programs can also be developed or marketed to those who are interested in the area but have not attended a program or used information. Specifically, Generation X and African American respondents are interested in but not using the money, family, and home Extension programs. Finding ways to move these groups from interested non-users to users could benefit those groups. On a more general level, African Americans, households with children, households in suburban areas, those with lower incomes, and primary buyers (of foods or plants) are more likely to have an interest or use Extension programming (Table 6). Combined with the awareness results, program timing and location of delivery appear to be important themes. This speaks to potential accessibility issues. People in these segments of interest may be more time-constrained (e.g., lower incomes) or live in areas that were not a focus of traditional Extension outreach (e.g., suburban). Moreover, a lack of awareness may drive the lack of attendance. An example of how to increase access is to be cognizant of public transit lines and their proximity to program areas if the program is in person, or the timing and asynchronous availability of online programs so as not to exclude users who may be more time-constrained. The usage of online recordings of programs and databases as well as greater visibility of available programs and services can help reach this audience.

The difference in both program use and awareness between respondents with a connection to agriculture and those without a connection is potentially due to the extensive use of Extension programs and services in the wider agricultural industry. This leads people with any connection to the industry to be at a minimum aware of the existence of Extension and other university outreach programs, even if they have not made use of them. Therefore, if Extension or other outreach programs are looking to expand their user base, focusing information campaigns and advertisements in non-agriculture sectors would be more successful at bringing in new users.

Extension, as well as other outreach programs, are designed to help bring new insights and knowledge to the general public. This mission requires outreach services to continue to grow and change with the needs and composition of the general public. If outreach services cannot be accessed by all who wish to use them, be it due to a lack of means or a lack of awareness, then Extension and similar programs are not fully completing their goals. This look into where those awareness and access weaknesses currently are can help close the gap between where Extension and outreach programs are and where they could be, notably with respect to engaging interested persons that are not taking advantage of Extension programming.

There are several limitations to this study. First, the results are only generalizable to the overall population if the survey sample is representative of the overall population's preference and usage of Extension resources. There is no way to know if the survey sample's preference and usage mirrors that of the overall population. However, by mirroring demographics and socioeconomic characteristics of the survey sample to that of the overall sample, we can have some confidence that the survey results are generalizable to a larger group. Second, we provided a general definition of Extension to respondents. The survey results are robust if respondents utilized the definition provided and did not utilize a preconceived notion of what they viewed Extension as.

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Research Article

Does Exam Formatting Affect Grades in Online Agricultural Marketing Courses?

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Abstract
Understanding factors affecting student performance in online exams can help improve the accuracy and equity of performance assessment tools. While there is a significant body of literature dating back to the 1980s on the accurate assessment of performance in traditional in-person exams, the literature evaluating online exams in online classroom settings has been scarce. During the COVID-19 pandemic, online course offerings along with online exams in these courses have surged, leading to a renewed interest in understanding the extent to which formatting of exam questions could affect students' grades. This study contributes to the literature on student exam performance in online classes by evaluating how scores are affected by two exam formatting treatments: ordering exam questions by chapter number and by question difficulty level. Two exams were administered in an online Agricultural Marketing class in two consecutive semesters. We investigate the treatment effects on average exam scores and exam grade distributions. The results show that neither type of exam formatting treatment has a significant impact on grade outcomes.

1. Introduction

Student performance in higher education institutions has been continuously monitored as the COVID-19 pandemic forced many in-person courses to be offered online (Rahim 2020; Clark et al. 2020). The pandemic has brought unforeseen consequences for universities across the United States, as instructors had to scramble and adapt their curriculum to a distance-based online environment. This dramatic shift has been coined as "emergency online learning" due to the unprecedented teaching adaptations that had to occur. Courses that were traditionally face-to-face have found new ways to teach and assess students. Information technology (IT) capacity at universities has been expanded, and teaching faculty have become "instructional MacGyver's" (Hodges et al. 2020). Universities were not alone in facing challenges adapting to the fast-paced changes in delivery; students from different socioeconomic backgrounds also faced distinct issues during the unprecedented times of the COVID-19 lockdowns (Rahim 2020). The "emergency online learning" ignited by the COVID-19 lockdowns has facilitated online teaching to become a more widely accepted form of educational delivery as the pandemic lingered for months (Manfuso 2020).

In this study, we leverage an experiment conducted during the COVID-19 pandemic to analyze whether instructors' exam formatting choices, with respect to the order of questions appearing in online exams, play any significant role in students' test performance. We investigate the impact of two specific formatting variations on student grades: (a) the ordering of questions by ascending vs. descending difficulty and (b) the ordering of questions chronologically vs. reverse chronologically by chapter. These formats are of interest because ascending vs. descending difficulty might differentially influence students' outlook and confidence during a test, while chronological vs. reverse chronological order of questions might influence students' performance on an exam through primacy (remembering earlier things learned) and recency (remembering last things learned). The findings of the study have

implications for addressing the accuracy and fairness of online assessments in evaluating student performance, which is an increasingly relevant issue given the prevalence of online teaching during and after the COVID-19 pandemic. To our knowledge, this study is the first to specifically focus on online exams and courses offered in agricultural economics, and to question whether exam formatting affects the performance of agricultural economics students taking online courses.

There are different reasons for why exam formatting could be consequential for student performance. Context cues that sequential (by chapter) exam questions carry can inherently give memory retrieval cues and impart an advantage to students. On the other hand, exam questions ordered by difficulty levels, from easier to harder, can boost confidence levels of students and provide another type of advantage to students (Russell et al. 2003). Another possibility, ordering the most difficult questions first on an exam, is that such initial questions can anchor a student's perception of an exam and affect their self-evaluation on the test (Bard and Weinstein 2017).

Exam formatting and its impact on student performance were first investigated when a psychology professor questioned whether anti-cheating techniques were detrimental to student grades (Norman 1954). Norman (1954) compared how students fared in exams that were formatted with questions ordered in a forward sequence by chapters versus those ordered in a reverse sequence by chapters. His experiment concluded that the order of questions did have a significant impact on student exam scores. A multitude of studies in the fields of psychology, economics, and STEM have followed, which replicate Norman's (1954) study, adding variations to his experiment along the way (e.g., Denny et al. 2019). Studies pertinent to agricultural economics are summarized in Table 1. The study by Perlini, Lind, and Zumbo (1998) added an interesting variation in analyzing exam formatting; they added the order of question difficulty (from easier to more difficult or vice versa) to the ordering by chapters. They concluded that none of the exam formats with which they experimented led to any significant advantages or disadvantages for student exam grades (Perlini et al. 1998). Other studies investigating the effects on student performance of ordering exam questions by difficulty and chronological coverage (or chapter) have been inconclusive (Davis 2017; Hauck, Mingo, and Williams 2017). The studies mentioned in this paper are relevant to the experimented exam formats, but there are also additional exam formats or variations of the ones tested here that could be further considered and are discussed in the Discussion section.

All exams evaluated in the aforementioned studies were given in the traditional classroom setting as traditional in-class exams. Only two studies have examined online exams in relation to how their formatting impacted student performance. One of these two studies was conducted online with more than 19,000 students from Latin America and Spain participating in short math exams that differed by the order of question difficulty (Anaya et al. 2021). Students were offered questions ordered in ascending and descending difficulty, as well as random patterns of easy and difficult questions at the beginning and end of the test (2 easy/1 difficult question at beginning and 1 easy/2 difficult questions at the end, and vice versa). Students who took the easy-to-difficult exam format had a higher probability of completing the exam and answering more questions correctly. In the second study by Lippi (2016), exams formatted by different question types (multiple choice or short response) were found to affect student performance significantly. We contribute to this segment of the literature by studying online exam performance in an agricultural economics course in relation to the ordering of questions by chapters covered and by difficulty level.

2 Experimental Design

Agricultural and Food Marketing is an undergraduate course in the Department of Food and Resource Economics at a land-grant university. It is held online in an asynchronous format. The course consists of nine modules that cover all aspects of traditional and agricultural marketing, dealing with all players in the food value-added supply chain. The course requires a total of four exams, with the first three exams

Table 1: Relevant Literature on Exam Formatting

Name	Year	Field	Question (treatment)	Results
Hambleton and Traub	1974	Mathematics	E-H (Easy to Hard), H-E (Hard to Easy)	E-H performed better.
Chidomere	1989	Marketing	Forward and Random-Ordered	No significant difference.
Heck and Stout	1991	Finance	Forward, Reverse, and Random-Ordered	No significant difference between Forward and Random; Reverse performed worse than Random.
Carlson and Ostrosky	1992	Microeconomics	Forward and Random-Ordered	No significant difference.
Geiger and Simons	1994	Accounting	Forward and Random-Ordered	No significant difference across 5 of 6 exams. Forward performed better on 6th exam.
Perlini, Lind, and Zumbo	1998	Psychology	Forward, Reverse, and Random Chapter Order. E-H, H-E, and Random Difficulty Order	Chapter Order had no statistically significant results; H-E performed better.
Russell et al.	2003	Marketing/Management	Forward, Reverse, and Random-Ordered	Forward and Reverse performed better than Random, but significance is not consistent.
Vander Schee	2009	Marketing	Forward, Reverse, and Random-Ordered	No significant difference.
Miller and Andrade	2020	Psychology (Online)	H-E, E-H, and other variations	Impacted completion

covering one third of the material each (i.e., three modules covered in each of the first three exams) and the fourth exam being cumulative over all modules covered in the semester (i.e., nine modules covered in the fourth exam). The data on the first two exams were used for the analyses in this study, which was checked for Family Educational Rights and Privacy Act (FERPA) compliance and approved by the Institutional Review Board (IRB) of the university. The study was conducted as a natural field experiment, where students completed the exams in the course without knowledge that they were taking part in a research study. This helps improve data quality because it avoids students' awareness of the study from unintendedly impacting their performance on the test. Students completed exams through an e-learning management system called Canvas. Each exam consisted of 25 multiple choice questions to be answered over a duration of 50 minutes. As expected from an agricultural marketing course, many exam questions are conceptual in nature, with a few involving mathematical calculations. Each exam was made available by the instructor on Canvas for a period of 24 hours, during which

students can log in to complete the test. Once a student starts the exam, they must complete the test within 50 minutes. Students are not allowed to pause the exam. To prevent cheating and academic dishonesty, each exam is proctored using Honorlock, which is an online proctoring service that requires each student to go through a process of identity verification and surrounding environment check. After the checkup process, Honorlock monitors the students' conduct during the exam by recording their activity and flags any suspicious behavior. The instructor can review Honorlock's video recording for each student to verify adherence to the academic honesty policy of the university. Honorlock can effectively detect cheating behavior (Dadashzadeh 2021; Chen et al. 2022), while also relying on artificial intelligence, rather than live monitoring through an agent, to provide a less intrusive environment that helps avoid additional stress or anxiety during the online-proctored exam.

The experiment was conducted over two semesters, Fall 2020 (August 30–December 9) and Spring 2021 (January 11–April 21), which were used to test two treatments related to exam formatting. Exam 1 was used to test whether the order of questions by difficulty level affected students' performance. Students in the Fall 2020 semester received a version of Exam 1 with ascending order of question difficulty, while students in the Spring 2021 semester received a version of Exam 1 with the same questions but in a descending order of difficulty. The difficulty of each question was assessed following Bloom's taxonomy to get an objective determination of relative difficulty when assigning questions to ascending and descending difficulty orders (Krathwohl 2002). Bloom's taxonomy organizes learning objectives in a pyramid in ascending order of complexity and specificity. The bottom-up order in this pyramid is recollection, comprehension, application, analysis, synthesis, and evaluation. We followed this framework to assign a difficulty level to each question based on its nature (i.e., whether it requires recollection, comprehension, application, etc., of course content to answer the question). Exam 2 was used to test whether the order of questions by sequence of chapters affected students' performance, where students in the Fall 2020 semester received a version of Exam 2 with a chronological order of questions by chapter, while students in the Spring 2021 semester received a version of Exam 2 with the same questions but in a reverse chronological order by chapter. Table 2 summarizes the experimental design.

Table 2: Summary of Experimental Design

Exam	Format	Sample Size	Mean (SE)	Min (Max)	Average Time Taken (Mins)	95% Confidence Intervals for Average Grade
Exam 1						
Fall 2020	Ascending Difficulty (Easier to Harder)	96	76.5 (1.84)	26 (100)	23.4	[72.9, 80.2]
Spring 2021	Descending Difficulty (Harder to Easier)	99	79.0 (1.69)	32 (100)	22.8	[75.6, 82.3]
Exam 2						
Fall 2020	Forward Sequence of Chapters	93	83.7 (1.36)	46 (100)	23.6	[81.0, 86.4]
Spring 2021	Reverse Sequence of Chapters	98	82.2 (1.66)	30 (100)	23.9	[78.9, 85.5]

The variables collected for the analysis were the exam grade and individual factors, including the students' major, GPA, gender, school year (i.e., freshman, sophomore, junior, or senior), and level of course activity preceding each exam (i.e., number of course content views during the period preceding each exam). The exam grade was used as an indicator of student performance, while individual factors were controlled for in the analysis to determine robustness of the results.

3 Results

The data were analyzed to determine the effects of differing exam formats on both average student performance as well as the distribution of grades. The two outcomes allow for a more in-depth assessment of the treatment effects that goes beyond direct comparison of means, as commonly done in previous studies.

3.1 Analyzing Average Exam Grades

Table 2 presents the average grades for each exam across the treatment groups. The average grade for Exam 1 was between 76 and 79 percent, while the average Exam 2 grade was between 82 and 84 percent. Exam 1 shows the average grades for the exam formats with ascending vs. descending order of question difficulty, while Exam 2 shows the average grades for the exam format with chronological vs. reverse chronological order of questions by chapter number. In both cases, we find no significant effect across the exam format (t-test, $p > 0.3$).[1] While chronology and order of difficulty had no significant impact on average exam grades, there was a significant difference in student performance between Exam 1 and Exam 2 in both semesters, with students performing significantly better on Exam 2 compared to Exam 1 (p value = 0.003). There are multiple possible explanations for this result. One possible explanation is that students have become generally more familiar with taking online exams and/or course structure after completing Exam 1, which may have helped them perform better on Exam 2. Another potential explanation is that students could have perceived Exam 1 as harder, due to the introduction of new vocabulary and methods earlier in the course.[2] One other explanation might lie in the differing exam formats in Exam 1 and Exam 2, as the order of questions varied by either difficulty in Exam 1 or by chapter/module in Exam 2.

We use regression analysis to estimate the following model of exam grades:

$$Exam\ Grade = \beta_1 \times Format + \beta_2 \times Ag.Econ.Major + \beta_3 \times GPA + \beta_4 \times Activity + \beta_5 \times Male + \beta_6 \times School\ year\ + Constant + \varepsilon \quad (1)$$

Two specifications were estimated for each exam, one serving as a baseline model containing only the treatment variable (see columns [1] and [3] in Table 4). The other model controls for individual factors (see columns [2] and [4] in Table 4). A Tobit model was estimated for each specification to account for censoring of observations at the upper and lower ends of the dependent variable (0 and 100). The treatment variable for each model was a dummy variable. For Exam 1, ascending order of difficulty equals 1, and descending order of difficulty equals 0, while for Exam 2, forward order of chapter/module equals 1 and reverse order of chapter/module equals 0. The individual factors include the student's GPA, online course activity preceding each exam (i.e., number of course content views during the period preceding each exam), gender (male or female), major (whether they are an economics or agricultural economics major), and school year they were in when they took the exam (freshman, sophomore, junior,

[1] The comparison of exam formats across ascending and descending order of difficulty resulted in a p value = 0.320, while the comparison of exam formats across chronological and reverse chronological order of questions resulted in a p value = 0.503.
[2] The content across Exam 1 and Exam 2 are similar in terms of difficulty of questions, as both exams' questions have similar Bloom's taxonomic levels. However, it is possible that students found the material in Exam 2 easier, which could explain the higher average grade on Exam 2 compared to Exam 1.

Table 3: Summary Statistics of Subjects' Individual Factors

Variables	Fall 2020 Mean (Std. Dev)	Spring 2021 Mean (Std. Dev.)	*p* value
Economics or Agricultural Economics Major	0.469 (0.502)	0.414 (0.495)	0.443
GPA	3.157 (0.438)	3.259 (0.504)	0.131
Number of Course Content Views	350.705 (192.883)	350.684 (185.363)	0.999
Male	0.646 (0.481)	0.556 (0.499)	0.198
School Year	3.510 (0.562)	3.455 (0.558)	0.453
Observations	96	99	

Notes: Standard errors are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

or senior). Summary statistics for the individual factors are presented in Table 3, showing balance in all variables between semesters. This demonstrates well-balanced treatment groups, which supports the internal validity of the study.

As shown in the regression results in Table 4, we find no evidence of a significant treatment effect for neither Exam 1 nor Exam 2. The coefficient estimates on order of difficulty in Exam 1, and order of chronology in Exam 2, were not statistically significant under either specification. Therefore, results from Table 4 suggest no significant effects of either chronology or order of question difficulty on average exam performance in an online agricultural economics course.

Looking at individual factors, we observe that being in an agricultural economics major was positively correlated with performance on Exams 1 and 2. This result is intuitive, considering that students in agricultural economics are more frequently exposed to similar concepts in other classes, which can improve their performance compared to non-majors. GPA was also positively correlated with student performance on both exams, which is again intuitive, and suggests that students with a higher GPA performed better on the exams in this course compared to students with a lower GPA. Notably, a student's level of course activity in the period preceding each exam was not significantly correlated with performance on either exam. One possibility here is that the number of course content views made by a student is indeed not correlated with their performance in the course. Another possible explanation is that students could have downloaded the online course content on their personal computer to access offline at a later time, which could mean that they made offline course content views that were not captured in the data. School year was only significantly correlated with exam performance in Exam 2, where the correlation was positive. On the other hand, gender was not significantly correlated with performance on either exam.

Next, we analyze how the exam letter grades are affected by each exam formatting treatment. Exam scores for each student were converted to a letter grade following the letter grade breakdown implemented by the university, but only focusing on letter grades and not on the plus/minus system to avoid a large loss in degrees of freedom in the model (for further information on course grading scale and assignment weights, please see the Appendix). Given the ordered categorical nature of this variable, an Ordered Logit model was estimated using the same covariates in Table 4. The results of the Ordered Logit estimations are reported in Table 5. Consistent with the previous analysis, we find no significant

Table 4: Tobit Regressions Analyzing Effect of Question Difficulty Order and Chronology Order on Average Exam Score

Variables	Exam 1 [1]	Exam 1 [2]	Exam 2 [3]	Exam 2 [4]
Question Order by Difficulty	-3.302	-2.954		
	(2.739)	(2.647)		
Question Order by Chapter/Module			0.889	1.002
			(2.392)	(2.340)
Agricultural Economics Major		6.249**		5.384**
		(2.851)		(2.466)
GPA		11.648***		9.596***
		(2.968)		(2.625)
Level of Course Participation		-0.009		-0.012
		(0.011)		(0.017)
Male		2.625		0.798
		(2.880)		(2.512)
School Year		-0.127		4.289**
		(2.373)		(2.049)
Constant	80.377	41.857	83.444	36.186
	(1.933)	(13.099)	(1.677)	(11.711)
Observations	195	193	191	189
Log Likelihood	-785.173	-766.504	-738.753	-719.005

Notes: Standard errors are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

effect of either treatment on exam letter grades. The results in Table 5 also show a positive correlation between course grade and both GPA and being an economics or agricultural economics major. Moreover, we find a lack of significant correlation between exam letter grades and individual factors related to school year and gender, which indicates lack of robustness in the influence of these factors on student exam performance.

3.2 Analyzing Distributions of Exam Grades

To further understand the extent of the treatment effects, we analyze how the order of question difficulty and chronology affects the distribution of exam grades. Figure 1 presents the cumulative distribution functions (CDFs) of the grades in Exams 1 and 2. The panels include two CDFs, one for each order variation within the respective treatment. Panel A shows the figures where the exam formatting treatment was question order by difficulty, and Panel B shows the figures where the exam formatting treatment was chronological order of questions by chapter number. Both panels show no statistically significant differences in the cumulative distribution of student grades across groups (Kolmogorov-Smirnov test, Exam 1 p value = 0.738, Exam 2 p value = 0.904). This implies that manipulating the order of question difficulty or the chronological order of questions on the exam does not impact the distribution of student grades in an online agricultural economics/marketing course.

4 Discussion and Conclusion

The results of this study show that students perform similarly when questions in online exams are ordered in ascending vs. descending difficulty, and also when questions are ordered forward vs. backward in chronology (i.e., chapter order). This could indicate that the ordering of exam questions by difficulty or chronology does not affect student performance, which would benefit the robustness of

Table 5: Ordered Logit Regressions Analyzing Effect of Question Difficulty and Chronology Order on Exam Letter Grades

Variables	Exam 1 Odds Ratio (Std. Error) [1]	Exam 1 Odds Ratio (Std. Error) [2]	Exam 2 Odds Ratio (Std. Error) [3]	Exam 2 Odds Ratio (Std. Error) [4]
Question Order by Difficulty	-0.246	-0.273		
	(0.256)	(0.263)		
Question Order by Chapter/Module			0.129	0.194
			(0.262)	(0.275)
Agricultural Economics Major		0.543*		0.542*
		(0.282)		(0.295)
GPA		0.926***		0.860***
		(0.298)		(0.303)
Level of Course Participation		-0.001		-0.003
		(0.001)		(0.002)
Male		0.208		0.221
		(0.283)		(0.290)
School Year		0.050		0.284
		(0.235)		(0.247)
Cutoff 1 (F to D)	-1.680***	1.462	-2.284***	1.376
	(0.230)	(1.298)	(0.284)	(1.363)
Cutoff 2 (D to C)	-1.082***	2.084	-1.354***	2.343*
	(0.205)	(1.303)	(0.223)	(1.366)
Cutoff 3 (C to B)	-0.359*	2.873**	-0.819***	2.920**
	(0.193)	(1.315)	(0.205)	(1.372)
Cutoff 4 (B to A)	0.787***	4.080***	0.365*	4.184***
	(0.202)	(1.328)	(0.196)	(1.386)
Observations	195	193	195	193
Log Likelihood	-301.211	-290.293	-272.902	-261.508

Notes: Standard errors are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

online exams as an assessment tool. However, another possibility is that the effects of question ordering by difficulty and chronology on student online exam performance are nonlinear and follow some kind of a U-shaped relationship. This could be determined in future studies by comparing performance on both ascending and descending difficulty exams (or forward and backward chapter-ordered exams) with a version where questions are randomized. Under this setting, a U-shaped relationship would be manifested as a significant treatment effect in the same direction for both orders compared to the randomized version.

This study adds to the literature on exam formatting by extending this research to online testing environments and to courses in agricultural economics. While some previous studies have documented significant effects, this study finds no evidence of such effects in an online exam environment. It is still important to understand why previous studies find significant results to fully grasp the divergence in findings in the literature. There is a variety of potential explanations for why exam performance could be impacted by superficial factors (Kolski and Weible 2018; Arora, Chaudhary, and Singh 2021). One explanation relates to the role of anxiety and the environment the student is in. Stowell and Bennett (2010) demonstrated how the students who experienced test anxiety in a traditional exam would not experience test anxiety when a similar exam was administered online. Another explanation relates to

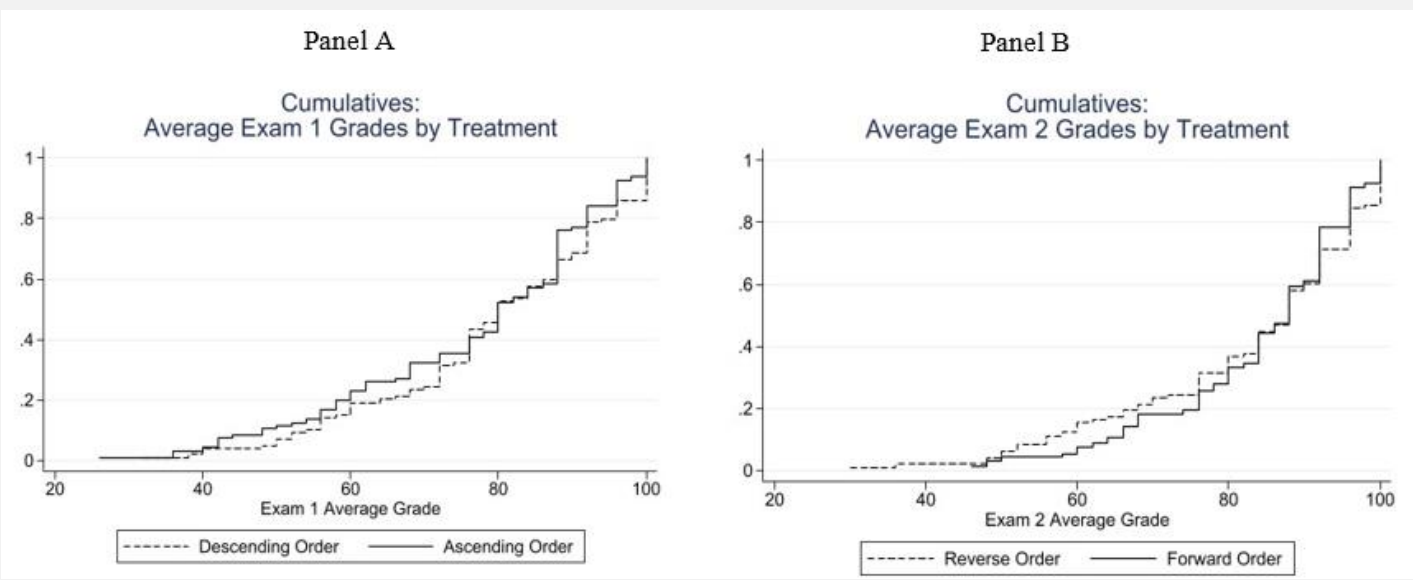

Figure 1: Cumulative Distribution Function for Exam 1 and Exam 2

anchoring and its effect on student perception of exam performance. Weinstein and Roediger (2012) demonstrated that people tend to anchor their exam performance in the beginning of the exam, and this affects their post-diction feedback. They argue that exam formatting could indeed affect students because these "inaccurate self-evaluations are critical for students to identify gaps in their knowledge"; therefore, this can have an effect on study habits or test anxiety (Bard and Weinstein 2017).

Our study has some limitations, which present an opportunity for further research on this topic. The implementation of the experiment consisted of students taking the exams online. Although the questions on each exam were presented separately on individual pages, which increases the salience of the treatments, there were no restrictions on how the students could move between questions in an exam, allowing them to move forward or backward from question to question. A more controlled version of this experiment, which prevents students from moving back and forth between questions, could also lead to different results. However, implementing such a controlled environment in an online course carries logistical and administrative challenges because students would be denied the right to review answers on previous questions. The exams were also implemented in two separate semesters; although both semesters were during the height of the COVID-19 pandemic (therefore, students across both semesters were experiencing the same environment), an experiment where exam formats were tested within the same semester would improve the robustness of a similar study. Additionally, our data set did not include information on all sociodemographic characteristics of the students or other behavioral factors like study habits, which should be considered in future research because they can provide great insights through sub-analyses over different student groups.

Other extensions of this study include adding variations of the exam formats utilized here, such as changing the difficulty order of questions within chapters or having multiple exam formats tested simultaneously. Future studies can also use exams that cover a larger portion of the course content (e.g., cumulative final exams). Our study utilized the first two exams taken during the semester, each of which spanned one third of the course material over six weeks of study. While this is a reasonable load to think that concepts like primacy and recency might create a significance between exams ordered forward vs. backward in chapters, extending this study to an exam that spans heavier material over the duration of the entire semester can further improve the robustness of our results. Additionally, our study analyzes the impact of exam formatting in only one course, and extending this research to multiple courses within agricultural economics could improve statistical validity of the results. This also implies that our results may or may not generalize to other courses in agricultural economics and across departments. However,

the fact that students in the course come from diverse majors puts this as a possibility, which warrants future investigations of the treatment effects across different courses and student populations.

Our analysis of online exam formatting, specifically ascending vs. descending difficulty and forward vs. backward chapter order, suggests that university systems and professors who have made the transition to online courses can vary the format of their exams across these versions without worrying about unintended effects on overall performance of students in their class. This allows professors, specifically those within agricultural economics departments, to focus on other factors that could possibly affect online student learning outcomes and to continue to resort to switching exam formats to help add a barrier to cheating in online exams.

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Appendix

Excerpt from Agricultural and Food Marketing Syllabus:

Grading Policies

Final Score:

Your final grade will be calculated based on the following weights:

Assignments	32%
Exams	36%
Discussion Posts	10%
Project	22%

The letter grade will be determined using the following grading scale

Points	Letter Grade
92%-100%	A
89%-91.9%	A-
86%-88.9%	B+
82%-85.9%	B
79%-81.9%	B-
76%-78.9%	C+
72%-75.9%	C
69%-71.9%	C-
66%-68.9%	D+
62%-65.9%	D
59%-61.9%	D-
Below 59%	E

Figure A1: Grading Policies for Agricultural and Food Marketing Class

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Teaching and Educational Method

Training Underrepresented Students via an Interdisciplinary Food Safety Outreach Program

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Abstract
Many higher education institutions strive to provide applied training to their students, such as by encouraging internships and including experiential learning activities in courses. This article summarizes students' participation in an outreach program as an alternative form of receiving applied training while attending college. Funded by a governmental grant and implemented by faculty and students, an interdisciplinary food safety outreach program provided a learn-by-doing opportunity to students. This article summarizes students' participation in the project under the leadership of faculty and concludes with a brief list of best practices for involving students in similar future projects.

1 Introduction

Food safety is an important issue for the agricultural and food industry, consumers, and policy makers. The U.S. Centers for Disease Control and Prevention estimates that each year, 3,000 people die and another 128,000 people are hospitalized due to foodborne illnesses in the United States (Centers for Disease Control and Prevention 2018). In addition to illnesses, hospitalizations, and lives lost, the economic burden of the pathogen contamination of food is substantial. Recently, the U.S. Department of Agriculture Economic Research Service updated its estimate of the economic burden caused by food safety recalls and outbreaks. As of 2018, the total cost is estimated at $17.6 billion, a 13 percent increase from the previous estimate in 2013 (U.S. Department of Agriculture, Economic Research Service 2022). To address this important issue with the food supply, in addition to appropriate policies and new technologies, it is important for companies and government agencies to have access to motivated and experienced food safety professionals (Freedman 2021). The food system is complex and food contamination may occur at any stage of the supply chain (Centers for Disease Control and Prevention 2022). Contaminated food affects different segments of the population in different ways, often leading to more severe health outcomes in children, elderly, and the immuno-compromised (FoodSafety.gov 2022). Hence, professionals with a holistic understanding of food safety issues—from the technical and regulatory, to the health implications and economic risks—will be better positioned to improve the safety of our food throughout the supply chain, in future decades (Freedman 2021).

Food safety jobs and careers are plentiful and span across multiple disciplines. In an analysis of job opportunities for food safety professionals across various disciplines, Stevenson (2015) projected that the increase in the number of positions from 2010 to 2020 would be as high as 24 percent for certain professions. While pursuing higher education degrees, in most cases, students obtain a narrow view of food safety, based on the discipline that they have chosen to study. The technical aspects of food safety are addressed in food science, food technology, and animal science courses. The business and demand implications of food safety outbreaks are discussed in agribusiness and agricultural economics courses. The regulatory aspects of food safety are discussed in agricultural policy and law courses. The communication and public relations aspects of food safety are discussed in agricultural communication

courses. Other disciplines that also address food safety include microbiology, epidemiology, environmental sciences, plant sciences, soil sciences, and bioprocess engineering. It is rarely the case that students get a comprehensive, system-wide perspective on food safety during their college education. A deviation from this are the handful of food safety minors offered at universities in the United States, which usually require courses across several disciplines. However, according to our assessment, none of the food safety minors we have reviewed provide the social sciences perspective regarding food safety.[1]

This article highlights how students of various disciplines were provided an opportunity to participate in an interdisciplinary Food Safety Outreach Program (FSOP). This program allowed student participants to both expand their knowledge of food safety issues from the point of view of other disciplines, as well as obtain hands-on experience with various aspects of providing food safety training to farmers. The objectives of this article are two-fold. First, the article outlines a recently completed interdisciplinary FSOP and students' involvement in this project. Second, the article outlines lessons learned and a list of best practices in involving students in outreach and extension projects, from the authors' perspective, as leaders of the project and as educators.

The article is organized as follows. The next section includes a brief discussion of the importance of hands-on and experiential learning activities to better train students for their professional careers. This section also provides information on the specific outreach project that was implemented utilizing students' assistance and/or including students' participation. The third section provides detailed information on each activity organized as part of the outreach project, and outlines students' participation. The fourth section provides a list of comments from student participants, highlighting the importance of participating in this project. The final section discusses lessons learned and contains a list of best practices in involving students in outreach and extension activities.

2 Background

The benefits of experiential learning activities are well documented in the literature (see for example Knobloch 2003 and Riley 2020). While there are many pedagogical methods of engaging students in hands-on activities during their higher education, recently a few studies have highlighted the importance of engaging students in extension and outreach projects (Cuffey et al. 2022; Liu and Zhang 2022; Marshall et al. 2022; Schmit, Stamm, and Severson 2022). While in some cases, the goal of involving students in extension-related projects is to better achieve the learning outcomes for a specific class, in other cases, the goal for this involvement (particularly at graduate-level programs) is to increase capacities in future extension professionals. This article highlights students' involvement with an interdisciplinary outreach project, where "outreach" is defined as a set of programs (trainings, workshops, etc.) to distill and communicate research-based information to industry stakeholder audiences. Students' participation in the project served the dual goal of providing faculty project leaders with assistance for project implementation, as well as providing students with a perspective into food safety that they had not been exposed to before.

While there are many articles summarizing successful interdisciplinary and cross-institutional extension and outreach projects, to our knowledge this is the first one that focuses on students' role, involvement, and training (Conner et al. 2022). The next section describes the outreach program in more detail, followed by a discussion about students' involvement and participation.

[1] The food safety minors offered at universities in the United States include: The Food Science/Safety Interdisciplinary Minor at Colorado State University, Food Safety Minor at Cal Poly Pomona, and Interdepartmental Minor in Food Safety at Iowa State University.

2.1 The Food Safety Outreach Program

The FSOP is a National Institute of Food and Agriculture program that provides funding to various entities to implement food safety education and outreach programs. Most projects are focused primarily on small-scale farmers and food processors. With a maximum award of $300,000, community outreach projects focus on the development of food safety outreach and education programs that address the needs of small, specialized, and underserved audiences (U.S. Department of Agriculture, National Institute of Food and Agriculture 2021).

In September 2019, our group of faculty representing four disciplines, from a large state university and a community college, was awarded a grant to provide interdisciplinary food safety training to small underserved farmers of leafy greens in the Central Coast of California.[2] The need for food safety training and regulation compliance among small-scale farmers is well-documented in the literature (Canales, Silva, and Anderson 2022). The FSOP included: (a) Produce Safety Alliance (PSA) Grower Training, (b) Agribusiness and Crisis Communication Food Safety workshops, (c) Grower Produce Safety workshop, and (d) field visits to growers to provide personalized food safety training based on the needs of their operations. While for some trainings, standard curriculum recognized by regulatory agencies was used (such as for the PSA Grower Training), for other trainings the faculty prepared and delivered the curriculum with assistance from students. A summary of the funded projects is publicly available (U.S. Department of Agriculture, National Institute of Food and Agriculture 2022).[3]

The target farmer audience for the outreach program included small-scale operators in the Central Coast region of California.[4] Given recent food safety outbreaks in the leafy greens' industry, priority was given to small growers of leafy greens who would benefit from the training; however, we did not exclude other small-scale farmers who expressed interest. The primary language spoken by many of the target farmers was Spanish, hence Spanish translation was offered in most of the outreach events.

One of the stated objectives as part of a FSOP grant was to include students (associate, bachelor's, and master's) in the FSOP, as event assistants, as participants, or in some cases as both. Doing so would introduce students to the practice of food safety, and hopefully inspire them to pursue careers in this field, hence increasing food safety capacity across industries.

2.2 Impact of COVID-19

The global pandemic has had an impact on extension and outreach activities across the country (Boland et al. 2022). National stay-at-home orders in the spring of 2020 quickly prompted travel and other restrictions at university campuses and other institutions. California mandated the first state-wide stay-at-home order, on March 19, 2020 (Office of Governor Gavin Newsom 2020). This order came less than two months after we implemented the first group training—the PSA Grower Training—the first portion

[2] The four disciplines include agribusiness, food science, agricultural communication, and agricultural science. Note that the community college is a designated Hispanic-Serving Institution.

[3] The proposed activities/objectives of the outreach program are listed below as written in the proposal.

a. Provide Produce Safety Alliance (PSA) Grower Training to 40 small farm operators of Hispanic origin, and students.
b. Complete in-person day-long field visits to 15 individual farms in the Santa Maria valley by personnel from the two institutions of higher education (including four professors and multiple students) to train and assist farmer participants with various aspects of food safety regulation compliance, record keeping, and crisis communication and stakeholder engagement plan.
c. Students will be intensely involved with all aspects of the outreach project outlined above. By involving students, we seek to train the next generation of food safety specialists, much needed in the food and agriculture sector.

[4] The target audience as defined on the project proposal includes: "Target group: Given the sizeable leafy greens' production in the Santa Maria valley, we will focus specifically on farm operators who grow leafy greens. Small and very small farmers of Hispanic origin are the primary demographic because this group of farmers is considered at a disadvantage in understanding and complying with food safety regulation, due to cultural norm differences and language barriers."

of activity 1 of the FSOP (refer to footnote 3). During the first outreach event, both local farmers and students completed the day-long training and were awarded certificates of completion. In the next section we describe in more detail students' involvement in planning and carrying out this and other outreach activities.

After the first outreach event, due to the various restrictions of the global COVID-19 pandemic, the activities could not continue in the same manner and the same timeline as outlined in the project proposal. While the target group of farmers would benefit from food safety training at any time, challenges with the global pandemic such as labor shortages and disruptions in the food supply chain, decreased the urgency of this particular training program. Implementation rules for the Food Safety Modernization Act (FSMA) already provided a longer compliance period for small-scale farming operations that made up the project target group (U.S. Food and Drug Administration, FSMA Compliance Dates). In addition, programmatic considerations, such as concurrent Spanish translation, involving students in project activities, and so on—led to the postponement of the implementation of most of the outreach events. Due to these challenges, a request for a Change in Scope for the project was submitted to and approved by the funding agency. As such, the project was modified to remove the second stated activity—field visits to farming operations (see footnote 3). Instead, additional online and in-person group trainings were added to the project—a format that resonated better with the preferences of the target audience, but also allowed for closer collaboration with the students.

3 Student Involvement in Outreach Efforts

The first objective of this article is to summarize students' involvement in the interdisciplinary FSOP described in the previous section. There are two ways in which students were involved in the project: (1) by assisting faculty in organizing and delivering the food safety trainings and workshops, and (2) by participating in the trainings and workshops, particularly those focused on disciplines other than the one they were majoring in (for example, food science students attended trainings organized by the agribusiness and agricultural communication faculty, and vice versa). We summarize both ways of student involvement in the sections below.

Student assistants were of diverse backgrounds, including Hispanic origin and first-generation students. Table 1 summarizes the profile of the *student assistants* involved with the project, specifically, the degree programs, fields of study, and their roles and responsibilities in the project. Student assistants were recruited by the faculty announcing the opportunities for involvement in their courses and were selected primarily based on their availability. While most of the student assistants were involved in the project for short periods or individual tasks (such as translating at a training event), four students (two students majoring in food science, one student majoring in agribusiness, and one student majoring in agriculture) were involved in the project for the duration of the project.

3.1 Summary of Outreach Activities and Specific Student Involvement and Training

Students were involved with all group training events for our project, including the PSA Grower Trainings, Agribusiness and Crisis Communication Food Safety Workshop, and Grower Produce Safety Workshop. All student assistants were paid an hourly rate equivalent to the rate of undergraduate teaching assistants (for associate and bachelor's students), and graduate teaching assistants (for Master's students). For each training and workshop event, below we summarize both students' involvement with organizing the specific event, as well as students' participation in the event as attendees.

3.1.1 PSA Grower Training

The FSMA Produce Safety Rule requires "at least one supervisor or responsible party for your farm must have successfully completed food safety training at least equivalent to that received under standardized

Table 1: Student Assistants Involved with Food Safety Outreach Program
Academic Institutions:
Allan Hancock College (a Hispanic-Serving Institution) (3 students)
Cal Poly–San Luis Obispo (18 students)
Degree Programs:
Associate (3 students)
Bachelor of Science (16 students)
Master of Science (2 students)
Fields of Study:
Agribusiness (3 students)
Agriculture (3 students)[1]
Agricultural Communication (9 students)
Food Science (6 students)
Students' Roles and Responsibilities:[2]
Developing and distributing promotional materials (21 students)
Event set-up and logistics (16 students)
Designing materials for and leading activity stations (6 students)
English–Spanish and Spanish–English translation (16 students)
Study and compilation of training materials (10 students)
Completing the trainings offered (21 students)
Distribution of certificates and post-event follow-ups (5 students)
Social media, Zoom, and in-person interactions with participants (21 students)

[1] Represents the Allan Hancock College major.

[2] The number of students in this section adds up to more than 21 because most students assisted with several tasks. These statistics are also provided in the tables below, broken down for each training and workshop.

curriculum recognized as adequate by the FDA" (U.S. Food and Drug Administration–Code of Federal Regulations Title 21). One way to fulfill this requirement is to have individuals complete the PSA Grower Training course (Association of Food and Drug Officials 2023). This formal food safety training covers practical aspects of running a farming operation, such as worker health and hygiene, soil amendments, on-farm wildlife and domesticated animals, farm water, postharvest handling of produce, and the creation of a farm food safety plan (Association of Food and Drug Officials 2023). In order to provide this training to farmers and students, two faculty members completed the PSA train-the-trainer course and led both of the PSA trainings that were offered as part of the project. Table 2 offers a summary of the PSA Grower Trainings and student involvement. Out of the 40 attendees, 10 students successfully completed the PSA Grower Training, earning their certificates of completion. Importantly, half of the students were from social science fields and would not have learned the information covered in this training in their college courses. All ten student participants were also involved with assisting with various aspects of the two training sessions offered. Specifically, for the PSA Grower Training events, students were involved in multiple aspects, from event promotion to set-up and translation. Agricultural communication students assisting with the event had an opportunity to put their classroom skills into practice creating promotional communication materials.

Table 2: Produce Safety Alliance Grower Training
Trainings Offered:
Training 1: 17 Total Participants, January 2020
Training 2: 23 Total Participants, June 2021
Students Completed Training:
Agribusiness (1 student)
Agricultural Science (1 student)
Agricultural Communication (4 students)
Food Science (4 students)
Students Assisted With (10 Students Involved)[1]:
Designing and Distributing Promotional Materials
Event Set-Up: Welcoming and Registering Attendees
Studying Training Materials in Advance
Translation: English–Spanish and Spanish–English
Interacting and Networking with Farmer Attendees

[1] The same students both assisted with the events and were participants who earned their PSA Grower Training Certificates.

For students assisting with translation during the event, the role required additional training and preparation beyond the classroom. Students from all fields and both institutions assisted with translation during the event. Multiple translators were used to provide the best quality translation possible, short of hiring cost-prohibitive professional translation services. Since the PSA training materials are available both in English and Spanish, student translators were asked to study the training manuals in advance of the training. Leading up to the event, students met weekly with faculty project leaders to ask questions and ensure appropriate understanding of the training materials. This was an important step for all student translators, because while all had the language skills necessary, they lacked the specific food safety knowledge, as well as the corresponding vocabulary in one or both languages. Students took turns in providing simultaneous translation, because attendees whose preferred language was Spanish wore headsets during the event. Importantly, students also translated questions from the audience (Spanish into English), allowing for an excellent flow for a bilingual event. The PSA Grower Training is designed to be delivered as a full-day course, but many trainers either provide the training in one single language or provide the training across multiple days in order to accommodate for translation services. In this case, we were able to provide the training simultaneously in two languages within the allocated time, hence saving busy farmers time while also reaching the target audience.

Finally, it is important to note that during the training events, students had opportunities to interact with farmers, listen to their questions, and observe their concerns about food safety regulation and assurance of food safety at the farm level. While some of the topics covered during the training may be discussed in college classes at the macro level, the practical aspects of the interaction between constraints, information, regulation compliance, and profitability were discussed in much more depth during these trainings, providing students real-world experience outside of their classroom environment.

3.1.2 Agribusiness and Crisis Communication Food Safety Workshop

Food safety outbreaks and recalls have critical implications for businesses and consumers. The vast agricultural economics literature outlines the implications of food safety outbreaks for various industries, including the leafy greens' industry (see for example, Arnade, Calvin, and Kuchler 2009). In agricultural communications literature, crisis and risk communication are an identified research theme (Williford et al. 2016) where scholars frequently explore food safety crisis communication (such as in Barr, Irlbeck, and Akers 2012; Irlbeck et al. 2014; Opat, Magness, and Irlbeck 2018; Calley, Myers, and Gibson 2019; and Gibson et al. 2019). However, while this literature and information may be more accessible to agribusiness and agricultural communication students, it is likely largely unknown to students in other fields, as well as among small-scale farmers. A goal of this project was to distill the current body of literature from these disciplines in a short workshop for farmers and students.

The training materials for the Agribusiness and Crisis Communications Food Safety Workshop were prepared by the agricultural economics and agricultural communication faculty, with assistance from students. The first workshop was held shortly after the stay-at-home order, in May 2020, and thus it was held remotely over Zoom.[5] Participants included farmers, food industry representatives, and students. The second workshop was held in May 2022, and it was also held remotely over Zoom. Participants were primarily food science students.

On the agricultural communication side, the workshop included topics such as a brief history of major food safety outbreaks since the 1990s, do's and don'ts of food safety crisis communication, including understanding principles of good crisis communication such as lessons on uncertainty, risk, and threat perception. It also included information on pre-event preparation and planning, developing genuine and deep partnerships with stakeholders, and communicating effectively, early and often during crisis events. On the agricultural economics side, the workshop discussed the economic burden of food safety outbreaks, implications of recalls in agricultural commodities versus branded food products, consumers' demand response during food safety recalls, estimating costs of regulation compliance, industry strategies to reduce food safety outbreaks, and steps of recovering from food safety recalls for affected companies/brands. For farmers and students (particularly food science students), these topics were interesting and thought-provoking, and importantly, not covered elsewhere in the formal curriculum.

Since these were virtual events, five student assistants were primarily involved with event promotion, as well as with material preparation and compilation. Both sessions were held in English only. Student assistants managed the technical aspects of the Zoom sessions as well as kept track of attendance and issued certificates of completion, after the event. Table 3 summarizes key statistics about the trainings as well as students' assistance.

3.1.3 Grower Produce Safety Workshop

One of the objectives of the outreach project was to provide on-site individualized training to target farmers, covering topics such as the design of a food safety plan, keeping track of food safety compliance costs, the design of a crisis communication plan, among other topics. However, due to the global pandemic as well as small-scale farmers' limited time availability, we had difficulties providing the number of on-site trainings that was initially proposed. Via a change in scope, we requested to modify this part of the objective and instead offered an additional group workshop, which took place in June 2022.

[5] The first training, titled "Food Safety Crisis Communication, Data Analytics, and Marketing Training," was sponsored by a separate small grant from California State University Extended Education.

Table 3: Agribusiness and Crisis Communication Food Safety Workshop
Trainings Offered:
Training 1: 70 Total Participants, May 2020
Training 2: 25 Total Participants, May 2022
Students Completed Training:
Food Science (25 students)[1]
Students Assisted With (5 Students Involved):
Designing and Distributing Promotional Materials
Preparing and Compiling Training Materials
Zoom Session Assistance
Digitally Distributing Certificates to Attendees

[1] Only includes participants from Training 2. Training 1 was sponsored via a different grant, and it was held remotely shortly after the start of the global COVID-19 pandemic. Due to allowing as much flexibility for participation as possible, this event was completely open to the public. As such, attendees were not asked to register beforehand, and we did not collect any information related to their background (such as whether they were students or industry representatives). Note, five student assistants involved with organizing the event were agricultural communication students; hence, they are not counted in the 25 student participants who were all food science students.

The Grower Produce Safety Workshop provided an opportunity for farmers and students to receive an update on the FSMA Proposed Rule on Agricultural Water, as well as discuss in more depth additional topics including sanitation and inspection compliance. The workshop included Activity Stations for participants to interact, learn, and ask questions, as well as a brief presentation by a food safety inspector to discuss inspection procedures and checklists. Compared to all other events, this event included a longer Q&A session and more active participation from the audience. Table 4 summarize the key statistics from this workshop.

3.2 Collaboration with a Community College

An important component of this project is the collaboration between a state university and a community college. While being certified as a Hispanic-serving institution, Allan Hancock College also serves many first-generation students and students with farming backgrounds. These backgrounds and experiences made Allan Hancock College students a great asset to the team because students helped identify and reach farmers in the target audience, as well as assisted with a successful delivery of the program given their language skills and cultural background. Researchers and extension workers alike recognize the importance of language and cultural sensitivity in delivering successful extension programs; hence, we strongly believe that this program greatly benefited from students' involvement (Nabwiire et al. 2022).

However, an unplanned added benefit of this collaboration was the unique experience that it offered Allan Hancock College students, particularly those that either transferred to Cal Poly during the program or planned to do so, to earn a four-year college degree. In the case of the transfer students, participating in this program offered the benefit of getting to collaborate with professors in three departments at Cal Poly. Transferring from a small community college to a large state university, students may often encounter challenges in forming relationships with professors, which in turn may

Table 4: Grower Produce Safety Workshop
Trainings Offered:
Training 1: 22 Total Participants, June 2022
Students Completed Training:
Agribusiness (2 students)
Agricultural Science (2 students)
Food Science (2 students)
Students Assisted With (6 students)[1]:
Designing and Distributing Promotional Materials
Researching and Identifying Target Audience Participants
Preparing Materials for Activity Stations
Leading Activity Stations
Event Set-Up
Translation: English–Spanish and Spanish–English
Interacting and Networking with Farmer Attendees

[1] The same students both assisted with the event and were participants who earned their Grower Produce Safety Workshop certificates.

affect their internship and job prospects, graduate school recommendation letters, and so on. In a review of the literature, Ivins, Copenhaver, and Koclanes (2017) find that faculty collaborations are an important factor assuring transfer students' success at the new institution. In our program, we offered transfer students the opportunity to form relationships and collaborate with faculty as well as provided them with guidance on university resources and support. The relationship with students has the potential to be mutually beneficial—program leaders benefit from the unique background and experiences of the community college students, and students benefit from the connections with faculty. While there is literature on the factors that affect transfer students' success more generally, the impact of opportunities to collaborate with faculty in projects similar to ours, before students transfer, should be further investigated.

4 Feedback from Student Participants

Due to the scope of this outreach project, specific assessments of learning objectives for students were not included in the program. However, at the conclusion of the program, we contacted student participants and student assistants to ask for written feedback. Below we have included the responses of the students who responded to our inquiry.

- "*After making a career change and selecting the agriculture industry, establishing a strong foundation with my education in agriculture was an important step towards my future and career goals. By completing both the* ***Produce Safety Alliance Grower Training*** *and* ***Grower Produce Safety Workshop*** *that were offered at Allan Hancock College, I can enter the agriculture industry with a new set of skills that will make me more competitive when searching for a job and a strong addition to any company*." (Agriculture Student, Allan Hancock College)

- "*I participated in the **Agribusiness and Crisis Communication Food Safety Workshop** and was introduced to many facets of food safety economics and communication. I was taking food safety at the time, and it was very helpful to review the case studies. In class, we would look at them from a microbiological and hazard prevention point of view, but in the workshop, we were able to look at the studies from a communication perspective. Understanding how crises are communicated can be just as important as solving the crises themselves*." (Food Science Student, Cal Poly)

- "*As a college student who would soon be transitioning to a full-time role in the industry, I recognized the value of participating in projects that would help me develop a strong understanding of the current issues facing agriculture. My involvement with this project through the **Grower Produce Safety Workshop** helped me learn about current food safety regulations under the Food Safety Modernization Act. I am grateful to have had the opportunity to work alongside professors on this project and connect with local industry professionals in an effort to share the importance of keeping our food products safe."* (Agribusiness Student, Cal Poly)

- "*The **PSA Grower Training** opened my eyes to a whole other form of agricultural communication—rather than informing the public of agricultural activities, this program set out to inform and enhance the lives of our own farmers. I was introduced to the world of USDA with their plethora of regulations, which has been immensely beneficial as I start my first post-graduate job and help farmers navigate USDA and California Department of Food and Agriculture (CDFA) programs and applications*." (Agricultural Communication Student, Cal Poly)

- "*Participating in the **PSA Grower Training** was a great opportunity for me to apply tangible agricultural communication skills and acquire technical knowledge about food safety protocols under the Food Safety Modernization Act (FSMA). The program provided local growers with access to critical education that they would normally not receive, which is why the support of this training was so important*." (Agricultural Communication Student, Cal Poly)

- "*Only looking at curriculum, food safety almost puts on blinders for students because we become fixated on this 'battle' between us, the product makers/producers, and them, the hazards of the environment. So much so, that we begin to lose sight of why we are doing this: To provide trusted, safe, wholesome food products. Participating in the **Agribusiness and Crisis Communication Food Safety Workshop** helped me to 'refocus my perspective on food safety as not just this fight against microbes and other hazards, but to include, in that fight, the negative psychological impacts that occur when that fight that we were fixated on, is lost. This course was essential in my recognition that food safety requires setting aside our pride as a business, to refocus on those who are impacted most by our failure (the consumers)."* (Food Science Student, Cal Poly)

- "*I truly enjoyed being a part of this project. The trainings were beneficial for me personally, but also for the agribusiness leaders who participated. I now better understand the overlap between social science, policy, and food science when it comes to ensuring food safety. I think food safety trainings should be accessible to all in order to prevent any type of harm*."
(Food Science Student, Cal Poly)

5 Involving Students in Outreach: Best Practices

While this was a short (2.5 years), relatively small budget (about $200,000) project, which took place in the middle of a global pandemic—we believe the best practices outlined below are applicable to other types of interdisciplinary outreach projects and provide valuable insight for other academics seeking to involve students in outreach efforts. This list of best practices is based on our collective experience working with students on this project, and as such, it is not a conclusive list of best practices, but rather a starting point. Lessons learned from other project leaders outlined in future articles, as well as research articles that focus on measuring student learning outcomes by participating in such projects, will inevitably add to this list in the future.

a. *Include student assistants in outreach projects.*
   Even if students are primarily engaged with administrative and event organization tasks, they learn about the subject matter in small ways: studying materials, interacting with attendees, proofreading training materials, and so on.

b. *Extend the opportunity to participate to all students.*
   Announce the opportunity to be a part of the project to all students in your classes, emphasizing that a high GPA or academic performance of a certain level is not a requirement. For students who express interest, requiring a resume to apply may discourage some students who think they lack experience. Instead, meet with them one-on-one, if possible, to learn about their skill set and personal background. Meeting with students to explore their unique skill set may be a more effective way of involving a diverse set of students. Relevant skills may include technical skills, communication skills, language skills, and skills in event planning and social media promotions, among others. Relevant backgrounds may include farming or small business background and links to the project target audience (which may help with recruiting project participants, being aware of cultural sensitivities, and understanding language barriers, among others).

c. *Pay student assistants.*
   While some students may be interested to participate for the experience, paying all students is a better approach because it attracts a diverse set of students. Particularly, first-generation as well as underrepresented and marginalized students may not have the luxury of engaging in a project without pay, even if it benefits them academically. In addition, for many grant-funded projects, including a budget line for undergraduate assistants will not overwhelm the budget constraints.

d. *If possible, hire a part-time administrative assistant.*
   For larger, multidisciplinary, and/or cross-institutional grants, it is important to budget a part-time (or full-time) administrative assistant. Such an assistant would be in charge of helping students complete the paperwork and any required trainings, complete travel requests for students, process students' reimbursement requests, and so on. This is particularly important for a long-term project because many students might assist throughout the project, for a semester or for a single event.

e. *Meet with students one-on-one and as a group.*
   Support and mentor student assistants throughout the project, particularly via brief one-on-one or group meetings. If graduate students are involved in the project, seek their assistance in mentoring undergraduate students. If your outreach efforts are in a specific area, such as food safety, this time with students serves to inspire and prepare them for careers in that area, and hence, increases professional capacities for the future.

f. *Provide students with the opportunity to assist in events across disciplines.*
Agricultural economics and agribusiness students assisting with food and animal science events, bioengineering and agricultural communication students assisting with economics events, etc.—these opportunities allow students to study the same issues from the lens of a different discipline, in an applied setting. Such experiences are enriching and might just lead to a more well-rounded workforce for the food and agriculture industry.

g. *Include students of diverse backgrounds and degree levels.*
If possible, collaborate with local community colleges and involve students from these institutions in the project. The project will be richer because of the diverse backgrounds, experiences, and skills the students bring. But also, it introduces community college students to the world of research and outreach in a less threatening way, potentially motivating them to seek undergraduate degrees and/or careers in fields related to food and agriculture.

h. *Measure the learning and career impact on students.*
Design thoughtful methods to measure the impact on students. This may be done by including a set of learning objectives and assessing such objectives by utilizing pre- and post-tests. Other options include following up with student participants to understand what role, if any, the participation in the outreach/extension activity had on their choice of job after graduation. This is one of the major limitations of this article that we hope future literature will help fill.

i. *Do not be discouraged!*
Most multiple-year projects do not go as planned, even for seasoned project leaders. Whether the target audience is defined too narrowly, or whether a global pandemic occurs in the middle of the project implementation, at times it is necessary to shift direction. The same applies for student involvement in the project. For example, you may plan to have the same five students assist with the project implementation for the duration of the project but end up having 25 students engaged in smaller parts instead. Many unforeseen circumstances may affect project implementation, but the solutions that emerge may in some cases work even better than the initial plan as proposed.

6 Conclusions

The food and agriculture industry stands to benefit from a well-trained workforce. Project leaders for extension and outreach projects stand to benefit from assistance from students in project implementation. In turn, by being involved in outreach projects, students learn new knowledge and skills, create new connections with faculty and industry, and earn a modest pay. As such, extension and outreach projects involving students are a unique public-private partnership to generate and distribute knowledge to the industry, while training a new workforce. As an added benefit, for cross-disciplinary projects, students may learn more about a specific issue from the lens of other disciplines.

In this article, we have summarized the first attempt at involving students in an interdisciplinary project related to food safety outreach. We have briefly highlighted the project and discussed students' involvement in all aspects of the project. A unique part of the project was that it included a collaboration between a state university and a Hispanic-serving community college. We concluded by listing the best practices of involving students in outreach projects. While the central part of this project was to provide training opportunities to the local farmers, future projects involving students should also explore in more depth the longer-term learning and career impact on student participants.

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Case Study

Market Power in the U.S. Peanut Industry

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JEL Codes: L1, L2, L4, Q13
Keywords: Farm support programs, oligopsony, oversupply, peanuts, price-fixing

Abstract
This case study is motivated by recent developments in the U.S. peanut industry involving allegations of an illegal exercise of buyer market power by the three largest peanut buyers (peanut shellers) in the country. They purchased raw peanuts directly from peanut growers. Peanut growers filed a class action antitrust lawsuit alleging that these buyers engaged in a price-fixing conspiracy aiming to suppress and stabilize prices of peanuts paid to peanut growers beginning in 2014. The case study introduces economic, business, and legal issues related to the alleged peanut price-fixing cartel. The case study presents economic models that help explain conduct and performance of the peanut industry in the analyzed setting, and it includes basic market and price analysis. The intended audiences are undergraduate and graduate students, as well as extension and outreach communities. A teaching note summarizes student learning objectives, teaching strategies, and student background knowledge. The teaching note also includes multiple-choice questions, as well as suggested answers and guidance to analytical, discussion, and multiple-choice questions.

1 Introduction

The U.S. peanut industry is a highly concentrated industry on the peanut purchasing (buying) side. While there are numerous peanut farmers growing and selling peanuts, there are only three large buyers (peanut shellers) who purchase raw peanuts directly from peanut growers. These three peanut shellers control approximately 80 to 90 percent of the market. The peanut shellers are oligopsonists, who theoretically can exercise buyer market power by lowering peanut prices they pay to peanut growers.

In May 2020, peanut growers (plaintiffs) filed a class action antitrust lawsuit against the three largest peanut shellers in the United States: Birdsong Corporation (Birdsong), Golden Peanut Company, LLC (Golden Peanut), and Olam Peanut Shelling Company, Inc. (Olam) (defendants). In their complaint, peanut growers alleged that these peanut shellers engaged in an input price-fixing conspiracy (cartel) aiming to decrease and stabilize prices paid for Runner peanuts beginning in 2014, violating Section 1 of the Sherman Act (Bloch 2020; "In Re Peanut Farmers Antitrust Litigation" 2020). The peanut growers claimed that because of this price-fixing conspiracy, they received lower prices for peanuts and were underpaid. The peanut shellers settled this lawsuit with peanut growers for a total amount equal to $102.75 million (Bunge 2021; "In Re Peanut Farmers Antitrust Litigation" webpage 2022).

The objective of the case study is to explain recent developments in the U.S. peanut industry involving allegations of illegal exercise of buyer market power by the three largest peanut shellers in the country, as well as related economic, business, and legal issues. The case study focuses on applications of economic models that may explain the buyer market power of the three largest peanut shellers in the analyzed industry setting, as well as a basic empirical market, price, and profitability analysis utilizing publicly available data from the U.S. Department of Agriculture.

2 U.S. Peanut Industry

This section discusses peanut production, varieties, and uses; the industry structure; marketing arrangements used by peanut growers and peanut shellers; and government programs affecting the peanut industry.

2.1 Peanut Production, Varieties, and Uses

Table 1 summarizes peanut area planted, production, prices, value of production, and the number of peanut farms for the leading peanut-producing states in the United States for 2020 (U.S. Department of Agriculture, National Agricultural Statistics Service 2022a, 2022b). Peanuts are planted in the spring (April/May) and harvested in the fall (September/October). The Runner, Spanish, Virginia, and Valencia are the four peanut varieties grown in the United States (National Peanut Board 2022). The Runner variety is the largest share of the U.S. peanut crop: 80 percent (Schnepf 2016). Runner peanuts are used to manufacture peanut butter because their kernel size is suitable for quality roasting. Runner peanuts are grown in Alabama, Florida, Georgia, Oklahoma, South Carolina, and Texas.

The shares of Virginia, Spanish, and Valencia varieties in the total U.S. peanut crop are 15 percent, 4 percent, and 1 percent, respectively (Schnepf 2016). Virginia peanuts are sold as snack peanuts and in-shell peanuts because they have large kernels. Virginia peanuts are grown in North Carolina, South Carolina, Texas, and Virginia. Spanish peanuts are used to produce peanut butter, snack peanuts, and confections. Their kernels are small and round with red skins. Spanish peanuts are grown in Oklahoma and Texas. Valencia peanuts are used to manufacture all-natural peanut butter, and they are also sold as in-shell peanuts. Valencia peanuts are grown in New Mexico.

Peanuts may be consumed in fresh form, but typically are consumed as processed products. The latter include peanut butter, roasted peanuts (snacks), peanut oil, and peanut flour. Peanuts are also used to produce biodiesel (Agricultural Marketing Resource Center 2022). Figure 1 depicts the quantities of peanuts allocated to different demand uses (disappearance) for the period from 2002 to 2020. The peanuts used as food represent the largest share of all peanuts available in the market, followed by exported peanuts.[1] Figure 2 depicts the quantities of peanuts allocated to different categories of food uses and peanut consumption (use) per capita during the period from 2002 to 2020. Peanut butter is the primary food use for peanuts, followed by snack peanuts and peanut candy.

2.2 Government Programs Affecting the U.S. Peanut Industry

Beginning in the 1930s and through 2002, federal government programs directly affected peanut industry production and marketing. In particular, peanut marketing quotas (a form of supply management) effectively regulated the quantity of peanuts produced each year (Jurenas 2002). The peanut marketing quota system was a form of price support program, which included two loan rates and limited the quantity of peanuts produced for domestic market for food uses, which were eligible for the higher level of the two loan rates. Peanuts produced in excess of the marketing quota had to be exported or diverted to lower value uses and were eligible for a lower loan rate.

In 2002, the peanut industry was deregulated through implementation of a marketing quota buyout program (Dohlman and Livezey 2005; Dohlman, Foreman, and Da Pra 2009). Peanut growers became eligible for Marketing Assistance Loans (MALs) that were previously only available to growers of selected field crops (corn, cotton, soybeans, wheat, etc.; Congressional Research Service 2019).

[1] The peanut supply each year includes peanut stock at the beginning of the year, peanut production, and peanut import. The import has a very small share in the total peanut supply. Figure A1 presented in the Appendix depicts the peanut supply sources in the 2002–2021 period.

Table 1: The U.S. Peanut Industry: Acres Planted, Production, Prices, Value of Production, and Number of Farms, 2020

State	Acres Planted	Production	Price	Value of production	Number of farms[2]
	Thousand	Million pounds	$ per pound	$ million	
U.S. Total	*1,662.5 (100.0)*	*6,158 (100.0)*	*0.21*	*1,294 (100.0)*	*6,379 (100.0)*
Georgia	810 (48.7)[1]	3,317 (53.9)	0.20	673 (52.0)	2,838 (44.5)
Texas	190 (11.4)	485 (7.9)	0.26	125 (9.7)	576 (9.0)
Alabama	185 (11.1)	622 (10.1)	0.21	131 (10.1)	667 (10.5)
Florida	175 (10.5)	564 (9.2)	0.20	115 (8.9)	661 (10.4)
North Carolina	107 (6.4)	410 (6.6)	0.22	90 (7.0)	614 (9.6)
South Carolina	84 (5.1)	296 (4.8)	0.21	63 (4.9)	477 (7.5)
Arkansas	39 (2.3)	182 (3.0)	0.19	35 (2.7)	77 (1.2)
Virginia	28 (1.7)	112 (1.8)	0.22	25 (1.9)	189 (3.0)
Mississippi	23 (1.4)	97 (1.6)	0.19	19 (1.5)	113 (1.8)
Oklahoma	15 (0.9)	59 (1.0)	0.22	13 (1.0)	115 (1.8)
New Mexico	6.5 (0.4)	15 (0.2)	0.29	4 (0.3)	29 (0.5)

Source: U.S. Department of Agriculture, National Agricultural Statistics Service (2022a, 2022b)
[1] The individual state's shares in the U.S. total are in the parentheses.
[2] The number of farms is for 2017 (U.S. Department of Agriculture, National Agricultural Statistics Service 2022b).

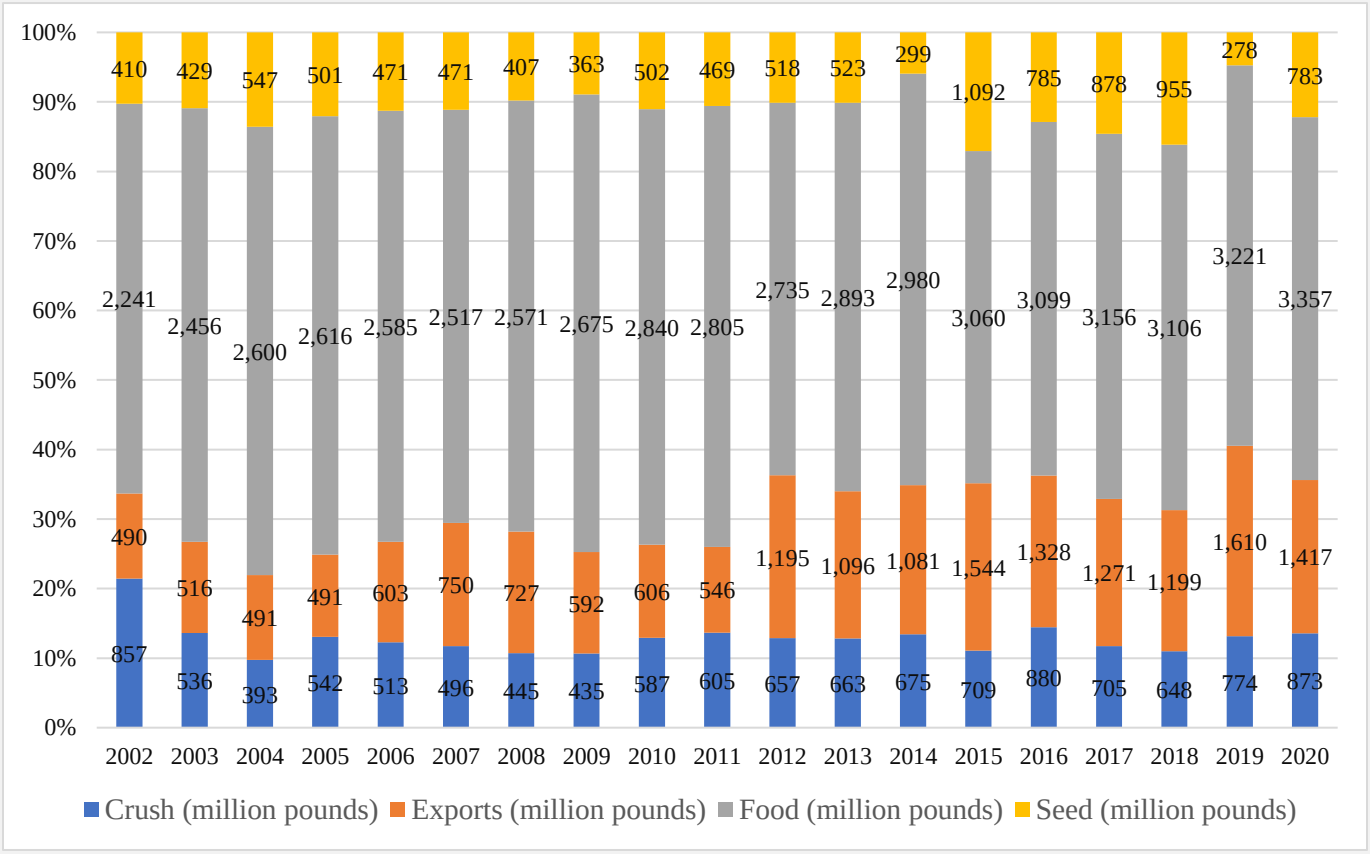

Figure 1: The U.S. Peanut Industry: Demand (Disappearance), 2002–2020

Data Source: U.S. Department of Agriculture, Economic Research Service (2022a)
Note: The seed category also includes loss, shrinkage, and residual uses (farm use and local sales).

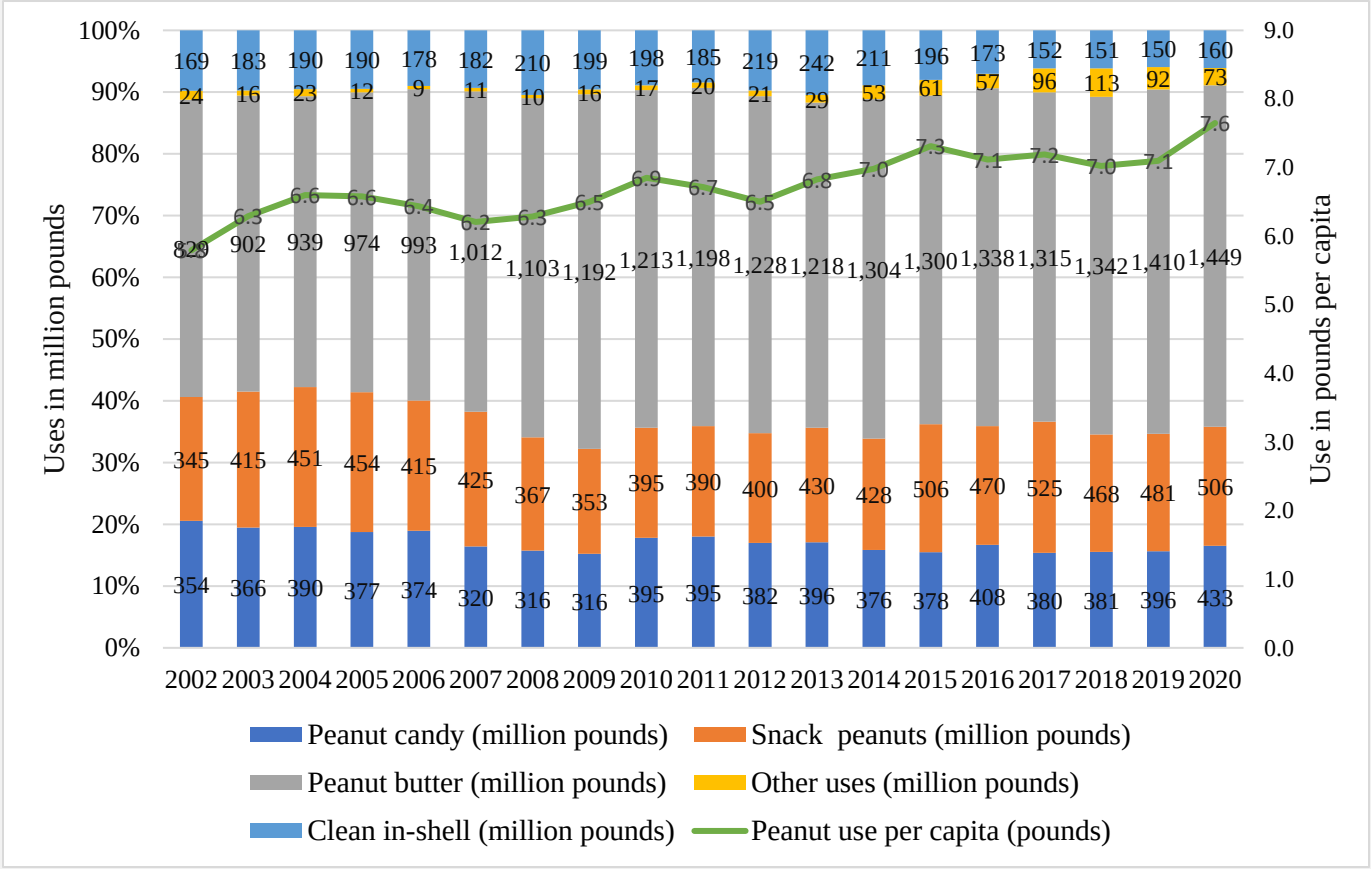

Figure 2: The U.S. Peanut Industry: Food Demand (Uses) and Food Use per Capita, 2002–2020

Data Source: U.S. Department of Agriculture, Economic Research Service (2022a)

The MAL program provides interim financing in the form of a government loan to producers of agricultural commodities covered by the program for up to nine months following the harvest, when commodity prices are typically the lowest (Schnepf 2016; U.S. Department of Agriculture, Farm Service Agency 2016; Congressional Research Service 2019). This program serves as a safety net for agricultural producers because MAL rates act as price floors, practically ensuring that agricultural producers receive a minimum price equal to the MAL rate. Since 2002, the MAL rate for peanuts has been $355 per ton or 17.75 cents per pound of peanuts. The total loan proceeds received by agricultural producers under the MAL program at the time of enrollment (after the harvest) are approximately equal to the statutory established loan rate for a particular commodity times this commodity's quantity placed under the loan.

MALs are nonrecourse loans. Agricultural producers can either repay the loan principal and interest or forfeit their agricultural commodities to the Commodity Credit Corporation (CCC). In the latter case, the U.S. Department of Agriculture takes the ownership of forfeited commodities. When peanut growers have their peanuts under MALs, if market prices are high (above the MAL rate), then these peanut growers can sell peanuts in the market and repay the MAL to the government. If peanut prices remain low (below the MAL rate), peanut growers should keep the MAL proceeds and allow the U.S. Department of Agriculture to take ownership of their harvested peanuts. The loan repayment rates are calculated by the U.S. Department of Agriculture and, in the case of peanuts, are announced on a weekly basis. The National Posted Price for Peanuts (NPP) is used to determine the loan repayment rates for peanuts (U.S. Department of Agriculture, Farm Service Agency 2022).

The 2014 Farm Bill introduced two new programs for agricultural producers eligible for MAL benefits, including peanut growers: Price Loss Coverage (PLC) and Agriculture Risk Coverage (ARC),

which provide an additional layer of income protection for these agricultural producers. Agricultural producers are periodically given options to select one of these programs for each commodity. Almost all peanut growers (99.7 percent) have selected PLC, because it provides more benefits in terms of payments and risk protection, when compared to ARC (Schnepf 2016). PLC payments are made on "peanut base acres," which represent historical peanut planting area on each farm. The 2014 Farm Bill also introduced "generic base acres" and allowed PLC payments to be made on these acres in proportion to the area of peanuts planted in each particular year (Schnepf 2016).[2]

The established limit for aggregate government payments under MAL, PLC, or ARC programs made to all covered commodities, except for peanuts, is $125,000 per person per year (Schnepf 2016). Because of the marketing quota buyout program implemented in 2002, there is a separate payment limit for farmers growing peanuts, which is also $125,000 per person per year. Therefore, growers who grow peanuts and other covered crops may potentially be eligible for $250,000 per person per year.

2.3 Peanut Shellers[3]

The peanut shelling stage of the peanut supply chain is highly concentrated. Currently there are three large peanut shellers who purchase most raw peanuts from peanut growers. Birdsong and Golden Peanut are the two largest peanut shellers, with a combined market share[4] of peanut handling equal to approximately 70 to 80 percent (Adjemian et al. 2016; "In Re Peanut Farmers Antitrust Litigation" 2020).[5] Olam is the third largest peanut sheller, with market share equal to at least 10 percent. Approximately one dozen of smaller peanut shellers comprise the remaining market share. Cooperatives of peanut growers represent some of these smaller peanut shellers.

Peanut shellers purchase raw peanuts directly from peanut growers. Peanut shellers clean, shell, and sort peanuts to sell them to food manufacturers (American Peanut Council 2022). Peanut shellers procure raw peanuts through buying points located in peanut growing regions. Raw peanuts are delivered to buying points first, and then they are delivered to the shelling plants owned and operated by peanut shellers. The buying points are either owned by peanut shellers or independently owned. The buying points do not have any pricing power, and they do not take the ownership of peanuts. The buying points facilitate transactions and convey pricing information on behalf of peanut shellers to peanut growers.

Birdsong operates six shelling plants in Georgia, Texas, and Virginia. Birdsong also operates 85 buying points in the southeast and southwest regions of the United States. Golden Peanut operates shelling plants in Georgia, Texas, and internationally. Golden Peanut operates more than 100 buying points. Golden Peanut is owned by Archer Daniels Midland Company (ADM), one of the largest food and feed processors in the world. Olam operates shelling plants in Alabama and Georgia. Olam operates approximately two dozen buying points. Olam is owned by Olam International Limited (OIL), which is a large agribusiness company operating in 60 countries.

Several mergers and acquisitions involving peanut shellers took place in the last decade. To enter the U.S. peanut shelling market, OIL purchased McCleskey Mills in December 2014, then the third largest peanut sheller in the country having a 12 percent market share. In 2015, Golden Peanut acquired Clint Williams Company (known as Texoma Peanut Company) after it filed for bankruptcy. This bankruptcy threatened to adversely affect peanut growers in Arkansas, Mississippi, Oklahoma, and Texas. In June

[2] The "generic base acres" are former cotton base acres. Under the 2014 Farm Bill, cotton is not eligible for PLC or ARC payments (Schnepf 2016).

[3] The information presented in this section is primarily from "In Re Peanut Farmers Antitrust Litigation" (2020), a complaint filed by peanut growers in the court.

[4] The combined market share of N largest firms in the industry is the N-firm concentration ratio, which is a commonly used measure of market concentration (Besanko et al. 2006). CR4 (N = 4) is the most frequently used measure. It is considered that if CR4 exceeds 75 percent, an industry is conducive to collusion, and if CR4 is smaller than 40 percent, an industry is not likely to present competition concerns (Hovenkamp 2005).

[5] There were 92 peanut shelling companies in the United States in 1970 ("In Re Peanut Farmers Antitrust Litigation" 2020).

2016, OIL purchased Brooks Peanut Company, then the sixth largest peanut sheller in the country. In December 2018, McCleskey Mills and Brooks Peanut Company were merged. The merged company was renamed as Olam Peanut Shelling Company.

2.4 Option Contracts

Since 2002, after the industry deregulation, the primary marketing options for peanut growers have been MALs provided by the government and option contracts with peanut shellers (Rural Advancement Foundation International-USA 2007; Hollis 2014). Option contracts generally fall in the category of marketing contracts used by agricultural producers to sell agricultural commodities to their buyers (MacDonald and Korb 2011; Prager et al. 2020).[6]

For peanut growers, an option contract is an output forward pricing method, which helps manage market and price risks (Paul, Heifner, and Helmuth 1976; Bolotova 2022). Before or during the peanut production season, peanut growers sign option contracts to lock in the peanut price and quantity specified in the contract. Peanut growers own peanuts that they produce during the production season. Due to the design of option contracts, peanut growers must be enrolled in the U.S. Department of Agriculture MAL program.

For peanut shellers, an option contract is an input forward pricing method, which allows them to ensure a steady supply of the needed quantity of peanuts that have desirable quality characteristics. Under option contracts, peanut shellers have the exclusive right (option) to purchase peanuts out of the MALs of peanut growers signing these option contracts. For peanut shellers, option contracts are not an obligation to purchase peanuts.

The peanut pricing system included in option contracts has two main components: MAL repayment rate (which is announced by the government) and option premium (Nadolnyak, Revoredo, and Fletcher 2005; Rural Advancement Foundation International-USA 2007; Adjemian et al. 2016). If a peanut sheller (buyer) decides to not exercise the option contract, a peanut grower (seller) keeps the option premium. If the peanut sheller exercises the option contract, the sheller buys peanuts out of the MAL of the peanut grower at the current loan repayment rate. The sheller makes this payment (repays the loan on a grower's behalf) to the government. The peanut grower receives the option premium from the peanut sheller and the MAL proceeds originally received from the government, when the grower signed up for the program.

Since 2002, after the industry deregulation, the national average MAL rate has been $355 per ton of peanuts or $0.1775 per pound of peanuts (Schnepf 2016; U.S. Department of Agriculture, Farm Service Agency 2016; Congressional Research Service 2019). The MAL rate varies depending on peanut variety (Runner, Valencia, Virginia, or Spanish) and segregation (Segregation 1, 2, or 3); the latter reflects the overall quality of peanuts (U.S. Department of Agriculture, Farm Service Agency 2020). Most peanuts are graded as Segregation 1 (highest quality). In addition, the MAL rate for Segregation 1 is adjusted for premiums and discounts for the presence and/or absence of various peanut quality characteristics (U.S. Department of Agriculture, Farm Service Agency 2019).

The option premiums set by peanut shellers in option contracts vary depending on peanut variety, whether peanuts are irrigated or non-irrigated, quantity of peanuts, quality of peanuts (Segregation 1, 2, or 3), and additional requirements for specific peanut quality characteristics affecting quality of processed peanut products (Revoredo-Giha, Nadolnyak, and Fletcher 2005; Rural Advancement Foundation International-USA 2007). The overall industry conditions affecting peanut shellers' decisions on the amount of option premiums to offer each year include peanut stock already available from the previous year, expected peanut production, and expected prices of competing crops that peanut growers may decide to plant, such as corn, cotton, and soybeans (Adjemian et al. 2016).

[6] The peanut industry's option contracts are distinguished from options on futures contracts traded at organized exchanges, such as Chicago Mercantile Exchange (CME). Futures markets (futures contracts and options on futures) do not exist for peanuts.

3 Alleged Input (Peanut) Price-Fixing Cartel of Peanut Shellers[7]

In May 2020, peanut growers filed a class action antitrust lawsuit against Birdsong, Golden Peanut, and Olam alleging that these peanut shellers conspired and colluded to decrease and stabilize prices paid for Runner peanuts beginning in 2014. The plaintiffs argued that the following peanut industry conditions and conduct of the defendants indicated a presence of the peanut price-fixing cartel of the three largest peanut shellers in the country ("In Re Peanut Farmers Antitrust Litigation" 2020).

1). The peanut shelling stage of the peanut supply chain is highly concentrated and therefore susceptible to effective collusion. First, there are three large peanut shellers who control up to 90 percent of peanut shelling. Consequently, peanut growers do not have sufficient marketing options. Second, unlike in the case of many other agricultural markets, there is no spot market for peanuts, which would serve as an alternative marketing strategy to option contracts offered by peanut shellers. This situation further limits marketing options for peanut growers.

Third, unlike in the case of many other agricultural markets, there is no futures market for peanuts. Futures markets serve important risk management and price discovery functions. Futures markets provide critical price information that agricultural producers use to make planting, production, and pricing decisions. Consequently, the peanut industry is characterized as a thin market, which lacks market and price transparency and makes it difficult for peanut growers to make informed production and pricing decisions.[8]

2). Prior to 2014 (the period prior to the alleged price-fixing conspiracy), peanut prices fluctuated, reflecting changes in peanut market conditions. For example, between 2011 and 2013, adverse weather conditions affecting the peanut industry made it challenging for peanut shellers to manage risks, plan input (peanut) procurement, and plan their peanut shelling activities. This situation created incentives for peanut shellers to engage in a price-fixing conspiracy to suppress and stabilize Runner peanut prices paid to peanut growers.

3). After 2014 (the period of the alleged price-fixing conspiracy), peanut prices remained low and unchanged. The peanut prices did not fluctuate in response to changes in peanut production costs, supply, demand, and weather conditions. The artificially low and stable peanut prices reflected effective collusion among peanut shellers. For example, in 2018, Hurricane Michael (Category 5) affected peanut crops in Alabama, Florida, and Georgia, leading to significant peanut supply disruptions, which was expected to cause peanut prices to fluctuate. Contrary to these expectations, peanut prices remained flat.

4). During the period of alleged price-fixing conspiracy (2014–2019), peanut shellers over-reported peanut inventory quantities to the U.S. Department of Agriculture to create a false impression of a peanut oversupply to use this situation to offer artificially low Runner peanut prices to peanut growers. In addition, peanut shellers under-reported peanut prices to the U.S. Department of Agriculture to further suppress and stabilize Runner peanut prices.[9]

[7] The information presented in this section is primarily from "In Re Peanut Farmers Antitrust Litigation" (2020), a complaint filed by peanut growers in the court.

[8] A market is referred to as a thin market, if the proportion of spot market sales is small as compared to the proportion of sales attributed to alternative marketing agreements (for example, marketing contracts), or if the spot market does not exist (Adjemian et al. 2016; Adjemian, Saitone, and Sexton 2016).

[9] U.S. Department of Agriculture, National Agricultural Statistics Service, administers voluntary surveys of peanut shellers to collect information on peanut stocks and prices used to develop weekly "Peanut Prices" reports and monthly "Peanut Stocks and Processing" reports (U.S. Department of Agriculture, National Agricultural Statistics Service 2022c, 2022d). These survey-

5). During the period of alleged price-fixing conspiracy (2014–2019), peanut shellers offered practically identical option contracts for purchasing peanuts from peanut growers. These contracts were offered on the same day or within a few days and often after one of the industry meetings sponsored by these peanut shellers. Peanut growers have extremely limited negotiating power about the terms and conditions included in these contracts. The peanut prices set in option contracts are determined by peanut shellers.

6). Peanut shellers attended various industry meetings on a regular basis, where they had opportunities to discuss and exchange private market and price information to facilitate and enforce their price-fixing conspiracy. Peanut shellers exchanged private price information using phone calls.

4 Theoretical Frameworks

This section presents a graphical analysis of alternative economic models that may explain buyer market power of peanut shellers and its effects on raw peanut prices that peanut shellers pay to peanut growers. First, buyer market power of peanut shellers is explained using a classic economic model of the profit-maximizing behavior of oligopsonists forming an *input* price-fixing cartel. Second, buyer market power of peanut shellers is explained from the perspective of peanut growers, who face peanut oversupply (overproduction) and consequently receive lower raw peanut prices.

4.1 The Peanut Industry as a Classic Oligopsony

Based on the number of buyers (peanut shellers) operating in the U.S. peanut industry, the industry is a classic oligopsony—market structure with a relatively small number of large buyers. To understand oligopsony market power, this market structure is evaluated relative to a perfectly competitive industry.

Figure 3 is a graphical representation of an economic model explaining the profit-maximizing behavior of a perfectly competitive industry and industries with buyer market power (oligopsony and monopsony). The inverse demand curve (labeled as P) is a graphical representation of the inverse (price-dependent) demand function for shelled peanuts that peanut shellers face. The marginal cost curve (labeled as MC) is a graphical representation of the marginal cost function of peanut shellers (the same as the inverse supply curve for raw peanuts). The marginal cost for peanut shellers is the cost of raw peanuts in this model. Raw peanuts are the *input* for peanut shellers. Peanut growers are sellers (suppliers) of this input. Peanut shellers make decisions on the *input* quantity to purchase. The *input* price that peanut shellers pay is a function of the *input* quantity they purchase.[10] From the perspective of peanut shellers, price-quantity combinations depicted in Figure 3 are *input* prices and *input* quantities.

To maximize its profit, an oligopsony (the three largest peanut shellers) purchases the *input* quantity (Qo), which is smaller than the *input* quantity purchased by a perfectly competitive industry represented by many buyers (Qc). The *input* price an oligopsony pays (Po) is lower than the *input* price a perfectly competitive industry pays (Pc), and oligopsony's profit is higher than the profit of a perfectly competitive industry by Pc - Po in $ per unit or (Pc - Po) * Qo in total $. The oligopsony's profit increases due to the decrease in input costs.[11]

based peanut prices are also used to determine the National Posted Price (NPP) for Peanuts announced on a weekly basis. The NPPs are used to determine MAL repayment rates and various types of government payments made to peanut growers.

[10] In this subsection, given that raw peanuts are the input, raw peanut price and quantity are related within the inverse supply framework. A decrease (increase) in input quantity causes input price to decrease (increase).

[11] In this case study, "profit" refers to *economic* profit, which is different from *accounting* profit. Accounting profit is equal to revenue minus costs associated with generating that revenue. Economic profit is equal to revenue minus costs associated with generating that revenue and minus opportunity cost. Opportunity cost is the forgone benefit of using capital in an alternative business venue. A simple example is earning interest on the money deposited in a savings account in a bank.

Assume that oligopsonists form an *input* price-fixing cartel. Theoretically, they aim to act as a single buyer in the industry (i.e., a monopsonist). To maximize their *joint* profit, oligopsonists decrease the *input* quantity they purchase (Qo) possibly to the *input* quantity purchased by monopsony (Qm).[12] As a result, the oligopsony price (Po) would decrease to possibly approach the monopsony price (Pm). Due to the cartel, the profit of the oligopsonists acting as a single buyer further increases by Po - Pm in $ per unit or by (Po - Pm) * Qm in total $, which is a cartel underpayment to the sellers of input. The monopsony's profit increases due to the decrease in input costs.

The cartel underpayment to sellers of the input expressed in total $ is the shaded rectangle in Figure 3. The cartel underpayment is the basis for damages that peanut growers aimed to recover during antitrust litigation. In summary, the buyer cartel's effects on sellers of the cartelized product are a decrease in the product quantity purchased from these sellers, a decrease in the product price paid to the sellers, and a deadweight loss. The latter is the "DWL" triangle in Figure 3. Because of DWL, there are sellers who do not sell their product due to lower prices.

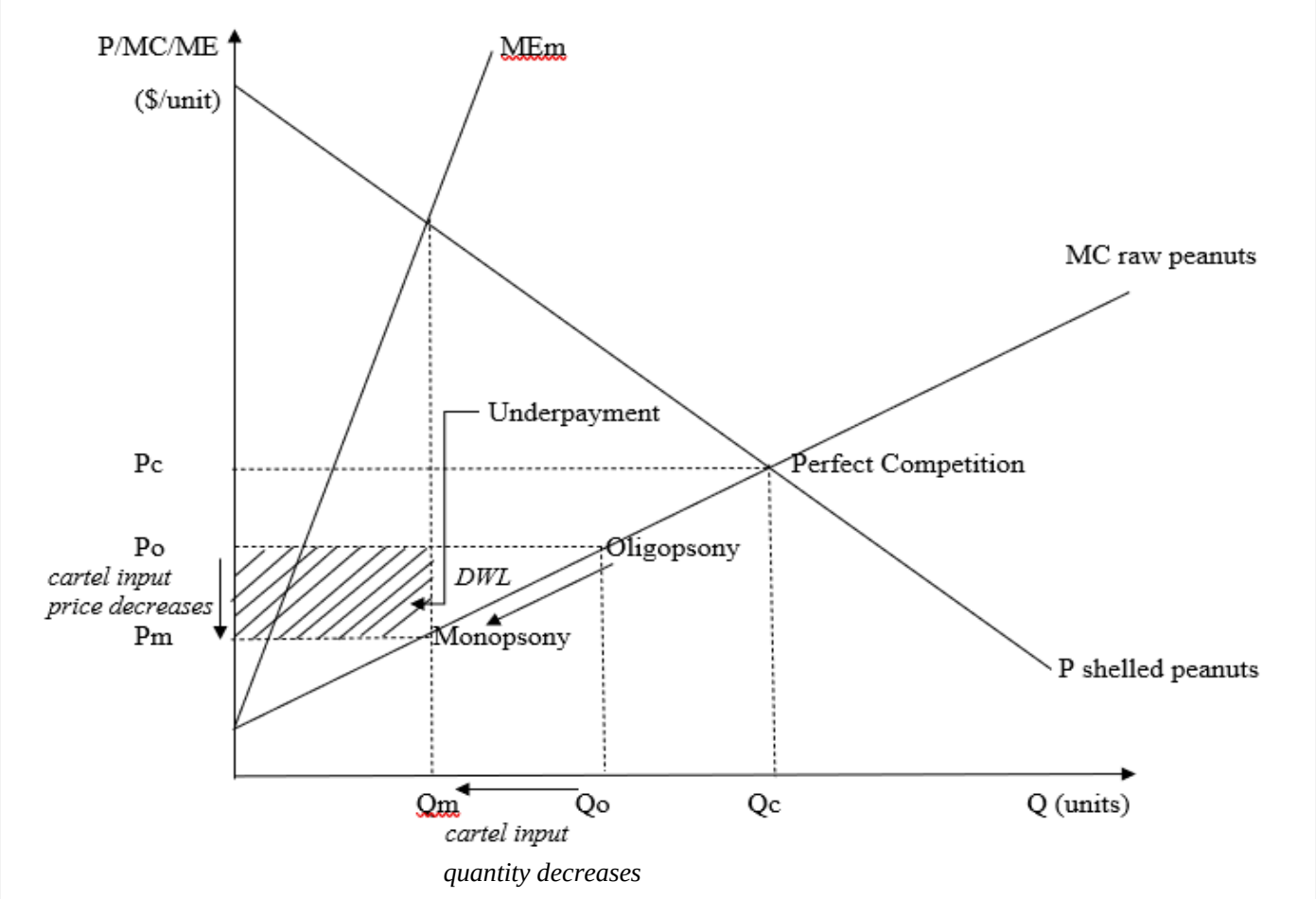

Figure 3: The U.S. Peanut Industry as a Classic Oligopsony: The Effects of Buyer Market Power of Peanut Shellers on Raw Peanut Quantities and Prices

Note: Raw peanuts are the input for peanut shellers.

[12] Monopsony maximizes its profit when it purchases the input quantity, which is at the intersection of Marginal Expenditures (MEm) and demand (P) curves on the graph. Given a linear supply (marginal cost) curve, MEm curve is twice as steep as the supply curve, and both curves have the same Y-axis intercept. Economic models of oligopsony and monopsony are explained in standard textbooks used in economics and agricultural economics programs (Besanko and Braeutigam 2002; Norwood and Lusk 2008).

4.2 The Peanut Industry Faces Peanut Oversupply

Based on the number of sellers (peanut growers) operating in the U.S. peanut industry, this industry has a perfectly competitive market structure. There are many peanut growers in the industry. The size of each farm is small as compared to the overall industry size. Peanut growers are price-takers, who individually cannot influence market prices. As in many agricultural industries, the peanut industry may periodically face agricultural oversupply due to the effects of agricultural production and price cycles (Kohls and Uhl 2002; Bolotova 2019).

Figure 4 depicts two scenarios for the peanut industry. The first one is a perfectly competitive industry scenario. The second one is a peanut oversupply scenario. The inverse demand curve (labeled as P) is a graphical representation of the inverse demand function for raw peanuts that peanut growers face. The marginal cost curve (labeled as MC) is a graphical representation of the marginal cost function of peanut growers. Raw peanuts are the *output* for peanut growers. Peanut shellers are buyers of this output. Peanut growers make decisions on the *output* quantity to produce. The *output* price they receive is a function of the *output* quantity they produce and sell.[13] Using the perspective of peanut growers, price-quantity combinations depicted in Figure 4 are *output* prices and *output* quantities.

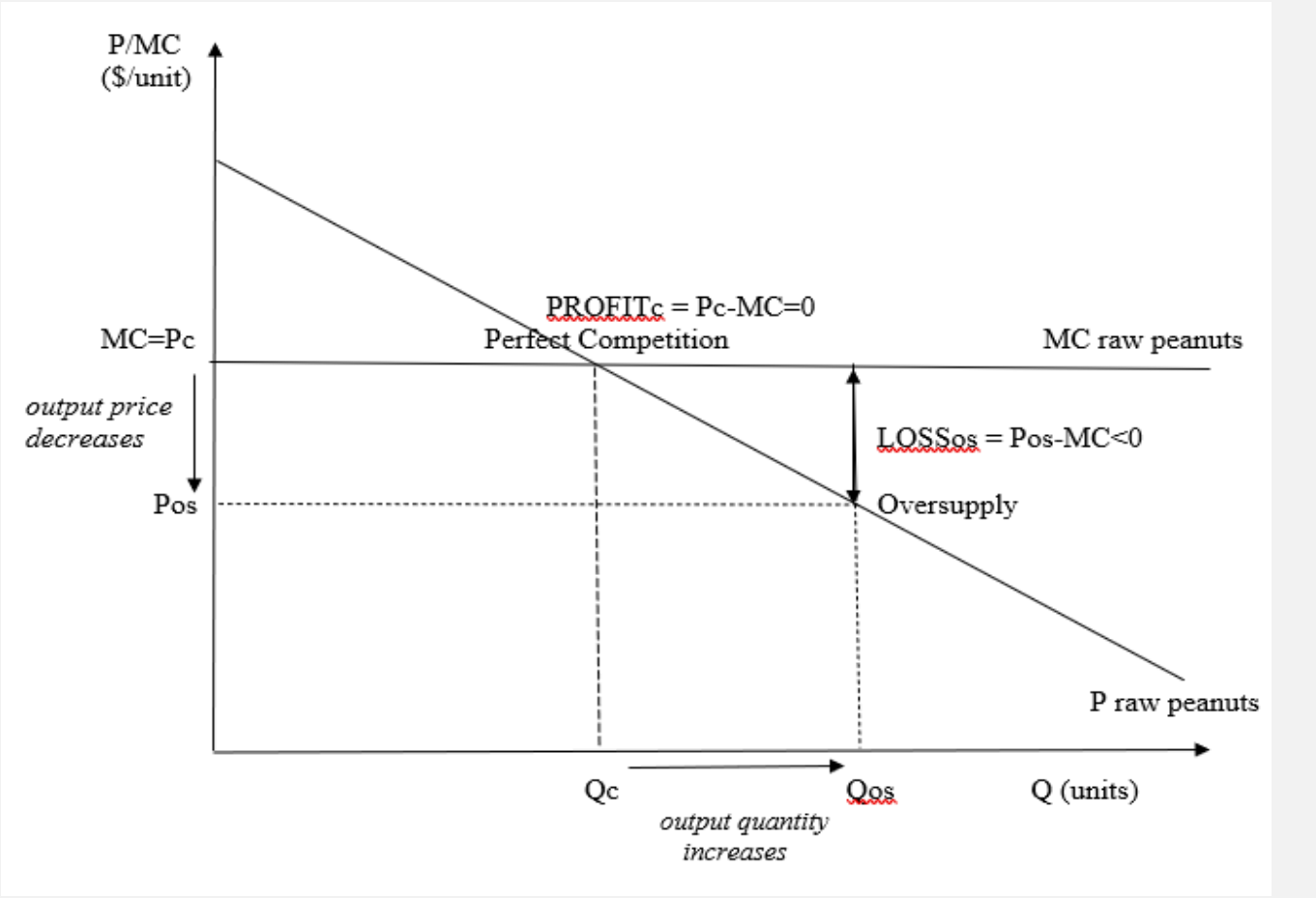

Figure 4: The U.S. Peanut Industry in Two Market Scenarios: Perfect Competition and Peanut Oversupply: The Oversupply Effect on Raw Peanut Quantity and Price

Note: Raw peanuts are the output for peanut growers.

[13] In this subsection, given that raw peanuts are the output, raw peanut price and quantity are related within the inverse demand framework. A decrease (increase) in output quantity causes output price to increase (decrease).

In a perfectly competitive industry scenario, peanut growers produce the *output* quantity (Qc) at which the *output* price (Pc) is equal to marginal cost (MC). The industry marginal profit (price-cost margin) is zero in this scenario (PROFITc = Pc – MC = 0). In a peanut oversupply scenario, peanut growers produce the *output* quantity (Qos), which is larger than the *output* quantity in a perfectly competitive industry scenario (Qc). The *output* price that peanut growers receive (Pos) is lower than the *output* price in a perfectly competitive industry scenario (Pc), and the industry marginal profit (price-cost margin) is negative (LOSSos = Pos – MC < 0). Peanut growers incur losses.

There are several reasons the peanut industry can periodically face peanut oversupply. First, the industry deregulation in 2002 (due to the marketing quota buyout program) led to an increase in peanut production (Dohlman and Livezey 2005; Dohlman, Foreman, and Da Pra 2009), which may have contributed to lower peanut prices received by peanut growers.

Second, agricultural production and price cycles periodically may lead to the years when agricultural industries experience oversupply (Kohls and Uhl 2002; Bolotova 2019). For example, in response to higher peanut prices received in the previous year, peanut growers would increase peanut area planted in the current year, which would increase total peanut quantity produced at harvest, and consequently decrease peanut prices and profit during the following marketing season (Bolotova 2019). Figure 5 depicts the relationship among the peanut production and price variables during the peanut production and marketing seasons. Third, the PLC program introduced in the 2014 Farm Bill may have increased incentives for peanut growers to increase peanut area planted, and consequently peanut production, to increase the amount of government payments they receive.

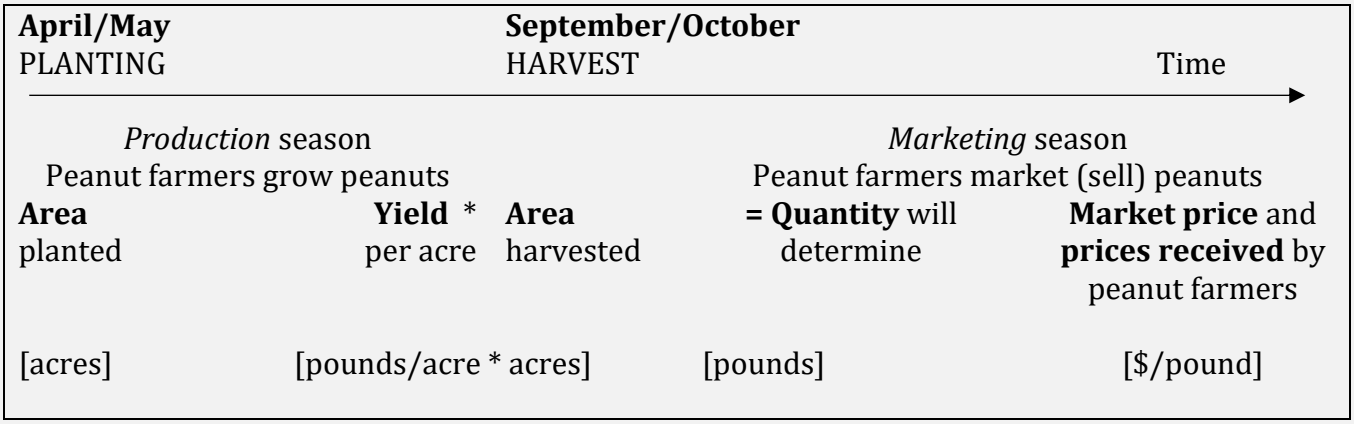

Figure 5: Peanut Production and Marketing Seasons: Peanut Quantity Produced and Price

In the oversupply scenario, peanut shellers as buyers of raw peanuts face the increased quantity of peanuts available in the market and consequently pay lower peanut prices. The peanut price peanut shellers pay is a function of the peanut quantity available in the market (raw peanut price and quantity are related within the inverse demand framework). The peanut shellers might exercise their buyer market power in the oversupply scenario by capitalizing on already decreasing peanut prices due to a peanut oversupply.

The alleged input price-fixing cartel of the peanut shellers might have further depressed peanut prices, while taking advantage of peanut production and price cycles. As it is stated in the complaint filed by peanut growers in the court, the three largest peanut shellers did perceive their market environment as the one with peanut oversupply ("In Re Peanut Farmers Antitrust Litigation" 2020). This is the reason they allegedly over-reported peanut inventory (they "increased" peanut quantity) and under-reported peanut prices (they "decreased" peanut prices) to the U.S. Department of Agriculture. Peanut growers

alleged that by doing this, peanut shellers created a false impression of peanut oversupply to offer artificially low prices to peanut growers.

5 Antitrust Issues

Section 1 of the Sherman Act (1890) prohibits contracts, combinations, and conspiracies in restraint of trade in interstate commerce. Price-fixing agreements (cartels or conspiracies) among competitors (firms selling or purchasing the same or similar products) are examples of the restraints of trade that are most damaging to the market. Price-fixing agreements aim to increase, decrease, or fix (stabilize) product prices, and can be verbal, written, or inferred from the conduct of firms (Federal Trade Commission 2022). The market effects of a typical *input* price-fixing cartel are a decrease in the product quantity purchased by the cartel members (buyers of the product), a decrease in the product price paid to the sellers of this product, a welfare transfer from the sellers to the buyers (underpayment), and a deadweight loss, due to which there are also sellers, who do not sell the product because of lower prices (Figure 3).

For violations of the Sherman Act, plaintiffs are entitled to recover treble damages under the Clayton Act (Hovenkamp 2005). The underpayment is the basis for damages in the *input* price-fixing cartel cases. The underpayment is the difference between the product (peanut) price actually received by sellers (peanut growers) and the product (peanut) price they would have received absent the cartel times the product (peanut) quantity sold. Plaintiffs (peanut growers) were entitled to recover three times the underpayment.

The peanut shellers settled the lawsuit with peanut growers at the end of 2020 and beginning of 2021. The monetary settlements included $7.75 million paid by Olam, $45 million paid by Golden Peanut, and $50 million paid by Birdsong ("In Re Peanut Farmers Antitrust Litigation" webpage 2022). While they agreed to pay monetary damages, the peanut shellers did not admit to any wrongdoing in their settlement agreements with peanut growers ("In Re Peanut Farmers Antitrust Litigation, Notice of Class Certification" 2022).

6 Discussion and Analytical Questions

The teaching note provides answers to all questions, additional guidance to selected questions, and multiple-choice questions that can be included in in-class assignments, quizzes, and exams.

1. Discuss the U.S. peanut industry: peanuts as a product (varieties, production regions, and uses), peanut growers, and peanut shellers. In addition to a relevant information presented in the case study, use data presented in Table 1 and data depicted in Figures 1 and 2 to develop your discussion.

2. Discuss government programs that currently affect the U.S. peanut industry.

3. Explain option contracts used by peanut shellers and peanut growers. In particular, explain the peanut pricing system included in these contracts.

4. Discuss the peanut industry conditions and conduct of the three largest peanut shellers that may have indicated a presence of the peanut price-fixing cartel.

5. Using a graphical analysis, explain conduct and performance of the peanut industry (changes in raw peanut quantities, prices, and industry profit) in the situations described in Questions 5.1–5.3. In the case of each question, draw and label relevant curves and depict relevant input (peanut) price-quantity combinations to complete the graphical analysis.

5.1. Assume that peanut shellers (buyers of raw peanuts) behave as a classic oligopsony forming an *input* price-fixing cartel. First, explain changes in raw peanut quantity, price, and industry profit in the oligopsony scenario, relative to a perfectly competitive industry scenario. Second, explain changes in raw peanut quantity, price, and industry profit in the monopsony scenario (i.e., *input* price-fixing cartel of peanut shellers), as compared to the oligopsony scenario.

5.2. Assume that in the original scenario the three largest peanut shellers act as a single monopsonist by operating an *input* (peanut) price-fixing cartel. Peanut growers discover the existence of this cartel and file an antitrust lawsuit against these peanut shellers. Assume that during the antitrust litigation period (the new scenario), the three largest peanut shellers stop coordinating (colluding) on peanut price (i.e., the price-fixing cartel collapses). Determine the type of market structure of the peanut industry in the period of antitrust litigation. Explain changes in raw peanut quantity, price, and industry profit in the antitrust litigation period, as compared to the original scenario of the price-fixing cartel.

5.3. Assume that in the original scenario the three largest peanut shellers act as a classic oligopsony. Assume that in the new scenario peanut growers organize several cooperatives that would be involved in peanut shelling. These cooperatives are competitors to the three largest peanut shellers. With the new entry of several cooperatives of peanut growers, the number of peanut shellers increases and the peanut shelling stage of the peanut supply chain becomes more competitive (less concentrated). Determine the type of market structure of the peanut industry in the new scenario. Explain changes in raw peanut quantity, price, and industry profit in the new scenario with the entry of cooperatives of peanut growers, as compared to the original scenario.

6. Using a graphical analysis, explain conduct and performance of the peanut industry (changes in raw peanut quantity, price, and industry profit) in the following situation. Assume that peanut growers (sellers of raw peanuts) face peanut oversupply. Explain changes in raw peanut quantity, price, and industry profit in the oversupply scenario, relative to a perfectly competitive industry scenario. Draw and label relevant curves and depict relevant *output* price-quantity combinations to complete the graphical analysis.

7. Perform an analytical analysis of the peanut price-quantity relationships and industry profitability for the two market scenarios depicted in Figure 4: a perfectly competitive industry scenario and a peanut oversupply scenario. To complete this analysis, use the following assumptions. The peanut inverse demand function is $P = 0.29 - 0.01Q$ (P is in $ per pound, and Q is in billion pounds), and the marginal cost of producing peanuts is $0.25 per pound. Marginal cost is the same in the two scenarios. Assume that the U.S. peanut industry produces the following total peanut quantity in these two market scenarios: 4 billion pounds and 7 billion pounds.

7.1. Using the peanut inverse demand equation, marginal cost, and quantities, calculate the following economic measures to complete a profitability analysis of the peanut industry. For each market scenario, calculate peanut price in $ per pound, total costs in $, total revenue in $, total profit in $, and price-cost margin (profit) measured in $ per pound and as a percentage of the peanut price (Lerner Index of market power). Classify each scenario as a peanut oversupply scenario or a perfectly competitive industry scenario.

7.2. Discuss the results of your analysis. First, draw a figure similar to Figure 4 of the case study to show the two analyzed market scenarios: show relevant curves, price-quantity combinations, and price-cost margins. Second, explain the patterns of peanut price-quantity relationships and industry profitability in the two scenarios. In which scenario(s) are peanut growers better off? In which scenario(s) are peanut growers worse off? In which scenario(s) are peanut buyers better off? In which scenario(s) are peanut buyers worse off? Explain your reasoning.

8. Evaluate the U.S. peanut industry dynamics in the period of 2008–2019 by analyzing data presented in Table A1, Figure A2, and Figure A3 included in the Appendix. Table A1 summarizes yearly data and descriptive statistics (averages and coefficients of variation) for peanut area, yield per acre, production, price, and value of production for the pre-cartel period (2008–2013) and the cartel period (2014–2019; U.S. Department of Agriculture, National Agricultural Statistics Service 2022a).[14] Calculate changes in averages and coefficients of variation in the cartel period, relative to the pre-cartel period, for the economic variables reported in Table A1 and record them in this table. Describe the results of your analysis. Are changes in peanut production and price in the cartel period, relative to the pre-cartel period, consistent with a classis oligopsony scenario or a peanut oversupply scenario? Explain your reasoning.

9. Evaluate profitability of the U.S. peanut industry and peanut growers in the period of 2008–2019 by analyzing data presented in Table A2 and Figure A4 included in the Appendix. Table A2 summarizes yearly data and descriptive statistics (averages) for the peanut industry's value of production, operating costs, total costs, and profit (U.S. Department of Agriculture, Economic Research Service 2022b). Calculate changes in averages in the cartel period, relative to the pre-cartel period, for the economic variables reported in Table A2 and record them in this table. Describe the results of your analysis. Are patterns of the peanut industry profitability consistent with a perfectly competitive industry scenario or a peanut oversupply scenario in the two analyzed periods? Explain your reasoning.

10. Familiarize yourself with the U.S. Department of Agriculture data sources used to collect economic variables presented in Tables A1 and A2 included in the Appendix. The teaching note provides additional guidance and weblinks to data sources.

10.1. Use the U.S. Department of Agriculture National Agricultural Statistics Service *Quick Stats* database to download peanut area planted and harvested, yield, production, price, and value of production presented in Table A1.

10.2. Use the U.S. Department of Agriculture Economic Research Service *Commodity Costs and Returns* portal to download costs and returns data for peanuts presented in Table A2.

11. Discuss legal (antitrust) issues related to the conduct of peanut shellers described in this case study. Explain the outcomes of the Peanut Farmers Antitrust Litigation.

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[14] The Notice of Class Certification states the period of alleged cartel as January 2014 to December 2019 ("In Re Peanut Farmers Antitrust Litigation, Notice of Class Certification" 2022). Therefore, in the empirical analysis presented in the case study, the cartel period is 2014–2019. The pre-cartel period is 2008–2013. The length of the pre-cartel period is chosen such that it is equal to the length of the cartel period (6 years).

Appendix

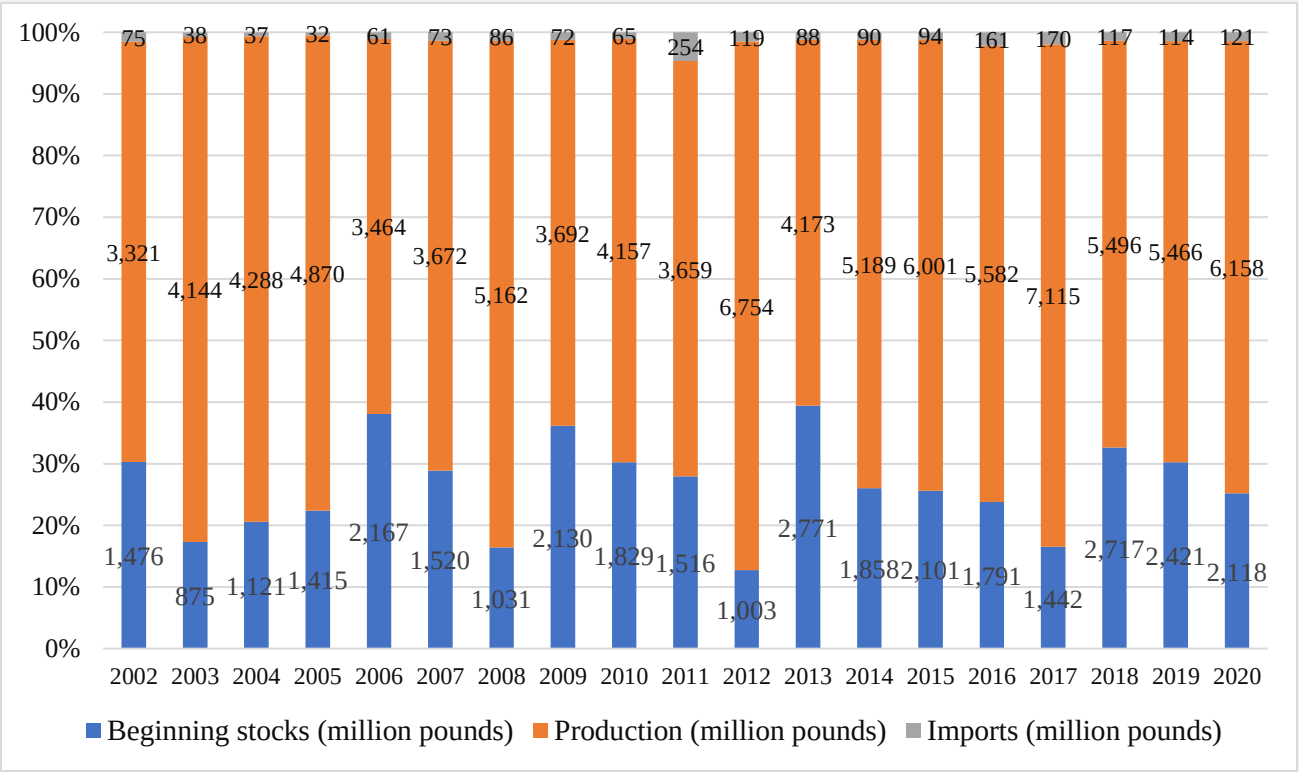

Figure A1: The U.S. Peanut Industry: Supply, 2002–2020

Data Source: U.S. Department of Agriculture, Economic Research Service (2022a)

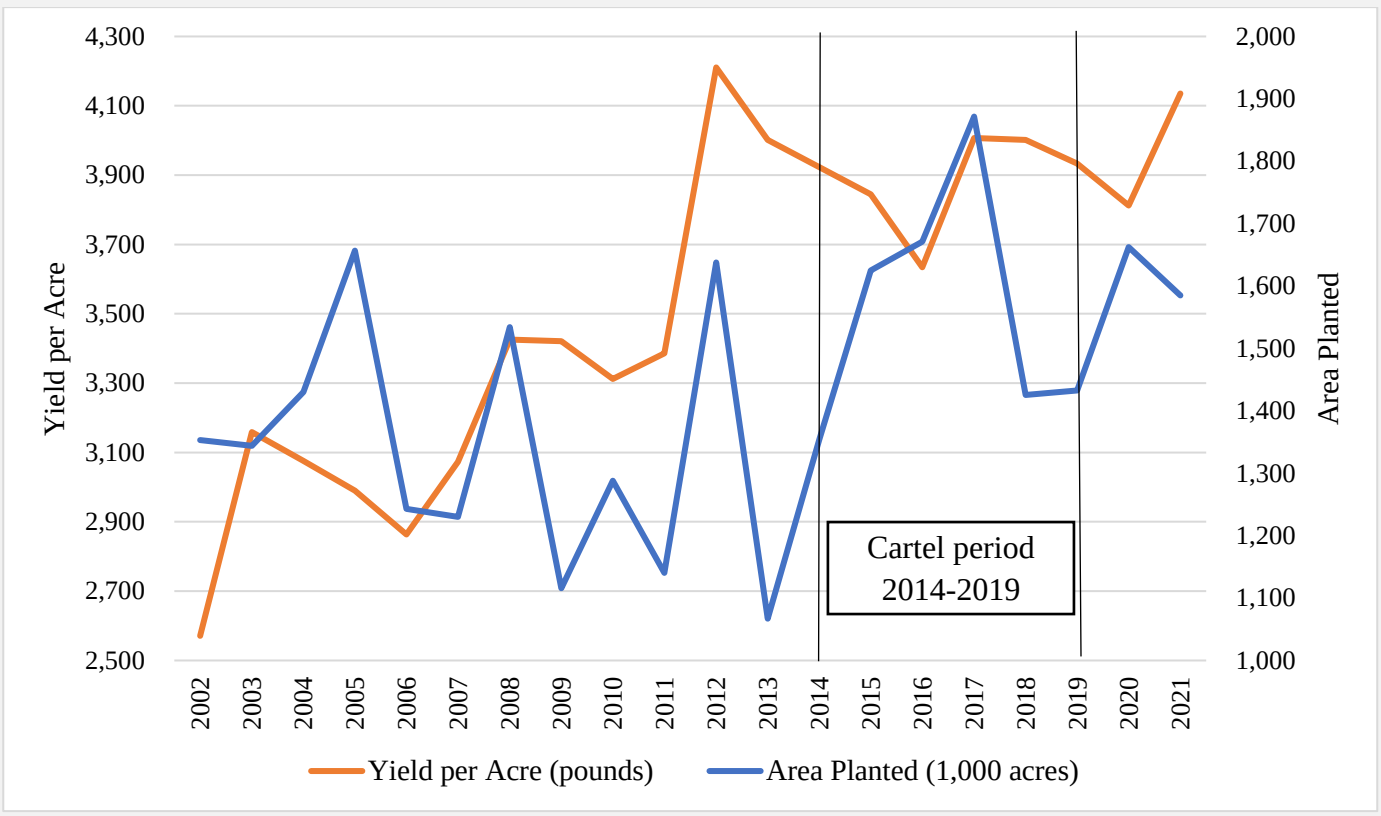

Figure A2: The U.S. Peanut Industry: Area Planted and Yield per Acre, 2002–2021

Data Source: U.S. Department of Agriculture, Economic Research Service (2022a)

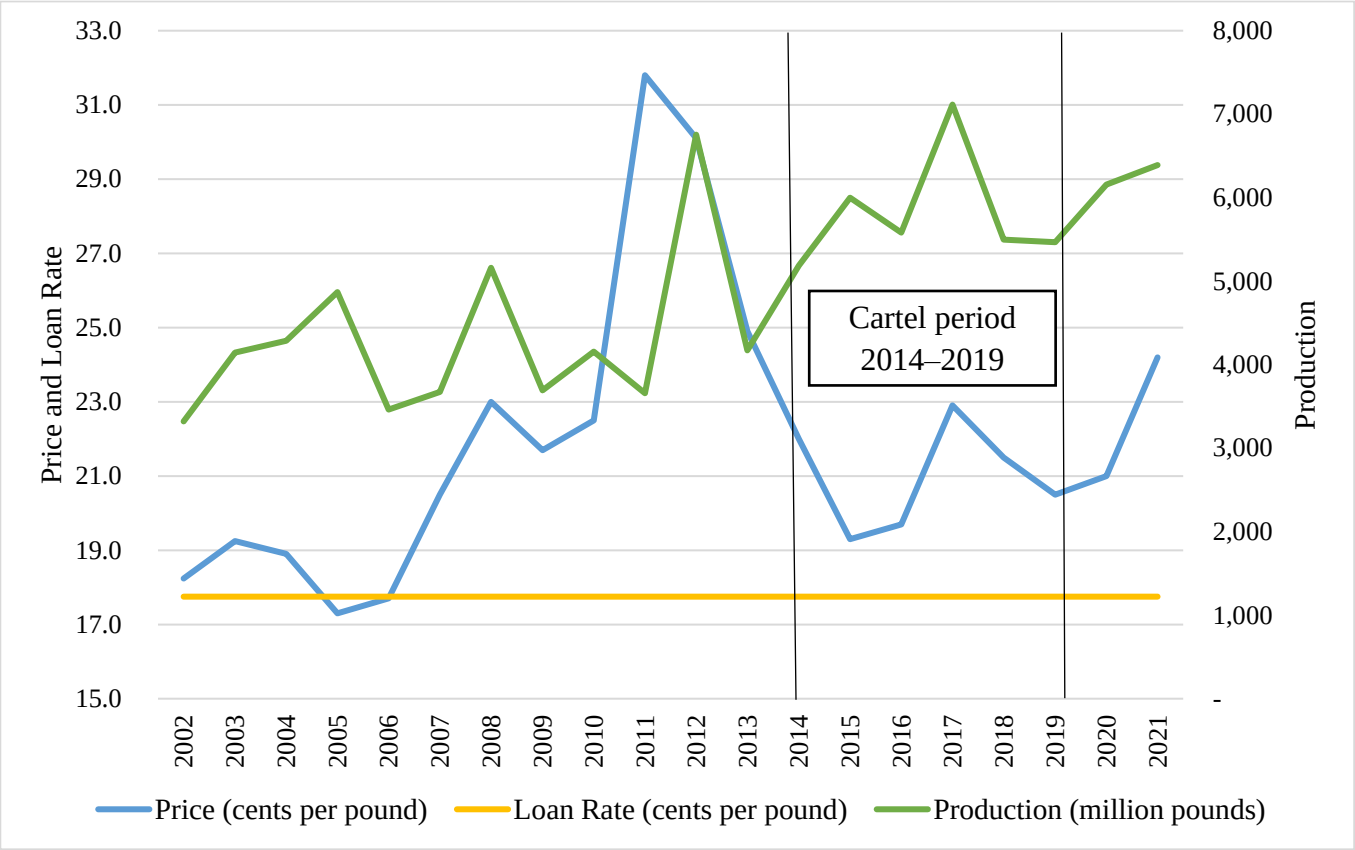

Figure A3: The U.S. Peanut Industry: Production, Prices, and Marketing Assistance Loan Rate, 2002–2021

Data Source: U.S. Department of Agriculture, Economic Research Service (2022a)

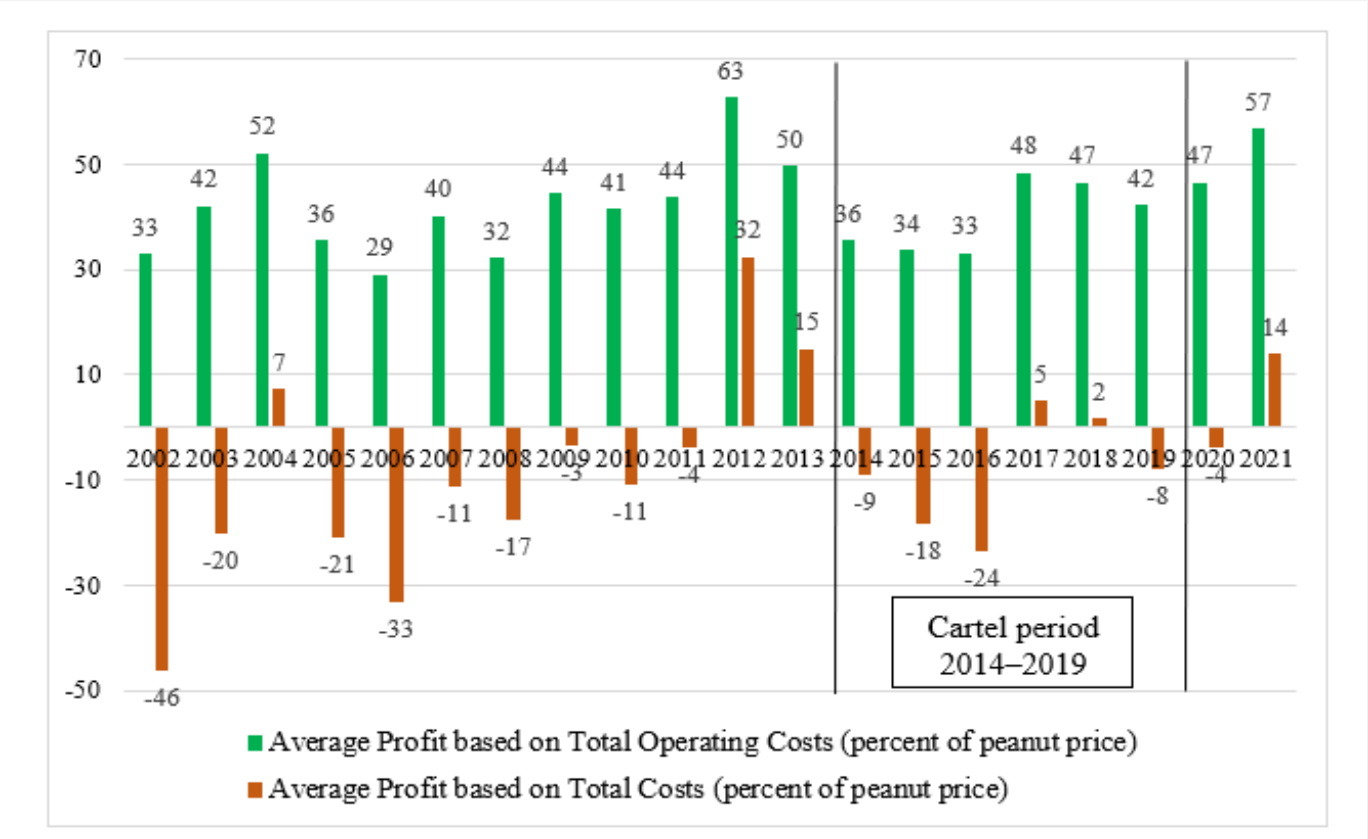

Figure A4: The U.S. Peanut Industry Profitability, 2002–2021

Data Source: U.S. Department of Agriculture, Economic Research Service (2022b)
Note: The profit measures depicted in this figure are calculated by the author using data presented in Table A2.

Table A1: The U.S. Peanut Industry: Area Planted, Area Harvested, Yield per Acre, Production, Prices, and Value of Production, 2008–2019

Year	Area planted	Area harvested	Yield per acre	Production	Price	Value of production
	Million acres	Million acres	Pounds	Billion pounds	$ per pound	$ billion
Pre-cartel period: 2008–2013						
2008	1.534	1.507	3,426	5.162	0.230	1.194
2009	1.116	1.079	3,421	3.692	0.217	0.793
2010	1.288	1.255	3,312	4.157	0.225	0.939
2011	1.141	1.081	3,386	3.659	0.318	1.169
2012	1.638	1.604	4,211	6.754	0.301	2.026
2013	1.067	1.043	4,001	4.173	0.249	1.055
Average	**1.297**	**1.261**	**3,626**	**4.599**	**0.257**	**1.196**
CV	**0.18**	**0.19**	**0.10**	**0.26**	**0.17**	**0.36**
Cartel period: 2014–2019						
2014	1.354	1.323	3,923	5.189	0.220	1.158
2015	1.625	1.561	3,845	6.001	0.193	1.161
2016	1.671	1.536	3,634	5.582	0.197	1.088
2017	1.872	1.776	4,007	7.115	0.229	1.634
2018	1.426	1.374	4,001	5.496	0.215	1.176
2019	1.433	1.390	3,934	5.466	0.205	1.131
Average	**1.563**	**1.493**	**3,891**	**5.808**	**0.210**	**1.225**
CV	**0.12**	**0.11**	**0.04**	**0.12**	**0.07**	**0.17**
Change in cartel period, relative to pre-cartel period						
Average (units)	____	____	____	____	____	____
Average (percent)	____	____	____	____	____	____
CV	____	____	____	____	____	____
CV (percent)	____	____	____	____	____	____

Data Source: U.S. Department of Agriculture, Economic Research Service (2022a)
Note 1: Production is determined by area harvested and yield per acre (Figure 5). Value of production is determined by production and price.
Note 2: The area harvested may be smaller than the area planted due to crop failure (because of weather, insects, and diseases), lack of labor, low market prices, or other factors (U.S. Department of Agriculture, Economic Research Service 2019).

Table A2: The U.S. Peanut Industry: Value of Production, Costs, and Profitability, 2008–2019

Year	Value of production	Operating costs (OC)	Total costs (TC)	Total profit based on OC	Total profit based on TC	Yield	Average profit based on OC	Average profit based on TC
	$ per acre					pounds per acre	$ per pound	
Pre-cartel period: 2008–2013								
2008	748.17	516.80	874.00	231.37	-125.83	3,602	0.06	-0.03
2009	814.89	462.05	842.58	352.84	-27.69	3,606	0.10	-0.01
2010	764.50	458.74	845.27	305.76	-80.77	3,512	0.09	-0.02
2011	917.80	526.14	950.51	391.66	-32.71	3,202	0.12	-0.01
2012	1,451.49	559.66	991.01	891.83	460.48	4,177	0.21	0.11
2013	1,102.26	564.34	940.70	537.92	161.56	4,164	0.13	0.04
Average	**966.52**	**514.62**	**907.35**	**451.90**	**59.17**	**3,711**	**0.12**	**0.01**
Cartel period: 2014–2019								
2014	867.12	564.01	944.69	303.11	-77.57	4,046	0.07	-0.02
2015	762.70	510.21	899.80	252.49	-137.10	3,930	0.06	-0.03
2016	713.74	482.07	878.62	231.67	-164.88	3,499	0.07	-0.05
2017	934.49	489.52	887.68	444.97	46.81	3,993	0.11	0.01
2018	917.44	498.60	902.99	418.84	14.45	4,085	0.10	0.00
2019	864.43	505.38	932.82	359.05	-68.39	4,035	0.09	-0.02
Average	**843.32**	**508.30**	**907.77**	**335.02**	**-64.45**	**3,931**	**0.08**	**-0.02**
Change in cartel period, relative to pre-cartel period								
Average (units)	_____	_____	_____	_____	_____	_____	___	___
Average (percent)	_____	_____	_____	_____	_____	_____	___	___

Data Source for costs, value of production, and yield: U.S. Department of Agriculture, Economic Research Service (2022b). The profit measures are calculated by the author.

Note: Total profit is the value of production less a relevant cost measure. Average profit is total profit divided by yield per acre. Total operating costs include costs associated with purchasing variable inputs, such as seeds, fertilizers, agricultural chemicals, repairs, drying, etc. Total costs include total operating costs and allocated overhead. The allocated overhead includes costs associated with purchasing or renting fixed inputs (machinery, equipment, and land), costs of labor, taxes and insurance, etc.

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Case Study

To Rebuild or Not to Rebuild When Disaster Hits

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JEL Codes: Q454
Keywords: Decision-making, leadership, management, poultry

Abstract
The management decision process is often complex and multidimensional with various competing factors. The type of leadership, the approach for analysis, and a priori beliefs factor into decision making. This case provides an example of how multifaceted management decisions are in the context of profitability, risk, uncertainty, succession, and leadership frameworks using a comprehensive economic analysis for a fictional poultry operation. Students are asked to apply concepts in financial analysis, risks analysis, and critical thinking to provide a realistic management decision based on all these concepts. The issues in the case relate to natural disasters, farm succession planning, leadership frameworks, and farm survivability. The case provides flexibility in approach and concept rigor based on the course.

1 Introduction

Henrietta Bacon has lived in the hills of Madison County, Arkansas, for 60 years. Motivated by the rapidly growing poultry sector, Henrietta pursued a bachelor's degree in poultry science from the University of Arkansas. She fell in love with the production and innovation in farming. Post-graduation, she received a loan and invested in broiler houses on the farm where she grew up, naming it Chicken Holler Farms. Chicken Holler Farms has four 60-foot by 600-foot curtained sided houses on 20 acres. As a condition of her contract with a major poultry integrator, a company that owns multiple levels of production, and as a testament to her own passion for production technologies, she regularly (every 10–15 years) updates her facilities, making improvements in lighting, ventilation, cooling, and monitoring systems. For example, she was the first in the state to install cooling cells and better mister systems to combat the heat of Arkansas summers, which often reach temperatures above 100°F. This investment in the cooling system led to reductions in mortality and improvements in overall productivity, measured by the feed conversion ratio (FCR; the conversion of a pound of feed to a pound of weight), leading to greater profitability. Her integrator field technicians use her farm and management practices as a model for high production performance in the region.

Beyond the broiler houses, Henrietta and her husband, Chris Bacon, have a small cow-calf beef operation, running 30 head of brood cows on the acres surrounding the broiler houses. They invested in additional land surrounding the farm and have since inherited her parents' property, so that they have 150 total acres. They cut enough hay from their farm to support their cattle during the winter. Chris is a principal at the local high school but helps on the cattle enterprise on nights and weekends. In addition to poultry and cattle, Henrietta works part-time at her local church and has taken several short-term positions over the years. Henrietta wants to retire in five years and cut back on her other on-farm duties.

The Chicken Holler Farm is a multigenerational farm that has been the identity of Henrietta's family for generations. The idea of cutting back or retiring introduces the question of how the farm will be passed down or if it will. The Bacon's have two children. They both grew up helping on the farm and hope to see it continue. They have a son who is a successful lawyer but lives three hours away, and a daughter who is a freshman at the University of Arkansas majoring in poultry science that wants to take over the farm when she completes her degree. There is also concern to whether the daughter would be able to secure a loan to build new facilities or get a grower contract. If Henrietta rebuilds now, the

grower contract would be in place and remain with the farm, and her daughter would be grandfathered in, taking over the contract and making the loan payments for the farm. If they choose to not rebuild, there is no guarantee of a broiler contract in the future as her integrator is beginning to concentrate production in the next county.

To meet the labor needs of the farm, including broiler house clean out, hay cutting, and working cattle, Chicken Holler Farms hires hourly labor. Typically, these employees work at the local turkey processor. This labor is intermittent due to the seasonal nature of turkey processing, especially for this plant. Hiring labor for Chicken Holler Farms helps support local laborers with extra income and pours back into the local community. Without these extra hours, these workers would potentially have to move to a neighboring county to earn a livable wage throughout the year, and Henrietta would not have help on her farm.

As with all agricultural production, broiler farming comes with inherent risks, including weather such as natural disasters or erratic weather, production risks, and operational risks. Natural disasters such as ice storms, tornados, and floods are commonplace in northwest Arkansas where Chicken Holler Farms thrives (Figure 1). Over the last 40 years, Chicken Holler Farms has had to weather many disasters. In 2009, there was a particularly destructive ice storm that caved in the roof of broiler house #3. Additionally, Henrietta had to rebuild a roof as well as replace the cooling system on broiler house #2. Ten years ago, a tornado moved through Chicken Holler Farms destroying a hay field and wiping out two of the broiler houses. Henrietta decided to use the insurance money to rebuild those houses, upgrade the other houses, and expand the cattle enterprise. However, during the past storm season, another rare tornado moved through Madison County destroying all her broiler houses.

Henrietta now faces a decision about the future of Chicken Holler Farms. To rebuild all the houses, she would need to take out a substantial loan, with a 15-year repayment schedule, beyond the time she wanted to quit farming broilers. The most recent insurance payout will not cover 5 years of lost income. Her daughter has expressed interest in taking over a broiler farm, but this is uncertain and

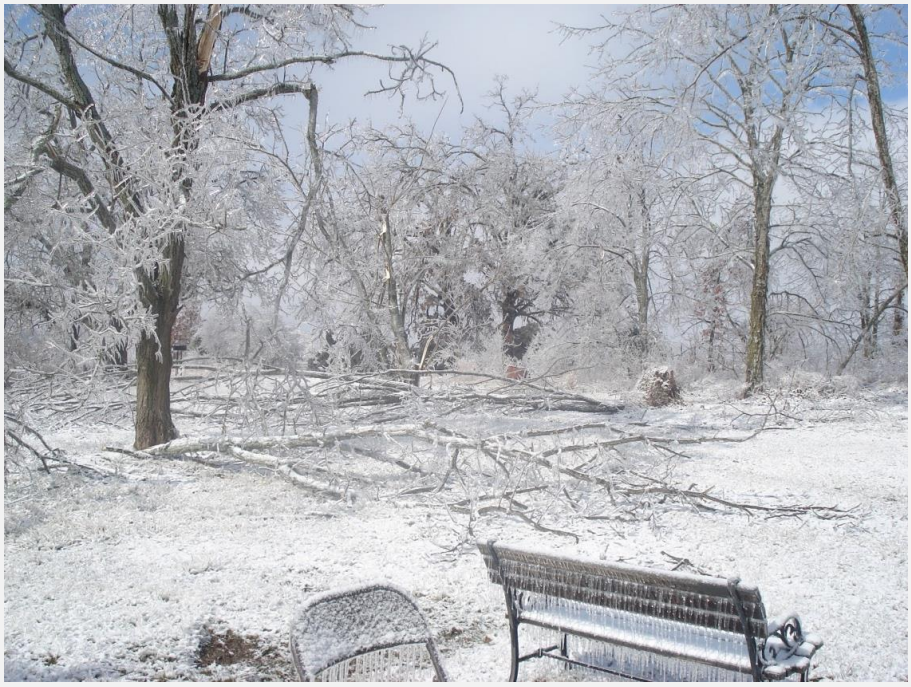

Figure 1: Tree Damage from the 2009 Ice Storm in Madison County, Arkansas

Source: Sharp, 2009.

would not happen until after her graduation, which raises the question of contracts and loan uncertainty. Henrietta must consider all the factors related to labor, succession, farm management, income streams, and a concern for possible future disasters when weighing the decision to rebuild or not rebuild.

2 Poultry Production in the United States

Poultry is the fastest growing animal protein in the world due to its relatively affordable production, efficient conversion of feed to gain, and increasing demand by a rising middle class (OECD/FAO 2020). Poultry benefits from economies of scale in production, especially in highly concentrated production regions such Georgia or Arkansas, as shown in Figure 2 (U.S. Department of Agriculture 2022). With more than 42,000 broiler farms in the United States, the U.S. poultry industry is mainly characterized by production of broilers (i.e., meat type chickens), which account for 70 percent of total U.S. poultry production, with 16.4 percent destined for international markets (U.S. Department of Agriculture, National Agricultural Statistics Service 2019; U.S. Department of Agriculture 2021; U.S. Department of Agriculture, Office of the Chief Economist 2021).

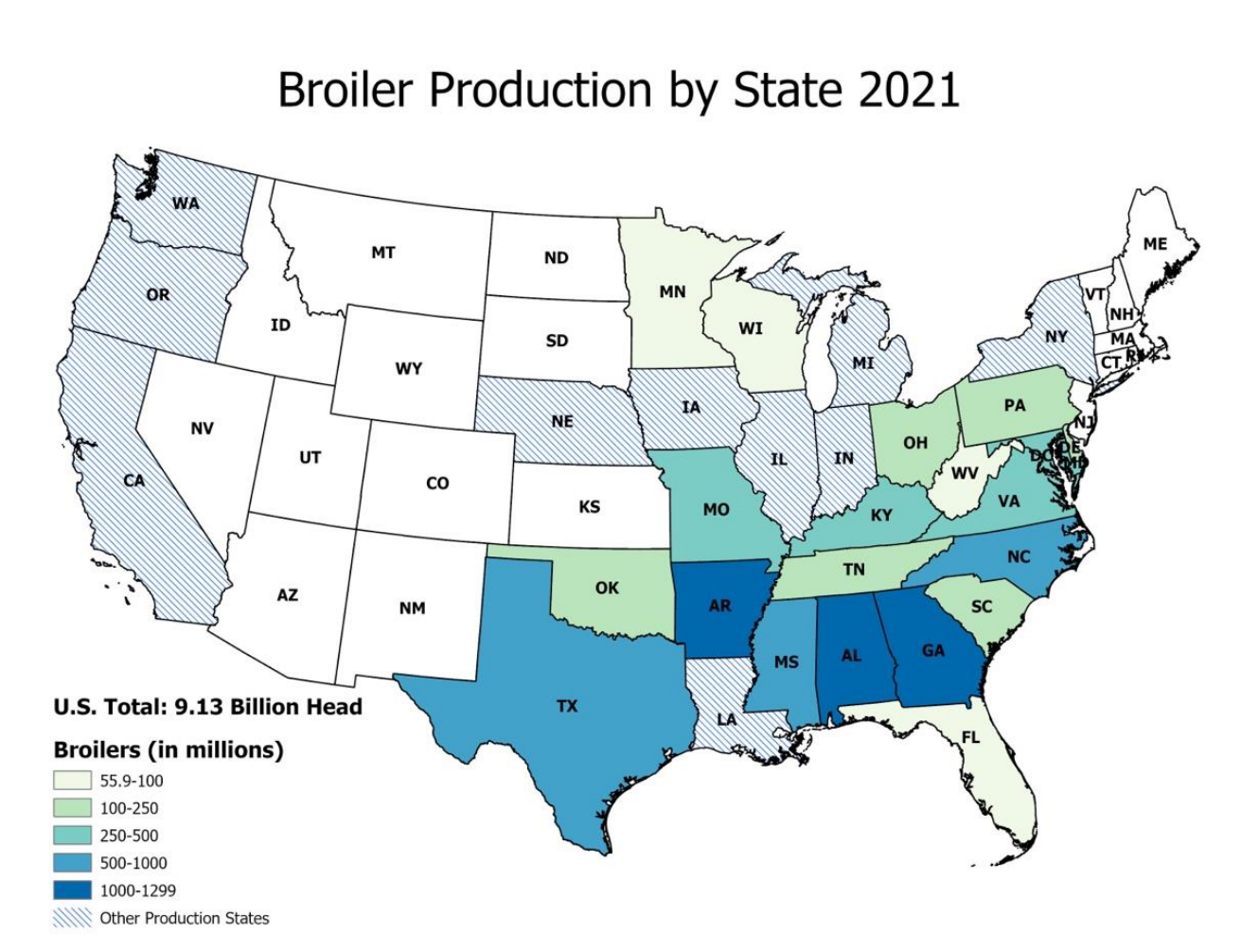

Figure 2: 2021 Broiler Chicken Production by State, Millions of Head

Source: Figure developed from U.S. Department of Agriculture, National Agricultural Statistics Service (2022) production data

Since the 1950s, through mergers, acquisitions, and development of internal capacity, the poultry industry has vertically integrated, where an integrator owns multiple levels of production including breeding, hatching, feed, production, processing, transportation, or distribution. Vertical integration allows for a reduction in transaction costs between stages of production to maximize profits. For instance, if a poultry integrator owns their own feed mill, they reduce the cost of purchasing feed, removing the profit margin of the mill, which reduces the cost of production, increasing the profits of the integrator. There are approximately 30 federally inspected integrators in the United States including Tyson Foods Incorporated, JBS US Holdings, Cargill Meat Solutions, Smithfield Foods, and Purdue Farms (National Chicken Council 2021). It is with one of these integrators that Chicken Holler Farms contracts with to grow birds.

2.1 Broiler Production Basics

Almost all (99 percent) of broiler production is carried out by contract with independent growers in the United States, such as Chicken Holler Farms. Growers agree to furnish land, facilities, management, biosecurity, and labor while the integrators supply birds, feed, medications, and technical assistance. The integrator retains ownership of broilers throughout the birds' lives. Growers are paid based on the weight of broilers at harvest with financial incentives for livability, feed conversion, and uniformity, which are all driven by grower management. Henrietta is often paid top incentives driven by her investments in innovative production technologies.

Broilers are raised in large growout houses, often with several houses on a farm. These houses have solid floors with bedding, typically rice hulls, straw, or other soft woods. The bedding is replaced between flocks to reduce ammonia buildup from urea and excrement and to maintain a healthy growing environment. Modern houses typically use solid walls controlled through tunnel ventilation to exchange air throughout the house and regulate temperature. The ends of the houses often have cooling pads that cool incoming air to regulate temperatures during warm periods. Alternatively, houses can be partially walled with curtains, which controls air flow and exchange in the house, though these make it harder to maintain optimal temperature and humidity levels. Henrietta's newest houses have solid side walls, but she previously used retrofitted ones that were curtained with updated mister systems. If she chooses to rebuild, she will build up to current production specifications and would build solid side-walled houses with a high-tech monitoring system, all of which requires capital to cover the needed investment.

2.2 Additional On-Farm Production

Many U.S. broiler growers also produce other livestock, including cattle, equine, or other small ruminants on their farms. Broiler production requires adequate land surrounding a poultry house to maintain a safe and healthy biosecurity border for broilers. While other poultry are not allowed on farms for biosecurity reasons, a grower may use the land for forage, crops, or hay production, or to graze livestock. As long as biosecurity, which includes foot baths at entry points, limiting traffic on farm, truck washes, and appropriate down time between flocks, can be upheld, these other enterprises are permitted on broiler farms.

3 Risks and Uncertainties

Farming is an inherently risky enterprise. Environmental conditions like temperature and rainfall can severely impact crop yield or animal performance. Natural disasters occur when extreme environmental conditions lead to loss of life, damage, or hardship (U.S. Environmental Protection Agency 2021). Natural disasters also have broader economic consequences because indirect impacts ripple through the economy (Wouter Botzen, Deschenes, and Sanders 2019). For example, a farmer who has experienced loss no longer buys feed from the local miller or may defer purchases extending the economic impact of natural disasters. Arkansas experienced 60 billion-dollar disasters between 1980 and 2017, amounting

to an average annual cost of $10–$20 billion dollars per year (NOAA National Centers for Environmental Information 2021). The costliest disasters to the state are tropical cyclones (tornados) and winter storms (see Table 1 and Figure 3), both of which have directly impacted Chicken Holler in the past.

Table 1: Billion-Dollar Events to Affect Arkansas from 1980 to 2017 (CPI-Adjusted)

Disaster Type	Events	Events/Year	Percent Frequency	Total Costs[b]	Percent of Total Costs
Drought	14	0.4	23.3%	$5.0 B–$10.0 B	41.9%
Flooding[a]	7	0.2	11.7%	$2.0 B–$5.0 B	20.6%
Freeze	2	0.1	3.3%	$100 M–$250 M	1.9%
Severe Storm	28	0.7	46.7%	$2.0 B–$5.0 B	29.3%
Tropical Cyclone	3	0.1	5.0%	$250 M–$500 M	2.5%
Winter Storm	6	0.2	10.0%	$250 M–$500 M	3.8%
All Disasters	**60**	**1.6**	**100.0**	**$10.0 B–$20.0 B**	**100.0%**

Source: NOAA National Centers for Environmental Information (2021)

[a] Flooding events (river basin or urban flooding from excessive rainfall) are separate from inland flood damage caused by tropical cyclone events.

[b] Monte Carlo simulations were used to produce upper and lower bounds for total costs (Smith and Matthews 2015).

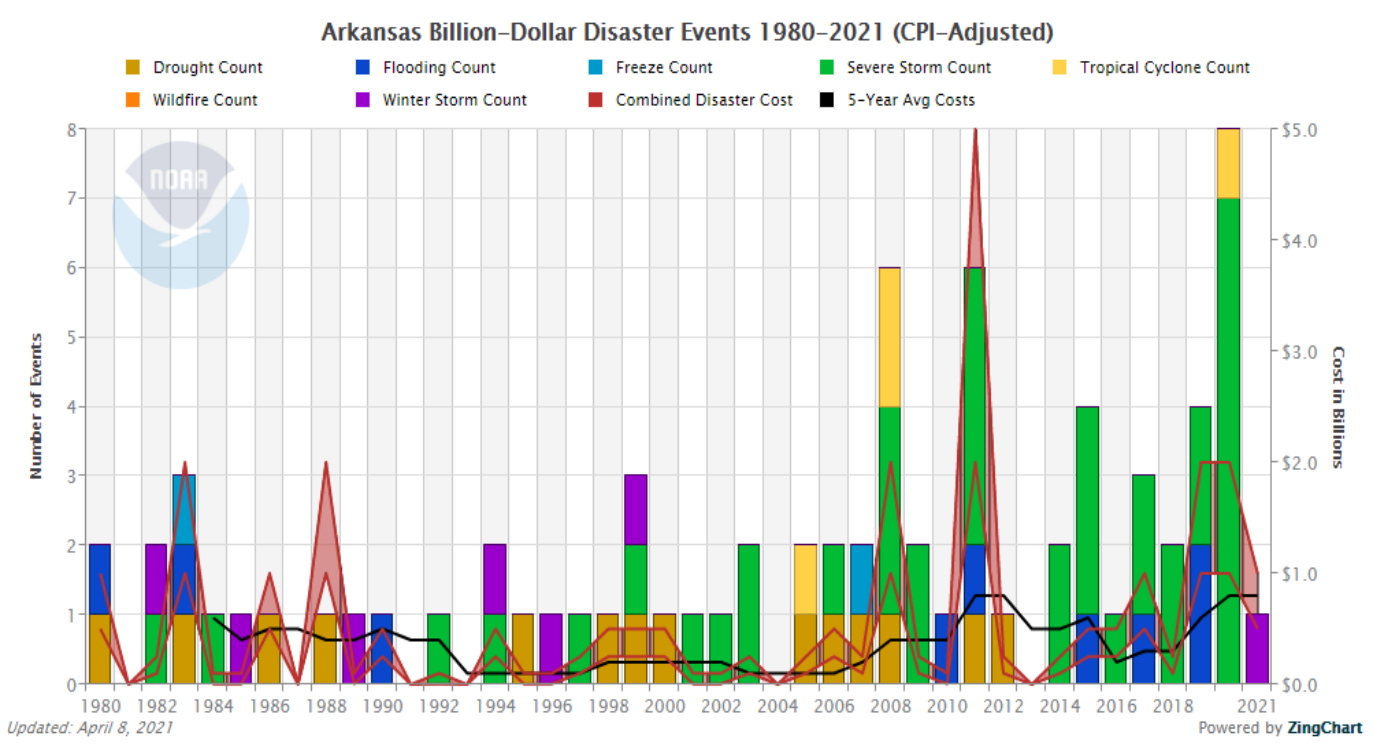

Figure 3: Arkansas Billion-Dollar Disaster Events 1980–2021 (CPI-Adjusted)

Source: NOAA National Centers for Environmental Information (2021)

The impacts from natural disasters can be catastrophic in the short and long term financially, psychologically, and physically for the grower and their community. Trauma is shared by the community related to stress due to loss of lives, livelihoods, animals, and material wealth (Walsh 2007). In communities where traumatic losses from natural disasters have occurred, "symptoms such as depression, anxiety, substance abuse, and relational conflict . . . are common" (Walsh 2007, p. 210).

These impacts are further exacerbated by stress related to dealing with insurance, which serves to compound the effects of the disaster making the social and mental impacts long-lasting. For Chicken Holler Farms, the insurance money has finally been released after months of paperwork, lost farm income, and cleanup efforts. Henrietta has come to terms with the loss of chickens, infrastructure, and a favorite oak tree by the river, and she feels able mentally and physically to rebuild, although she remains weary of another disaster in the future.

4 Leadership and Strategic Management

To gain and sustain a competitive advantage, an organization must be able to adapt and undergo organizational change (Hirlak and Kara 2018). The ability of an organization to adapt and the ways in which an organization sustainably changes, depends on the leader and leadership frame that dominates their decision making (Sowcik, Carter, and McKee 2017). A decision that may seem appropriate for one organization may not be appropriate for another. The use of leadership frames were developed by Bolman and Deal (2021) and help to understand how leadership perspectives drive organizational decision making. The four frames include structural, human resources, political, and symbolic. Within each of these leadership frames, decisions are motivated and based on different factors (Sowcik, Carter, and McKee 2017). In the structural frame, the organization is goal-oriented, and decisions are typically made in a top-down fashion. On the other hand, in the human resources frame, there is lateral coordination of goals, and it is recognized that organizations exist to serve human needs. In the political frame, power drives resource allocation based on competing coalitions. Finally, in the symbolic frame, decisions are legacy- and culture-driven where preservation of identity dominates. While all these frames may be present at some point in time for an organization, it is important to understand which one dominates and why that leadership frame is relevant to the given decision.

For Henrietta, her farm is a business, but it is also a family legacy. She is the owner and operator, but she also provides a valuable source of income and meaning to the workers who depend on her for seasonal income and provide valued expertise for Henrietta who never seems to have enough hands or time to complete all farm tasks that arise. She pays her workers well, and they use this income to pay for little league soccer, food, and vacations. She knows that prior to Thanksgiving, they are working overtime at the local turkey processor to get the turkeys ready for the holidays, while January and February are hard months for them as they are laid off due to a decreased demand for turkey processing. These are the months Henrietta relies on these workers to make upgrades to her houses, check on newborn calves, and contend with whatever strange weather Arkansas throws at her and her farming operation.

Henrietta also knows that her daughter has expressed interest in taking over the family farm. Her daughter, though young, is a hard worker and goal oriented. She will not likely change her mind about wanting to farm, but she may forgive Henrietta if she decides not to invest in the poultry operation. Thankfully, there are many jobs in Northwest Arkansas for a poultry science major. Henrietta knows that she will not be able to continue farming in the long term due to her age and own retirement goals. Henrietta wants to consider all these factors in her decision making about the future of Chicken Holler Farms. She is uncomfortable making a decision that could potentially harm her employees and her daughter's dream without adequate justification.

5 Financial Management

Finally, Henrietta does not want to make a poor financial decision that will have long-term implications. She currently makes $100 per week with her off-farm work. She could take on a full-time position earning $36,360 per year, which would limit her ability to volunteer in her community and manage the farm. After paying off all outstanding debt and renovations resulting from the previous natural disasters, Henrietta has $10,536 in insurance funds to save for retirement. If she rebuilds, total costs will be

$1,485,000 to build four new broiler houses. If she rebuilds, Henrietta's annual income after paying the loan payments and production expenses is $50,068 per year. Each year, Chicken Holler Farms hires various farm laborers for about 400 hours per year at $15 per hour. If they choose to not rebuild, then this labor will not be needed. The family also has existing financial obligations including $1,900 per year in education expenses for their daughter and upcoming fence repair costs of $3,000. The cow-calf operation earns $10,230 per year. If the poultry houses are not rebuilt, the property will be repurposed for cow-calf grazing, and the herd size will increase as will the costs for hay, minerals, medicine, and so on, leading to a net income from the cow-calf enterprise of $20,460 per year.

6 Decision Making—What Should Chicken Holler Farms Do?

Henrietta has a big decision to make but must consider all information to make the best choice:

(1) To rebuild Chicken Holler Farms taking on a new loan and all the potential risks associated with farming; or

(2) To not rebuild the poultry houses and instead work off-farm and expand the existing cattle operation.

To make the best decision, it is best to break down the intricacies of poultry farming, natural disasters, and social dynamics for decision making. Next, a financial analysis is relevant to determine the optimal financial decision. Finally, you should consider all components of relevance to the case, using a comprehensive view of the economic and noneconomic considerations simultaneously, to make a final decision.

7 Discussion Questions

Given what you have read about Chicken Holler Farms, consider the following questions and how they impact your final decision:

1. What will the farm look like if Henrietta rebuilds or if she does not rebuild?
2. Consider the risks associated with poultry farming. How might those risks affect profits and the future of her farm? What nonfinancial risks are important to consider? (Hint: Consider natural disaster risks, financial risks, farm succession, and leadership risks.)
3. Who will be impacted by Henrietta's decision? What stake do they have in the decision? Do you think they would make the same decision as Henrietta? Is there one solution that increases the welfare of all involved stakeholders?
4. What kind of leadership frame seems to dominate in the case of Chicken Holler Farms? Based on this leadership frame, how do you think Henrietta typically makes decisions related to her farm?
5. What factors outside of those discussed in the case might influence the decision for Chicken Holler Farms?
6. What decision should Chicken Holler Farms make?

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