PURDUE
AGRICULTURAL ECONOMICS REPORT

Spring 2023 Graduate Student Issue
Editor's Welcome

Welcome to the Spring 2023 Purdue Agricultural Economics Report (PAER). For the third year in a row, this issue highlights the interesting, relevant, and practical research findings from undergraduate, master's, and doctoral students in the Department of Agricultural Economics at Purdue University.

In the first article of this issue, Nicole Widmar, agricultural economics professor and graduate program coordinator, chronicles the state of the Agricultural Economics Graduate Program. Most notably, the department's graduate program continues to uphold the tradition of innovation, welcoming the inaugural cohort of online Professional M.S. in International Agribusiness students in Fall 2023. The cohort is in addition to the incoming M.S., Ph.D., M.S.-M.J., and M.S.-M.B.A. students. It is exciting that our department offers such comprehensive graduate degree options.

The remainder of this issue highlights student research focused on two groups important to agricultural economists: food consumers and farmers. The first section of articles is related to the economic challenges faced by food consumers. First, Ph.D. students, Laxmi Adhikari, Yizhou Hua, and Yifei Wang, along with Holly Wang, professor of agricultural economics, use a consumer survey to uncover the degree to which consumers would value a new healthy snacking option, tofu chips. Next, an article by Ph.D. student Zach Neuhofer finds that milk consumers do not respond as expected to labels providing scientific information on the sustainability of milk production systems. In the last article pertaining to consumers, undergraduate students, Ethan Buck, Morgan Hinz, Yuxi "Jimmy" Jiang, and Xiuyun "Lisa" Wen, along with Todd Kuethe, professor and Schrader Endowed Chair in Farmland Economics, examine the accuracy and optimality of food price inflation forecasts. Food price inflation has been a key topic of economic interest since the beginning of the COVID-19 Pandemic.

The final three articles focus on farmers' economic issues. Like the work in food price inflation, the first two articles by Ph.D. student Hari Regmi are motivated by the COVID-19 pandemic. First, Regmi uses various data to identify the sources and quantities of the record high total governmental assistance to Indiana farmers as a result of the COVID-19 pandemic. In his second article, Regmi compares the financial health of Indiana farms to the larger groups of U.S. and Midwestern farms from 2012 – 2021. In the last article of this issue, M.S. student Margaret Lippsmeyer and Michael Langemeier, professor of agricultural economics, discuss how effective farm managers engage in acquiring knowledge and experience, while seeking opportunities to collaborate. Additionally, Lippsmeyer and Langemeier provide practical suggestions on how farm managers can pursue further knowledge, experience, and collaboration.

Our hope is that this issue will provide you with some insight into the community of young scholars in our graduate program. Additionally, we hope that you will share our view that our current students are working on important and relevant issues. On behalf of the Agricultural Economics graduate student community, we thank you for engaging in our work, as we seek to advance Purdue University's Land Grant Mission.

- *Chad Fiechter*

Ph.D. Student and 2023 Graduate Editor for PAER

PURDUE AGRICULTURAL ECONOMICS REPORT

Title	State of the Agricultural Economics Graduate Program, Update April 2023
Author	Nicole Olynk-Widmar, Professor, Associate Head, and Graduate Program Chair of Agricultural Economics
Article ID	*PAER-2023-18*
Date	May 9, 2023

The Fall of 2022 was an active one for our Graduate Program. We were excited to fund the first ever Graduate Program Networking, Relationship Building, and Recognition Grants in the Department, facilitating trips for several of our students to share their research and graduate program experiences with students at institutions around the country. In addition, we were excited to devote time to AgEcon Graduate Student community building through our writing retreat at Martel Forest and Halloween and Winter Holiday events in the main office.



Our Graduate Students are working actively in all facets of our Land Grant Mission areas, including guiding in the educational endeavors of our undergraduate students via classroom and extracurricular activities, providing leadership in Extension and engagement activities, and conducting research. AGEC Graduate Student Spotlights have shared our student's stories and provided insights into our varying, yet uniting, motivations for AgEcon research, teaching, and Extension activities.

The Department recently received approval to offer a new Professional Masters in International Agribusiness entirely online last year. This new Professional Masters in International Agribusiness degree allows students to select one Graduate Certificate to complete within (and towards!) their MS degree, either the Online Graduate Certificate in Spatial Data Science offered by the College of Agriculture or the Biotechnology Quality & Regulatory Compliance Graduate Certificate offered by Agricultural and Biological Engineering. We will welcome students to this online Professional Masters in International Agribusiness for the first time in August of 2023! We're excited to offer this new online program for the first time alongside our residential MS and PhD programs, hybrid MS-MBA, and online MS-MJ programs.

We hosted our Graduate Student Recruitment on campus in March. In addition to welcoming 17 visiting prospective MS and PhD students to our Department, we were excited to host a reception for the Department's faculty, staff, and graduate students. We are looking forward to welcoming nine incoming MS students and eight incoming PhD students to our Department this Fall. We're excited to continue to nurture the diverse community of scholars comprised of our graduate students, faculty, and staff in the Department of Agricultural Economics.

If you have questions about our AgEcon MS, PhD, MS-MJ, or Professional Masters in International Agribusiness (PMIA) Programs, please reach out to Ryan Good, Graduate Program Administrator, at rrgood@purdue.edu If you have questions about the MS-MBA in Food and Agribusiness Management, please reach out to MS-MBA Program Manager Taryn Nance, at tnance@purdue.edu

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PURDUE
AGRICULTURAL ECONOMICS REPORT

Title	Consumer Demand for Innovative Healthy Snack in the US
Author	Laxmi D. Adhikari, Yizhou Hua, Yifei Wang, and H. Holly Wang
Article ID	*PAER-2023-19*
Date	May 9, 2023
Summary	According to consumer preferences, healthier snack options with favorable sensory attributes are increasingly sought after, with physically active individuals placing greater emphasis on product quality, while those leading sedentary lifestyles prioritize calorie content and taste.

1. Introduction

Overweight and obesity are growing problems in the world. Among important contributors including diet and eating behaviors, snacking, has become a major component of modern eating behavior (McGill & Appleton, 2009). The US market experienced $135.7 billion in sales of snacks in 2020 (Statista, 2022). Snacks often have low positive nutrients such as protein, vitamins and fiber, and more negative nutrients than regular meals, such as salt, sugar, acrylamide (a possible carcinogen in fried foods) or carbohydrate with empty calories (Baskar & Aiswarya, 2018). Healthier snacks are being developed, such as freeze-dried tofu chips. In this study, we use a choice experiment to find consumer preference for certain attributes of freeze-dried tofu chips, a new, healthy snacking alternative. Literature has reported many benefits of freeze drying, including maximum retention of the original food structure, color, flavor, and nutritional value, not needing to add preservatives to retain freshness, and no acrylamide (Chen et al., 2022).

There is a vast amount of literature about consumer food choice including snacks. Many have examined attributes such as taste, nutrients, satiety, convenience, and country of origin (COO) in making snack purchase decisions (Zbib et al., 2010; Bilman et al., 2010). However, studies show that consumers are more likely to focus on the absence of negative nutrients, such as additives, trans fats, sugar, and genetically modified organisms. Further, these studies also study each attribute independently as if they can be separated. Aside from food attributes, consumers' own characteristics such as health attitude and social status are also found relevant (Lacy & Huffman, 2016). In contrast, not enough attention has been paid to the presence of positive attributes in snacks, such as freeze drying, new processing technology, nor to consumers' preference for a healthy lifestyle. Despite the fact that snack product attributes coexist, this factor has been omitted in previous analysis. There is also a lack of analysis on the attribute package approach although some attributes only coexist. To fill these gaps, the objective of this study is to 1) study consumer snack preferences focusing on the positive attributes, like freeze drying; 2) build a model with attribute packages; and 3) include the consumer lifestyle as a characteristic to explain their preference.

2. Method

We use a choice experiment to find consumer preference for certain attributes for a new healthy snack product, tofu chips, measured by willingness-to-pay (WTP). Choice experiments are a state-of-the-art method to investigate the stated preference of consumers for hypothetical, new, and/or

non-market goods, when the revealed preferences are not available. Based on Lancaster's random utility theory, an individual obtains a utility, *U*, through consuming a good from two parts, a deterministic part, *V*, which is derived from the attributes consumed, and a random part, ε, determined by unobserved factors.

$$U = V + \varepsilon, \text{ and } V = \beta' X, \quad (1)$$

where X is the vector of product attributes and β is the associated marginal utility parameters.

Using the mixed logit model, we estimate the coefficients of each attribute of the snack, allowing each consumer to have their own coefficient estimate to account for preference heterogeneity. Then we calculate the WTP for attribute *k* using the formula, $WTP_k = -2\beta_k/\beta_{price}$.

Consumers' WTP for attribute *k* may be influenced by many factors, such as their demographics, lifestyle and snacking frequency. We conduct a regression analysis on the WTPs.

$$WTP_k = f(demographcis, lifestyle, snacking\ frequeny) + e \quad (2)$$

Using this method, we will be able to quantify how much more or less a consumer would be willing to pay for the freeze-dried tofu chip. This information can be used by companies or policy makers to guide the pricing or regulation of future snacking.

3. Data and descriptions

Data for this study were collected in June 2022 through online survey by a global survey company, Dynata. The sample includes 1000 respondents from two major metropolitans, New York and Chicago. Unlabeled choice experiments for Tofu chips are administered to the respondents. They are offered two alternative Tofu chips for them to either buy one or not buy either.

Each alternative product is labeled with a price, a healthiness package, a COO, and a taste level. The particular levels are determined by an optimal efficiency experiment design from the preset levels. The healthiness package attribute has four levels, namely 1) Fried (120 calories, non-keto or vegan); 2) Freeze dried (50 calories, non-keto or vegan); 3) Vegan (freeze dried, 50 calories, non-keto, vegan); and 4) Keto (freeze dried, 50 calories, keto, non-vegan). The taste attribute has three levels, not crunchy, crunchy and very crunchy, and the COO is either imported or domestic. Prices of $ 6.5, $ 8 and $9.9 per bag are considered. The imported, fried and not crunchy product is used as the base and the WTP premium for each attribute is calculated.

Demographic and economic information including consumer's gender, age, household size, education level, employment status, and annual income is collected. How active a respondent's lifestyle is measured by the categories of athletic, active, medium and low, as well as the snacking frequency have also been collected. Descriptive statistics is presented in Table 1. The mean age of respondents in our sample is 45.54 years and the mean years of schooling is 15.09, almost with a college degree. There is an almost equal percentage of males and females. Nearly half of the respondents lead a medium active lifestyle, about a third consider themselves active, while nearly one fifth are not active. The average snacking frequency is 1.77 times a day.

Table 1: Descriptive statistics

Variables	Mean/Percentage
Age (years)	45.54
Gender (%)	
Male	48.20
Female	51.80
Education (years of schooling)	15.09
Income ($1000)	87.15
Lifestyle (%)	
Athletic (e.g., CrossFit, body build, training for Marathon etc.)	5.70
Active (e.g., regular gym visits, hiking trips, having physical job)	29.70
Medium (e.g., walking chores, gardening, dog walking, frequent walks)	45.30
Not active (minimal activities)	19.30
Snack consumption frequency in a day	1.7662

4. Results

4.1 Willingness to pay estimation

We estimate a mixed logit model in Stata version 17 and calculate mean WTP. Our results are presented in Table 2. All the coefficients are statistically significant and in line with consumer theory. With the increase in price of snack, consumer utility is decreasing. Similarly, the choice to not consume tofu chips (optout) has a negative and significant effect on the utility. However, the utility increases if the chips are:, freeze dried, vegan, keto, crunchy, or very crunchy and produced domestically.

Table 2: Parameter estimates from the mixed logit model and willingness to pay

Variables	Mean Coefficients	Standard Deviation Coefficients	Mean WTP ($)
Price	-.1714***	NA	
	(.0323)		
Optout	-3.0524***	NA	
	(.2948)		
Freeze dried	1.6657***	1.033575***	19.70
	(.1249)	(.0741163)	
Vegan	1.8536***	1.120123***	21.90
	(.1324)	(.0754144)	
Keto	1.7153***	-.5205058***	20.25
	(.1232)	(.0827037)	
Crunchy	.9249***	.7088535***	10.80
	(.1013)	(.0698975)	
Very crunchy	.9667***	.6294685***	11.42
	(.0971)	(.0782844)	
US origin	.3846***	.590675***	4.40
	(.0493)	(.083168)	
Number of observations		12000	

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

We have estimated WTP for six different attributes of tofu chips. An average respondent is willing to pay $19.70 more for a bag of tofu chips that is freeze dried with 50 calories than for a bag of chips that is fried with 120 calories. The WTP premium becomes $21.90 for vegan and $20.25 for keto, both of which are freeze dried with 50 calories. This means the freeze dry attribute has a value much higher than fry, while the additional keto or vegan only brings a small premium. We also find that crunchiness is an important sensory attribute to consumers, as they are willing to pay

$10.80 higher than the not crunchy ones, while this value has a small increase to $11.42 for extra crunchiness. These results confirm that consumers value the health features brought by freeze drying and the sensory feature of crunchiness. COO is also an important factor for consumers of tofu chips, as they show a $4.40 price premium for domestic above imported products.

In additional to the means, the density curves of all six WTPs are represented Figure 1. Vegan, freeze dried, and keto WTPs have similar distributions. They all have a wide range, suggesting that consumer preferences are highly variable or are willing to pay different prices for the same attributes. Values range from negative $40 to positive $60. The negative values show some respondents prefer fried over freeze dried. The WTP for the US origin curve shows bimodal distribution with one peak at zero and the other at around ten. It shows one group of consumers is indifferent to the COO, whereas the other group prefers domestic products. Similarly, crunchy and very crunchy show dichotomized preferences on this sensory attribute, with one group caring more than the other. These attributes have less heterogeneity.

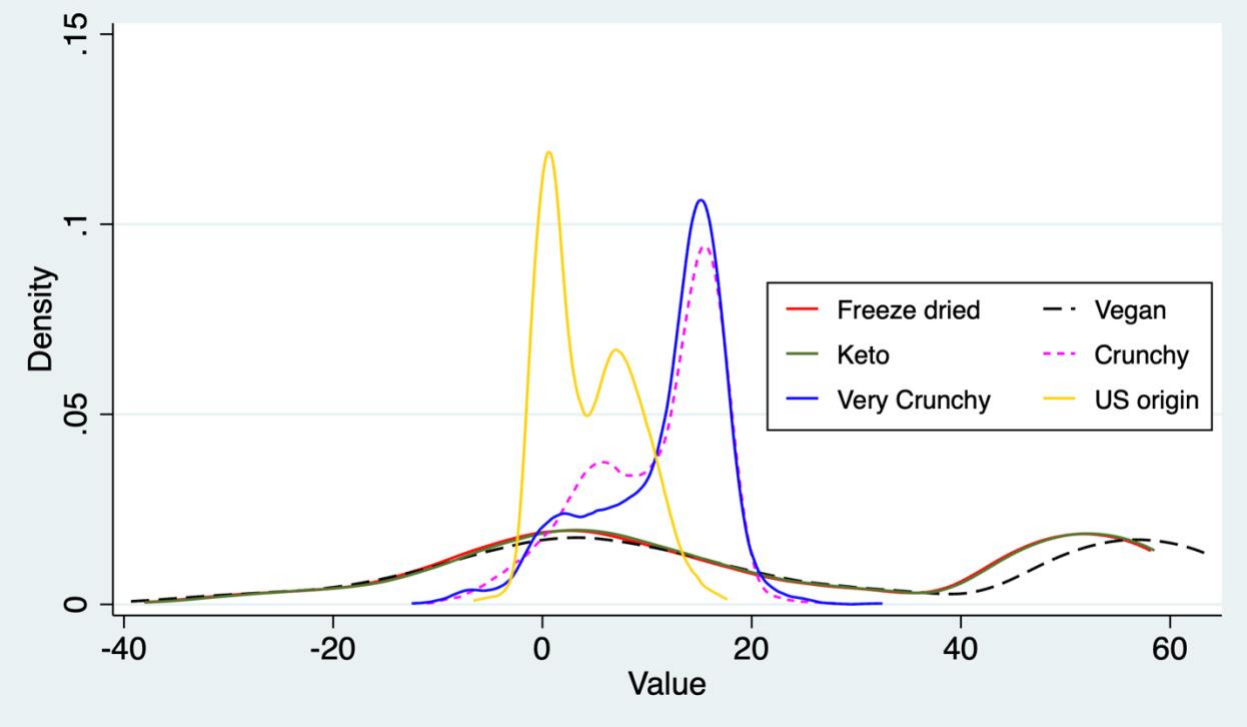


Figure 1 Density plot of willingness to pay

4.2 Factors Influencing Willingness to Pay

In order to better understand the consumer characteristics driving our WTP results, we utilized regression analysis. Our estimated results of WTP for four different attributes, namely freeze dried, crunchy, very crunchy, and US origin are presented in Table 3 (as the keto and vegan WTPs are very similar to freeze dried). All four models include the same explanatory variables, and the consistent results are that the WTP heterogeneity comes only from the lifestyle variables. Interestingly, our results show that consumers who engage in vigorous exercise (athletic) are willing to pay $12 less for a freeze dried than the medium active group people, while both groups are willing to pay more for freeze dried than fried. This indicates they accept snacks with higher calorie content compared to those who do not exercise much. One possible reason for this could be that individuals who engage in vigorous exercise may perceive that they burn a large amount of energy and need the calories. The not active group has the highest WTP, $9 more than the base group, for freeze dry for the same reason but in the opposite way. Snack frequency contributes to

WTP for freeze dry positively, $1 for each more time snacking in a day, which can be explained that those who consume more snacks know they need to eat more healthily.

For the sensory attributes crunchy and non-crunchy, the less active the consumers are, the higher WTP premiums they have, indicating sensory enjoyment is more important to the less active consumers. While the WTP for US origin, a sign of quality, shows a different pattern. The most active people care most, about $1.8 higher than the base group, while the least active people pay $1.2 lower than the base group.

Table 3: Willingness to pay regression results

Variables	Model 1 Freeze dry	Model 2 Crunchy	Model 3 Very Crunchy	Model 4 US origin
Gender	-1.1128	0.0567	-0.0332	0.2513
	(1.6030)	(0.3953)	(0.3929)	(0.2744)
Age	-0.0126	-0.0055	-0.0007	-0.0012
	(0.0485)	(0.0120)	(0.0119)	(0.0083)
Education	0.0239	0.0405	-0.0189	-0.0381
	(0.3949)	(0.0974)	(0.0968)	(0.0676)
Income	-.0089	-.0034	-.0026	.0018
	(.0140)	(.0034)	(.0034)	(.0024)
Lifestyle				
Athletic	-12.7469***	-3.1480***	-4.2120***	1.8086***
	(3.5191)	(0.8678)	(0.8625)	(0.6024)
Active	-7.4307***	-2.1796***	-2.3501***	1.0123***
	(1.8744)	(0.4622)	(0.4594)	(0.3209)
Not active	8.9722***	1.0467**	0.6598	-1.1690***
	(2.1610)	(0.5329)	(0.5296)	(0.3699)
Snack frequency in a day	1.4733*	0.0570	0.0084	-0.0313
	(0.7993)	(0.1971)	(0.1959)	(0.1368)
Constant	19.8229***	11.2316***	12.7758***	4.6073***
	(6.3048)	(1.5547)	(1.5452)	(1.0792)
Observations	1,000	1,000	1,000	1,000
R-squared	0.0650	0.0472	0.0547	0.0399

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

5. Conclusion

Snacks are convenient foods that supplement meals for the special needs of today's busy professionals, people engaging in vigorous exercises, and raising children. Consumers' welfare can be improved by having the option of healthier snacks that have long shelf life and good sensory attributes. This study provides empirical evidence on the preference of US consumers for these new, healthy snacks. Overall, results show that, on average, there exists a high willingness to pay for freeze dried tofu chips that have lower calories and higher protein than their fried counterparts, with a large variance. US consumers value the crunchiness sensory attribute and snacks that are produced domestically, potentially due to this factor being a quality indicator. Consumers leading an active lifestyle care more about quality, while those consumers leading an inactive lifestyle care more about calories and tastes. For tofu chips, a single plant-based snack, keto and vegan make a small difference. Professionals in the food processing industry, health societies, and health-conscious consumers should benefit from these findings.

References

Baskar, G., & Aiswarya, R. (2018). Overview on mitigation of acrylamide in starchy fried and baked foods. *Journal of the Science of Food and Agriculture*, *98*(12), 4385–4394. https://doi.org/10.1002/jsfa.9013

Bilman, E. M., Trijp, J. C. M., & Renes, R. J. (2010). Consumer perceptions of satiety-related snack food decision making. *Appetite*, *55*, 639–647.

Chen, K., Zhang, M., Bhandari, B., Sun, J., & Chen, J. (2022). Novel freeze drying based technologies for production and development of healthy snacks and meal replacement products with special nutrition and function: A review. *Drying Technology*, *40*(8), 1582–1597. https://doi.org/10.1080/07373937.2021.1967375

Lacy, K., & Huffman, W. E. (2016). Consumer Demand for Potato Products and Willingness-to-Pay for Low-Acrylamide, Sulfite-Free Fresh Potatoes and Dices: Evidence from Lab Auctions. *Journal of Agricultural and Resource Economics*, *41*(1), 116–137.

McGill, R., & Appleton, K. M. (2009). Reasons for snack food choice and the prevalence of fruit snacking in Northern Ireland. *The Proceedings of the Nutrition Society*, *68*(OCE3). https://doi.org/10.1017/S0029665109991005

Statista. (2022). *Topic: U.S. snack foods industry*. Statista. https://www.statista.com/topics/1496/snack-foods/

Zbib, I. J., Wooldridge, B. R., Ahmed, Z. U., & Benlian, S. (2010). Selection criteria of Lebanese consumers in the global snack food industry: Country of origin perceptions. *Journal of Consumer Marketing*, *27*(2), 139–156. https://doi.org/10.1108/07363761011027240

PURDUE
AGRICULTURAL ECONOMICS REPORT

Title	Can a sustainability facts label reduce the halo surrounding organic labels (Neuhofer et al., 2023)?
Author	Zachary T. Neuhofer
Article ID	*PAER-2023-20*
Date	May 9, 2023
Summary	We analyze the effects of a sustainability facts label on organic choice. We find that the presence of the hypothetical label increased the likelihood of organic purchase, and led to consumers increasing their perception of organic relative to conventional.

Motivation

A common method used to relay information about food products are labels such as, the Nutrition Facts Label (NFL) and the USDA organic label**.** Consumers often use food labels to form beliefs about food attributes they are uncertain of. In some cases, these beliefs may be unsupported by the best scientific evidence**.** One common label that consumers often form unsupported beliefs about is the USDA organic label. Prior research has found that many consumers believe that products with a USDA organic label are healthier or better for the environment than their conventional alternatives (Campbell et al., 2014; Chandon, 2013; Durham, 2007; Schleenbecker & Hamm, 2013).

Currently, there are no environmental labels on food products that provide objective scientific information that resemble a layout like the NFL. Some environmental and sustainability labels are a signal that specific certifications have been met such as, the USDA organic label, Energy Star certification, or Safer Choice labels (EPA, 2020; USDA, 2022). Other labels such as, the EnergyGuide labels on appliances provide quantitative scientific data, but are limited to a single metric (Newell & Siikammki, 2014). This leads us to consider if a standardized "sustainability facts label" (SFL) could decrease consumers' unsubstantiated health and environmental beliefs about organic products.

Methods

We undertake a survey of consumers to better understand how information provided in a label affects the choice of organic, as well as beliefs related to the healthiness, taste, environmental impact, and animal welfare of organic and non-organic options.

We collected our data through an online survey using a nationally representative sample of 2000 milk consumers in the US (Figure 1). To qualify for our survey, the respondent had to state they purchased dairy milk at least once every few months and be a primary shopper in their household. Respondents began the experiment by selecting whether they preferred 2% or whole milk. Next, they answered questions regarding their beliefs on a variety of health and environmental metrics comparing organic and conventional milk. The next portion was the initial control choice in which the consumers chose between an organic and conventional option both in a binary choice and a sliding scale indicating the intensity of preference, and were separated into two price treatments (Figure 2). After the control choice, the respondents were exposed to one of three label treatments; the NFL only, the SFL only, or both the NFL and SFL. After the choices, the respondents answered the belief questions again as a manipulation check and demographic information.

The label design included information gathered from nutrition and environmental data on milk production. We collected the nutrition data from the USDA ARS database for both conventional and organic milk (USDA ARS, 2022). The data collected for the environmental facts were gathered from life cycle analyses (LCAs) on organic and conventional milk production in the United States, and European Union (EU) countries such as, the Netherlands, and Germany from 2001-2020 (J. L. Capper et al., 2009; Judith L. Capper & Cady, 2020; de Vries & de Boer, 2010; Thomassen et al., 2008). International estimates were included for two primary reasons; one is that there was a general lack of LCAs conducted on US farms for organic milk, another is that organic certifications in the EU are generally accepted and labeled as USDA organic when sold in the US (USDA AMS, 2016, 2022). The metrics we included were the calories, total fat, cholesterol, sodium, total carbohydrates, protein, global warming potential, energy use, land use, water use, and an animal welfare measurement (Figure 3).

We estimated our results primarily using a statistical model known as a logistic regression. We assume the choice of organic is dependent on the price difference between organic and conventional milk, and the label treatments the respondents were placed in. Additionally, we use t-tests and chi-squared tests to make statistical comparisons between groups.

Results

We observed that respondents in the low price organic treatment were more likely to select organic than those in the high price treatment from a chi-squared test. Additionally, we observed that a significant number of participants changed their choice from either conventional to organic or vice versa after exposure to the labels. When controlling for all treatment effects in the regression model and individual specific effects, we find that those exposed to either the SFL alone or both labels were more likely to select organic milk.

We did find that the facts panels altered the beliefs of the respondents. Those exposed to the SFL increased their perception that organic performed better on environmental metrics than conventional. Those exposed to the NFL decreased their perception that organic had fewer calories and more protein than conventional.

Conclusions

We observe that the presence of the SFL increases the likelihood of choosing organic which is contrary to our hypothesis. We had predicted that information that showed similarity in the environmental impact between organic and conventional milk would decrease the likelihood of selection or at least be insignificant at altering the beliefs or choice. It may be that consumers did not understand the metrics on the label using the scientific units seen in LCAs and would be understood better using either environmental messages or unit approximations such as “carbon emissions per mile traveled by a car”. The results of this study show that using labels presenting objective scientific data may not be the best way to display sustainability information. In an era where consumers increasingly care about animal welfare and sustainability of food products, other label options may need to be considered to effectively communicate this information.

References

Campbell, B. L., Khachatryan, H., Behe, B. K., Dennis, J., & Hall, C. (2014). U.S. and Canadian Consumer Perception of Local and Organic Terminology. *International Food and Agribusiness Management Review*, *17*(21–40).

Capper, J. L., Cady, R. A., & Bauman, D. E. (2009). The environmental impact of dairy production: 1944 compared with 2007. *Journal of Animal Science*, *87*(6), 2160–2167. https://doi.org/10.2527/jas.2009-1781

Capper, Judith L., & Cady, R. A. (2020). The effects of improved performance in the U.S. dairy cattle industry on environmental impacts between 2007 and 2017. *Journal of Animal Science*, *98*(1), 1–14. https://doi.org/10.1093/jas/skz291

Chandon, P. (2013). How package design and packaged-based marketing claims lead to overeating. *Applied Economic Perspectives and Policy*, *35*(1), 7–31. https://doi.org/10.1093/aepp/pps028

de Vries, M., & de Boer, I. J. M. (2010). Comparing environmental impacts for livestock products: A review of life cycle assessments. *Livestock Science*, *128*(1–3), 1–11. https://doi.org/10.1016/j.livsci.2009.11.007

Durham, C. A. (2007). The impact of environmental and health motivations on the organic share of produce purchases. *Agricultural and Resource Economics Review*, *36*(2), 304–320. https://doi.org/10.1017/S1068280500007115

EPA. (2020). *Recommendations of Specifications, Standards, and Ecolabels for Federal Purchasing | Sustainable Marketplace: Greener Products and Services | US EPA*. https://www.epa.gov/greenerproducts/recommendations-specifications-standards-and-ecolabels-federal-purchasing

Neuhofer, Z. T., Lusk, J. L., & Villas-Boas, S. (2023). Can a sustainability facts label reduce the halo surrounding organic labels? *Applied Economic Perspectives and Policy*, *November 2022*, 1–31. https://doi.org/10.1002/aepp.13350

Newell, R. G., & Siikammki, J. (2014). Nudging Energy Efficiency Behavior: Role of Information Labels. *SSRN Electronic Journal*, *1*(4). https://doi.org/10.2139/ssrn.2467676

Schleenbecker, R., & Hamm, U. (2013). Consumers' perception of organic product characteristics. A review. *Appetite*, *71*, 420–429. https://doi.org/10.1016/j.appet.2013.08.020

Thomassen, M. A., van Calker, K. J., Smits, M. C. J., Iepema, G. L., & de Boer, I. J. M. (2008). Life cycle assessment of conventional and organic milk production in the Netherlands. *Agricultural Systems*, *96*(1–3), 95–107. https://doi.org/10.1016/j.agsy.2007.06.001

USDA. (2022). *Guidelines for Organic Certification of Dairy Livestock*. https://www.ams.usda.gov/sites/default/files/media/Dairy - Guidelines.pdf

USDA AMS. (2016). *Importing Organic Products in to the US*. https://www.ams.usda.gov/sites/default/files/media/Importing Organic Products Factsheet.pdf

USDA AMS. (2022). *AMS Dairy Program – EU Dairy and Composite Product Certification Programs*. https://www.ams.usda.gov/services/imports-exports/dairy-exports/eu-dairy-exports

USDA ARS. (2022). *FoodData Central*. https://fdc.nal.usda.gov/index.html

Figure 1: Experimental Flow

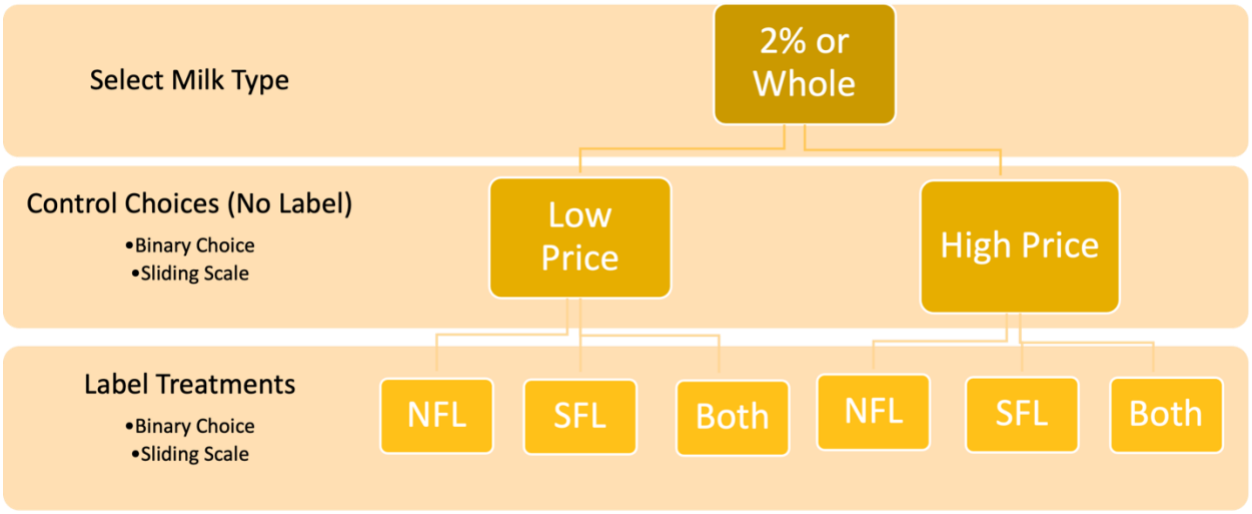


Figure 2: Control Choice Example with Sliding Scale

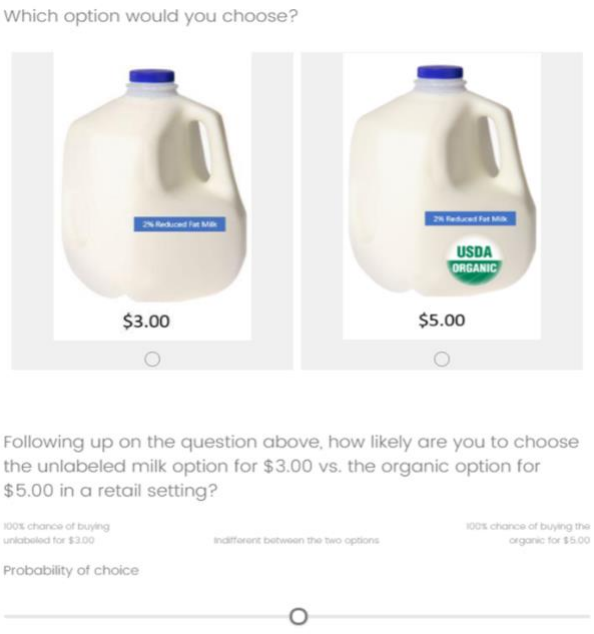


Figure 3: Example of Both Labels Combined: Organic, 2% milk

PURDUE AGRICULTURAL ECONOMICS REPORT

Title	The Accuracy of USDA's Retail Food Price Forecast
Author	Ethan Buck, Morgan Hinz, Yuxi "Jimmy" Jiang, Xiuyun "Lisa" Wen, and Todd H. Kuethe, Schrader Endowed Chair in Farmland Economics
Article ID	*PAER-2023-21*
Date	May 9, 2023
Summary	A team of undergraduate researchers find that USDA retail food price forecasts provide accurate predictions at short horizons.

In 2021, U.S. consumers spent roughly $2.1 trillion on food, which accounted for approximately 10.3% of disposable personal income (USDA Economic Research Service, 2022). Since the onset of the COVID19 pandemic, food prices have increased substantially. Between August 2021 and August 2022, consumer prices for all food increased by 9.1%, with grocery prices rising by 13.5% and menu prices jumping 8.0% (U.S. Bureau of Labor Statistics). One of the primary sources of information on current and future retail food prices is USDA ERS's Food Price Outlook.

This study examines the accuracy of the consumer retail food price forecasts of USDA ERS's Food Price Outlook between 2004 through 2022. The forecast predicts annual food price changes as reported by Bureau of Labor Statistics' Consumer Price Index. The timeline of USDA ERS's food price forecast is shown in Figure 1. The forecast is conducted monthly, with each vertical tick mark represents one forecast. The initial forecast is released in July of the preceding year. For example, the first forecast for 2023 food price changes was released in July, 2022. For each year, USDA produces a total of 18 monthly predictions for each price series.

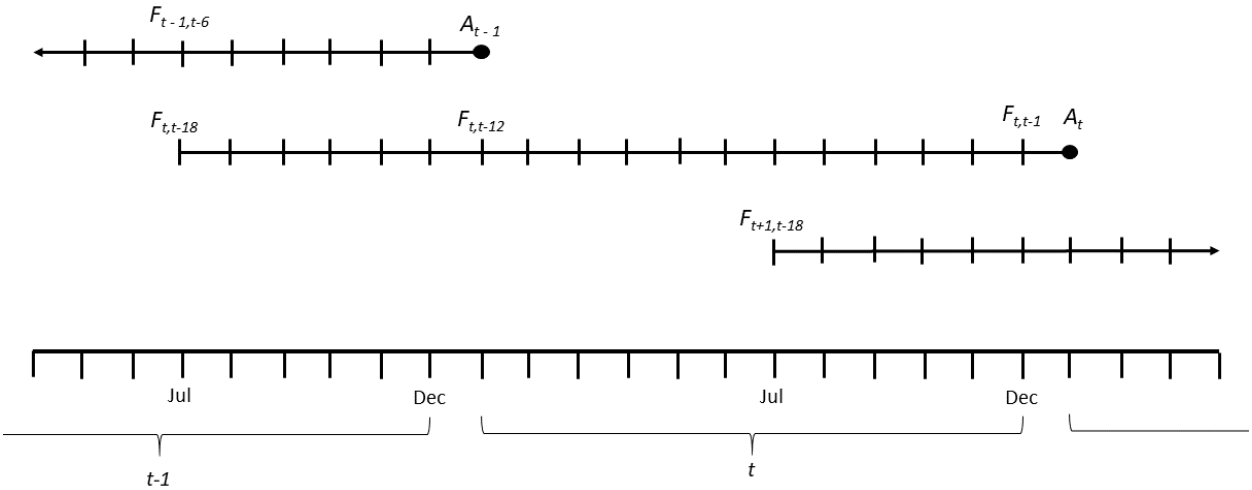


Figure 1: ERS Food Price Forecast Timeline

Forecasts are generated for a series of 22 nested price series. While our comprehensive study examines each of the series, this brief highlights the findings for three headline price forecasts: (i) all food, (ii) food at home (i.e., grocery prices), and (iii) food away from home (i.e., menu prices).

The forecasts are reported as a fixed one percent interval (e.g., 1 – 2% or 4.5 – 5.5%). The forecasts maximize the probability that this one percent interval contains the realized price change. Figure 2 plots the forecasts from 2004 through 2022 at four horizons: the initial forecast released in July the year before

(18-month horizon), the first forecast of the calendar year in January (12-month horizon), the forecast released in July of the reference year (6-month horizon), and the final forecast released in December of the reference year (1-month horizon). The one percent interval forecasts are represented by the vertical black bars, and the realized outcomes are represented by the dashed red line.

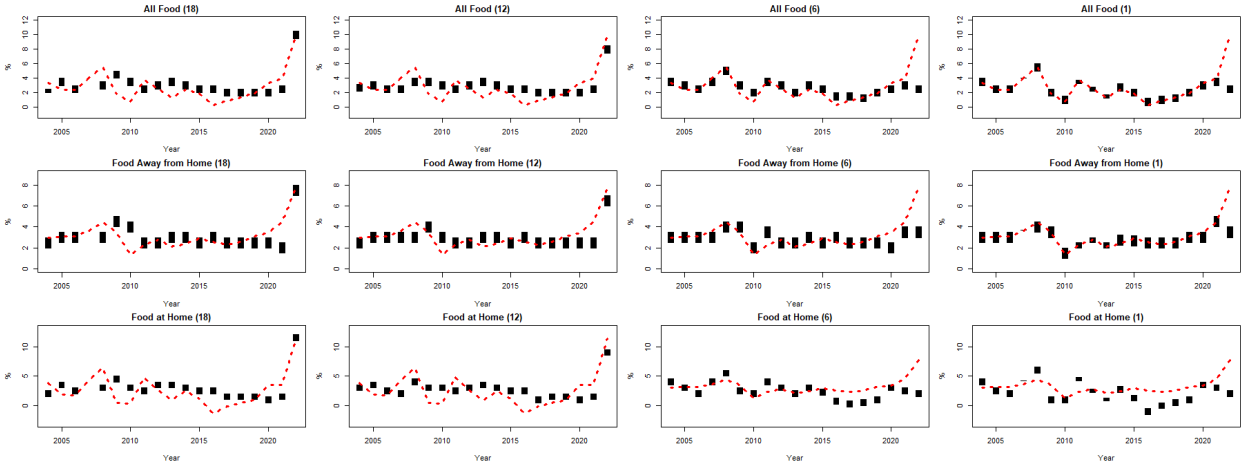


Figure 2: Food price forecast and observed outcomes, 2004 – 2022

The accuracy of interval forecasts is measured by the "hit rate" or the average number of times that the observed outcome falls within the reported interval throughout the history of the forecast. We calculate the hit rate for each price forecast at each horizon. The forecasts are expected to improve throughout the forecast cycle, and as a result, the hit rate is expected to increase as the realized outcome approaches.

As shown in Figure 3, the forecasts generally improve as the horizon shortens. For example, the hit rate suggests that realized price changes for all foods fall within the predicted interval 22% of the time for the initial forecast (18-month horizon), but the hit rate for the final forecast in December (1-month horizon) improves to 95%. The hit rate for food away from home is markedly lower, beginning at 6% and improving to 79%. The food at home category has the best initial hit rate, at 56% but a lower ending hit rate, at 89%.

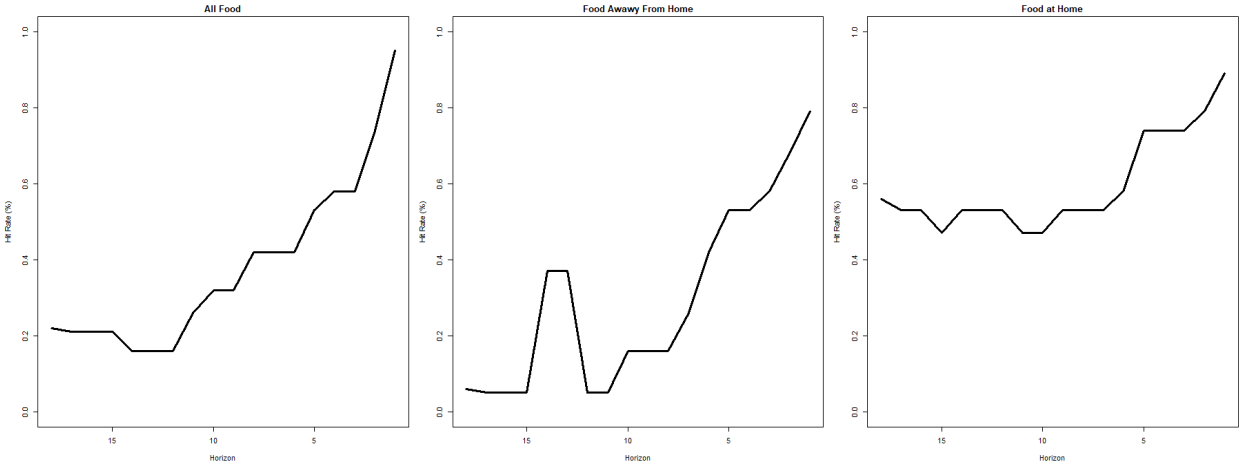


Figure 3: Average hit rate by forecast horizon, 2004 – 2022

Overall, the accuracy measures suggest that USDA retail food price forecasts are better at predicting changes in grocery prices than changes in menu prices. However, the forecasts provide good predictions of food price changes in later periods of the forecast cycle.

PURDUE
AGRICULTURAL ECONOMICS REPORT

Title	COVID-19 Assistance to Indiana Producers in 2020 and 2021
Author	Hari P. Regmi
Article ID	*PAER-2023-22*
Date	May 9, 2023
Summary	Historically, Farm Bill programs have provided a majority of farm income support to producers. In recent years, especially 2020 and 2021, the pandemic assistance payments comprised the largest share of government assistance to Indiana producers. The average government payments per farm ($35, 497) was a record high in 2020 (35.2% of net cash income).

Introduction

There were significant supply and demand disruptions due to the COVID-19 pandemic, especially in the first year of the pandemic 2020. This resulted in significant fluctuation in commodities prices, including a rapid and sudden decrease in the commodities prices in the first half and middle of 2020. To offset the price decline and additional marketing costs incurred by producers, the USDA implemented several pandemic-related programs, including the Coronavirus Food Assistance Program (CFAP) using authority from bills passed to provide assistance to US businesses. Farm operations were also eligible to receive assistance from programs administered by other U.S. federal agencies. One of the major sources of non-USDA assistance was from the forgivable Paycheck Protection Program (PPP) loans administered by the Small Business Administration (SBA) with assistance from the U.S. Treasury.

This program resulted in a record-high government payment of 45.5 billion (in real 2023 dollars) to the farm sector in 2020 (at the national level). In this report, we analyze government payments, especially COVID-19 pandemic assistance, received by Indiana producers from USDA (labeled USDA pandemic assistance) and non-USDA sources (labeled non-USDA pandemic assistance) in a format similar to Giri et al. (2021), which examined assistance from CFAP and PPP loans to Illinois producers. We use publicly available data from the CFAP database, PPP database, and the Economic Research Service's Farm Income and Wealth Statistics data product released on Feb 7, 2023, and Agricultural Resource Management Survey (ARMS) summary data.

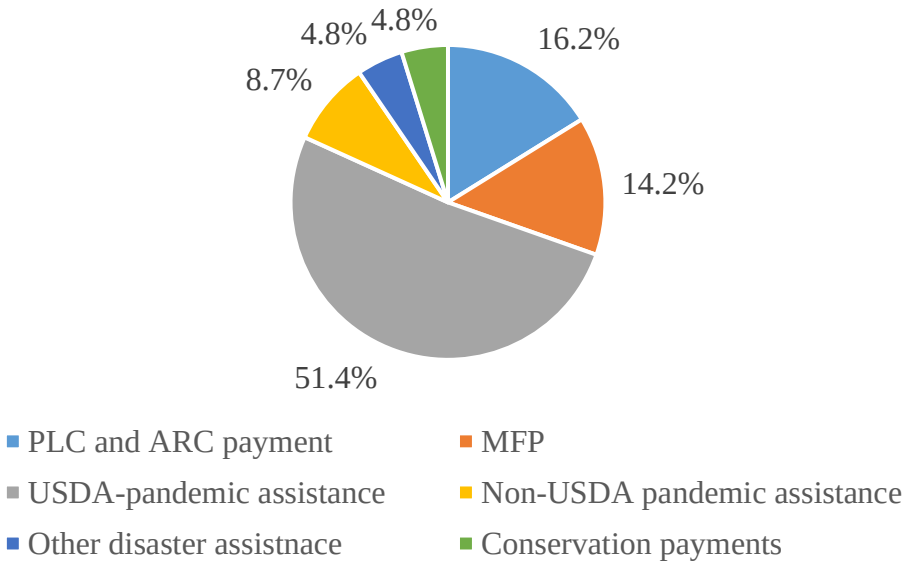
USDA Pandemic Assistance Payments

Coronavirus Food Assistance Program was the primary COVID-19 pandemic assistance relief program for agricultural producers administered by the USDA. CFAP provided financial assistance to agricultural producers and ranchers that were directly affected by the COVID-19 pandemic. Agricultural producers who incurred a substantial increase in marketing costs or a substantial decline in sales or prices due to the COVID-19 pandemic were eligible for assistance under the CFAP program (USDA, 2020).

Figures 1 and 2 represent the different components of direct government payments to Indiana producers for two years (2020 and 2021) in real, inflation-adjusted 2023 dollars. Indiana producers received $1.5 billion direct government payments in 2020. The lion's share of the government payments came from USDA-pandemic assistance in 2020, $764 million, which was more than 50% of total government payments received by Indiana producers. The regular Farm Bill programs payments (including those from PLC and ARC) accounted for 16.2%, or $ 240.4 million. Market Facilitation Payment (MFP) program accounted for 14.2%, or $211.8 million, and other ad hoc disaster assistance programs (such as payments

from Wildfire and Hurricane Indemnity Program, Emergency Relief Program, Quality Loss Adjustment Program, and other Farm Bill designated disaster programs) accounted for 4.8%, or $70.9 million, of total government payments to Indiana producers in 2020.

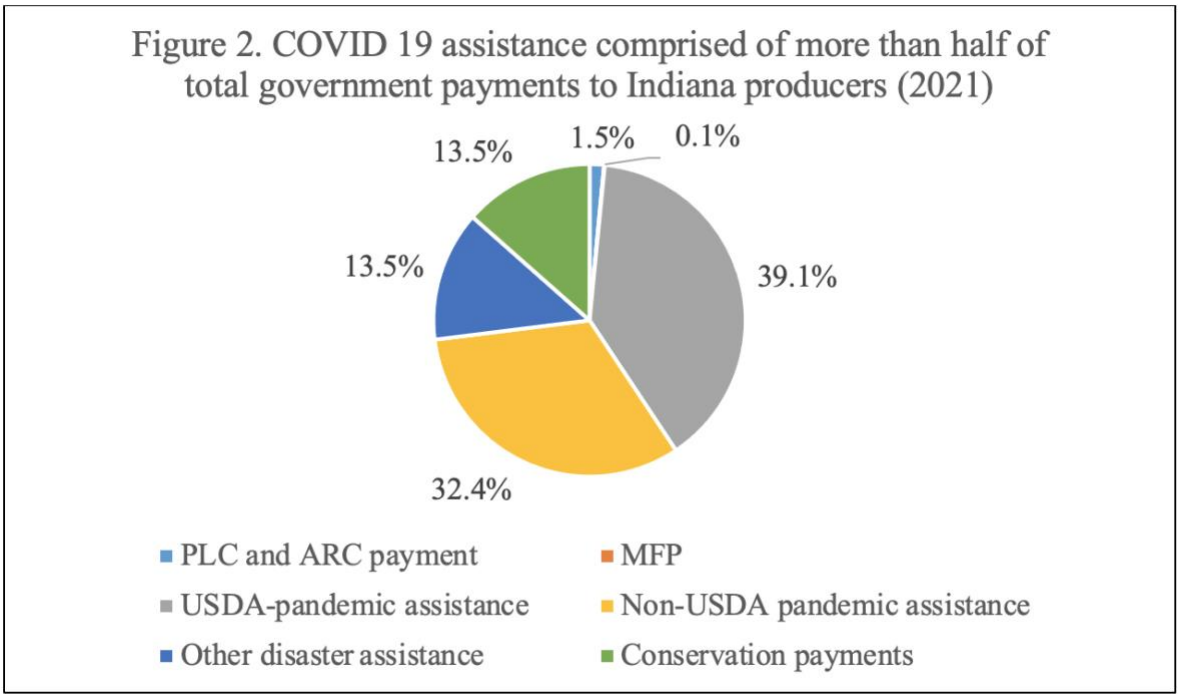
Figure 1. COVID 19 assistance compirised of more than half of total government payments to Indiana producers (2020)



Indiana producers received $716.9 million in direct government payments in 2021, which is almost half of the total government payment received by agricultural producers in 2020. The decline in USDA pandemic assistance payment lowered the total government payment in 2021. In 2020, Indiana producers received $764.4 million USDA pandemic assistance payments whereas they received $278.5 million in 2021.

Indiana producers received $128.9 million non-USDA pandemic assistance payments in 2020, which was 8.7% of total government payments (figures 1 and 2). However, in 2021, Indiana producers received a $230.5 million non-USDA pandemic assistance payment, which is 78.7% or 101.6 million higher than the payment received in 2020.

Overall, USDA-pandemic assistance payments made to Indiana producers decreased in 2021 as compared to 2020 (declined from more than 50% share in total government payments in 2020 to 39.1% in 2021 or declined from 764.4 million to 278.5 million). However, non-USDA pandemic assistance payments increased from 2020 to 2021, 8.7% share of total government payments in 2020 to 32.4% in 2021. This shows that non-USDA pandemic assistance was an important source for producers in 2020 and, even more, in 2021.



Non-USDA Pandemic Assistance Payments: Paycheck Protection Program

The Small Business Administration administered the PPP program to support small businesses, including the farm sector. The SBA group crop production and animal production subsector according to the North American Industry Classification System (NAICS) code. The crop production subsector is coded as NAICS 111 and the livestock production subsector is coded as NAICS 11.

Table 1 shows approved PPP loans for Indiana producers in 2021. The SBA data indicates that the crop production sub-sector received $243 million PPP loans, and the livestock sub-sector received $82.80 million PPP loans. The crop production sub-sector received a greater amount of loan assistance relative to the animal production most likely because crop production is more labor intensive and PPP was designed to offset labor expenses.

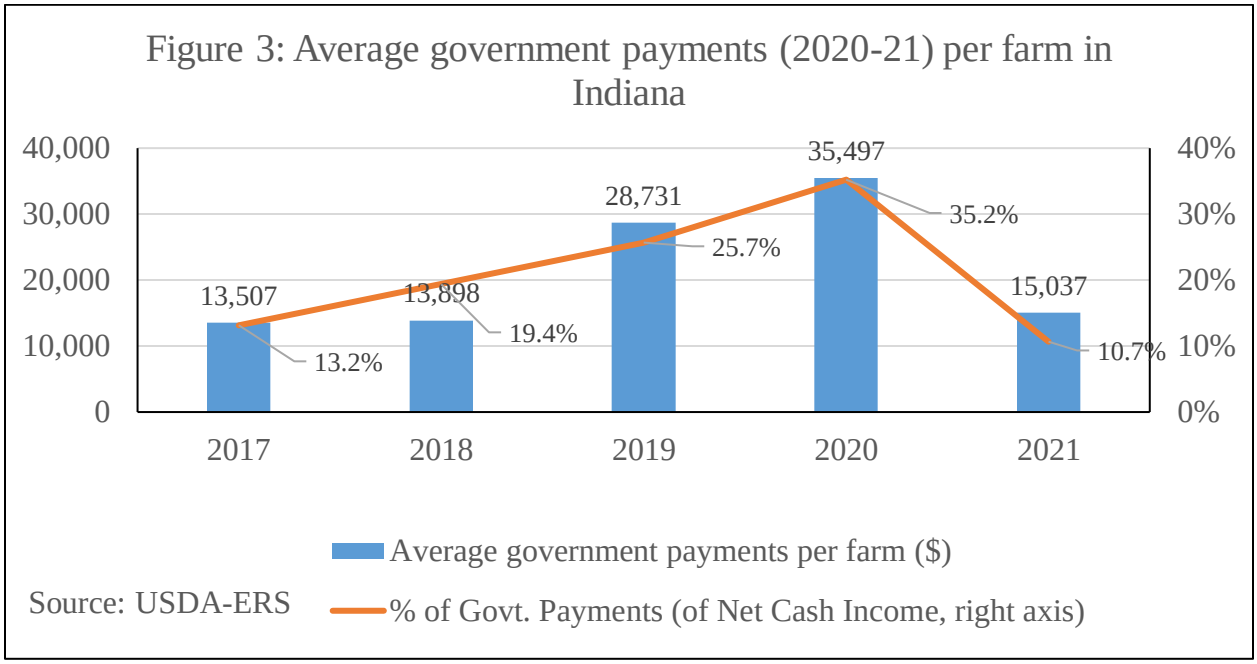
Table 1 also presents PPP loan forgiveness rate (forgiveness amount/approval amount). The PPP loans were to be forgiven if the recipients met the forgiveness requirements, including 60% or more of PPP loan for payroll expenses within 24 weeks of receiving PPP loan on labor expense (SBA 2022; Giri et al. 2023). The unforgiven PPP loans (and loan amount) become a regular low-cost loan for the recipient. Results indicate that 98.3% of total PPP loans made to Indiana agricultural producers had been forgiven, which is similar to the national-level farm sector PPP loan forgiveness rate of 98% (Giri et al., 2023). We do not find a difference in loan forgiveness rates between crop and animal production subsectors.

Table 1: PPP approved loans and forgiveness rate for Indiana producers in 2021

Subsector	Approved loans ($ million)	Forgiveness rate*
Crop production (NAICS 111)	243.00	98.3
Animal production (NAICS 112)	82.80	98.1
Total	325.80	98.3

Average government received by Indiana producers in recent five years (2017-2021)

Figure 3 shows the average government payments per farm in Indiana for the five years from 2017 through 2022 using ARMS web tool data. Data indicate that the average government payment per farm was a record high in 2020 at $35,497 (35.2% of total net cash income) followed by $28,731 in 2019. The higher government payment in 2019 compared to 2017 and 2018 might be due to higher MFP payments and higher government payments in 2020 and 2021 might be due to USDA pandemic assistance and non-USDA pandemic assistance payments. We also calculate the share of government payments to net cash income and present results in figure 2. Results indicate that the share of government payments was a record high in 2020, 35.2% of net cash income to Indiana producers.



Conclusions

Historically, Farm Bill programs have provided a majority of farm income support to producers. In recent years, especially 2020 and 2021, the pandemic assistance payments comprised the largest share of government assistance to Indiana producers. The average government payments per farm ($35, 497) was a record high in 2020 (35.2% of net cash income). In 2020 and 2021, Indiana producers received more than $1.1billion from USDA pandemic assistance programs and more than $359.5 million from non-USDA pandemic assistance programs. Indiana crop production sub-sector received almost three times more PPP loans compared to the animal production sub-sector, however, PPP loans forgiveness rate (98%) was similar for both subsectors and on par with the national level.

References

Coronavirus Food Assistance Program 1 Data. Available on Coronavirus Food Assistance Program 1 Data | Farmers.gov

Coronavirus Food Assistance Program 2 Data. Available on Coronavirus Food Assistance Program 2 Data | Farmers.gov

Giri, A.K., D.Subedi, J.Janzen, and l. Tettech. 2021. “Pandemic Assistance to Illinois Agricultural Producers in 2020 from the Coronavirus Food Assistance Program (CFAP) and the Paycheck Protection Program (PPP)” https://farmdocdaily.illinois.edu/2021/10/pandemic-assistance-to-illinois-agricultural-producers-in-2020-from-cfap-and-ppp.html.

Giri, A.K., D. Subedi. A.K.Mishra, E. Wesley F. Peterson, R. Baral, and H.P.Regmi. 2023. “(Un)Forgiven Paycheck Protection Program (PPP) Loans to the Farm Sector.” CHOICE (forthcoming).

Paycheck Protection Program data. Available on PPP data (sba.gov)

US Department of Agriculture. 2020. Coronavirus Food Assistance Program 2 Cost-Benefit Analysis. US Department of Agriculture, Washington, DC. Available on https://www.farmers.gov/sites/default/files/documents/CFAP2-CBA-09252020.pdf

US Department of Agriculture, Economic Research Service. 2022. Government payments by program. Available on https://data.ers.usda.gov/reports.aspx?ID=17833#P4fda7f1a989d4de7 aaac4001448c80a9_2_118iT0R0x14

US Department of Agriculture, Economic Research Service. 2023. ARMS Farm Financial and Crop Production Practices. Available on https://www.ers.usda.gov/data-products/arms-farm-financial-and-crop-production-practices/

PURDUE AGRICULTURAL ECONOMICS REPORT

Title	Indiana Farm's Financial Health in Light of Economic Uncertainties
Author	Hari P. Regmi
Article ID	*PAER-2023-23*
Date	May 9, 2023
Summary	Over the past ten years (2012-2021), Indiana farms were relatively stable according to liquidity and solvency indicators. However, Indiana farms were relatively less efficient than Midwest and US farms measured by operating expense ratio.

Introduction

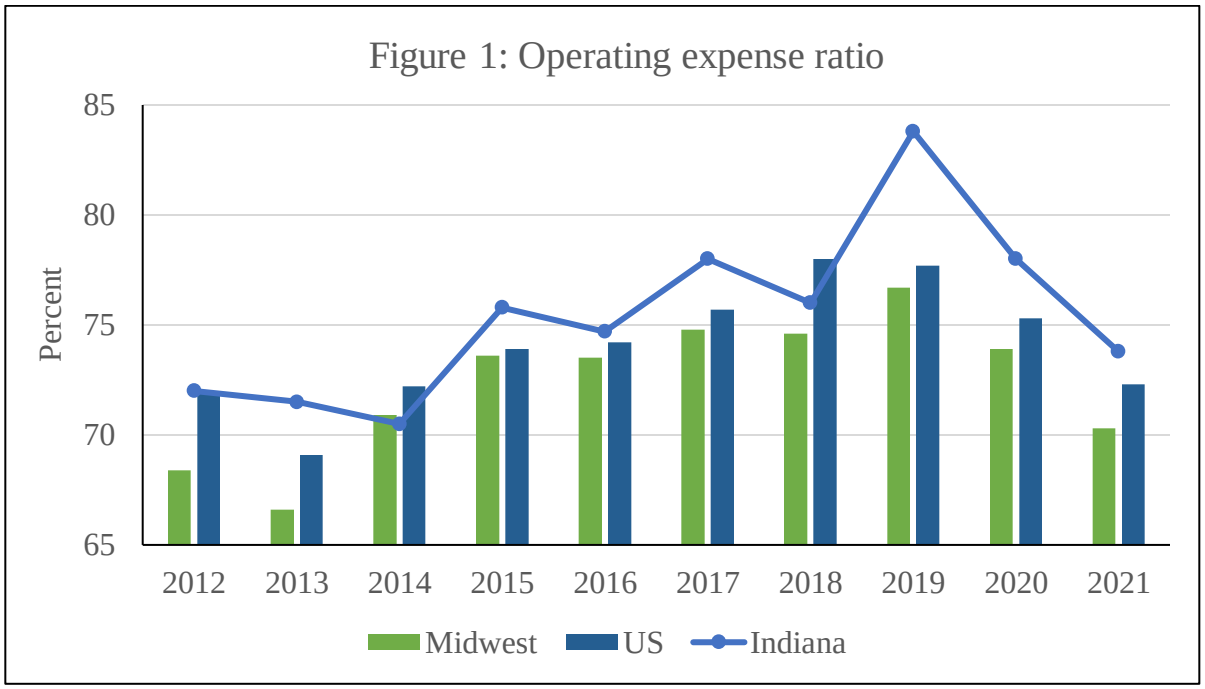
This report evaluates the financial performance and position of Indiana farms relative to those in the Midwest and U.S. to gauge the standing of Indiana's farms in relative terms. We analyze four financial ratios to measure farm financial performance with respect to efficiency, liquidity, profitability, and solvency. USDA-Economic Research Service (ERS) provides detail documentation for the farm sector financial ratios (USDA-ERS, 2023). In this report, we use publicly available USDA-Agricultural Resource Management Survey (ARMS) summary data for Indiana, the Midwest region, and the US to compare the financial conduct and performance of Indiana farms.

1. Efficiency ratio

Efficiency ratios measure a farms' ability to use its assets to generate revenue. Efficiency ratios are important because an improvement in efficiency ratios usually translates to improved profitability. The operating expense ratio is one of the most commonly used efficiency ratios. The operating expense ratio is calculated as follows:

$$\text{Operating expense ratio} = \frac{\text{Cash operating expense}}{\text{Value of farm production}}$$

The operating expense ratio measures the extent to which the cash income generated by the farm business is absorbed by the cost of production for the specific year. A lower value of operating expense ratio is preferred because the lower the ratio, the more effective the farm in generating returns. Figure 1 shows the operating expense ratio for Indiana, Midwest, and US farms from 2012 through 2021. We find that the operating ratio for Indiana, Midwest, and US farms consistently increased from 2014, reached to the highest point (83.8 %) in 2019 and then started to decline. Indiana farms' operating expense ratio was higher relative to the Midwest farms and US farms for all years (except for 2014 and 2018). We find that Indiana farms were relatively less efficient than Midwest and US farms as measured by operating expense ratio. For 2021, the latest year with available data, operating expense ratio for Indiana farms, Midwest farms, and US farms were 73.8%, 70.3%, and 72.3%, respectively. This shows that while the ratio was higher in previous years, Indiana farms are comparable to other farms across the region and country.

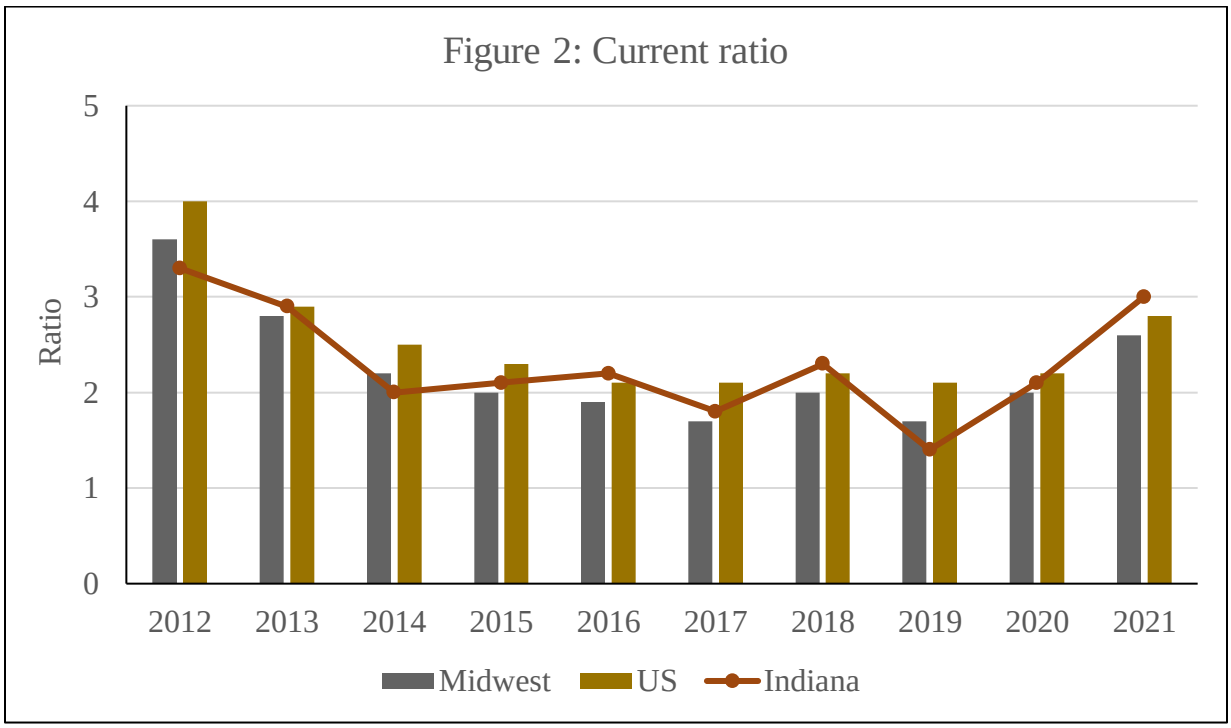


2. Liquidity ratio

Liquidity refers to the ease with which farm assets can be converted into cash to meet farm expenses and debt payments. Liquidity ratios indicate farm's ability to cover short-term obligations as the payments come due. We analyze one of the most commonly used liquidity measures, current ratio. Mathematically,

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

Figure 2 shows the current ratio for Indiana, Midwest and US farms from 2012 through 2021. A higher value (generally, above two) of current ratio is preferred because it indicates that the farm is more liquid and has better coverage of outstanding short-term debts. A current ratio value of below one indicates financial stress, while between one and two is considered acceptable (FFSC, 2022). In general, Indiana farms, Midwest farms and US farms had current ratio above the acceptable threshold of one in the past ten years. For 2021, the latest year with available data, current ratio for Indiana farms, Midwest farms, and US farms were 3, 2.6, and 2.8, respectively. Indiana farms were able to maintain the highest current ratio (3) for 2021 as the economy have been recovered from the COVID-19 pandemic.

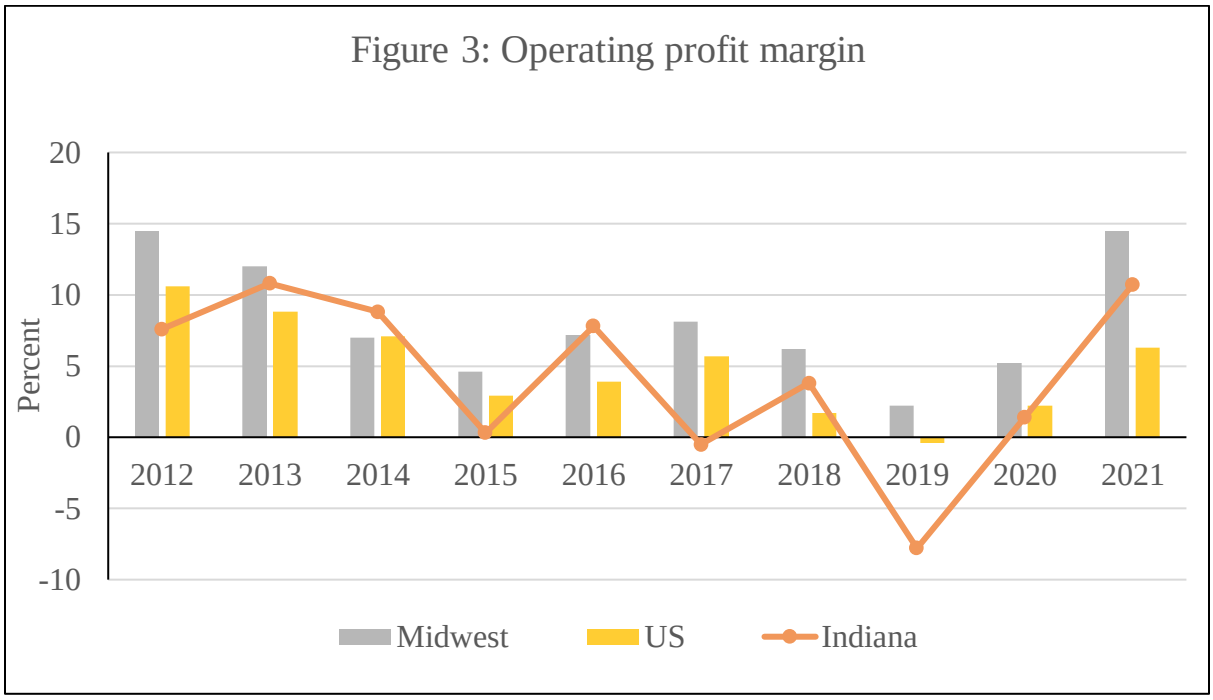


3. Profitability ratio

Farm profitability refers to the farm sector's ability to generate returns from production inputs. Net farm income, which is the leftover income after all the factors of production are paid, is one of the commonly used indicators of farm profitability. However, it is difficult to benchmark net farm income because of differences in farm size and scales of operation (Chandio et al., 2022). We use one of the most commonly analyzed profitability indicators, operating profit margin (OPM), which accounts for scale of farm operations, as captured by farm profitability per unit of output. The operating Profit margin is calculated as follows:

$$\text{OPM} = \frac{\text{Net farm income} + \text{interest expense} - \text{Return to unpaid labor and management}}{\text{Value of production} + \text{government payments}}$$

Figure 3 shows the operating profit margin for Indiana, Midwest, and US farms. Higher value of operating profit margin is preferred (> 25%). ERS categorizes farm operations as low risk (OPM 25%), moderate risk (10% ≤ OPM < 25%), and high risk (OPM< 10%) based on OPM. The operating margin indicators show that farms in Indiana, Midwest, and US were under moderate to high risk for most of the past ten years. Although Indiana farms had relatively higher operating profit margin (except for in 2019) compared to Midwest and US farms, Indiana farms were still in the high-risk zone for most of the past 10 years. Despite the effect of COVID-19 pandemic, in 2021, Indiana farms operating margin improved (10.7%).

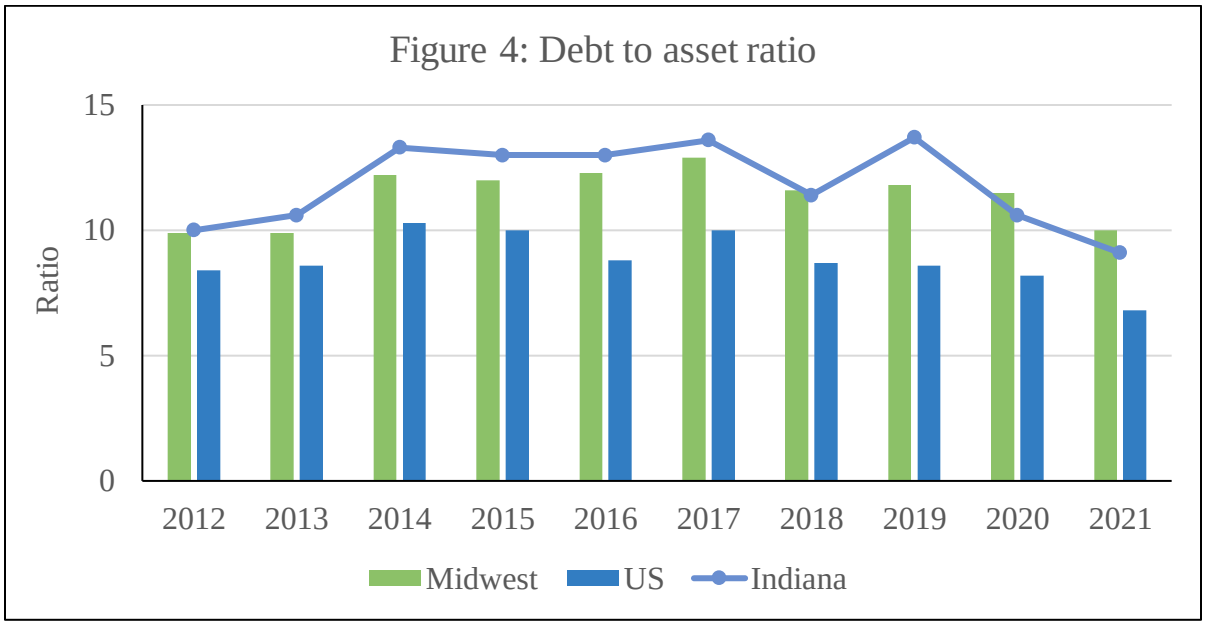


4. Solvency ratio

Solvency ratios show farms' ability to satisfy its debt obligations. Solvency indicators are often referred to as leverage ratios and indicate the degree to which the farm is able to pay all of its financial liabilities by selling all assets. Solvency indicators are particularly important to understand farm financial risk and borrowing capacity. We use debt-to-asset ratio as a measure of farm solvency. Debt-to-asset ratio measures the proportion of farms' assets owed to the lender to cover debt obligations.

$$\text{Debt} - \text{to} - \text{asset ratio} = \frac{\text{Total farm debt}}{\text{Total farm assets}}$$

Figure 4 shows debt to asset ratio for Indiana, Midwest, and US farms for the past ten years. Debt-to-asset ratio equal to one indicates that all farm assets are financed by debt. Higher debt-to-asset ratio indicate a lower level of solvency, thus lower ratio (generally below 30) is preferred. We find that Indiana, Midwest, and US farms debt to asset ratio were relatively stable and under 30% over the last ten-year (from 2012 through 2021). Indiana farms had higher debt-to-asset ratio relative to Midwest and US farms for most of the years over the past ten-year period. However, we find that Indiana farms had lower debt-to-asset ratio (9.1) for 2021 relative to Midwest farms (10).



Conclusions

We discuss multiple financial ratios of Indiana, Midwest, and US farms focusing on four indicators of farm financial performance: Efficiency, Liquidity, Proficiency, and Solvency. These measures can be used to track Indiana farms' relative performance and to identify the areas for improvement or take initiative actions to improve performance. We find that Indiana farms were relatively stable according to liquidity and solvency indicators. However, Indiana farms were relatively less efficient than Midwest and US farms measured by operating expense ratio. Further, profitability indicators (measured by operating profit margin) for Indiana farms were more uneven for the past ten years with the largest profit loss in 2019. Recently, Giri et al., (2022) also indicate that at the national level, most of the financial ratios for 2020 were weaker than their respective average over the twenty-year average (2000-2019). In light of increased interest expense due to tighter monetary policies of the Federal Reserve and forecasted decrease (at national level) of farm income, Indiana farms might need to find ways to increase efficiency. While the financial conduct and position of Indiana farms for the most part are not worrisome, it seems that farm operators might need to carefully engage in risk management strategies.

References

Chandio, R. H.Wu, A.L.Katchova, A.K.Giri, and D. Subedi. 2022."Benchmarking Ohio Farms' Financial Health." Available on OhioFarmsFinancialsARMS.pdf (osu.edu)

Farm Financial Standards Council "Financial Guidelines for Agriculture." 2022. ⟨ Council Updates Financial Guidelines Documents – Farm Financial Standards Council (ffsc.org)⟩

Giri, A.K, C. Litkowski, D. Subedi, and T. McDonald. 2022. "COVID-19 Working Paper: Farm Sector Financial Ratios: Pre-COVID Forecasts and Pandemic Performance For 2020". Available on https://www.ers.usda.gov/publications/pub-details/?pubid=104535

USDA-Economic Research Service. 2023a. Farm Income and Wealth Statistics-Documentation for the Farm Sector Financial Ratios. Available on https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/documentation-for-the-farm-sector-financial-ratios/#trrfe

PURDUE
AGRICULTURAL ECONOMICS REPORT

Title	Experience, Knowledge, & Collaboration: Why Good Managers Make an Effort to Improve
Author	Margaret Lippsmeyer and Michael Langemeier, Professor of Agricultural Economics
Article ID	*PAER-2023-24*
Date	May 9, 2023
Summary	Knowledge, experience, and collaboration work hand in hand with one another to improve farm output per unit of input (i.e., productivity). This article reflects on the impact these three factors have on farm productivity and describes how each relates to management strategy.

Introduction

Knowledge, experience, and collaboration work hand in hand with one another to improve farm output per unit of input (i.e., productivity). Pursuit of one of these items without the others creates a disparity between farms able to survive and those that thrive in the industry. But the question arises, why do these factors play such a critical role in farm performance?

This article reflects on the impact these three factors have on farm productivity and describes how each relates to management strategy. The article is the first in a series that will address strategic risk.

Experience

Experience accumulates through years of developing an understanding of the industry you are working in. Because of past experiences, farmers have a good idea of the time of year to plant crops, apply fertilizers, pesticides, market finished products, and how to manage unforeseen challenges that may arise. Farming becomes second nature to those with years of experience, whereas new entrants to the industry lack this sense.

One prominent benefit of experience in agriculture is that costs decline with experience. Porter (1980) states "newly started firms, with no experience, will have inherently higher costs than established firms and must bear heavy start-up losses from below- or near-cost pricing in order to gain the experience to achieve cost parity with established firms (if they ever can)". So, while the role of experience in the farming industry, is difficult to quantify, it plays a significant role in determining farm profitability and success.

Experienced farmers operate much more independently and efficiently. A study by Rejesus et al. (2008) indicates that experience in the industry reduces reliance on farm programs, such as those offered through USDA and extension services. However, despite supplemental information not playing as crucial of a role for well-established firms, they remain a good resource when questions arise.

Because survival in the agricultural industry is highly dependent on level of experience, if new entrants are to be successful, they need to gain experience rapidly and effectively. This may be done through farm work experience, internships, or participation in mentor programs to decrease impacts of the entry barriers. While we have discussed the critical role of experience, its role as a competitive advantage should not reduce a manager's obligation to improve knowledge and collaborate with other industry professionals.

Knowledge

Knowledge and experience are deeply intertwined with one another, however for the purposes of this article, knowledge relates to the information absorbed from formal educational opportunities. These come in many forms, whether it be through courses, reading, or discussions with industry professionals, all of which expand your knowledge on up-to-date farming practices.

When it comes to risk, according to Apgar (2006) there are two general forms: learnable risks and random risks. Learnable risks possess uncertainty because we haven't learned all there is to know about the subject. These risks can be mitigated through expanding our knowledge. Random risks, on the other hand, are unpredictable and expansion of knowledge cannot reduce levels of uncertainty for these instances (Apgar, 2006).

It's in the best interest of a farm to mitigate learnable risks through accumulation of knowledge as rapidly as possible. Learning about different production strategies, technology advancements, strategies of competitors, and ways to reduce input costs are all important. However, it's also critical to consider the potential changes that are upstream and downstream of production that can influence your profitability. This includes sourcing of inputs, determinants of input prices, potential limitations to supply, and responses to each of these relative changes. Downstream considerations include gaining knowledge about consumer preferences, learning how to create products that match these preferences, potential market disruptions, and diversifying who you sell to in case one buyer has financial difficulties. As is commonly noted, it is seldom a good idea to have all your eggs in one basket.

Ability to increase knowledge rapidly and effectively regarding business opportunities is a major contributor to maintaining a prominent position in an industry. Farms able to incorporate items learned through research and expanding knowledge will maintain a definite production advantage over competitors with inferior abilities to learn and adapt.

Collaboration

Accumulation of knowledge and experience play a large role in establishing a competitive advantage in an industry. This may lead to the false premise that in order to maintain a competitive advantage in the market, new strategies and innovations should not be shared. Secrecy is likely not what's best for your operation, nor the agricultural industry as a whole. Sharing ideas allows for critiques from an outside perspective, insight into alternate innovation possibilities, and further improvements to strategies which will reap additional benefits.

Farmers aim to run a profitable entity, but also to supply food and other goods to the general population. To maximize our ability to fulfill these goals, collaboration among peers and even among competitors is often necessary. Whether that's a formal networking or cabbaging onto practices used by others through observation, dispersion of information truly is the only way to bring about progress.

Studies have indicated adoption of new technologies is highly dependent on collaboration in the agricultural industry. Adoption occurs at different rates across farmers with different characteristics, largely due to heterogeneity in learning strategies. Early adopters generally obtain and process more information independently while later adoption of technology signals a reliance on social networks for information (Chavas & Nauges, 2020). Risk preference is also a contributing factor that influences adoption of new equipment or farming strategies. Finger et al. (2022) differentiate farmers into two distinct groups based on risk preference, proactive and reactive learners. Proactive learners are innovators and early adopters, with drive to seek out new knowledge and engage across social networks. In contrast, reactive learners are described as risk averse, adopt business-as-usual models, are hesitant to adopt new technologies, and may be reluctant to engage in social networks.

Farmers with more risk averse tendencies often begin using new technologies long after others have switched. As noted by Chavas and Nauges (2020), "technology adoption in agriculture is an engine of economic growth and an important way to increase farm productivity and improve food security around

the world". As new technologies continue to emerge, collaboration will increase in importance. Studies emphasize the importance of social networks in the farming community, whether that be through formal meetings, extension programs, or casual interactions. Encouraging frequent networking and collaboration can help prevent individuals from lagging behind industry standards and fuel more efficient agricultural production.

Impacts on Operation

Now let's address why making an effort to increase knowledge, experience, and collaboration is beneficial for farm performance. The factors noted above (i.e., experience, knowledge, and collaboration) have been shown to be positively related to farm performance in previous studies. A review of 102 studies on *Management Practices and the Financial Performance of Farms* found that knowledge acquisition and management experience have distinct impacts on financial performance (Vanhuyse et al., 2021).

Vanhuyse et al. (2021) concluded that experience positively affects profitability and financial efficiency. They also indicated that collecting and responding to new knowledge is an essential function for financial and technical performance. The article had a lesser focus on impacts of collaboration, but indicated that particularly for smaller sized farms, collaboration is important for sustaining financial performance. In general, findings stress the importance of lifelong learning and participating in networks with industry specialists, which of course would include other farmers.

Strategies for Improving

Throughout this article, we have encouraged leaders in agriculture to cultivate curiosity and improvements in their farming practices. To maintain a competitive advantage in the agricultural sector and continue to encourage growth in the industry, farmers and ranchers need to commit to the pursuit of knowledge and collaborate with peers.

There are numerous sources of information which can be beneficial for on-farm decision making, insight into current and future market conditions, prevalent pests and how to effectively manage them, and much more. We would be remiss if we did not note that online publications and software targeting the agriculture sector are available from land grant universities. A few examples include farm management and agricultural finance information from the *farmdoc* team and Purdue's Center for Commercial Agriculture, risk management software (Right Risk) from Colorado State, and financial analysis software from University of Minnesota's Center for Farm Financial Management. The important point is to gather information that will provide new perspectives and industry insight, with a goal of setting your farm apart from those unwilling to make this investment.

In summary, strategic farm managers continuously gather information on new technologies, look for new business opportunities, and learn through their mistakes as well as mistakes made by others. The following points of reflection may aid you in determining how you compare to other farming professionals and identify growth opportunities.

- How do geopolitical conflicts impact my operation; what recent events in the news might influence my profitability in the coming season?
- Where are my farm inputs sourced from (seed/feed/sprays/fertilizer) and what will disrupt my ability to acquire them?
- Are substitute products available for farm inputs in case prices increase drastically or input availability becomes problematic?
- Am I collecting accurate farm data, how have we been using the farm data we collect, and what are ways in which we could use it better?

- Do we regularly assess employee performance to ensure the labor we pay for is of sufficient quality?
- What new varieties/crops would create opportunities for diversification on my farm with minimal investment in new capital?
- Would growing a different crop give me an advantageous position in an emerging market?
- What networks for farmers are available that I can join or participate in discussions? These might include grower associations, agricultural podcasts, social media groups, and attending extension meetings or conventions.
- Is there sufficient diversity in who I sell my products to?
- Can I adapt to changes in consumer demand?
- What opportunities are available in my local area for farmers seeking further education?
- What production technologies are on the cutting edge of research and development? How will this technology impact my farming operation?
- Will adopting new technology increase my farm productivity and profitability?
- How would different marketing strategies impact our profitability?
- How do my competitor's management strategies differ from my own? Is there a clear benefit to one strategy over the others? Should I change my strategies?

References

Apgar, D. (2006). *Risk intelligence: Learning to manage what we don't know*. Harvard Business Press.

Chavas, J. P., & Nauges, C. (2020). Uncertainty, learning, and technology adoption in agriculture. *Applied Economic Perspectives and Policy*, *42*(1), 42-53. doi:https://doi.org/10.1002/aepp.13003

Finger, R., Vroege, W., Spiegel, A., De Mey, Y., Slijper, T., Poortvliet, P. M., ... & Meuwissen, M. (2022). The Importance of Improving and Enlarging the Scope of Risk Management to Enhance Resilience in European Agriculture. doi:https://doi.org/10.1017/9781009093569.003

Michael, E. P. (1980). Competitive strategy: techniques for analyzing industries and competitors. *Editorial Free Pr, ISBN*, *13*, 9780029253601.

Rejesus, R. M., Knight, T. O., Jaramillo, M., Coble, K. H., Patrick, G. F., & Baquet, A. (2008). Preference for risk management information sources: implications for extension and outreach programming. *Agricultural and Resource Economics Review*, *37*(1), 106-116. doi:https://doi.org/10.1017/S1068280500002185

Vanhuyse, F., Bailey, A., & Tranter, R. (2021). Management practices and the financial performance of farms. *Agricultural Finance Review*, *81*(3), 415-429. doi:https://doi.org/10.1108/AFR-08-2020-0126.