

# Applied Economics TEACHING RESOURCES

Volume 4, Issue 1, March 2022

## Editor

Jason Bergtold,  
Kansas State University

## Teaching and Educational Methods

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Trading Commodity Futures and Options in a Student-Managed Fund

*Matthew A. Diersen and Zhiguang Wang*

Adaptation of Teaching Strategies During the COVID-19 Pandemic

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Why No Debt? A FRICTO Analysis of the Capital Structure of Cal-Maine Foods Inc.

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## Teaching and Educational Commentaries

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The aim is to provide an inclusive outlet for research, teaching and Extension education scholarship encompassing but not limited to research articles, case studies, classroom games, commentaries, experiential learning, and pedagogy. The goal is to support and advance teaching and Extension education within the scholarly areas of agricultural and applied economics, and agribusiness economics and management. AETR seeks to publish articles that are diverse in both scope and authorship. It serves as a platform for addressing and contributing to our understanding of important societal issues, including inequality and discrimination, as well as how shifts in pedagogy (e.g., growing reliance on remote and hybrid learning modalities) may impact accessibility and inclusion.

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## Teaching and Educational Methods

# Trading Commodity Futures and Options in a Student-Managed Fund

Matthew A. Diersen<sup>a</sup> and Zhiguang Wang<sup>a</sup>

*South Dakota State University<sup>a</sup>*

JEL Codes: A22, A23, Q02

Keywords: Broker, commodities, experiential learning, speculation

### Abstract

Student-Managed Investment Fund (SMIF) programs and classes often involve the active management of a stock or equity fund. Complementing these is a unique fund, similar to a commodity pool, that invests directly in agriculture futures and options contracts. This paper presents a trading course that is offered where the class proposes and executes trades in the POET Student-Managed Agricultural Commodities Fund, which is owned by the South Dakota State University (SDSU) Foundation. The course objectives are to: (1) enhance market analysis skills, (2) master trading tools and techniques, and (3) advocate for prudent risk management in trading. Trading drills are used to gain competency in a speculative setting that requires detailed understanding of order entry and exit timing, price levels, and various order types. Real trades are considered including buying and selling futures, options, and combinations of agriculture-related contracts in a margin account. While many of the executed trades are “textbook examples” of how trading should work, the nuances provide teachable moments. The curriculum and fund characteristics are described here to inform other programs that may want to consider adopting a similar course.

## 1 Introduction

There are several ways for students to learn about investing. Attending lecture-based classes is one approach. Participating in an investment club may include exploring various investments and competing in a trading simulation. Student-Managed Investment Fund (SMIF) classes offer experiential and active learning through the management of a stock or equity fund. Bruce and Greene (2014) provide a broad overview of SMIF approaches and other ideas for incorporating experiential learning. Complementing these is a unique fund, similar to a commodity pool, that invests directly in agriculture futures and options contracts. Such a course, AGEC 484—Trading in Commodity Futures and Options, is taught by faculty in the Ness School of Management and Economics (NSME) at South Dakota State University (SDSU). The course is an agricultural economics elective, popular with agricultural business majors and those in other majors in the College of Agriculture, Food, and Environmental Sciences.

The course had been listed for many years and was historically run as a trading pool, where the students formed a partnership and pooled together capital to serve as seed money for trading (and paid tuition). The general experience with that approach was usually a lack of capital needed to make representative trades. Early losses would also greatly constrain making additional trades later in the semester. The general layout followed that of producer clubs (see Jones 1993 and Yost 2011) and of similar classes (see Parcell and Franken 2009; and Schroeder, Tierney, and Kiser 1995). Students always appreciated the experiential learning of placing trades. However, the partnership format meant enrollment was limited, and administering the course became increasingly difficult.<sup>1</sup> Thus, the course had not been taught for several years despite continued demand from students for the course.

<sup>1</sup> To be a trading pool, the students had to form and join a partnership with capital contributed by themselves. A partnership needs to be recreated each time the class is offered. The number of partners is capped at 15 members.

The objective of this article is to describe a SMIF-style course that directly incorporates trading commodity contracts in a margin account. The fund development and overall curriculum are described here to inform other programs that may want to consider adopting a similar course. The objectives of the course are to: (1) enhance market analysis skills, (2) master trading tools and techniques, and (3) advocate for prudent risk management in trading. An endowed fund is not necessary to have this type of course, but having one influences how the students approach trading. Various trading drills are also discussed as they provide a foundation for making real trades. The trades themselves are interesting in their scope, scale, and process.

Unlike the pooled settings, students in the course propose and execute trades in the POET Student-Managed Agricultural Commodities Fund, which is owned by the SDSU Foundation, following the efforts of an enlightened donor. The POET Fund is distinct from Isengildina-Massa and Ramsey (2019), which only invests in exchange traded funds. While the use of options is not unique to a SMIF (Saunders 2014), the NSME may have the only one that strictly focuses on commodities. Due to the risks associated with futures and options, especially outright futures positions, risk management is critical to the survival and success of this type of fund. This also creates a unique environment for experiential learning in commodity futures and options.

The POET Fund has become a key aspect of AGE 484, a three-credit undergraduate elective course in the NSME curriculum. The course meets Monday-Wednesday-Friday from 11:00 to 11:50 CST, which corresponds to the release time of major fundamental publications, such as *World Agricultural Supply and Demand Estimates* and *Crop Production* reports. The course is taught in the First Dakota National Bank e-Trading Education Lab with ten Bloomberg terminals and nine regular computers. The course follows a lecture format at the beginning of the semester and transitions to student-led trade proposals, group discussion, and voting. There are lectures reviewing futures, introducing or reinforcing options on futures, aspects of fundamental and technical analysis, and practical trading techniques. The trades may include buying and selling futures, put options, call options, and combinations of agriculture-related contracts. Enrollment in the course was high enough to warrant adding a fall semester section and at times expanding the cap from eighteen to twenty-seven students.

## 2 POET Fund

The POET Fund was started in 2018 and enhanced in 2019 by generous donor gifts. The donor understood the equity needed to facilitate trades and cover margin exposure. SDSU communicated with the Commodity Futures Trading Commission (CFTC) prior to starting the fund because of the historical treatment of similar classes as trading pools. The class functions as an Educational Marketing Club, thus positions must be closed by the end of the semester. The fund is owned by the SDSU Foundation, which opened a corporate account with margin trading. An introducing broker helped communicate with the futures commission merchant when setting up the account. The class *thought* they would be able to trade for real following the receipt of the initial gift in early 2018. However, it took several attempts to get the paperwork correct to open a margin account. Once started, the ongoing performance is supposed to keep the fund operational. Trading started for real in Spring 2019 with a corn futures position.

The fund follows a brief set of investment guidelines, modeled after SMIF guidelines (see Bruce and Greene 2014) with some influence from CFTC regulations. As the fund is not soliciting funds from nor interacting with the public it does not require formal regulatory disclosures. The fund allows students to gain knowledge of the practical aspects of trading commodity contracts. The students seek to achieve risk-adjusted returns or returns commensurate with the risk of trading futures and options, while preserving capital for future students. To protect other assets of the SDSU Foundation, ongoing trading costs and any losses incurred are limited to equity in the fund. The portfolio consists of commodities directly and indirectly related to agriculture, with exposure limits by commodity and security.

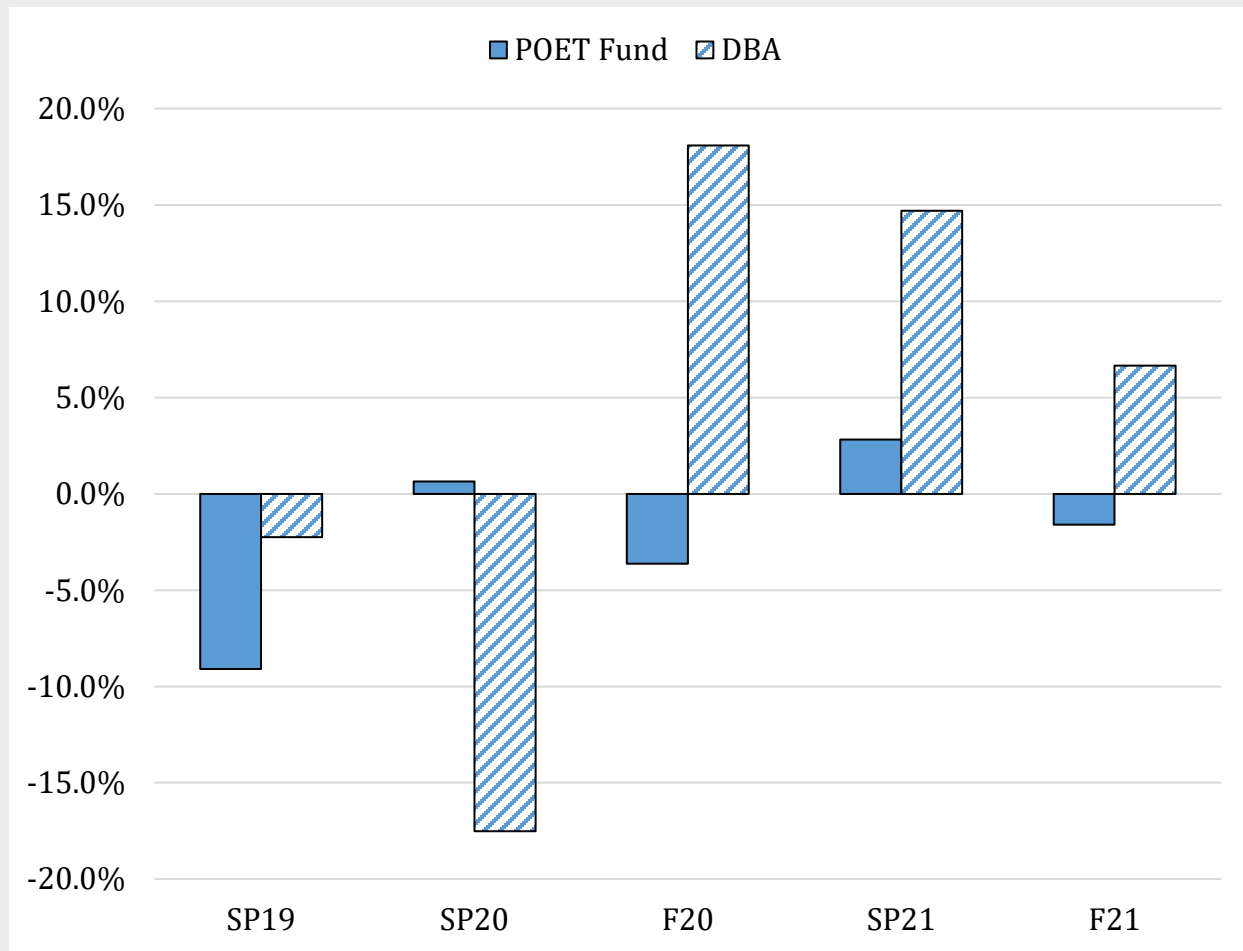
The fund uses a full-service introducing broker to oversee the account. The primary broker is an SDSU alumnus, and the firm has experience with hedging and speculating customers in the agricultural commodity space. With the brokerage account arrangement, the capital that can be at risk is limited to 50 percent of the total equity in the account at a given time. In addition, the broker is familiar with the investment guidelines and sees that those limits are not exceeded. The brokerage account is set up with access to the main data of the CME Group, but not other exchanges. The fund pays market rates for full-service, broker-assisted speculator trades. As such, the broker is on-call for any trade questions and order placement. The brokerage firm serves as an objective or fiduciary third party between the class and the SDSU Foundation. The firm has experience with speculative aspects (e.g., STOP orders and spreads) that are outside the normal scope of experience for most hedging students (and their instructors). The firm also places and monitors orders, which is necessary with complex exit plans.

Unlike in paper-trading drills, there seems to be a psychological difference trading real money. When asked to reflect on the difference, the students cite the additional preparation done when proposing real trades. The students take the responsibility seriously or invest more effort when it is not just a homework assignment or a game. They do not want to be the class that “lost” money or ruined the opportunity for future classes. They seem risk-averse and often must be cajoled into making the first trade of the semester. They are treated as analysts who are tasked to manage the fund (“business”) as opposed to a “gamer” in a paper-trading environment. They also take pride when positive outcomes add to the fund. Several groups of students have also competed in the CME University Trading Challenges. Those students also report perceiving paper trading and real trading as different. With homework and paper trading, there is not a high cost of making a mistake.

Like other SMIF courses, the students are trying to perform well in the fund when compared to the overall commodity market. The fund has a limited trading horizon (a semester), but some benchmarks are useful. Informally, the class is exposed to the Bloomberg Commodity Index, the S&P GSCI Commodity Index, and the Barclay Agricultural Traders Index. Invesco DB Agriculture Fund (DBA), which holds a portfolio of long commodity futures positions, has been a tractable and transparent benchmark. As shown in Figure 1, the fund performance has ranged from a loss of 9.1% to a gain of 2.8% (after commissions and fees). The fund returns have not been as variable as DBA returns. However, the portion of capital deployed has been low, and the portfolio needs to be restarted each semester. U.S. Treasury 4-Week T-Bills serve as a risk-free benchmark asset class. Relatively low interest rates have made interest earnings a low priority.

### 3 Trading Drills and Platforms

Trading drills are class exercises or homework assignments used to gain competency in a speculative setting that requires detailed understanding of order entry and exit timing, price levels, and various order types. Trading drills also reinforce hedging tools and tactics covered in the prerequisite course, for example, buying put options. The layout of the typical drills is shown in Table 1.



**Figure 1. Relative Performance During Various Semesters**

**Table 1. Trading Drills Used for Homework Exercises**

1. Selling futures (practice only)
2. Buying futures (with exit)
3. Buying put options (practice only)
4. Buying call options (with exit)
5. Portfolio competition
6. Hedging application
7. Futures or options spread

Early in the semester students are assigned a futures trade to execute, for example, selling a contract then buying it back. This allows them to become familiar with any trading platform used and to practice the basic process of trading. Then, a graded drill is assigned where students are asked to pick an expected price direction and place a futures trade consistent with those expectations. They must correctly pick the price direction for the exit order, a limit order above or below the entry price. A stop order may also be required to assure that risk is limited. Drill feedback at this stage is critical. There is often disparity in prior knowledge, and this is a useful point in the learning process to fill in any knowledge gaps and assure real trade proposals cohere with expectations.

After another practice drill, an option drill is assigned where the students select an expected price direction and buy an option accordingly. Thus, if they expect the futures price to increase, they should buy a call option. They then select a price objection (or premium objective) and place a corresponding

limit sell order as an exit strategy. Drill feedback is critical here also to assure that students understand the mechanics of trading options. An additional drill instructs students to build a portfolio of several futures and options across different commodities. Other drills are used as needed to explore other aspects (such as spreads, straddles, or hedge scenarios) or to serve as a nudge to see how a particular trade strategy may play out.

Trading drills and exercises are completed by simultaneously learning different trading platforms. Starting in SP20, the students made extensive use of the CME Group website and their Trading Challenge platform. Students are generally familiar with the CME Group site, but an account is needed to access a Practice Account and certain features. The CME Group is contacted to set up Private Challenges that the students join. The instructor is the facilitator of the challenge and can see the completed trades of the participants. The CME Group site also has an extensive set of education resources that can round out or complement the curriculum. Usually, one challenge is used for preliminary drills, then another challenge is started for the portfolio drill.

Other platforms have included ThinkorSwim, Commodity Challenge, and Interactive Brokers.<sup>2</sup> The instructor interface and ease of use vary across platforms. ThinkorSwim was widely used in SP18 and SP19 for trading drills. Commodity Challenge is very useful for crop hedging exercises and has been adopted in other NSME courses. Interactive Brokers has been extensively used by the NSME Investment Club and in an Investments course. In AGE 484, it has been used extensively for more complex drills as it allows for paper trading across an extensive set of securities, allows the instructor to see open orders (e.g., limit orders), and allows students to see trade confirmations and brokerage statements.

Even though the course meets in the trading lab, there can be more students than terminals. Demand for lab time varies, so having the ability to complete assignments outside of class is facilitated by using different platforms. Having an app version means the students can use their smartphones (or similar device) and complete drills remotely, eliminating excuses for not having continuous access to the trading lab. When in the lab, students have a wealth of market information available, but no ability to trade directly via the Bloomberg terminals. The terminals make it easy to isolate contracts by expiration month to observe seasonal patterns masked when looking at a nearby price chart. The terminals can also be used to track the portfolio and perform analytical tasks such as back testing.<sup>3</sup> Toward the end of the semester, the students turn in a program trade idea of their choosing that they back-test and verify so that it can be implemented.

## 4 Real Trading Experience

Hedges learned in other courses have fixed exit plans, generally tied to a spot market transaction. For example, a crop producer may sell futures to hedge new-crop corn and lift the hedge at harvest. Speculation has no natural exit date. Trades may offset at any time before maturity. Speculation has no natural exit price. Limit orders may be used at a desired level, and they work on futures and option premiums. Stop orders may be used to contain losses, but only on futures positions. Trading drills prepare the students to place trades, but analysis is needed.

An early assignment is a soft trade pitch. Students select a commodity to analyze and provide a general overview for the class. This naturally leads to a discussion of contract months, trading expiration dates, delivery periods, liquidity, and so on. It also starts students thinking about price directions and/or reasons for potential price changes. Trade proposals gradually become the primary use of class time and may have a fundamental, technical, or arbitrage focus. Students can vet proposals outside of class using

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<sup>2</sup> The Thinkorswim platform, formerly accessible through an educator module titled TD Ameritrade U, can be accessed at [tdameritrade.com](http://tdameritrade.com). The other platforms can be accessed at [commoditychallenge.com](http://commoditychallenge.com) and [interactivebrokers.com](http://interactivebrokers.com).

<sup>3</sup> Bloomberg terminals use mnemonics for functions on their platform. Commonly used are Multi-Asset Risk System (MARS) to assess risk and return of the portfolio holdings and Back Testing (BT) to evaluate potential technical trading strategies and optimize trading parameters.



email and online discussion threads, or through other interactions. Trades are made following a majority approval by the class (or a quorum thereof) and can be adjusted if warranted.

After lectures and any class details are handled, the mantra becomes “What do you like?” This follows Peter Lynch’s writings about his early trading days. Students respond initially with known commodities (e.g., buy corn), a fundamental reason, or a technical signal that has caught their attention. They may read that ethanol production has increased, potentially signaling an increased demand for and higher price of corn. This could be supported with an observation that the Relative Strength Index (RSI) is yet still at a relatively low level. They then use professional discourse to convince their classmates to adopt a trade. As the class gains experience, a follow-up question is invariably “Why?” This encourages students to provide a more detailed rationale for any trade, which makes both good and bad trade outcomes easier to absorb.

The instructor orders trades with the introducing broker. Generally, the trades are vetted with the broker for reasonableness. The instructor is set up with a limited power of attorney. This allows for electronic access to a trading platform and the ability to place trades. The instructor can then place trades directly with this setup. If/when done, the communication with the broker is documented to maintain accountability of both parties for the SDSU Foundation.

Trades vary in motivation, scope, risk level, and return expectations. Typically risk management of futures positions is through stop orders or coverage with options. Futures and options positions generally have a limit order as an exit plan. Contract months are chosen to avoid delivery situations. The margin account, by its nature, limits exposure as an unmet margin call would generally result in liquidating positions. The trades gradually build a portfolio that will consist of futures and options contracts. Students serve as compliance and/or risk managers, monitoring trades and investment policy parameters. Generally, this is two students each semester that can be called upon for student-guidance. These students are consulted on trade proposals to see that they are not too risky. They may be consulted if a trade needs to be modified before being filled, generally because of an incomplete entry or exit strategy. They double check any trades to assure they were placed correctly. Following SMIF protocols, having students serve as sector leaders has been explored, but not implemented. A student could be the point person, for example, for grains and oilseeds trades. This could help maintain exposure to different sectors or limit too much exposure from direct trades and spread trades. The sectors are not as well-defined as in the equities markets.

Some of the trades from Spring 2020, shown in Table 2, reflect the scope of trades possible. With hindsight, the results are often “textbook examples” of how trades should work. When a futures position is correctly placed, a limit order is tripped exiting the position (such as the lean hogs trade). When the forecasted direction of a futures price is incorrect, or the range between the current price and the stop price is too narrow, then a stop order is tripped, exiting the position (such as the corn position). Generally, puts and calls are initially bought, then sold with understandable gains or losses depending on the price move (such as the soybean meal and milk options positions, respectively). Spreads are challenging as they are attractive from a margin perspective, but they are not commonly used by producer-hedgers (such as the live cattle position). The limit and stop levels show the completeness needed when there are risk limitations and no clear hedge date to dictate offsetting a position.

Often trade proposals are abandoned. Sometimes there is not enough interest to get a “second” on an idea. At times there are not enough votes in support of a trade. Following a discussion with the broker, an otherwise reasonable idea may be cancelled. The class stayed out of lean hogs futures one year because it was quite volatile. Another time a milk strangle was tabled after the broker pointed out it was already in the settlement period and not likely to increase in value as expected, which led to revisiting the analysis and finding a flaw in how the data were interpreted.

**Table 2. Interesting Trades Executed During Spring 2020**

Contract	Rationale	Entry	Exit	Net
Lean Hogs Futures	Consistent drop after report	Sell at 71.60	LIMIT at 69.60	\$800
Soybean Meal Call Option	Indications of increasing demand	Buy at 7.15	Sell at 6.50	(\$65)
Corn Futures	Potential feed demand	Buy at 3.4275	STOP at 3.3275	(\$512.50)
Milk Put Option	Indications of decreasing demand	Buy at 0.35	LIMIT at 1.35	\$2,000
Live Cattle Futures Spread	Expect reversion to long run	Buy Jun–Dec at -9.125	STOP at -11.625	(\$1,090)

Notes: Entry points may be close to the market when there is time to place trades during class or pitched with some leeway if placed later. The exit points were executed, and generally had a counter strategy in the other price direction. The net figure does not include commissions and fees.

At the end of each semester, the students prepare a report to stakeholders summarizing trading activity and fund performance. They start with individual observations about major factors that influenced the markets, for example, strong exports, weather events, or changing economic conditions. They then look back at trades they were involved in and write a brief reflection on how the trade worked out or what may have been done differently. Depending on the semester, this has varied from a general discussion in class to a discussion board post to email communications with the instructor. It is a time to assess how well the students understood the trades and provide feedback or thoughts on improvements going forward. A final report is then synthesized into a two-page synopsis of the factors and the trades. The fund performance, gross, and net returns after commissions and fees, is compared to different benchmarks. The report is then shared with the SDSU Foundation, any donors, and future classes.

Being an instructor for this type of course is challenging. You may have to encourage trade ideas and generate excitement in the process. You may have to see that the investment policy is followed, which means vetoing some ideas as too risky or outside of the scope of the fund, (e.g., day-trading ideas). At times you may be the only one willing to provide a counter-argument to an idea. You also may have to professionally clarify, redirect, or correct situations where the ideas proposed do not cohere or are not internally consistent. For example, someone may say they expect the price to fall and propose buying a call option.

Being an instructor for this type of course is rewarding. Student engagement in this course and the SMIF course is higher compared to other classes. The nature of the course allows instructors to connect with the students based on their interests and experience. Students’ curiosity raises the bar on the instructor’s theoretical and practical knowledge in commodity markets and trading. Thus, the instructor needs to keep abreast of all economic and market developments. Natural gas, lumber, rice, and various option spreads were not in the NSME repertoire until explored as potential trades. Instructors can interweave different contracts so the students will have solid analogies to build on when they enter their careers. Both students and the instructor evolve as all learn continuously, the latter of which is not

necessarily true for many courses.

## 5 Place in the Curriculum

The course has a prerequisite course, AGEC 354—Agricultural Marketing and Prices, which requires either principles of microeconomics or principles of macroeconomics. In AGEC 354, the intent is to give students an overview of what can affect commodity markets, an understanding of basis, and knowledge of how to hedge using forward and futures contracts. Students are also introduced to options as hedging tools. Thus, AGEC 484 builds directly on the foundation from the prerequisite. Distinct from other courses, there is little coverage in AGEC 484 of basis nor the theory of storage. The emphasis is on applying price analysis and forecasting techniques. This allows the course to complement AGEC 454—Economics of Grain and Livestock Marketing, with its hedging applications, as well as FIN 420—Student-Managed Investment Fund, where students manage a stock portfolio actively and a balanced index ETF-based portfolio of stocks and bonds passively (with assets under management of over half a million dollars) from the perspective of a long-term investor. These courses are components of a minor in Commodity Risk Management.

The topics covered in AGEC 484 complement the trading drills and a progression from lectures to real trading (Table 3). The textbook, Carter (2018), serves as a common reference for the class. There is extra emphasis on order types and various U.S. Department of Agriculture (USDA) reports. Heavy emphasis is placed on options, both practical and conceptual, which also distinguishes AGEC 484 from other classes. There is a review of put and call options. Black’s option pricing model is explored and used to explain premiums and to back out implied volatility. The various option Greeks are also explored. Delta is useful when discussing price targets and the likelihood of an option being in the money. Theta is useful when discussing the holding period for a position and the cost of having optionality. Vega was useful for discussing changes during the COVID-19 pandemic. As stressed by Purcell and Koontz (1999, p. 248), “Volatility to the options trader is as important as basis is to the hedger.” Much of the content is covered during the first half of the semester. The second half of the semester has time for spread trades, benchmarks, and regulation.

There are several key distinctions between this type of course and other traditional courses: experiential learning, the dynamic nature of market, and open-endedness. All three characteristics require an experienced or knowledgeable instructor and/or a partnering broker because the course spans agriculture, economics, and finance. The instructor will need to instill confidence in students and

**Table 3. Topics Covered in AGEC 484**

Review of futures
Overview of options
Order types
Fundamental analysis
USDA reports
Put and call options
Option pricing
Technical analysis
- Midterm -
Spread trading
Program trading
Commodity funds
Regulation
- Final -

empower them in decision making. Specifically, experiential learning emphasizes immersion in the role of being a commodity analyst in an ever-changing market compared to the more passive role of a student. The dynamic nature of market, under which the class operates, affords unlimited opportunities to learn as opposed to the more defined structure in traditional courses. The open-endedness means that there will be no correct answer *ex ante* to any questions related to trading as opposed to the mostly known answers to questions in traditional courses. Students might be uncomfortable making decisions or tend to over-analyze situations because of market uncertainty or a lack of confidence. The course experience makes them competent trading and instills confidence for their future endeavors.

The emphasis on experiential learning seems to attract students to the course. AGEC 484 is popular with those returning to farming and ranching operations. Such students really want to know how to trade the contracts they may use in future hedging situations. The course has also drawn interest from students interested in brokerage or trading careers. When demanded, it has been possible to cover aspects such as preparation for the Series 3 examination. Following the Investment Policy, the trades are supposed to have a root in those used by agribusinesses. This means that a trade should have a hedge analogy and not be a day trade. At the same time, the format of the POET Fund requires some knowledge and techniques associated with speculative aspects of trading. As a result, the students learn more about different aspects of trading than they would in a focused hedging course.

To date, assessment of learning has focused on a pre- and post-class Likert scale metrics (e.g., a 1–5 scale about level of marketing knowledge) that the students self-report. At the beginning of the semester, students are asked to rate their marketing knowledge on a scale from 1 to 5. If they struggled with AGEC 354, they are likely a 1. If they aced AGEC 354, they are likely a 5. Other related coursework, an internship, or extensive experience would be reasons to rate themselves as a 3 or 4. This allows for some targeting teaching as those with more knowledge can be challenged, and those struggling can be helped more. The instructor shares a goal of moving everyone up at least a level by the end of the semester. Across five semesters, the rating has averaged 2.36 at the beginning and 3.68 at the end, indicating the students self-report knowing more after the semester. In addition, the formal course evaluations generally reflect a positive experience for students. Ramsey and Isengildina-Massa (2020) offer other ways to assess this type of course.

There is a graduate section taught concurrently in the spring semester, AGEC 584. This would be an elective for students pursuing an M.S. in Economics in the NSME and other programs. The students have a supplemental reading list with higher-level articles and industry resources to complement the textbook and trading exercises. The graduate students generally use the Bloomberg terminals more than the AGEC 484 students. In addition, they explore commodity index funds and related contracts. Hull (2016) is a suggested textbook. The number of students tends to be small, so they are integrated into the regular class for trading and homework.

In the spirit of continuous improvement, the course has been modified over time. Initially the class was set up in a hybrid format, only meeting in person on Thursdays. However, in SP19 two of those Thursdays were snow days. More frequent interaction was demanded by students informally and in formal course evaluations. The class now meets three times a week. There is regular interaction with the broker, as well as interaction with other brokers/analysts and other agribusinesses, that continue to inform the content and trades. The outline is not rigidly structured. Thus, the class was able to adapt to inverted markets in S21 and has been able to address topics of interest to a specific class. Whole class periods can be devoted to discussing a particular trade, the importance of a specific USDA report (e.g., Cattle on Feed) or a particular approach (e.g., a synthetic put). The outcome is a student that is competent in trading and confident in how and why they are trading.

## 6 Concluding Thoughts

While AGECE 484 meets the needs of NSME students, the course could be adapted in other programs. The course provides a deep dive into the practical aspects of commodity trading. The drill exercises and focus on options may complement other courses. By placing trades in drills and in the POET Fund, the students increase their comfort level with trading. The scope could be tailored for a different program. The focus has been on major row crops and livestock, but that could be adjusted for grains only, soft commodities, metals, and so on. The scope could be broadened to be more targeted toward Series 3 aspects. The endowment certainly helps—more is preferred to less. Limited wealth has meant some trades have not been feasible. Having the experiential aspects allows for a complement to lecture- and textbook-focused courses. The content is very current and fluid, as contract specifications change, margin levels change, and software packages change. The art is finding a balance between covering the necessary concepts and incorporating the dynamic aspects of the market.

**About the Authors:** Matthew A. Diersen is a Professor at South Dakota State University (Corresponding author: [matthew.diersen@sdsu.edu](mailto:matthew.diersen@sdsu.edu)). Zhiguang Wang is a Professor at South Dakota State University.

**Acknowledgements:** An earlier overview of the course was shared as a 2020 AAEA Selected Poster. We thank conference participants for feedback. We also thank participants in the 2021 NCCC-134 Conference for their insights on similar trading courses.

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4(1) doi: 10.22004/ag.econ.320044

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## Teaching and Educational Methods

# Adaptation of Teaching Strategies During the COVID-19 Pandemic

Luis Moisés Peña-Lévano<sup>a</sup> and Grace Melo<sup>b</sup>

University of Wisconsin—River Falls<sup>a</sup> and Texas A&M University<sup>b</sup>

JEL Codes: A22, A30

Keywords: Active learning, evaluation, online tools, student engagement, teaching, teaching innovations

### Abstract

The COVID-19 pandemic forced drastic changes in teaching methodologies, shifting from in-person courses toward fully online platforms. This article presents teaching strategies used to modify two traditional face-to-face courses (Economics of Resource Use and International Agricultural Trade) and one synchronous online course with in-person review sessions (Quantitative Methods in Food and Resource Economics) into an entirely virtual setting. This article discusses the challenges of moving content online while maintaining interaction with the students. It also exposes significant factors that have become impending challenges for online instruction during the pandemic. This study also examines students' perception of their learning experience. Using a paired comparison test, academic performance was evaluated before and during the pandemic, showing that teaching methodologies implemented in the three courses were able to keep students' engagement throughout the spring semester. These methodologies sought to provide a personalized approach and keep students engaged in the lectures. Further, this study discusses the impact of the pandemic on the students' perception of their learning experience.

## 1 Introduction

In 2018, the U.S. Department of Education estimated that about 35 percent of college students took at least one online course during their career preparation (Lederman 2019). The shift toward online instruction has been accelerated since mid-March of 2020 due to the coronavirus (COVID-19) pandemic (Kiesel et al. 2020). To comply with the stay-at-home regulations, universities around the globe migrated from traditional in-person courses to online education (Crawford et al. 2020).

In a short period of time, instructors modified their original content to teach classes virtually either *synchronously* (using telecommunication software) or *asynchronously* (pre-recording classes so students could access them at any time). These modifications limited instructor-student interaction. To overcome this challenge, some instructors used online websites, discussion boards, and online office hours. Nonetheless, many students experienced disrupted learning activities; for instance, they migrated to other states and countries. These events further exacerbated students' stress, especially those who had difficulties with internet access and proper study space (Bao 2020; Castle 2020; Melo et al. 2021).

To investigate how instructors and students faced the pandemic challenges, we used three undergraduate-level courses in agribusiness taught during spring 2020 as case studies. We discuss the teaching methodologies implemented to enhance their learning experience. Two of the three courses were traditional courses delivered in a small classroom setting that switched from in-person to an online learning environment. The third course was an asynchronous online course with in-person revision sessions and office hours, which remained online using the same teaching methodologies; however, the in-person activities were substituted by synchronous sessions, including synchronous review sessions and remote office hours.

We contrast learning under two scenarios: before and after the shift toward a fully online teaching environment. The teaching tools are based on methods presented in Peña-Lévano (2020) and were modified to be used in multiple types of courses at any education level. The study reveals that

adaptations to teaching methodologies, including synchronous review sessions, prompt feedback of graded assignments, and constant communication with the students, were crucial for helping students face the transition of instruction during Spring 2020. Undergraduate students in the three courses responded positively to these efforts. Their willingness to stay engaged in the class activities was vital for their academic success. Nevertheless, many students expressed that not working with their classmates was a major stressing factor.

This study exposes lessons from pre-pandemic online and pre-pandemic in-person courses to have a more comprehensive understanding of the potential effects of the pandemic on students learning, even among those enrolled in online courses before the pandemic. It also investigates important external factors that affect the students' academic performance. This research article discusses and addresses several important questions that have emerged during the COVID-19 pandemic: (1) What are the significant challenges encountered by the students that affected their academic performance during the pandemic?, (2) How can the instructor motivate active learning in both synchronous and asynchronous learning environments? Specifically, what methods can be effective in a virtual setup that could mimic the face-to-face environment when teaching analytical and mathematical tools?, and (3) Does the implementation of different teaching strategies (i.e., online review sessions, asynchronous presentations, among others) help online instruction and students' academic performance? Thus, this paper presents several methods to promote active learning and students' engagement in class during the pandemic.

As of November 2021, many colleges across the globe have continued with the online modality due to the spread of different COVID-19 variants across the world. However, online instruction faces five main barriers, which have been emphasized in our study, and it is consistent with the literature. First, the successful delivery of online courses is challenged by the lack of (in-person) interaction with the instructors, especially for large classes that offer laboratories and have field trip experiences (Deming 2020; Melo et al. 2021). Synchronous courses had difficulties motivating students to participate during live sessions, especially those with limited internet connections or preferring not to use a camera during class (Deming 2020). Second, many instructors were required to move face-to-face courses to online formats on short notice, adding substantial time commitments in order to learn online tools and prepare these materials (Marcus 2020). Third, online instruction involves self-directed learning; the success of this method depends on the structure, design, and attractiveness of the lessons (Drange, Sutherland, and Irons 2015). Self-learning is challenging to achieve when students do not feel motivated or engaged in the material. Fourth, upper undergraduate courses in agricultural and applied economics often involve computer software for simulations or data analysis. Students receiving online instruction may face external technological constraints such as access to computer laboratories, familiarity with operating systems, or issues with software versions (Perreault et al. 2002; Peña-Lévano 2020). Finally, students faced stress associated with moving from their apartments and/or houses in traditional on-campus cities during the semester. Students also expressed concerns about lack of a proper learning environment and not having social interactions with their peers (Klass 2020; Melo et al. 2021).

## 2 Background

This article illustrates adaptations of teaching methodologies during the pandemic. We focus on three upper-level undergraduate courses taught by one of the authors, including two pre-pandemic in-person courses: International Trade Policy in Agriculture and Economics of Resource Use, and one pre-pandemic online course: Quantitative Methods in Food and Resource Economics with in-person sessions. The inclusion of this last course was intentional to evaluate whether students learning response to methodologies was different between online and in-person courses. These three-credit courses (described in Table 1) were offered during Spring 2020 at the University of Florida as part of the core curricula of the agribusiness major.



**Table 1. Core Undergraduate Courses Described in this Study**

Class Code	Course Name	Description	Imparted at
<b>Deliver Pre-Pandemic: Fully in-person</b>			
AEB 2451	<b>Economics of Resource Use</b> (Junior level)	<ul style="list-style-type: none"> <li>• Focuses on understanding the effect of human actions on agricultural sustainability, environmental degradation, and the use of natural resources.</li> <li>• Topics include environmental policy, externalities, open resources and public goods, pollution control, and environmental analysis tools.</li> </ul>	Plant City <i>(This course was open to Agriculture Education students)</i>
AEB 4242	<b>International Trade Policy in Agriculture</b> (Senior level)	<ul style="list-style-type: none"> <li>• Examines the economic forces that influence the international trade patterns between the United States and other countries.</li> <li>• Designed to have active discussions related to real current events and policies, including the Farm Bill, domestic labor and environmental regulations, international treaties, multiregional agreements, and trade barriers, among other topics.</li> </ul>	Plant City
<b>Delivery Pre-Pandemic: Online course with in-person review sessions, computer lab, and office hours.</b>			
AEB 3510	<b>Quantitative Methods</b> (Junior level)	<ul style="list-style-type: none"> <li>• Topics include systems of linear equations, matrices, multivariate calculus and integration, sequence and series, linear programming, and computer simulations of economic problems. Pre-recorded lessons were posted on the online class platform.</li> <li>• For details about this course, please see Peña-Lévano (2020).</li> </ul>	Gainesville Plant City

### 2.1 Methods in the Traditional In-Person Courses

Face-to-face classroom settings allow for student-teacher interaction, in which the learning process and student engagement largely depend on the instructor’s pedagogy (Kuh et al. 2006). Previous studies have shown that active student participation is positively correlated with academic performance (Carini, Kuh, and Klein 2006; Trowler 2010; Lei, Cui, and Zhou 2018). Taking these facts into account, four assessments were implemented in the two (traditional) in-person courses:

- 1) *In-class questionnaire:* Each weekly unit (i.e., chapter of a course) includes a questionnaire, which is a set of conceptual questions and problems covering the most relevant material of the unit. A sample can be found in *Appendix A*. This task is solved during the class session and submitted at the end of the week. This graded activity seeks to engage students as they must pay attention to the lecture in order to answer it correctly. This questionnaire also may serve as a study guide for the students.
- 2) *Oral presentations:* Students were asked to prepare three-minute presentations explaining the most relevant aspects of an environmental (or trade policy) issue, followed by a one-minute Q&A session. An evaluation criteria sheet provided guidelines on what is expected from this activity, including

suggestions regarding slides design, content, and letter size. A sample can be found in *Appendix B*. Dankel and Ohlrich (2007) showed that repeated presentations during a semester may provide positive results for students' critical thinking, communication, and oratory skills. Therefore, multiple short presentations were scheduled during the semester in which students also had the opportunity to interact with their peers and the instructor in the Q&A session.

- 3) *Final poster presentation*: Students were scheduled to present an assigned environmental (or trade policy) topic in a poster presentation during the last week of classes. Professors from the Tampa area were intended to attend the event and evaluate the presentations. The goal of this task was to improve the students' communication skills and their ability to summarize and deliver information in an effective manner.
- 4) *Field trips*: A visit was scheduled to a restored wildlife recreational park located in mid-Florida (i.e., Lake Apopka Wildlife Drive). Guides provided a tour showing the protected area and explaining the biodiversity found at the location. The staff also provided a workshop describing the restoration project and the preservation of the wildlife. This permitted students to associate the concepts learned in class in a real-life application that showed the impacts of environmental degradation and policies needed to preserve wildlife and restore natural habitats.<sup>1</sup>

In summary, the four methodologies sought to promote active participation, interaction with peers and the instructor, and experiential learning,<sup>2</sup> which are key aspects to incentivize student engagement in class (Helme and Clarke 2001; Zepke, Leach, and Butler 2014).

## 2.2 Modification to the In-Person Courses

The pandemic forced sudden changes in the teaching methodology for the courses. Rapid modifications were implemented during mid-March to ensure a positive learning experience despite the external challenges faced by the students. Lectures of the in-person courses were offered then synchronously online via Zoom at the same class hours. The usual teaching methodologies for the in-person courses were adapted to these conditions as follows:

- 1) *In-class questionnaires* were now conducted during the online sessions. The instructor discussed the class material while sharing on his screen the PowerPoint presentation. Any mathematical procedure was taught using a desktop camera, where the instructor solved the problems on paper, showing the steps on the camera. The use of paper mimicked a whiteboard, and students were welcomed to ask any questions during the session. This technique was originally used to create the lecture videos for the asynchronous course, Quantitative Methods, with the difference that here, this procedure was shown live with the participation of the students.
- 2) From *short oral presentations* to *recorded short presentations*, students were still required to deliver their short presentations on their assigned topics. However, they were asked to record the explanation over their slides, with a duration not longer than three minutes. The files created by each student were then uploaded to Canvas (the e-learning platform for the courses). Thus, all students could watch them and answer related questions in the homework assignments.

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<sup>1</sup> Field trips were sponsored by the Field & Fork scholarship at the University of Florida.

<sup>2</sup> Experiential learning is an engaged learning process whereby students learn by participating in different hands-on activities such as laboratory experiments, internships, practicums, field trips, and study abroad.

- 3) From *final poster presentation* to *final online presentation*, students addressed a contemporary topic from an economic standpoint. There were some differences with the small presentations: (I) the presentation was held live via Zoom during the final week of the semester, (II) the score was established by invited guest professors who acted as the “online audience,” (III) the length of the presentation was twelve minutes with well-defined evaluation criteria, (IV) the audience (including classmates) had three minutes to ask any questions or comments regarding the presentation.
- 4) In order to comply with the stay-at-home regulations, the remaining *field trips* were canceled.

Compared to the beginning of the semester, one additional teaching strategy was adopted during the pandemic:

- 5) *Interactive Excel sessions*: The second half of the semester included Excel applications in two topics of Economics of Resource Use: benefit-cost analysis for environmental projects and valuation methods. During the class Zoom session, the instructor shared his Excel spreadsheet on screen, allowing students to observe how the professor created the template and solved step-by-step each Excel problem. Likewise, students were able to share their spreadsheets with the instructor to address any challenges. At the end of the class day, students were required to submit the final version of their Excel file. This task helped to ensure active learning and constant class participation. In addition, some of these sessions were recorded by request of the students, so they were able to re-watch them later when doing homework assignments.

A summary of the adaptations in the teaching strategies adopted for the two in-person courses is provided in Table 2.

**Table 2. Teaching Methodologies Before and After the Pandemic for the Courses Initially Designed to be Taught In Person**

Undergraduate Courses Taught In-Person	Before the Pandemic	During the Pandemic
International Policy Trade (Senior level)	<ul style="list-style-type: none"> <li>• In-class questionnaire</li> <li>• Short oral presentation</li> </ul>	<ul style="list-style-type: none"> <li>• Synchronous: In-class questionnaire</li> <li>• Asynchronous: Recorded short presentation</li> </ul>
Economics of Resource Use (Junior level)	<ul style="list-style-type: none"> <li>• Final poster presentation</li> <li>• Field trips</li> </ul>	<ul style="list-style-type: none"> <li>• Synchronous: Final online presentation</li> <li>• Synchronous: Interactive Excel sessions</li> </ul>

### 2.3 Methods in the Traditional Online Course

Quantitative Methods (in Food and Resource Economics) is an asynchronous online course divided into different units. Two types of pedagogical methods are used to address the challenges of teaching mathematical principles while using an online setting: active learning (pre-labs, quizzes, and face-to-face reviews) and class personalization (office hours and computer labs). Specifically:

1. *Pre-labs* and *quizzes* are evaluation tools designed to promote active learning. *Pre-labs* are a short task with four to five problems whose solutions can be found in the recorded video lectures of the lesson. *Online quizzes* seek to reinforce the major concepts of the unit and prepare students for the midterms. Answers to quizzes are posted immediately after deadlines. Students also receive *study guides* that

provide them with a summary of the units covered in the modules and help them study for the midterms.

2. *Face-to-face review sessions, office hours, and computer labs* with the professor have become methods to personalize the class. The instructor visits Gainesville every two or three weeks, particularly before midterms, to provide in-person review sessions to students. During the sessions, the instructor (i) solves most of the problems in the *study guide* and also (ii) motivates students to work in groups to solve additional exercises. During the *computer labs*, students bring their laptops to ensure that they have installed the software correctly and can solve the problems presented in the *pre-labs* and the video lectures. The professor usually shows some additional examples and helps them to create their own Excel templates. More information about these online evaluation techniques can be found in Peña-Lévano (2020).

Students also have access to a *discussion board* where they may ask the professor and the Teaching Assistant (TA) any questions in regard to assignments. The instructor also communicates constantly with the student, providing prompt feedback via email and encouraging a personalized environment.

These efforts have been praised by the students in all semesters this class has been offered, with course ratings above 4.64 out of 5.00. Even in the class evaluation of Spring 2020, students provided insights into the instructor's methodology and assistance applied before the pandemic (see *Appendix C* for students' feedback of instructor).

## 2.4 Modifications to the Online Course

Quantitative Methods required fewer modifications than the two in-person courses (as seen in Table 2). However, a significant challenge in this asynchronous online course was the personalization aspect of the class, as the instructor was not able to travel to Gainesville for the rest of the semester. Thus, although pre-labs, quizzes, and discussion boards continued their format as active learning instruments, the pandemic forced to make modifications to the in-person session components.

Review sessions, office hours, and computer labs were offered as synchronous online Zoom sessions, using a similar methodology described earlier in section 2.2. The professor used the desktop camera to show live, step-by-step, how to solve the problems mimicking the video lectures. For the computer components, the instructor shared his screen displaying an Excel spreadsheet on Zoom and proceeded to solve each problem together with the students. If a student faced any challenge, the Excel file was shared with the instructor using Canvas so that it could be addressed immediately. This interaction helped to preserve student-instructor interaction and provide prompt feedback, which are instruments that encourage students' engagement toward the class material (Allgood, Walstad, and Siegfried 2015; Picault 2019). Table 3 summarizes the teaching methodologies adaptations for the online course.

## 3 Students' Perceptions and Performance

This section discusses the students' perception of the teaching methodologies used in Spring 2020 and their opinion regarding their modifications during the second half of the semester after returning from their Spring break. The surveys were conducted in April 2020, at the end of the Spring semester, in which they were asked to compare their learning before and during the lockdown.

**Table 3. Teaching Methodologies for Each Course Type Before and After the Pandemic for the Course Originally Designed to Be Taught Online**

Undergraduate Courses Taught In-Person	Before the Pandemic	During the Pandemic
<b>Quantitative Methods</b> (Junior level)	<ul style="list-style-type: none"> <li>• Asynchronous activities: pre-labs, quizzes, and discussion boards</li> <li>• In-person activities: review sessions, office hours, and computer labs</li> </ul>	<ul style="list-style-type: none"> <li>• Asynchronous activities (no change): pre-labs, quizzes, and discussion boards</li> <li>• Synchronous activities: review sessions, office hours, and computer labs</li> </ul>

### 3.1 From Traditional In-Person to Synchronous Online Courses

Students taking Economics of Resource Use and International Policy Trade in Agriculture were asked in an anonymous survey their perception on the learning retention<sup>3</sup> of the class material (in percent of content learned) before and during the pandemic. All thirteen students<sup>4</sup> were located at Plant City, with most of them working full-time or part-time, starting their junior or senior years, and with ages ranging from nineteen to thirty-one years old. In order to help students with their work schedule, the courses were offered in a three-hour class on a specific day of the week, so students only needed to take one day off in order to attend the lectures. This class arrangement was preserved for the entire Spring 2020. All thirteen students in both courses responded to this survey (100 percent response rate). Their response is depicted in the two histograms of Figure 1. Before the pandemic, 77 percent of students stated that they were learning at least 50 percent of the class material. During the lockdown period, 70 percent of them expressed that they still were learning at least 50 percent of the content; however, the distribution became more centered, with fewer students being confident that they had mastered the lectures. This provides suggestive evidence that the modification to teaching methodologies helped to keep students learning the material.<sup>5</sup> However, because of the small sample size, the results should be interpreted with caution.

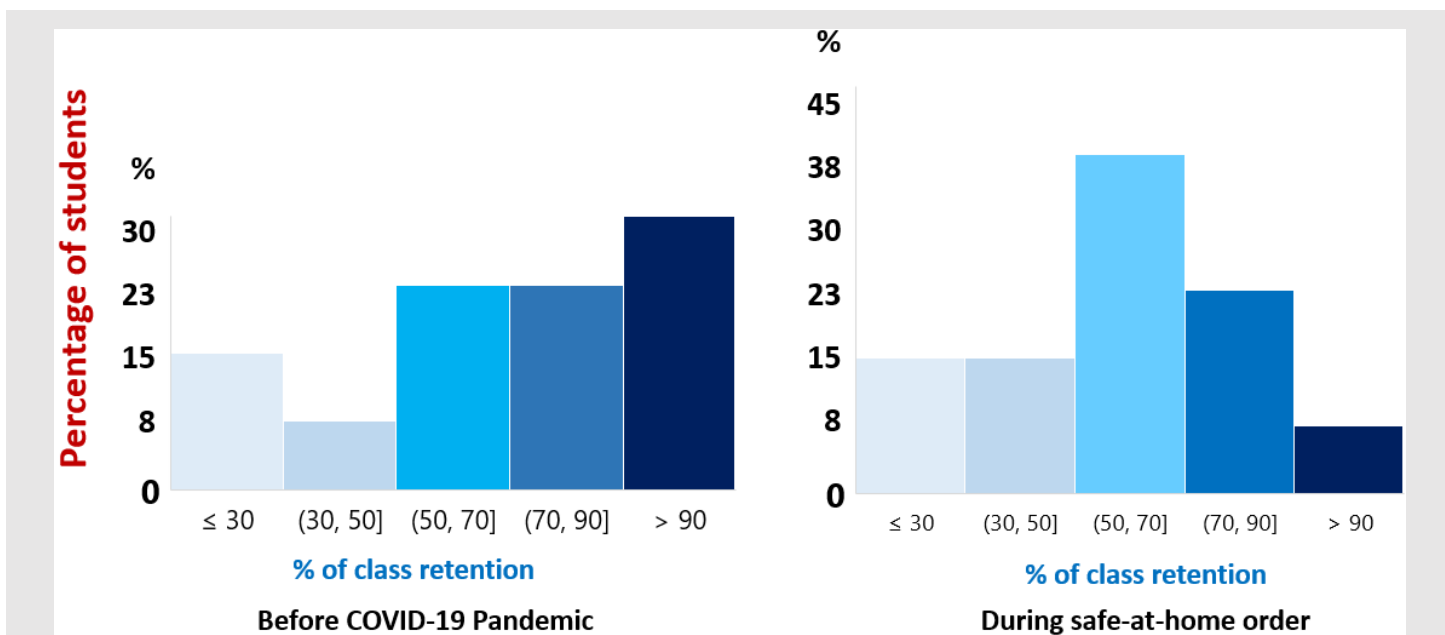
Students in Plant City reported that they did not have to relocate from their residences. For this reason, relocation was not accounted as a stressor factor at this location. However, many of the students have families (spouse, parents, and/or children). Thus, about half of them expressed that it was challenging to find a balance between spending time studying and taking care of their family members (as depicted in Figure 2). Interestingly, responses from the survey show that not being able to meet with classmates to study and/or collaborate while doing homework was the most important factor that added stress. Allgood, Walstad, and Siegfried’s (2015) article suggests that students’ engagement on the class material may be improved by interaction and connection with peers, which is more difficult to achieve by working together remotely. This may be particularly true for students in Plant City, as they take most of their core courses together and in small groups, allowing them to know each other better and work on their tasks in teams.

Plant City students choose this location in order to have a personalized teaching experience and a college degree from the University of Florida, without the need to move to the main campus (Gainesville). The in-person courses in small classrooms are also one of the attractive features of the Agribusiness major for students that seek a non-online college degree. Thus, it is not surprising that students

<sup>3</sup> Learning retention is the process of acquiring and storing information in the long-term memory.

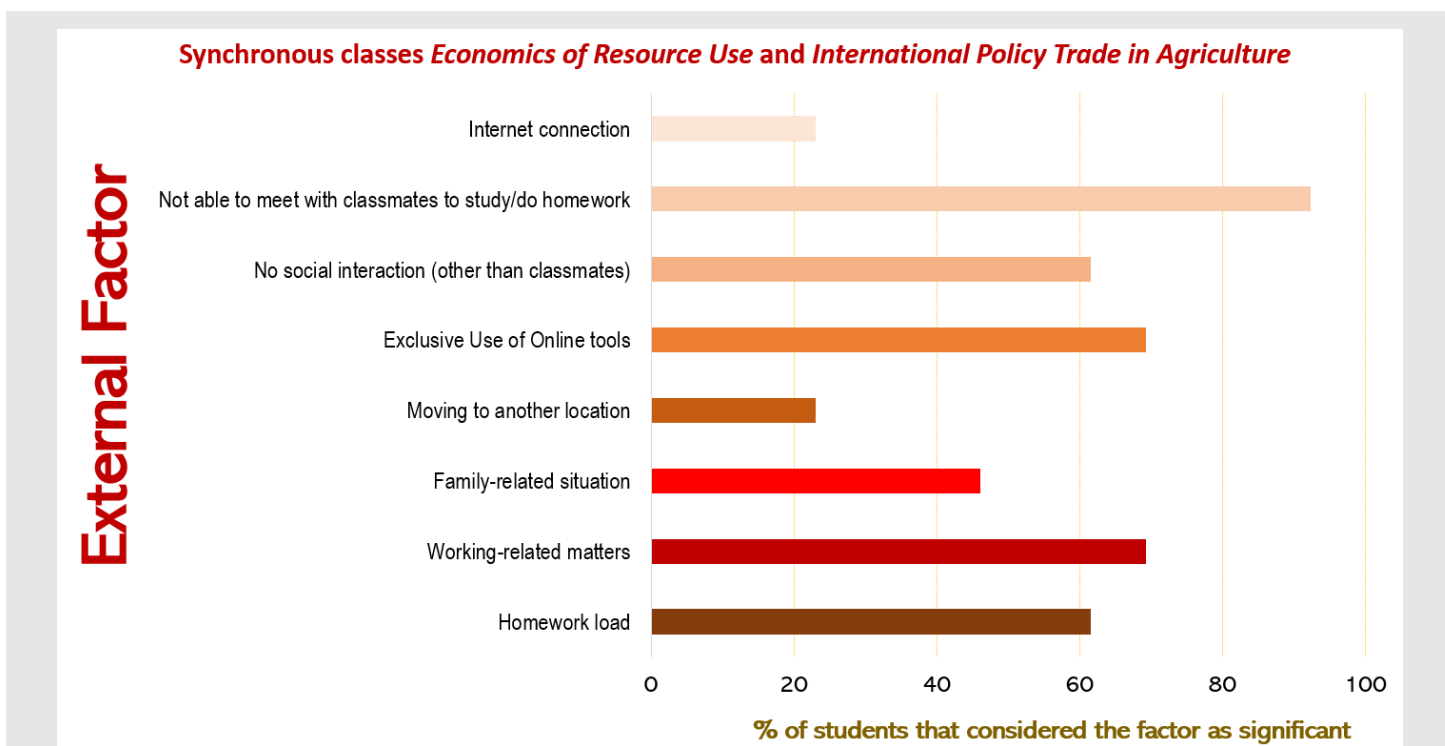
<sup>4</sup> Seven students in Economics of Resource Use course and six students in International Policy Trade in Agriculture.

<sup>5</sup> Despite counting with the participation of all thirteen students, given the small sample size, testing whether these proportions are statistically different would not provide an overall insight for larger classes.



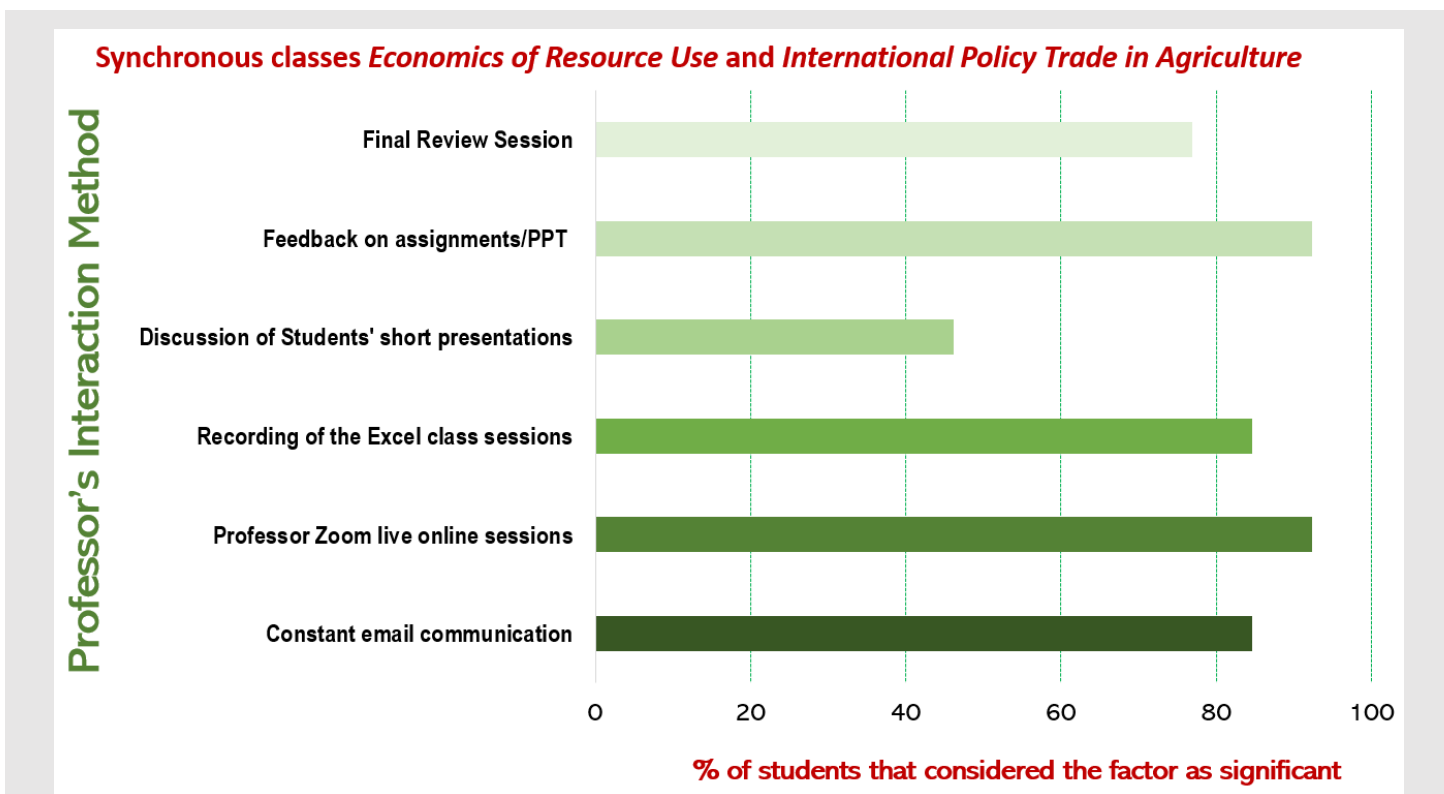
**Figure 1. Students' Opinion about Learning Retention—in Percent of Material Students Perceived They Learned Successfully—Before and During Lockdown for Synchronous Classes**

emphasized that working only online was also an important stressor during the pandemic. Finally, considering that most students have part-time or full-time jobs in Plant City, it is not unexpected that about 70 percent of the surveyed students considered working-related matters during the pandemic were a factor challenging class performance.



**Figure 2. Students' Perceptions of External Factors that May Have Affected their Performance in the Synchronous Courses**

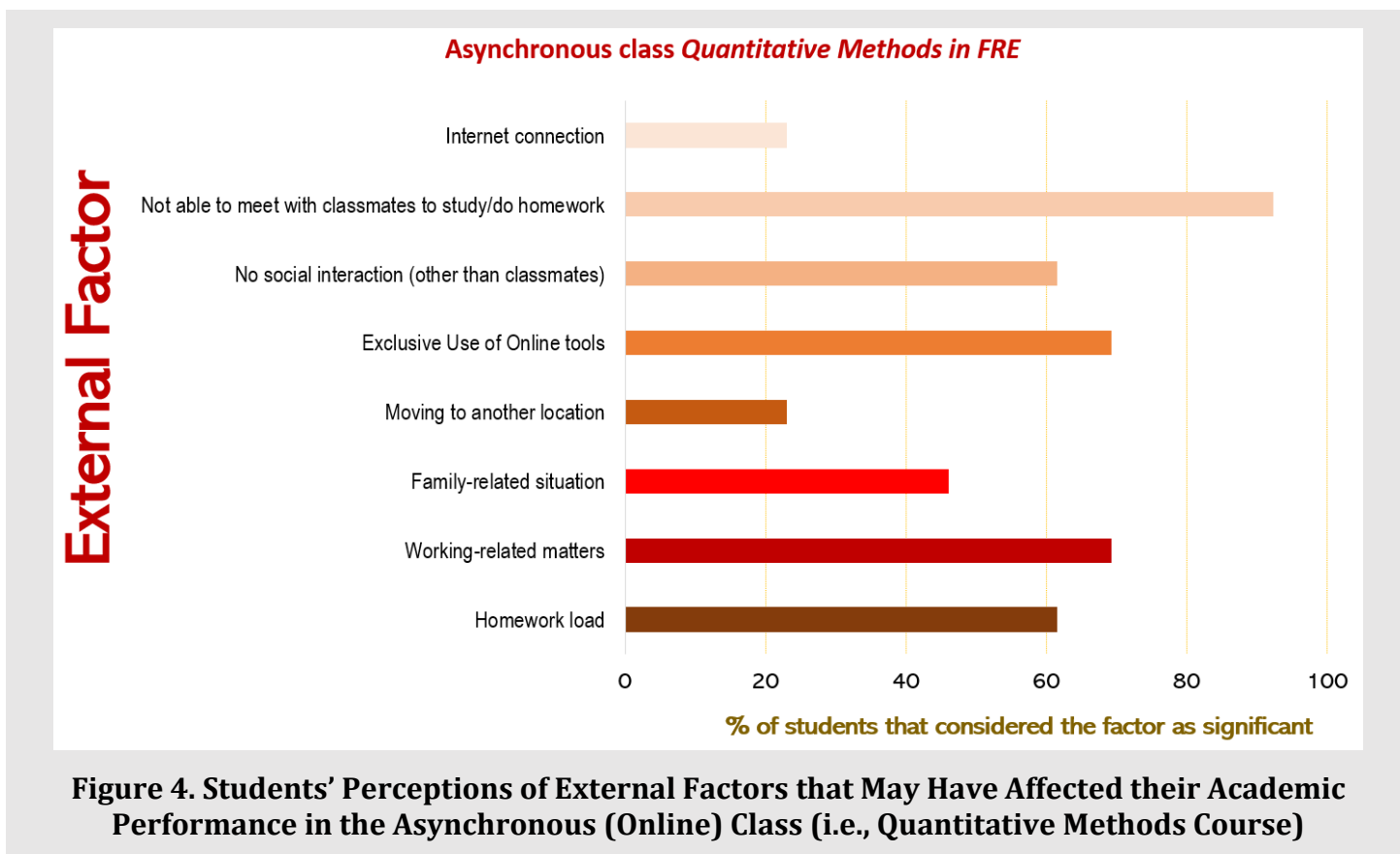
In an effort to help students to reduce the stress during the pandemic, the instructor attempted to keep constant communication with the students, providing prompt feedback on their tasks. Their perceptions regarding these interaction methods are graphically summarized in Figure 3. Interestingly, recording the *interactive Excel sessions* (the new teaching methods adopted during the pandemic) was an important tool supporting student-teacher interaction. Figure 3 shows that about 92 percent of the students responded that the professor’s prompt feedback on assignments and oral presentations, as well as the synchronous online sessions, were key methodologies that helped them to mitigate the stress induced by the pandemic. As stated by Kuh et al. (2006), student engagement is improved by an active interaction between a professor and students, which may act as an essential contributor to academic performance. (See *Appendix A* for students’ qualitative feedback in the two courses.)



**Figure 3. Students’ Perceptions of the Professor’s Interaction Method that May Have Helped to Mitigate the Stress on Class Performance During the Pandemic**

### 3.2 Adapting the Online Course

During the pandemic, the structure of Quantitative Methods did not change drastically compared to the traditional classes. However, almost all 34 students taking this course were originally in Gainesville or at a nearby location. Most of them were full-time students who lived on campus or in apartments, pursuing a four-year college degree in Agribusiness or a related major. Ergo, many of them needed to relocate when COVID-19 became an impending concern. Not surprisingly, more than 50 percent of the class expressed that moving to another location added substantial stress and affected their academic performance (shown in Figure 4). Interestingly, the major stressing factor perceived by the students was not being able to meet with classmates to study or do homework together, similar to the case of the synchronous courses in Plant City. An attribute that calls attention is that more than half of students also emphasized that having to depend exclusively on online tools was a stress contributor, which shows the importance of the absence of in-person sessions/interactions with the professor.



Perceptions regarding their learning of the class material changed drastically during the pandemic (displayed in Figure 5). This was supported by a paired  $z$  test ( $p$ -value  $< .05$ ) that compared the perception of each student regarding class retention prior to the pandemic and during the stay-at-home order. About 82 percent of the students responded that they were learning at least 70 percent of the material prior to the mandate. In contrast, only 20 percent of students expressed that they were learning that percentage of the material during the quarantine period.

This change in perception can be attributed to several factors: (i) students moving from the main campus to a different location with limited internet access may have difficulties accessing the course videos or the online help sessions, (ii) the relocation to distant locations made students delay their coursework in many classes simultaneously for several days or even weeks, and (iii) the impending stress of the pandemic affected the concentration and mental health of several students, especially those who were taking care of their family and relatives (as expressed in Figure 4).

The interaction between students and the instructor was also important for many students, in particular the constant email communication (Figure 6). Likewise, more than half of the class (eighteen out of thirty-four students) participated in the online computer labs, of which fifteen of them said they found these sessions helpful. Students also found crucial the role of the TA for this course. Eighty-nine percent of students that participated in the Excel sessions expressed that the assistance and help from the TA were above average during the pandemic. The result of these efforts was reflected in the positive evaluation comments, praising both the instructor and the TA (see *Appendix A*).



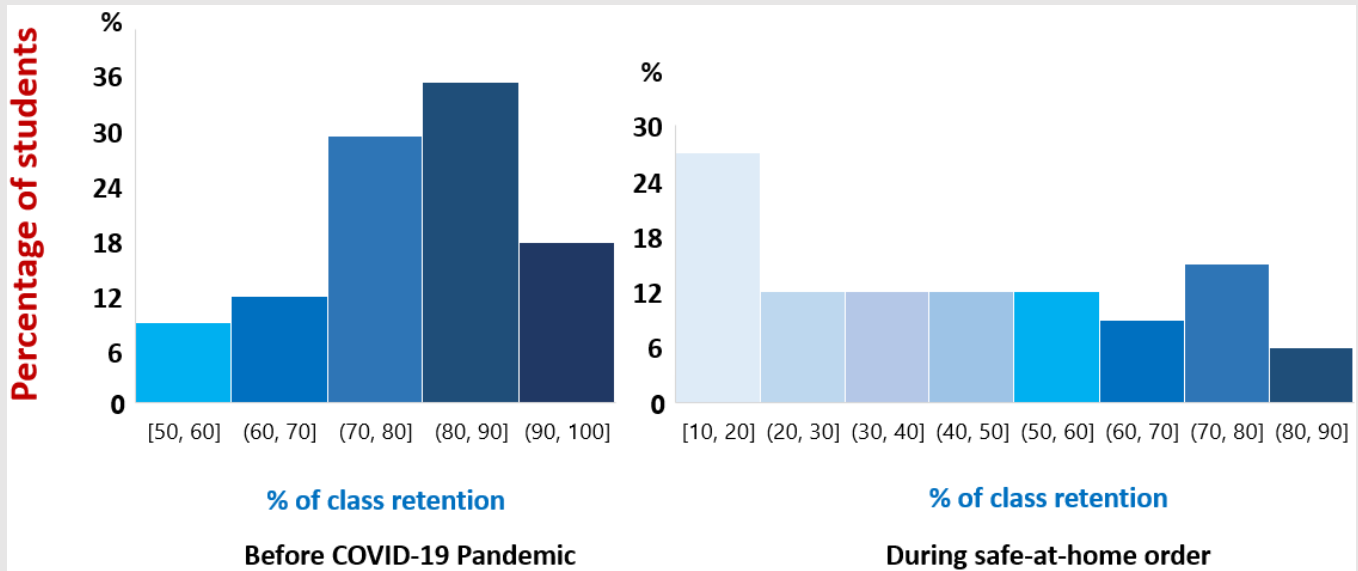


Figure 5. Students' Opinion About Class Material Retention (in Percent) Before and During Lockdown for the Asynchronous (Online) Course (i.e., Quantitative Methods Course)

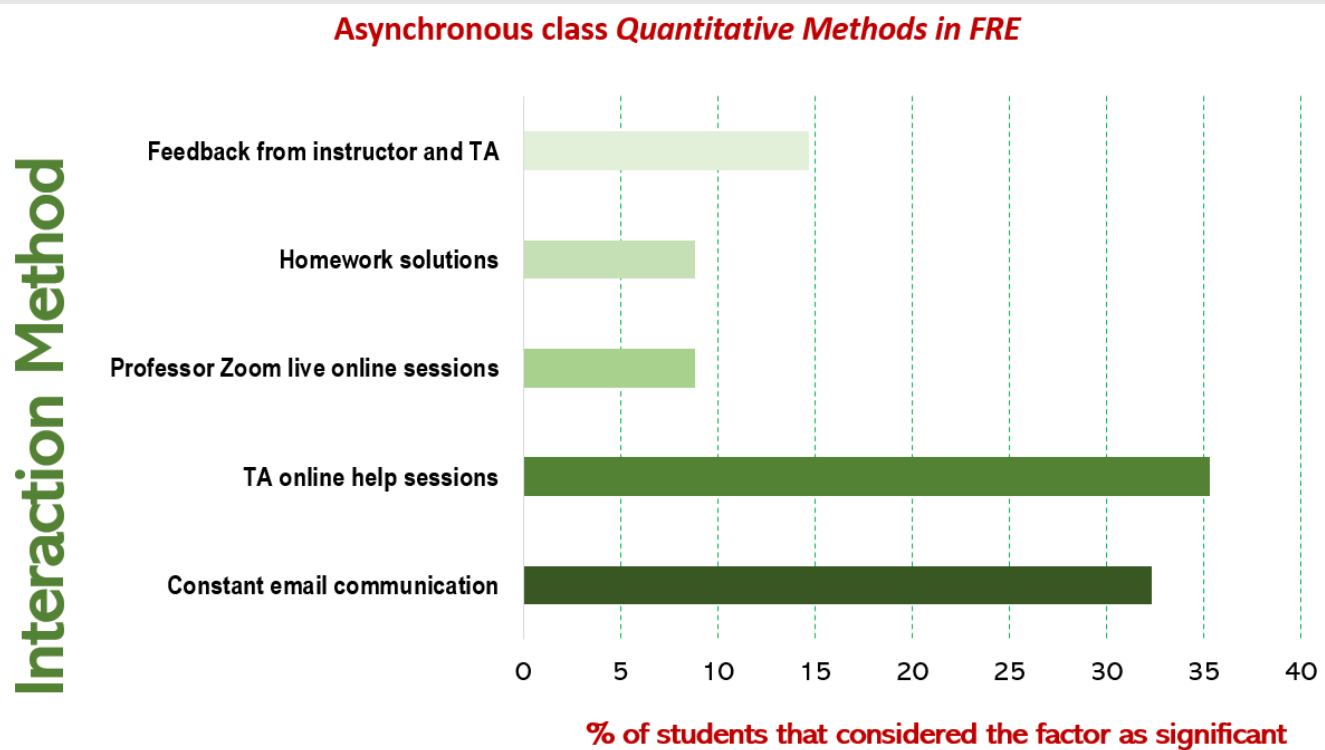


Figure 6. Students' Perceptions of the Professor and TA's Interaction Method that May Have Helped to Mitigate the Stress on Class Performance During the Pandemic

### 3.3 Students' Performance

A paired comparison test was used to contrast the academic performance of students prior to and during the pandemic for each course. Particularly, quizzes and homework assignments were compared for each course. The average score of each activity before and during the pandemic was evaluated to determine

whether the adaptation of the teaching methods could have affected students’ performance. Table 4 shows the summary statistics of the paired samples, whereas Table 5 shows the statistical analysis of these pairs. For Economics of Resource Use, students scored overall a lower grade (-1.84 points) in quizzes but received a higher score (+2.93 points) in their homework assignments. This may suggest that students benefited from the *interactive Excel online sessions*, which were crucial components in the homework.<sup>6</sup> This is particularly true for the students that were in the Agricultural Communication and Education major, for whom this software was a new tool.

**Table 4. Summary Statistics of the Paired Samples**

Course	Task	Pandemic Timing	Mean	N	Standard Deviation
<i>Pre-pandemic in-person course</i>					
<b>Economics of Resource Use</b>	Quiz	Prior	21.89	7	2.19
	(Base = 25 points)	During	20.04	7	2.34
	Homework	Prior	46.21	7	3.56
	(Base = 50 points)	During	49.14	7	2.53
<b>International Agricultural Trade</b>	Quiz	Prior	8.73	6	8.73
	(Base = 10 points)	During	8.41	6	8.42
	Homework	Prior	31.57	6	2.33
	(Base = 35 points)	During	29.25	6	4.72
<i>Pre-pandemic online course</i>					
<b>Quantitative Methods</b>	Quiz	Prior	8.29	34	1.30
	(Base = 10 points)	During	8.82	34	1.56
	Homework*	Prior	85.25	34	12.48
	(Base = 100 points)	During	78.21	34	28.88

Note: Quizzes for these courses are based on 25 points.

\*For comparison between homework assignments, they are expressed based on 100 points.

In contrast, scores were not statically significant at the 5 percent level for students taking International Trade Policy and Quantitative Methods. This suggests that, despite the drastic changes in teaching methodology and not being able to work with classmates, students were able to keep a similar quality in their academic performance. Interestingly, when looking at Figures 1 and 5 that show students’ perception, students seemed afraid that the pandemic might have a negative impact on their learning. However, Tables 4 and 5 show that this was not reflected in their grades. In fact, many of them were able to increase their score in both synchronous and asynchronous courses.

Students expressed that this improvement in scores was also in part to the ability of the instructor to change the structure quickly while keeping constant communication with them while understanding students’ specific circumstances. This is supported by correlational evidence based on students’ comments on the course (see *Appendix A*).

<sup>6</sup> Quizzes for this course did not include Excel problems as they are short tasks.

**Table 5. Results of the Paired Sample Test**

Course	Pair (Before–During)	Mean	N	Standard Error	Z-Test <sup>a</sup>	Degrees of Freedom	<i>p</i> -value (two-tailed)
<b>Economics of Resource Use</b>	Quiz	1.84	7	0.49	3.77	6	< .01
	Homework	-2.93	7	0.60	-4.86	6	< .01
<b>International Agricultural Trade</b>	Quiz	0.31	6	0.28	1.92	5	.31
	Homework	2.33	6	1.21	1.12	5	.11
<b>Quantitative Methods</b>	Quiz	-0.53	34	0.26	-1.96	33	.06
	Homework	7.05	34	3.46	4.03	33	.09

<sup>a</sup> Z test is used for this evaluation as the study counts with the entire population of students' scores.

## 4 Conclusion and Final Remarks

The COVID-19 pandemic led to unexpected changes to the social and educational aspects of college students' lives. Instructors needed to make structural shifts in the delivery of the courses in a short period of time. Common challenges regarding teaching online during 2020 were related to (1) successfully delivering the material of the courses given the time constraint, (2) lack of experience in teaching online and implementing different teaching tools, (3) how to keep students motivated in the courses during the pandemic, and (4) how to minimize difficulties with technology and software used in the courses.

To investigate how instructors and students coped with these challenges, we evaluated the case of three agribusiness undergraduate-level courses during Spring 2020. These courses were International Trade Policy in Agriculture and Environmental of Resource Use—both typically taught in-person in Plant City, and Quantitative Methods in Food and Resource Economics—delivered asynchronously in Gainesville with in-person sessions. Regardless of the initial delivery method, the three courses shared similar class methodologies during the stay-at-home period. Synchronous review sessions, prompt feedback of graded assignments, and constant communication with the students were key methods to help students face the transition of instruction during the Spring semester. Students from both locations responded positively to these efforts. Nevertheless, both groups of students expressed that not being able to work with their classmates was a major factor of stress affecting their learning.

This article provides three insights into the development of virtual courses and delivery of online instruction of courses that heavily rely on mathematical components and software applications.

- 1) Synchronous demonstration of problems using the software assigned in class (such as Microsoft Excel) helps students to understand how to work with spreadsheets and other analytical tools needed for their assignments. In particular, it is important to remember that students have heterogenous experience and skills with computer software. For this reason, it is suggested to record these sessions so students can review them later at their own time and pace. This practice should continue in the post-pandemic world as students are diverse in terms of their attention capacity, learning style, and technical skills. One caveat is that providing them with recorded lectures would reduce attention span and attendance rate to the live sessions. One approach to address this issue is sharing recorded lectures only to students who request them for valid reasons (e.g., absence due to illness).
- 2) Students did not seem optimistic regarding their performance during the sudden change in their academic courses. However, they reported that an appropriate methodology and constant communications help them to alleviate the stress induced by the pandemic.

- 3) For asynchronous classes, monthly or biweekly live office hours may help students to engage in the course material because the one-to-one interaction with the instructor may allow them to solve any specific question on the content or express their concerns.

**About the Authors:** Luis Moisés Peña-Lévano is an Assistant Professor at the University of Wisconsin—River Falls (Corresponding author: [luis.penalevano@uwrf.edu](mailto:luis.penalevano@uwrf.edu)). Grace Melo is a Visiting Assistant Professor at Texas A&M University.

**Acknowledgements:** The authors thank the Field and Fork Program for supporting the Plant City program. The authors also acknowledge Fei He, teaching assistant of Quantitative Methods in Spring 2020, for her support and marvelous work with the students, and Kati Lawson, faculty lecturer from Plant City, for providing guest lectures (prior pandemic) on the Economics of Resource Use course, which allowed students to understand the importance of effective communication when addressing environmental and economic issues. This research was reviewed and approved by the Institutional Review Board at the University of Florida (IRB# IRB202002074).

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4(1) doi: 10.22004/ag.econ.320045

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## Appendix A—Sample of In-Class Questionnaire (Lab Activity)

For simplicity, spaces have been removed from this summarized sample of the activity.

10

### LAB ACTIVITY Free trade economics

#### CONCEPTS AND SHORT PROBLEMS

1. Autarky occurs when a country does not trade with other nations.  True  False
2. For a nation to be an autarky, it must be self-sufficient.  True  False
3. The equilibrium at autarky occurs when domestic supply  domestic demand.
4. It is projected in 2050 that \_\_\_\_\_% (50/40/30/70) of the countries will depend on each other.

#### CONCEPTS AND SHORT PROBLEMS

5. At free trade, countries \_\_\_\_\_.
6. At free trade, goods are traded at \_\_\_\_\_ price (\_\_\_\_\_).
7. For a country to export, the domestic price must be \_\_\_\_\_ (greater/lower) than the world price. In that way, the country will export its \_\_\_\_\_ (shortage/excess supply).
8. The welfare change when a country exports is \_\_\_\_\_.
9. When a country exports, the winners are the \_\_\_\_\_ (producers/consumers), whereas the other party loses.
10. For a country to import, the domestic price must be \_\_\_\_\_ (greater/lower) than the world price. In that way, the country will import its \_\_\_\_\_ (shortage/excess supply).
11. The welfare change when a country imports is the following: \_\_\_\_\_.
12. When a country imports, the winners are the \_\_\_\_\_ (producers/consumers), whereas the other party loses.

#### PRACTICE!!!

Consider that the world only has two countries (Austria and Switzerland). All currency is in Euros:

► Austria Market (Index A)

$$\left\{ \begin{array}{l} \text{Demand: } Q_D^A = 800 - 10P \\ \text{Supply: } Q_S^A = 200 + 30P \end{array} \right.$$

► Switzerland Market (Index B)

$$\left\{ \begin{array}{l} \text{Demand: } Q_D^B = 100 - 5P \\ \text{Supply: } Q_S^B = 40 + 15P \end{array} \right.$$

13. What is the autarky equilibrium for each country?
14. Who will export? \_\_\_\_\_ Why? \_\_\_\_\_
15. Set up the export supply: \_\_\_\_\_.
16. Set up the import demand: \_\_\_\_\_.
17. What is the world equilibrium? \_\_\_\_\_.
18. Who imports? \_\_\_\_\_. How much? \_\_\_\_\_.
19. The exporter is \_\_\_\_\_, which sells \_\_\_\_\_ units to the foreign market.
20. What are the consumer and producer surpluses for each country? \_\_\_\_\_.

## Appendix B—Sample Evaluation Criteria for Final Presentation

Criteria	Novice (0 pts)	Intermediate (2 pts)	Fair (5 pts)	Good (8 pts)	Outstanding (10 pts)	Score
<b>Time limit</b>	Student has not prepared adequate time for presentation (< 2 or > 8 minutes).	Student is having difficulties with time limit, either short (2.5 minutes) or long (7 minutes).	Student is learning to adjust to adequate time: 3 minutes or 6 minutes.	Student is close to adequate time: < 3.5 minutes or > 4.5 minutes.	Student is able to present in effectively 4 minutes.	
<b>Poster presentation design</b>	Design of the poster was taken from a basic design with poor colors, excessive number of lines per slide, difficult to read, images are not consistent with the presentation flow.	Design was directly taken from PowerPoint with no modification, background colors are not attractive and makes difficult to read for the audience, images are not high definition.	Design was based on template, modified to make it organized, the background colors are good but are not a good contrast with the letter color, images are not high definition.	Good design, colors are adequate, modified from other presentations, images are in good resolution but definition decreases in big screen; letter size is adequate, but the content is still difficult to read.	Design of the presentation is novel and attractive, colors are adequate, images are clear and have a reason in the presentation, letter size is acceptable, and the poster is easy to read.	
<b>Presentation skills</b>	Student constantly reads from notes and is not able to keep the flow of the presentation.	Student is able to keep the flow of the presentation but only while reading from notes. There are constant pauses for rephrasing.	Student keeps the flow of the presentation, reads moderately, there are some pauses but does not capture the audience attention.	Student promotes some discussion during the presentation, but audience is not completely engaged, reads moderately but there are some pauses during presentation.	Student actively engage classmates in the presentation, shows proficiency in the topic, and provides an entertaining environment.	
<b>Content</b>	Lack of content, the topic was not covered in a state-of-art manner.	The presentation points out the major concepts of the topic but lacks providing details on the specific aspects of the topic. Content is not based on research or trustable news.	Presentation covers major concepts and some details, but it is unable to connect the ideas from previous and sequent slides. Content is based on trustable news but not relevant research.	Student covers major concepts and details and slides are connected providing flow for the presentations. Content is based on research and trustable news but is not recent and/or global.	Student covers major concepts and specific details, based on research and trustable news (in references). It provides examples that occur at the regional and global scale, consistent with the flow of presentation.	



<b>Economic application</b>	Student is unable to connect how the presentation is connected to economics.	Student attempts to provide examples from economics but lacks explaining the economic basis.	Student is able to provide examples of economic applications; however, the media content is not based on trustable facts. Student makes fair connection with economics, but there is not full explanation in the presentation.	Student provides examples of economic applications based from books, research, and articles but still has limited explanation on how the economic principles are applied to these examples. Student also provides references.	Student provides examples of economic applications based from books, research, and articles, with full understanding of the economic theory applied in the example.	
<b>TOTAL</b>						

Criteria	Novice (0 pts)	Fair (2 pts)	Fair (5 pts)	Good (8 pts)	Outstanding (10 pts)	Score
<b>Organization</b>	Organization of the presentation is unclear, and it is not easy to follow.	There is some level of organization though there are many ambiguities and irrelevances. Abbreviations are not explained, ineffective transitions.	There is some level of organization with few ambiguities and irrelevances. Abbreviations are not explained. Transitions are still drastic with no clear connection between slides.	Presentation has a clear organization structure with some ambiguities, easily followed, good transitions and structured format.	Presentation is clearly organized; easily followed; effective, smooth, and logical transitions; and professional format.	
<b>Voice and language</b>	Audience is unable to hear the student.	Audience is unable to hear part of the presentation due to constant low voice.	Audience is able to hear the presenter, but there are parts that voice breaks.	Tone of voice is adequate for the audience with slight moderate issues.	Tone of voice is adequate for the audience.	
<b>Language</b>	Presenter does not use proper basic language while presenting.	Presenter uses adequate basic language but is unable to connect simple sentences.	Presenter uses compound sentences but makes too many grammatical mistakes, and there are several signals of cacophony.	Vocabulary is varied, specific, and appropriate; frequently uses economic and correct vocabulary and grammar.	No cacophony, sentences are well structured, language is professional, and proper economic language is used.	
<b>Q&amp;A</b>	Student is not able to answer any questions correctly.	Student is able to only answer one or less than 50 percent of the questions correctly.	Student is able to answer two or 50 percent of the questions correctly.	Student is able to answer three or 75 percent of the questions correctly.	Student is able to answer all questions correctly.	
<b>Abstract</b>	Student did not write the summary of the presentation.	Student provided only certain points but did not establish objectives.	Student was able to provide a main objective and some specific details, but they were not connected.	Quality of summary is acceptable, it included introduction, objectives, it was organized, and used divisions but did not mention major points.	Quality of summary is outstanding, with no grammar mistakes; it includes an introduction and objectives; it was organized, used divisions and subdivisions, and covered major points and a conclusion.	
<b>TOTAL</b>						

## Appendix C—Students' Feedback

### C.1 Feedback from Students Reported in Course Evaluations for the Two Traditional In-Person Courses and the Online Course Before the Pandemic

*"Dr. Luis was always available to help students who were struggling and made a huge effort to get to Gainesville to provide in-person instruction despite living two hours away and the course being online."*

*"He's very flexible with office hours and answers emails promptly, which is really good. He's also really understanding of individual circumstance in getting the quizzes and pre-labs in. He provides good examples in his lectures and does a good job of explaining how exactly to work the problems, making sure we actually understand the material."*

*"Dr. Luis also brought a positive attitude to his office hours, review sessions, and more recently the Zoom meetings. It didn't matter what the class threw at him, Dr. Luis was able to adapt and promote a positive learning experience by providing help to each and every student who requested it."*

*"Very fun to be around and really knows how to explain topics and concepts. I enjoyed the office hours and learned the most there, face to face."*

### C.2 Feedback from Students Reported in Course Evaluations During the Pandemic for the Two Traditional In-Person Courses

*"He is very knowledgeable in many topics for the class. He does well breaking things down for us to understand it better. Economics is tough, but he helps in any way he can."*

*"Dr. Luis demonstrates to all of his students that he cares about their academic success by his availability to help answer questions about assignments through quick email responses and Zoom calls."*

*"Dr. Pena-Levano is helpful, patient, and intelligent. He is enthusiastic about the topic and is always available to help when called upon."*

*"Excellent job in being fair with the students, giving them an opportunity to learn the material in a way that didn't have us stressing about the assignments. Good job with the new notes system in class."*

### C.3 Feedback from Students Reported in Course Evaluations During the Pandemic for the Online Course

*"This instructor was one of the best professors I have had in college. He went over and beyond anything he 'had' to do to help us as an online instructor. Professor Luis is not only a teacher but also a mentor."*

*"The instructor did his best to help students, but because the class is online, the TA, Fei, was the biggest contribution to this course! When the professor came to campus, he was very helpful!"*

*"Dr. Luis's strengths are that he is always willing to help and provide feedback on assignments, he provides quick response times when students email him with questions, and he does everything he can to make sure students understand the material and succeeds."*

*"Dr. Luis was always available to help students who were struggling and made a huge effort to get to Gainesville to provide in-person instruction despite living two hours away and the course being online. [...] Dr. Luis's sole focus was for his students to understand the material he was teaching and constantly emphasized how important mastering the topic was for courses beyond his own."*

*"The instructor strength is that he is very enthusiastic about the course as well as the TA."*

*"I've never had a TA that helped so much! Hosting office hours each week and before exams holding review sessions. The class being online was very challenging, and the TA basically taught the class in person for anyone who attended her helpful office hours."*

### C.4 Feedback from Students Reported in Course Evaluations During the Pandemic for the Two In-Person Courses and the Online Course, Emphasizing Student-Specific Adaptations of the Teaching Methods During the Pandemic

*"Dr. Luis was the most helpful professor I have had in my college career. He was very accessible through Canvas message, and the in-person review sessions were extremely appreciated and greatly contributed to my knowledge of the material."*

*"Dr. Luis's strengths are that he is always willing to help and provide feedback on assignments, he provides quick response times when students email him with questions, and he does everything he can to make sure students understand the material and succeed."*

*"He's very flexible with office hours and answers emails promptly, which is really good. He's also really understanding of individual circumstances in getting the quizzes and pre-labs in. He provides good examples in his lectures and does a good job of explaining how exactly to work the problems, making sure we actually understand the material."*

*"Dr. Luis is an excellent instructor and was very helpful with every step of the course. He provides great feedback and is very encouraging and understanding of any issues."*

*"Dr. Levano took the time to help me in any way that he could. He was quick to respond to messages and offered to help with assignments [...]. He made the course easier to understand for a person who isn't a Food and Resource Economics major."*

## Teaching and Educational Methods

# Nudge or Sludge? An In-Class Experimental Auction Illustrating How Misunderstood Scientific Information Can Change Consumer Behavior

Laura A. Paul<sup>a</sup>, Olesya M. Savchenko<sup>b</sup>, Maik Kecinski<sup>a</sup>, and Kent D. Messer<sup>a</sup>

*University of Delaware<sup>a</sup>, University of Florida<sup>b</sup>*

JEL Codes: A20, D82, D83, D90, D91, Q25, Q28

Keywords: Behavioral economics, classroom game, experiential learning, informational nudge, second-price auction, willingness-to-accept

### Abstract

Scientific information can be used to help people understand and describe the world. For example, consumers regularly seek out information about their food and drink to help inform their purchasing decisions. Sometimes, however, consumers can respond negatively to this information, even when the information did not intend to convey a negative signal. These negative responses can be the result of misunderstandings or strong, visceral, emotional behavior, that can be challenging to foresee and once arisen, difficult (and expensive) to mitigate. In this paper, we show how educators can use an in-class economic experiment to introduce the power of a sludge—a small behavioral intervention that leads to worse outcomes. We provide a step-by-step guide to take students through a demand revealing design using a second-price, willingness-to-accept (WTA) auction that tests preferences for tap water and bottled water when students receive total dissolved solids (TDS) information. Additional classroom discussion topics are presented, including comparing nudges and sludges, the public response to the treatment of tap water, and the role of safety information in consumer response.

## 1 Introduction and Background

Consumers regularly seek out scientific information about their food and drink to help inform their decisions and preferences. While this search is generally viewed as a positive process, in some instances consumers respond to scientific information in unintended ways. Consumer responses can be difficult to foresee and, once they occur, hard (and sometimes expensive) to mitigate. On the other hand, firms can misuse this information via product labels by stigmatizing other products, thus profiting from consumer confusion and strong, visceral responses to products that pose no risk to them—Thaler (2018) called this “nudging for evil.”

Information provided by labels have often been seen as a type of “nudge” popularized by behavioral economics. A nudge is “any aspect of the choice architecture that alters people’s behavior in a predictable way without forbidding any options or significantly changing their economic incentives” (Thaler and Sunstein 2008, p. 6). Nudges are low-cost interventions made at the point of a decision, and they can have large effects on behavior, but they have been referred to as “sludges” when they end up misleading people by making it more difficult for individuals to make decisions that reflect their preferences (Thaler 2018; Sunstein 2020). Nudges—and their dark side, sludges, can be used in a variety of ways. People, perhaps unknowingly, frequently experience them in marketing and policies. Nudges are an important avenue through which students can learn about behavioral economics. The objective of this paper is to illustrate the power of behavioral economics through experiential learning with an in-class experiment using a second-price, willingness-to-accept (WTA) auction that measures the impact of an information treatment, a nudge. Specifically, students submit their WTA as an auction bid for performing the task of drinking water after receiving information about the total dissolved solids (TDS) in different water types. Learning about behavioral economics and the impact of information could be particularly pertinent for undergraduate students in environmental economics, agricultural economics,

environmental and resource economics, or public policy classes, among other audiences.

The in-class experiment developed here explores potential for information to evoke stigma and make a task (somewhat) controversial. Disgust (or disutility) is evaluated through changes in WTA elicited using a second price auction, an incentive compatible economic mechanism. Measuring students' WTA to perform a task, as opposed to measuring the more common willingness-to-pay (WTP) to avoid the task, is easier to operationalize in the classroom setting. The key difference between WTA (the minimum amount of compensation a participant will accept for performing a task) and WTP (the maximum amount of money a participant is willing to pay to not perform a task) is one of framing. WTA is more straightforward in the classroom setting to deal with a potentially unpleasant task for several reasons, including that it avoids the possibly problematic scenario of asking students to pay something in a class activity, or the expensive scenario of sufficiently endowing every student before the activity.

Behavioral economics is relevant in many courses, from core microeconomics to specialized courses in marketing and consumer behavior. We include suggestions for linking the experiment to real-world issues, specifically, the impacts of a sludge on the public's demand for tap water versus bottled water. Additional topics include, for example, food labeling for GMOs, rbST-free, or organic-produced items. One could also imagine using this approach in other food contexts that could invoke a negative consumer response such as new meat-free products or the use of insects as a novel protein (perhaps in powdered form). Embedded in this activity's discussion is the stigmatization of safe and cost-effective public drinking water, such as recycled water. Recycled water involves the treatment of wastewater for immediate and direct human consumption. This water, once treated, is as safe as any other treated water (Chen et al. 2013). Consumers have been shown to largely reject recycled water as its potentially contaminated origins are too salient (Savchenko et al. 2019). Nonetheless, recycled water may be a cost-effective way to provide clean and safe drinking water to many areas dealing with water scarcity now and in the future. Removing TDS from drinking water can significantly increase consumer acceptability, even though the low initial levels of TDS do not present any risk to consumers. TDS is a measure of the small amounts of organic matter present in water that are generally harmless for human or environmental health. Understanding consumers' behavioral response to different framings of information thus offers pathways for firms to use sludges to stigmatize competitors' products. For example, the company ZeroWater promotes their treated bottled water as containing zero TDS, even though there is no scientific information that suggests that TDS should not be present in drinking water. This suggests the question, does information on TDS in drinking water impact consumer choice? Likely the answer is yes—and the experiment discussed here will show students how impactful sludges can be.

Given the importance of nudges and sludges in different contexts, there is the additional value to extend the conversation to further lessons from behavioral economics on the role of safety and environmental information in decision and policy making. In fact, the impacts of information on decision making provides an important foundation for broader and policy-relevant classroom discussion. Nudges are a great way to engage students in interesting and entertaining real-world scenarios, for example, improving airport bathroom cleanliness by putting an image of a fly in a urinal to improve aim, and therefore, cleanliness. Although appealing due to their simplicity and low cost, nudges can fail by inducing the “wrong” behavior, or by having no effect at all (Sunstein 2017; Bicchieri and Dimant 2019). In a meta-analysis of 100 experiments using nudges, Hummel and Maedche find that two thirds of the effects are statistically significant and the median effect size is 21 percent (Hummel and Maedche 2019). In other words, not only are nudges occasionally ineffective, but they sometimes harm decision makers by enabling firms to appear to protect consumers while in fact doing the opposite (with a sludge; Willis 2013).

Comprehension of the potential for nudges and sludges to influence behavior is important for students in applied and agricultural economics, and agribusiness undergraduate and graduate programs,

both as decision makers and future choice architects.<sup>1</sup> Science communication skills are in high demand across sectors, so it is important that students should be able to distinguish what is a nudge and what is a sludge. This in-class experimental game can facilitate the discussion of the impact of information on WTA.

## 2 In-Class Experiment to Demonstrate the Impact of Scientific Information

This is a versatile in-class experiment that can be made locally relevant by using tap water. After completing this activity, we anticipate several learning outcomes:

1. Students will be able to critically examine when information provided is a positive nudge or negative sludge.
2. Students will be able to discuss the role of information in decision making as it relates to different public policy contexts, such as treated drinking water.
3. Students will understand and be able to define WTA.
4. Students will be able to participate in and understand a second price auction by stating their WTA for completing a task.
5. Students will be able to compare the distributions of WTA before and after receiving new scientific information.
6. Students will be able to think critically about the proper regulatory response to a situation where the public's assessment of a risk is different than the scientific/expert assessment.

The materials required to run this experiment include printed handouts with instructions and information about the water sources, a labeled jug containing treated tap water, bottled water, a TDS meter, envelope, cash to be used for payoffs, and small paper cups. The method to evoke stigma regarding water quality is to illustrate the TDS in tap and bottled water using a TDS meter.<sup>2</sup> TDS typically does not pose any human health risks. However, the measurements can provide participants with a visible difference between the tap water and bottled water, influencing their WTA for drinking each. Instructors should plan for about 75 minutes to complete the experiment and discussion afterward.

The design of the experiment depends on the class size. For larger classes, the experiment will have a between-subject design—that is, one group will receive the TDS information and one group will not receive the TDS information. For smaller classes (i.e., fewer than 24 students), the experiment should have a within-subject design, where the second-price auction will be conducted twice, first before the TDS information treatment is received and then again after the treatment. The remainder of this paper will describe a larger class setup (the Appendix includes options for smaller classes).

The classroom experiment consists of three parts. First, the instructor explains the second-price auction mechanism and provides students with an opportunity to participate in a practice round of a second price auction using a simple task, such as drawing a picture. Second, one half of the students (treatment group) use a TDS meter to measure the TDS content in both the tap water and bottled water. The other half of the students (control group) receives no additional information. Third, an auction is conducted using the task of drinking two ounces of tap water and drinking two ounces of bottled water. The difference in the distribution of WTA from the treatment and control auctions for the two types of water is a measure of the impact of the information provided. Graphically comparing a histogram of WTA

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<sup>1</sup> Thaler and Sunstein (2008) coined the term choice architect to describe those who design policies or marketing. Whether a student pursues a career in government or industry, it is likely that they will at some point have the opportunity to design a choice framework for others. In this context, it is usually difficult to be neutral, and there are profit or welfare incentives to nudge a decision maker in one direction without limiting the independence of their choice.

<sup>2</sup> At time of writing, TDS meters are available on amazon.com for less than \$20. For example, <https://www.amazon.com/HM-Digital-TDS-4-Measurement-Resolution/dp/B0002T6L5M>.

in each treatment group for the two types of water will give visual information about the similarities or differences in distribution of WTA. Depending on the level of the class, instructors may test the null hypothesis if the difference in WTA between tap and bottled water is the same across treatment groups.<sup>3</sup> Alternatively, in a simpler framing, the instructor could just present the count of people who would have performed the task of consuming each water at a single price point.<sup>4</sup> This experiment can either be conducted using pen and paper (templates included in Appendix), or electronically through a system such as Google Forms, Qualtrics, or Poll Everywhere.

## 2.1 Introduction to the Activity and Second-Price Auctions

Second-price auctions are a useful tool to reveal demand because they induce participants to bid their true value. Further, participating in an auction can be a fun and interactive experience for students.

To begin, the instructor provides important notices for the experiment:

1. Each participant will receive written instructions (see Appendix). These instructions will describe several tasks (e.g., draw a picture, drink two ounces of water), and students will be asked to indicate the minimum compensation amount (WTA) to do the task.
2. Student decisions may affect the amount of money they will earn (or alternatively extra credit points).
3. No deception is permitted in experimental economics.

The instructions include an introduction to the key concepts of the *offer* and the *payoff*. The offer is the minimum amount of money a participant requires (WTA) to perform a given task. The payoff is the amount of money earned. In these auctions, participants will write down (or submit electronically) their offer, being sure to keep it private from their classmates. The participant with the lowest offer<sup>5</sup> wins the auction, and their payoff is the amount in the second-lowest offer. Offers must be between \$0.00 and \$9.99.<sup>6</sup> If a student refuses to perform a specified task for any amount less than or equal to \$9.99, the student may offer \$10.00, and they will not need to perform the task, no matter what. In the case of a tie for the lowest offer, the winner will be chosen randomly among the lowest offers, and that winner will be paid the lowest offer.

Instructors may also wish to implement a maximum compensation, particularly in the case of a small class size to eliminate the possibility of students colluding at \$9.99, or in the case that everyone makes high offers. If so, include the following instructions:

However, there is a limit on the maximum compensation to be paid. This value is determined by the instructor before the start of the session. This limit may be as high as \$9.99 and is chosen randomly for each part of the experiment. The maximum possible compensation is written on a piece of paper in the sealed envelope labeled with today's date at the front of the room. We will ask one of you to draw an envelope and show the limit to everyone at the end of this part of the experiment.

The use of the second-lowest offer to determine the payment creates incentive compatibility. Instructors may present the following example to class to emphasize this: suppose the task is to eat a

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<sup>3</sup> Of course, because class sizes are often relatively small, a nonsignificant outcome from a test, or a failure to reject the null is weak evidence for the null hypothesis versus the alternative hypothesis.

<sup>4</sup> Another simple starting point would be to first ask participants, which of the two products they want, then one could use the auction to try to measure this preference with greater precision.

<sup>5</sup> In the case of a tie, the instructor may choose to allow multiple winners, or could use a random number generator (i.e., <https://www.random.org/>) to select one winner.

<sup>6</sup> The example presented here is based on the \$0–\$10 interval. However, instructors are free to use any interval that makes sense to them or helps them to stay within a certain budget.



piece of broccoli. Offers must be \$0.00–\$9.99. Student A would be willing to eat the broccoli for \$0.00 but wants to try to game the system to earn money *and* eat the broccoli, so they offer \$1.00. Student B offers their true value of \$0.10. The sealed envelope (if included) is revealed to be \$7.50. Student B wins the auction, eats the broccoli, and earns \$1.00 (the second price, and lower than the sealed envelope). Student A lost utility because they did not get to eat the broccoli, even though the price was more than their WTA. Student A therefore has the incentive to submit their true value of \$0.00. The incentive compatibility feature of a second-price auction is in contrast with a first-price auction, in which the winner receives the winner’s offer. So, in the example above, there is no dominant strategy to offer truthfully because both Student A and Student B may receive some positive gain if they offer a slightly higher amount than their true value.

After introducing the concepts, instructors can move on to practice auctions using practice tasks, such as “draw a picture.” Figure 1 provides an example sheet that may be used to complete these auctions. Data may be manually entered in a spreadsheet by the instructor. Alternatively, students may submit bids electronically. The use of pen and paper versus electronic submissions will likely depend on class size—for small class sizes, for example, fewer than 24 students, pen and paper works well.

To help improve student comprehension, the offers can be ordered from lowest to highest and written on the board. Then, the lowest offer can be identified, the task implemented, and the payment made to the individual. Students can be encouraged to ask questions at any point of this process. After ensuring comprehension of the auction mechanism and its incentive compatibility with the illustration below and an example auction, the instructor proceeds with the remainder of the activity.

## 2.2 Measuring the Impact of the Sludge

The main part of the classroom experiment proceeds with second price auctions for drinking tap and bottled water. For the treatment group (half of the class) the instructor delivers information that is factually true, harmless, but may be stigma evoking. The information is provided by conducting a TDS test to measure the TDS level in the tap and bottled water. The control group (remaining half of the class) receives no additional information. There are several different approaches for the instructor to provide TDS information to one half of the class but not the other. For example, the experiment could be conducted in teaching assistant sections that are already subdivided. Or an instructor could leave half of the students out of the room. Alternatively, in the context of remote learning, breakout rooms could be used if the class would reconvene later. After the information is conveyed, the instructor conducts the

What is the least amount of money you are willing to accept to perform the tasks below?

- Offers must be \$0.00–\$9.99.
- Person with the lowest offer is the winner and will receive second lowest offer.\*
- If you are absolutely not willing to perform the task for less than \$10, you may offer \$10, and you will not have to perform the task.

**Draw a Picture**

Offer: \$

\*Or the predetermined maximum amount, to be revealed at the end of the experiment.

**Figure 1. Training Activity: Second-Price Auction**

auction to measure the auction results for the two groups. Figure 2 illustrates an example form to administer the second-price auction for two types of water.

There are several methods to provide accurate scientific information that is likely to evoke stigma (or “sludge”) against the treated public tap water. The TDS test is a good option because it provides easily comparable measures of the types of water and can be verified by the students. If taking a TDS measure is not an option, a simple information-only intervention can potentially also elicit stigma. We take advantage of a disgust response from the reminder that drinking water may have once been in contact with noxious substances. Figure 3 illustrates results from this activity when conducted at a public university. After providing information on TDS content of tap and bottled water, WTA offers for drinking bottled water decreased while the WTA offers for drinking tap water increased, indicating a move away from the stigmatized public tap water.

Figure 3 shows differences observed before and after providing undergraduate students with information about TDS content of two water types (tap and bottle). These results come from the authors’ in-class experiments using the design described in this paper.

### 3 Discussion Suggestions and Conclusions

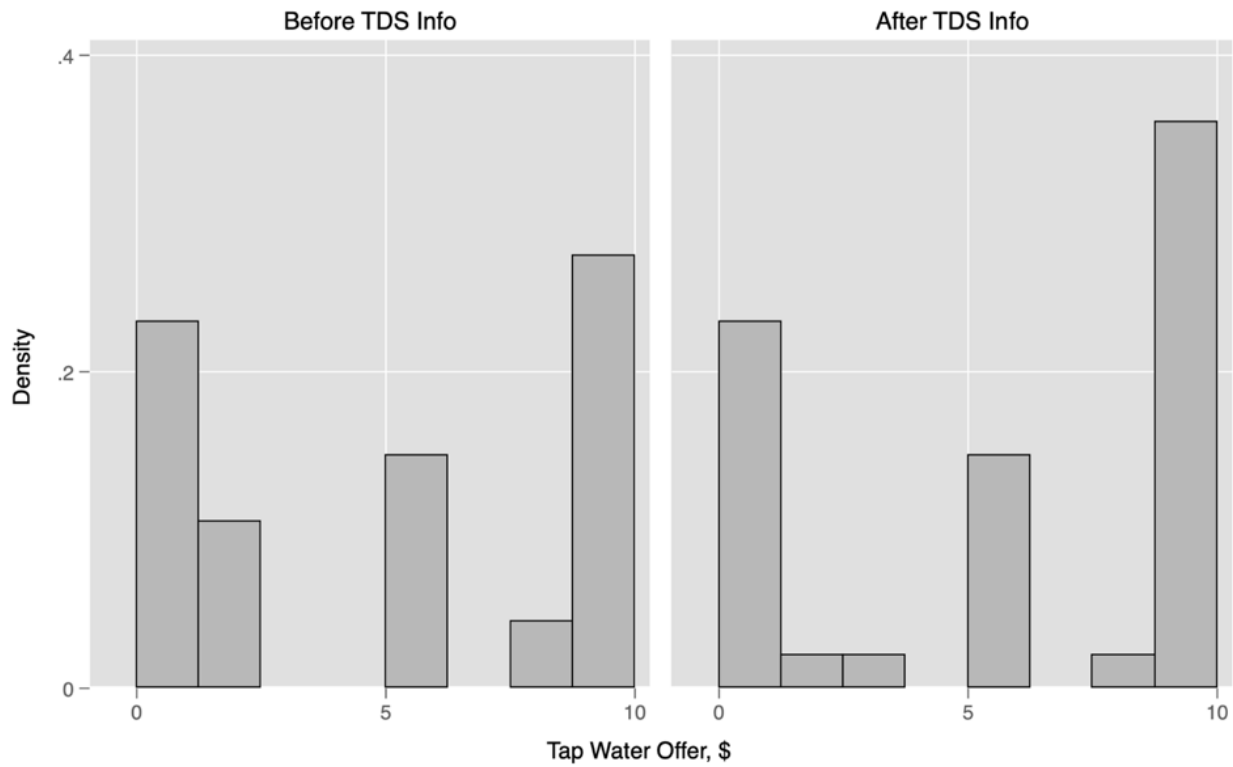
To facilitate classroom discussion, the instructor should present the students with the summaries of their offers in the auctions for a view of what happened during the activity. The instructor should describe what are TDS and how they generally present no human health risk. In the authors’ experience, average WTA for bottled water from the group that received the information about TDS tends to be lower than the group that did not (in other words, the level of concern is lower with the information about TDS). Then, the instructor should move on to define nudges (and sludges) and give examples of nudges in policy and marketing. A sludge is a nudge that makes it more difficult for individuals to make wise decisions that reflect their preferences. In the authors’ experience, the TDS measure increases the class mean WTA of drinking the more sustainable and economical tap water, despite the harmlessness of TDS. Students at this point should understand how the TDS information could be a sludge that impedes the treatment groups’ valuation. This discussion should take place after the experiment and could include a

What is the least amount of money you are willing to accept to drink 2 ounces of the following water sources?

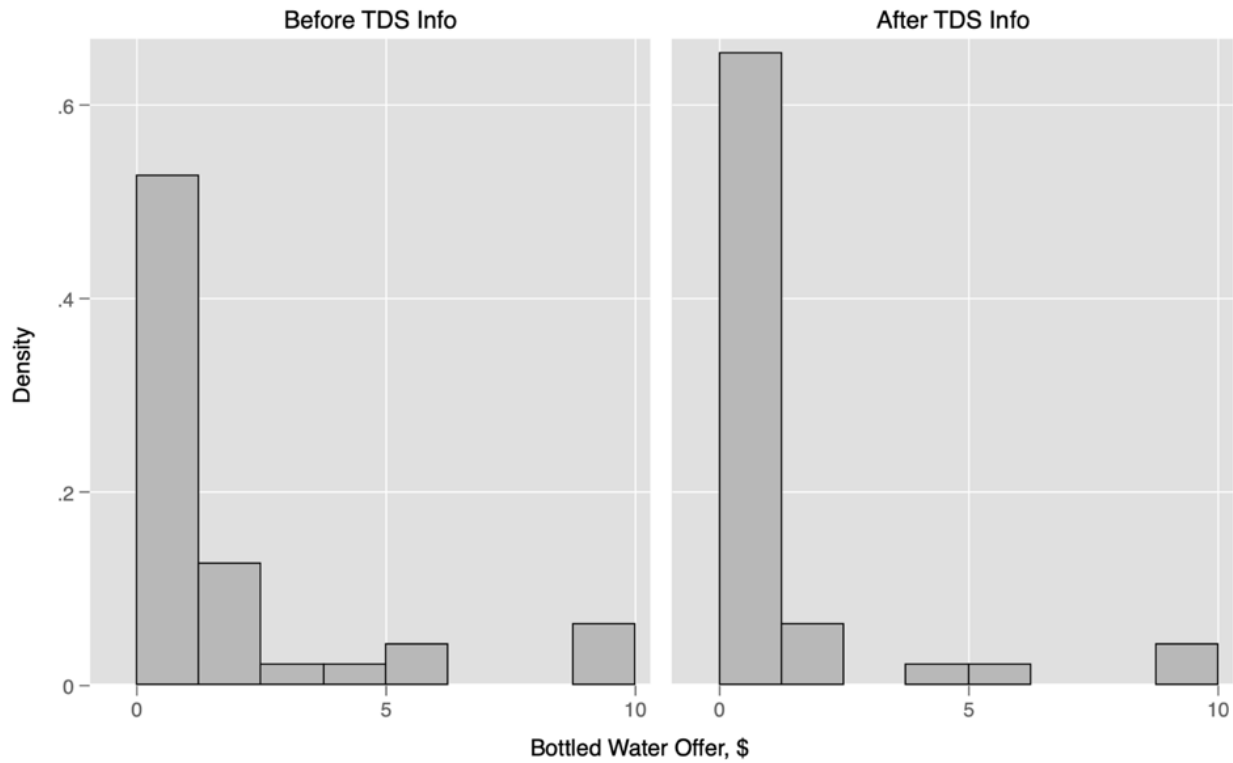
- Offers must be \$0.00–\$9.99.
- Lowest offer is winner, will receive second lowest offer.\*
- If you are absolutely not willing to perform the task for less than \$10, you may offer \$10 and you will not have to perform the task.

Bottled Water	Tap Water
Offer: \$	Offer: \$

**Figure 2. Second-Price Auction for Drinking Water**



Graphs by TDS Information Treatment



Graphs by TDS Information Treatment

**Figure 3. Experimental WTA Results from 39 Undergraduate Student Participants**

simple survey or interactive question-and-answer between the students and instructor to see how the TDS measure was perceived.

At this point, students should have a better understanding of the potential for lessons from behavioral economics to influence policy and behavior. The instructor may also want to present the results shown in the manuscript (Kecinski and Messer 2018). This activity can relate to many different topics that can be selected based on the course;<sup>7</sup> in this section, we propose four potential discussion topics.

1. Nudges and sludges: Discuss examples from other contexts where informational nudging is or is not effective.
2. Response to recycled water: Discuss the issues involved in consumer response to different types of drinking water, specifically recycled or reused water.
3. Scientific labels and fear: Discuss the role of science and consumer fears in policy making (e.g., TDS concentrations in water, labeling for GMOs, rbST, organic production).
4. Policy: Discuss the proper regulatory response to a situation where the public's assessment of a risk is different than the scientific/experiment assessment.

Thaler's (2018) *Science* article describes "nudging for evil" as a sludge—interventions that make it more difficult for individuals to make wise decisions that reflect their preferences. While helpful nudges continue to be a major aspect of choice architecture, examples of intentionally malevolent use of nudges by profit-seeking firms abound: the difficulty of receiving promised rebates or cancelling a subscription because of the power of the default or status quo of continuing to pay for the subscription. Public sector examples include the difficulty of voter registration and immigration processes, student financial aid applications, and health care enrollment—processes that already have notoriously high transaction costs. Sunstein (2020) proposed a *sludge audit* for both the private and public sectors. In-class discussion could include what sludges the students experience, for example, the hurdle of complicated financial aid forms (Dynarski et al. 2018) or the difficulty of unsubscribing from paid services. In the context of this in-class activity, the TDS measure is providing additional information to muck up the students' value of the drinking water. TDS is generally not harmful, and some mineral water will necessarily have high levels. The added information at the time of the decision made it more difficult for students to evaluate their choices.

Different communities will have different water-related issues that can be highlighted in class, including the balance of surface and groundwater, the presence of natural contaminants, or elevated risk of water shortages due to drought. Instructors are encouraged to do their own research on local drinking water supplies, such as source and potential pollution issues. Generally, larger cities may rely more on surface water whereas rural areas may be more reliant on ground water (this will also depend on geographic location). Similarly, certain geographic locations may present with their own unique challenges. For example, there are various locations in several Asian countries (including China, Bangladesh, and India) that have naturally occurring arsenic in ground water. Other water issues, such as eutrophication, impact surface waters around the world. Additionally, discussion could include news coverage of policies that resulted in large scale lead contamination in Flint, Michigan, United States. Moreover, regardless of the specific water issue and geographic location, it is likely that climate change will intensify threats to water availability and quality (IPCC 2021), and so we suggest to including important information concerning the impacts of climate change on the water cycle.

A discussion about water shortages, either local or global, and the role of public opposition to water recycling development would represent an important, policy-relevant extension of the exercise.

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<sup>7</sup> For a class that focuses on experimental methods, there are several additional relevant topics, including a discussion on auctions as a method for eliciting value and measuring the impact of a nudge.

For example, instructors can engage students in a discussion about the importance of the source of recycled water by introducing research on consumer acceptance of recycled water for drinking, recreation, and irrigation uses. This discussion can be enriched with examples of large-scale water reuse projects, including those that failed due to consumer concerns, such as East Valley Water Recycled Project in Los Angeles, California, and those that successfully operate today, such as the Groundwater Replenishment System facility in Orange County, California. Instructors can further motivate students to think about how consumers' experience with drought can shape their perceptions of recycled water. For example, consumers who have experienced a higher frequency of drought might be more willing to purchase products produced with groundwater drawn from an aquifer recharged with recycled water.

In addition, instructors can discuss the policy implications of consumer stigmatization of produce grown with recycled water or the impact of information about benefits and risks associated with recycled irrigation water on consumer preferences. A class could further discuss how product branding and processing, social preferences, and public decision making can help alleviate stigma. Further, there is a broad experimental literature that can be incorporated in class discussions. This paper describes using only local tap water and bottled water; however, this experiment can also be conducted using filtered water. Filtering the tap water using the ZeroWater home water filter, which reduced the TDS levels similar to Penta ultra-purified bottled water, mitigated the stigma of the tap water. These results suggest that the tap water was stigmatized due to the presence of TDS, which were removed in the filtering process.

The abundant (and sometimes contradictory) scientific information available to consumers about food and drink requires careful consideration to sift through it all. Labeling to communicate specific processing aspects and origins has become commonplace, and not always with good outcomes. Ask students what labels they look for on food and beverage products and whether they believe there to be a scientific backing for those labels. Discuss what their reaction might have been if bottled water was labeled "TDS Free" or "Contains TDS." Labeling can be a nudge with good outcomes by providing important scientific information about the health and safety of a product. However, labeling can easily become a sludge—complicating a consumer's decision with unhelpful information.

Finally, instructors are encouraged to have a discussion on what is the proper regulatory response to a situation where the public's assessment of a risk is different than the scientific or expert assessment. To help stimulate the discussion, students may be encouraged to read "Regulations in Happyville" by (Salanié and Treich 2009), who discuss the welfare impacts of a situation where regulators invest taxpayer money in water cleanup technology in response to the public's incorrect belief that their drinking water supply is contaminated.

In conclusion, behavioral economics is a powerful framework for understanding decision making in many contexts, and nudges (or sludges) provide an important introduction to it. This paper describes an in-class experiment to illustrate the role of scientific information in the context of valuing different types of drinking water. These concepts are relevant to a range of economics courses taught in applied and agricultural economics or agribusiness programs.

**About the Authors:** Laura A. Paul is a Postdoctoral Researcher at the University of Delaware (Corresponding author: [lpaul@udel.edu](mailto:lpaul@udel.edu)). Olesya M. Savchenko is an Assistant Professor at the University of Florida. Maik Kecinski is an Assistant Professor at the University of Delaware. Kent D. Messer is the S. Hallock du Pont Professor and Director of the Center for Experimental & Applied Economics at the University of Delaware.

**Acknowledgements:** This research was supported by the U.S. Department of Agriculture National Institute of Food and Agriculture, #2019-67023-29854.

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4(1) doi: 10.22004/ag.econ.320046

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**Case Study****Negotiating for a Grain Elevator Purchase: Valuations of Willingness to Buy and Willingness to Sell**Austin Liepold<sup>a</sup>, Marin Bozic<sup>b</sup>, and Michael A. Boland<sup>b</sup>*Ceres Global Ag.<sup>a</sup>, University of Minnesota<sup>b</sup>*

JEL Codes: A21, M21, Q14

Keywords: Agribusiness, case study, finance, oats, net present value

**Abstract**

North America Small Grains Trading Company (NASGTC) is a North American grain trading company investigating grain elevator location prospects to expand their grain origination territory. In 2021, NASGTC purchased grain at a premium from third-party suppliers or country elevators in North America to fill their terminal space at various locations or directly ship to their small grain (defined as oat, hard red spring wheat, rye, durum, and canola) end-user customers with a focus on identity-preservation to help support consumer label claims. Since its founding in 2013, NASGTC has operated terminal elevators efficiently without any origination locations. The NASGTC is in initial diligence to acquire the assets of a Canadian grain elevator to originate additional oats. The objective of this case study is to determine whether it is economically feasible to acquire a grain elevator to own more of the margin in the oat supply chain.

**1 Overview**

Clare Walsh's job is to quantify risk and analyze opportunities for North America Small Grains Trading Company (NASGTC) and has been tasked to make a recommendation regarding the valuation and possible acquisition of a grain elevator in Canada to originate additional oats. Clare is a 2016 graduate with a Master of Science in agricultural and applied economics from a well-known midwestern U.S. university, and her supervisor is Vice President of Business Development for NASGTC. He has tasked Clare to complete an oat origination, merchandising, and operating analysis assuming NASGTC is able to purchase the elevator and develop an acquisition price for her supervisor and the senior management team to consider. Specifically, Clare must: (1) Create a Microsoft Excel spreadsheet workbook and spreadsheets that are linked and lead to a decision-making tool for analysis of asset valuation; and (2) Apply the concepts of net present value (NPV), understand the components of the calculation and origin of the data for the formulae. These analyses are needed to be used if NASGTC is to make an offer for the grain elevator. Clare's analysis is to identify the value being created in the transaction.

The seller, a well-known multinational grain trading company, has placed the grain elevator with an agent who has informed NASGTC that the seller is eager to sell the elevator. The seller has Canadian export terminal space in Thunder Bay (Ontario) and Vancouver (British Columbia); U.S. export terminal space in Duluth (Minnesota), New Orleans (Louisiana), and Portland (Oregon); and many inland grain elevators in Canada and the United States. However, this particular inland grain terminal is not strategic for the seller since it is centrally located in a primary oat growing region in Manitoba and Saskatchewan, and oats are a small part of their portfolio. However, oats are a strategic crop for NASGTC, which sources oats for North America food buyers in consumer-packaged goods and ingredient users in bakery and food service with key delivery points in New England, the greater Ohio region, southern Great Plains, and southern California. This grain elevator purchases spring wheat and canola but in small quantities, and for purpose of this analysis, Clare is focusing solely on oats.

It is common to hear people joke that oats were the only major commodity to see a declining volume of acreage since 1900 because of the switch from horse transportation, which consumed oats, to

the combustible engine which used gasoline. However, oats for consumer end uses have increased as oats are viewed for their nutritional content. Long-standing breakfast cold cereal brands such as Cheerios owned by General Mills and hot cereal brands such as Quaker and new entrants have created new oat products. In addition, oats were included in many protein bars. Oatmilk (made by Sweden's Oatly and Danone Silk's Oatmilk) or oat beverage (introduced in 2018; discontinued 15 months later by Quaker Oats) are marketed as an alternative for vegans.

This is not the first such economic analysis Clare has done for her employer. She has done more than 70 similar analyses for NASGTC that resulted in six acquisitions to help NASGTC more than double in size with more than 150 employees. Part of her job is to identify potential acquisitions that NASGTC could target that fit NASGTC's business goals. She conducts high-level analyses of potential income including quantity sold (sales) and prices; opportunities for price risk management through price contracts with producers or use of Chicago Board of Trade (CBOT) futures; and quantity risk management such as marketing contracts with producers. Included in these analyses was economic opportunities for price premiums or volume premiums for preserving the crop identity from producers' farms through delivery at the grain elevator and through their logistics pipelines to the end user.

In addition, Clare conducts a high-level estimation of average costs per bushel or ton including procurement price, transportation, labor, and other variable costs of grain handling for NASGTC. In addition, she analyzes the fixed costs if the asset was part of NASGTC's business, as well as high-level acquisition costs. A high-level analysis includes using all public data and any internal knowledge identified by Clare. Her modeling can be used to do more precise analysis once NASGTC has engaged the seller through a confidentiality or Non-Disclosure Agreement (NDA). Clare summarizes a recommendation for the targeted acquisition in a one-page memo that identified the economic returns and costs and its strategic fit with NASGTC. This memo and appending analysis would be used by NASGTC senior leadership team to decide whether to proceed to engage in discussions with the potential seller.

Clare and the other two employees including her supervisor comprise the NASGTC Business Development team. They think of themselves as a grease gun because their task is to determine and develop fact-based analyses with as much precision as possible and to accept responsibility for the outcome through high standards for individual quality of work. The NASGTC's founder considers this to be an example of Savant Leadership, a term often used within NASGTC.

The NASGTC has two business segments in grain and product merchandising and supply chain logistics. Grain and product merchandising includes originating small grains from Canada's Prairie Provinces (Alberta, Manitoba, and Saskatchewan) and the U.S. northern Great Plains (Montana, North Dakota, and South Dakota). The buyers demand high quality with regard to known origin, consistent moisture percentage, and other factors with a fairly well-known pattern of demand. Supply chain logistics include transloading products other than the small grains being merchandised to NASGTC's buyers, including hydrocarbons, fertilizer, chemicals, and other industrial products. In addition, this business segment extends NASGTC's expertise in transportation and logistics (such as barge, rail, truck, and ocean-going vessels) to other grains outside of its core small grains including dry beans, such as chickpeas and lentils. In both segments, the overall goal is to reduce quantifiable risk as much as possible.

One goal for NASGTC is to become the number one oat supplier in North America with key expertise in low average costs of origination and logistics, identity preservation, delivery on futures contracts with CBOT, oat milling for certain strategic accounts, and feed demand. This potential acquisition would help further that goal, and because there are only five grain elevators in the heart of oat growing territory, it is not common to see an elevator come up for sale.

## 2 The Deal-Making Process for Negotiations

Clare follows a well-known deal-making process for negotiations doing this type of economic analysis. Her graduate degree allowed her to take graduate courses in her university's College of Business. Clare's



course in negotiating used a seven-step process that was widely taught in similar courses and used by consulting firms. Her supervisor told Clare in the interview process that NASGTC approached deal making as an art to craft deals with potential sellers who were not actively selling assets. As a new firm, NASGTC was approaching potential sellers who included well-established firms. Thus, NASGTC chose to focus on value-creation instead of negotiation through haggling. The seven-step deal-making process for negotiations that Clare was taught included:

- 1) Prioritizing the strategic over the opportunistic,
- 2) Prioritizing value creation right from the start,
- 3) Creating a broad and detailed value creation plan,
- 4) Focusing on people and intangibles such as culture and fit,
- 5) Investing in integration and execution after the deal and making sure those costs are accounted for initially,
- 6) Understanding your potential biases that could lead to value destruction because you do not understand the seller's motivations, and
- 7) Having clarity regarding success.

The NASGTC uses all seven steps. The focus of Clare's job is to perform analyses to support all seven steps, but specifically she does the analysis in step 2 on value creation. Clare knew that doing the analyses for potential targeted assets that fit strategically into NASGTC's business segments allowed NASGTC to approach potential buyers who might not have been engaged in a review of their asset portfolio for potential divestitures but who might listen to a proposal from NASGTC. The use of a precise, fact-based approach with a clear focus on identifiable risk and value creation is a key element of NASGTC's Savant Leadership approach. In this particular case, NASGTC had approached the multinational company two years ago but were told that the grain elevator was not for sale. The firm's agent had reached out to them recently to indicate the firm had changed its mind.

### 3 Identifying Value Creation

Clare is to lay out the data needed by the integration and execution team to get implementation done right away to identify value creation. She is responsible for the second set in the deal-making process for negotiations. The NASGTC business model is built around strategic assets such as a focus on logistics and transportation and the ability to segregate and preserve the identity of crops for customers with well-known demands. Clare knows that identification of risk and quantifying that risk is critical for ensuring the value created beyond the first year.

In this case, the seller has already decided to explore a sale of the asset by hiring an agent to identify potential buyers including NASGTC. The reality is that there are only a handful of potential buyers, and the seller knows that. The NASGTC is engaged with the seller through an NDA, and Clare is beginning the full diligence process. Once she completes and sends her analysis to her supervisor, a decision is made on whether to proceed with an offer subject to board of director approval. If an offer is made and accepted, further diligence is required prior to the offer being finalized. This additional diligence includes tasks such as identifying soil, water, and possible pollution sources; the locations' employees; contractual issues such as land title and leases; and similar factors. If this analysis is satisfactory, then pre-close procedures are finalized, and the close and integration is done with NASGTC. Clare understands the desire by NASGTC to be a leader in oat origination and that her analysis could likely lead to an acquisition.

The NASGTC has already executed an NDA and initial exploratory conversations have begun. As is the case in other deals, the seller has agreed to not engage in conversations with other potential buyers. Clare has comprised a list of questions through interviews with the seller to learn about how the company

makes money, such as information and data about components of margin, assets, strategic relationships, and other data to help her do a more in-depth analysis of revenues and costs. In addition, she has received information on the grain elevator's competitive position in the industry based on historical data on quantities procured and sold to individual buyers. Clare must further analyze the strategic fit and alignment of the potential acquisition about NASGTC's future goals in the oat supply chain. Finally, she must consider whether there are further opportunities not being used by the seller to add value to the acquisition. Such opportunities might include written supply agreements with existing NASGTC customers or export buyers.

## 4 Possible Deal Breakers

Clare must identify any possible "deal breakers," which may include environmental issues with the site, such as soil contamination from underground diesel or refined fuel tanks, as well as fertilizer or chemical spills, given many grain elevators have diversified into supplying farm inputs, storing them on the same site. Similarly, road issues may be a deal breaker as many grain elevators were built on the principal road artery in a small town, and the road was parallel to the rail line. As small towns increased in size and roads were redone to handle larger vehicles including semitrucks, curb access and other problems could emerge such that producers might have difficult delivering grain. This would be a potential deal breaker.

Some grain elevators are located on land owned by the railroad, and the site is leased back to the elevator in a long-term agreement whereas some grain elevators own the land. Lease provisions sometimes automatically result in a renegotiation of the lease upon change of ownership, which might make the deal uneconomical. Another deal breaker might be labor contracts since NASGTC does not want to take on defined benefit retirement programs that might exist with a unionized work force. The NASGTC has a defined contribution retirement program.

The ability to expand grain handling and storage and segregate grain at the site is critical. Lack of such abilities is also a potential deal breaker since NASGTC believes any acquisition must include opportunities for volume growth and include the ability to preserve the identity of crops, which means the need for flexible storage bins to segregate by small grain type or variety. Such deal breakers could be offset by changes to the original offer, but Clare is to identify the economic value of such value adjustments. To the best of her knowledge, Clare has verified all the data from the buyer. In this case, most of the information is in her high-level analysis, and the in-depth diligence has verified this information. No big deal breakers have been identified so far. Her next step is to approach her supervisor to understand the NASGTC team responsible to plan for post-close integration, operation, and growth. Their data is incorporated into further analysis.

## 5 Information to Close the Deal

Prior to the close, the senior leadership team approves the material being used to close the deal. This material includes the (1) set of Microsoft PowerPoint slides containing a summary of the acquisition, (2) any diligence reports such as a Phase 1 Environmental Site Assessment Report (Phase 1 ESA) of the site, and (3) the initial integration plan (\$500,000 estimated cost plus a \$1.7 million upgrade in the first year and \$2 million upgrade in the second year for rail upgrades and dryer replacement), and full economic model that is provided in a Microsoft Excel spreadsheet workbook with multiple worksheets and cells protected for full understanding of critical assumptions. A Phase 1 ESA is an analysis of any soil or groundwater issues that might impact the environment and human health and a necessary part of a real estate transaction.

The economic model includes an analysis of the impact to the projected income sheet, balance sheet, and cash flow projections and lender report. All NASGTC employees use the same formatting in all their spreadsheets to create a common translation. For example, all currency is expressed in Canadian dollars, and all physical units are expressed in metric tons. Inputs that are considered assumptions and

could be varied in that cell such as weighted average cost of capital (WACC), marginal tax rates, insurance costs, and various other costs are identified in blue bolded Calibri font. Outputs that are outputs from a summation formula of revenues, costs, or other data in Excel were identified in black bolded Calibri font. Finally, Excel cells that are fixed formulas to help make decisions were highlighted in yellow. A matrix of various price assumptions based on past and forecasted future prices and quantities are used to better understand how sensitive the analyses are to changes in the prices and quantities.

These are submitted to the NASGTC board of directors who must approve any capital expenditure, such as for the proposed acquisition of the grain elevator. The board of directors includes the NASGTC founders who have invested in the company through investment of their equity capital and own the company. The board must approve the acquisition and may request additional diligence. Finally, prior to the close of the deal, a closing package is prepared using legal counsel and finance experts such as accountants or auditors who lay out the flow of funds. The closing package outlays the components of the deal in detail and defines all key words in the agreement to translate the legal and financial information for all readers. A communication plan for stakeholders such as employees, neighbors, and others in the community is prepared. The final onboarding and integration plan is laid out including decision authority, and an initial operating and risk management plan is finalized.

## 6 Preparing the Final Report

Clare is to prepare her final Microsoft Excel workbook and PowerPoint slides that will be reviewed by the senior leadership team. Her oat origination, merchandising, and operating analysis has been completed in a PowerPoint slide deck, which have been taken directly from her spreadsheet workbook with different spreadsheet menus for her analysis of origination, operations, merchandising, and grain elevator valuation. Appendices contain slides with information on input assumptions, the commercial team report summary on origination, and operations team report summary on integration and annual ownership costs. Although Clare has prepared many reports over the past five years, there is a little extra pressure on this potential acquisition because of its strategic fit for NASGTC.

Clare has worked from home during the Covid-19 pandemic, and this report to her supervisor will be done via Zoom. She makes herself another cup of coffee and sits at her kitchen table to practice her valuation conclusions once more before the meeting. In particular, the maximum valuation that NASGTC would be willing to pay for the grain elevator acquisition must be presented along with her analysis of the minimum valuation that the seller would be expected to sell the grain elevator for. The difference or overlap between both valuations provide input for the leadership team to develop a negotiation strategy. She needs to get these analyses done. It is time to finish her report.

**About the Authors:** Austin Liepold is a Business Development Manager at Ceres Global Ag. Marin Bozic is an Assistant Professor in the Department of Applied Economics at the University of Minnesota. Michael A. Boland is a Professor in the Department of Applied Economics at the University of Minnesota (Corresponding author: [boland@umn.edu](mailto:boland@umn.edu)). The authors are listed in reverse alphabetical order.

4(1) doi: 10.22004/ag.econ.320047

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**Case Study****Why No Debt? A FRICTO Analysis of the Capital Structure of Cal-Maine Foods Inc.**Carlos J.O. Trejo-Pech<sup>a</sup> and Susan White<sup>b</sup>*University of Tennessee<sup>a</sup>, University of Maryland<sup>b</sup>*

JEL Codes: G30, G31, M21

Keywords: Agribusiness finance, cage-free eggs, corporate finance, optimal capital structure

**Abstract**

Cal-Maine Foods Inc., the largest egg producer in the world, has historically operated with low debt. Cal-Maine reported in its 2021 third fiscal quarter no debt on its balance sheet, making this company one of the few debt-free publicly traded agribusinesses in the United States. This case analyzes Cal-Maine's capital structure, which represents a rare case for exploring and challenging the notion of optimal capital structure in theory and practice. Understanding the rationale behind a debt-free firm's policy is puzzling because financial theory predicts that adding debt up to a certain level—the optimal capital structure—creates economic value for equity holders. According to surveyed chief financial officers, there is also evidence that practitioners use an optimal capital structure framework for financial management decisions. By applying a framework allowing for both qualitative and quantitative analysis, this case reviews the benefits and costs of debt in the capital structure, as applied to Cal-Maine. The case asks students to evaluate potential recapitalization policies in which Cal-Maine adds debt to its capital structure and uses debt proceeds plus excess cash to repurchase shares at the prevailing price as of the end of May 2021. The target audience is graduate business and agribusiness students, although the case could be used in an elective advanced undergraduate finance course.

**1 Introduction**

By May 2021, covid restrictions and consumer avoidance for dining-in had drastically reduced demand for eggs in the food service egg segment. In contrast, the lockdown had increased demand and prices of eggs at food retail stores as families were consuming more eggs while staying at home, because eggs were a convenient and well-priced form of protein (King 2020b). This situation negatively affected profits of those small egg producers who supplied eggs to the food service segment, but was less problematic for large and vertically integrated companies like Cal-Maine Foods Inc. (Cal-Maine), which was capable of packing and grading eggs to sell to retail stores and benefit from higher prices.<sup>1</sup> Indeed, by May 2021, Cal-Maine's financial accounting performance, on an annual accumulated basis, had slightly improved relative to pre-pandemic levels. However, financial analysts' recommendations regarding Cal-Maine's financial strength were mixed. While some analysts recommended that investors buy Cal-Maine's equity, others recommended holding or not buying this equity (New Constructs 2021a, 2021b; Reuters 2021; SADIF 2021; ValuEngine 2021).

Cal-Maine has historically operated with low levels of debt, and in late 2019 the firm retired all its outstanding long-term debt (Cal-Maine Foods 2020a), making Cal-Maine one of the few debt-free publicly traded firms in the United States. While having no debt provided a firm with financial flexibility, this practice was counterintuitive according to finance theory, which predicts that a firm should have debt in its capital structure even when it does not need debt financing because debt might

<sup>1</sup> In 2020, Cal-Maine was ranked the largest egg producer in the United States and the world, housing an estimated flock of 44.26 million hens (O'Keefe 2021a). The firm sold more than one billion dozen eggs per year, and its equity traded on NASDAQ under the ticker CALM. Chicken eggs in their shell, as sold in most food retail stores, are commonly referred to as shell or table eggs. The term "shell egg" is used in this study.

create economic value. As an example, the tax break offered by debt financing could be substantial for a firm, with the benefits accruing to its equity holders.

Given the combination of Cal-Maine's financial strengths and weaknesses, the firm's position within the egg industry, and external financial analysts' recommendations: Was mid-2021 a good time for Cal-Maine to recapitalize its balance sheet by contracting debt? How might Cal-Maine's potential capitalization affect its dividend policy and income taxes? What impact might a share repurchase policy have? Should Cal-Maine play it safe by keeping its current capital structure with no debt? The objective of this case is to review the benefits and costs of debt in the capital structure, as applied to Cal-Maine. Specifically, after analyzing this case, students should be able to:

1. Evaluate a firm's capital structure decisions, both qualitatively and quantitatively;
2. Assess a firm's choice of dividend policy;
3. Perform a ratio and financial statement analysis to assess the financial health of a firm; and
4. Discuss the impact of changes in capital structure on a firm's weighted average cost of capital.

## 2 FRICTO: A Framework for Capital Structure Analysis

Finance theory predicts that the presence of debt in a firm's capital structure creates economic value accruing to equity holders, but after a certain level, additional debt may erode value. In other words, theory predicts the existence of an individual firm's optimal or target capital structure,<sup>2</sup> which may include a significant level of debt. In practice, financial managers in firms trading their equities in a stock exchange seem to agree to some extent. Graham and Harvey (2001) surveyed financial managers showing that 81 percent of firms made debt vs. equity financing decisions guided by a target or estimated optimal capital structure.

However, determining the appropriate mix of debt and equity and timing to change a firm's capital structure could be very complicated in practice because theory does not provide a clear, unambiguous method for such estimations for a given firm (Kester and Hoover 2005). There are multiple, and sometimes ambiguous, cost and benefit trade-offs for choosing the appropriate debt and equity mix and the best timing for a recapitalization. Timing refers to when a company issues debt or equity and the signal that these actions send to the market. Conventional investing wisdom says "buy low, sell high." When a firm issues equity it is in essence selling equity. Investors know that a firm knows more about that firm than an unconnected investor. If a firm issues new equity it may be signaling that management thinks the stock price is high since it would be dilutive for a firm to issue equity if the price were low. Similarly, it is better for a firm to issue new debt when interest rates are low or are expected to increase in the future. These complexities may explain why firms like Cal-Maine would pursue, at least temporarily, an extreme debt-free capital structure policy.

One analytical framework to evaluate capital structure decisions is FRICTO, an acronym representing elements that are relevant for financing decisions: flexibility, risk, income, control, timing, and others (Sihler 1971; Kester and Hoover 2005). FRICTO captures relevant trade-offs to consider when evaluating alternative capital structures in a firm. For example, a firm without debt like Cal-Maine might need to raise capital for strategic growth. Just moving away from no debt to a certain amount of debt might increase income expressed in earnings per share (EPS) or return on equity (ROE), but might also increase risk as the firm would be committed to fixed payments in the future. The change of stakeholders' perceived level of risk would depend on cash flow variability and might in turn have a cascade effect on the company's weighted average cost of capital and ultimately in its stock value. Alternatively, a firm might be inclined to raise equity instead of debt but find out that it is not the appropriate time to raise equity due to a combination of its current stock price, its stock return momentum, and the current and

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<sup>2</sup> Defined as the proportions of debt and equity that *maximize* economic value for equity holders.

projected level of interest rates. The decision on the optimal debt to equity mix could become complicated when other FRICTO elements are considered in the analysis.

## 2.1 FRICTO Elements

The questions asked in a FRICTO analysis and the analytics used to evaluate them are summarized in Appendix 1. The FRICTO elements are summarized as follows.

*Flexibility:* Some firms require more financing options than others. Typically, a firm's debt capacity is finite, and a firm with too much debt may be forced to use more costly equity financing. Firms with aggressive capital spending or acquisition strategies may choose to use more flexible equity or hybrid financing rather than debt financing, which has contract provisions that could, for example, require the firm to maintain specified ratios, limit future debt, and have principal and interest that must be paid back on a fixed schedule.

*Risk:* Some firms engaged in volatile industries may choose conservative financing options to protect the firm in times of financial adversity. If a firm has fixed obligations, including interest and principal repayments, lease payments, preferred stock dividends, and so on, it will want to ensure its operating cash flows are sufficient to cover its obligations. More debt means more fixed obligations. Firms with more stable cash flow no matter the economic circumstances, for example, grocery stores, may choose to have more debt in their capital structure.

*Income:* Income, in FRICTO, refers to income per shareholder rather than to the value of net income. Assuming a firm is accepting only positive net present value projects, shareholders will prefer higher (vs. lower) return on equity, return on assets, and earnings per share. Generally, higher debt—as long as the debt will not cause financial distress—results in higher income per shareholder. Note that this does not necessarily mean the firm should always aim for the highest net income possible. The number of outstanding shares impacts income per shareholder, which is the more appropriate measure of shareholder income.

*Control:* This element refers to how concentrated shares are and how dilution of ownership might be impacted by the issuance of additional shares. If there are many small shareholders, issuing additional shares will be dilutive, but will not necessarily significantly impact shareholders' ability to control the firm. If shares are concentrated among a few large shareholders, then those shareholders might be reluctant to issue additional shares and risk losing control of the firm.

*Timing:* Timing refers to the economic and financial environment at the time new financing is issued. Firms generally would only want to issue new shares if management believed the stock price was low and issue new debt when interest rates were low. Future expectations also come into play. For example, if a firm knew it would need financing in the future and it also expected interest rates to rise, it might issue debt now to avoid paying higher interest rates in the future.

*Others:* Others refer to any factors that were not addressed under the first five elements. For example, a very conservative management team that wanted to maintain a high bond rating might choose equity over debt even if the prior elements pointed to benefits from debt financing.

## 3 Cal-Maine Foods

### 3.1 The Company and the Industry

With a 16.8 percent estimated market share in the United States (IBISWorld 2021), Cal-Maine is the largest chicken egg firm in the United States and the world housing 44.26 million hens (O'Keefe 2021b). Top U.S. egg producers housing at least 10 million hens include Rose Acre Farms (27.60 million hens), Versova Holdings L.L.P. (20.06 million hens), Hillandale Farms (20.00 million hens), Daybreak Foods (15.00 million hens), Michael Foods (13.50 million hens), MPS Egg Farms (11.10 million hens), and Prairie Star Farms (10.60 million hens) (O'Keefe 2021b). Most large egg firms are highly mechanized, vertically integrated, and highly cost-effective. According to an *Egg Industry* magazine 2020 survey, egg

producers have been actively pursuing consolidation in recent years (O’Keefe 2020). The survey noted that 66 producers owned more than 90 percent of total industry layers. The ten largest producers owned about 54 percent of total industry layers compared to 50 percent five years earlier.

The egg business is capital intensive. The large flock of hens needs physical space, plus equipment to feed the chickens and collect eggs, and capital to sort and package the eggs for safe shipping. Like most large egg producers, Cal-Maine is a vertically integrated company producing, grading, packaging, marketing, and distributing conventional and specialty eggs. Specialty eggs include eggs produced using cage-free and organic methods. In conventional egg production, hens are kept in smaller cages, with automated feeding and egg collection. Cal-Maine has expanded its cage-free production, even though this was more costly because of consumer demand for more humanely produced shell eggs and regulations. About 24.6 percent of eggs in the United States are produced using cage-free methods (O’Keefe 2021a). Cal-Maine sells its eggs to national and regional grocery chain stores, club stores, food service distributors, and egg product sales outlets.

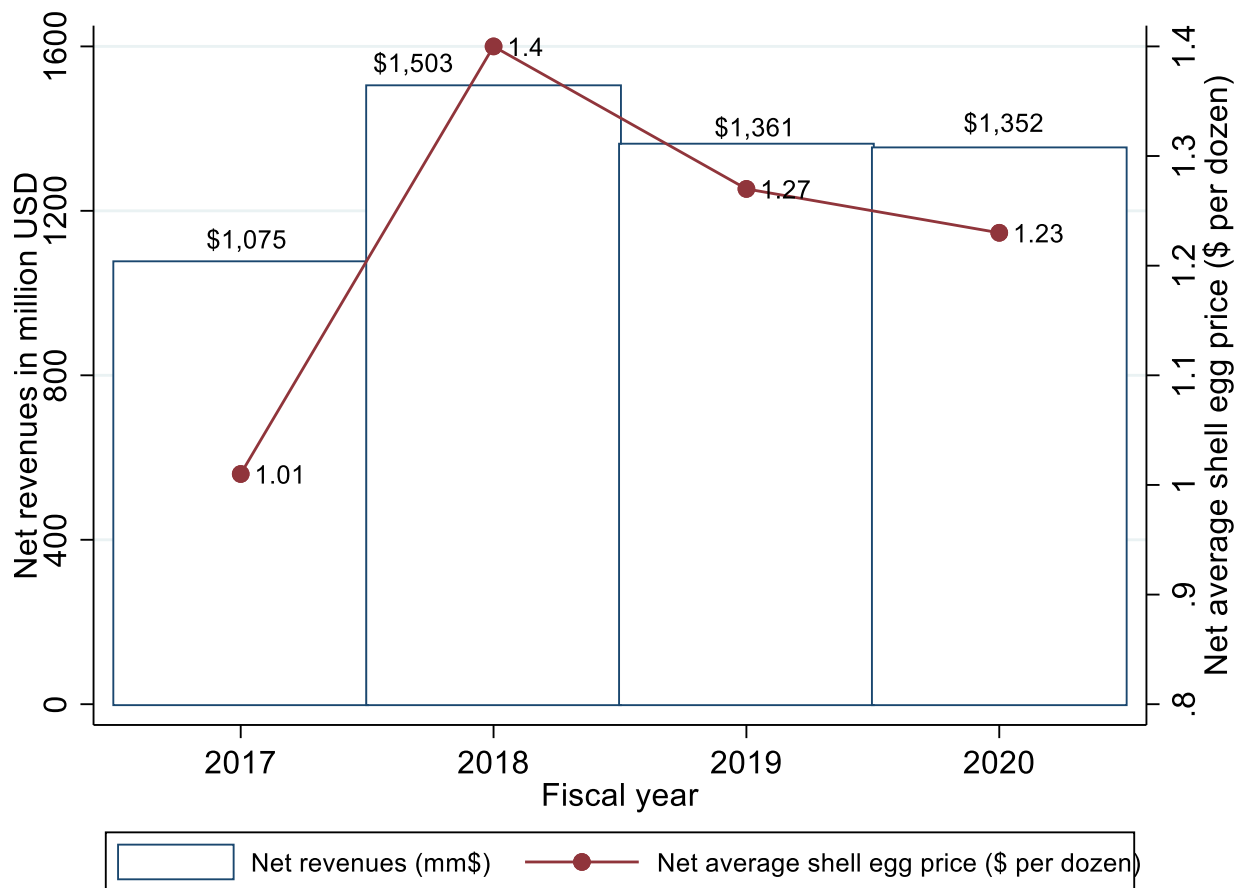
The egg business is risky in that there are many factors beyond Cal-Maine’s control. For example, the firm lost a large percent of its flock to avian flu in 2014–2015, and an eventual bad weather season can significantly increase the cost of grains used to feed the hens. On the other hand, eggs are a staple food in every grocery store, consumed by millions daily. IBISWorld characterizes the egg industry as one with very high revenue volatility, high capital intensity, high competition (but decreasing due to consolidation), and moderate to high regulation with new laws driving a transition from conventional egg production to a cage-free egg production system (IBISWorld 2021).

Unlike the rest of U.S. egg producers, Cal-Maine is a publicly traded company. This facilitates Cal-Maine’s access to capital but also puts additional pressure on the firm. Publicly traded companies are highly scrutinized by equity analysts focused on short-term results. Because it is the only publicly traded firm in its segment it is difficult to establish financial benchmarks when analyzing Cal-Maine. Recent research provides a strengths, weaknesses, opportunities, and threats (SWOT) analysis for Cal-Maine as of the end of the firm’s 2020 fiscal year (Trejo-Pech and White 2021).

### 3.2 Investment, Financial Performance, and Risk

In a presentation to investors in late 2020, Cal-Maine provided an overview of historical revenues, product mix, cash holdings, use of capital, and investment pipeline (Cal-Maine Foods 2020b). Figures 1 and 2 show recent annual revenue, average egg prices, and total eggs produced broken down by product categories as of the end of Cal-Maine’s fiscal years, ending in May 2020. Cal-Maine’s top ten buyers included Walmart/Sam’s Club, H-E-B, Publix Super Markets, Food Lion, ALDI, US Foods/Sysco, Kroger, CCF Brands, Costco, and Wakefern, with the top three buyers representing about one half of Cal-Maine’s 2020 fiscal year total revenue. Figure 3 shows the use of capital broken down by capital expenditures, acquisition of other firms, and dividends paid. Cal-Maine’s current Growth Strategy and Acquisitions contains the following (Cal-Maine Foods 2021b):

*“Our growth strategy is focused on remaining a low-cost provider of shell eggs located near our customers. In light of the growing customer demand and increased legal requirements for cage-free eggs, we intend to continue to closely evaluate the need to expand through selective acquisitions, with a priority on those that will facilitate our ability to expand our cage-free shell egg production capabilities in key locations and markets. We plan to continue to closely evaluate the need to continue to expand and convert our own facilities to increase production of cage-free eggs based on a timeline to meet the anticipated needs of our customers. As the ongoing production of cage-free eggs is more costly than the production of conventional eggs, aligning our cage-free production capabilities with changing demand for cage-free eggs is important to the success of our business.”*



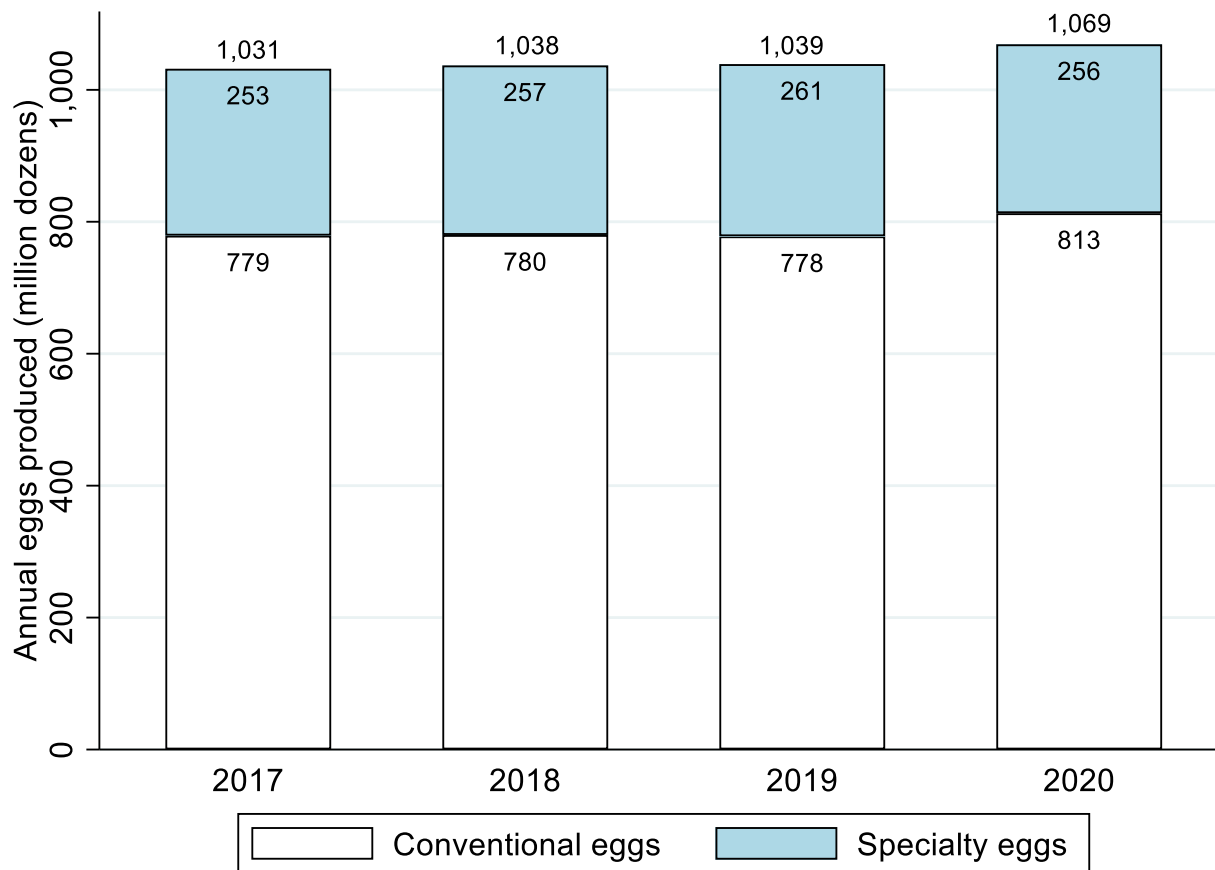
**Figure 1. Cal-Maine’s Historical Revenue (\$ million) and Egg Prices (\$ per dozen)**

Source: Cal-Maine Foods (2020b).

Driven by consumers’ changing preferences and cage-free regulations, the egg industry has been transitioning, in recent years, from conventional to cage-free production. Egg producers like Cal-Maine have been converting, whenever technically possible, their conventional production facilities to produce cage-free eggs and investing in new cage-free facilities to catch up with demand. By the end of 2020, it was estimated that 24.6 percent of the total U.S. layer flock of 325.5 million shell egg laying hens were cage-free hens (i.e., 80.1 million layers of this total were cage-free housed). Cal-Maine’s mix of conventional and cage-free eggs volume in 2020 was very similar to the national average of one quarter cage-free and three quarters of conventional eggs (Trejo-Pech and White 2021). According to industry predictions, egg producers will need to quickly invest in cage-free facilities within the following decade to comply with demand (Markets Insider 2017; Wong 2017; Trejo-Pech and White 2020; O’Keefe 2021a).

Recently, *Egg Industry* magazine surveyed egg producers housing approximately 60 percent of the total U.S. layer flock (O’Keefe 2021a). On average, surveyed egg producers predict that cage-free will represent about 45 percent of production by 2025 and 60 percent by 2030. This implies that housing for more than 13 million hens per year would need to be converted to cage-free in the following five years, which represents an aggressive goal when considering that the national cage-free flock grew 9.3 million from 2019 to 2020. Overall, according to surveyed egg producers, it is estimated that egg producers would convert approximately one third of their housing from cages to cage-free and free-range in the





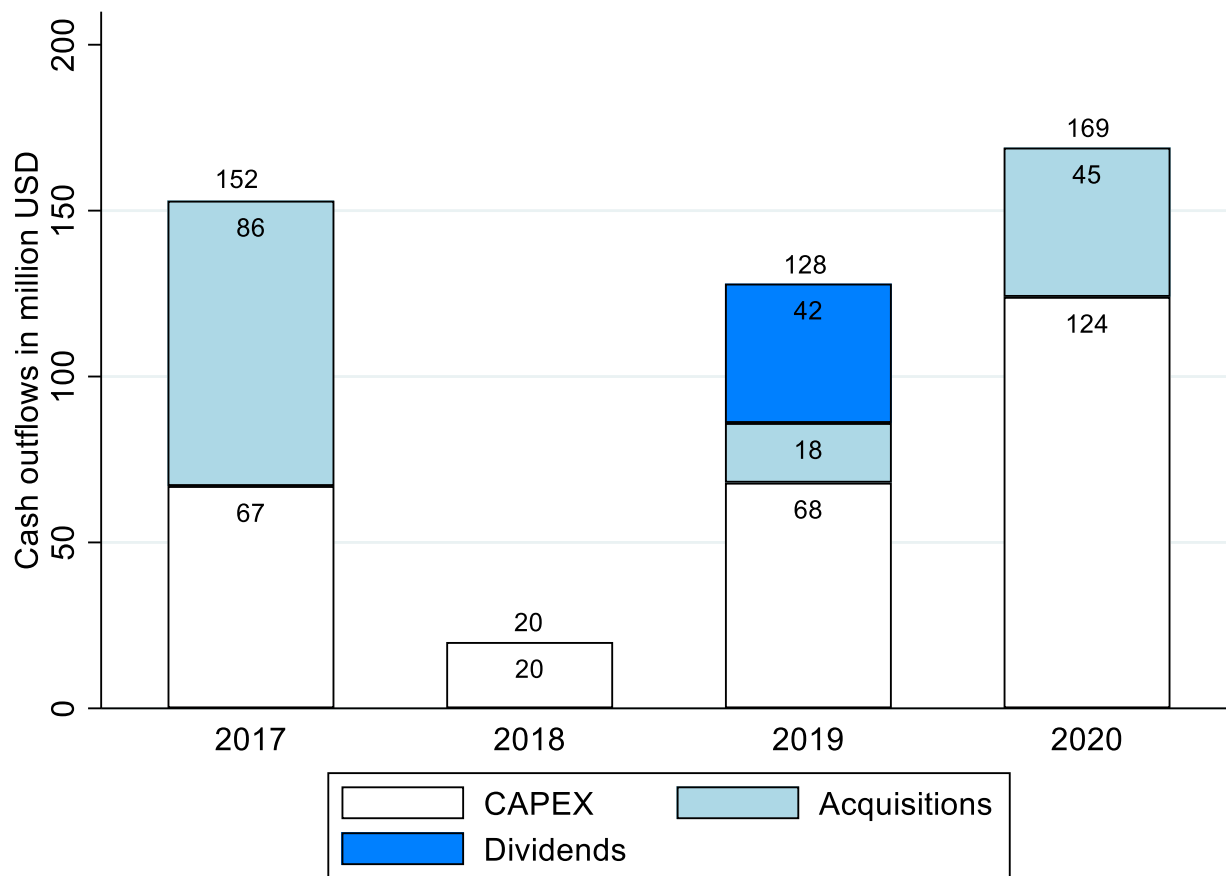
**Figure 2. Cal-Maine’s Historical Egg Production (in million dozens) by Categories**

Source: Cal-Maine Foods (2020b).

next decade (O’Keefe 2021a). In 2020, Cal-Maine estimated that industry-wide investment from 2021 to 2026 would total about \$6.5 billion (Cal-Maine Foods 2020b).

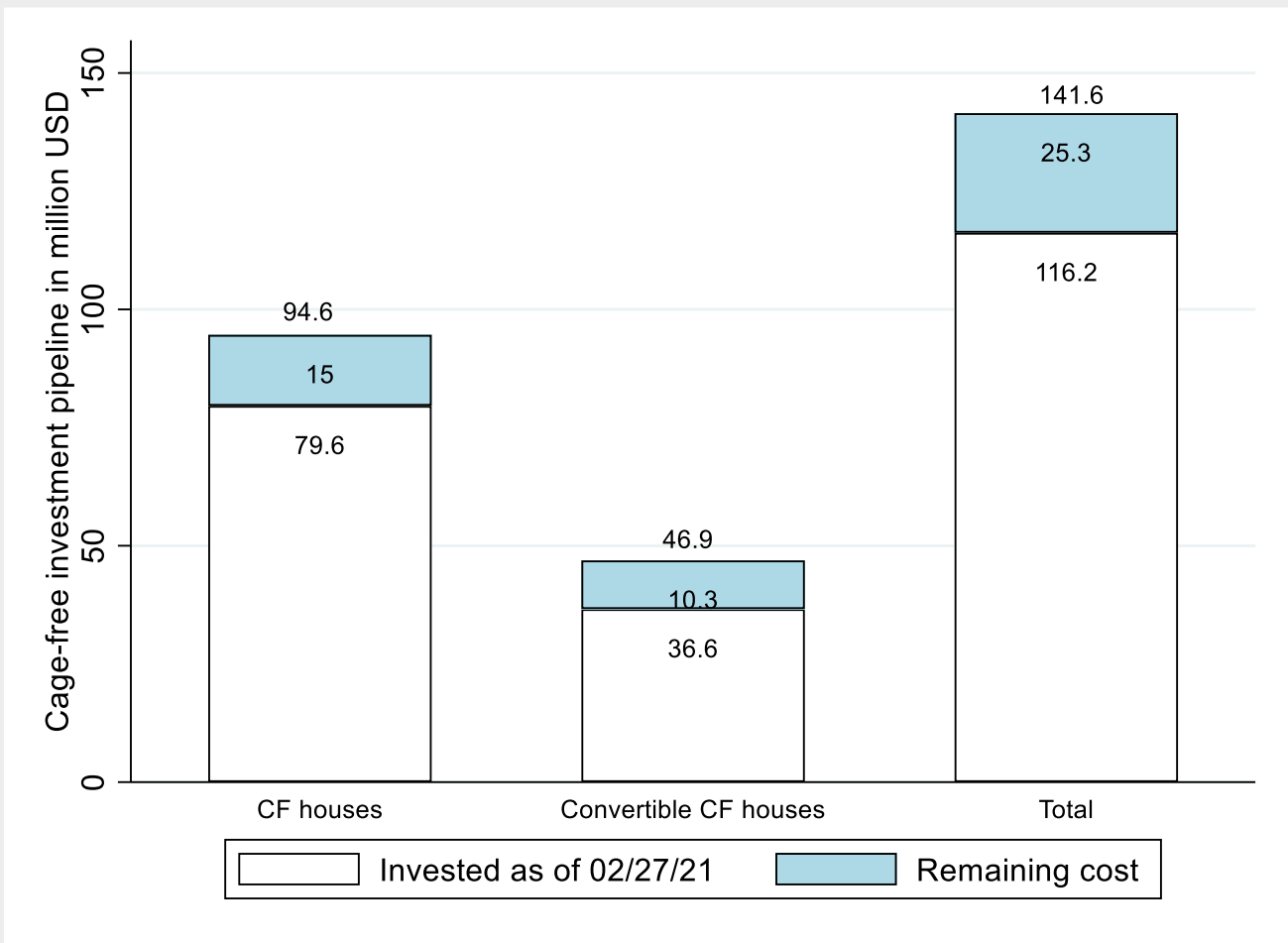
Cal-Maine aims to meet future consumer cage-free demand by combining organic growth from reinvesting its earnings and through acquisitions. In its 10Q, third quarter 2021 fiscal year report, the company reported having \$141.6 million in cage-free investments under construction, with \$116.2 million already spent as of the end of February 2021 and \$26.3 million to be spent in the following months (Figure 4). Cal-Maine also reported that accumulated investment in cage-free facilities since 2008 totaled \$418 million (Cal-Maine Foods 2021a).

Cal-Maine has historically grown by acquiring other firms. In the previous 30 years, Cal-Maine acquired 22 firms, and management recently stated the firm planned to continue its program of buying other egg producers. Cal-Maine’s management believed that the shell egg market was fragmented with meaningful consolidation opportunities, the firm was well-equipped to capture synergy in potential acquisitions, and small egg producers viewed Cal-Maine as a buyer of choice (Cal-Maine Foods 2020b). While the company certainly has experience in acquisitions, there is research showing that capturing synergies is a risky proposition and that a high proportion of acquisitions in the United States actually destroy economic value for current shareholders (Bruner 2004). Overall, Cal-Maine management believes that their “current cash balances, investments, cash flow from operations, and revolving credit



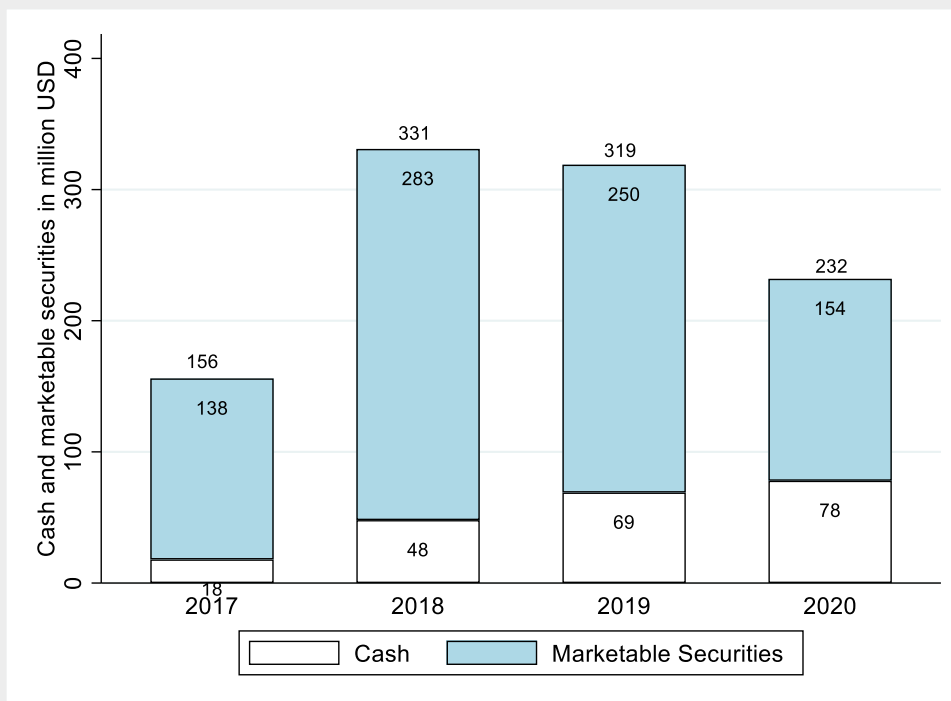
**Figure 3. Cal-Maine’s Selected Use of Capital per Fiscal Year**

facility will be sufficient to fund [their] current and projected capital needs for at least the next twelve months” (Cal-Maine Foods 2021a, p. 28). Indeed, cash and cash equivalent holdings in Cal-Maine’s balance sheet have been relatively high in recent years, as shown in Figure 5. Other financial metrics are shown in Table 1, and financial statements are provided in Appendix 2. Table 1 provides traditional financial accounting ratios and two risk market-based measures: the Altman’s Z score, which predicts a firm’s likelihood of bankruptcy, and a firm’s beta, which measures the risk of a publicly traded firm in a market portfolio according to the Capital Asset Pricing Model (CAPM). Operational risk relates to variability of earnings or cash flows. Figure 6 illustrates how variable Cal-Maine’s gross margins and EPS have been from 2016 to 2021.



**Figure 4. Cal-Maine’s Cage-Free (CF) Layer and Pullet Houses Investments Pipeline for the Current Fiscal Year as of the End of February 2021**

Source: Use of capital from Cal-Maine Foods (2020b) and investment pipeline from Cal-Maine Foods (2021a).



**Figure 5. Cal-Maine’s Cash Plus Marketable Securities as of the End of Fiscal Year**

Source: Cal-Maine Foods (2020b).

### 3.3 Financing

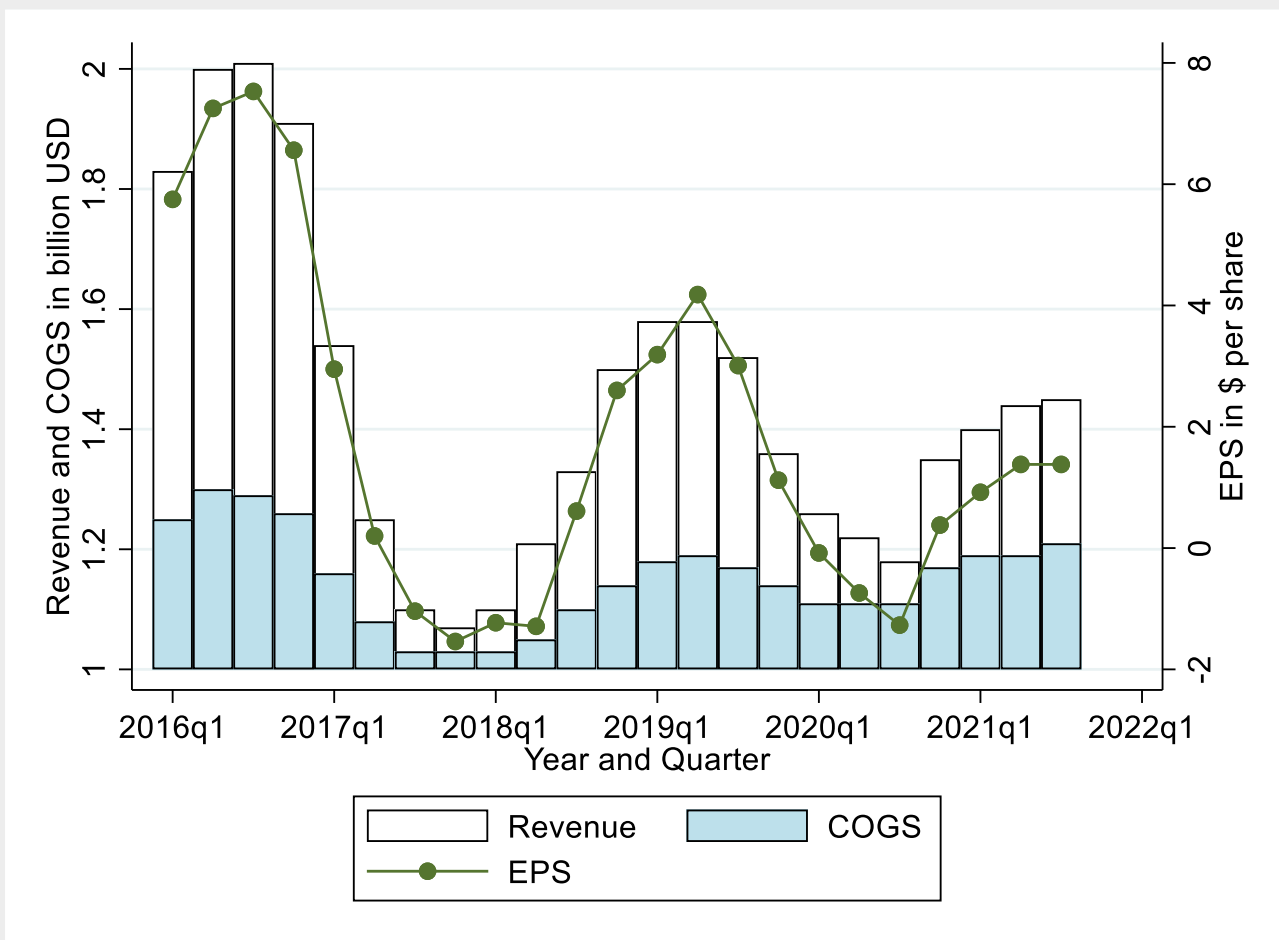
Finance theory supports the existence of patterns within firms’ and industries’ capital structures. For example, pharmaceutical firms tend to have less debt in their capital structure than steel manufacturers. Researching new drugs is an inherently risky business. Pharmaceutical giant Merck recently wrote off two potential coronavirus vaccines because they proved to be too ineffective in trials. Yet, Merck has been a successful, experienced vaccine producer in the past. Because it is difficult to know if expensive research would pay off or be discarded, pharmaceutical firms tend to have low to no debt in their capital structure. In contrast, firms operating in industries with large investments in physical capital, particularly equipment that could be tasked to multiple uses, tend to have more debt in the capital structure since this equipment would have value in a bankruptcy sale.

Cal-Maine seems to deviate from what capital structure theory prescribes. The company has historically operated with low debt. Figure 7 compares Cal-Maine’s annual debt to invested capital ratios with median ratios for companies in the health (including pharmaceuticals), steel, food, meals (including restaurants), and retailing (including food stores) industries during the last decade. Further, in late 2019 Cal-Maine retired all its outstanding long-term debt (Cal-Maine Foods 2020a), converting it into one of the few debt-free publicly traded firms in the United States. Under the simplest interpretation of the capital structure theory, this is anomalous. The tax break offered by debt financing, for instance, can be substantial for a firm, depending on current and future income tax rates and firm margin levels. However, as elaborated in section 2, a FRICTO framework analysis can be used to analyze Cal-Maine’s unusual choice of debt structure.

**Table 1. Cal-Maine’s Selected Financial Metrics**

	2016	2017	2018	2019	2020	Feb. 2021
<b>Profitability</b>						
Return on assets	28.8%	(7.6%)	10.4%	2.6%	0.3%	3.5%
Return on equity	39.2%	(8.4%)	14.0%	5.7%	1.8%	6.8%
Return on capital	34.6%	(9.1%)	12.5%	3.1%	0.4%	4.1%
<b>Margin Analysis</b>						
Gross margin	34.0%	4.2%	24.0%	16.4%	13.5%	16.8%
EBITDA margin	27.0%	(7.6%)	15.7%	7.5%	4.8%	8.6%
EBIT margin	24.6%	(12.1%)	12.1%	3.5%	0.5%	4.5%
Net income margin	16.6%	(6.9%)	8.4%	4.0%	1.4%	4.6%
<b>Asset Turnover</b>						
Total asset turnover	1.9x	1.0x	1.4x	1.2x	1.1x	1.2x
Fixed asset turnover	5.1x	2.5x	3.4x	3.1x	2.7x	2.6x
<b>Short-Term Liquidity</b>						
Current ratio	7.5x	6.7x	5.4x	7.6x	5.6x	5.2x
Quick ratio	5.6x	4.2x	3.9x	5.2x	3.5x	3.1x
Cash conv. cycle	47	66	59	61	60	58
<b>Long-Term Solvency</b>						
Total debt to equity	2.8%	1.3%	0.6%	0.3%	0.3%	0.0%
Long-term debt to equity	1.0%	0.7%	0.3%	0.1%	0.2%	0.0%
Net debt to EBITDA	-0.7x	1.8x	-1.4x	-3.1x	-3.6x	-1.5x
<b>Risk</b>						
Altman Z score	12.6	8.4	9.8	11.0	8.7	8.4
CAPM beta	0.69	0.61	0.53	0.48	0.47	NA

Notes: (1) Financial ratios estimated by authors using financial statements by Standard & Poor’s Net Advantage Capital IQ database (Standard and Poor’s 2021). Ratios are as of the end of Cal-Maine’s fiscal years, ending in May. EBITDA is earnings before interest, taxes, depreciation, and amortization; EBIT is earnings before interest and taxes, and CAPM stands for capital asset pricing model. (2) Firm’s annual betas are the average of daily CAPM betas obtained from Beta Suite by WRDS (WRDS 2021).

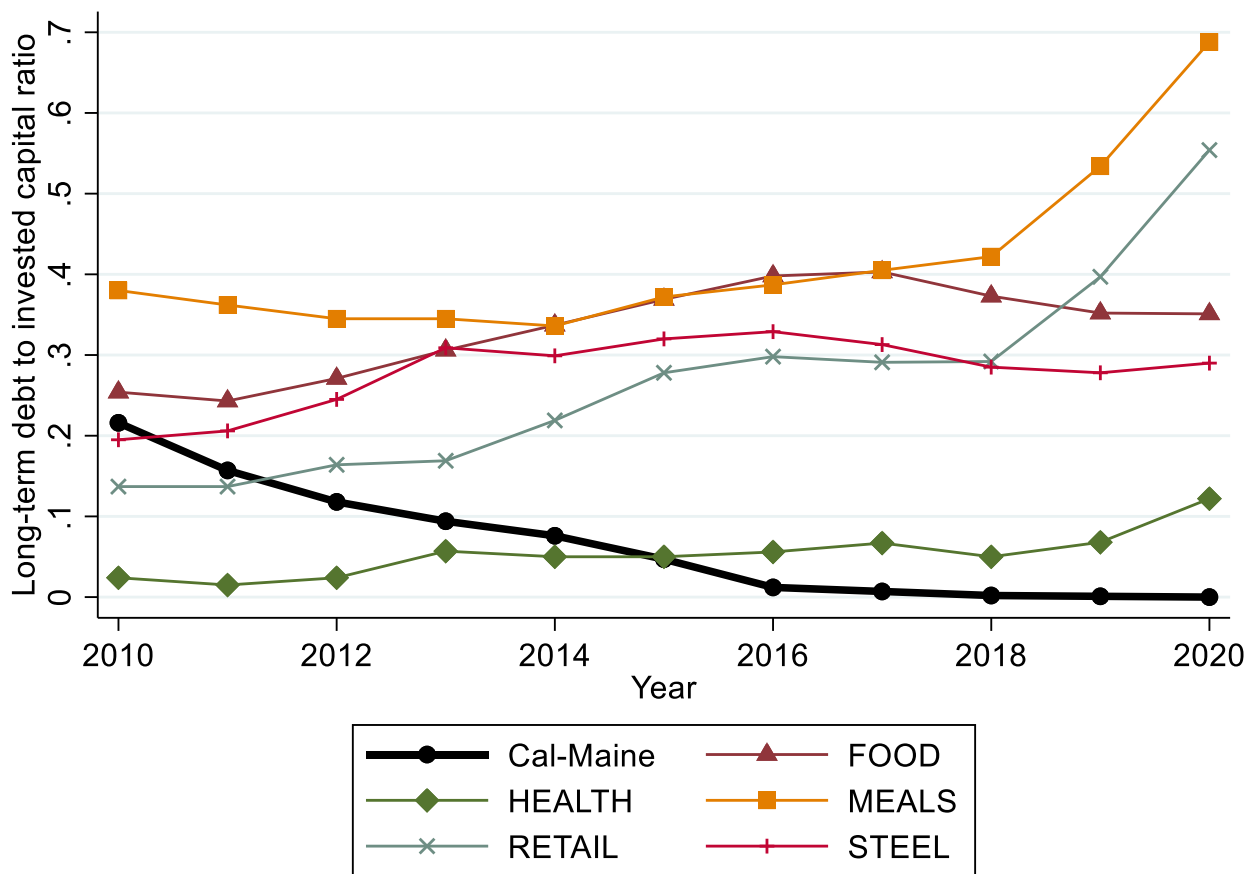


**Figure 6. Cal-Maine’s Last Twelve Months Earnings per Share (EPS), Revenue, and Cost of Goods Sold**

Notes: Q refers to the quarterly financial statements reported to the Securities and Exchange Commission. The line depicts EPS (in \$, right axis), the white bars show revenue (in \$ billion, left axis), and the blue bars show the cost of goods sold (\$ billion). Source: Standard & Poor’s Net Advantage (Standard and Poor’s 2021). Accessed on May 29, 2021.

### 3.4 Shareholders and Stock Returns

As of April 2021, Cal-Maine had 46,056,163 shares of common stock and 4,800,000 shares of Class A common stock. One hundred percent of the Class A shares were owned by members of Cal-Maine’s founding family who also owned common stock shares, controlling 57.7 percent of total voting power (Cal-Maine Foods 2021a). As stated in Cal-Maine’s 2021 third quarter 10Q report (Cal-Maine Foods 2021a), management believed that such ownership might discourage certain types of transactions in which the holders of common stock might otherwise receive a premium for their shares over current market prices. Cal-Maine management further recognized in the referred quarterly report that the company’s sale or availability for sale of substantial amounts of common stock could adversely impact its stock price and dilute current owners’ share of the business. The corporation had authorized the issuance of 120,000,000 shares of common stock, with 44,056,163 shares outstanding as of March 29, 2021, meaning that a substantial number of shares could become available for sale in the market (Cal-Maine Foods 2021a). If the company chose to raise capital through offerings of common stock in the future, existing stockholders’ equity interest might be diluted, which might adversely affect Cal-Maine’s stock



**Figure 7. Long-Term Debt to Total Investment Ratios for Cal-Maine and Selected Industries**

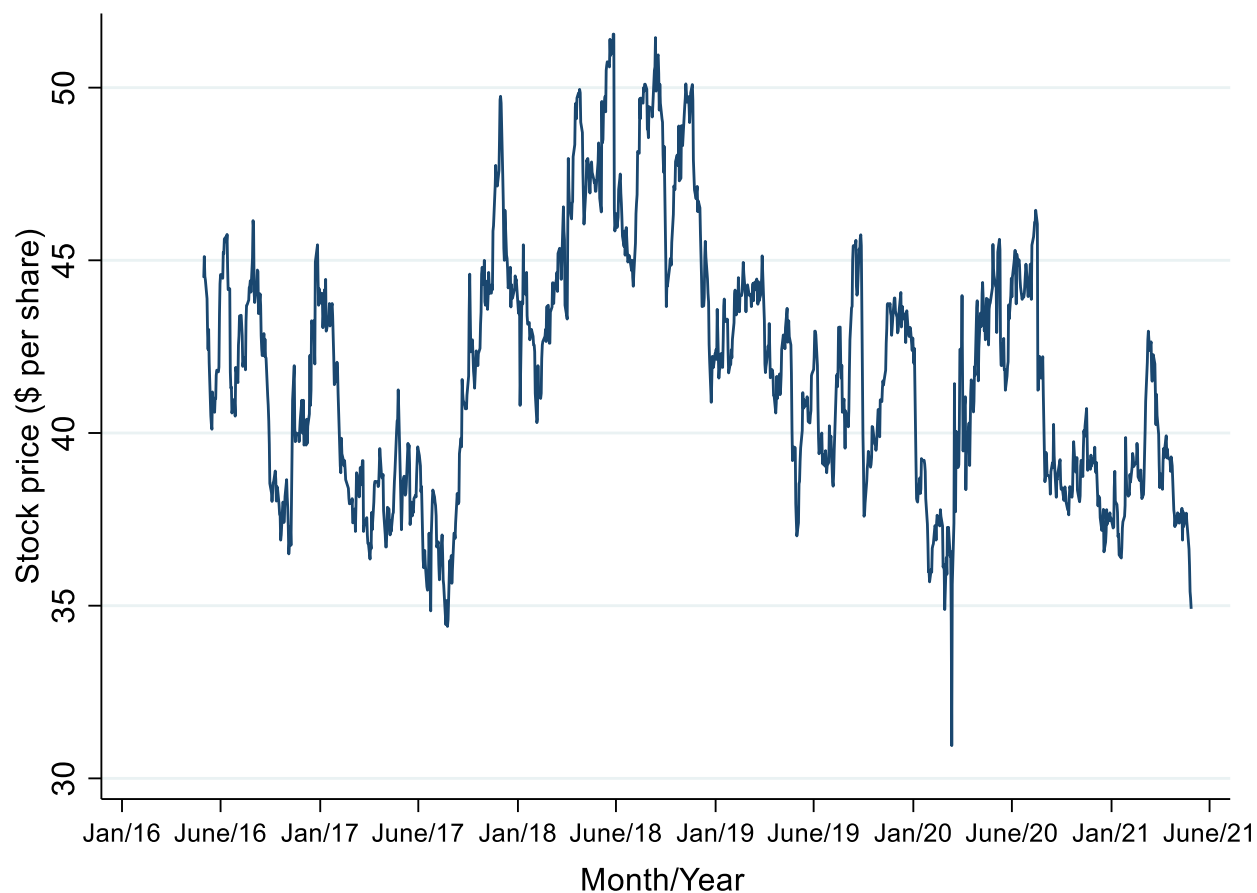
Notes: Figure 7 shows long-term to total investment (debt plus equity) ratios for Cal-Maine Foods Inc. and median ratios for selected industries, including all publicly traded firms in these U.S. industries, according to Fama and French’s 30 industries classification.

Source: Prepared by authors using data from Financial Ratios Suite by WRDS (WRDS 2021).

prices—but such an effect could not be predicted, according to the firm. Figure 8 shows Cal-Maine’s historical stock prices, and Figure 9 compares Cal-Maine’s stock return performance with stock performance of selected food companies and stock market indices over time (Standard and Poor’s 2021).

### 3.5 Cash and Dividends

Cal-Maine maintained a relatively high cash level. Cash plus marketable securities represented about 15 percent of total assets as of March 2021, and 23 percent on average between 2016 and 2021. Consistently, Cal-Maine’s net (of cash) debt to the market value of equity as of September 2020 represented a negative 10 percent, compared to a positive 30 percent median for ten comparable agribusiness firms according to Capital IQ’s analysis. Cal-Maine’s cash policy was closely related to its leverage and dividends policies.



**Figure 8. Cal-Maine Foods Inc. Stock Prices (\$ per share)**

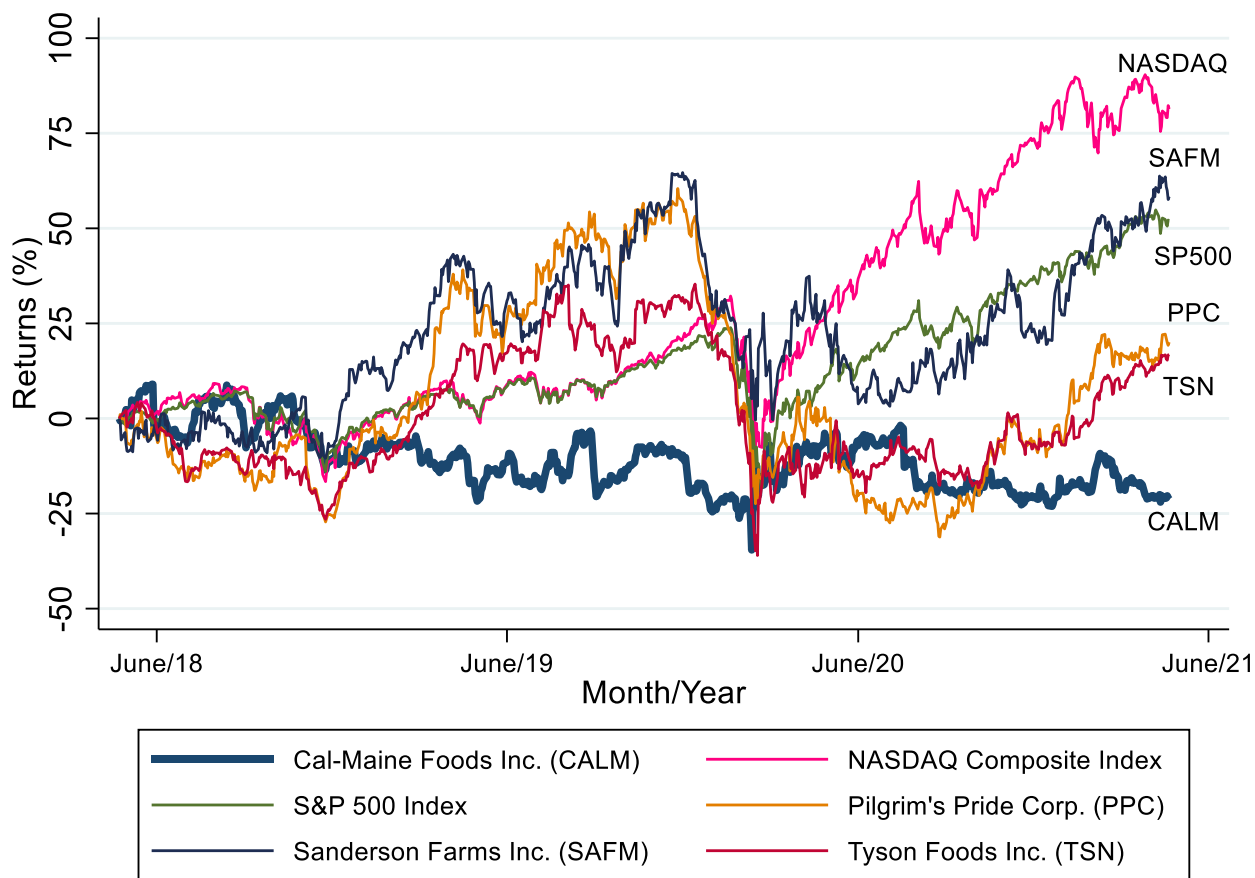
Source: Standard & Poor's Net Advantage (Standard and Poor's 2021). Accessed on May 29, 2020.

In some respects, Cal-Maine's dividend policy also contradicts finance theory.<sup>3</sup> A conservative financial management may explain why a mature firm with relatively high cash would not have a stable-dividend policy. A firm with negative-return<sup>4</sup> excess cash is expected to return that cash to its shareholders who could earn higher returns on that distribution. Cal-Maine did not pay dividends in 2020 because its dividends policy, tied to reported earnings, precluded the firm from doing so. Specifically, Cal-Maine's dividends policy stated that dividends could only be paid from current earnings, and in a low-earning year, the firm could not pay out a dividend even if it had excess cash on hand.

<sup>3</sup> Cal-Maine's variable dividends policy is available at <https://www.calmainefoods.com/investors/dividend-policy/>.

<sup>4</sup> Cash not needed for operations is considered to be a negative return on investment. Cash is typically invested in short-term safe securities, such as Treasury bills. Treasury securities, because of their low risk earn low returns. Those returns are taxable to the firm, further reducing that return. An investor would prefer that this excess be distributed. The investor could in turn invest in low-risk Treasury securities if desired, and avoid double taxation (firm income tax plus personal income tax) or could invest in higher risk, higher return investments.



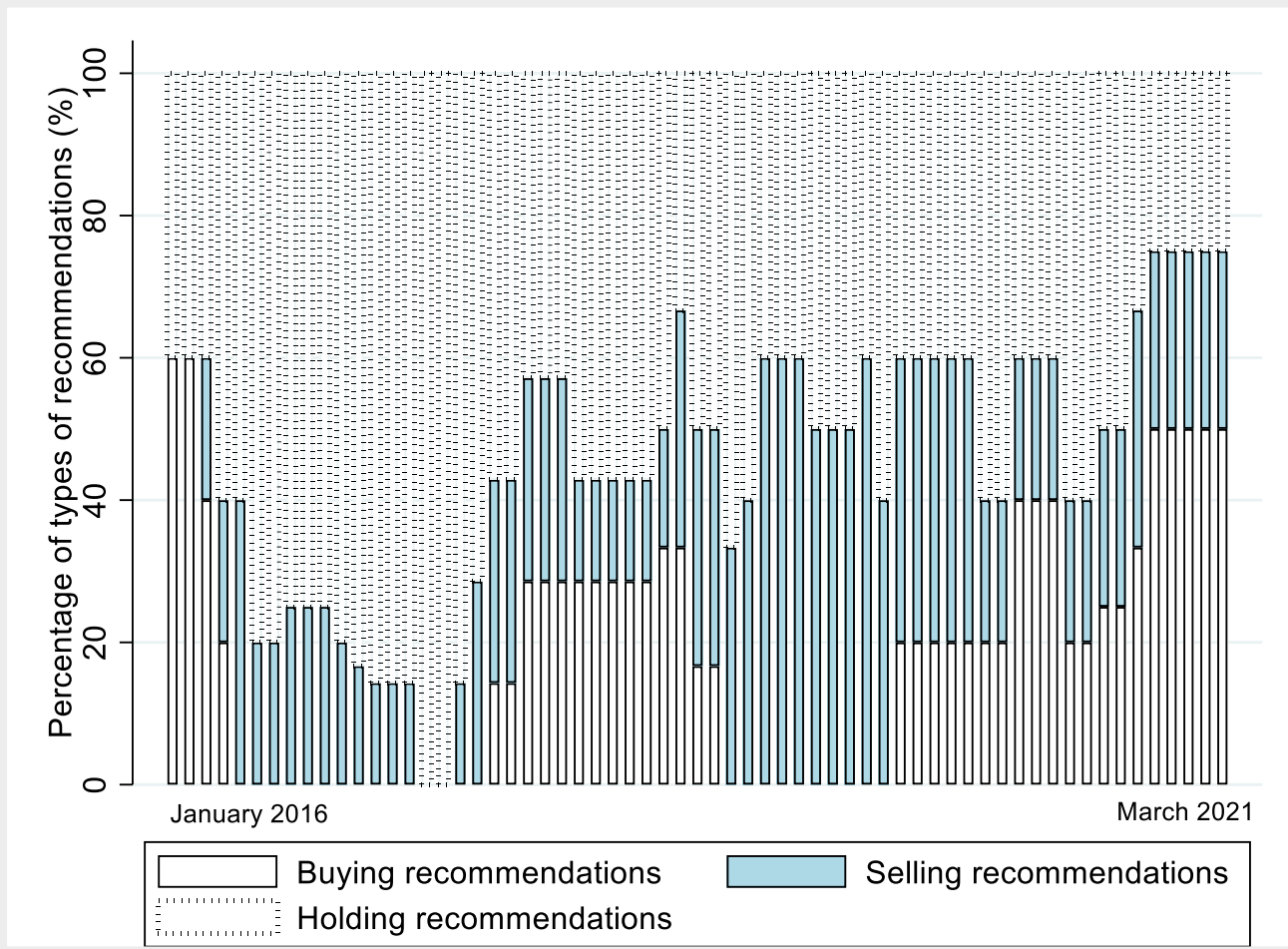


**Figure 9. Cal-Maine and Peers Stock Returns**

Source: Standard & Poor’s Net Advantage (Standard and Poor’s 2021). Accessed on May 29, 2020.

#### 4 Most Recent Financial Performance: Time for Recapitalization?

In its 2021 third quarter 10Q filing dated March 29, 2021, Cal-Maine reported slightly better financial results compared to the previous year (Table 1, Appendix 2, and Figure 9; Cal-Maine Foods 2021a). While the COVID-19 lockdown negatively affected small egg producers, Cal-Maine’s large scale provided the firm flexibility and resources to efficiently reach retail stores’ high demand and high prices, as Cal-Maine’s CEO commented (King 2020a). However, during the weeks that followed the 10Q report, Cal-Maine stock prices declined to about \$35 per share by the end of May 2021 (Figure 8). With some exceptions, that is, the beginning of the current pandemic, this stock price was well below previous Cal-Maine’s stock price levels since 2017. Some financial analysts covering Cal-Maine were not very enthusiastic about the firm’s equity prospects (New Constructs 2021a; Reuters 2021; SADIF 2021; ValuEngine 2021). Figure 10 provides financial analysts’ monthly recommendations to investors regarding trading on Cal-Maine’s equity from 2016 to 2021. Perhaps it was time to recapitalize Cal-Maine’s balance sheet now that stock prices were low—which meant the firm could buy back shares at lower prices?



**Figure 10. Analysts' Stock Trading Recommendations for Cal-Maine's Equity**

Notes: Buy percent, sell percent, and hold percent represent the percentage of monthly recommendations by analysts to investors regarding Cal-Maine's equity.  
 Source: IBES Consensus Recommendations, obtained from the WRDS database.

Table 2 presents the most current financial figures reported by Cal-Maine<sup>5</sup> and proforma restatements under alternative capital structure scenarios assuming 30 percent and 50 percent debt to capital ratios.<sup>6</sup> The potential recapitalization scenarios assume that Cal-Maine issues debt and uses the proceeds plus some excess cash to repurchase stocks at the prevailing price as of the end of May 2021, at \$35. Each scenario yields differing expected earnings per share (details on the proforma statements are provided in Table 2 in the next section).

## 5 Discussion Questions

A FRICTO-based analysis may help to explain Cal-Maine's very-low historical capital structure policy. The analysis may also provide insights on how likely this firm is to keep its debt policy unchanged or change it (i.e., acquire significant debt) in the foreseeable future given the current industry and financial market conditions. Below we suggest a list of questions that should guide a systematic FRICTO analysis. The

<sup>5</sup> These financial figures were reported by Cal-Maine as of February 2021, the most current financial data available at the time this case study was prepared. Instructors using this case are recommended to ask students to calculate an alternative scenario, say 70 percent debt to capital ratio (refer to suggested discussion questions).

<sup>6</sup> These scenarios are only potential scenarios provided as examples to evaluate their potential effects on Cal-Maine's value.

qualitative-based question can be responded by assessing whether each FRICTO element justifies a low, moderate, or high capital structure for Cal-Maine. This case study provides enough information for this assessment. For instance, section 3.2 in this case discussed historical and prospective investing, financial performance, and risk factors affecting Cal-Maine. This discussion could be related to the flexibility, income, and risk components of FRICTO, and an assessment could be provided. Similarly, section 3.4 of the case discusses issues related to control. The quantitative-based question is broken down in specific questions linking standalone FRICTO components. Some of these questions (i.e., those related to tax savings and EPS) rely on proforma restatement metrics of Cal-Maine alternative capital structures (Table 2). Other questions could be addressed by conducting financial statements and ratio analysis or other topics typically covered in finance courses, such as the weighted average cost of capital.

1. Using the financial statement and ratios given in the case, discuss Cal-Maine's financial strengths and weaknesses.
2. Perform a qualitative FRICTO analysis on Cal-Maine.
3. Perform a quantitative FRICTO analysis on Cal-Maine, which could include the following:
  - 3.1. Recalculate all financial metrics provided in Table 2 by adding an alternative debt to capital ratio scenario = 70 percent. Use the same assumptions stated in Table 2 except for interest rate, which would equal 3.50 percent (i.e., interest rates would grow from 2.25 percent in the 50 percent scenario to 3.50 percent in the 70 percent scenario).
  - 3.2. Discuss the tax benefits from higher debt (Income element of FRICTO).
  - 3.3. Discuss earnings per share under various levels of debt (Income element of FRICTO).
  - 3.4. Discuss potential cash needs, for future acquisitions and expansion, if Cal-Maine continues its past policies at the same pace (Flexibility element of FRICTO).
  - 3.5. Estimate changes in beta if Cal-Maine acquires more debt. Discuss how this might impact the firm's risk and weighted average cost of capital (WACC) under various levels of debt (Risk element of FRICTO).
  - 3.6. Assess the variability in Cal-Maine's income (Risk element of FRICTO).
  - 3.7. What impact would restructuring have on shareholder's control? (Control element of FRICTO).
  - 3.8. At the time of the case study, is the stock market (and Cal-Maine's specific stock price) relatively high or low? Are debt costs relatively high or low (Timing element of FRICTO)?
4. Based on the qualitative and quantitative analysis, briefly discuss what capital mix is most appropriate for Cal-Maine.

**Table 2. Actual Figures as of the End of February 2021 and Proforma Restatements for Cal-Maine's Alternative Capital Structures (\$ Million Except Indicated Otherwise)**

	Actual Feb. 2021	Proforma restatements Feb. 2021 for:	
Capital structure (debt to capital ratio)	0%	30%	50%
Revenue	1,452.5	1,452.5	1,452.5
EBIT <sup>1</sup>	64.9	63.8	63.8
Interest <sup>2</sup>	-12.0	5.7	10.8
Other	-2.8	-2.8	-2.8
Profit before taxes	79.8	60.9	55.9
Income taxes <sup>3</sup>	13.0	9.9	9.1
Profit after taxes	66.8	51.0	46.8
Common shares outstanding <sup>4</sup>	48.86	38.94	33.48
Earnings per share	1.37	1.31	1.40
Interest coverage (EBIT to interest)	-5.4	11.1	5.9
Cash and equivalents <sup>5</sup>	180.7	120.7	120.7
Total debt	0.0	286.9	478.2
Equity	1,016.4	669.5	478.2
Common stock price	35.0	-	-
Average market value of common stock	1,710.0	-	-
Excess cash		60.0	60.0
New debt <sup>6</sup>		286.9	478.2
Repurchase		346.9	538.2
Reduction in common shares		9.91	15.38
Interest rates for recapitalization		2.00%	2.25%

<sup>1</sup> EBIT declines in proforma results due to interest income foregone from the \$60 million "excess" cash used to buyback shares (the difference between actual cash balance minus assumed cash balance at 10 percent of total assets). The decline in interest income is assumed to occur at 1.88 percent, the interest yield reported by Cal-Maine in its February 10Q financial report.

<sup>2</sup> Interest expenses depend on debt levels and varying interest rates for recapitalization. Interest rates are assumed to vary across capital structure scenarios, consistent with the expectation that debt increases interest rates given that higher debt implies higher financial risk. Thus, assumed interest rates are 2.00 percent (for the 30 percent capital structure scenario) and 2.25 percent (for 50 percent capital structure) before taxes.

<sup>3</sup> The assumed income tax rate = 16.3 percent, Cal-Maine's effective tax rate in its most current financial report as of the end of February 2021.

<sup>4</sup> Common shares outstanding, in millions, across capital structures, equals actual common shares minus "reduction in common shares."

<sup>5</sup> Excess cash and cash equivalents is estimated by subtracting target cash and equivalents to actual cash and equivalents. Target cash and equivalents is assumed to be 10 percent of total assets.

<sup>6</sup> New debt is added to the balance sheet in the proforma results by issuing an amount of debt that achieves the capital structure target (e.g., 30 percent and 50 percent scenarios) and using the debt proceeds to repurchase common stock. Thus, repurchase equals excess cash plus new debt. New debt ( $D_1$ ) is calculated by solving:  $T^* = \frac{D_1 + D_0}{D_0 + E_0 - EC_0}$ , where  $T^*$  is the target capital structure (debt to capital),  $D_0$  is actual debt,  $E_0$  is actual equity, and  $EC_0$  is actual excess cash returned to investors via the repurchase program. In other words, target capital structure is total debt after recapitalization divided by the book value of capital after recapitalization.

**About the Authors:** Carlos J.O. Trejo-Pech is an Assistant Professor in the Agricultural & Resource Economics Department at the University of Tennessee (Corresponding author: [ctrejope@utk.edu](mailto:ctrejope@utk.edu)). Susan White is a Clinical Professor in the Robert H. Smith School of Business at the University of Maryland.

**Acknowledgements:** this work was partially supported by the USDA National Institute of Food and Agriculture, Hatch Multi-State project 1020537.

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4(1) doi: 10.22004/ag.econ.320048

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## Appendix

### Appendix 1. Questions and Analytical Tools to Consider for Capital Structure Decisions under FRICTO

Element	Questions to Ask	Analytical Tools
Flexibility	What are the company's future financing needs? Is this a stable, low growth company? Does the firm anticipate making high dollar purchases, like acquiring another company? Is management in this firm unsure about the firm's future?	Ratio and financial statement analysis. Main ratios are leverage ratios, including times interest earned, debt/equity ratio, return on equity, and current ratio.
Risk	What is the company's and industry's risk of bankruptcy? Does the company have a higher portion of tangible or intangible assets? It is a high growth or mature firm? Are cash flows stable or unpredictable? Heavy capital expenditures? Is the firm profitable overall when compared to companies in the same industry?	EBIT/EPS analysis (calculating EPS at various levels of debt and equity financing to determine which financing strategy provides the highest EPS). Variability of earnings (calculating standard deviation of earnings as a measure of total risk) and beta with and without increased debt as a measure of market risk.
Income	What financing strategy provides the highest income per shareholder?	Ratio analysis, for example calculating return on equity, profit margin, and other profitability ratios.
Control	Will issuing equity cause a potential control problem? Is this a closely held company, where management owns a large portion of the stock, and is unwilling to give up control? Or, are shareholders diverse, so a new equity issue is less likely to shift control?	Calculate dilution (percentage ownership decline) if new equity is issued.
Timing	Are stock prices and interest rates high or low? What signal will be sent by issuing debt or equity?	Determine economic conditions at the time of the proposed issuance and view future stock market and interest rate projected trends.
Other	Are there any other factors not covered in the above elements? Is management unusually risk averse? Does the firm want to maintain a given bond rating? Is the firm closely held and the owner is concerned about the impact of financing on the liquidity of the firm?	Evaluated on a case-by-case basis depending on the characteristics of the firm being analyzed.

Source: Notes by authors, summarized from Kester and Hoover (2005) and Sihler (1971).



**Appendix 2. Cal-Maine's Selected Financial Statement Items (\$ million)**

Financial Item	2016	2017	2018	2019	2020	Feb. 2021
Revenue	1,908.7	1,074.5	1,502.9	1,361.2	1,351.6	1,452.5
Cost of goods sold	1,260.6	1,029.0	1,141.9	1,138.3	1,169.1	1,208.3
Selling, gral. and adm. expenses	177.8	176.0	179.3	174.8	176.2	179.3
Operating income (EBIT)	470.3	(130.5)	181.7	48.1	6.3	64.9
Net interest (expenses) gains	10.1	10.5	11.7	17.8	14.6	12.0
Net income	316.0	(74.3)	125.9	54.2	18.4	66.8
Cash and short-term investments	389.5	156.0	331.0	319.4	232.3	180.7
Receivables	79.3	117.2	85.8	71.8	98.4	130.3
Inventory	154.8	160.7	168.6	172.2	187.2	207.7
Total current assets	626.3	436.2	587.5	567.8	522.3	522.9
Net property, plant, and equipment	392.3	458.2	425.4	456.3	560.6	587.9
Other long-term assets	93.2	138.7	137.5	132.2	123.9	120.5
Total assets	1,111.8	1,033.1	1,150.4	1,156.3	1,206.7	1,231.3
Accounts payable	36.3	30.6	37.8	39.2	55.9	99.9
Current portion of LT debt	16.3	4.8	3.5	1.5	0.0	0.0
Other current liabilities	30.9	29.2	66.5	34.2	37.3	1.0
Total current liabilities	83.5	64.7	107.8	74.9	93.2	100.8
Long-term debt	9.3	6.1	1.2	0.0	0.0	0.0
Other non-current liabilities	101.7	117.8	85.7	91.6	103.8	114.0
Total liabilities	194.4	188.6	194.8	166.5	197.0	214.8
Total equity	917.4	844.5	955.7	989.8	1,009.7	1,016.4
Depreciation & amortization	44.6	49.1	54.0	54.7	58.1	59.6
Change in accounts receivable	21.2	(37.2)	31.4	16.0	(28.3)	(28.3)
Change in inventories	(8.5)	2.4	(8.0)	(2.3)	(9.7)	(9.7)
Change in accounts payable	(8.5)	(9.5)	28.4	(14.3)	17.7	17.7
Cash from operating activities	388.4	(45.9)	200.4	115.1	73.6	124.8
Capital expenditure	(76.1)	(66.7)	(19.7)	(68.0)	(124.2)	(103.4)
Sale of property, plant, and equipment	2.9	0.1	1.0	1.6	3.3	4.7
Cash acquisitions	0.0	(85.8)	0.0	(17.9)	(44.7)	(0.1)
Cash from investing activities	(219.1)	52.7	(163.9)	(47.8)	(61.4)	(138.6)
Total debt issued	0.0	0.0	0.0	0.0	0.0	0.0
Total debt repaid	(25.3)	(16.5)	(4.8)	(3.8)	(1.7)	(0.2)
Repurchase of common stock	(1.8)	(1.7)	(1.1)	(1.0)	(0.9)	(0.9)
Common dividends paid	(120.9)	0.0	0.0	(41.7)	0.0	0.0
Cash from financing activities	(148.9)	(18.3)	(5.7)	(46.5)	(3.4)	(1.1)
Net change in cash	20.4	(11.5)	30.9	20.8	8.9	(14.8)

Source: Standard &amp; Poor's Net Advantage Capital IQ database (Standard and Poor's 2021)

## Teaching and Education Commentaries

# The Knowledge and Skills Required to Be a Successful Entrepreneur

Luis Alberto Sandoval

Zamorano University

JEL Codes: A20, L26, N36

Keywords: Data literacy, entrepreneurship, innovation, resilience, Zamorano, risk

### Abstract

Entrepreneurship has become an important topic at universities, especially in developing countries where the job market has become saturated and wages are low compared to the developed world. To strengthen its entrepreneurship curriculum, Zamorano University asked its alumni what knowledge and skills are required to be a successful entrepreneur. To analyze the responses, data mining techniques were employed. Interpretation of the results of word frequencies, associations, and a dendrogram yielded nine thematic areas that should be the focus of entrepreneurship programs at universities, according to actual entrepreneurs and experts working in agriculture. While some of the themes were expected, such as discipline-specific and business administration knowledge, other themes, such as resilience to a changing business environment, were sort of a surprise.

## 1 Entrepreneurship

*“The activity of setting up a business or businesses, taking on financial risks in the hope of profit”*  
~ Oxford Languages (2021)

The field of entrepreneurship has come a long way over the last 30 years, to the point of becoming a formal discipline. Universities have developed complex curriculums, which are often accompanied by entrepreneurship opportunities. At some point, students present their ideas to sponsors or compete for funding to launch their businesses. In some of the most successful cases, universities have also established centers dedicated to the topic of entrepreneurship (Morris and Liguori 2016).

While entrepreneurship can take many forms, there is a growing trend of start-ups related to agriculture and climate, and investors have paid attention. According to PwC (2021), venture capital invested in climate tech has increased fivefold over the past decade.

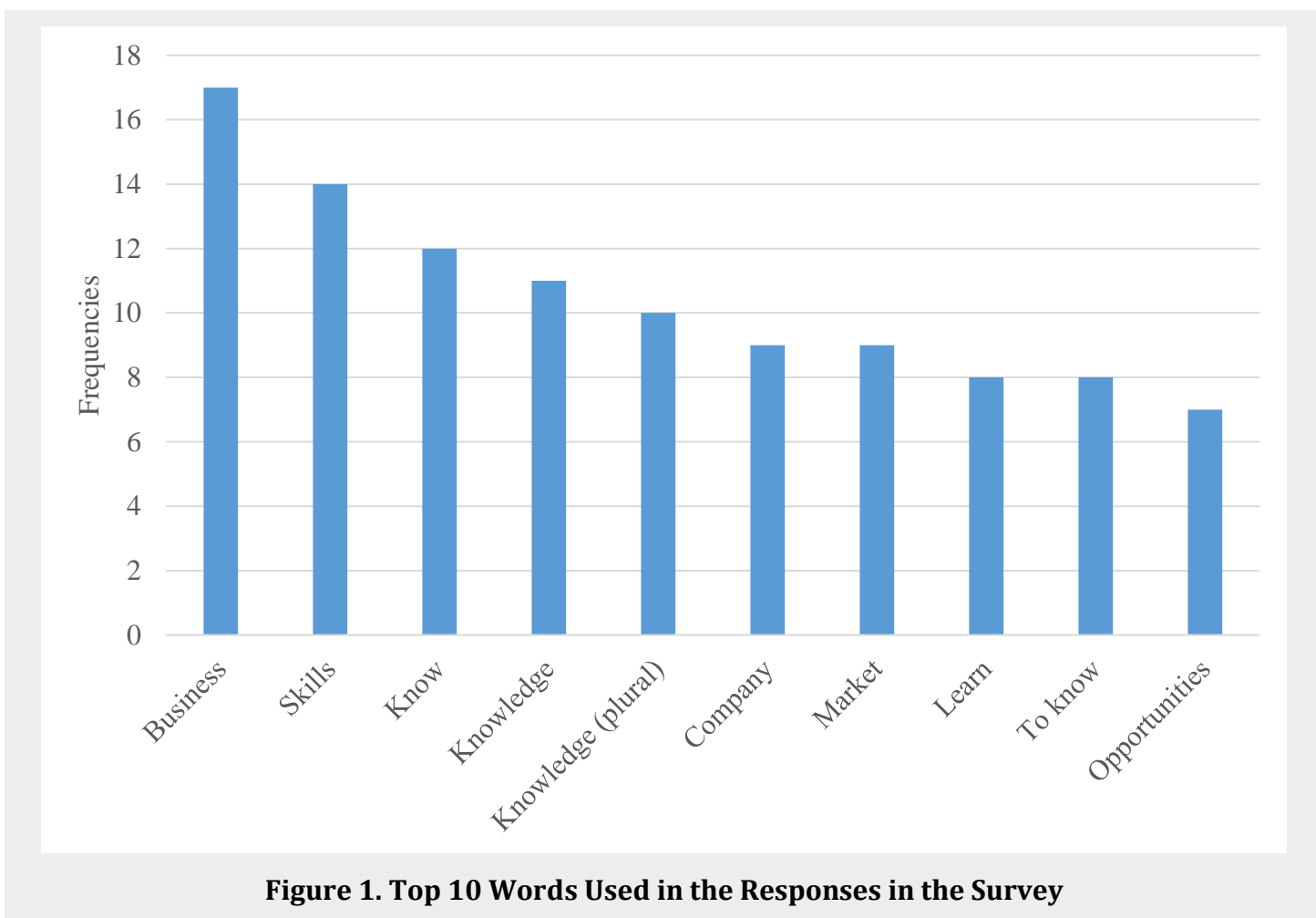
Not all entrepreneurs may start their business based on an innovation that may change the world. However, academic entrepreneurship programs are responsible for providing students with the tools to be successful, regardless of the type of entrepreneurial activity or business of their choosing. In any case, it is vital to identify the most valuable skills and knowledge to be a successful entrepreneur. In developing regions, such as Latin America, teaching students to be entrepreneurs is of utmost importance. The job market has become saturated, and wages are low compared to those in more developed regions.

Zamorano University in Honduras is one of the academic institutions seeking to strengthen their entrepreneurship curriculum and resources. In the process of doing so, among other things, we as university faculty decided to ask our alumni the following question: “What knowledge and skills are required to be a successful entrepreneur?” A survey was sent out with that question, allowing alumni to answer in essay format. This teaching commentary aims to present the identified thematic areas that arose from the survey and should be taught at universities or as part of curriculums, according to entrepreneurs and specialists in Latin America.

The survey was sent through Zamorano University’s alumni network and was open from April 15 to May 3, 2021. The survey received 80 responses. We asked for the participation of entrepreneurs and researchers among alumni familiar with the topic. Due to the unstructured nature of the data set, it was analyzed using “R” statistical software via text-mining techniques. The “R” packages used include tm, qdap, and ggplot, among others. The steps taken for the analysis included: (1) data set cleaning and preparation, (2) frequency analysis of terms, (3) estimation of associations with select terms, (4) development and assessment of dendrograms, and (5) identification and definition of thematic areas. Because of the relatively small size of the data set, text-mining techniques were not required, but were employed.

In the first step, data set cleaning and preparation for analysis, punctuation, capital letters, and stop words such as “as,” “the,” and “is,” but in Spanish, were removed, and a term document matrix was created.

In the second step, the frequencies, or the number of occurrences of each word, were estimated. The most important finding of this step was that, as expected, respondents used several variations of the same word. The top ten words are shown in Figure 1.



The objective of the third step, estimation of associations with selected terms, was to find the most important word associations (correlations) with the words “skills,” “knowledge,” and “learn” along with their variations. Emphasis was given to these words because survey participants were literally asked to elaborate on what are the skills and knowledge required to be a successful entrepreneur. Hence, words correlated with these three and their variations would help identify such skills and knowledge. Only

moderate to strong correlations,  $\geq 0.4$ , were considered. In Table 1, the relevant associations with each word are shown. It is important to consider that there were more words with moderate to high correlations, but these were not necessarily relevant for the analysis.

**Table 1. Word Associations**

Base Words	Word Associations
Skills	Soft, listen, technological, be related, organize, languages, talk, learn, structure, communication, analytical.
Knowledge	Technological, be related, promotion, productivity, production, languages, communicate, communication, commercialization, analytical, alternative, agreement, deep, market, business, needed, wide, administration, technical, innovation, financing, service, product, projection, marketing, self-confidence, sales.
Learn	Production, crops, harvest, neuroscience.

A dendrogram is a type of tree visualization that shows how similar or associated objects are, in this case, words. One important feature of the dendrogram is that it allows visualizing relationships between words. For example, a group of words clustered together may be associated with a word in a superior hierarchical level. For example, the word “innovate” was consistently used with a cluster of words related to processes, costs, and marketing. While the dendrogram is not shown because it is in Spanish, key findings included: (1) the words “to know” and “skills” were used similarly, (2) the words “knowledge” and “market” were used similarly or together, and (3) as expected, “to know” and “skills” were consistently used with a cluster containing all other words.

Finally, in step five, frequencies, associations, and the dendrogram were examined together to conclude the thematic areas that should be taught to provide undergraduate students with the required skills and knowledge to be successful agricultural entrepreneurs. The identified thematic areas, in no classification order, are:

1. Business administration
  - a. Sales analysis
  - b. Finance
  - c. Risk management
2. Continuous learning (learn to learn)
3. Analysis of market opportunities
4. Innovation
5. Resilience
6. Soft skills
  - a. Learn to deal with failure
  - b. Communication
7. Analytical skills (data literacy)
8. Discipline-related technological knowledge
9. Discipline-specific knowledge

## 2 Discussion

Some of the thematic areas were expected, such as business administration, analysis of market opportunities, and soft skills (communication), as they are required to legally establish a business and prepare the entrepreneur to make a sales pitch of the business to investors or new clients. The other thematic areas provide interesting food for thought when considered in the light of the comments from survey participants along with the personal experiences of those associated with Zamorano University's Entrepreneurship Center (CIEZ).

### 2.1 Continuous Learning

Overall, respondents acknowledged that no university degree could provide students with all the skills and knowledge required to be successful agricultural entrepreneurs. Therefore, entrepreneurs must be ready to continue learning after college, primarily through non-degree continuous education courses. This is particularly challenging, as students may not have the discipline and motivation to start and finish online self-paced courses. Hence, they should *learn to learn*.

### 2.2 Innovation

Innovation is a trending topic in higher education but is usually misinterpreted as invention. Two trends were identified in the analysis: (1) internal innovation and (2) product innovation, mostly new product and services research and development. Established businesses must incorporate innovation to make their administrative processes efficient, reduce costs, and manage innovation processes within the business to deliver new products and services to customers through some form of Research, Development, and Innovation (R&D+i), regardless of the type of business. Regarding new product and services research and development, respondents indicated the need to teach innovation to undergraduates so they can take their inventions all the way to market, especially for technical majors. Students in technical fields usually develop new products and services with little knowledge of market demand. Usually, they lack the required knowledge to push their ideas beyond the development phase, resulting in the efforts not generating any potential value after all.

### 2.3 Resilience and Learning to Deal with Failure

According to Duke University's Fuqua School of Business (n.d.), there are five phases in the entrepreneurial process: (1) idea generation, (2) opportunity evaluation, (3) planning, (4) company formation/launch, and (5) growth. In our experience at the CIEZ, students enjoy the hype of the idea generation phase but abandon the process either at the opportunity or planning phase, especially if majoring in a technical field. According to our respondents, students must be resilient and not become unmotivated if their original idea is initially not feasible. Instead, they must take all new knowledge acquired through the process and evaluate all possible alternatives that derive from their original idea. One respondent said: "Entrepreneurship can be very romantic, especially if you had the idea when you were young, but you should not marry that idea and instead seek what is best for business." Students must acquire the emotional intelligence to deal with failure, as almost no enterprise gets it right and is successful in the first attempt.

### 2.4 Analytical Skills and Discipline-Related Technological Knowledge

With the advent of the Internet of Things (IoT), which are cloud-connected or smart devices, and Agriculture 4.0, which includes better and cheaper hardware for data collection and higher data analytical capacity, students must be data literate. Otherwise, they will not be able to take advantage of the abundant information that is being generated at all levels in the value chain. It must be kept in mind that students do not need to be data scientists with the skill to perform complex analyses. However, they

need to understand the structure of data they have available to them, as well as be able to obtain and correctly interpret descriptive statistics and visualizations.

Additionally, entrepreneurs must continuously monitor and learn new technology advances that relate to their business. A respondent said, “Because I am technologically savvy, my business had an online presence, and we had good communication with our clients through social media. When the pandemic came, we already had a channel of communication with our clients, and we were able to deliver products using delivery apps quickly.”

## 2.5 Discipline-Specific Knowledge

Frequently, students have ideas for which they do not have the knowledge to develop. For example, a student may have an idea for a plant-based meat substitute and be an agriculture economics major. In this case, the student may soon abandon their entrepreneurship goal simply because they do not have the technical skills to produce a prototype. Our respondents emphasized that entrepreneurs must have deep discipline knowledge in the field they want to start a business, as well as business administration knowledge. Students must either have access to deep knowledge on their own or learn to team up (effectively) with peers who contribute such knowledge to the enterprise.

Frequently, teamwork is promoted during classroom exercises and fairs. If the professor does not randomly or strategically create the teams, students do it themselves by friendship or prior connection, which may finally lead to social loafing (Boren and Morales 2018). The problem with social loafing, when students put less than their fair share of the team effort, is that it may hinder the development of a promising idea or give credit and even financial rewards to students who do not deserve it. In short, the professor must ensure students learn to conform effective and productive teams.

## 3 Conclusion

According to 80 entrepreneurs and experts in Latin America, nine thematic areas should be taught at universities and in college curriculums to be able to educate successful entrepreneurs. Some of the identified thematic areas were expected and constitute the basis of entrepreneurship, such as business administration, market analysis, communication, and discipline-specific knowledge. Others, like innovation, analytical skills, continuous learning, and discipline-related technological knowledge, reflect trends in the agricultural sector, such as big data and precision and digital agriculture. Therefore, knowledge and skills in agriculture 4.0 will be fundamental to thrive in an increasingly digitalized agricultural sector. Finally, resilience and learning to deal with failure, which is not knowledge or skills, but abilities related to emotional intelligence, should be developed mainly during the early stages of entrepreneurship programs.

**About the Authors:** Luis Alberto Sandoval is Associate Professor of Agribusiness and Institutional Research Coordinator at Zamorano University (Corresponding author: [lsandoval@zamorano.edu](mailto:lsandoval@zamorano.edu)).

**Acknowledgements:** Research with human subjects followed standard protocols and was approved by appropriate administrators at Zamorano University. Participation was anonymous and informed consent was received by participants.

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4(1) doi: 10.22004/ag.econ.320049

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