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Beyond Grades: Using Incentives to Motivate Students

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Abstract

Economists study how incentives motivate human behavior. However, besides grades, professors do not frequently employ incentives to motivate students in the classroom. This may be because expenses associated with classroom incentives often remain unreimbursed or because other implementation costs are high. In this paper, we demonstrate methods educators can use to motivate student behavior while minimizing costs. We identify a range of options that include: incentives appropriate for large sections, an effective monetary incentive system suitable for smaller classes, tips for using an assortment of non-monetary incentives, and methods for leveraging social capital to motivate student learning and engagement.

Introduction

Economists are familiar with the discipline's accepted mantra, put simply, that "people respond to incentives." In his popular book, *The Armchair Economist*, Landsburg (2007) reaffirms this statement by explaining that "most of economics can be summarized in four words, 'People respond to incentives.' The rest is commentary." Similarly, Mankiw (2014) emphasizes the motivational power of incentives by identifying it as a central theme in his best-selling, principles-level economics textbooks.

In practice, economics educators assign grades as a singular incentive to motivate students. Interestingly, most professors do not actively use any additional methods to incentivize student performance in their classrooms. Most likely, instructors of economics engage in a quick cost-benefit analysis, often choosing to avoid the costs associated with providing additional classroom incentives. However, several alternative methods exist that motivate student behavior, yet minimize the personal costs associated with implementing the use of incentives in the classroom.

This paper identifies and demonstrates ways in which educators can use incentives as a motivational tool in their classroom to increase student learning and engagement. We identify a range of options that include: incentives that are appropriate for large sections, an effective monetary incentive system suitable for smaller classes, an assortment of tips for using non-monetary incentives, and methods for leveraging social capital to help students meet learning goals. We begin with a discussion on how to motivate students at the start of the academic term starting with several first-day-of-class activities, then continue by exploring a motivational toolbox for the remainder of the semester, and conclude by identifying incentives that are particularly useful in large lecture courses.[6]

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[6] Each recommendation mentioned has been used successfully in the classroom by at least one of the authors of this paper.

Why Motivating Student Learning Matters

Economists understand that both monetary and non-monetary incentives matter and that these tools can be used to motivate student learning and classroom engagement. An educator's ultimate goal is to spark a love of learning that allows students to meet the learning objectives of the course and progress towards graduation and beyond. While fostering intrinsic motivation is often preferable (Kohn 1993), extrinsic motivational strategies can also be leveraged by instructors in order to promote behavior that is conducive to learning. For example, students who attend and pay attention in class, develop and participate in supportive student learning networks, and apply significant effort towards understanding course material, create a classroom environment that is engaging and ripe for academic achievement. This type of educational culture can help increase student learning by deepening their overall knowledge, understanding, and retention of course material.

Research in educational methods and strategies with regards to identifying and influencing student motivation is mixed for K-16 students. Turner, Thorpe and Meyer (1998) uncover a variance in motivational patterns for different types of learners. Doppelt and Schunn (2008) find that the perceived importance of a task can act as a primary source of motivation for students. Stefanou and Parkes (2003) determined that the type of course assessment used, i.e. projects versus tests, influences student motivation. Zusho, Pintrich and Coppola (2003) explored fluctuations in student motivation, uncovering a general decline in students' motivational levels over the course of a semester, as well as a decline in certain cognitive strategies used in understanding course materials. However, in identifying motivation as a tool for academic success, Linnenbrink and Pintrich's (2002) research is the most promising, explaining that students should not be labeled as merely "motivated" or "unmotivated", but instead "educators are urged to consider ways in which the learning environment can be altered to enhance all students' motivation." Therefore, in order to motivate students towards learning, we outline a collection of low-cost strategies that are conducive to creating this type of positive educational environment which include: creating a better classroom environment, actively demonstrating motivation, building student learning networks, using money as a motivational device, using low-cost, non-monetary alternatives, and methods for motivating students in large lecture courses (see summary in Table 1).

Table 1: Summary of Activities

Time in the Semester	Motivation Suggestion
Before the first day of class	Post an "enhanced" syllabus to your course management system. Email your students welcoming them to your course.
First Day of Class	Sticky-Note Demonstration, building study team networks
After first assignment	Email to perfect scores
After each subsequent assignment	Email to those who still have all perfect scores
In class 3rd – 4th week	Candy Bar to a student you recognize is on time to class every day and participates
Before each exam	Post motivational video like: https://www.youtube.com/watch?v=MFzDaBzBlL0 Or motivation picture like: (figure with PASION).

After each exam	Email to top 10%, hand written thank-you note to top couple of students.
Near the end of the course/after the course	Email or personal note to top students to consider taking more economics courses, majoring, doing an independent study, or working for you as a research/teaching assistant in the future.
Anytime	Monetary system for incentives, coffee-shop office hours

Strategies for Motivating Students from the Start

Teacher behaviors and attitudes towards students are positively related to student motivation and cognition (Wilson 2006). This "social capital" that teachers build with their students starts on the first day of the semester and continues throughout the course. Many pedagogical experts agree that having a successful first day of class has long-lasting implications with regards to a student's appreciation of the entire semester (Acchiardo and Mateer 2015) and increases both instructor and course satisfaction (Hermann, Foster, and Hardin 2010; Wilson and Wilson 2007). Tips for a successful first day include introducing students to the process of learning (Duffy and Jones 1995), using the entire time allotted for the class to show the importance of class time (McKeachie and Hofer 2001), and setting expectations (Nilson 2010; Wolcowitz 1984). Several tips are described in this section to assist with ensuring a successful first day of class, starting with a discussion of the syllabus which can help get each semester off to a cracking start.

Making the Syllabus Matter on the First Day

The syllabus is an important part of a student's first-day impressions of both the instructor and the classroom. It is a vehicle that can help express enthusiasm for the subject, as well as competence in organizing the course. A syllabus is designed to transmit essential course information, but few syllabi do so in a compelling way. A thorough reader simply finds the instructor's contact information, grading scale, make up policy, and course calendar -- just like any other syllabus. However, in an engaging syllabus, the student will also find an informal introduction to the course and personal information about why teaching is enjoyable for the professor, all designed in a way that's fun. Acchiardo and Mateer (2015) argue that educators must "go beyond grades" in the syllabus so that students will want to learn. In general, the content of the syllabus remains unchanged, but efforts towards making it more attractive for students to read can pay off substantially. For a one-time cost of creating a peppier syllabus, professors can signal to students that the study of economics is interesting, engaging, and even entertaining which can make the syllabus matter as a teaching tool (Chamlee-Wright and Hall 2014). As an example, the first page of Matthew Rousu's redesigned syllabi is included in Appendix A.

Demonstrating Motivation on the First-Day

Using a motivational demonstration on the first day of class can also help get students into the right mindset as the semester begins. Tierney (2014) recommends a demonstration that begins with the instructor asking for a student volunteer. This volunteer is given a Post-it note and asked to place it as high as they can on a wall. Normally, the student places the sticky note on the wall as high as they can without exerting too much effort, which is exactly what is expected. The instructor can then ask the class, "What question did I ask?" and at this point students begin to realize that the volunteer did not place the note as high as they possibly could. To reach the highest point, the student could have jumped, climbed up on a chair, or even asked for help from their peers. After a brief discussion, the instructor can give the volunteer an additional Post-it note and ask them again to put it as high as they can.

This demonstration can be repeated, along with pauses for class feedback and discussion, for multiple rounds until it is obvious that the student cannot place the note any higher. The instructor can then conclude this demonstration with motivational words, such as: informing students that they can do better than they think, reminding them to not give up after a failed attempt, encouraging them to reach out to other students, as well as the professor, for additional guidance, and the importance of listening carefully to instructions. In addition to helping encourage students, this type of demonstration can also help set expectations about the effort required from the first day in order to succeed in their academic pursuits.

Developing Networks on the First Day

Another easy, first day motivational activity is a simple "business card" shuffle. In this in-class exercise, Holder (2015) recommends setting out markers, pens, and stacks of small 3x5 inch index cards around the classroom prior to the start of class. As students enter, they are instructed to grab three index cards and write information that they do not mind publicly sharing with their classmates. This can be something as simple as their first name and university email address or it can include more detailed contact information. Students are then asked to duplicate this information on the remaining index cards and choose two other students to exchange cards with in order to begin connecting with others. The student's third informational card should be exchanged with the instructor's own business card, ensuring easy access to the professor's contact details for the semester.

This introductory activity is a great time to explain to students the importance of forming strong peer-to-peer learning networks as an informal support system within the educational environment. This is particularly relevant for first time college attendees who may feel overwhelmed or suffer from "imposter syndrome" in higher education (Caltech Counseling Center 2015). This simple first-day exercise is designed to increase communication while decreasing student anxiety by helping students easily connect with other students, begin the process of building their own student learning networks, and allowing them to continue conversations beyond the classroom walls.

Instructors can further facilitate the building of student learning networks and discover additional ways to motivate their students by using the power of social networking sites such as Twitter, Facebook and Instagram in the classroom. One easy social media activity is to encourage students to create an "ECONSelfie", an assignment where students identify an economics concept and share it with the class in the form of a "selfie" styled photograph (Al-Bahrani, et al. 2015). An alternative introductory social media activity is to task students with finding examples of economics in the world around them and tweet it using an established class or project hashtag, such as #everydayecon or #realworldecon (Holder 2014). Since all fifty states include basic economics concepts throughout their K-12 grade-level standards (Council for Economic Education 2016), this type of learning activity early in the semester allows students to reach back and build upon their foundational knowledge in economics. Connecting and reinforcing the concepts in economics that students already know and are familiar with to the broader expectations found within a university-level economics course can help reduce anxiety that is prevalent within the first few days of the semester. In addition, exposure to the informal learning support available through peer-to-peer connections via social media networks can provide students with a unique communication tool for the remainder of the course.

Strategies for Motivating Students throughout the Semester

First-day activities can add value in terms of motivating students early on in the semester and can be integrated into any course with minimal costs to the instructor. However, motivating students in the classroom is not limited to the start of the semester. Instead, motivation is a tool that can be leveraged throughout the length of the course and often includes the use of both monetary as well as non-monetary incentives. By identifying a number of strategies for motivating student learning, including methods for using monetary incentives without going broke along with the use of non-monetary incentives, professors can influence positive student behaviors throughout the entire semester.

Using Monetary Incentives without Going Broke

There are many ways professors can use monetary incentives to motivate students without overspending. The benefit of using actual money is that it is the one incentive that is best understood. Unfortunately, it can often be too costly depending upon the number of students or the number of activities or events for which it is used. However, there are steps professors can take to lower the costs of using monetary incentives in the classroom.

Rousu (2015) presents a system where students engage in games for money throughout the semester at no-cost to the professor. Under this system, all students pay a small experiment participation fee at the beginning of the semester.[7] The professor then puts the money into a bank account for the semester and sets up a system where students compete for money which is tracked on a spreadsheet. The collected money is then used to provide incentives for experiments throughout the semester. At the end of the semester, the professor will withdraw the money and pay it back to students at the end of the semester.[8] This system can work well for smaller classes, but may not work as well for larger classes. However, there are other ways in which monetary prizes can be used with only modest expense to professors of small or large classes.

One way to incentivize with only modest expense is to offer cash prizes to only one student or some small subset of students. This is a method that can be used to motivate an entire class with minimal costs. Professors can also have activities where some students end up paying money into the class to help offset money paid out. For example, Geerling and Mateer (2015) developed an activity for teaching the law of supply using karaoke. To implement this, the instructor tells the class that they will pay somebody to perform karaoke for the class. However, the professor explains that they are only planning to pay the person who is willing to do it for the lowest price. The activity begins by having every student stand, indicating that they are willing to perform the service for the class at an absurdly high price (say $500,000). As the instructor slowly lowers the price, students are told to sit down when they are no longer willing to perform karaoke for the given price. In most large classes, a student can be found who is willing to perform karaoke for free. In some cases, when the professor gets to a price of zero, multiple students will still be standing. In that case, students will even pay the instructor to become the person who sings. Better still, with this and other activities, the learning that takes place in the classroom is memorable. Students often take videos, post the classroom activity on social media, and leave the room talking about the in-class experience. Similarly, to illustrate the law of demand, donuts or other low-priced items can be auctioned off in class. Generally, the winning bid to obtain the item is substantially more than the prevailing store price, which can help offset expenditures for future course experiments.

Using Non-monetary Incentives to Motivate Engagement

Alternatively, the use of non-monetary incentives in the classroom to motivate student engagement can stretch the dollars set aside for incentives across a greater number of students. The use of smaller and cheaper non-monetary incentives allow the educator to extend the time period in which the incentive can be used and paid for. In addition, keeping the rewards “low stakes” avoids some of the unintended consequences prevalent with larger “high stakes” monetary incentives (Levitt and Dubner 2005, page 17).

There are many non-cash incentives professors can use to motivate students. For example, tangible objects of intrinsic or implied value, a special privilege or reward, or even a transaction that makes the receiver feel a sense of accomplishment are all useful as a motivational tool. In fact, some non-monetary incentives that are available for the economics educator to utilize are exceedingly simple, such as: food, school supplies, games, and dime-store prizes.

Holder (2015) brings a candy jar to class each day to encourage class participation and supplies students with pencils and snacks, as well as inexpensive single-subject spiral notebooks as an effective incentive strategy to attend class. One option is to distribute these items to students for correctly answering questions or participating in class discussions. Alternatively, local small businesses or fast food chains in the surrounding area are usually willing to make in-kind donations of small denomination gift cards or

[7] All students are required to pay the experiment fee, although it is best that the professor is willing to cover the fee for a student that claims he/she cannot pay the fee.

[8] Before trying this method, we strongly recommend that educators seek approval from relevant authorities, e.g. dean or department head. See Rousu (2015) for more details.

loyalty coupons for use as classroom motivation. Even the on-campus bookstore is often willing to donate small gift certificates or discounted items, particularly for large classes on campus.

However, incentives are not limited to cash or in-kind rewards. Simply striving to make class interesting and make learning fun through gamification of economics concepts can be rewarding for students by engaging them in the material and increasing their involvement with other students. By increasing the benefits of attending class or decreasing the costs of attendance in terms of boredom, students can be motivated to learn since attending class is the first step towards understanding the material, particularly if the classroom lecture adds value.

Additionally, students respond to tangible positive incentives even if they are not directly exchangeable for relevant goods or services. For example, Holder (2015) uses a token economy that awards stickers, poker chips, tickets or even colored paperclips to students. These visual signals of achievement can be awarded to students for answering questions, class participation, collaboration, or other positive actions. An incentive structure can be designed to exchange tokens for actual prizes at the end of the class, or at the end of the week, the month, or even the semester. Again, this allows the professor to stretch their dollars and reach more students who can potentially earn small awards and helps minimize the unintended negative incentive for students who do not receive tokens or larger awards throughout the year.

Another idea that builds community and helps motivate students throughout the semester is holding office hours in a coffee shop. By holding coffee shop office hours, the professor can help break down the impersonal nature of an official office visit by providing easily accessible office hours in a public location. In addition, the alternative location helps students who may be intimidated by approaching the instructor directly for help. This is particularly true for courses taught primarily to younger students whose feelings about office hours are often polluted by the fact that teacher meetings in their high school academic career were an indication that they were either in trouble for their behavior or struggling academically.

The genius of the coffee shop for office hours twist is the central idea of meeting students as equals in a neutral location. People are more social when they share food or drink, and students are no different. Students are more likely to show up, linger longer, and be more willing to share personal stories in this setting. The motivation for both teaching and learning, is the opportunity for creating an engaging and personal connection within the educational environment. Generally speaking, coffee shop office hours tend to work best when they occur immediately before or after class meeting times.

Social Capital as a Motivational Method

The power of non-monetary motivational methods based on social capital cannot be overlooked. A kind word, emotional support or an encouraging quote or note to the class can form the foundation for a positive learning environment for students. A reminder to students of the benefits of completing their education on a daily or weekly basis can help those students who struggle without the benefit of a support network. This is particularly relevant for 1st generation students who may not have family or friends who are supportive of their pursuit of higher education.

Oftentimes, significant instructor motivation goes towards students who are not performing their best. This is not necessarily a bad pedagogical practice, but many students who are performing well may feel left out. Tierney (2014) demonstrates a simple, time-honored method for showing appreciation towards top students, writing personal thank-you notes. Giving a hand-written thank-you note to students who score well on exams or participate in class will motivate students who are already doing well to continue working hard in their economics course. For educators with a larger course load, sending an email version of a thank-you note for high performance is also an effective measure for increasing student motivation and showing appreciation for students who are performing at the highest levels.

Instructors can also motivate students by increasing the sense of community and connectedness with their students. Educators who utilize a Facebook group, a Twitter account, or a learning management system to post information items for students can use these same tools to post motivational quotes, figures, and videos. These messages can be posted at random times throughout the semester or at times when students may need extra motivation: for example, during finals week or before quizzes, midterms or other exams. An additional low-tech method is to use a motivation quote or image at the start of each class or as an ending slide to finish the lecture. See Table 2 for a collection of sites that provide motivational messages that are useful to share with students on a regular and ongoing basis.

Table 2: Motivational Sites

Site Name	Site Link
Entrepreneur	http://www.entrepreneur.com/article/247213
Forbes	http://www.forbes.com/sites/kevinkruse/2013/05/28/inspirational-quotes/
Keep Inspiring Me	http://www.keepinspiring.me/positive-inspirational-life-quotes/
Lifehack	http://www.lifehack.org/articles/productivity/50-motivational-quotes-that-will-put-your-motivation-on-overdrive.html

Another non-monetary incentive that builds social capital and is useful for motivating good students is the incentive of future opportunities. A professor can recruit "A" students to become preceptors, tutors or supplemental instructors for their course for the following semester by telling students that they are looking for students who actively participate in the course throughout the semester and earn A's on each exam. Consequently, enthusiastic, hard-working students are thrilled to hear that they will have the chance to become a student-leader for a course that they enjoyed. Similarly, other methods include recruiting top students for the university's peer-led tutoring program or offering the opportunity to participate in an independent study or internship that focuses on undergraduate research in a subsequent semester. Students who recognize the value of early experience within their field or who discover their own love for teaching and learning are highly motivated by these types of future opportunities.

Strategies for Motivating Students in the Large Lecture

Teaching large classes requires getting the incentive structure "just right" in order to encourage participation. One technique is to allow students to earn extra credit when they participate with especially insightful answers, volunteer for demonstrations, or distinguish themselves by going beyond normal classroom behavior. One successful innovation is creating an alternative set of currency (see Figure 1) or participation dollars. This currency can be given to students for participation, a great answer, or even just to reward those who chose to attend on the Friday afternoon before Spring Break. This is a highly visible way of recognizing exemplary contributions and is easy to implement as extra credit. For example, in Acchiardo and Mateer's (2015) grading scheme, $1,000,000 is equal to 100% for the course. Therefore, $500 participation dollars equals a 0.05% increase in a student's final course grade. While the overall amount of extra credit a student could earn throughout the course is quite low, less than 1% of the final grade throughout the course, the possibility of earning this extra credit is an especially strong motivator for some students.

Figure 1: Pictures of Extra Credit Currency

Another technique that works especially well in a large class is buying someone lunch. Spending hard-earned cash is not often advisable, but the occasional gesture is very powerful. One example for

utilizing method can be demonstrated with a simple Think-Pair-Share question, a method where students think about the answer on their own and then form pairs and share answers with one another. Once this process is complete, the instructor can ask if there was anyone in the room who struggled with the question and was unsure of their answer but now feels more confident in their answer. Typically, many hands will go up throughout the classroom. The instructor can then rephrase the question and ask if there is anyone in the room who was unsure of their answer, but impressed by the answer of their partner and because their partner explained the answer to them they became convinced that their group had the correct response. A smaller subset of hands will usually be raised. Then, the professor can ask those students with their hands still up if any of them would like to "volunteer" their partner to explain the answer to the class. Predictably, students will excitedly point at their partners, many of whom may look embarrassed. At this point, the instructor should approach the most excited student, get their partner's name, and ask the partner if they would come to the board and work out the problem. Once the volunteered student has agreed, the professor can announce, "[NAME of PERSON], is going to teach us some economics. Let's give them hand!" and hand the student a microphone. When classmates are applauding for their fellow classmate, the student almost always comes up to explain how they solved the problem. When the selected student gets the explanation right, which they always do, they should be thanked and given $5 to buy lunch. This small gesture completely breaks down the usual, one-way instructor learning dynamic and it also shows that students are in charge of their own education, student input is valued, and participation is rewarded in the course.

Conclusion

The idea that incentives matter is a core principle in economics. Yet many professors struggle with motivating students beyond simply using grades. In this paper, examples are provided for setting up a monetary system that uses money frequently, methods are illustrated for using money sparingly but effectively, first day relationships are built up in order to motivate students, and a framework is designed for building social capital in the classroom. In addition, we provided special tips for motivating student learning and engagement in both small and large classrooms and all tips defined in this paper feature minimal costs to the professor and have been utilized first-hand by the authors of this paper.

Some limitations are worth noting based on the authors' shared experiences using these methods. First, the list of motivational methods is not all-inclusive – there are plenty of other effective methods. Second, the suggestions described here are not necessarily suitable for every instructor. In fact, of the four authors who co-wrote this paper, none use every single idea mentioned in this paper. Instead, with this paper as a starting point, motivational methods can be personalized and instructors should begin with the one or two ideas that seem most natural and that fit with their own distinct personality, classroom culture and teaching style, adapting the teaching methods over time for their own students.

Universally, economists recognize that incentives motivate human behavior. Likewise, economics educators should realize the power incentives can wield towards improving academic performance within their own classroom. This paper acts as a useful tool for educators, providing them with a storehouse of instructional methods that acknowledges a central theme in economics, allowing instructors to harness the power of incentives in order to motivate all students towards a love of learning that exists beyond grades.

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Appendix A: Sample Syllabus (First Page)

PRINCIPLES OF MICROECONOMICS

WITH DR. MATTHEW ROUSU

ECON 202 **Spring 2016**

Course Description

Principles of Microeconomics introduces principles of supply and demand, how they affect levels of output, price, and employment under various market structures. This course is part of a two-course sequence in economics.

Course Learning Goals:

1. Gain an understanding of how market interactions lead to determination of market prices and quantities and the welfare effects of these interactions. You will also learn about the methods governments use to regulate markets, including the effects of minimum wages and taxes.

2. Gain an understanding of the basic methods of economic analysis, including supply and demand analysis. You will learn how to use supply and demand analysis to examine a number of issues that are a source of conflict, including taxes, price floors and price ceilings, inequality of wages, and more.

3. Gain an understanding of how knowledge in economics is based on prevailing economic theories.

Course Web Page

This course is set up through Blackboard. I use Blackboard to post homework assignments, to occasionally provide outlines of the PowerPoint notes used in class, to provide classroom announcements, to provide links to the online lectures, and more.

Lecture Time & Location:
MWF, 8:45am-9:50am,
Steele Hall 007

Dr. Rousu's office:
Apfelbaum Hall 311

Contact Information:
Phone: 570-372-4186
Email: rousu@susqu.edu

Office Hours:
M,W 10:00-11:00
T 8:15-9:15

Note from Dr. Rousu:
I could also meet with you outside of office hours if necessary—email to set up a time.

One goal of this course is for you to realize that economics is everywhere, even in pop culture! Did you know these shows/songs were illustrating economics?

Syllabus Contents:

- Required Purchases for Class
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Keynesbiscuit, Marketariat, and the Fool in the Shower: Metaphors for Teaching Policy Lags in Macroeconomics Principles

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Abstract

Principles of macroeconomics textbooks devote a great deal of space to countercyclical fiscal policy, but generally provide only scant coverage to factors that make its application difficult in the real world. In fact economists are generally skeptical of the ability of fiscal policy to smooth the business cycle because of the policy-lag problem. This paper provides a metaphor—a horserace between active policy and the self-correcting mechanism—that can help students move into the higher levels of Bloom's taxonomy of learning (analyzing, synthesizing, and evaluating) with respect to fiscal policy. The metaphor can be extended to include discretionary monetary policy as well.

Introduction

Fiscal policy—tax and spend policy designed to help achieve key goals such as full employment and price stability—is a keystone of any class in the principles of macroeconomics. Textbooks generally devote at least one chapter to fiscal policy, and many implicitly devote much more than this since the topic is in the background of discussions of aggregate demand and supply, the traditional Keynesian "aggregate expenditure" model, and the spending multiplier effect. Textbooks often also include historical examples of the government's attempt to fight economic downturns through spending increases or tax cuts. For example, Mankiw (2015, p. 370) cites the Kennedy tax cut of 1964. Hubbard and O'Brien (2015, p. 541) cite the Bush tax cut of 2001, of which Hubbard was a key designer. Of course all up-to-date texts cite President Obama's stimulus policy of 2009 as an application of Keynesian-style fiscal policy.

But the economics profession, particularly since Lucas and Sargent (1979), has expressed increasing skepticism regarding the efficacy of countercyclical fiscal policy. An important reason for this skepticism is that fiscal policy is confronted with long time lags, which make it difficult to achieve the desired countercyclical effects (Blinder, 2004). This is particularly true with respect to combatting recessions, which generally last an average of 9 months. Despite this, the typical principles textbook teaches the Keynesian fiscal policy model in such a way that students are led to believe that it is an easy game of influencing aggregate demand through direct autonomous spending injections or tax cuts. End of the chapter or on-line questions often present students with numbers and ask them to specify how much government would need to spend to close an output gap (i.e. if the spending multiplier was 10 and GDP was $300 billion below full employment, how much would government spending would need to rise to close the gap?).

To give students some real-world flavor, textbooks generally spend a couple of paragraphs dealing with the policy-lag problem and how it can limit the effectiveness of fiscal policy. For example, Mankiw (2015, p. 372) writes, "In the United States, most changes in government spending must go through congressional committees in both the House and the Senate, be passed by both legislative bodies, and then be signed by the president. Completing this process can take months, or in some cases, years. By the time the change in fiscal policy is passed and ready to be implemented, the condition of the economy may well have changed." Acemoglu, Laibson, and List (2015, p. 316-317) provide some detail with respect to the implementation of policy noting "It takes a long time to build a bridge, a highway, or a school. Plans have to be drawn up. The

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local community has to be consulted…. Environmental impact studies have to be conducted. Contractors have to be hired. And only then, construction begins."

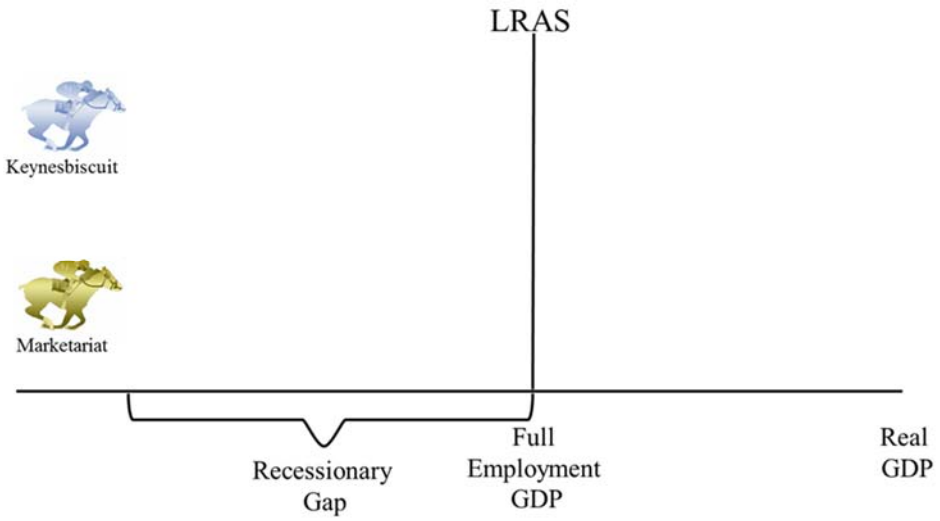
Still, while most textbooks may spend 25 to 50 pages outlining how fiscal policy works in theory, they generally spend only a page or so talking about how policy lags render fiscal policy ineffective in the eyes of many economists. Thus, the typical textbook approach to teaching fiscal policy in principles classes is heavy on the first two learning domains of Bloom's taxonomy—learning and applying. But to get students to higher levels of the taxonomy—analyzing, synthesizing, and evaluating—instructors should spend much more time on issues such as the policy-lag problem when discussing fiscal policy. This paper lays out an approach to teaching the policy-lag problem that we have found to be highly effective. We set up a horserace between two contestants—active fiscal policy and the self-correcting mechanism—and describe the factors that will determine which horse is more likely to get an economy that has been shocked out of full employment to the finish line first.

The Policy-Lag Problem

Milton Friedman, in a dialogue with Walter Heller, a prominent Keynesian economist who was the Chair of President Kennedy's Council of Economic Advisors, wrote that the Keynesian "goal of an extremely high degree of economic stability is certainly a splendid one. Our ability to attain it, however, is limited…. the attempt to do more than we can will itself be a disturbance that may increase rather than reduce instability" (Friedman and Heller, 1969, p. 48). We like to present this quote to students after we have outlined the basic Keynesian model of fiscal policy. We then present them with the following situation—suppose the economy is hit with a shock that causes GDP to fall below its full employment level and causes unemployment to rise about its natural rate. If we leave things to the self-correcting mechanism, the economy will certainly get back to full employment at some point. History shows that the average postwar recession lasts an average of 9 months and the economy generally returns to full employment within a year or two after that. The key issue of discussion is whether Keynesian-style fiscal policy can get us to full employment faster and this discussion cannot be completed without a thorough exploration of the policy-lag problem.

To make this discussion livelier for students, this scenario can be set up as a horserace. As shown in Figure 1, we like to draw a picture on the board with two horses stacked above a horizontal line that doubles as an X-axis for Real GPD. The finish line, to their right, is a vertical line drawn at potential output—i.e. the full employment level of GDP (if the concept of Long Run Aggregate Supply has been discussed at this point, one can label the finish line as such). The distance between the horses at the "starting gate" and the finish line is a recessionary output gap.

Figure 1. Illustration of the Policy Horserace



It is fun to allow the students to suggest names for the horses—one of whom will represent the self-correcting mechanism, and the other of whom will represent active fiscal policy. The two best suggestions that the authors have heard from students in the past are "Marketariat" for the self-correcting mechanism horse and "Keynesbiscuit" for the active policy horse. Of course these are plays off of the names of two of the most famous racing horses in history, Secretariat and Seabiscuit. Creative students may come up with even better, and more contemporary, names.

First, it is important for students to understand that neither horse will reach the finish line instantaneously—neither markets nor policy makers are perfect. The case for Keynesbiscuit crossing first is easy to make based on the material covered up that that point in the class—increases in government spending or tax cuts will boost aggregate demand and move the economy toward full employment faster than the self-correcting mechanism alone would. But what is the case for Marketariat?

Economists have noted as early as Friedman (1953) that time lags act as a constraint for effective policy. Lags are sometimes divided into two categories, inside and outside, where inside lags refer to the time it takes to recognize the problem and implement a policy, while outside lags refer to the time it takes for the policy to have an effect. Alternatively, as is our pedagogical preference, one can break the lags into the following four—each of which has a self-descriptive name—Recognition Lag, Decision-Making Lag, Implementation Lag, and Impact Lag.

The next step is to talk about the race. If the instructor wants to be humorous, he/she can mimic the voice of a horse race announcer—"there's the gun, and their off!" Well at least one of them. Marketariat is a pretty slow horse, but at least he runs at the gun. As the economy has been shocked out of equilibrium, market forces are operating through the price mechanism to slowly bring the system back to equilibrium. Keynesbiscuit—whose movements are assumed to depend upon active fiscal policy—is still standing at the gate. Why? This horse did not hear the gun because it takes policy makers time to recognize that a problem exists. Data are backward looking and the economy may be contracting for several months before the recession is recognized. For example the US economy experienced a recession that began in July 1953, but President Dwight Eisenhower's Economic Report of the President (1954, p. iv) in January 1954 only wrote that the administration "would not hesitate to use any or all [policy] weapons as the situation may require" should a recession occur. During the Recognition Lag, which may generally take between 3 and 6 months, Marketariat is slowing working his way toward the finish line while Keynesbiscuit is standing still.

Once the problem is recognized, policy makers have to decide what action to undertake. Here the whole process of congressional action for budgetary items can be discussed. Congress forms committees and proposes various spending and tax cut bills. Debate ensues until a bill emerges that is passed by both the House and Senate and signed by the President. Students can discuss how long they think this process will take. In the meantime, Marketariat is slowly inching his way to the full employment finish line as the recession is likely approaching its trough. Keynesbiscuit, of course, is still standing at the starting gate as he has not been given any way to start moving—i.e. aggregate demand has not yet been influenced at all by active policy.

Of course to the extent that the economy has automatic stabilizers built in (i.e. taxes are a function of income or profits and citizens are eligible for unemployment insurance or other safety nets), Keynesbiscuit may begin to move earlier. If Keynesbiscuit is solely a metaphor for discretionary fiscal policy—hence the overriding issue is whether government should pass new tax and spend stimulus policies in light a recession—then such stabilizers can be said to have no effect on this horse's movements. The instructor could even choose to assign the automatic stabilizers to moving Marketariat if the discussion's intention is to address whether discretionary policy should be employed. But if we define Keynesbiscuit's movements as anything related to aggregate demand, then certainly automatic stabilizers will cause Keynesbiscuit to move during the Recognition and Decision-Making Lags. The decision on how to treat automatic stabilizers with respect to the horse race metaphor—whether they move Keynesbiscuit, Marketariat, or neither horse—is up to the instructor.

After discussion of the Decision-Making Lag, the students can be presented with some hypothetical stimulus policies that have been signed by the President, and asked how long these would take to implement. First, for example, consider a major tax cut bill. The IRS has to change the withholding schedules so as to leave more dollars in workers' paychecks. Companies' human resources divisions must them implement these new policies so that future pay checks can be increased, thus boosting aggregate demand through the current income channel. In many recent stimulus cases (1975, 2001, 2008), tax "rebate" checks were sent which provided a lump-sum check to households. For example Bush's Economic Stimulus Act of 2008 became law on February 13 and the government then sent payments of up to $600 per tax payer and $300

per dependent child out to every taxpayer between May and June of 2008—three to four months after the law was passed. In any case, the Implementation Lag associated with getting this tax cut into workers' hands is likely to take at least three months or so.

If, on the other hand, the stimulus package includes government spending on say new infrastructure, the Implementation Lag could be much, much longer. Discussion along the lines of the quote from Acemoglu, Laibson, and List (2015), mentioned earlier in the paper, can take place. Students can be asked how long they think it would take between the time a bill is passed allocating $200 billion for new infrastructure, and when the first (and last) worker on one of those projects receives a paycheck. Experience from the Obama stimulus, which included over $200 billion in infrastructure clearly illustrates this problem as it took years for all this money to be spent—and only a very miniscule amount was spent within a year of the stimuluses' passage. President Obama admitted in June 2011 that with respect to implementing the infrastructure aspects of his stimulus policy, "shovel ready was not as shovel ready as we expected."[2]

Even under the most optimistic assumption, the three lags above will take at least 8 to 10 months, and likely will take much more than this time. Taylor and Castillo (2016) show that for the 11 postwar recessions, it has taken an average of 10.6 months from the recession's start before the very first discretionary fiscal policy was implemented—and generally the full bevy of stimulus policy was not implemented until several months after that. Thus Marketariat, has a tremendous head start on Keynesbiscuit in our metaphorical horse race. Given these policy lags, the typical recession will likely be over before Keynesbiscuit leaves the starting gate.[3]

Now that the first dollars have been injected into the economy, Keynesbiscuit is finally on the move. And as the fiscal injection continues to be pumped into the economy over the next several months—or years depending on the specific nature of the tax cut or spending boost—Keynesbiscuit will accelerate faster and faster and almost certainly will be moving faster than Marketariat, assuming Marketariat has not already crossed the finish line. But even the stimulus itself takes time to have its full effect—defined as the Impact Lag. As the spending multiplier suggests, one person's spending is another person's income. Thus the multiplier is a dynamic process that takes time—Jim receives $100 from the stimulus and spends $90 buying some shoes from Jane, who takes $81 of those and buys a hat from George, and so on. Through this dynamic process, dollars injected into the economy today will be "multiplying" throughout the economy for several years.

The Race to Full Employment: Who Wins?

A key issue then is whether, despite all these lags, Keynesbiscuit can get to the finish line before Marketariat. Much of this depends upon how fast we believe the self-correcting mechanism that Marketariat embodies is. Students can again be reminded that a typical recession last less than a year and recovery back to full employment is generally relatively swift. The instructor can certainly attribute some of the rapidity of the average recession's ending to automatic stabilizers (or monetary policy, which is discussed later), but the main point of the metaphor is to discuss the effectiveness of discretionary fiscal policy such as a tax cut or spending increase that is intentionally passed in response to a recession. Another major factor in Keynesbiscuit's speed relative to Marketariat is how effective the government is at passing carefully targeted and timely fiscal policy. A final factor is how far away the finish line is from the race's starting point. If the downturn is particularly long and deep, such as the Great Depression of the 1930s, or perhaps even the more recent downturn and very slow recovery of the Great Recession of 2007-2009, Keynesbiscuit could potentially overtake Marketariat before crossing the finish line of full employment. The policy lag problem is much less of an issue in long steep depressions as it is in a more "garden variety" recession. There is no right or wrong answer to the question of who wins. As is the case in many topics in macroeconomic policy, critical thinking leads to the conclusion that the real-world answer depends on many factors.

[2] https://www.youtube.com/watch?v=O55aRrvXtio

[3] As addressed earlier, if the instructor assigns Keynesbiscuit's movements to both discretionary fiscal policy and automatic stabilizers, the horse will move prior this period, but Keynesbiscuit will not pick up the major speed the stimulus policy creates until this stage.

Overshooting the Target

To conclude the discussion of the policy lag problem as it relates to the implementation of Keynesian-style fiscal policy, one can return to the last phrase of the Friedman quote above—"The attempt to do more than we can will itself be a disturbance that may increase rather than reduce instability." Friedman argued against employing discretionary fiscal policy because he felt that policy makers would overshoot their target and make the business cycle more volatile rather than less.

Friedman used his own metaphor—the "fool in the shower"—to describe this. Suppose, as is often the case in older structures, that there is a lag between the time in which the water faucet knob is turned and when the water coming from the spigot changes temperature. If a showering person feels the water is too cold, he or she will turn up the hot knob. However, the temperature does not change right away because of the time lag. The person, not accounting for the time lag, turns up the hot water even more. Finally the action begins to take effect, but when the full effect is felt, the water is now too hot. The person will then reach for the knobs again to turn the temperature down. But the water remains scalding hot because of the time lag. The panicked person turns up the cold dramatically even more. Finally the water begins to cool down, but now it is too cold again as the target has been overshot. The process repeats ad infimum. The fool in the shower is constantly fine tuning the knobs—overshooting the target—and never gets a comfortable shower. Applied to economic policy, the business cycle has deeper ups and downs rather than more stability. The fool in the shower metaphor is one that really brings the issue to life for students and helps them gain a deeper understanding of policy issues.

In relation to the horserace metaphor, Keynesbiscuit is likely going to be moving at his fastest speed several months after the policy is implemented—and if history is a guide this implementation probably did not occur until after the recession was over. So now when the economy is recovering on its own volition, a Keynesian stimulus is going to add juice to that recovery, which certainly may be appropriate at first if the economy is still below full employment. But the recovery may soon turn too hot and inflation may rise and/or asset bubbles may form. Now we have a new problem and government clearly needs to take new countercyclical steps to slow Keynesbiscuit down. The policy maker may wish to pull the reigns and say "whoa," but the same policy lag problem that we faced in getting Keynesbiscuit to start running will now effect the ability to get him to stop.

These policy lags were the reason that Milton Friedman was against the use of discretionary policy, but instead favored policies that involved following automatic rules. Incidentally, when one of us was teaching at the University of Virginia circa 2000, a student came up after the lecture on this topic and said that a mystery had been solved. Milton Friedman was apparently this student's uncle and the student said that Friedman's shower faucets had markers on the knobs. Cleary, the student deduced, these markers allowed Friedman to follow his own rule-based approach as he could always turn the knobs to the same location, rather than engage in fine tuning the shower's temperature.

Fed o' War

Thus far, the intention of the article has been to help instructors discuss the policy-lag problem as it relates to fiscal policy. In most textbooks fiscal policy is first presented well before monetary policy. When the instructor does address monetary policy (or if the instructor delays talking about the policy-lag problem until after both types of policy have been discussed), a new horse may be added to the race—that of the Federal Reserve's employment of discretionary monetary policy. We like to name this horse "Fed o' War" (after Man 'o War, perhaps the greatest thoroughbred racehorse of all time).

Blanchard, Dell'Ariccia, and Mauro (2010) note that prior to the Great Recession of 2007-2009 there was a broad consensus that if countercyclical policy was to be attempted at all, it should come via monetary, not fiscal, measures—i.e. Fed o' War was considered to be a superior horse to Keynesbiscuit. While monetary policy is still subject to the same length of the Recognition Lag that fiscal policy encounters, there are reasons to believe that significant differences exist with respect to how long some of the other lags may last. After all the Federal Reserve meets regularly every 6 weeks and can call emergency meetings, as it did when it cut rates after a conference call of FOMC members a few days after the terrorist attacks of September 11, 2001. The Federal Open Market Committee consists of only 12 members and the body is generally far less politically contentious and fractured than Congress.

While these facts have the potential to shorten the potential Decision-Making Lag substantially in comparison to fiscal policy, the Fed has still been known to act more slowly than what hindsight shows was the appropriate time. For example, the Fed has been likened to the "fool in the shower" with respect to its decision making regarding interest rates in the mid-2000s. In the aftermath of the recession of 2001, the federal funds rate was cut to an historic low level of 1.25 percent in November 2002 and further cut to 1 percent in mid-2003. The rate remained at this level until the summer of 2004 when the Fed slowly began a series of 25 basis point increases until the rate was normalized in 2006. These low interest rates, combined with a steadily growing economy, contributed to the sharp housing bubble of 2003 to 2006. By the time the Fed normalized rates, the bubble was about to pop, leading to economic fallout of 2007-2009 (Baum, 2012).

In terms of the Implementation Lag, again the Fed can certainly act much more quickly than fiscal policy makers can—overnight interest rates can be changed immediately and the Fed can quickly influence the money supply through the buying and selling of government securities (Taylor, 2000, p. 27). Still, with respect to the Effectiveness Lag, it is widely recognized that changes in the money supply act with a long and variable lag, and it is not unambiguously clear whether lags associated with the effectiveness of monetary policy are generally longer or shorter than those of fiscal policy. For example, the Fed's "Quantitative Easing" actions between November 2008 and October 2014, in which the Fed purchased $4.5 trillion worth of assets, had somewhat limited effectiveness in relation to the size of the stimulus. The reason is that despite the asset purchases of this amount, the money supply did not grow by anywhere near $4.5 trillion because banks increased their holdings of excess reserves from $1.9 billion in August 2008 to $2.6 trillion in January 2015 (Craig and Koepke, 2015). Banks may eventually lend out these excess reserves—if the Fed does not remove them first—but whatever amount of time it takes between the Fed's asset purchase and the banking system lending this new money out is clearly representative of a long Effectiveness Lag for the Fed's Quantitative Easing program.

In terms of the three horse race—Marketariat, Keynesbiscuit, and Fed 'o War—again the purpose is to develop students' critical thinking skills rather than to declare an unambiguous and clear-cut winner amongst these three. As discussed earlier, the answer as to who wins the metaphorical horse race depends upon many factors. However, most economists would argue that in response to a typical recession Fed 'o War is the odds on favorite to beat Keynesbiscuit in a head-to-head matchup, and that he is the horse that has the best shot at beating Marketariat. In advanced classes, the instructor can bring in the concept of interest rates hitting the zero bound during a deep and long downturn—in which case Keynesbiscuit may be the horse that takes the crown.

Conclusion

While principles of economics classes generally spend a great deal of time on the broad topic of fiscal policy, most economists are skeptical about its effectiveness in counteracting the business cycle. Unfortunately, textbooks do not typically devote much space to the major shortcoming of countercyclical fiscal policy—the policy-lag problem. But if we want to move our students further up Bloom's taxonomy of learning, to stages such as evaluating and analyzing ideas, discussions of policy lags need to be given more attention. This paper discusses some metaphors—a horserace between active policy and the self-correcting mechanism, as well as Milton Friedman's "fool in the shower"—as engaging ways to present the policy lag problem. We hope that these metaphors will serve as a useful tool for introductory (or intermediate-level) economics instructors.

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Through the Lens of Life: Teaching Principles of Economics with Humans of New York

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Abstract

Stories create a direct and powerful connection between students and the course material, increasing their level of attention, bringing abstract economic concepts to life, and refining critical thinking skills. *Humans of New York* is a project that chronicles stories of ordinary New Yorkers. It provides an opportunity to connect students with illustrations and personal accounts of economics in the real world. This can reduce the abstract nature of theory and give students concrete examples of economic terms and concepts; in a way that reflects their own environment, culture, or experiences. We highlight these stories and show how to incorporate them into lectures.

Introduction

Students enrolled in principles level courses find the study of economics to be abstract, dry, and irrelevant. The strict assumptions we impose upon our models can make economics appear unrealistic and its effects on the lives of our students are often hard to identify. The abstract nature may explain why it is difficult for students to retain information after completing principles courses.[3] Instructors teaching at the principles level will acknowledge that making economics relevant to the student can be a challenge. In response to this, recent efforts in economic education have explored opportunities to make content relevant by utilizing literature, popular media, music, and art to teach economics.

In this paper, we provide a new resource for economic educators, a storehouse of real life examples that can be used to engage students with the economics of the real world. *Humans of New York* (*HONY*) is a photojournalism project devoted to sharing images and conversations of real life New Yorkers that has continued to spread both in scope and in popularity. These *HONY* images and their accompanying captions are filled with many useful examples of economic concepts and illustrate the relationship of economics to the world outside of the classroom. Instructors utilizing *HONY's* illustrated stories can enhance their students' learning experience by using them to provide concrete, real life examples of economics while simultaneously benefiting from the power of images to help reinforce major concepts and ideas.

Literature Review

There are roughly one million students enrolled in a principles level course in the United States each year. Annually, 30,000 students will graduate as economics majors, with 10,000 of those deciding to pursue the degree after taking a principles level course (Allgood, Walstad and Siegfried, 2015). However, most students enrolled in principles courses do not go on to become economics majors. Research has suggested that one reason might be due to the way economics is taught. Since Becker and Watts (1996) criticism of economic educators and their teaching style, there has been a shift towards innovative teaching methods

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[2] The authors would like to thank Alan Grant and two anonymous referees for their helpful comments.

[3] Walstad and Allgood (1999) find that there is a slight difference in economic knowledge between seniors that took a principles class and those that did not.

and the incorporation of new teaching tools. According to data from the National Center for Education Statistics (NCES), economics majors have increased from 17,577 to roughly 28,000 in the period between 1998 and 2012.[4] While the number of majors is increasing, one statistic persists: most students who take an economics course do not go on to major in economics. Another ongoing issue for the field is highlighted by Allgood and Walstad's (1999) research that reported that seniors with principles level exposure scored 62% on an economics exit exam. While this is 14% higher than seniors without any exposure to economics, it is important to recognize that 62% still represents a deficiency in comprehension. Therefore, it is essential for economic educators, particularly at the principles level, to incorporate teaching methods that increase the retention of economic content and interest in economics as a major.

In order to increase student interest in economics, boost the retention of economic content, and make the subject more applicable to students, economic educators have utilized many new teaching tools. One tool is the use of literature as a complement to traditional teaching methods (Cotti and Johnson, 2012; Hartley, 2001; Watts, 1998; Watts, 2002). Economic educators have also used literature in upper division courses (Vachris and Bohanon, 2012) to help make economics more memorable and interesting (Bransford, Brown and Cocking, 2000). The use of literature has progressed towards the use of Great Books of Western Civilization (Hartley, 2001), historical novels (Cotti and Johnson, 2012) and short stories (Ruder, 2006) in economics classrooms. This transition from passive to active learning through the use of literature-based stories helps students retain more information versus traditional lecture-based models.

While there are no empirical studies that examine the efficacy of the use of stories in the economics classroom, studies have indicated that there are benefits to diversifying teaching methods (Hoyt, 2003). Researchers have suggested that the use of memorable classroom activities can increase student learning and retention (Al-Bahrani, Holder, Patel and Wooten, 2015; Bransford, Brown and Cocking, 2000), while Vazquez and Chiang (2014) make a strong argument for using images to enhance learning and retention of economic content. Using cognitive science research, they go as far as to suggest that it is more effective to use images rather than text in traditional PowerPoint presentations (Clark, 2008; Medina, 2008; Watts and Christopher, 2012).

Using images and stories is an improvement upon the less engaging "chalk and talk" method that Becker and Watts (1996) criticized. Hoyt (2003) promotes the use of real life content in order to help make economics relevant to students. She also promotes using students' own experiences and popular culture as examples in the classroom. The benefit of using *HONY* is that it combines the power of storytelling, real life examples, and images. Through social media, many students already have exposure to *HONY* and can readily relate to it. We find that the use of *HONY* images to reinforce major themes in economics provides educators with an opportunity to attract new students, increase retention of economic content, allows students to see economics in real life situations, and helps students to begin to think like an economist.[5]

What is *HONY*?

HONY begins with the story of its founder, Brandon Stanton, a bond trader who was fired from his job in the financial industry in 2010 after the subprime mortgage crisis. He is an excellent example for students of cyclical unemployment. He decided to build his human capital in an alternative area and began what he termed a "photographic census of New York City," setting a personal goal to take 10,000 portraits of New York City residents. As he began to share his personal project through Facebook, Twitter, Instagram, and the *HONY* website, his fan base grew. He began interviewing the people he photographed, and his work expanded to include the personal stories captured in his images (Stanton, 2013). Today, *HONY* has 17.7 million followers on Facebook, 5.4 million on Instagram and almost 425,000 Twitter followers[6]. Almost 5,000 photos and three books later, Stanton's story and *HONY*[7] offer a perfect opportunity for students to relate economics to the real world by connecting classroom content to a compelling picture and a personal story.

[4] https://nces.ed.gov/programs/digest/d13/tables/dt13_325.92.asp

[5] Allgood, Walstad, and Siegfried (2015) Siegfried et al. (1991), Siegfried (1998) find that most economics faculty list "thinking like an economist" as a goal of an economics undergraduate degree.

[6] Per https://www.facebook.com/humansofnewyork/, https://www.instagram.com/humansofny/ and https://twitter.com/humansofny , at the time of this writing.

[7] The official *Humans of New York* website: http://www.humansofnewyork.com/

Why Economic Educators Should Use *HONY*

HONY is a unique, low-tech, easily accessible, pedagogical tool in contrast to other more costly, technology-dependent methods for improving economic education. This ease of accessibility also allows *HONY* to integrate well into active learning assignments such as think-pair-shares, creative writing, and social media projects (Al-Bahrani and Patel, 2015). It also builds upon the use of images for teaching economics (Vazquez and Chiang, 2014; Al-Bahrani, Holder, Moryl, Murphy and Patel, 2016) and serves to further integrate the humanities into economic education (Al-Bahrani, Holder, Patel and Wooten, 2015).

HONY can act as a vehicle for translating the abstract concepts of economic theory to more applicable real world examples. This approach to teaching economics allows the class to discuss sensitive and sometimes personal topics that can often be difficult for the instructor to introduce, such as poverty, discrimination, illegal markets, and social injustice. Its relatable content gives students examples of how economic concepts can be found in their own lives. Slamecka and Graf's (1978) seminal work on the generation effect asked a straightforward question, namely, is a self-generated word better than one that is externally presented? As students begin to create connections with their own stories, they generate the economic concepts internally and are able to recall the concepts more easily.

HONY also allows educators to connect with different types of learners in their classroom. When principles of economics courses are offered as part of the general education core or as a required business core, a wide range of student learning profiles are present in a single classroom. Educators must provide ample opportunities for differentiated learning to take place, while simultaneously minimizing their own costs. Other methods of using learning hooks to meet the needs of diverse groups of students have been well-documented in the literature (Hoyt, 2003), in particular the use of popular media such as music, movies, and television to attract and retain interest in economics (Mateer, 2012). *HONY,* as a teaching tool, has not previously been introduced to the economic education community; however, the down to earth way in which it presents the everyday stories of regular people makes it a particularly relatable and powerful media resource to incorporate in your classroom.

How to Use The *HONY* Collection for Principles of Economics (HONYEcon)

In HONYEcon, we have selected *HONY* stories that are well-suited and relevant to principles level courses in economics and cover a wide range of topics applicable to both microeconomics and macroeconomics. We discuss how to use these stories to help students correctly identify abstract economic concepts and connect with tangible real world examples. We also provide an example of a think-share-pair with each story. They have been organized to follow a traditional principles course in economics.

HONYEcon easily scaffolds with Bloom's revised six-part taxonomy (Anderson and Krathwohl, 2001) for categorizing educational goals (remember, understand, apply, analyze, evaluate, and create).

- As discussed previously, the photographs and stories help learners *remember* the relevant economic concept(s). Instructors may direct students to the associated webpage, distribute the material as a handout, or include the story and photograph in a slideshow.

- An explanation of how the photo and story relates to the economic concept being taught increases the *understanding* of the concept. Instructors can use the examples in HONYEcon to introduce new concepts at the start of a lecture or reinforce a concept at the conclusion.

- Once instructors have sufficiently demonstrated how economics is illustrated through *HONY,* small group discussions or think-pair-share activities give students an opportunity to *apply* this technique to other selected stories and *analyze* and *evaluate* their own and other students' application of economics to the story. In an alternate *application* exercise, students access the *HONY* site on their own and identify economic concepts and themes that align with course content. Exemplary findings can be integrated into the instructor's subsequent slides and lectures.

- The ultimate learning goal is also within reach. Students can be assigned a project to *create* their own *HONY*-style posts that illustrate economic concepts. This type of differentiated assessment has the added benefit of being a powerful tool for attracting non-traditional majors to the discipline and is essential

in helping students retain content at the highest level of learning and engagement (Al-Bahrani, Holder, Patel and Wooten, 2015).

The progression outlined above helps the instructor guide students towards "thinking like an economist." Instructors incorporating HONYEcon into their courses may consider introducing this idea through an activity on the first day of class. Begin by distributing a story from HONYEcon with an accompanying extension question to each student. Ask them to find other students with the same story. In this way they will form small groups, discuss the extension question, and formulate an answer to share with the class. After each group shares their answer, the instructor provides the economic terminology as an introduction to what will be covered in the course. This method helps students begin to connect real world stories with economic concepts from the very start of the course and ultimately culminates with the creation of their own story by the end of the course.

The *HONY* Collection for Principles of Economics

Our first story (Figure 1) revolves around a young man who decided to attend medical school and gave up playing music. This seems to be a wise choice, since only a few musicians ever earn as much as a physician, and illustrates the concept of *opportunity cost*. However, he laments that a friend with whom he used to record covers has now become quite successful making recordings, and he wonders if he made the right choice. When they caught up recently, they decided to make a new cover together. Because she has become famous, the new cover has "more views than the combined total of everything else I ever worked on." You sense that he might have pursued a different path if he had known that his collaborations with her would have become so successful. He gave up that opportunity when he went to medical school, which economists refer to as a *sunk cost*. His *opportunity cost* was the chance at stardom that his friend achieved. The fact that he was not willing to pursue a career in music tells us that he preferred a certain income with less variability to an uncertain career with a lot of variability in earnings and illustrates that economics is about *choices*, *tradeoffs*, *uncertainty*, and *risk preferences*.

Think-pair-share prompt: To extend this example, play the song for the class http://bit.ly/1vcds0j and ask students what career they would pursue if they knew with 100% certainty that they would be successful. Is it the career they are currently pursuing?

Figure 1: Medical School vs. Music

"Before medical school I was really into music. I'd work really hard on some songs, and post them on YouTube, and sometimes they'd get a few thousand views. There was a girl I used to collaborate with. We did a few covers together. But I went to medical school, and she skipped college and focused on music full time. Anyway, she's doing great now. All her songs get hundreds of thousands of views, and she just got back from a tour in Asia, and is talking with some major record labels. The funny thing is, she stopped in New York awhile back, and we met up and recorded a cover together, just for old time's sake. We just threw it together really quickly, but because of who she is now, that song got more views than the combined total of everything else I ever worked on. It's funny how things work out."

http://www.humansofnewyork.com/post/101206206631/before-medical-school-i-was-really-into-music

In our second story (Figure 2), life has taken an unexpected twist for this gentleman. Early on, he discovered that he could accomplish his personal goals, such as having a successful career and traveling, without investing precious resources into obtaining a college degree, so he dropped out of school. This

served him well until he found himself looking for a match on the dating *market* at age thirty. He found that potential matches were assessing his suitability and repeatedly finding him wanting. He explains that his lack of degree sends the wrong *signal* to women, "it's just gotten too embarrassing to keep explaining why I don't have a degree. It's a deal breaker with most women at this age. They might spend the night with me, but they won't call me in the morning." His experience is not unique. Often the process of dating requires that two people, who know relatively little about one another and suffer from *asymmetric information*, quickly evaluate the *costs and benefits* of pursuing a relationship beyond the first meeting. They may rely on previous experience to fill in the missing information and will pay attention to *signals*. For instance, they may have found that people without a college degree have lower salaries than others or perhaps non-college graduates may be perceived as less intelligent than their college-educated counterparts. Rather than investing the time to find out if those generalizations are true, they decide to move on to someone else. This behavior aligns with *search theory* in economics. This gentleman has found that a college degree has tremendous value in the dating *market* as a *signal* of his quality as a potential marriage partner.

Think-pair-share prompt: Would you date someone without a college degree? Why or why not?

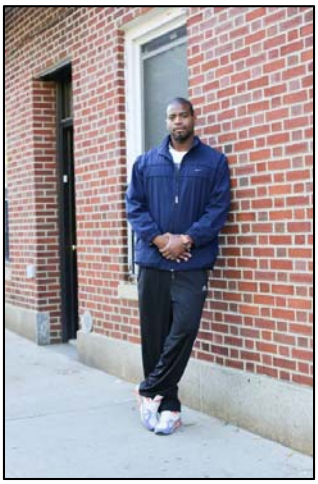

Figure 2: The Degree as a Market Signal

"I dropped out of college when I was nineteen, and now I'm going back at the age of thirty. I didn't think I needed a degree for the longest time. I travelled a lot, and I've always been employed. But it's just gotten too embarrassing to keep explaining why I don't have a degree. It's a deal breaker with most women at this age. They might spend the night with me, but they won't call me in the morning. So I'm going back. But I'm much more focused now. I'm impatient. I'm the oldest one in my class, so I don't even want to socialize. I have no interest in getting a beer with you after class. Unless you're good at trigonometry."

https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/1110928808981218/?type=3&theater

Our third story (Figure 3) is brilliant, simple, and straightforward. In keeping with Israel Kirzner's (1997) definition of an *entrepreneur*, our featured New Yorker is looking to combine resources in a way that provides value to his customers and is focused on the process of discovery. He wants an added measure of security for his future enterprise and is looking for something that others will consistently want, even while many other things in their lives may change. What fits the bill? Funeral services and liquor! There are very few *substitutes* for these two things, and their *price elasticity of demand is relatively inelastic*. It's no wonder these businesses have been in existence for centuries!

Figure 3: Funeral Parlors and Liquor Stores

"I want to either open a liquor store or a funeral parlor."
"Why those two things?"
"I figure those are the two things that everyone needs."

http://www.humansofnewyork.com/post/91147105781/i-want-to-either-open-a-liquor-store-or-a-funeral

Think-pair-share prompt: Since Kirzner's entrepreneur is a person who is known for discovering previously unnoticed *profit* opportunities, another question for your students could be, "Do you think this entrepreneur could successfully pursue both businesses simultaneously?" Answers may include a discussion of *complementary* goods.

Our fourth story (Figure 4) is about a woman from Brooklyn's Cobble Hill who lived in a rent-controlled apartment. She was ready for a change and told her friends that she was thinking of moving to Atlanta to open a café. They all said, "Don't do it. You'll regret losing the apartment," but she ignored their advice and moved anyway. Almost immediately, she knew it was a mistake. She discovered that the services she enjoyed walking to in New York City were harder to get to in Atlanta because of the lower population density, an *urban economics* issue. Eventually, she moved back to New York City; however, when she returned, she could only afford a room. The woman in the story and others who live in rent-controlled apartments pay rent below *market equilibrium prices*. That means landlords who own rent-controlled apartments receive below-market rent for their units. This changes the *incentive* structure in the marketplace. Not surprisingly, the *quantity demanded* for rent-controlled apartments exceeds the *quantity supplied* when there is a *price ceiling* and results in a *shortage*. This simple story illustrates the basics of *supply* and *demand*.

Think-pair-share prompt: Ask students if they support or oppose a binding price ceiling on rents in the community surrounding their university.

Figure 4: New York City Living

"I lived in Cobble Hill for 20 years. I had a rent-stabilized apartment. But I got tired of the city. I got tired of the crowds, and the people bumping into you, and nobody saying 'Excuse me.' So I had the idea to move to Atlanta and try to open a café. My friends said: 'Don't do it. You'll regret losing the apartment.' But I was feeling adventurous. I was tired of New York. I knew I made a mistake the first day I was there. I didn't have a car. I had to walk a mile to Trader Joe's. There were no cabs anywhere. No f****g cabs. What the f**k? And the hills! So many hills! And the movie I wanted to see was two counties away. Two counties! I don't even want to talk about laundry day. I missed being able to get everything I needed on my block. I missed the sidewalks, and the tall buildings, and the half-priced Broadway tickets, and the restaurants. I can take the crowds now. I can handle it. But I lost my apartment! I don't know where to live. An apartment that size is going to cost me twice as much now. I can only afford a room. I should have listened to my friends. Oh man, I messed up."

https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/1127514683989297/?type=3&theater

Our fifth story (Figure 5) features a couple from Idaho who owned a dairy farm that went broke because the government dropped the price support for milk, an example of farm *subsidies*. This change in government policy resulted in the *structural unemployment* of many dairy farmers who found the skills they possessed as dairy farmers were no longer demanded. This particular couple ended up moving to Barrow, Alaska (a wonderful example of *labor mobility*) and cultivating skills that helped them build libraries. More importantly, the story describes the real, long-run benefits of *economic change*. Job loss associated with structural changes in the economy is often highly publicized, but the simultaneous creation of new jobs is often less newsworthy. This couple's livelihood was significantly impacted by changes in the economy, yet they ended up serving Eskimos by helping to build new libraries, a *public good*, in an underserved and comparatively poor part of the United States. This story helps us recognize the *deadweight loss* created by *subsidies* and realize that there is an *opportunity cos*t to continuing them. When we employ more dairy farmers than the unsubsidized market would otherwise demand, we miss out on having enough people to build libraries.

Think-pair-share prompt: Ask students to identify a public good (other than a library). What makes the public good selected valuable to society?

Figure 5: Alaskan Librarians

"We lived in Idaho, but our dairy farm went broke when the government dropped the price support for milk. Then I saw an ad in the paper looking for someone to build a library for Alaska's first Eskimo college. I needed a job, and I'd studied library science in college, so we packed up all our kids and moved to Alaska. We stayed for 17 years, and I started libraries in about a dozen Eskimo villages. We lived for a few years in Barrow, which is the northernmost city in the United States. It was completely dark for several months a year. The temperature would fall below zero in October, and wouldn't get back above zero until May. We've had an interesting life for a couple of farm kids."
http://www.humansofnewyork.com/post/128783146116/we-lived-in-idaho-but-our-dairy-farm-went-broke

In our sixth story (Figure 6), we find a young lady who has come to the realization that the decisions she makes in the present often bear a cost in the future, a key component of *intertemporal decision making* and an illustration of *present bias*. Her "short term self" and "long term self" have contradictory preferences as she states, "I wish I'd partied a little less." The decision to go to a party seems to have little relevance on one's long term goals when we weigh the *marginal costs vs. the marginal benefits*, but taken together, the effect of many decisions to party may have more bearing on the future when we consider the *total costs vs. the total benefits*. In an attempt to be true to her short term self, the young lady realizes that she is shortchanging her long term self. This is consistent with theories from *behavioral economics* that individuals tend to value their present utility over their future utility.

Think-pair-share prompt: Ask students to recall an instance where they chose a short-term gain over a long-term one.

Figure 6: Short Term vs. Long Term Self

"I wish I'd partied a little less. People always say 'be true to yourself.' But that's misleading, because there are two selves. There's your short term self, and there's your long term self. And if you're only true to your short term self, your long term self slowly decays."

http://www.humansofnewyork.com/post/78679045171/i-wish-id-partied-a-little-less-people-always

Our final story (Figure 7) revolves around a man who is approaching retirement. He is almost finished putting his children through college, and he will soon be faced with a new budget constraint, living on social security. Despite *social security's cost of living adjustments*, it is not quite enough to maintain his *standard of living* at today's prices. However, he has realized that he can stretch his dollars by moving to Mexico. "For $300 a week, I could have a place to stay, a satellite dish, a fishing pole, and some rum." According to the theory of *purchasing power parity*, the *exchange rate* between Mexico and the United States should equalize differences in prices across a wide range of goods. However, factors like local labor market conditions, transportation costs, and trade regulations will create differences in the cost of living between the two countries.

Think-pair-share prompt: Of the four things mentioned by this man, which ones would be most likely to adhere to the *law of one price*? Why?

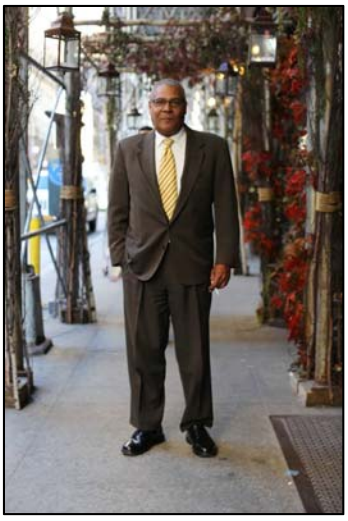

Figure 7: Retirement in Mexico

"Both my kids will have graduated from college in 4.5 years, and I'm heading to Mexico. I'm not kidding. Social Security goes a long way down there. For $300 a week, I could have a place to stay, a satellite dish, a fishing pole, and some rum."

https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/553181074755997/?type=1&theater

Additional Posts from *HONY*

There are far more posts on *HONY* containing economics than this space allows. To further illustrate the scope for using *HONY* to engage students across many topics in economics we provide 20 additional thumbnails following the Reference list

Conclusion

We have used the storytelling power of Brandon Stanton's *Humans of New York* to connect students with abstract economic concepts. The illustrations and personal accounts tell a story of economics in the real world and are useful as a teaching tool to provide students with concrete examples of economic terms, concepts and theories. These short stories reflect cultures, experiences and environments with which students can readily identify, keep course content relevant, and help students view economics through the lens of real life.

In this paper, we have provided a new resource, HONYEcon, that can be integrated into any existing course with ease and provides an opportunity for the instructor to engage students using a storehouse of real life examples of economics. As students become invested in the *HONY* stories and discussion extensions, they will begin to "think like an economist" and connect economics with the world that surrounds them.

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Figure 8: Additional *HONYECON* examples

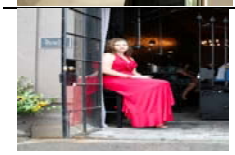
	There is a stigma in the Congo around women with jobs. *Division of labor, Comparative Advantage, Social Norms* https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/747611671979602/?type=3&theater
	One day you will have so much education that you will teach in America. *Time Preferences, Public Goods, Positive Externalities, Standard of Living* https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/871487469592021/?type=3&theater
	I have several inventions that I'm hoping to patent once I get to America. *Property Rights, Human Capital* https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/1144337492307016/?type=3&theater
	I am waiting for the day when I don't have to work so hard. But there's no finish line. *Marginal Productivity, Income, Wants, Needs, Marginal Propensity to Consume* http://www.humansofnewyork.com/post/99566680686/i-keep-waiting-until-the-day-when-i-dont-have-to
	We decided early on that we didn't want to have kids. *Opportunity Cost, Subjective Values* https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/803940599680042/?type=3&theater
	A young man flees to Jordan to escape the war. *Tradeoffs, Opportunity cost, Choices, Unintended Consequences* https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/1140695772671188/?type=3&theater
	I used the last four digits of my son's student ID number: 0-8-0-0 to win the lottery. *Expected Value, Opportunity Cost, Risk Taking* https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/816372718436830/?type=3&theater
	What was the most frustrating part of social work? "All the best people leave." *Marginal Revenue Product of Labor, Opportunity Cost, Trade-offs* http://www.humansofnewyork.com/post/99850459871/ive-spent-my-career-in-social-work-finding-jobs
	Cooper Union's mission statement stated that the school should always be free. *Economics of Education, Subsidies, Deficits, Debt, Trade-offs* http://www.humansofnewyork.com/post/100770674111/this-was-the-only-four-year-degree-school-that
	After I finish my shift at the bakery, I start my shift at Starbucks. I work 95 hours per week at three different jobs. *Living wage*, *Opportunity cost* http://www.humansofnewyork.com/post/107714386711/after-i-finish-my-shift-at-the-bakery-i-start-my
	I think if we were all being honest with ourselves, very few of us ever meet The One. *Marginal Thinking, Marginal Benefit vs. Marginal Cost, Search Cost* http://www.humansofnewyork.com/post/101438589176/i-think-if-we-were-all-being-honest-with

My father saw my mom cleaning inside and knocked on the window. Here I am. *Labor Supply, Immigration*

http://www.humansofnewyork.com/post/102027595426/my-father-came-from-nicaragua-and-got-a-job-as-a

So I bet everything. And the next day I got a call from my broker. I'd lost everything *Human Capital, Risk Aversion, Risk Taking, Preference Reversal, Investment*

http://www.humansofnewyork.com/post/102368713956/i-got-a-masters-in-mathematics-from-columbia-and



I'm an actor, a plus-sized model, and a boxer. But for the next four hours I'm a hostess. Because I need $100. *Trade-offs*

https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/497851986955573/?type=1&theater

I'm trying to raise my daughter with the same values that I learned in Jamaica. *Wants* versus *needs*, *Personal finance*, *Present bias*, *Budget constraints*.

http://www.humansofnewyork.com/post/102101391301/im-trying-to-raise-my-daughter-with-the-same

When you turn 40, they start looking for someone younger. *Discrimination, Marginal Productivity of Labor, Opportunity Cost*

http://www.humansofnewyork.com/post/90968328031/when-youre-25-you-feel-like-youre-riding-a

If you are opening a business just for the money you'll fail. *Barriers to Entry, Start Up Costs*

https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/532049290202509/?type=1&theater

There I was a princess. Here I am an immigrant. A servant. *Immigration, Cost of Living, Opportunity Cost*

https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/710709775669792/?type=3&theater

Nowhere in the world have more challenges to economic growth than Syria and Iraq. *Human capital*, *Financial capital, Solow growth model, Negative-sum game*

https://www.facebook.com/humansofnewyork/photos/a.102107073196735.4429.102099916530784/1143522465721852/?type=3&theater

The whole block chipped in and got this snow blower because we don't want the old timers having heart attacks from shoveling. *Marginal Thinking, Free-Rider Problem*

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An Excel-Based Approach for Teaching Markowitz's Portfolio Optimization Theory

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Abstract

This paper presents a simple method for teaching the Markowitz Portfolio Optimization topic. The use of Microsoft Excel or Corel Quattro Pro enables students and investors who do not possess a great deal of mathematical and programming expertise to identify mean-variance efficient portfolios which consist of more than two assets. Through this hands-on learning experience, students achieve a deeper understanding of the theory. The exercise also gives the students an eye opening lesson on the practical usability of spreadsheets.

Introduction

In past decades, many undergraduate finance professors have preferred to teach the Capital Asset Pricing Model (CAPM) in much more detail than they have chosen to teach the concept of portfolio optimization in a Markowitz (1959) Model. Many professors have breezed through the subject of finding the standard deviation of a portfolio by showing the equation for the standard deviation (σ_p) of a two asset portfolio, and ignoring the growing equation as more assets and more realism are added.[2] We often then release our students into the job pool, where they will have the software for optimizing these portfolios, yet may consider it a black box of sorts, where something magical happens but they are truly unaware of why it happens.

Now, with the potential trouble in finding a truly risk free rate[3], it is even more important to turn to the concept of diversified risk and return, giving our potential graduates some solid, more intense instruction in portfolio theory. The use of Microsoft Excel stressed by Benninga (2011) or Corel Quattro Pro enables students and investors who do not possess a great deal of mathematical and programming expertise to identify mean-variance efficient portfolios which consist of more than two assets.

Excel's Solver is used by Stephens (1998) to solve for Markowitz's efficient frontier and optimum portfolio; however, familiarity with matrix notation and Lagrange multipliers was needed. Kwan (2001) identified optimum portfolios with and without short selling, again using Excel's Solver.

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[2] This is understandable, since the formula grows exponentially with the addition of each additional security to the portfolio. For example, the standard deviation of a portfolio of two securities is the square root of $W_a^2Var(a)+W_b^2Var(b)+ 2W_aW_bCov(ab)$ and the standard deviation of a portfolio of three securities is the square root of $W_a^2Var(a)+W_b^2Var(b)+W_c^2Var(c)+2W_aW_bCov(ab)+2W_aW_cCov(ac)+2W_bW_cCov(bc)$ while the standard deviation of a portfolio of four securities is the square root of $W_a^2Var(a)+W_b^2Var(b)+W_c^2Var(c)+W_d^2Var(d)+2W_aW_bCov(ab)+2W_aW_cCov(ac)+2W_aW_dCov(ad)+2W_bW_cCov(bc)+2W_bW_dCov(bd)+2W_cW_dCov(cd)$ and the standard deviation of a portfolio of 50 securities is the square root of OMG.

[3] With rising debt of many of the traditionally viewed "risk-free" governments in recent years, the subject of where to find a proxy for the risk free rate is fodder for an entirely different paper, and will not be discussed further here.

Carter, Dare, and Elliott (2002) demonstrated how to set up and solve for mean-variance efficient portfolios in a spreadsheet model which does not require matrix algebra. The weights for mean-variance efficient portfolios are found utilizing Excel's Solver. In the classroom exercise, monthly stock-price data for five companies from December 1998 through December 1999 were downloaded from the Yahoo! Finance site. Arnold (2002) used Excel's matrix functions for his portfolio optimization classroom project. His model allowed for portfolios of more than two assets, and he extended his example into regression analysis. Solver's limitations with discontinuous functions are discussed by Johnson, and Liu (2005). They presented an Excel Spreadsheet Model which solved for mean-variance efficient portfolios allowing for short sales but did not use the absolute value function. Their model would not require a working knowledge of matric algebra.

Grover and Lavin (2007) considered the investor's limited understanding of portfolio optimization theory and its associated mathematical concepts as a significant barrier in the investor's ability to efficiently manage his or her portfolio. End-of-month closing prices of the mutual funds in the tax-deferred TIAA-CREF defined contribution variable annuity retirement plan and the Russell 3000 market index from December 2000 through December 2005 were used. They demonstrated how the Excel Solver program could be employed by investors to periodically rebalance and optimize their mutual fund portfolios.

As a means to familiarize students with portfolio mathematics, Livingston (2013) presented several investments applications of Excel's matrix multiplication functions. Methodologies for identifying efficient portfolios using both Excel's Solver and MMULT tools are described, but the results differed. Through the use of Markowitz's linear efficient set, the author concluded the MMULT portfolios were truly efficient.

What all of the above have in common is a very high level of spreadsheet and or mathematical sophistication which, while accurate in result, fails to achieve our goal of providing an effective way to *teach the process* of portfolio optimization. Successful graduates will have optimization software at their fingertips through their employers, so what is needed in the classroom is a teaching tool, to show them the process of portfolio optimization, *so that they will understand* what the software will be doing for them.

To that end, we have developed an iterative spreadsheet model to solve for portfolio optimization. Users observe the impact of changing asset weights on a portfolio's risk and return as they identify efficient portfolios through trial and error. A spreadsheet can be set up easily by students that have a control panel of sorts, whereby they can use trial and error to find the weights in the portfolio until they get close to the optimum lowest possible σ_p while still maintaining a set required expected return for the portfolio (π_p). We have used this methodology for nearly a decade in investment classes, and it opens the students' eyes in various important ways.

First of all, it gives the students an understanding of the components of the portfolio standard deviation formula. Using the matrix format of the portfolio, they can actually count how many of each multiple are added into the equation.

Secondly, it gives the students a hands-on method of learning that cannot be achieved with a mere lecture format. Many times, when the students finally get the spreadsheet to work and have seen that now they can lower the risk of the portfolio simply by playing with the weights of the various assets contained in that portfolio, a spark of understanding, and (dare I say it?)--interest in the material, ignites. In our classes, we have heard more than one excited "I get it!" while helping the students in the computer lab with this assignment.

Third, if you give each team a different required return, the teams will get differing minimum σ_p which helps to reiterate the lesson that higher return requires higher risk.

And finally, this exercise gives the students an eye-opening lesson on the practical usability of spreadsheets and that is certainly helpful in their future careers.

This paper presents this rather easy method of teaching the Markowitz Portfolio Optimization topic. The next section starts with the final solution to show how the "control" panel for a four asset portfolio looks and works.

The Control Panel

In order to solve a complex problem using Excel, one must have the variables on the same screen with the results, even if the entire problem takes up much more volume than can be displayed therein. In our classroom project, we instruct the students to highlight a small area of the screen where they display three types of values.

First, they must have an area where they label the input values for the weights of the four randomly selected assets in the portfolio. Instruct the students to put the weights in a column next to the cells where they will input the values. We start with a naïve weighting of .25 for each asset. This will allow the students to have a working model before we start attempting to optimize.

Next, we label two other areas of this small control panel and place the cells where the values will display next to them. One of these areas is the solution to the expected return of the portfolio (π_p). To solve for the expected return, use the input weights and the mean values from the daily percentage change data per security in the formula which calculates a simple expected value. This expected value will show in this spot on the control panel and will recalculate when the student changes the weights.

The other is the σ_p solution value, calculated elsewhere in the spreadsheet using the input weight cells in the control panel and showing the final valuation displayed in the control panel. Exhibit 1 shows a sample control panel for the spreadsheet. The student will be able to make changes in the weights of the different securities in the portfolio and see the resulting changes in the risk and the return of that portfolio.

Control Panel		
Weight A =	0.25	σ =
Weight B =	0.25	
Weight C =	0.25	π =
Weight D =	0.25	

Exhibit 1

Data Series and Descriptive Statistics

We instruct the students to go to Yahoo Finance and download prices for four randomly selected stocks that we have chosen. We prefer to select the stocks ourselves to ensure the educational experience and to emphasize the random selection. For this paper, we used daily stock data for four stocks, PDCO, AAPL, ECOL, and RAS for the number of years in which all four have been listed. In this case, the data runs from January 2, 1998 until February 4, 2014 when the data was collected.

The students are instructed to place the stock data in columns with the rows corresponding to the same dates. Then they are shown how to calculate four more columns with the percentage rate of change for each stock from market close to market close. This second set of columns is then used to produce descriptive Exhibit 2 shows our spreadsheet layout minus the multiple pages of daily stock prices. Notice that the percentage change columns are the columns that we will have our students use, not the raw price data columns.

The mean, variance and standard deviation of a portfolio can be readily computed using Excel and placed in the cells in the sections shown. Now that the descriptive statistics have been calculated, finding the standard deviation of the portfolio and the expected return of the portfolio (as shown in the next section) is quite simple.

DAILY PRICE DATA OF CLOSING PRICES WITHOUT DIVIDENDS

Date	PDCO	%Δ	AAPL	%Δ	ECOL	%Δ	RAS	%Δ
2/4/2014	39.25	0.512164	508.79	1.44757	34.64	0.697674	8.52	1.549464
2/3/2014	39.05	-2.27728	501.53	0.185777	34.4	-3.80313	8.39	-0.59242
1/31/2014	39.96	-0.7698	500.6	0.164072	35.76	-1.75824	8.44	0.956938
1/30/2014	40.27	0.725363	499.78	-0.19371	36.4	-0.95238	8.36	0.844391
1/29/2014	39.98	-0.32411	500.75	-1.13524	36.75	-0.72934	8.29	-0.48019
1/28/2014	40.11	0.652447	506.5	-7.99273	37.02	0.298022	8.33	0
1/27/2014	39.85	-0.35009	550.5	0.811251	36.91	-0.29714	8.33	3.349876
…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…
1/5/1998	7.4	2.635229	4.71	6.802721	0.78	0	8.68	1.283547
1/2/1998	7.21	---	4.41	---	0.78	---	8.57	---

Exhibit 2

The Covariance Matrix

Once the Control Panel is framed in, and descriptive statistics are computed, this is a good time to begin to help the students understand more difficult concepts. Things are not as simple for finding the σ_p as they are for finding the expected value of the portfolio(π_p). Explain that the reason for the difficulty in finding the standard deviation of a portfolio is the fact that there are interactions between individual securities. These interactions make the calculation much more complicated than a simple weighted average.

With this in mind, have the students start with a covariance matrix wherein they list the securities by row and again by column. In order to make sure the student understands how this relates to the formula for the σ_p, ignore the convenient feature available on Excel that calculates the covariance directly. Instead, calculate the covariance between security x and security y the long way, using the equation statistics for use in building the model.

$COV(x,y) = \rho_{x,y}\sigma_x\ \sigma_y$

where $\rho_{x,y}$ = the correlation coefficient between x and y , and

σ_x , σ_y = the standard deviations of x and of y.

Exhibits 3 through 5 show the introductory covariance matrix in three different forms, which evolve as we teach the class. Exhibit 4 shows the matrix of all the covariances possible between four securities in a portfolio, while Exhibit 5 breaks down the covariance into the component parts of correlation coefficient between two securities and standard deviations of each of those securities in the diagonal.

And finally, in Exhibit 6, we explain that the covariance between a security and itself is the variance of that security, so the diagonal of our matrix can be rewritten as presented:

[iii] Note that the professor may choose to use the expected returns here as an excuse for a reminder discussion of efficient markets, biased ratings of analysts, etc. Notwithstanding all of these issues, the students must use something for the expected return of each security. As the instructor, you will make the decision for them, either choosing to use the mean of the data listed (historical) or give the students a number external to the time series data which represents an expected return derived from other sources.

[iv] The writer will not insult the reader with "how to" instructions for calculating formulas. Our students may need help with this section, however, with an explanation from the instructor for the use of "=" to start each formula, "*" for multiplication, and "/" for division.

DESCRIPTIVE STATISTICS OF THE RATES OF RETURN IN PERCENTAGE

Descriptive Statistics	Correlation Coefficient	
PDCO-AAPL	0.14688	
PDCO-ECOL	0.07266	
PDCO-RAS	0.21616	
AAPL-ECOL	0.07578	
AAPL-RAS	0.19247	
ECOL-RAS	0.09565	
	Std. Dev.	Mean
PDCO	2.14682%	0.06517%
AAPL	2.96067	0.16326
ECOL	4.89653	0.20961
RAS	4.2141	0.08581

Exhibit 3

Covariance Matrix (formula)

	A	B	C	D
A	COV (A,A)	COV (A,B)	COV (A,C)	COV (A,D)
B	COV (B,A)	COV (B,B)	COV (B,C)	COV (B,D)
C	COV (C,A)	COV (C,B)	COV (C,C)	COV (C,D)
D	COV (D,A)	COV (D,B)	COV (D,C)	COV (D,D)

Exhibit 4

Covariance Matrix (detailed formula)

	A	B	C	D
A	ρ(A,A) σA σA	ρ(A,B) σA σB	ρ(A,C) σA σC	ρ(A,D) σA σD
B	ρ(B,A) σB σA	ρ(B,B) σB σB	ρ(B,C) σB σC	ρ(B,D) σB σD
C	ρ(C,A) σC σA	ρ(C,B) σC σB	ρ(C,C) σC σC	ρ(C,D) σC σD
D	ρ(D,A) σD σA	ρ(D,B) σD σB	ρ(C,D) σC σD	ρ(D,D) σD σD

Exhibit 5

Covariance Matrix (formula)

	A	B	C	D
A	VAR(A)	ρ(A,B) σA σB	ρ(A,C) σA σC	ρ(A,D) σA σD
B	ρ(A,B) σB σA	VAR(B)	ρ(B,C) σB σC	ρ(B,D) σB σD
C	ρ(A,C) σC σA	ρ(B,C) σC σB	VAR(C)	ρ(C,D) σC σD
D	ρ(A,D) σD σA	ρ(B,D) σD σB	ρ(C,D) σD σC	VAR(D)

Exhibit 6

Exhibit 7 shows the actual covariance matrix computed from the stock data. The reason we want the students to understand how the covariance matrix breaks-down into subcomponents is so that when they are finished, they can use this method to find the formula for the standard deviation of a portfolio of any "n" securities simply by reading a matrix.

At this point, the weights of each security in the portfolio (W_i) need to be inserted into the formulas within the matrix cells. To make the lesson clearer for the students, you can have them copy the matrix down to another workspace on the spreadsheet, and to make the insertion easier, have them place the cell reference for each weight from the control panel at the top of the row and the left of the column that corresponds to the correct security.[4]

Covariance Matrix (Values) OF THE RATE OF RETURN IN PERCENTAGE

	PDCO	AAPL	ECOL	RAS
PDCO	4.608848	0.933582	0.763773	1.95556
AAPL	0.933582	8.765565	1.098565	2.401396
ECOL	0.763773	1.098565	23.97597	1.973784
RAS	1.95556	2.401396	1.973784	17.75863

Exhibit 7

Exhibit 8 shows how this next iteration of the matrix starts to take shape. Note that the student enters, from the control panel, the cell reference for each weight on the outside of the matrix only in order to be able to see the weights and then move onward to entering them into the formula of each matrix cell. What should be visible in the places we have labeled "Cell Ref. Weight i" should be .25, since those are the weights that are statistics for use in building the model entered in the control panel at this point. Exhibit 9 shows the Covariance matrix with the numbers from the example stocks multiplied by the weights corresponding to the column and row of the matrix.

Note that W_i in Exhibit 9 should actually be the cell reference for the weight of security i in the control panel, so that when the student changes the weight in the control panel, it will be reflected in the new calculation for the σ_p.

Once the weight of each row and each column is multiplied into the formula, all that needs to be done now is to sum up each row and column to get the variance of the portfolio. Then find the standard deviation by taking the square root of the variance.

[4]The reason for using $\rho_{xy}\,\sigma_x\,\sigma_y$ as the covariance instead of just letting Excel calculate the covariance initially will become apparent on the next pages.

Covariance Matrix (Formula and Cell Weight Reference Positions)

		Cell Ref. weight A	Cell Ref. weight B	Cell Ref. weight C	Cell Ref. weight D
		A	B	C	D
Cell Ref. weight A	A	VAR(A)	ρ(A,B) σA σB	ρ(A,C) σA σC	ρ(A,D) σA σD
Cell Ref. weight B	B	ρ(B,A) σB σA	VAR(B)	ρ(B,C) σB σC	ρ(B,D) σB σD
Cell Ref. weight C	C	ρ(C,A) σC σA	ρ(C,B) σC σB	VAR(C)	ρ(C,D) σC σD
Cell Ref. weight D	D	ρ(D,A) σD σA	ρ(D,B) σD σB	ρ(D,C) σD σC	VAR(D)

Exhibit 8

Covariance Matrix (Values after Weight Multiplication) for the Rates of Return in Percentage and the Weights Assigned to Each

		0.25	0.25	0.25	0.25
		PDCO	AAPL	ECOL	RAS
0.25	PDCO	0.288053	0.058349	0.047736	0.122222
0.25	AAPL	0.058349	0.547848	0.06866	0.150087
0.25	ECOL	0.047736	0.06866	1.498498	0.123361
0.25	RAS	0.122222	0.150087	0.123361	1.109914

The sum of the weights must equal 1. Assume no short sales.

Exhibit 9

As stated above, this is a fairly simple exercise, which, if properly prepared with a lecture using Exhibits like those above, can lead to some actual excitement from students as they produce their own spreadsheet using real market data that you have chosen. Exhibit 10 will be useful in the "Learning" section where students learn how to find the formula for the standard deviation of a portfolio of any size.

The Learning

This is an excellent time to explain to the students that now they can find the standard deviation formula for a portfolio of any size. A good starting point is to use the formula for the σ_p of a two asset portfolio, which is found in Corporate Finance and Investments texts and is shown below:

$$\sigma_p = (W_a^2 Var(A) + W_b^2 Var(B) + 2W_a W_b Cov(AB))^{.5}$$

Now using Exhibit 10 on an overhead projection, the professor can block off the rows and columns corresponding to the additional securities so that only the rows and columns for securities A and B are showing. Have the students count the terms and see how they fit into the textbook formula. Next, show all the columns again and ask the students if they can find the formula for a four security portfolio. This is a great teaching opportunity. They can count the number of diagonal ($W_i^2 Var(i)$) terms and they can count the number of necessary other terms ($2W_i W_j Cov(ij)$). The use of a matrix format makes this formula much easier to understand.

Covariance Matrix (formula for teaching the written formula for σ_p)

		A	B	C	D
A		WA WA VAR(A)	2 WA WB ρ(A,B) σA σB	2 WA WC ρ(A,C) σA σC	2 WA WD ρ(A,D) σA σD
B			WB WB VAR(B)	2 WB WC ρ(B,C) σB σC	2 WB WD ρ(B,D) σB σD
C				Wc Wc VAR(C)	2 WC WD ρ(C,D) σC σD
D					WD WD VAR(D)

Exhibit 10

[vi] In the student's matrix, there should be values showing in the cells, where they have used computed descriptive statistics from the unique time series data of each security (provided by you, the instructor),as described in Exhibit 2.

After the above important lecture point, it will be time to let the students generate their own data to construct an efficient portfolio. Either have the students do this in some sort of classroom setting, or have them bring it in to class the next period. If the students have built their spreadsheets correctly, they should be able to keep the control panel on screen and change the weights of the securities (which must always add up to one) in the portfolio while watching how the π_p and σ_p change as they do so. This is the point where students actually express excitement. They suddenly realize that this exercise had a purpose. Explain that they can find the right proportion of each security to create a portfolio with the least risk per a given expected return. The good students pick this up quickly. The average students learn how to do it as well. The financial concepts covered in this paper are; portfolio structure using excel, the impact of the size and direction of covariance and correlation on portfolio diversification, how optional portfolio structure can mitigate risk, systematic risk and unsystematic risk, and risk- return trade-off.

As an added point of learning, assign different teams to find the lowest σ_p with a different required π_p to each team. This is usually a homework assignment due the next period.[viii] Upon return to class, each team places results on the board. It will be readily apparent that there is increased risk with increased return.

At this point, solver can be introduced to students to find the efficient portfolio and to compare its result with the trial and error result. In addition, the efficient frontier could be mapped using the two efficient portfolios. The operation steps the exercise followed to achieve its desired learning goals are:

A) Data collection
B) Conversion pricing data to rates of Return
C) Computing average rate of return and standard deviation for each asset
D) Computing covariance between stocks
E) Computing correlation between stocks
F) Assigning weight to be allocated to each stock
G) Computing the portfolio risk and return from the covariance matrix
The authors will be happy to provide the excel solution upon request.

Summary

As stated earlier, the purpose of this paper is education. There are quicker methods to solve for the portfolio standard deviation. Quadratic Programming, using a statistical software suite, or a targeted solution program specifically designed for portfolio investment, or even using add-ons for Excel will all quickly result in an accurate solution. These methods tend to have a "black box" effect, leaving the students unsure of point or purpose. What the students really need is instruction on the *how* and the *why* of weighting optimization for the portfolio.

We have shown above how, when using a spreadsheet such as Excel, students can learn what happens inside the black box software program that they will be using in the future. Spreadsheets are very effective for working out the lecture points, and also have double educational value, since spreadsheets are a medium

that our students will need to be able to adapt for many problems in their future careers. It works well with portfolio optimization, and the fact that the results arrive by trial and error by changing weights manually allows the students to learn the process. This helps our students decipher (understand) this "black box" of more sophisticated portfolio optimization software. They will understand what the computer is solving, and why. Additionally, the methodology presented here gives an intuitive understanding of the reasons for and the capability to build the rather burdensome formula for the standard deviation of the portfolio. Most importantly, this is hands-on learning, giving students a way to learn by doing.[5]

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[5] Some place this equation in an appendix or in a footnote. If it can be arranged to be in class when they are building the spreadsheet, perhaps more students will at least try to do their own work.

Instructional Videos in an Online MBA Finance Course

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Abstract

We examine student viewing behavior of videos in a 100 percent online class. We find that on average students in the class only watch approximately 42 percent of the videos assigned. We find that students that spend more time viewing the videos for the course have higher final exam scores. Student perception of the usefulness of the videos also enhances their final exam score, indicating that students should be advised on the appropriateness of online course work given their learning style.

Introduction

This study examines whether the number of videos watched by students and the percent completion of the videos for students in an online MBA finance course affected student performance in the course. For each chapter of the book students were provided videos created by the instructor to teach the material from the chapter. Students could also use the required textbook (Ross/Westerfield/Jordan Fundamentals of Corporate Finance), the assigned Connect homework and material which included LearnSmart and other videos provided by the textbook publisher.

There are a number of benefits to online videos of course lectures. One of the most important is the convenience to the students of being able to access the videos at a time that is convenient to them. When students are working on homework questions they can access the video(s) with the relevant material, start and stop the video(s) as needed, and with as many repetitions as desired. The convenience factor may also increase time on task and therefore improve student learning. Chickering and Gamson (1987) equate learning to time plus energy. The convenience of student using the videos when they desire may increase time spent on task and student performance. The quality of lectures may also be higher compared to face-to-face lectures as the professor has the ability to make multiple recordings and choose the preferred one.

In this study, we use a 100 percent online course taught over a six-week summer session and examine how the student viewing behavior of videos affects their grade on a comprehensive final exam. We control for educational background, ability, and other forms of effort. We find that the more time students spend watching the instructor created videos the higher their final exam score. This is consistent with the Chickering and Gamson (1987) hypothesis that time spent is an important aspect of student learning. Additionally, we find that student perception of the videos also matters. Students that ranked the videos higher on a Likert scale had higher exam scores as well. These results can proxy for either student preference or that if a student perceived the videos to be worthwhile they got more out of them. One implication for instructors using online videos would be to communicate to students the empirical finding that high viewership leads to higher course performance. Additionally, students should be advised on whether an online viewing format best suits their learning style if they have the choice between face-to-face and online formats.

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Literature Review

Ross and Bell (2007) examine the use of lecture video recordings in online and face-to-face classes.[2] They found that course score was positively related to the number of lectures viewed online for those students that did not have access to face-to-face lectures, while the impact was negative for those students that did have access to face-to-face lectures. Wieling and Hofman (2010) find that the course grade of the student was positively affected by both the number of lectures students attended in person and viewed online, but the benefit of online lectures was greater for the students who attended fewer face-to-face lectures. Choi and Johnson (2007) compared problem-based video instruction with and without group discussion for social science students. While they find video based instruction favorably impacts learner satisfaction, comprehension and retention versus text-based instruction, they did not find group discussion of the videos had an impact. The favorable impact on learner satisfaction was greater for male students versus female students. Kelly, Lyng, McGrath and Cannon (2009) find that video teaching of clinical nursing skills is supported, but in conjunction with lecture demonstration rather than as a substitute. The nursing students had a preference for the presence of an expert and the ability to ask questions over video delivery. Kelly, et. al. note older students had more favorable attitudes toward online instructional videos. More mature students may benefit more from the flexibility of viewing videos when it is most optimal for them, such as after their children have gone to bed. Zhang, Zhou, Briggs and Nunamaker (2006) compare types of video learning. They find interactive videos (self-paced, anywhere, just-in-time) lead to better learning outcomes and satisfaction versus videos without individual control.

Similarly, Terry, Macy, Clark and Sanders (2015) examine the impact of lecture capture on student performance for business students. Lecture capture records audio and video of classroom activities for later student viewing. They find student performance improves three percent on the final exam for students in business courses with lecture capture verses those without capture. They find effort (measured by homework score), grade point average (GPA), ability (SAT/ACT score) and major are also positively related to final exam score, while age and status as a transfer student had a negative impact. Neither race nor gender significantly impacted student performance. Johnson, Joyce, and Sen (2002) find student effort, as measured by the amount of time and number of attempts on repeatable computerized quizzes, favorably influences student performance. Rich (2006) finds similar results when effort is measured by attempting the homework, class attendance, arriving to class on time, and participation in class discussion for a senior level corporate finance class. Spivey and McMillan (2013) examine the frequency that Blackboard study materials were accessed on student performance in an undergraduate financial institutions and markets class. The study resources included recorded PowerPoint lectures and recorded Excel lectures using Adobe Captivate, as well as selected current issue readings. The results indicated student performance was positively influenced by study effort and more evenly spaced studying was more effective than cramming. This current study continues the exploration of the impact of effort on student performance in finance classes, with effort captured by the frequency of watching and percentage completion of online video lectures.

Data and Methodology

This study involved a 100 percent online non-synchronous six-week Fundamentals of Finance MBA class. Fundamentals of Finance is the first and only finance class required in the MBA program. The class consisted of 16 male students and 9 female students. Following Spivey and McMillan (2013) and others we include a variable to capture gender, though prior research has not been consistent regarding the role of gender in performance in finance courses. Female is a dichotomous variable equal to one if the student is female.

As shown in Table 1, the class started with 28 students, 2 dropped the course and we were not able to get a GMAT score for one of the students leaving a final sample of 25 students. GMAT score acts as a proxy for ability. The average GMAT score for the 25 students in the class was in the 33rd percentile. This variable is similar to ACT score used by Terry et. al. (2015) and reflects academic ability. We hypothesize a positive and significant relationship between course performance and GMAT score. The size and number of our

[2] Note that the studies discussed in this section are not specific to finance course work unless specifically noted. Bredthauer and Fendler (2016) examine success factors in an online undergraduate core finance course but do not specifically examine video viewing behavior.

online course offerings and adoption of video technology place a limit on the sample size we were able to obtain. Future studies using larger sample sizes would be worth conducting.

The main resources suggested and available to students were the Ross/Westerfield/Jordan Fundamentals of Finance textbook and accompanying online Connect homework and resources. The instructor provided 75 videos that were recorded and edited using Camtasia software and posted with links available in the Canvas course software. The videos ranged in length from 2 to 17 minutes. The aim of the videos was to cover a specific concept within a chapter rather than the entire chapter. Most chapters had between 5 and 7 videos. Students were allowed to watch the videos as many times as they desired and at any time they chose during the course time window.

Table 1 - Student Information

Number of Students	28
Students withdrawing from the course	2
Total Students Used in Analysis	25
Average GMAT percentile	33.0#
Students with an Undergraduate Business Major	7
Students with an Undergraduate Engineering/Science Majors	4
Students with an Undergraduate Accounting/Finance Majors	5

#GMAT score missing for one student; student was removed from study

The videos were stored in a database called Echo Center which allows students to view the videos, take notes, and create bookmarks. In addition, Echo Center keeps track of how many times a student views each video and the percentage completion. Students were not told that the instructor would have access to this information and the instructor did not review it on an individual basis. No portion of the final grade for the class was assigned based (directly) on students watching any or all of the videos.

Video Viewing Score variable measures the number of videos watched times the percent completion scaled to 100. Table 2 provides descriptive statistics on the View Score variable along with the other variables used in the study. This variable measures how many of the videos a student watched and accounts for the percentage completion for the video scaled to 100. A score of 100 would occur if a student watched every video to completion one time. A score of over 100 is possible if a student watched one or more videos multiple times. The average video view student score was 43.80 with a median of 44.16. This means that on average students watched only about 44% of the videos. Remembering that some students in the class were business majors, many may have covered some of the class material before and thus decided not to watch some videos. The range on the view score variable went from a low of 0 to a high of 140.94. This indicates that at least one student in the class did not watch any part of any of the videos and one student likely watched multiple videos, multiple times. Spivey and McMillan (2013) provide evidence that the number of times a video is viewed has a positive impact on student course performance, therefore we hypothesize Video Viewing Score will have a significant and positive sign.

Table 2 – Univariate Statistics

Variable	Mean	Median	Standard Deviation
Video Viewing Score	43.80	44.16	41.79
Business Major	0.24	0.00	0.44
Engineering/Science	0.16	0.00	0.37
Accounting/Finance	0.20	0.00	0.41
GMAT	32.04	26.00	23.01
HW attempts	23.44	23.00	7.72
Female	0.36	0.00	0.49
Ranking of Videos	4.56	5.00	0.66

The instructor also used the Connect software that accompanied the text for homework assignments. For the homework attempts variable (HW Attempts), students are allowed to work the homework as many times as they wished and were given the score commensurate with their best attempt. After the first attempt, students could see the correct answer. The attempts variable needs to be treated with some caution as some students attempted the homework once, found the correct answer and then updated their mistakes and ended up with two attempts even though the second might have been a somewhat feeble attempt. For students that kept trying without looking to the answers, time spent doing the homework could be an indicator of effort. In observing this variable, it appeared that students could leave their computer yet the clock would not stop, making for a noisy control variable. Thus, the paper uses the HW attempts variable rather than a time on task variable to proxy for effort. The HW Attempts variables is similar to Terry, Macy, Clark and Sanders (2015) homework score variable that they used as a proxy for effort. We hypothesize a positive and significant coefficient for this variable.

Using the Video Viewing Score variable and the time spent on the homework assignments, we are able to test if either variable increased student performance as measured by their score on the cumulative final exam. We also measured how useful the students found the instructor created videos and are able to test if the perception of the video usefulness also increased student performance on the final exam.

The 25 students in the class included 5 who were undergraduate accounting or finance majors. We would expect these students to score very highly and perhaps not need to view any of the videos to achieve a high score. The course contained an additional seven students that were undergraduate business majors, but not finance or accounting majors, so presumably they had taken at least one finance course before. There were four students in the class that were engineering or science majors as undergraduates and an additional nine students that were neither business nor engineering/science. Indicator variables for Business Major, Accounting/Finance Major, and Engineering/Science Major were used to control for undergraduate field of study. Terry et. al. (2015) find a positive and significant relationship when they examine the impact of students having a major that is the same as the discipline of the course. In our case, the major variable reflects prior undergraduate major and captures both prior experience in finance courses (Business or Accounting/Finance major) and similarity of course discipline and undergraduate major discipline (Business or Accounting/Finance major). The hypothesis is that the Business and Accounting/Finance majors variables will have a positive impact on student performance. Given that the Corporate Finance course is more quantitative than a typical MBA class, our hypothesis is that Engineering and Science Majors might have an advantage based on the math background that would be necessary to complete their undergraduate degrees.

Results

Using the score on the cumulative final exam as the dependent variable, a regression analysis was used to determine if the View Score variable had an effect on the student's performance in the class. Control variables for the regression included indicator variables for undergraduate major, GMAT score, HW Attempts, and Female. Table 2 provides descriptive statistics for these control variables. While the average GMAT percentile was 32.04 this was driven by upper outliers as the median percentile was 26.00. The HW Attempts variable averaged 23.44 with a median of 23.00. There were 14 homework assignments, so a HW Attempts variable of 23.67 would indicate that the student on average tried each homework problem about 1.69 times. Additionally, 36% of the sample were female students (9 of 25).

Results in column A of Table 3 indicate an intercept for the regression of 41.25 with a t-value of 3.37 that is significant at the 1% level. This intercept represents students with an undergraduate degree in a non-business or non-engineering/science field. The coefficient for an undergraduate degree in business is 17.13 and for an undergraduate degree in either accounting of finance the coefficient is 20.28. Both of these variables are significant at the 5% level. As expected in an introductory level MBA class, having a business degree (especially an accounting or finance degree) improves your performance in the class as you are likely to have seen the material before. The coefficient for the engineering/science undergrads is 5.29, but that coefficient is not statistically significant.

Additionally, the coefficient on the GMAT variable is 0.43 and is significant at the 5% level. An average GMAT score in the 33rd percentile (the average for the sample), would thus add an expected extra 33 * 0.43 = 14.19 points to a student's final exam score. This is consistent with Terry et. al. (2015) and Johnson, Joyce, and Sen (2002) which report similar results for ACT score.

Surprisingly, the HW Attempts variable, while positive, was not statistically significant. Johnson, Joyce, and Sen (2002) find a positive and significant effect for effort on course performance, when effort is measured

by either number of quiz attempts or time spent on quizzes. Rich (2006) finds a similar result when effort is captured by number of days the students were prepared to ask or answer questions about homework. Johnson, Joyce and Sen (2002) note that there can be different strategies used by students making it difficult to measure effort. While some students rapidly answer questions, view their results, and repeat the assignment multiple times, other students prefer to spend more time answering the questions and use fewer repetitions. In one case, the number of attempts captures effort, while time on task captures it in the other.

Table 3 – Video Viewing Score: Regression Results

	Panel A	**Panel B**
Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Intercept	41.25 (3.37)***	52.28 (5.44)***
Business Major	17.13 (2.51)**	19.04 (3.70)***
Engineering/Science	5.29 (0.47)	3.40 (0.41)
Accounting/Finance	20.28 (2.78)**	8.92 (1.44)
GMAT	0.43 (2.55)**	0.25 (1.89)*
HW attempts	0.27 (0.77)	0.41 (1.52)
Video Viewing Score	0.12 (1.84)*	0.14 (2.78)**
Female		-19.78 (-3.88)***
R-Square	0.49	0.73
Observations	25	25

*,**, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

The coefficient on the Video Viewing Score variable is 0.12 and is significant at the 10% level. This implies that one would expect that if a student viewed all of the videos in their entirety once, this would increase their score on the final exam by 12 points or almost one and a third letter grades. At an average viewing score of 43.80 from Table 2, the effect would be about 5.3 points or half of a letter grade. This result is consistent with Terry, et. al. (2015) and Wieling and Hofman (2010) which report access to lecture capture and the number of online video lectures viewed, respectively, positively influence student performance

In column B of Table 3, we added a gender control variable. Adding a control variable for female students did not significantly change the results for any of the other variables with the possible exception of the Accounting or Finance major control variable whose coefficient is now less than its previous value and is no longer statistically significant.[3] With the addition of the Female dummy variable, the Video Viewing Score variable has increased from 0.12 to 0.14 and is now significant at the 5% level. Additionally, the R-squared statistic for the regression with the female dummy variable increased from 0.49 to 0.73.

[3] Four of seven business majors are female. None of the four engineering/science majors are female. None of the five Accounting/Finance majors are female.

The coefficient on the Female dummy variable is -19.78 and is statistically significant at the 1% level. Choi and Johnston's (2007) results indicate that video instruction had a more positive impact on male students' perceived learning satisfaction versus female students, though not on student comprehension or retention. Spivey and McMillan (2013) provide inconsistent results for the impact of gender when examining how use of Blackboard study materials affects student performance. The average GMAT percentile for the females in the class was 23 percent versus 40 percent for the males**.** Generally speaking, research on the effect of gender on performance in media rich classes has yielded inconclusive results.

Terry (2002) provides evidence that male students outperform female students in the introductory finance class by more than one letter grade, while Borde et al. (1998) also finds males outperform, the magnitude is much smaller at two percentage points. Terry (2002) also discusses the complexity of the relationship between gender and course performance. Female students in his sample had a significantly higher GPA and significantly higher prior grades in statistics and economics courses, yet underperformed males in the finance class. Borde, et. al. (1998) also reports the GPA of the female students is significantly higher than the male students. Lumsden and Scott (1987) and Ferber, Birnbaum, and Green (1983) report males outperform females in economics classes, but on multiple choice versus essay tests. In the Terry (2002) study, when the sample was limited to classes that use multiple choice tests, the gender variable and the majors variables other than accounting (finance, management, marketing, computer information systems) were no longer significant. Therefore, the effects of gender, major, and exam type are complex and unclear from prior research. Since our study involves only one class that all students took multiple choice exams, we cannot sort out that effect from gender or major. Also, our study involves MBA students and most prior research on finance class performance is related to undergraduate students. While beyond the scope of this study, clearly a better understanding of the role of gender in performance in finance classes is needed, particularly given the magnitude of the effect reported in this and other research. Self-selection and/or performance of women in online learning environments could be intervening variables.

At the end of the course we surveyed the students to get feedback about the usefulness of the videos. Students ranked the videos on a 1-5 Likert scale with 5 being the most useful on the effectiveness of the videos. Students responded with a range of 3 - 5 and the average was 4.56 as shown in Table 2. The appendix of the paper is a compendium of the student's responses to the open ended question of why they ranked the usefulness of the videos with the score they used.

To see the effect of the perception of the usefulness of the videos, two regression models were used. In the first model, the score on the final exam was the dependent variable and the ranking of the videos was the only independent variable. The second regression extends the first by adding the control variables from the prior regression model presented in Table 3.

As can be seen by Panel A in Table 4, the effect of the video ranking on the performance on the cumulative final exam is both significant and striking. The intercept for the regression is only 34.63. This implies that without the videos, students would not pass the class. The coefficient on the video ranking is 9.20 and is significant at the 10% level. At an average ranking of 4.56 (from Table 2), this variable implies that the videos increased the performance on the final by an average of 4.56 * 9.20 = 42.0 points. The regression in Panel B supports these results. Even in the presence of the control variables, the effect of the ranking of videos variable increases to 9.74 and is now significant at the 5% level.

Conclusion

We conclude that student viewing of instructor created videos improves final exam scores which we use as a proxy for student learning. Student perception of the videos significantly improved final exam scores as well. The implication for an instructor using online videos in a 100 percent online class is that they may wish to communicate the finding that empirical studies have demonstrated that viewing of the videos is likely to improve student learning and increase grades. As mentioned in the paper, our sample size should be considered in the interpretation of the results. Future studies should attempt to use more students in the sample and examine better ways to control for and test the effect of homework preparation on course success.

Table 4 – Ranking of Video: Regression Results

	Panel A	Panel B
Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Intercept	34.63 (1.54)	16.72 (1.05)
Video Viewing Score		0.19 (4.03)**
Ranking of videos	9.20 (1.89)*	9.74 (2.86)**
Business Major		12.36 (2.48)**
Engineering/Science		-4.66 (0.63)
Accounting/Finance		0.04 (0.01)
GMAT		0.19 (1.66)
HW attempts		0.25 (1.04)
Female		-23.21 (-5.03)***
R-Square	0.14	0.84
Observations	23	23

*,**, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

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Appendix: Student Comments explaining their ranking of the usefulness of the videos

The videos were great because they were engaging. Due to the videos, this was the best online class i have ever taken. I also liked how the videos were in small nuggets.

I found the videos easy to understand, the examples were relevant and clearly presented and, most importantly, it was highly beneficial to have the opportunity to repeat parts of the video in order to build understanding or review a calculation.

The videos helped tremendously in learning how to do the connect homework. I really got a lot of this class by these tutorials. These videos provided wonderful examples that also helped take the tests.

The videos resembled an in-class environment and I experienced no technical issues.

The videos do an excellent job in explaining what is needed for the chapters as an overview, but sometimes, such as in chapter 14, there is much more information in the book or in the online practice quizzes and problems.

The videos were well put together and went into detailed explanations of the covered topic. I prefer the recorded lectures because I could stop if I needed to and watch them when I had time to do so.

The videos were a great way to clarify how particular formulas were executed for problems which have more complex given data than those provided in the textbook. In essence, the videos showed how these topics would appear in practice instead of the textbook examples demonstrating the topics in a vacuum.

I ranked the videos high because they helped to narrow down the focus of the chapters for such a fast course. Also, the problems worked out with explanation were helpful in combination with reading the chapters. Finally, the videos were great because you could focus completely on the "lecture" without having to worry about taking detailed notes and missing something. Then try to work a problem and rewind as needed.

It was easy to follow along and I liked how when he wrote we could see it so it felt like I was in a classroom watching a professor write on a whiteboard

Interactive. Makes the course more interesting.

Videos were convenient and easy to review over and over again. However, the student is limited when the desire to ask a question immediately arises.

The videos were a great supplement to the text and homework. Couldn't have gotten through the course without the instructor participation.

If you sit through all of the videos there really shouldn't be any unanswered questions. The only thing that is sometimes left out is how to complete problems with excel, but that is understandable as you want people to actually understand the math.

Powerpoints were well prepared as was the video. The video had good examples and the professor explained everything that was important

I think that with an online class a lot of times they are very basic and learn on your own. These tools have helped to learn and guide us through the material.

In my view, the videos introduced the content at a basic level but some of the homework content seemed at a much higher difficulty level. I would put in some more difficult guided examples to really prepare us for the homework questions that were very challenging.

I was able to rewind and listen to parts that I did not understand. It was an excellent tool

I gave a rank of 4 (1 being least helpful, 5 being most helpful). They were extremely convenient to use. I was able to choose which topic I wanted to review multiple times. I found these videos more useful than an in-class lecture. One negative aspect was that help was not right there in person when needed if I did not fully understand a concept.

I thought that the videos were very clear and articulate. There was an extremely nice balance of theory and practice problems that really help drive home the content.

The videos were helpful in introducing and explaining the topics, while the homework was helpful in reinforcing the concepts and helping with understanding the calculations. The only reason the videos did not get a 5 is because there often seemed to be a disconnect between the video instructions and the homework--which made the homework more difficult.

Probably one of the better if not best online courses I have experienced. The videos were helpful and thorough while not being too winded. The only downside I had was with the software of the videos and sometimes they were laggy and had to start over. Also I would like if the videos were able to be downloaded or viewed on an iPad so that I could watch them while traveling when WiFi is unavailable. Overall great course.

I'm not sure if 1 is high or low but I thought the videos were really useful....

They were good supplements to the read. I really got about 90% of what I needed from the readings; however, every time I watched one of the videos I walked away with a little more clarity on one of the subjects in the chapter.

The videos are great. It gives me an opportunity to view them on my time schedule, stop and pause to do calculations to see if I come up with the same answer, and to watch them again just before an exam. I watched them a second before the final and I think it help out with my total understanding of the material. I know for sure after I get my grades.

With the sections, I would go through and learn from the book. I would the proceed to the homework. When questions would arise it was extremely helpful to have the videos to go to in order to break it down better than the book.

Sometimes the numbers used in the audio didn't match the numbers used in the example that was written on the slides. It was also hard to decipher what was written on the slides sometimes.

The professor was able to walk me through each question and explain the relevance.

The videos were more useful than trying to learn it out of the book. The commentary added in the videos often helped clarify any areas where the book wasn't sufficient at getting a point across.

Duration and Convexity Using Polynomial Least Squares –Some Educational Aspects

Manuel Tarrazo [1]

Abstract

We apply polynomial least squares (PLS) techniques to the calculation of risk indicators for bonds and fixed income portfolios such as duration and convexity. These indicators can be easily obtained with few observations —three in the quadratic case, four for the cubic specification. PLS procedures can be calculated with matrix functions or with regression procedures readily available in spreadsheets. In this study we stress the educational advantages of the methodology. At the practical level, PLS procedures allow investors and analysts to calculate most important fixed income data indicators straightforwardly by simply collecting observations of market values for a bond or bond portfolio and of associated key interest rates.

Introduction

Fixed income investments provide contractual payments to their owners in the form of coupon payments and sometimes price appreciation as well. At maturity, the bond price is identical to the face value. Duration and convexity are indicators of risk in fixed income investing. Duration is an indicator of the effects of a change in the reinvestment rate on coupon cash flows and on the market value of the investment. Convexity, on the other hand, is an indicator of the effects of interest rate volatility on bond values. Both duration and convexity are normally computed either by obtaining the first and second derivatives of the theoretical relationship between a bond's price and its yield to maturity or by using a closed-form formula. The first option can be implemented using a tabular calculation in a spreadsheet, Fabozzi (2000). Closed-form formulas provide one-step calculations. In the case of duration, a very handy closed-form formula is due to Hawawini (1982, Chapter 2), and another one due to Chua (1985, 1984), see also Choi and Park (2002). Closed-form formulas are as old as the duration concept itself —Maucaulay provided a closed-form for duration, see Smith (1988) and references therein. For convexity, one can use Brooks and Livingston's equation (1989), or Blake and Orszag's (1996). Research in finding closed-form approximations offers benefits besides the simplification of numerical computations, Babcock (1985), Brooks and Livingston (1992), Heck, Zivney, and Modani (1995).

In the first section of this note, we present what seems to be the easiest way mathematically, if not also computationally, to calculate duration and convexity. This method uses a parabolic, least squares approximation that does not need to rely upon the theoretical price-yield to maturity relationship, and can be applied to a few actual price-interest rate market observations, which is ideal to ascertain sudden changes in market conditions. The methods presented are a natural application of EXCEL array function and other specialized functions such as INDEX and LINEST.

Modern finance has become very sophisticated, and professionals and researchers use many tools in their day-to-day work. Our contribution highlights educational aspects of polynomial least squares which, despite the apparently narrow focus, exhibit a variety of elements: calculus, linear algebra and matrix operations, regression theory, fixed income analysis, and EXCEL techniques. The usefulness of this contribution may be best determined by the angle in which it is approached: methods, financial theory, or EXCEL methods. A professor wishing to illustrate nonlinear relationships could hardly find a more suitable example than

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polynomial least squares. Another professor interested in clarifying fixed income analytics is likely to emphasize the price effects of changing economic and credit conditions, and in this matter it seems that polynomial least squares have much to offer in practical settings, see Tarrazo (2015). Yet another approach is to illustrate how different roads lead to the same result using EXCEL techniques.

Duration and convexity using polynomial least squares

The analysis of a typical fixed income security —e.g., a corporate or a government bond— starts with the relationship between the bond's price and its yield to maturity (ytm), which is summarized in the yield to maturity equation:

$$P_0 = \sum_{t}^{T} \frac{cr * face}{(1 + ytm)^t} + \frac{face}{(1 + ytm)^T} \quad (1)$$

Where, T = maturity of the bond, t = starting period of analysis, cr = coupon rate, face = face value of the bond, P = market price of the bond, and ytm = yield to maturity.

Duration and convexity are obtained from Equation (1) by calculating its derivatives analytically or numerically. Let x represent the yield to maturity, p the price of the bond, and p = f(x) the relationship between the bond price and its yield, as shown in equation (1) above. It can be shown, see Fabozzi (2013, Chapter 4), or De La Grandville (2001, Chapter 4), that

duration	= d	= dp/dytm / p	(2)
dollar duration	= dp/dytm	= d * p	(3)
convexity	= cvex	= $dp/dytm^2$ / p	(4)
dollar convexity	= $dp/dytm^2$	= cvex * p	(5)

where dp/dytm, dp/dytm2 represent the first and second derivatives of price with respect to yield to maturity in equation (1), and d represents what is known as (Macauley) modified duration throughout this note.

Nearly every instructional text in fixed income investing shows how to use these formulas in conjunction with Taylor's expansion to approximate price changes due to changes in the yield. Equations (6) and (7) show how to calculate the approximate dollar change (dp) and the relative change (dp/p) in the bond price, respectively.

$$\Delta p = d * p * \Delta x + 1/2 * cvex * p * \Delta x2 \quad (6)$$

$$\Delta p/p = d * \Delta x + 1/2 * cvex * \Delta x2 \quad (7)$$

Where Δp and Δx represent the incremental change in price and yield to maturity, respectively ("Δ" stands for Greek symbol delta representing an increment not necessarily infinitesimal; if the increment is taken to be infinitesimal, the usual notation becomes dp as in price "differential").

Heck, Zivney, and Modany (1995) (HZM hereafter) suggest a straightforward procedure to compute duration and convexity based on the curvature of the relationship between the bond price and its yield. Their procedure is to start with a given base case, for example, a bond of the following characteristics: maturity, T = 18; coupon rate, cr = 6% (semiannual); price, p = 1265, which provide a yield of yield of 9%. Next, we calculate prices corresponding to a small change in the yield (Δi = 0.0002, annually, which corresponds to a Δi = 0.0001 in semiannual terms). That would provide the corresponding price estimates (p-hat in estimation/econometrics terminology).

Table 1 shows the calculations carried out by HZM.

Table 1. Duration and convexity, as in Heck, Zivney, and Modany (1995)

Lines		M(iddle)	L(ower)	U(pper)
1	ytm-a	9.0000%	8.9800%	9.0200%
2	cr-a	12%	12%	12%
3	face	1000	1000	1000
4	time	18	18	18
5	ytm-sa	0.045	0.0449	0.0451
6	cr-sa	0.06	0.06	0.06
7	t-sa	36	36	36
8	df	0.20502817	0.20573574	0.20432311
9	adf	17.66604058	17.68962710	17.64250320
10	pv coupons	1059.96243463	1061.37762612	1058.55019187
11	pv face	205.02817403	205.73574312	204.32310578
12	price	1264.99060866	1267.11336924	1262.87329765
13	((L+U-(2*M))	0.00544957	(prices)	
14	(delta-ytm)^2	0.00000001		
15	M(iddle) price	1264.99060866		
16	Convexity	**107.69989705**		
17	delta-ytm	-0.0002		
18	deltap	2.12276058		
19	dur-modified	**8.390420329**		
	semiannual			
20	a = cr*(1+ytm)*adf	1.107660744	1.109033482	1.106290806
21	b = t*(ytm-cr)*df	-0.110715214	-0.11183795	-0.109598914
22	c = cr+((tym-cr)*df)	0.056924577	0.05689339	0.056955586
23	duration = (a+b)/c	17.51344632	17.52744083	17.4994582
24	duration-modified	16.75927877	16.08317198	16.05160356
	annual			
25	duration-y	8.756723158		
26	duration-modified-y	8.379639386		

The original calculations are complemented with additional information a) to relate their contribution to other methods, and b) to relate their contribution to the polynomial methods we will present next. Line 1 shows the yearly yield-to-maturities, used to calculate bond prices, appearing in line 12, using time-value-of-money (TVM) formulas. Lines 13-19 show HZM's (1995) main results. Convexity (107.6998) and modified duration (8.3904) are calculated by the curvature of the relationship between the bond price and the yield to maturity. HZM's ingenuity is twofold. First, rather than having to calculate duration and convexity first, and then the price changes, because of (6) and (7) above, we can obtain these numbers easily if we know the rest of values (p, Δp, and Δx). Second, their strategy keeps the focus on yield changes, which are what moves fixed income securities in practice. This means that any procedure that facilitates approximating bond prices may have considerable usefulness especially in troubled markets.

While HZM's procedures are very straightforward, two issues should be taken into account when replicating their numbers. One, they use a semi-annual bond in their example, which requires the

corresponding semi-annual data to be processed (lines 5-7) in our analysis. The numbers have to be annualized at the end (lines 25-6). The other item is that the calculations require quite a number of decimals to work well –note, for example, lines 14 or 17. Furthermore, the authors round results to two decimal places.

Approximating nonlinear relationships

Polynomial least squares is the name for a type of regression where the relationship among variables is nonlinear, but it is modeled as linear in the coefficients. As HZM's procedure, it builds on the same insight included in Taylor's approximations. A given variable could be approximated by a single number, say p = a. However, its behavior may be better captured by associating it with another variable with some explanatory power, p = a + b x. The prospects get better because we can nest additional higher orders of the explanatory variable (yield) in the linear specification, without affecting the explained variable (bond price). At this point, Taylor's second order approximation reminds us of a quadratic curve. This, in turn, provides us a very easy way to calculate duration and convexity because the quadratic function is well known and very easy to manipulate. Using up to the second order of Taylor's expansion is equivalent to using this function:

$$p = f(x) = a + b\,x + c\,x^2 \quad (8)$$

Its derivatives, and therefore duration and convexity, are easily calculated:

$$dp/dytm = b + 2\,c\,x \quad (9)$$

$$dp/dytm^2 = 2\,c \quad (10)$$

$$d = dp/dytm / price = (b + 2\,c\,x) / price \quad (11)$$

$$cvex = dp/dytm^2 / price = 2\,c / price \quad (12)$$

Second, the parameters a, b, and c can be easily calculated via ordinary least squares with a special data matrix that is simple to build. In sum, a quadratic form in two variables can be estimated with parabolic ordinary least squares, a second degree specification of polynomial least squares. Note that the price-yield relationship is nonlinear but, in the parabolic specification (8), the relationship is kept linear at the level of the power of the x variables.

Polynomial least squares

The top of Table 2 presents preparatory computations to calculate duration and convexity. It shows the three bond prices, under the heading "p" (p-hat later on in econometric notation), corresponding to three yield to maturity discount rates, and their corresponding time-value-of-money factors ("df", discount factor; "adf", annuity discount factor). The decimals are important because the computations are very sensitive to second-order effects.

We start by calculating the initial price-yield to maturity points for a 10-basis point spread around the annual 9% rate. The spread can be changed, but it is important to keep the extreme points equidistant from the initial value (symmetric spread). The initial bond prices were calculated with semiannual compounding. As mentioned earlier, "df" and "adf" represent the discount and annuity discount factors, respectively. As shown in Table 1, lines 8-12, Equation (1) can be simplified by treating coupon cash flows as annuity payments:

$$p = [cr*face*adf\,(ytm, T)] + face\,df\,(ytm, T) \quad (13)$$

Next, we build the regression matrices X, and Y as shown in the second panel in Table 2. The calculations of the coefficients a, b, and c can be done in a number of ways, as we will note later on, for example, by using the usual regression matrix inversion The ordinary least squares solution for a 10-basis point spread is a = 2770.817627, b = -22862.30957, and c = 68121.10156.

Table 2. Polynomial Least Squares (Parabolic specification).

Step 1: Calculate yield and prices

Obs	ytm	df	adf	p
1	0.089	0.208591211	17.78446718	1275.659241
2	0.090	0.205028174	17.66604058	1264.990609
3	0.091	0.20152766	17.54884263	1254.458218

Step 2: Prepare matrices

Obs	intercept	x = ytm	$x^2 = ytm^2$	price
		X		Y
1	1	0.089	0.007921	1275.6592
2	1	0.09	0.0081	1264.9906
3	1	0.091	0.008281	1254.4582

Step 3: Compute polynomial least squares coefficients

a = 2770.817627
b = -22862.30957
c = 68121.10156

Step 4: Calculate duration and convexity

p-hat	dp/dytm	duration	error	error^2
1275.6593	-10736.753	8.4166312	-7.941 E-05	6.307E-09
1264.9906	-10600.511	8.3799130	-7.962 E-05	6.339E-09
1254.4582	-10464.269	8.3416641	-7.989 E-05	6.382E-09
			MSE	9.514E-09
	$dp/dytm^2$	cvex		
	136242.20	107.70214		

We can calculate duration and convexity as explained in equations (9-12). The values for the derivatives, duration, convexity, estimated prices (p-hat), errors, squared errors, and mean-squared-error (MSE), respectively, are shown at the last panel in Table 2.

Heck, Zivney, and Modani (1995) obtain the following values for the 9% annual yield to maturity, after some rounding as noted earlier: modified duration = 8.38 years, convexity = 107.70.

Polynomial least squares in EXCEL

EXCEL offers several ways to obtain estimates a, b, and c leading to the computation of duration and convexity.

1. The first way is to use matrices and matrix multiplications, which we have done up to this point. Using matrices refreshes the basic "ordinary least squares" procedures underlying "polynomial least squares" and lets students practice EXCEL's underrated, but very powerful, array functions.
2. The second way is to use EXCEL's "Data - Analysis" utility and have the regression run for us by the "Regression" module. We obtain the output shown below. Note the values for R-squared and the standard error of the regression. Those are typical for interpolation procedures, which are designed to estimate with the minimal amount of data points.
3. A third way is to get the values for the parameters a, b, and c by clicking on the graph of the three-point price-ytm relationship, and letting EXCEL do the job: a) right-click on the chart-line and select "Add Trenline"; b) select "Polynomial", order 2; and c) choose the option "Display equation on chart." Pressing "OK" will display the following label on the chart "y = 68121x2 - 22862x + 2770.8" which contains the values for c, b, and a. As you may note, the label does not seem to display all the decimals, perhaps because an automatic resizing feature of the label-box cuts them off.
4. One might think of using some Visual Basic for Applications (VBA) programming to extract the values of interest from the label, but this is not recommended. First, it is more difficult than it seems and requires several lines of code with "string" processing functions. Second, EXCEL's INDEX function can be used to extract values from other functions, such as those used in least squares procedures (LINEST). In other words, INDEX can extract the information from LINEST without running the estimation procedures themselves, which is the fifth and last method we will examine.
5. Table 3 shows how to obtain the PLS-LINEST coefficients via EXCEL's INDEX function.

Whether we use EXCEL or not, risk measures such as duration and convexity can be calculated in several ways: 1) a table form, which is the one generally available in textbooks; 2) closed-forms; 3) the graphical approach illustrated in Heck, Zivney, and Modani (1995); or 4) polynomial least squares techniques (PLS). Therefore, some readers may argue that we hardly need any more ways to compute duration and convexity. Even EXCEL provides two functions for duration and modified duration (DURATION, MDURATION). In addition, there are resources that use Visual Basic for Applications (VBA) to provide professional-level functions and modules. For example, Benninga (2008) provides a VBA function to compute the duration for cash flows of uneven payments. Jackson and Staunton (2001) provide VBA-functions to compute Chua's duration and Blake and Orszag's convexity, both of which are closed-form formulas.

Our response is that different material is useful for different purposes and at different stages of professional development. Students learning the intricacies of fixed income analysis for the first time can hardly afford being distracted by VBA procedures. These students also need to see how things work from the inside. There is no need for "black boxes" to compute duration or convexity. Learning how to do it from scratch, with an easy method, reinforces the theory and provides much needed spreadsheet expertise. By the way, the fastest, most straightforward yield to maturity-based way to compute duration and convexity is not mentioned in the pedagogical literature. It is this: obtain a price-ytm point, change the yield by a very small amount, e.g., di = 0.0000001, to obtain a new price-ytm point which, in turn, is used to compute the duration increment and duration itself. Then we calculate "dispersion" and use the results accumulated up to this point to compute convexity, see De La Grandville (2001, p. 163 and 181), and Tarrazo (2005), for analysis and applications of dispersion. This procedure is numerically easy to follow, but it requires considerable knowledge of fixed income formulas and, therefore, is not appropriate for the classroom. Note also that PLS computes both duration and convexity simultaneously, not sequentially.

Finally, and importantly, the computation of price changes via PLS procedures is also an improvement over Taylor expansions-based approximations: a) it is very easy to implement with commonly available tools, b) it does not require that we provide analytical derivatives, instead, the procedures themselves provide numerical values for those derivatives; and c) it often provides better approximations. In our case, PLS provides exact approximations for the values provided. For these reasons, PLS seems most suitable for obtaining empirical estimates of duration and convexity using most recent, actual market data, see Tarrazo (2015) where they are deployed to assess quick changes in market conditions using 10-year sovereign bond data for several countries, including Greece, Italy, Spain and Portugal.

Table 3. Polynomial Least Squares (Parabolic specification).

Step 1: "Name" the ranges for the three price-ytm points. This can be easily done by highlighting this block

ytm	price
0.089	1275.659
0.09	1264.991
0.091	1254.458

on the spreadsheet page, and using the top-bar menu in this sequence: "Insert", "Name", "Create", "Top row," "OK."

Step 2: Use the following EXCEL formulas to obtain the parameters a, b, and c:

a = INDEX(LINEST(price,ytm^{1,2}),1,3)
b = INDEX(LINEST(price,ytm^{1,2}),1,2)
c = INDEX(LINEST(price,ytm^{1,2}),1)

These formulas correspond to the expression: price = a + b ytm + c ytm^2.

Step 3: (Optional check with regression tools)

Regression Statistics			
Multiple R	1		
R Square	1		
Adjusted R Square	65535		
Standard Error	0		
Observations	3		
	Coefficients	Std. Error	t Stat
Intercept	2770.817761	0	65535
X Variable 1	-22862.31256	0	65535
X Variable 2	68121.11816	0	65535

Concluding comments

We have presented polynomial least squares procedures that simultaneously calculate duration and convexity for a bond or a portfolio of bonds quickly and accurately with only three data points and with a simple regression, or with straightforward matrix operations. The procedure not only compares favorably to available alternatives in computational terms, but it also appears to be the easiest possible approach. In addition to the ease of calculation, perhaps the most attractive feature of polynomial least squares methods is that they work with very few observations —three for a quadratic approximation, and at least four for a cubic. The manager only needs to collect a few observations on prices and a key interest rate to calculate empirical duration and convexity. This can be done periodically or at critical times such as when large amounts of assets under management approach maturity.

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Incorporating the Bloomberg Professional Terminal into an Introductory Finance Course

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Abstract

This paper addresses a gap in the financial education literature regarding the use of the Bloomberg Professional Terminal in the classroom. As more and more Bloomberg Terminals find their way into colleges and universities, finance academics have responded by highlighting how the Bloomberg Terminals can be incorporated into upper level finance and economics courses. Unfortunately, a gap has been created as these papers do not address the use of the Bloomberg Terminal in introductory finance courses. This paper will provide a series of examples that provide the scaffolding needed to incorporate the Bloomberg Terminal into an introductory finance course.

Introduction

Bloomberg LP is a financial data, software, and media firm that derives the majority of its revenue from its Bloomberg Professional Service (Timms 2014), which provides financial data, news, and analytics through the ubiquitous Bloomberg Terminal. Subscribers can access historical and real-time accounting, financial, economic, and market data across every major asset class and market sector. Currently, Bloomberg has terminals in over 720 Universities and Colleges spanning across 120 countries.[2]

This article presents a series of assignments designed to incorporate the use of the Bloomberg Terminal into the introductory finance course. These assignments can be used individually or collectively as a semester long project and cover most of the major topics presented in the introductory course.

Students are introduced to the terminal with a low stakes, non-finance, task (using the terminal to search for job openings) that does not necessarily have a specific correct answer. Once the students have 'broken the ice' with the terminal, it is time to delve into the project in earnest. The eight component assignments of the project will require students to examine a firm's management, supply chain, financial statements, financial ratios, debt, equity, WACC and capital structure. Students use the Bloomberg Terminal both as source of information that they must interpret (i.e. financial ratios) as well a source of data that can feed into their own calculations (i.e. calculating required return using CAPM). Throughout the course these assignments, students will be exposed to 25 different Bloomberg Terminal functions covering corporate financial data, current news, security analysis, valuation, and more.

Literature Review

While there is a growing body of literature regarding the use of a Bloomberg Terminal in academia (see Coe (2007); Holler (2008a; 2008b); Scott (2010); Lei and Li (2012); Croushone and Kazemi (2014), and Kazemi (2015)), little information is focused on integrating its use into the introductory finance course. Rather, the existing literature is largely divided into two categories regarding Bloomberg in the classroom. The first category focuses on the efficacy and implementation of Bloomberg's existing educational components designed to instruct students on the use of the terminal. The second category explores ideas and methods to incorporate the data and analysis accessed via the Bloomberg Terminal into the student's coursework.

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Holler (2008a; 2008b) extensively evaluates the Bloomberg Global Product Certification Program where users can participate in a self-directed certification program designed to impart the basics of the Bloomberg Terminal. Scott (2010) illustrates, in great detail, how the Bloomberg Global Product Certification Program can be the center piece of a one credit course. It should be noted that the since publication of these articles, Bloomberg, LP has updated its training and education offerings. The Bloomberg Essentials training program, or BESS, is the most recent incarnation of the product certification program discussed in Holler (2008a; 2008b) and Scott (2010).

In one of the earliest papers entirely devoted to incorporating a Bloomberg Terminal into finance coursework, Coe (2007) offers a few brief examples that highlight the use Bloomberg as a data source across a wide range of courses (Financial Management, Investments, International Finance, Derivatives, and Banking). Coe (2007) provides an excellent, broad, introduction to Bloomberg designed to whet the appetite of any finance professor seeking to incorporate real world data into his or her classroom; as such, he necessarily eschews a detailed application to any one course. Lei and Li (2012) illustrate the use of the Bloomberg Terminal in a Security Analysis and Portfolio Management course through the process of creating an equity analysis report. In the production of this equity analysis report, students use the Bloomberg Terminal as the primary resource to perform top down analysis of a firm (Lei and Li 2012). The authors also point out the surprising disconnect between the extensive use of the Bloomberg Terminal in the finance industry and the dearth of resources available to faculty looking to incorporate it into their curriculum (Lei and Li 2012). Croushone and Kazemi (2014) outline the use of the Bloomberg Terminal in economics courses for macroeconomic and monetary policy analysis. They also observe that "students learn about data and about economic events better when they can put their hands on the data or manipulate it" (Croushore and Kazemi 2014, p. 1). Furthermore, the authors contend that using a Bloomberg Terminal fosters a "deeper understanding of both data and theory" (Croushore and Kazemi 2014, p. 1). Adding to prior work, Kazemi (2015) presents a five step approach to incorporating Bloomberg into various economic and upper level finance courses that centers around the impact of economic news on financial markets. Kazemi (2015) also briefly summarizes the literature pertaining to the use of technology in the classroom and its impact on student performance, engagement, and enrollment. Specifically, Kazemi (2015) points out that research has found that using appropriate technology to foster active learning in the classroom allows professors to cover more advanced material (Walbert and Ostrosky 1997), increases student enjoyment of lectures (Elliott 2003; Lass, Morzuch, and Rogers 2007), and leads to an improvement in student performance (Walbert and Ostrosky 1997; Cahill and Kosicki 2000). Kazemi (2015, p. 80) asserts that "many features of the Bloomberg technology are consistent with the literature's accepted practices for improving students' learning experience." Additionally, Payne and Tanner (2011, p. 93) find that incorporating technology (specifically referencing the Bloomberg Terminal) to provide a "real-world application" of the same topics presented in an introductory finance course leads to enhanced student understanding and elevated career prospects.

Furthermore, the benefits of experiential learning have been noted in education for over seven decades, with Dewey (1938) "being the first to promote the "learn-by-doing" education model" (Dolan and Stevens 2006). In their study, Dolan and Stevens (2006) point out several studies (Simpson 1997; Loomis and Cox 2000; Walstad 2001; and Becker and Watts 2001) that highlight the effectiveness of experiential learning and experiential learning components within the classroom. Furthermore, while exploring the use of experiential learning in wildlife courses, Millengah and Millspaugh (2003) assert that its effectiveness spans a range of learning styles. The authors also echo Kendrick (1996) in finding that experiential learning results in "greater retention of material" and "enthusiasm for the subject" (Millengah and Millsaugh 2003).

This paper adds to the growing literature by presenting the foundation of a modular project that reinforces the concepts taught in the introductory finance course through the use of the Bloomberg Terminal to examine real world examples and data. To the author's knowledge this is the first paper to illustrate the extensive use of Bloomberg in the introductory finance course.

The Assignment

The assignments below are intended to provide a scaffolding[3] that can be used as a starting point to build a project or series of assignments that are closely integrated into several of the major topics typically

[3] For the actual assignments given to students, please email the author

covered in a typical introductory finance course. Table 1 maps each assignment to a chapter in several commonly used introductory finance textbooks. A comprehensive list of Bloomberg Terminal commands used in the assignments presented below appears in the appendix.

Students are typically divided into groups of four or five and assigned a sector. Each group member must pick a specific company[4] from a curated list of firms to work on through out the semester. At the culmination of the project, each group must choose up to two of the firms to 'invest' in based upon everything they have learned during the project. The assignments presented below use Coca-Cola (KO) as an example.

Table 1: Mapping Bloomberg Assignments to Chapters in Introductory Finance Textbooks

Assignment	Brooks[a]	Ross, Westerfield, and Jordan[b]	Brigham and Houston[c]	Brealey, Myers, and Allen[d]
1) Getting Started	Chapter 1	Chapter 1	Chapter 1	Chapter 1
2) Financial Statements	Chapter 2	Chapter 2	Chapter 3	Chapters 28 & 29
3) Financial Ratios	Chapter 14	Chapter 3	Chapter 4	Chapter 28
4) Interest Rates	Chapter 5	Chapter 7	Chapter 6	Chapter 3
5) Bonds	Chapter 6	Chapter 7	Chapter 7	Chapter 3
6) Stocks	Chapter 7	Chapter 8	Chapter 9	Chapter 4
7) Risk and Return	Chapter 8	Chapters 12 & 13	Chapter 8	Chapter 7
8) WACC	Chapters 10 & 16	Chapter 14	Chapter 10	Chapter 9

Notes: a "Financial Management: Core Concepts" 3rd edition; b "Fundamentals of Corporate Finance" 10th edition; c "Fundamentals of Financial Management" 13th edition; d "Principles of Corporate Finance" 11th edition

Assignment #1 "Getting Started"

This first assignment is primarily designed to introduce the students to the companies they will be following throughout the semester. However, it begins with a brief detour to explore career opportunities in finance by looking through the job postings listed on the terminal. Lei and Li (2012) contend that knowledge of the Bloomberg Terminal will make students stronger job candidates. This idea can be extended further to say that students will be able to find better opportunities using the career resources within the terminal itself.

To begin assignment #1 students are instructed to search job openings in their geographical area of choice and select one that appeals to them.[5] Career opportunities can be accessed on the Bloomberg Terminal by typing "JOBS <GO>" and clicking on the '90) Job Search' button at the top right of the screen

Students can now begin investigating their companies. First, they can look up basic information about the company using Bloomberg's description page. This page (or collection of pages) contains a company profile, contact information for the company, key executives, as well as key ratios and other financial information. Coca Cola's description pages can be accessed by typing "KO <EQUITY> DES <GO>." Next, students will examine the internal and external 'players' for their company. The internal players for Coca Cola can be found by using the "KO <EQUITY> MGMT <GO>" command to see both the current management team and board of directors. Moving on to the external players, typing "KO <EQUITY> SPLC <GO>" will show Coca Cola's major suppliers and customers. In addition to simply listing the suppliers and customers, the 'SPLC' screen also shows the percentage of Coca Cola's revenue each customer contributes, as well as the percentage of Coca Cola's costs of goods sold that each supplier

[4] Providing a curated list for each group to choose from ensures there are no duplicates and allows the instructor to control as many variables as possible (i.e. the firm pays a dividend, has not had recent earnings losses, etc.…)

[5] Students can be instructed to search for specific job categories i.e. entry level jobs that require only a Bachelor's degree

represents. Finally, the "KO <EQUITY> CN <GO>" command will bring up a wealth of current news regarding Coca-Cola. Using these commands students can describe what their company does, who 'runs' the company (i.e. who are the key executives; who is longest serving executive; who is the longest serving board member; etc.…), who the company's major suppliers and customers are, and what is currently being written about the company in the major news outlets.

Assignment # 2 "Financial Statements"

The second assignment introduces the students to real financial statements using their assigned company. Students must use the Bloomberg Terminal to download the company's most recent annual financial statements into Excel. Once the statements are in Excel, students can calculate each firm's Operating Cash Flow, Net Capital Spending, Change in Net Working Capital, Cash Flow from Assets, Cash Flow to Creditors, and Cash Flow to Shareholders for each year. Coca Cola's financial statements can be found on the terminal by typing the command "KO <EQUITY> FA <GO>." From here students can view the Income Statement (I/S tab), the Balance Sheet (B/S tab), and the Statement of Cash Flows (C/F tab). These financial statement can be download into Excel by clicking on the '3) Output' button and choosing 'Download to Excel' within each statement. These Excel spreadsheet will need to have Bloomberg's Excel API functions removed before they can be opened on another computer. This is most easily done by selecting the entire worksheet, copying it, and pasting it over itself using Excel's 'paste special values' function. Now that each statement is in Excel, Coca Cola's cash flow figures can be calculated.

Assignment # 3 "Financial Ratios"

This third assignment has the students perform financial statement analysis using common size statements and financial ratios. The common sized balance sheet for Coca Cola can be found by once again using the command "KO <EQUITY> FA <GO>" and choosing the balance sheet tab 'B/S' and then the 'Common Size' option. Next, Coca Cola's common sized income statement can be created by clicking on the 'I/S' tab and choosing either the '% Adj' or '% GAAP' options (Bloomberg's adjusted statements eliminate the impact of one-time events). As with the financial statements presented in Assignment # 2, these common sized statements can easily be exported into Excel. Once the statements are common sized, students can begin performing basic trend and benchmarking analysis.

Instead of working through the calculation of each ratio, the financial ratio portion of this assignment focuses on analysis and interpretation. One particularly useful feature is the ability to create a custom tab of ratios in the Financial Analysis (FA) function and then share this tab with all other terminal users within the organization. This feature allows the professor to input the exact ratios used in the course, thereby ensuring that all students are analyzing the same set of ratios.[6] Coca-Cola's ratios can be found by typing the command "KO <EQUITY> FA <GO>" and clicking the 'Shared' tab. As with the financial statements used previously, this ratios tab can be exported to PDF or Excel by selecting the '3) Output' button.

One difficult task for all students is finding industry average ratios to use in benchmarking a company's financial performance. Fortunately, industry average ratios can be found on the terminal using the Relative Valuation (RV) function, where each firm can be benchmarked against the firm's sub industry, industry, industry group, or sector. As with the 'FA' function, we can create a custom tab that will allow us to benchmark only our chosen ratios.[7] To access Coca Cola's Relative Valuation screen type the command "KO <EQUITY> RV <GO>" and click on the 'Custom' tab and then select the appropriate custom made template. The ratio averages of all firms in the chosen category (sub industry, industry, etc.…) will appear in the top row of the table just above the firm being examined. As with the FA tables described above and in assignment # 2, the RV tables can be exported to Excel by clicking the '96) Output' button.

[6] From 'FA' screen click on the '9)Custom' tab, choose the '11)Create Custom' button, then enter the desired ratios into the input box. Once the custom ratios have been created click on '34)Share' to choose who to share the ratios with (i.e. all university users or specific users).

[7] In the 'RV' screen click on the '27) Custom' button, then the '31) Create Template' button, finally enter your desired ratio into the input box and click the 'Add Column' button. To share this with other users, click on the 'Saved Templates' button, then click on the settings icon (a gear or cog icon) and choose 'Share'.

Once students have firm and industry ratios, they can extend the basic benchmarking and trend analysis done with the common sized statements to include the strengths, weakness, and overall financial health of their firm over time as well as in comparison to the industry.

Assignment # 4 "Interest Rates"

This assignment will require the students to create an amortization table for a mortgage loan and will show them the impact of making additional principal payments over the life of the loan. They will also examine the US Treasury yield curve as well as the yield curve for their company.

First, the students must find a house they want to purchase in order to calculate a loan payment and create an amortization table. The Bloomberg Terminal has real estate listings within its classifieds section that can be accessed by typing the command "POSH <GO>" and selecting 'Real Estate'. Students should find a USD priced house in an area they like and use the 'GRAB' function to capture a screen shot of the listing. Monthly loan payments and an amortization schedule can be obtained by using the "MP <GO>" command and entering the amount borrowed and loan terms[8]. The amortization schedule can then be exported to Excel by clicking the '98) Download' button. Students can also view graphical representations of the total and periodic interest and principal paid on the loan by clicking the 'Chart' tab above the table (students can also easily create their own charts using the exported Excel table).

Next students can examine the impact of additional payments by entering prepayment amounts and frequencies in the 'Prepayment Options' box. Once the prepayments are entered (say $300 a month over the life of the loan), students can compare the difference in total interest paid and the length of the mortgage to the original loan calculated above.

The second part of this assignment is to examine the term structure of active US Treasury securities in comparison to the corporate term structure faced by an individual firm. Typing the command "KO <EQUITY> GC <GO>" will generate a yield curve based upon the term structure of rates for Coca-Cola's debt. To illustrate the difference between the corporate yield curve and the treasury yield curve click on '1) Browse' and choose 'US Treasury Active', then type "1 <GO>" in the command line to see the corporate yield curve in relation to the US Treasury yield curve. Students can be asked to interpret the spread between the corporate and government securities.

Assignment # 5 "Bonds"

In this next assignment students will explore bonds and the bond market. First, students can take a look at the current state of world bond markets by typing "WB <GO>" and selecting '10 Year' in the maturity selection box. Students can comment on the conditions of the various world bond markets - i.e. what are the lowest and highest yielding 10 year government securities and/or what is the yield of the 10 year U.S. Treasury.

Second, students will examine their company's long term debt. Coca Cola's outstanding debt securities can be seen by typing the command "KO <CORP> <GO>". Click on a specific issue and type "DES <GO>" to pull up the description screen for that particular bond. A PDF copy of the bond's prospectus can be downloaded by clicking on '36) CF Prospectus' or typing "CF <GO>" from the "DES" screen. Also, from the 'DES' screen clicking on '5) Ratings' will bring up the bond's rating from each rating agency as well the date the rating was issued. Coca Cola's ratings can also be found on the firm's credit profile by using the command "KO <CORP> CRPR <GO>".

Next students can analyze the nominal cash flows generated by the bond by using the terminal's 'CSHF' function to export these cash flow into Excel. Coca Cola's cash flows can be found and exported by typing the command "KO <CORP> CSHF <GO>" and clicking on '1) Export.' Once in Excel, students can calculate the bond's yield to maturity using the price, total face amount, coupon rate, and time to maturity; all of which can be found on the 'CSHF' screen. Additionally, clicking on the 'Present Value' tab will displays the total present value of all cash flows as well as the present value of each individual cash flow using either a term structure of discount rates or a single discount rate of the user's choosing. Entering the yield to maturity calculated earlier in the present value screen should allow the students to tie back to the price they used in their excel calculations. Finally, students can find a default probability for their firms using the Bloomberg Default Risk profile screen. Typing "KO <CORP> DRSK <GO>" will bring up Coca

[8] For example, 20% down payment at 3.25% for 30 years.

Cola's default risk profile screen. While generally beyond the scope of most introductory finance courses, the default probability does provide a concrete value to use when evaluating or comparing the riskiness of different firms and should reinforce the meaning of a firm's rating.

Assignment # 6 'Stocks'

We now turn to equities and the basics of stock valuation. In this assignment students will look at the global and domestic equity market before working through the valuation of their specific company. First, students can examine the current conditions of the world equity markets by typing "WEI <GO>." After examining the World Equity Index screen, students can comment on which markets are up, which markets are down, and specifically look at the S&P 500 (SPX) and Dow Jones Industrial Average (INDU).

Second, students will pull up the current global market intraday heat map by typing the command "IMAP <GO>." This will graphically present the current return on global markets with red representing the losses and green representing gains. In the 'Source' selection box, choose 'Indexes' and then choose 'S&P 500'; this will create an intraday market heat map for the sectors of the S&P 500 using the same red/green scheme. To pull up a description of the S&P 500, type the command "SPX <INDEX> DES <GO>." Page 1 of the description screen is a 'Profile' that provides a written description of the index, as well as some basic information (52 week high, low, 1 year return, YTD return, etc…). Page 2 of the DES function presents more return characteristics, such as the holding period and annualized returns for various periods along with some basic valuation information (P/E, Price-to-Book, EPS, Cash Flow per share, etc…). Next we can graph the S&P 500 over various horizons by typing the command "SPX <INDEX> GP <GO>". This should give the students an understanding of the trends and patterns in the domestic equity markets.

Next, students can perform a dividend discount (DDM) valuation of their company by using Bloomberg as a source of information and by using Bloomberg's built in DDM functions. Coca Cola's dividends can be found by typing the command "KO <EQUITY> DVD <GO>". This will pull up the recent quarterly dividends and the next period's forecasted dividend[9], as well as 1, 3, and 5 year dividend growth rates. Students can also set the range and scroll down to calculate the average annual increase in dividends. Often the stock valuation material comes before the discussion of risk, return, and the Capital Asset Pricing Model and simply treats a company's required return as a 'given' for the sake of valuation. Fortunately, we can use Bloomberg's Weighted Average Cost of Capital (WACC) function to find the firm's cost of equity capital. Typing the command "KO <EQUITY> WACC <GO>" will open Bloomberg's Weighted Average Cost of Capital screen, which contains Coca Cola's required return on equity. Students now have the data they need to calculate the intrinsic value of their firm using the constant dividend growth formula.

Many stock valuation lectures add a discussion of the two-stage or three-stage dividend growth model. This can be implemented by simply assuming two growth rates and using the data already collected above, or students can use the built in DDM function in the Bloomberg Terminal. The DDM model for Coca Cola can be found by typing "KO <EQUITY> DDM <GO>" and is a three-stage model that uses a period of high growth, a period of low growth, and a transitional period between the two. While Bloomberg's DDM model is populated with its own inputs, users can (and should) override the existing inputs with their own assumptions. The DDM screen will allow students to instantly see the impact on a stock's valuation from changing dividends (via the payout ratio), changing discount rates (via the risk premium), and changes in growth assumptions (either via the growth rates or the length of the different growth stages). Students can be asked to investigate the change in valuation from a given change in any of the inputs[10].

Assignment # 7 "Risk and Return - Beta and CAPM"

This assignment will have the students explore the relation between risk and return. To start, return and volatility can be presented graphically for a few indices of varying risk. For example, the daily returns can be plotted for the Russell 2000 (RTY), S&P 500 (SPY), and an investment grade corporate debt index (CORP) over a variety of horizons by using the daily comparison function. To do this, type the command "RTY <INDEX> COMP D <GO>" and enter 'SPX INDEX' and 'CORP INDEX' into the security

[9] Dividends are usually paid quarterly, however DDM is typically presented in the introductory course using annual figures. Students can simply multiply the next quarter's estimated dividend by four to calculate an annual dividend when implementing the DDM.

[10] For example, "what is the estimated intrinsic value of your firm if your long-term growth rate is cut by x%"

selection box. The time period can be altered to develop an understanding of the risk and return trade off over the short term and long term.

Next we examine the firm's required rate of return. First we start with the systematic risk of each firm by calculating its beta using Bloomberg's Historical Beta function. To find Coca Cola's historical beta calculation type the command "KO <EQUITY> BETA <GO>." Users can input the benchmark index, date range, frequency of return to calculate a 'raw' (regression) beta. Bloomberg also provides an 'adjusted' beta which is calculated by multiplying the 'raw' beta by .67 and adding .33 (a weighted average of the raw beta and the market beta). Second, we need to determine the firms equity risk premium by using the terminal's Equity Risk Premium (EQRP) function. Type "<KO <EQUITY> EQRP <GO>" to launch Coca Cola's equity risk premium screen. Coca Cola's required return can now be calculated using the CAPM equation by adding the risk free rate to the firm's equity risk premium. Users can also input an alternative beta on the 'EQRP' screen, which will alter the firm's equity risk premium and therefore the firm's required return. Students can also see the difference in required return when using the raw versus the adjusted beta and when using betas calculated over different time periods using different frequencies.

Assignment # 8 "Weighted Average Cost of Capital and Capital Structure"

This last assignment calculates the firm's weighted average cost of capital. As shown earlier, the terminal has a weighted average cost of capital calculator that can be found by typing the command "KO <EQUITY> WACC <GO>." This function will calculate the after-tax cost of debt, the cost of common equity, and the cost of preferred shares as well as the firm's capital structure weights. As with most of the functions on the Bloomberg Terminal, many of the inputs into these calculations are customizable. Clicking on the capital structure components will open up a window where students can override the firm's current capital structure with total debt and total market capitalization figures of their own. After clicking 'update' the firm's weighted average cost of capital will be recalculated with the new component weights. This will demonstrate the impact of adding or decreasing a firm's proportion of debt financing on its cost of capital[11]. While this certainly provides a quick and easy way to estimate a firm's cost of capital, it might be worthwhile to examine the firm's capital structure on its own.

The details of Coca-Cola's capital structure can be found by using the command "KO <EQUITY> CAST <GO>". A 'needle' gauge in the upper right corner shows the percent debt while a bar chart of the dollar value of each capital structure component is presented in the lower half of the screen. Clicking on the 'Security Detail' tab will display a table with the exact dollar value of each component. This security detail table will easily facilitate the calculation of capital structure weights. It is worth noting that the debt figures presented by Bloomberg here represent book value not market value; however, unless the firm is in distress, the impact should be minimal. Additionally, clicking on 'Exports' and choosing 'Export to Excel' will create an Excel file showing the details of each component of the firm's capital structure (i.e. market capitalization of common and preferred equity and the specifics of each debt issue).

A Brief Note on Implementation/Access to the Bloomberg Terminal

There are 6 or 7 Introduction to Finance courses at my institution a year, each with 25 to 30 students. Our lone Bloomberg Terminal is located in its own nook at the rear of the university's Trading Room, which also doubles as a classroom computer lab. The Trading Room is open from 8am to 10pm every weeknight and in any one semester approximately 37 – 40 hours per week are freely open to all students (i.e. there are no classes scheduled in the room). Additionally, given the layout of the trading room and location of the terminal within the room, a student could slip in to use the terminal without disturbing the class in progress. For the most part, the terminal is available whenever a student needs access with occasional, minimal, bottlenecks the afternoon or evening before assignments are due. Furthermore, many of the assignments are designed to have students collect information in the form of a screen grab, PDF, or Excel file which is then used to complete the assignment away from the terminal, reducing the actual time in front of the terminal for any one student

Summary

[11] The assignment given to students could ask for the firm's weighted average cost of capital at different debt levels (i.e. industry average).

As the Bloomberg Terminal extends its reach into more and more colleges and universities a gap has arisen between the growing resources available to facilitate its integration into advanced finance courses and dearth of resources dedicated to using the terminal in an introductory finance course. This paper fills that gap by presenting a modular series of assignments that utilize this industry leading technology to marry real-world financial data and analysis to the concepts presented in a business student's first finance course. This use of professional technology in a "hands on", experiential, context should increase enthusiasm, retention of the material and facilitate a deeper understanding of the core concepts presented in the introductory finance course. This framework can easily be used in part as the basis for individual assignments or as the foundation of a semester long project.

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Appendix: Description of Bloomberg Terminal Functions

The table below contains a comprehensive list of Bloomberg Terminal functions used in the assignment presented in this paper along with a brief description of each function.

Command	Function	Description
Assignment 1		
JOBS	Job Search	Search job openings posted to the Bloomberg Terminal
DES	Company Description	Overview of the company including basic financial information
MGMT	Management Structure and Profile	Detailed description of the company's management team and board of directors
SPLC	Supply Chain Analysis	Description of the company's relationship with its suppliers and customers
CN	Company News	Real time listing of news relating to the company
Assignment 2		
FA	Financial Analysis	Financial information including financial statements and financial ratios
Assignment 3		
FA	Financial Analysis	Financial information including financial statements and financial ratios
RV	Relative Valuation	Relative valuation comparison
Assignment 4		
POSH	Bloomberg Classifieds	Classified adds posted to the Bloomberg Terminal
MP	Mortgage Payment Calculator	Mortgage payment and amortization schedule calculator
GC	Graph Curves	Graphical representation of term structure (Yield Curve)
Assignment 5		
WB	World Bond Markets	Real-time world bond market index levels
DES	Company Description	Overview of the company including basic financial information
CF	Company Filings	Company documents filed with the SEC
CRPR	Credit Risk Profile	Detailed listing of historic and current debt ratings
CSHF	Cash Flow Analysis	Debt cash flow calculation and analysis tools
DRSK	Default Risk	
Assignment 6		

WEI	World Equity Indexes	Real-time world equity market index levels
IMAP	Intraday Market Map	Real-time market heat map
DES	Security Description	Overview of the company including basic financial information
GP	Graph Price	Graph of historical prices
DDM	Dividend Discount Model	Dividend discount model calculation tool
DVD	Dividend Summary	Detailed summary of dividends paid and dividend growth rate
WACC	Weighted Average Cost of Capital	Detailed calculation of the company's current weighted average cost of capital

Assignment 7		
COMP D	Comparative Return Analysis	Multi asset return comparison tool
BETA	Historical Beta Calculation	Detailed calculation of the company's historical beta
EQRP	Equity Risk Premium Analysis	Detailed calculation of the current equity risk premium (market and firm)

Assignment 8		
WACC	Weighted Average Cost of Capital	Detailed calculation of the company's current weighted average cost of capital
CAST	Capital Structure	Detailed calculation of the company's current capital structure

Teaching Corporate Finance using a Stock Trading Simulation: Student Expectations, Engagement, Performance, and Satisfaction

Serkan Karadas[1] and Adam Hoffer[2]

Abstract

This paper presents a stock trading simulation designed to be implemented in a Corporate Finance class. We survey students regarding their expectations for the class, engagement and motivation, and assessment of the game. We match the survey responses with student performance in the trading game and performance in the class overall. The survey results show that the stock trading game has a positive effect on student engagement. Furthermore, the participation in the stock trading game leads to a higher level of interest in future finance classes and careers in finance.

Introduction and Motivation

In Corporate Finance pedagogy, stock market activity often takes a secondary role to concepts such as capital budgeting and capital structure, and it is introduced later during the semester. For example, in *Fundamentals of Corporate Finance* textbook by Ross, Westerfield, and Jordan (RWJ hereafter), the discussion on how to acquire and read stock market information is relegated to the last two pages of Chapter 8.[3] The theoretical and empirical treatment of stock returns is provided in Chapter 12, and diversification is covered in Chapter 13.[4]

Students, however, expect stock market analysis to be an integral component to a Corporate Finance course. We discovered anecdotal evidence of such expectations following multiple semesters of teaching Corporate Finance.

In this study, we present a game created for implementation in a Corporate Finance course in which students must create a stock market portfolio and analyze their portfolios' results. Students are required to make five transactions approximately every two weeks, and they are evaluated primarily via participation.

We implemented the stock trading game in two different sections of Corporate Finance course that were taught in the same semester by the same instructor. We recorded each trade made by students as well as the performance of student portfolios. In each class we also surveyed students (i) to obtain their expectations regarding learning about stock market activity in the course, (ii) to measure students' perceptions of how the game related to course learning and satisfaction, and (iii) to evaluate game design and implementation.

Our paper contributes to the literature by demonstrating how a stock trading project can be successfully integrated into a Corporate Finance class and how this project affects student outcomes. Earlier studies report various outcomes from incorporating the stock trading game in finance classes. Our paper is unique in a way that we also offer a guide that instructors of Corporate Finance can use to successfully adopt stock trading games in their classes.

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[3] This is the best-selling text for Corporate Finance (Duong et al., 2014).

[4] The authors provide a picture of a stock market quote in Chapter 1, but they defer the discussion to later chapters.

Stock trading game is not universally implemented by finance faculty. In a survey of faculty who teach Corporate Finance, Saunders (2001) documents that the median finance professor underutilizes technology and he encourages future research on the effect of alternative teaching methods on student learning outcomes. In a more recent study, Waggle and Moon (2009) survey finance professors who teach Investment courses and find that fewer than 30% of them use stock trading games. We infer that this percentage is likely to be even lower for a Corporate Finance course. This is because a typical Investments course places more emphasis on topics such as trading, valuation, and asset pricing than do corporate finance courses (Waggle and Moon, 2009). We hope an additional contribution of our paper is that it provides a template for easy implementation of a stock market game into a Corporate Finance class.

The rest of the paper proceeds as follows. We provide the summaries of the relevant studies in Section 2. Section 3 outlines the stock trading game, with complete documentation and handouts provided in the Appendix. We also provide descriptive statistics of stocks and trades from a stock trading simulation case study. We discuss the survey design and the survey results in Section 4. We present our empirical methodology and report the regression results in Section 5. We conclude the paper in Section 6.

Literature Review

Empirical evidence suggests that the use of technology can improve student learning outcomes. Cagle et al. (2010) present evidence that the use of spreadsheets in principles of finance classes helps students understand the course material better. Hoffer (2015) describes the use of double auction software to facilitate borrower-lender transactions, and Holder et. al. (2015) enable students to showcase their technological savviness by making economics videos outside of class.

A variety of pedagogical studies show how instructors can promote active learning by incorporating tools such as excel functions (e.g., Zhang, 2014), economics data (e.g., Hoffer, 2014), and real-time financial data (e.g., Holowczak, 2005) into their economics and finance classes. Several studies have also presented some form of a stock market game as active learning platforms, but the audience for which the games are designed, and the outcome measures against which game performance are matched vary greatly. However, there is evidence that they are also helpful tools. For example, Harter and Harter (2010) find evidence that stock trading games embedded within the curriculum have a positive effect on financial literacy of high school students.

Moffit et al. (2010) incorporate an equity trading simulation into an introductory business course and a senior-level business course. They assess how much students learned about financial concepts via a pre-trading (at the beginning of the semester) and post-trading (at the end of the semester) tests. Students are graded based on making the required number of trades and performance; the stock trading project accounts for 30% of the course grade. An important caveat is that instructors do not teach any lessons on stock trading. The authors find that students improve their knowledge of the financial markets. Their analysis also documents lower pre-test and post-test scores for female students.

Our study differs from the study by Moffit et al. (2010) the following ways. We assess the student outcomes in a Corporate Finance course. We also teach students about the basics of investments and stock trading in the first week of classes. This training helps students evaluate the stock trading project as an internal part of the curriculum. Furthermore, students in our classes are required to write periodic trading reports that provide them with the opportunity to organize their trades and reflect on their learning experience.

Our survey results indicate that students find this aspect of the trading game helpful. Since we make the trading game an integral part of the course, we do not assess how much students have improved their knowledge of investment concepts from the game alone, as it is difficult to isolate the effect of the trading game from the effect of the course material on student learning. Our main goal is to understand how well the stock trading project complements a typical corporate finance curriculum and enhances student motivation in finance.

Dolvin and Pyles (2011) examine the relationship between students' mock portfolio performance and their interest in finance. In particular, they ask students to rate their knowledge of financial concepts and their interest in finance-related careers before and after the trading game. They find that the returns on students' mock portfolios do not affect the percentage change in their knowledge of financial concepts and their interest in financial careers. The authors suggest that instructors should not worry that poor portfolio performance may discourage students from studying finance or seeking employment in the finance industry.

Our study is similar to the work by Dolvin and Pyles (2011) in that we use surveys to seek student feedback and ask students about their level of interest in taking more finance classes and pursuing careers in finance. Our study focuses on Corporate Finance classes whereas Dolvin and Pyles (2011) survey the students in upper level Investments course. Furthermore, our survey specifically asks students the effect of the stock trading game on their learning outcomes.

King and Jennings (2004) investigate the effect of stock trading on students' learning outcomes in an introductory management course. They conduct investment literacy surveys at the beginning and at the end of the semester for a traditional-style (i.e., no simulation game) and augmented-style management course. They find that the incorporation of the stock trading game leads to better student learning outcomes and higher student satisfaction captured by student evaluations. Our study complements the work by King and Jennings (2004) showing that the stock trading game improves student learning and motivation for Corporate Finance students as well.

Lekvin (2005) assesses the learning outcomes of a trading game for students enrolled in a MBA and a special program for trading in Korea. Students in this game already graduated from college and were working in the banking industry. The game is much more advanced than a typical game geared towards undergraduate students, and it involves trading foreign currency swaps and options. Furthermore, for the students enrolled in the special program, the trading game is the only form of assessment (i.e., there is no traditional academic performance measures such as exams.) The author presents evidence that students with high scores from the trading game possess skills, but these skills are not related to their academic performance. Lekvin (2005) argues that trading games capture skills that are not well-measured by traditional assessment tools. Our results support Lekvin's findings.

Trading games can be adopted in non-equity investments as in Lekvin (2005) or to teach specific concepts regarding equity trading. For example, Ascioglu and Kugele (2005) outline an equity-based simulation game to teach students how stock prices are determined in the marketplace. The authors also conduct a survey asking students how the simulation game has affected their learning, and they report enhanced student learning outcomes from the game. Seiver (2013) uses OANDA, a foreign-exchange trading platform, in an international business finance class and documents a positive relationship between student exam scores and the dollar volume of their trades. He does not find any association between the exam performance and the number of trades that students make.

Stock Trading Simulation

Structure

We embed this assignment in a Corporate Finance course at Sewanee: The University of the South. Sewanee is liberal arts college with approximately 1,700 students. Corporate Finance is an elective course for economics majors; there is no finance major at Sewanee. However, Corporate Finance is a required course for all students minoring in Business Administration. Many economics majors take Corporate Finance either as part of business minor or for personal interest.

For the simulation, each student is endowed with a hypothetical $1,000,000. Over the course of a 15-week semester, students are required to submit five trading reports (four interim and one final).[5] Full handouts and assignment details are provided in the Appendix 1.

Each of the five trading reports has four parts. First, students summarize the important market and macroeconomic news. Next, students list their trades and the reason(s) behind each trade. Students then provide data on their best-performing investment, worst-performing investment and overall portfolio performance. Performance analysis is in line with Mayo (1990) who suggests that students should explain why they buy or sell a particular asset.[6] Finally, students must reflect and analyze their trading experience, discussing what they have learned.

[5] The project was approved by the local Institutional Review Board. The IRB materials are available upon request.

[6] The final trading report also embodies a comparative analysis part in which students compare their portfolio returns to the returns on S&P 500 index. There is support for benchmark-based comparison in the literature (McClatchey and Kuhlemeyer, 2000).

Appendix 1 also provides the blank template given to students for completion. Seiver (2013) uses a similar template for international business finance class and argues that such short reports might produce the largest educational benefit for students.

Approximately two weeks pass between each trading report, and students are required to make a minimum of 5 trades (equities or exchange-traded funds) for each trading report. This requirement is consistent with the general practice by finance professors. For example, in a survey of professors teaching Investments, McClatchey and Kuhlemeyer (2000) report that 71.9 percent of their survey respondents require minimum number of trades in stock trading games that they implement in their classes. The authors themselves use stock trading game in their classes, and they argue that some students feel uncomfortable about picking and investing in stocks, and some may not exert the necessary effort to trade stocks in the absence of incentives.

We use Trade Message (TMSG) platform on Bloomberg terminals to facilitate student trades and to provide students with an easy, electronic means of managing their portfolios. We encourage students to retrieve and use financial information from Bloomberg terminals that will be helpful to their investment decisions (see Sharma (2015), Lei and Li (2012), Jones and Swaleheen (2014), and Lei and Li (2015) for important Bloomberg functions and a discussion of student portfolio performance).

The stock trading simulation is worth 6% of the students' overall grade. The simulation grade depends on the proper completion of the trading reports and making the minimum number of trades for each trading report. We do not grade the students based on portfolio performance. While Rousu et al. (2015) demonstrate that performance incentives matter for student participation in classroom games and activities, Mayo (1990) discourages instructors using the portfolio performance as the primary tool for grading as it may lead to excessive risk taking and gambling-type investment behavior by students.

Incorporating the Stock Market Project into a Corporate Finance Course

We design the stock trading game in such a way that the project is integrated with the core topics of a Corporate Finance course. Table 1 connects the Stock Trading Simulation with corporate finance topics covered in the first 14 chapters of RWJ.

Table 1: Topics in Corporate Finance Relevant to the Stock Trading Simulation

Chapters	Topics	Connection to the Stock Trading Simulation
Chapter 1: Introduction [Ross, Westerfield, and Jordan *Fundamentals of Corporate Finance* Textbook]	Stock price maximization	-Use the management's goal as a motivation to study stocks
	-Ownership of corporations	-Explain to students that corporations are owned by shareholders, and in some cases the shares held by shareholders are sold in the marketplace. This helps students understand where the shares come from. A brief overview of the Initial Public Offering (IPO) process and a discussion on recent IPOs help students connect with the stock trading project.
	-Limited liability	-Explain to students that limited liability implies -100% threshold for stock returns.
	-Double taxation	-Explain to students that they will need to pay taxes on the dividend income that comes from their stock holdings.
Chapter 2: Financial Statements	-Order of items on the right-hand side of the balance sheet	-Discuss and explain it to students that shareholders have a secondary claim on firm's assets relative to lenders to the firm. This helps students understand that equity investments are riskier. If time allows, do examples where a company's assets decline in value, and how this affects the right side of the balance sheet. Examples where equity is completely wiped out due to asset write-downs demonstrates very clearly to students how risky stocks are.

	- Financial leverage -Owners' equity -Cash flows	-Do an example in which a student uses her own money as well as borrowed money at a certain interest rate (e.g., 10%) to purchase a stock. Discuss two scenarios where the stock price goes up and down significantly. Calculate the return in each scenario based on student's own capital (i.e., return on equity). Explain how financial leverage enhances returns or exacerbates losses on equity. If the trading platform allows margin trading, explain to students that this example shows how margin trading works. -Explain students the difference between the market value of equity and book value of equity, and do exercises on calculating the market value of equity (i.e., market capitalization). -Go over different classes of market capitalization (large cap, medium cap, and small cap) and what these classes imply for stock returns. -Explain to students the difference between accounting numbers such as net income and cash flows, and how a stock's value depends on the cash flows that it will generate for shareholders in the future.
Chapter 3: Working with financial statements	-Ratio analysis	-Briefly review the concept of fundamental analysis and explain to students how the ratios in this chapter can be used to perform fundamental analysis and how fundamental analysis can help with their investment decisions. -Explain to students how equity multiplier measures the extent of leverage. Students should remember from the previous chapter how the financial leverage affects returns. -Highlight the importance of return on equity (ROE) for shareholders. -Discuss the importance and implications of price to earnings (P/E) ratio. In particular, explain to students what high or low P/E ratio implies for their investment decisions. -Similar to the P/E ratio, discuss the market-to-book ratio at length and its potential uses in investment decisions.
Chapters 5 and 6: Time Value of Money	-Future value -Compounding -Present value -Discounting	-Explain to students how their initial endowment of $1,000,000 represents the present value and the ending portfolio balance represents the future value. -Ask students if they would prefer to get their $1 (per share) annual dividend from a hypothetical stock in two ($0.50 each) or four ($0.25 each) installments. This discussion not only helps students understand the importance of compounding frequency but also help them understand how it translates to their stock investments in real life. -Use the dividend example above to demonstrate how different payout schedules lead to different effective annual rates on their investments. -Discuss how, all else equal, higher returns translate higher future values (i.e., higher future portfolio balances.)

Chapter 7: Interest Rates and Bond Valuation	-Bond ETFs -Bond prices and interest rates -Interest rate risk -Price quotes in bond trading	-Explain to students how they can invest in bonds using exchange traded funds (ETFs). This discussion is especially helpful if the trading platform used does not allow bond trades. -Discuss the relationship between bond prices and interest rates, and how they can use this relationship in trading bond ETFs. -Discuss how interest rate risk can affect the value of their bond ETFs. -Discuss the bid price, ask price, and bid-ask spread for bonds, and mention to students that these terms are also relevant for stocks. Provide an example where an investor purchases a stock or a bond at the ask price, and sells it at the bid price.
Chapter 8: Stock Valuation	-Types of valuation -Future cash flows -Discounting -Components of required rate of return	-Discuss how students can use intrinsic value and comparables approach to value stocks. Our experience shows that humorous examples can help students understand this distinction very well. For example, instructors can ask students how they will value a chicken using intrinsic value and comparables (i.e., multiples) approach. Students are quick to respond that they will look at the prices of "similar" chickens in the marketplace for the comparables approach, and they will find the present value of eggs from this chicken as well as the final (terminal) value of this chicken to perform the intrinsic valuation. -Demonstrate to students how the intrinsic value of a stock can be found by discounting its future cash flows. Remind students that good corporate finance decisions are likely to generate higher future cash flows, increasing the value of the stocks in their portfolios. -Discuss how two stocks with identical future cash flows will have different values due to different required rate of returns. Use this discussion to highlight the importance of risk for stock prices. Students appreciate how the discount rate captures the risk and leads to different present values (i.e., values of the stock). -Review how returns are decomposed into dividends yield and capital gains yield. We introduce this distinction to students at the beginning of the semester. The material in this chapter provides a good review of the topic. -Do exercises for stock valuation using price-to-earnings multiples.
Chapters 9, 10, and 11: Capital Budgeting	-Overall purpose: value creation -Capital budgeting techniques -Cash flow projections	-Emphasize that the overall purpose of capital budgeting decisions is to create value for shareholders. All else equal, good projects should have a positive effect on stock prices. -Explain to students how positive net present value (NPV) projects can contribute towards shareholder's wealth and how this contribution is reflected in stock prices. -Explain to students that internal rate of return (IRR) is also used in determining the portfolio returns (See http://awgmain.morningstar.com/webhelp/Practice/Accounts/IRR_vs_Total_Return.htm for a simple exercise). -Explain to students that they can use cash flow projections to find the value of an entire company and its common stock as well.

Chapters 12, 13, and 14: Risk, Returns, and Cost of Capital	-Capital Asset Pricing Model (CAPM) -Beta -Weighted average cost of capital (WACC)	-Use the Capital Asset Pricing Model (CAPM) to establish the relationship between risk and stock returns. Students should be familiar with this relationship from the first week of classes. -Provide an intuitive explanation for beta and give actual examples of low and high beta stocks. -Explain to students that WACC is also used in enterprise valuation and equity valuation. Based on our anecdotal experience, student experience spikes in interest when they know that they can use these methods for further purposes (see Rosenbaum and Pearl, 2013, p.177).

Chapter 1 of RWJ strongly emphasizes the role of financial management in shareholder wealth maximization. The authors further stress that "[b]ecause of the goal of financial management is to maximize the value of the stock, we need to learn how to identify investments [capital budgeting] and financing [capital structure] arrangements that favorably impact the value of the stock" (p. 9). We take this relationship as the starting point of the stock trading project. We mention to students that financial managers make corporate finance decisions to enhance shareholders' wealth, and it is important to understand how stock prices move and what decisions and events affect stock prices.

Following the discussion on shareholder wealth maximization in the first class meeting, we immediately introduce key concepts such as risk-return trade-off and portfolio diversification via intuitive examples. For example, we used the following question to introduce the relationship between risk and return:

> *You have $1,000 that you like to invest. Two of your friends approached you, each asking to borrow $500 for one year. One of your friends has a stable job. The other friend is currently unemployed, and is hoping to get a job in the next few weeks. You decided to charge 6% interest to the friend with a stable job. Would you charge less than or more than 6% interest to the unemployed friend?*

Students overwhelmingly name rate greater than six percent. After such intuitive examples, we observed that students found it easier to understand the positive relationship between risk and returns for stocks. To help students understand different terms associated with trading, we also do numerical exercises on total stock returns, dividends yield, capital gains yield, price-to-earnings ratio.

Moreover, we present students a stock table and walk them through terms such as closing price, volume, 52-week high, and 52-week low. Our discussion of these material sometimes precedes their normal order in the textbook by weeks and sometimes by months. For example, in RWJ, the dividend yield is discussed in Chapter 8 (p., 243 and onward), and the portfolio diversification is discussed in Chapter 13 (p., 423 and onward). By front-loading these important concepts at the beginning of the semester, we hope that students see the stock trading game as an integral part of the course and feel more comfortable trading stocks. After covering the basic materials about stock returns and trading, we give students a few days to acclimate to the Bloomberg terminals and then begin the stock trading game.

After these classes, students trade stocks on their own and submit their interim trading reports. When appropriate, we continue relating the corporate finance concepts to stock returns.

We also found two readings very helpful for students. The first reading is an investor publication produced by the Securities and Exchange Commission (SEC) on asset allocation, diversification, and portfolio re-balancing.[7] The second reading, prepared by the editors of Kiplinger's Personal Finance magazine, walks students through important terms such as value stocks, growth stocks, price-to-earnings ratio, return on equity, dollar-cost averaging, and volatility.[8] We recommend that instructors assign these readings early in the semester and seek students' feedback on them. We share some of the student feedback on these in Appendix 3.

[7] This reading can be accessed at http://www.sec.gov/investor/pubs/assetallocation.htm

[8] This reading can be accessed at http://www.scag.gov/wp-content/uploads/2011/03/Stocks.pdf

Trades and Portfolio Performance from a Case Study

We collected data from 50 students in two sections of corporate finance who participated in the stock trading simulation. Students traded 464 different stocks over the course of the project. Table 2 presents the most frequently traded 10 stocks. Chipotle tops the list with 22 trades. This list contains companies like Facebook that arguably appeals to young people as well established companies such as General Motors and Exxon Mobil.

Table 3 provides firm-level descriptive statistics for all the stocks that students traded during the course of the project. We retroactively retrieved this data from Bloomberg terminals for the week preceding the start of the trading project. The mean number of trades per stock is 2.08, and the median number of trades is only 1. The median market capitalization (in millions of dollars) is substantially lower than the mean market capitalization, suggesting that the distribution is skewed to the right. The lowest market capitalization stock is $20,000 (SMC Entertainment Inc.), suggesting that some students traded penny stocks. P/E (price to earnings) ratio and P/B (price to book) ratio have both extremely high values, causing the mean to exceed the median.

Table 2: Most Traded 10 Stocks

Name	Ticker	No. of Trades	Market Cap ($ Millions)	P/E Ratio	P/B Ratio	Beta	Firm Age
CHIPOTLE MEXICAN GRILL INC	CMG	22	$ 14,400.28	30.06	6.64	0.00	10
APPLE INC	AAPL	19	$ 542,209.23	10.43	4.23	1.26	36
TESLA MOTORS INC	TSLA	19	$ 26,384.73	N/A	24.32	1.52	6
FACEBOOK INC-A	FB	18	$ 269,868.41	74.55	6.14	0.96	4
AMAZON.COM INC	AMZN	12	$ 271,606.56	466.10	20.39	1.07	19
GENERAL MOTORS CO	GM	12	$ 45,771.05	6.47	1.11	1.32	6
EXXON MOBIL CORP	XOM	12	$ 312,480.57	19.20	1.83	0.94	96
WALT DISNEY CO/THE	DIS	11	$ 154,900.75	17.20	3.65	1.03	59
SOUTHWEST AIRLINES CO	LUV	11	$ 25,591.47	11.17	3.46	1.11	45

Table 3: Properties of All Stocks Traded

	No. of Trades	Market Cap	P/E Ratio	P/B Ratio	Beta	Firm Age
Mean	2.08	$ 33,497.45	40.25	5.31	1.05	24.49
Median	1.00	$ 6,077.97	18.21	2.35	1.02	19.00
St. Dev.	2.53	$ 70,100.55	149.45	16.40	0.69	22.09
Max	22.00	$ 542,209.23	2403.60	229.55	3.58	101.00
Min	1.00	$ 0.02	2.51	0.09	-4.60	1.00

Table 4 presents the breakdown of sectors that students invested in based on the classification provided to us by Bloomberg.[9] Consumer Discretionary is the most heavily traded sector accounting for 24.38% of the trades. It is followed by Communications and Technology. The least traded sector is Utilities with representing less than 2% of the trades.

Student Survey

We surveyed the students about their experience with the stock trading game at the end of the project. The participation in the survey was voluntary, and the participants were awarded with a modest bonus point. Students in the college where we conducted this survey can major in economics or have a minor in business with finance concentration.

[9] Bloomberg did not associate 41 trades with a sector.

Table 4: Number of Trades per Sector

Sector Name	Number of Trades	Percentage of Trades
Communications	187	13.69%
Consumer Discretionary	333	24.38%
Consumer Staples	117	8.57%
Energy	126	9.22%
Financials	132	9.66%
Health Care	118	8.64%
Industrials	81	5.93%
Materials	97	7.10%
Technology	155	11.35%
Utilities	20	1.46%

Each section of Corporate Finance had 25 students, and we had 49 total responses. The survey asked students to rank on a scale of 1 to 5 (1= strongly disagree, 2= somewhat disagree, 3= neither agree nor disagree, 4= somewhat agree, 5= strongly agree) how much they agreed with each of 17 separate statements.

Table 5 presents the survey summary statistics. Students expected to learn stock trading as part of the course, with an average response of 4.3 out of a possible 5.0. This result supports our previous anecdotal observations of students being disappointed in the Corporate Finance course due to the lack of attention paid to stocks. We also take this result as support for including our stock market simulation as part of the course moving forward.

Table 5 – Survey Summary Statistics

Question	Mean (out of 5)	St. Dev.
Expectations		
I expected to learn about trading stocks in this course.	4.31	0.86
Engagement, Motivation, Learning		
The stock trading project helped me engage with the overall course material.	4.57	0.64
The stock trading project made me a more motivated finance student.	4.45	0.73
The stock trading project helped me understand the course material better.	4.29	0.83
The stock trading project increased my interest in future finance classes.	4.65	0.52
The stock trading project increased my interest in careers in the financial field.	4.37	0.85
The stock trading project helped me keep up with financial news.	4.39	0.63
Project Evaluation and Assessment		
The stock trading project was a valuable learning tool by itself.	4.57	0.70
The stock trading project helped me become a more knowledgeable investor.	4.47	0.67
Skills played an important role in my portfolio performance.	3.55	0.90
Luck played an important role in my portfolio performance	3.80	0.81
I was influenced by how and what my peers traded.	2.65	1.38

The minimum number of required periodic trades ensured that I traded stocks regularly.	4.22	0.76
The format of the trading reports made it easier to organize and report my trades.	4.57	0.53
The stock trading project complements the economics curriculum in Sewanee	4.51	0.58
I recommend that the instructor keeps the stock trading project of the course in the future semesters.	4.82	0.39
I recommend that the instructor grades the trading reports based on portfolio performance.	1.96	0.86

Students positively responded to the stock trading simulation in the evaluation of the project's effects on their engagement, motivation, and learning. Average responses in the Engagement, Motivation, Learning statement section ranged from 4.3 (helped me understand the class material) to 4.7 (increased my interest in future finance classes).

Students thought the simulation was a valuable learning tool (4.6) and helped them become better investors (4.5). Students also thought the simulation complemented the economics curriculum (4.5) and overwhelmingly agreed the project should be used again in future classes (4.8).

Regression Analysis

The goal of our regression analysis was to examine whether student expectations, motivation, evaluation, and project performance systematically vary based on demographics or class section. We employ an ordinary least squared (OLS) model for portfolio and project performance and we use an ordered logit model for survey responses in which our dependent variable is limited to a 1 to 5 response.

The OLS model is,

$$Y = X\beta + \varepsilon \quad (1)$$

where Y is portfolio performance (raw portfolio returns minus the returns on S&P 500), X is a matrix of student characteristics including *gender* (1=male), *senior* (1=a student is a senior), *class performance* (total points earned for the course excluding the stock market assignment), *section* (1=student in the second class section), and *Econ major* (=1 if the student was a declared economics major when taking the course), and ε is a robust standard error term.

We estimate the ordered logit model for each survey question.[10]

$$y^* = X\beta + \varepsilon \quad (2)$$

using the observed responses

$$Y = \begin{cases} 1 \text{ if } y^* \le u_1 \\ 2 \text{ if } u_1 < y^* \le u_2 \\ 3 \text{ if } u_2 < y^* \le u_3 \\ 4 \text{ if } u_3 < y^* \le u_4 \\ 5 \text{ if } u_4 < y^* \le u_5 \end{cases}$$

where Y is the survey response and $u_{1\text{-}5}$ represent the true value of the question held by the respondent, with 5 representing complete agreement with the question.

Results

Student class rank, gender, class performance, section, and major had no statistically significant relationship with the variation in the survey responses with the following exceptions.[11] Male students, more than female students, thought the project made them more motivated in the class and found the project to be

[10] Separate estimates of generalized logit and ordered probit are available upon request.

[11] The full empirical results Table is available upon request.

a valuable learning tool. These results provide empirical support to the gender disparity issue documented by Moffit et al. (2010). We also find that male students were less likely than female students to report that they were influenced by the trades of their peers.

Better performing students (points scored on all assignments other than the trading game) reported the game was a more valuable learning tool. Better performing students also attributed less of their portfolio performance to luck. Economics majors reported the stock trading project was less likely to help them keep up with financial news and economics majors were less influenced by the peers' trading decisions.

Table 6 presents the OLS performance regressions. The only variable that exhibited a statistically significant effect on any of the performance measures was *gender*. Male students' portfolios outperformed female student portfolios by 4.6 percentage points or approximately $46,000 based on the portfolio returns adjusted for the returns on S&P 500 over the course of the project. We also investigate the determinants of *Number of trades* by a given student and *Points earned on the project*. Overall, we find that student's class rank, class performance, and major played no significant role in portfolio performance, number of trades made, or student's grade on the stock trading simulation. The lack of relationship between class performance and portfolio performance is in line with Lekvin (2005) who argues that trading simulation captures part of student learning and skills that traditional assessment tools fail to capture.

Table 6 OLS Performance Regressions

	Percentage return above market	Total return (USD)	Number of trades	Points earned on project
Male	4.61*	46,382.0*	4.70	2.89
	(2.00)	(20,058.5)	(4.07)	(2.20)
Senior	-0.68	-6744.5	-0.87	-0.55
	(2.02)	(20,229.0)	(2.06)	(2.24)
Class points	-0.014	-144.3	0.00	0.04
	(0.021)	(209.1)	(0.024)	(0.034)
Section	1.11	11,099.7	1.59	-2.00
	(1.91)	(19,083.2)	(2.23)	(2.21)
Econ major	2.31	23,095.2	0.56	-0.90
	(1.94)	(19,429.3)	(2.27)	(2.06)
Constant	-8.50	112,681.9	-5.41	23.1
	(18.1)	(181,523.1)	(20.7)	(25.0)
N	49	49	49	49
R^2	0.103	0.103	0.074	0.113

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

Conclusion

We present a stock market simulation for implementation into a Corporate Finance class. We surveyed students and found that students expected stock trading to be an integral part of our Corporate Finance class.

Survey results following the implementation of the stock trading simulation in two Corporate Finance courses revealed that students enjoyed the game, thought the simulation enhanced their learning of the course, and increased the interest in taking future finance courses. We take these results as a strong signal from students that the stock trading simulation is a valuable addition to a Corporate Finance course.

Survey responses varied little based on gender, class rank, or student performance in the class. Similarly, data collected from our implementation of the stock simulation showed little variation in portfolio performance or simulation participation based on class rank or student performance in the class, however the portfolios of male students outperformed the portfolios of female students by an average of about four percentage points.

Overall, we found the stock trading simulation to be a great tool for teaching Corporate Finance. We recommend using a stock simulation in Corporate Finance courses and with the detailed assignment sheets provided in this paper, we aim to facilitate easy adoption of stock market trading for other instructors who desire to implement a similar simulation in their class.

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Appendix 1 Handouts, Instructions, and Forms

Instructions for Interim Trading Reports (ITRs)

You will submit five trading reports (four interim and one final) for this trading project. You need to make at least 5 trades for each trading report. Make sure to place your trades early enough so that they go through. For example, New York Stock Exchange opens at 9:30 am (Eastern) and closes at 4:00 pm (Eastern). When you factor in the time difference and how long it takes for your trades to be processed by Bloomberg, you need to make your trades hours before the market closes.

The trading report needs to be at least 350 words and at most 600 words. You will need to use the required template in the same folder with these instructions (Margins 1 inch in all corners. Times New Roman, Font Size of 12, Double Spacing). Name this template as ITR#_Lastname_Firstname where you should insert the report number after #. Fill in the first line in the template carefully (your name, report number, and word count). The due dates for the trading reports are listed on the syllabus.

Your report should be composed of three parts: market report, trading & portfolio report, and learning experience.

1. Market Report
This part of the report should provide a summary of general market and industry news such as GDP, unemployment, and inflation numbers.

2. Trading & Portfolio Report
In this part of the report, you are provided with two tables. The first table is *Table 2.1 Trading History & Decisions.* You need to list your transactions in this table. Multiple buy transactions in a given stock is considered a single trade for this report, and you should provide the aggregate number of shares you bought. For example, if you bought 50 Apple shares each day for 5 days in a row, you should report a single trade (250 shares bought) in your transactions table. Similarly, multiple sell transactions in a given stock is considered a single trade for this report as well, and you should provide the aggregate number of shares you sold. For example, if you sold 50 General Electric shares each day for 5 days in a row, you should report a single trade (250 shares sold) in your transactions table.

Please only list your buy and sell trades. If you have not made any changes in a stock position between trading reports, please don't report this lack of trading activity. For example, you bought 250 Apple shares and reported these trades in your trading report #1, but you have not made any changes to these positions (i.e., you are still holding onto these 250 shares), you should not list anything for Apple in Table 2.1 in your next report.

You can choose to invest your initial $1 million in any way you would like. The more stocks you buy, the less cash you have. If there is a very good stock that you want to buy, but you don't have any cash left in your portfolio, you will need to sell some of your stocks to get some cash back to your portfolio. You are also free in choosing in how much to invest in a given company.

After you input the necessary information in Table 2.1, you need to discuss briefly the reason(s) behind each trade. There is no strict criterion for the reasons. You may have bought Apple shares because you read an upbeat analyst report on Apple or you love their products and have great confidence in the company.

In class, we talked about trading stocks and the importance of diversification. There is another important issue that I want to bring to your attention: dealing with your losses. If you have stocks losing a lot of money, basically you are faced with two decisions: sell them or continue holding onto them. Investors hate to lose money so sometimes they hold on a losing stock until it goes down to pennies because the moment they sell, they face the reality that they lost money. Also keep in mind that for a stock to get back to the price you bought it for (break-even), it needs to go up more (percent-wise) than it went down. Let's say you bought a stock at $100 a share. It is now trading at $50 a share (went down by 50%). For it to get back to $100, it needs to go up by 100%!!! This is a lot of percentage points. So what should you do? You need to critically ask yourself what is going on: Is this stock going down because of some big negative information? Or investors are somehow over-reacting to a minor event and driving the stock down to unreasonable prices?

The second table in this part of the report is *Table 2.2 Portfolio Performance*. Here you need to provide performance-related information. In particular, you need to report the following: best performing stock and worst performing stock in your portfolio and overall portfolio performance.

3. Learning Experience

In this part of the report, you should write about what you have learned from your trading experience. Let's say that you made a poor investment decision. This is the place where you will briefly mention what you learned from this experience.

Simulation Summary Questions [Final Report Only]

1) State and explain your ranking in class. What contributed to this ranking?
2) What mistakes (if any) have you made? What have you learned from them?
3) If you were to start over your portfolio, what would you have done differently?
4) What has been the role of luck in your investment decisions?
5) What has been the role of skills in your investment decisions?
6) Do you think that the stock market is fair in that it gives each participant equal opportunity?

Trading Report Form

Name: Report Number: Word Count:

1. Market Report

2. Trading & Portfolio Report

Table 2.1 Trading History & Decisions

Name	Ticker	Shares	Trade	Reason

Table 2.2 Portfolio Performance

	Name	Ticker	Return (%)	Profit & Loss ($)
Best Stock				
Worst Stock				
Overall Portfolio				

3. Learning Experience

Appendix 2 – Student Feedback on Reading Assignments

Reading #1: Beginner's Guide to Asset Allocation, Diversification, and Rebalancing

"I enjoyed this reading and found it very educational. Although I am not investing real money yet in my life when I do I will definitely allocate it to the best of my ability in a way that will both fit my time horizon and risk tolerance."

"This was a great introductory article for me because I am pretty new to investing. Also, the article was very easy to read which caused me to take away a lot of valuable information from the article. I like the part about rebalancing which I have never heard of before. It makes sense because I am sure that investors can let their emotions get the best of them instead of following their investment plan."

"… [T]here were things in this article that I found very useful and helpful for even people with a career in finance. Most of the terms like not "putting all you eggs in one basket" and "no pain no gain" in regards to risk reward are all things that we have been familiarized with plenty of times. However, all of the simplistic real life examples that this article gave were helpful in solidifying that knowledge with simple examples that I would have never thought to use in regards to investing in the stock market."
"My personal reflections on this reading are that it is very important in regards to asset allocation to recognize the time horizon and the risk involved with different assets. Above all the idea of risk versus reward is crucial when talking about diversification and asset allocation. This idea is crucial when making investment decisions. Also, this crucial idea of risk versus reward can be handled effectively through the appropriate application of diversification and asset allocation. By applying both of these concepts to your portfolio you are presented with a situation in which the risk is fairly low, but the reward can still remain fairly high.

Reading #2: The Basics for Investing in Stocks

"While the last article we read provided a lot of good and simplistic information on how to invest in the stock market using everyday examples that we can all relate to, I thought that this article had much better information. This article provided a great deal of useful information not only about the basics of investing in the stock market, but also explaining the different kinds of stocks that the market offers and explaining how financial ratios are used without using a great deal of confusing financial jargon. Overall I thought this article provided very useful information about how to invest in the stock market, and it also did so in a clear and coherent manner."

"In my opinion, I thought this was the best reading we have had yet. In many aspects of the financial world, it is difficult to grasp concepts because they are explained or discussed in a very advanced dialog but this article did a fantastic job of sticking to the basics. By keeping the language simple, it was able to explain the fundamentals of investing in stocks in a concise manner. Obviously, more information is required in order to be a successful stock trader but articles such as this provide a solid foundation for that future knowledge. I was especially interested in when the article discussed selling a stock once it reached your target price. I must say that as a new investor, I had a stock reach my target price but I held on to it thinking it would climb even higher. In reality, the stock began to lose steam and eventually fell back below that target price. In the future, I will be sure to stick to my initial target price and try to keep emotions out of the decision making process."

"This article is more helpful than the last article due to its inclusion of strategies to assess value of stock through the use of the various valuation ratios we have discussed in class. This article also provides examples for where to find the information necessary to calculate these instruments. Also it provides valuable insight into the process of selling your stocks, it is important to note that taxes and brokerage fees will be deducted from your profits as well as setting a target price that is in accordance with your specific type of investment."

"This reading was very informational and taught me new things that I did not know about. Especially about all of the different kinds of stocks out there. I also found interesting the dollar-cost averaging method and how it can benefit people when they invest in intervals. I also learned more about dividend reinvesting and how people have the option to do that in a very easy manner. I enjoyed this reading because I think it has a lot of great information. I learned a lot from it and it is a good additional piece to the lectures."

"I think this reading did a very good job of putting most of the material that we have learned in this course so far into context by showing the importance of understanding why financial statements, stocks, and other investment concepts are the fundamentals to understanding finance. Not only did the reading give very specific information that built upon the concepts in our notes from the past few weeks in class, but it also have real-life implications of how these concepts are used to be informed investors. Since the stock market is one of the main ways that wealth has grown over the past 100 years, it is extremely important to be able to be able to think autonomously about why and how certain financial and investment decisions are made."

Increase Interest In Compound Interest: Economic Growth and Personal Finance

Tomi Ovaska[1] and Albert Sumell[1]

Abstract

Compound interest is in the center of both economic growth and personal finance, but treated as independent topics in most economics textbooks. This educational note first defines economic growth and the main factors behind it. Then, figures and tables are applied to show the power of compounding growth (inflation and purchasing power adjusted) for select countries over the last centuries. Right after, growth future value calculation practice problems follow. After mastering four distinct variants of the compound interest formula, the paper's focus moves to students and personal finance. The earlier formulas are now used to highlight the significance of long-term investing in one's financial future. Though economic growth and personal finance are not commonly taught together, this paper shows that these topics can complement each other and that students can gain additional insights into how compound interest is meaningful to their own lives.

Introduction

The material in this paper is designed to improve upon the way a typical economics principles course is taught. It is a challenging, brief introduction to both economic and personal income/savings growth. Economic growth - our increased ability to produce and consume goods and services we care about - is arguably the single most important topic covered in any Principles of Economics course. While individual income and savings are two sides of the same coin, economic and income/savings growth are all too often split into fragmented pieces and spread over an entire textbook. Given this decentralization, students in our experience rarely acquire a satisfactory understanding of both subjects. This is a surprising outcome, since they all share a key component – compound interest – and have real life implications to students far beyond simple micro- or macroeconomics. Any student that understands the concept of compound interest is already unknowingly immersed in related topics that matter to their personal lives, such as the time value of money, social security reform, equity investing, and retirement planning. This real-life connection provides for a potentially fertile ground to increase students' interest in both subjects.

The target audience of the material presented in the paper includes not only economics instructors, but also social science or part-time or adjunct economics teachers in universities and colleges, community colleges and high schools who may teach a periodic introductory course in economics. The material, especially the historic data, database information and calculations, have also been successfully used as a quick refresher course for beginning graduate students. This article is organized as follows. We start with a brief summary of the previous literature followed by an introductory examination of what economic growth is and its major determinants. Then we measure economic growth using the compound interest formula, which allows us to place growth in the context of personal finance. Finally, we discuss investment and savings strategies to show students how to benefit from compound interest in their personal lives. Each section includes footnotes of topic-related exercises such as videos, readings, calculations, discussion questions and data finding exercises.

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Previous Literature

Previous literature has shown that U.S. youth lack financial literacy and are generally ill-equipped to make important financial decisions (Butters, Asarta, and McCoy, 2012; Lusardi, Mitchell, and Curto, 2010; Mandell, 2008). Fortunately, a growing body of research suggests that personal finance education programs can positively impact financial behavior and learning outcomes among youth, ranging from elementary school to college students. For example, Hagerdon, Schug, and Suiter (2012) analyzed the effectiveness of a financial literacy program for Chicago's elementary school children. They found that students in the program showed significant improvements in their knowledge and attitudes about spending, saving, and investing. In a study of the impact of personal finance education on college students, Wann (2016) found that students who completed a 15-week personal finance course reported positive changes to their financial behavior, such as increased savings and reduced credit debt.

Understanding compound interest is essential to becoming financially literate and to making sound financial choices. Previous research suggests that individuals who understand compound interest save more (Stango and Zinman, 2009), are more likely to plan for retirement and participate in the stock market (Van Rooij, Lusardi, and Alessie, 2011), accumulate less debt, and are less likely to use high cost lenders (Lusardi and Tufano, 2015). However, the majority of K-12 teachers do not feel competent to teach personal finance topics (Way and Holden, 2009), and even the best instructors can find it challenging to ensure students have a thorough understanding of the concept and are able to apply it to their personal financial affairs (Beal and Delpachitra, 2003; Lusaridi and Mitchell, 2011).

There has been a limited amount of research on the pedagogy of compound interest. Previous research has investigated the effectiveness of different delivery methods (Goetz et. al. 2011), the influence of teachers' competency (Pournara 2013, Way and Holden 2009), the content of classroom instruction (Ghosh 2012), and the impacts of state mandates on financial behavior (Urban et. al. 2015). Most of this literature is focused either on K-12 students or specific to personal finance education classes, and the majority of individuals never take a course in personal finance in high school or college (Council for Economic Education, 2016). This paper aims to improve the standard approach by which compound interest is taught in a typical Principles of Economics course.

The pedagogical approach of this paper shares many elements with the Quality Teaching Model (QTM) by Ladwig and Gore (2003).[2] The QTM describes the three dimensions of effective teaching as the intellectual quality of learning experience, the quality of the learning environment, and the significance of the learning. With this in mind, the paper connects students well beyond the classroom, creating deep knowledge on and explaining the importance of the central idea: compound interest. The paper also uses its central idea to clearly connect two central concepts in economics - economic growth and personal finance - to each other.

One important element of the paper is its recognition that solutions to many problems require multiple perspectives. Encouraging students to think of them and inquire about the sources of the presented knowledge are important goals of the chosen approach. Furthermore, no matter how important a topic, learning it is hard if presented in a mind-numbing way. The paper engages students in a significant part of knowledge discovery, creating them opportunities to show their understanding of concepts. To achieve the level of higher-order thinking needed to link important ideas, the paper sets expectations high for students. The pride of understanding increasingly challenging concepts – as the paper is structured to move from easy to challenging – typically motivates students to want reach for yet higher levels.

A key part of the QTM is to make learning fun. It ought to allow students to engage in exploration and communication, and encourage them to elaborate on their responses. For that purpose the paper includes individual and group exercises, as well as general discussion questions for the entire class. After validating students' results, the three tier work level provides a convenient way to praise good work and offer words of encouragement of an additional push for incomplete work.

The various exercises in this paper and in our classes at Youngstown State University (group discussions, games, calculations, database research, videos, simulations, online calculators) all serve the same purpose: they engage students to want to learn more. Active learning provides for multiple perspectives and the depth of knowledge that is hard to reach with existing principles textbooks. In fact, in a survey of the ten best-selling principles textbooks at amazon.com, we found only that two included the formula for calculating

[2] See also Newmann (1996), Gore, Griffiths and Ladwig (2004), Gore (2007), Gore et al (2009).

future values. Furthermore, in our estimate, a typical book covered less than half of the essential personal finance material. This illustrates the need to not only incorporate compound interest more plainly with engaging personal finance lectures, but the opportunity to make them personally meaningful to students.

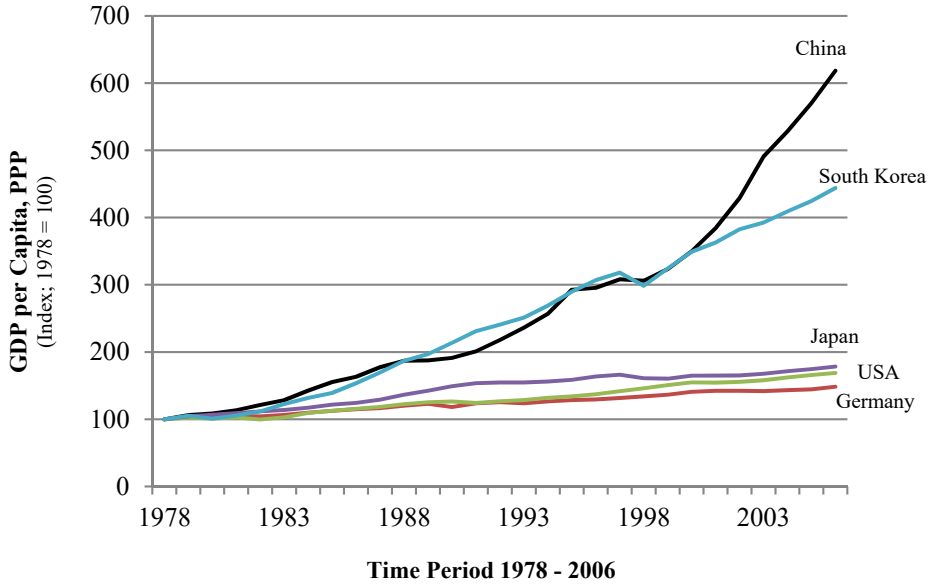
The concept's proof rests on our long-term personal experience with it, in addition to the existing academic literature. The amount of time it takes to go through the entire paper in a classroom is instructor-specific. In our experience, a typical time range to cover the entire paper is from four to six hours, although that can vary quite a bit depending on how long one lets the group discussions last and how much of the database work and calculations is completed during class. Group discussions in particular (in our case, groups of 5 students) can become quite inspiring and extensive, as different viewpoints are raised by each group.

What Is Economic Growth and Why It Matters?

Economic growth is measured by society's ability to produce all the goods and services it did over a given time period. The value of the output is measured by the cost of buying all those goods and services using prevailing market prices. The change in how much more or less one would have to spend on that output over time provides a meaningful way to compare nation's economic progress. For a typical country over the last 200 years, for every five years that the value economic output has been positive, it has been negative for one year. Thus, economic growth is cyclical by its nature.

Economic growth builds on earlier growth, which is known as interest growing on interest or simply compounding interest. *Figure 1* highlights the extraordinary effect that high and low compounding growth rates can have on the standard of living even in a relatively short period of time. For example, since 1978, Japan, USA and Germany have seen per capita income grow at a rate between 1.5 and 2% per year. That has translated to about 50 to 80% rise in purchasing power of their citizens. China and South Korea, on the other hand, have grown at an annualized compounded rate of nearly 7% and 6%, respectively. That has resulted in a purchasing power rise of more than 500% for China, and 350% for South Korea.

Figure 1. The Effect of Compounding Growth



Source: *The Maddison-Project*, http://www.ggdc.net/maddison/maddison-project/home.htm, 2013 version.

What Causes Economic Growth?

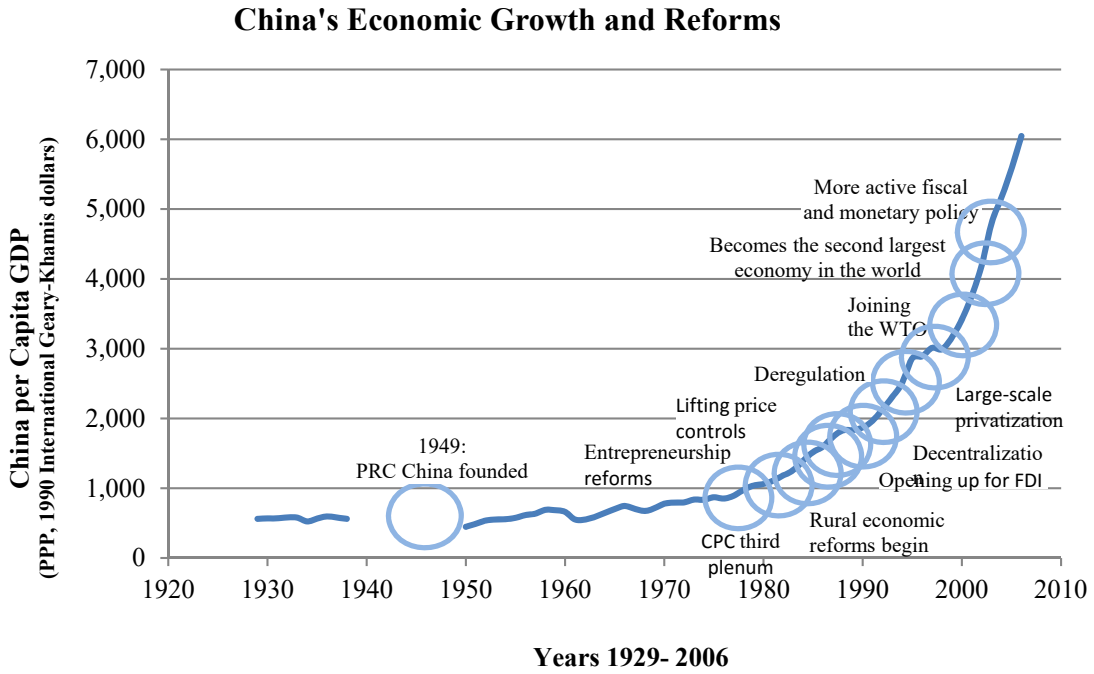
Levine and Renelt (1992) studied previous research on economic growth and ended up concluding that at least some 50 variables have a robust effect on growth. Four general reasons are most likely behind any economic growth: (1) more inputs (land, labor, physical capital) are added to the process producing more

output, (2) inputs have been reassigned to different, more productive uses, (3) a new technology has improved productivity, or (4) nation's institutions have been realigned to create people new incentives to be productive. Numbers (1) and (2) are associated with ***extensive growth***, numbers (3) and (4) with ***intensive growth***. History shows that extensive growth alone is very hard to sustain in the long run. Most developed economies rely nowadays almost exclusively on intensive growth. That is another way to say that increases in productivity – getting more out of a given input base – and realignment in institutional incentives determine the incomes in the world's wealthiest countries. A country on a lower development level, such as China, can rely more on both extensive and intensive growth.

Institutions, which include size of government, legal structure, property rights, access to capital, freedom of market exchange, and regulations, have been on the focus of the economic growth research recently. Institutions, the set of rules that govern societies, affect people's incentives to be productive. Well-set incentives result in new technologies, skills and entrepreneurship. Institutions incentivize people to a particular direction of economic action, which may be, as Baumol (1990) pointed out, good or bad. The set of rules make people to be economically more independent and highly productive or drive people to improve their lot by trying to redistribute existing resources (rent seeking) their own way.

Figure 2 shows an example of one country – China - how institutional change can affect economic growth. Since breaking up with the pure classical planning system and realigning its institutions towards the markets, China's GDP has experienced double-digit percentage growth in many of the last 40 years.

Figure 2. China's GDP per Capita Since 1929 and the Era of Institutional Reforms



Sources: Kornai (1992); The Maddison-Project, http://www.ggdc.net/maddison/maddison-project/home.htm, 2013 version, and Gwartney et al. (2015)

The consequence of these continuing high growth rates is quite remarkable; in over little more than a generation, the average Chinese citizen has seen her purchasing power sextuple. Successful switching from one economic system to another is not easy. As evidenced by the formerly socialist transition economies in Eastern Europe in the 1990s, during the first few years people's purchasing power of goods and services plummeted and it took a decade to just get to the pre-crash level. China, on the other hand, has not experienced such a drop. With the exception of one no-growth year, purchasing power adjusted incomes have risen every year since 1978.[3]

[3] **GROUP DISCUSSION**. Why has the value of China's output not dropped during its transition, while most other transition economies experienced a significant drop within the first decade after transitioning?

Why such focus on economic growth and rising incomes? While money buys food, shelter and clothing, it also buys better education and health care (life expectancy), increases the level of altruism in society, allows for more leisure time and travel and improved opportunities in life. With increasing wealth countries also have less poverty and serious crime and are much less likely to be involved in armed conflicts.[4] Overall, income increases people's general standard of living, or even happiness up to a point, as previous studies have shown (Kahnemann and Deaton, 2010).

How to Measure Economic Output: Gross Domestic Product (GDP)

A. Nominal GDP. The Gross Domestic Product (GDP) is defined as "the market value of all final goods and services produced in an economy during a given time period, for example one year." The GDP is used interchangeably with income in regular language. The regular GDP, sometimes called the nominal GDP, uses prices found in stores to record the value of all newly produced goods and services in a country. Then, the value of all that new production is aggregated to create just one number: the GDP. It is a good way to get a sense of the size of the economy and, with a few adjustments, which way it is moving. For example, U.S. GDP in 2014 was $17.61 trillion dollars.

B. Real GDP. If you want to know how the GDP is changing over time, it is done by deducting the percentage change in the general level of prices (inflation) in your economy from the percentage change in the GDP. That inflation conversion - nominal numbers into real numbers - allows us to see how the real output has changed. After all, from society's point of view only the real output of goods and services matters: adding a zero to the selling prices of all goods and services in our country would increase the nominal GDP by a factor of ten, but it wouldn't change the amount of our output, or affect our standard of living. For example: U.S. GDP in 2010 and 2014 were $14.96 and $17.61 trillion, respectively. That's a rise of 17.7%. Prices during the period rose by 8.4% (inflation, also called the price deflator). Therefore, U.S. real GDP growth from 2010 to 2014 was 9.3% (nominal growth minus inflation).[5,6]

C. GDP per capita. For further elaboration of the GDP it is typical to take the GDP and divide it by the country's population. This statistic, GDP per capita, gives each citizen's share in the value of the output produced. This is how society's average income and income progress is calculated. A country with a large GDP, however, does not necessarily have a large GDP per capita, and vice versa. For instance, consider the pair of Bangladesh and Luxembourg. Bangladesh had a 2014 GDP of $172.89 billion and population of 159.77 million, resulting in the GDP per capita of $1,082. The size of Luxembourg's economy is less than half the size of Bangladesh's, $64.87 billion. But with a population of 0.56 million its GDP per capita is $116,352, 108 times that of Bangladesh.

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[4] **CLASSROOM VIDEO**. For why income growth matters and how it has changed over time, watch Hans Rosling's *200 Countries, 200 Years, 4 Minutes - The Joy of Stats*, at https://www.youtube.com/watch?v=jbkSRLYSojo [4:00].

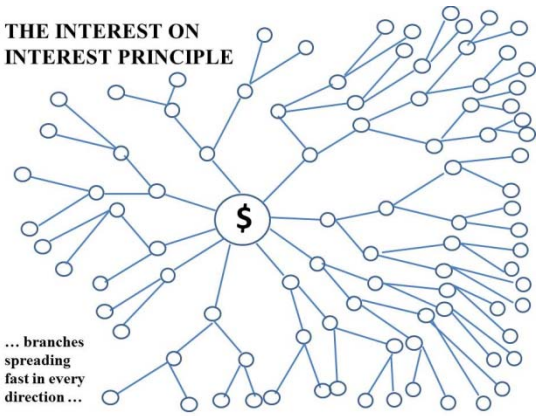
[5] **CREATING GDP and OTHER ECONOMIC GRAPHS**. Using the Federal Reserve Bank of St. Louis' (5) *FRED database*, students can create great-looking graphs about the change of the U.S. GDP and thousands of other variables over time, include several variables in one graph, and in many cases even create international comparisons. The graphing tool can be accessed at: https://research.stlouisfed.org/fred2/graph/

[6] **PRESIDENTIAL GAME**. Government policies, such as the level of government spending (G), taxation (T) and interest rates (i) are among factors affecting income growth. By smoothing the annual variability in output, they can further increase the nation's potential growth rate. Gregory Mankiw has put together one of the most interesting online economics games ever. In the Adobe Flash player-based game the player (The President) is given full powers to simultaneously change economy's (G), (T) and (i) to achieve real income growth and low unemployment and inflation. If voters are not happy with the results, however, they can impeach the president effective immediately, an interesting political economy twist in the game. That always ends of the game. On the other hand, if the President survives a full 24 years in office, he/she is assigned an economic policy score, which is then compared to the achievements of previous U.S. presidents. The game is fun, and engages also less advanced students and produces a player score that can be part of course grading. The Presidential game can be found at MacMillan website: http://www.macmillanlearning.com/catalog/static/worth/mankiw4/content/pga_menu02.htm

D. GDP per capita (PPP). One additional GDP transformation when comparing countries: adjusting the numbers to reflect the purchasing power parity (PPP) among countries.[7,8] The idea is that one single good may have a very different price in two countries. Yet, the GDP calculations treat the two goods as if they were not the same. Say, a haircut costs $15 in the U.S. and $1 in China. Those are the exact numbers which will be added to the respective countries GDP, despite the service being the same. To fix this flaw in GDP calculations, economists use numbers that have been adjusted for differences in local price levels. In country comparisons, this is the measure coming closest to gauging its people's ability to buy goods and services. For example, in 2014 U.S. GDP per capita was $55,230 and China's was $7,400. Adjusting for purchasing power, China's GDP per capita (PPP) rises nearly 70%, to $12,554 (U.S. GDP remains constant). This implies that goods and services in the U.S. are nearly twice as expensive as in China, meaning that the unadjusted GDP per capita understates what the average Chinese income can buy.[9]

Learning the Compound Interest Formula Inside Out

Figure 2. Compounding Interest



Growing consistently can change the fortunes of nations and their people very quickly. If one defines the length of one generation as 25 years, then it takes about 2.8% annual growth to double people's real incomes (PPP) in one generation. The respective numbers for other growth rates are 1% and 69.7 years, 2% and 35.0 years, 3% and 23.5 years, 4% and 17.7 years, 5% and 14.2, 6% and 11.9 years, 7% and 10.2 years, and 8% and 9.0 years. Thus, even seemingly small differences in annual growth rates have a meaningful difference in a generation's standard of living. As shown in Figure 1, persistent differences in growth over time can profoundly change a country's social fabric.[10]

To understand economic growth, or the lack thereof, one has to understand the inner workings of compounding growth rates.[11] The formula for annual compounding is:

$$FV = PV \times (1 + i)^t \quad (1)$$

[7] **GDP CALCULATIONS**: Using numbers given by the instructor, students calculate solutions for variants B, C, D in small groups in class. Students can also be asked to do the calculations at home, retrieving specific numbers from the World Bank's (1) *World Development Indicators* database at http://databank.worldbank.org/data/ . Several equivalent sources of data can be found at the American Economic Association's (2) *Resources For Economists on the Internet* data gateway at http://rfe.org/

[8] **WORLD GDP RANKINGS**. Looking up the latest GDP per capita (C or D) numbers for all countries from the (3) *Penn World Table* database at https://pwt.sas.upenn.edu/, students should copy the income data and paste it to MS Excel. Then, after using the Sort & Filter command, students can identify the ten wealthiest and poorest countries in the world. To get a fascinating look at the historic development of GDP figures, in some case going all the way to year AD 1, students can go to the (4) *Maddison Project* website at http://www.ggdc.net/maddison/maddison-project/home.htm Data (all in PPP) in this website shows the world's income per person was constant until just the last few hundred years, when the small, but unprecedented annual changes in income growth started to change the world radically.

[9] Any measure of GDP per capita will not inform students of the level of income inequality in a nation. To allow students to better understand the distribution of the nation's GDP, the World Bank's *World Development Indicators* also offers data on nations' poverty rates and Gini coefficients.

[10] **GROUP ASSIGNMENT**. Why is it that high growth rates don't tend to last over decades?
GROUP ASSIGNMENT. Use the *World Development Indicators* database at http://databank.worldbank.org/data/ to find GDP per capita (PPP). What has been the growth trend among the wealthiest countries since the Second World War? What do you think are the reasons behind it?

[11] **PERSONAL FINANCE**. In many principles classes there is a section for personal finance. In this section, students are encouraged to start saving as early as possible to take advantage of compounding interest. This paper's introduction to GDP compounding is intended to reinforce the concept, regardless of the order in which the two sections are taught.

Where PV is the present value (starting point, principal), FV is the future value (ending point), i is the annual interest rate (annual growth rate, %), and t is the years of compounding. The interest (i) always enters the formula divided by 100 (5% = 0.05). Consider the following Table 1 with two sets of examples (without and with parentheses).

Table 1. Present and Future Value

Present value (PV)	Interest rate (i)	Time in years (t)	Future value (FV)
$5,000	1	40	$7,444
($1,000)	(10)	(10)	($2,594)
$5,000	5	40	$35,200
($1,000)	(10)	(20)	($6,728)
$5,000	10	40	$226,296
($1,000)	(10)	(40)	($45,259)

The table shows a few noteworthy aspects of economic growth. First, a percentage change in interest rate is not proportional to the change in future value. When the interest rate rose by 100% (from 5 to 10), the future value rose by 543%. Thus, small changes in economic growth rates will have a striking effect on the GDP in the long run. Second, differences in the time to compound can have drastic effects on outcomes. Changing the compounding period from 20 to 40 years (+100%) increases the future value by 573%. [12] A short cut to calculating the approximate future value is using the rule of 72, which is formulated as[13]

$$R72 = \frac{72}{i} = \frac{doubling\ time\ of}{principal\ (in\ years)} \tag{2}$$

Suppose we start with a present value of $1,000, the interest rate is 9% and we want to know the future value in 48 years from now. Using the compound growth formula yields $62,585. Table 2 shows that if using the Rule of 72, the principal doubles every eight years (72/9=8), yielding $64,000, which is off by only $1,415, or 2.2%.

Table 2. Rule of 72

FV	$1,000	$2,000	$4,000	$8,000	$16,000	$32,000	$64,000
Year	2015	2023	2031	2039	2047	2055	2063

Sometimes one is interested in finding the corresponding compounding rate when moving between the present and future value. In this case one would take the FV equation and solve for the interest rate, using:

$$i = \left(\frac{FV}{PV}\right)^{\frac{1}{t}} - 1 \tag{3}$$

[12] **ONLINE SIMULATION**. The *EconEdLink* has a first-rate compound interest calculator. While it is set only for monthly additions of the principal, it shows the compounding effectively, and, importantly, separates the principal from the earned interest. The remarkableness of compounding shows, for instance, in the case where you deposit a monthly constant dollar amount in your investment account earning a steady 8% per annum interest. Of the end balance after 45 years of saving, only 11% are made of the monthly deposits, the rest comes from interest growing on interest. The calculator can be found at http://www.econedlink.org/tool/2/

[13] Many principles textbooks use the rule of 70 instead of the rule of 72. Although these show the same basic concept, we prefer the rule of 72 because it is conveniently divisible and more accurate for larger percentage growth rates.

For instance, suppose you wonder at what rate the U.S. economy has grown since 1960. So, go to the *World Development Indicators*, and look up the respective numbers for 1960 and 2014. You can select the following: nominal GDP (current $), real GDP (constant $), real GDP per capita (constant $) and real GDP per capita, PPP (constant $). If you are interested in the size of the economy, choose the GDP adjusted for inflation (real GDP). You find the 1960 GDP (constant 2005 $) to be $2.85 trillion and the 2014 GDP $14.96 trillion. The number of compounding years is 44. Plugging the numbers into formula (3) yields a value of *i* equal to 3.84% per year. You can double-check the correctness of the calculation by plugging the growth rate to the FV formula (equation 1).

Finally, suppose you are a policy planner who has committed to a particular mix of growth policies for the future. The country's current GDP per capita is $4,000, and the goal is to reach $10,000 with an accompanying annual 4% growth rate. Formula (4) will calculate how many years it will take to get to the goal. If you plug in the numbers to the formula you get 23.4 years. Had your economy grown at 7%, it would only have taken 13.5 years. To get the same results you can also use the natural logarithm (ln) instead of the log. [14,15]

$$t = \frac{(\log(FV) - \log(PV))}{\log(1+i)} \tag{4}$$

Economic Growth and Personal Finance

The institutions that provide for nations' economic growth are the same that provide the underpinnings for individuals' income growth. They protect achieved gains, provide opportunities for advancement and incentivize people to take up new challenges. People's skills – or human capital – are in the core of income growth. In all wealthy economies the great majority of income gains come not from increased amounts of resources, but rather from the productivity of people; how much more efficiently are resources being employed. Worker productivity (income) can be improved by education and training, which can determine a large portion of one's income in modern economies.

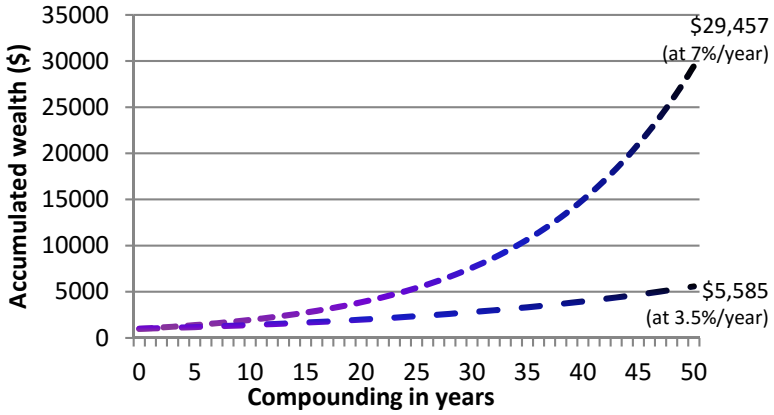
Extra income allows for extra savings. Perhaps the single most important reason for people to save today is retirement. In retirement, earned income typically drops to zero without a matching drop in expenditures. To aid new retirees in this transition, all developed countries have some form of retirement security insurance. In the U.S., most workers currently pay 6.2% of their income up to $118,500 towards guaranteed retirement income starting between 62 and 70 years of age. The worker contribution is matched by the employer. In this pay-as-you-go system (pay now, collect benefits later) the payments go into social security trust funds administered by the U.S. Treasury Department, which is tasked to ensure the timely payment of benefits to current retirees.

Currently about 60 million Americans receive social security benefits. The average benefit, however, is only $16,000 a year; just enough to replace 40% of the average recipient's final pre-retirement pay.[16] The highest annual benefit for someone retiring at 66 is capped at $32,000. The Social Security Administration predicts that at the current rate the social security reserve funds will be depleted around year 2033. If social security taxes and benefits are kept the same up to that point, the average payout then will drop immediately by 23%.[17] Fortunately, students and young workers are well positioned to plan accordingly. A small adjustment in their current lifestyle combined with the power of compounding interest over decades is likely all it takes to provide for a comfortable retirement, save for some unforeseen politico-economic disaster.
Figure 3 uses the future value formula (equation 1) to highlight the considerable long run effect compounding interest has on savings. The graph also shows the significant difference savings and investment choices can

[14] **CALCULATIONS**. Use the three equations to calculate FV, i, and t. In the first case set the numbers $500, 8%, 50 years. In the second use PV=$500, FV=$23,451, t=50. In the last formula use the numbers PV=$500, FV=$23,451, i=8%. After doing the calculations, one can see how the formulas share the same base.
[15] **CLASSROOM VIDEO**. Watch OECD's online video *Looking to 2060: A Global Vision of Long-term Growth* about the world's changing economic landscape at https://www.youtube.com/watch?v=fnIl212tBPk [3:27]
[16] *The Economist*, March 26-April 1, 2016, p. 78
[17] *Social Security Bulletin*, Vol. 75, No. 1, 2015, at www.ssa.gov

make. The respective curves both start from $1,000. The difference is that in one case the savings are invested in government bonds (compounding at 3.5% per year), in the other in a diverse mix of U.S. stocks (7%). While the latter rate is only twice that of the former, the difference in outcomes is considerable. After 50 years, the 7% compounding rate has created nearly 5.3 times the wealth of the 3.5% compounding rate. [18]

Figure 3. The Power of Compounded Savings



As Table 3 shows, the most significant increase in accumulated dollars happens at the end of the compounding period. At 7% per year, the first year only produced $70 in new wealth. The last year of compounding, however, resulted in $1,927 in new wealth. The moral of the story is simple: the later one starts saving, the higher the cost of procrastination. Starting to save just ten years later (at 30 rather than 20) will reduce one's wealth at the retirement age from $29,457 to $14,974. By waiting 10 years, or 20% of a working life, one would experience a decrease of nearly 50% in retirement income. To catch up, an individual would have to start with a dollar amount nearly twice as high as what would have been necessary with a ten year earlier start.

Table 3. The Cost of Procrastination: The Growth of $1,000 Invested at Various Ages

	Annual Compounded Real Interest Rate			
Age at the Time of Investment*	1%	3.5%	7%	9%
20	1,645	5,585	29,457	74,358
30	1,489	3,959	14,974	31,409
40	1,348	2,807	7,612	13,268
50	1,220	1,990	3,870	5,604
60	1,105	1,411	1,967	2,367
65	1,051	1,188	1,403	1,539

* Assumed age of retirement 70 years.

[18] Here again the EconEdLink is a powerful tool to highlight the effect of compounding. First experimenting with various contribution amounts, interest rates and time horizons, and then seeing the outcomes unfold in slow motion can be a lot of fun. The website can be found at: http://www.econedlink.org/interactives/index.php?iid=2

Many dream of being a millionaire by the time of retirement. What does it take to achieve that? Using the Present Value (PV) formula and interest rates from the above table, one can easily calculate the required contribution at various ages. The PV formula is calculated by taking equation (1) and solving for the PV by dividing both sides by the discount factor $(1 + i)^t$. The formula now becomes:

$$PV = \frac{FV}{(1+i)^t} \tag{5}$$

As shown in Table 4, the key to success is, once again, an early start. Setting the FV at $1,000,000, a lump-sum investment of $33,948 at 7% per year would do it if starting at age 20, whereas more than a $250,000 initial lump-sum would be required for a starting age of 50.

Table 4. Becoming a Millionaire: A One-time Saving Required to Reach $1,000,000

	Annual Compounded Real Interest Rate			
Age at the Time of Investment*	1%	3.5%	7%	9%
20	608,039	179,053	33,948	13,449
30	671,653	252,572	66,780	31,838
40	741,923	356,278	131,367	75,371
50	819,544	502,566	258,419	178,431
60	905,287	708,919	508,349	422,411
65	951,466	841,973	712,986	649,931

You may wonder: what does it take to become a millionaire, but on a fast track? The PV formula will provide the answer. The desired future value is $1,000,000. Setting the interest rate at 7% and the time at 25 years, a 20-year old would have to invest $184,249 right now to become a millionaire at 45. Such large investments, however, are not feasible for most young people. A more realistic solution would be to make automatic smaller monthly contributions towards one's investment goal. The benefit of this approach is that after some time savers typically won't even notice the 'missing' money that travels from one's regular bank account to an investment account. The formula to calculate the future value of periodic of payments is:

$$Principal\ after\ [n]\ years = PMT \times \left(1 + \frac{i}{t}\right)\left(\left(1 + \frac{i}{t}\right)^{nxt} - 1\right)\left(\frac{t}{i}\right) \tag{6}$$

where PMT stands for payment in dollars for every period, (i) the interest rate, (t) the number of payments in a year and (n) for number of compounding years. To use the formula: suppose a 20-year old starts a saving program depositing $75 per month for the next 50 years. Assuming a rate of return of 7%, the saver will have accumulated $410,988 at the end of the 50-year period. Of this, the saver contributed a total of $45,000 (600 months times $75); the remaining $365,988 was compounded interest. To magnify the compounding effect, one could combine a lump-sum payment(s) with automatic monthly or quarterly contributions over one's working career.[19] To accomplish this, the following short section provides one option for those who wanting to start their (preferably long) investment career.

From Theory to Practice: Setting the Plan for Retirement

[19] **COMPOUND INTEREST CALCULATOR**. The National Council of Teachers of Mathematics' Illuminations website includes a compound interest calculator that allows for a simultaneous use of lump-sum and monthly investing. The calculator can be found here: http://illuminations.nctm.org/Activity.aspx?id=3568

The Wilshire 5000 Total Market Index is a market-capitalization-weighted stock index, covering nearly 4,400 publicly traded companies in the U.S. Since it is not practical to buy an ownership share in each of them, index funds were created in the 1970s. They enable investors to buy shares in different bundles of companies, some of the funds covering the entire market(s). The benefit of owning a little share of every company is that the fortunes of any one company would matter very little to the investor: some companies will no doubt go bankrupt while others will reach unexpected new heights. By purchasing a broad swath of equities, the investor can get rid of company-specific risk. The bet an investor makes on the entire market is that the pattern that has held up in the U.S. over 200 years will continue to hold. Booms and busts come and go, but on average, the U.S. stock market has returned about 7% per year (real) compounded.

The next step in the plan is to choose a financial firm which will manage the investment account and offer the index fund(s). They will also do the bookkeeping, and provide periodic reports of the value of the portfolio. There are two particularly important considerations before choosing the specific custodian of one's money. First, the company must have a stellar reputation, and two, it has to charge the lowest fees possible. Many financial institutions easily pass the first criterion, but few pass both. It is not atypical for a custodian to charge an annual fee equal to or above 1% of the fund's assets – and yet – many first-class index funds can be had at 0.05% annual fee. Caveat emptor! Although 1% sounds insignificant, over decades the difference in the future value can be dramatic.[20] The key to minimizing investment fees is to choose a particular type of a custodian: a discount broker.[21] Due to their scale of operation they have shown the ability to push the fees investors pay to practically zero. In addition, whether by telephone or online, an investment plan can be established with as little as $100 and begin earning compound interest within a few days.

Conclusion

Economic growth and personal finance rely on a shared fundamental concept, the compound interest. Unfortunately, the conventional orthodoxy in a Principles of Economics textbook does not show this link. All textbooks cover economic growth to some extent, but exceedingly few mention compound interest in the context. Even fewer include a discussion of compound interest in a personal finance section. This paper seeks to show how the current practice can be improved upon. By linking the two topics around compound interest, and offering unique examples, exercises and classroom discussions, the paper is designed to encourage economic students and instructors to become more excited about two highly important matters in their life: their nation's and their own economic health.

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[20] **CALCULATE IT!** Consider the following example. Suppose you have $10,000 to invest and the expected market return is 7% per year the next 50 years. One financial institution (A) promises to invest your money in the Wilshire5000 index fund and take care of all the paper work, for an annual fee of 2.5% of your assets. A second equally reputable financial institution (B) promises the same as above, except its annual fee is 0.03% of assets. Using the future value formula, calculate how much less money an investor who went with financial institution A has compared to the investor who went with B.

[21] **DISCOUNT BROKERS**. Fidelity, Charles Schwab and Vanguard are examples of well-known discount brokers. Their webpages include large education sections on personal finance. A good source for general information source (with many online calculators) for investing and personal finance is Yahoo's Personal Finance, at finance.yahoo.com.

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The Impact of Teaching Financial Literacy to College Students

***Christi R. Wann*[1]**

Abstract

This study measures the learning outcomes and reported behavioral changes of students enrolled in a financial literacy course at a metropolitan university. A notable positive outcome is that 42 college students saved an aggregate of $30,198 in one 15-week semester. The average savings per student was $719. Many students began to save regularly, planned to start investing at a younger age, began to budget regularly, and decided that they would avoid the pitfalls of credit cards. The study results provide positive evidence for a possible solution to decrease the nation's student loan debt, prevent money problems, and increase student retention.

Introduction

The current personal financial education of college students among universities is lacking. With student debt topping $1 trillion, there is a growing need for universities to educate students in the area of personal finance, especially in the interest of student retention. However, the data related to the success of existing personal finance courses is sparse. This study measures the learning outcomes and reported behavioral changes of students enrolled in a personal finance course at a metropolitan university. The results of this study provide compelling motivation for colleges to seriously consider requiring a personal finance course for every enrolled student. Moreover, the results suggest that personal finance should be required for incoming freshman to educate students how to save, budget, and avoid debt in order to prevent money problems and increase student retention.

Approximately 70% of college students believe that their universities need to increase financial literacy initiatives and expand programs that teach students the skills they need to successfully manage their money (Higher One Holdings, Inc., 2010). Moreover, greater than 50% of college students who responded to the survey reported that they were late paying bills this year and that they did not know how much money to save in an emergency fund (Higher One Holdings, Inc., 2010). The study also revealed that 75% of college students save less than 5% of their income (Higher One Holdings, Inc., 2010). Therefore, it is important for universities to offer financial literacy programs and classes.

College students are at risk for dropping out of school due to financial problems. The National Center for Education Statistics (2012) found that 31% of college students leave school due to financial reasons. A greater percentage of males (42%) than females (23%) left due to financial reasons. Therefore, educating college students in the area of personal finance should help students to complete their degree.

Student loan debt has reached an all-time high of $1.2 trillion as of September 30, 2015, with 11.6% over 90 days delinquent or in default (Federal Reserve Bank of New York, 2015). In February 2014, Touryalai reported student loan debt levels at $1.08 trillion with similar delinquency rates. Based upon Federal Reserve data from 2006 to 2015, student loan debt appears to grow $2,726 per second (Berman, 2015) as measured by the new "national student loan debt clock." Although student credit card debt has declined due to the Credit Card Accountability, Responsibility and Disclosure Act of 2009, it seems that the debt usage has merely shifted towards student loans. Therefore, the objectives of this personal finance course can benefit college students by educating them to handle debt responsibly, avoid further debt, save,

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and budget. The benefits of this course can also insulate schools from attrition due to student financial problems.

Literature Review

The literature regarding the impact of financial literacy among college students is sparse. However, there have been a greater number of studies involving financial literacy programs within high schools. These studies have led to conflicting results regarding financial literacy education and future financial behavior (Lyons, Palmer, Jayaratne, & Scherpf, 2006; Bernheim, Garret, and Maki, 2001; Mandell, 2008; Mandell, 2009; Mandell and Klein, 2009). Bernham, Garret, and Maki (2001) used a Merrill Lynch survey and relied upon state records of whether a financial literacy course was required during the individual's high school time period. Although most respondents could not remember if they took a personal finance course in high school, this study found that respondents in states that required the financial literacy course saved a higher percentage of their income than those who did not. On the other hand, Mandell (2009) found that surveyed high school seniors who completed the Jump$tart Coalition for Personal Financial Literacy program were not more financially literate than seniors who had not completed the program.

There are other conflicting high school financial literacy study results. National survey results from the National Endowment for Financial Education (NEFE) curriculum revealed that self-reported financial behavior improved immediately after the course (Danes, 2004; Danes, Casas, and Boyce, 1999). In a follow up survey administered three months after the program, students reported making changes in spending and saving habits and were found to be more likely to repay debts in a timely fashion. Conversely, Mandell and Klein (2009) surveyed high school graduates who took a "well-regarded" personal financial management course and found little impact on financial literacy and financial behavior. In particular, students were likely to pay their credit cards on time, but not the full amount. Also, more students balanced their checkbook, but they also reported bouncing more checks.

The mixed results discussed previously could be related to the fact that high school students do not have many opportunities to demonstrate their acquired personal financial literacy skills at such young ages. The real problems created by inadequate financial literacy show up when high school students become independent college students who have the newfound freedom to manage their finances. College students are reporting more trouble with financial resources, student debt, and credit cards. Only 46 percent of incoming freshman college students reported that they had adequate financial resources to finish college (Noel-Levitz, LLC, 2009). The national percentage of incoming freshman that have "financial problems that are very distracting and troublesome" is 30 percent (Noel-Levitz, LLC, 2009). Further, the "share of 25-year-old Americans with student debt increased to 43% in 2012 from 25% in 2003, while the average loan balance rose 91%, to $20,326 from $10,649, New York Fed data show" (Gage and Lorin, 2014). A study conducted by Sallie Mae Bank (2013) found that the average federal loan balance for students is $8,815, which is at its highest level since 2008. Roughly half of seniors borrow to pay for college, which is significantly more than the one-third of freshman, sophomores, and juniors who borrow to pay for college (Sallie Mae Bank, 2013).

According to general studies on financial literacy, most consumers of all ages do not demonstrate an ability to make important financial decisions (Braunstein and Welch 2002; Perry, 2008). A survey by the Federal Reserve Bank of New York (2014) found that the understanding of the implications of federal loan delinquency by U.S. households was very weak. Only 28% of respondents knew that the government could: "A. Report that the student debt is past due to the credit bureaus, B. Garnish wages until the debt, plus any interest and fees, is repaid, and C. Retain tax refunds and Social Security payments until the debt, plus any interest and fees, is repaid*" (*Zafar, Bleemer, Brown, and van der Klaauw, 2014). Conversely, 81% of college students who borrow federal student loans and private education loans report feeling at least "fairly informed" to "very informed" (Sallie Mae Bank, 2013). Students appear to have been made aware of the repayment amounts, interest rates, and loan fees.

The reported worries of parents, efforts towards contingency plans, and willingness to borrow are also troublesome in the context of rising student debts. Parents worry the most about student loan rates increasing, student loans becoming less available, and that schools will raise tuition (Sallie Mae Bank, 2013). Also, only 21% of parents and their college students answered "strongly agree" to having a contingency plan to pay for college in the case of a financial or medical emergency (Sallie Mae Bank, 2013). The percentage of parents and students who report that they are "willing to stretch myself financially" are 58% and 62%, respectively. Further, 58% of students and 49% of parents would rather

borrow to "pay for college than not be able/have my child be able to go at all" (Sallie Mae Bank, 2013). Greater education about saving for emergencies and saving for college expenses can reduce the tendency and willingness of students and parents to rely on debt.

Overall, there is a downward trend in credit card ownership among college students. But, the longer a student stays in school, the more likely the student will obtain a credit card. In a 2009 study, Sallie Mae Bank found that 84% of college students had at least one credit card and 50 percent had four or more cards. And, 68% of college students charged items to their credit cards knowing they did not have the money to pay the bill (Sallie Mae Bank, 2009).

Recently, the percentage of freshmen, sophomores, juniors, and seniors owning a credit card was 14%, 27%, 46%, and 47%, respectively (Sallie Mae Bank, 2013). Thus, there is a decreasing percentage of students owning a credit card due to the Credit Card Accountability Responsibility and Disclosure Act of 2009. The Credit Card Accountability Responsibility and Disclosure Act of 2009 prohibits issuance of cards to people under the age of 21 unless a "parent, legal guardian, spouse, or any other individual who has attained the age of 21 having a means to repay debts incurred by the consumer in connection with the account" and the consumer submits financial information, "including through an application, indicating an independent means of repaying any obligation arising from the proposed extension of credit in connection with the account." However, there is an increasing trend in the acquisition of credit cards as students continue through college, as reported by Sallie Mae Bank (2013).

Methodology

This paper utilizes a survey as the primary data collection method to detect student learning of select course objectives and student attitudes towards learning objectives. During the spring semester of 2014, forty-two students were offered the chance to participate in a pre-course and post-course survey. The semester covered a fifteen-week period beginning on January 7, 2014 and ending on April 15, 2014. The class required students to learn basic life skills in personal finance using the text, "Foundations in Personal Finance" by Dave Ramsey. In particular, students were encouraged on the first day of class to save at least $500 in a separate emergency fund throughout the semester. Students were also encouraged to achieve as many of the Baby Steps as possible during the spring semester. Since the class consisted of traditional college students, the first four Baby Steps were the most applicable. The seven Baby Steps (Ramsey, 2011) are as follows:

1) Save $1,000 in an emergency fund ($500 if your household income is less than $20,000 a year)
2) Pay off all debt except the house utilizing the debt snowball
3) Save three to six months of expenses in savings
4) Invest 15% of your household income into Roth IRAs and pre-tax retirement plans
5) Save to fund college for your kids
6) Pay off your home early
7) Build wealth and give

Data Collection

A voluntary pre- and post-course survey along with a separate end of semester survey were used for data collection. All forty two questionnaires were completed and could be used in this study. The study participants were primarily business majors at a metropolitan U.S. university with an enrollment of approximately 12,000 students. The participants chose this course as an elective upper-level finance course ("Personal Finance"). The class consisted of twenty three males and nineteen females. Most students in the sample take 15 to 18 credit hours per semester and plan to graduate in 4 years. Also, it is very common for students to hold part-time jobs, with few holding full-time jobs. The actual surveys administered are located in Appendix A and B.

Results

Table 1 provides descriptive statistics that summarize the sample data relating to student emergency funds. The dollars saved in emergency funds was of particular interest to the researcher. Students were

encouraged to save at least $500 in their emergency funds throughout the spring 2014 semester. The average *Beginning Emergency Fund* was $1,348 and the average *Dollars Saved* was $719 for 42 students. The total amount saved by students was $30,198. This number is quite impressive for a metropolitan university consisting of many first generation college students. There were 29 students who began the class with $0 in their emergency funds. By the end of the class, 20 of these students saved a total of $9,498 representing an average of $475 per student. Nine students were unable to save money during the semester. Thirteen students started the class with an average *Beginning Emergency Fund* of $4,354. These 13 students saved an average of $1,592 during the semester.

Table 1: Descriptive Statistics for Student Emergency Funds

Variable	Sum	Mean	Median	Max	Standard Deviation	N
Panel A: Full Sample						
(1) Beginning Emergency Fund	$56,600	$1,348	$0	$35,000	$5,500	42
(2) Ending Emergency Fund	$86,798	$2,067	$500	$45,000	$7,004	42
Dollars Saved (2) - (1)	$30,198	$719	$300	$10,000	$1,653	42
Paired T-Test p-value		**0.0074**				
Wilcoxon Mann-Whitney Test			**0.0002**			
Panel B: Initial Savings = $0						
(1) Beginning Emergency Fund	$0	$0	$0	$0	$0	20
(2) Ending Emergency Fund	$9,498	$475	$500	$1,100	$279	20
Dollars Saved (2) - (1)	$9,498	$475	$500	$1,100	$279	20
Paired T-Test p-value		**0.0000**				
Wilcoxon Mann-Whitney Test			**0.0001**			
Panel C: Initial Savings > $0						
(1) Beginning Emergency Fund	$56,600	$4,354	$1,000	$35,000	$9,443	13
(2) Ending Emergency Fund	$77,300	$5,946	$2,500	$45,000	$11,989	13
Dollars Saved (2) - (1)	$20,700	$1,592	$700	$10,000	$2,811	13
Paired T-Test p-value		**0.0637**				
Wilcoxon Mann-Whitney Test			**0.3545**			

The data reflected in Table 1 does reveal one outlier. There was one student who began the course with savings of $35,000 and was able to save an additional $10,000 throughout the course. This student displayed an amazing ability to save. Excluding the outlier, the average *Beginning Emergency Fund* was $527 and the average *Dollars Saved* was $493 for the reduced sample of 41 students. The total amount saved by the reduced sample was $20,198. The exclusion of the outlier does not diminish the commendable saving efforts of the students. Therefore, excluding the one outlier, twelve students started the class with an average *Beginning Emergency Fund* of $1,800. These twelve students saved an average of $892. The median *Dollars Saved* by students with no initial emergency fund and those with an initial emergency fund are very similar at $500 and $450, respectively.

Finally, it should be noted that these numbers represent what students reported as savings in their emergency funds over the semester. It is unknown whether students subtracted any uses of the funds when an emergency took place. The emphasis of the question was to measure if students saved the minimum of $500 as instructed during the semester. The questionnaire also had the limitation of not asking how students funded their emergency funds. In other words, if students did not have jobs, it is possible that they saved money from receiving monthly checks from their parents.

The other survey results are analyzed as a longitudinal study of matched-pair data. Table 2 contains a summary of eleven two-way contingency tables with the same row and column categories measured over time (matched pair data). Responses for matched pair data are statistically dependent, resulting in special treatment for comparing proportions with binary data. McNemar's exact test for marginal homogeneity is appropriate because the statistic depends on student responses classified in different categories at the beginning of the semester and the end of the semester. In other words, the McNemar's test determines if there is a significant proportion of students who switch their answers from yes to no or true to false over the course of the semester. Then, inferences can be made as to whether learning occurred or behavior changed as a result of learning the course material.

Table 2: Pre- and Post-Survey Outcomes

Issue	Semester Beginning Proportion (1)	Semester Ending Proportion (2)	Difference in Proportions (2) - (1)	N	McNemar's Exact Test p-value
1. Does not know how to save on car insurance	72%	3%	**-69%**	39	0.0001
2. Believes income potential is one of the most important factors to choose a career	85%	36%	**-49%**	39	0.0001
3. No emergency fund	69%	21%	**-48%**	42	0.0001
4. No budget	93%	48%	**-45%**	42	0.0001
5. Believes credit cards are necessary to build credit	51%	10%	**-41%**	39	0.0001
6. Does not know how to protect identity	38%	0%	**-38%**	39	NA
7. Does not save regularly	41%	10%	**-31%**	39	0.0005
8. Believes it is important to build FICO score by obtaining credit cards and car loans	28%	3%	**-25%**	39	0.0020
9. Does not believe renter's insurance is necessary	28%	10%	**-18%**	39	0.0391
10. Does not know that three free credit reports can be obtained per year	21%	5%	**-16%**	39	0.0703
11. Believes student loans are necessary to attend college	23%	8%	**-15%**	39	0.0703

The results in Table 2 can be categorized as changes in behavior, beliefs, and knowledge. Issues 3, 4, and 7 describe behavioral changes. Issues 2, 5, 8, 9, and 11 describe changes in beliefs. Issues 1, 6, and 10 illustrate changes in knowledge.

The behavioral changes measured by pre- and post-surveys are related to emergency funds, budgeting, and saving. Issue 3 suggests that there is strong evidence of a decline in students with no emergency funds. The sample proportions of students having \$0 in their emergency funds are p_{beg} = 69% at the beginning of the semester and p_{end} = 21% at the end of the semester. The proportion of students with \$0 in their emergency fund decreased by 48% and is highly statistically significant. Issue 4 addresses budgeting behavioral changes. Ninety-three percent of students had not worked on a budget at the beginning of the semester versus only 48% at the end of the semester. The proportion of students who had no budget decreased by 45% and is highly statistically significant. Therefore, there is strong evidence in the decrease

of students who had not worked on a budget. Finally, Issue 7 reveals that there is strong evidence in the decrease of students who did not save regularly. The proportion of students who did not save regularly decreased by 31% and is highly significant. Further, the savings behavior in Table 1 confirm that students did save, although their schedule may not have been regular, as a result of the class.

The belief changes measured by the pre- and post-survey covers career choices, credit building, FICO scores, renter's insurance, and student loans. Students are encouraged to evaluate their natural strengths versus income potential when considering careers to ensure a higher rate of job satisfaction. Issue 2 shows that the proportion of students who believe that income potential is one of the most important factors in choosing a career decreased by 49% and is highly statistically significant. Issues 5 and 8 address building credit. Students are taught that it is not wise to run up credit card debt just to build their credit score. Students are encouraged to save money and pay cash for both large and small purchases. At the end of the semester, only 10% of students believe credit cards are necessary to build credit. This represents a decrease of 41% and is highly statistically significant. Further, the sample proportions of students who believe it is important to obtain credit card and car debt to build a FICO score decreased by 25% to 3% at the end of the semester. The emphasis was to debunk the myth that you need to run up credit card balances to improve your credit score. The commonly cited advantages of credit card ownership include convenience, record keeping, instant cash, building positive credit, and purchase protection.

Issue 9 represents the sample proportions of students who do not believe renter's insurance is necessary. The proportion of students who learned that renter's insurance is important increased by 18% and is significant at a p-value of 0.0391. Finally, Issue 11 establishes that the sample proportions of students who believe a student loan is necessary for college are 23% at the beginning of the semester and 8% at the end of the semester. The proportion of students who learned that taking out a student loan is not necessary to attend college decreased by 15% and is significant at a p-value of 0.0703. Therefore, there is some evidence of the decrease in the number of students who learned that it is possible to attend college without student loans.

Knowledge acquired measured by the pre- and post-survey covers the areas of car insurance, identity protection, and credit reports. Issue 1 in Table 3 reveals that the sample proportions of students who did not know how to save on car insurance are $p_{beg} = 72\%$ at the beginning of the semester and $p_{end} = 3\%$ at the end of the semester. The proportion of students who did not know how to save on car insurance decreased by 69% and is highly statistically significant. Students learned various ways to protect their identity (Issue 6). The sample proportions of students who did not know how to protect their identity are 38% at the beginning of the semester and 0% at the end of the semester. Everyone learned how to better protect their identity. McNemar's exact test statistic for marginal homogeneity cannot be calculated for Issue 6 due to the presence of two "zeros" in the two-way contingency table. In other words, no student went from knowing how to protect their identity to not knowing how to protect their identity. Similarly, students who did not know how to protect their identity learned how to protect their identity. However, this does not negate the fact that there is strong evidence in the increase of students who learned how to protect their identity. Finally, the sample proportions of students who do not know that free credit reports are available (Issue 10) are 21% at the beginning of the semester and 5% at the end of the semester. The proportion of students who did not know that a free credit report is available decreased by 16% and is significant at a p-value of 0.0703. Therefore, there is good evidence of the decrease in the number of students who do not know that free credit reports are available.

Results from a separate end of semester survey (see Appendix B) are reported in Tables 3, 4, and 5. These questions also measured behavior and attitude changes. Also a special focus on insurance product questions was included.

Table 3 reports behavioral changes in college students for the time period. An emphasis in the curriculum was to start paying off debt as soon as possible. As a result, 38% of students did start to pay down debt, 12% did not, and 50% of the class did not report having debt. Information was provided on how to check your free credit report. At the end of the class, 43% did check their credit report. Several students reported finding small inaccuracies which led them to contact the credit bureau for corrections.

Table 3: Reported Behavior Changes

Question	Answer	π	n
1. Have you started to pay down any current debt?	Yes	38%	16
	No	12%	5
	NA	50%	21
2. Have you checked your free credit report yet?	Yes	43%	18
	No	57%	24
3. Have you closed any credit card accounts this semester as a result of this class?	Yes	10%	4
	No	52%	22
	NA	38%	16

After learning about the advantages and disadvantages of owning a credit card, the last reported behavior change was that 4 students, or 10% of the class decided to close credit card accounts. Sixteen students selected the "NA" choice because they did not own credit cards. The personal finance course emphasized using cash or debit cards as a means for everyday purchases to encourage students to improve their budgeting skills. Overall, a significant number of students started to pay down their current debt and checked their credit report for the first time.

Table 4 reports attitudinal changes in college students for sample time period. Forty-eight percent of the class claimed that they would not open a credit card account in the future. About one-third of the class was unsure and 21% reported that they would open an account in the future. Many students felt that credit

Table 4: Reported Attitude Changes

Questions	Answer	π	n
1. Will you open a credit card account in the future?	Yes	21%	9
	No	48%	20
	Unsure	31%	13
2. Do you plan on paying cash for your next/first car?	Yes	83%	35
	No	17%	7
3. When you buy your next or first car, will you buy a used car or a new car?	Used	90%	38
	New	10%	4
4. Do you plan to start investing for your retirement sooner or later in life?	Sooner	98%	41
	Later	2%	1
5. Do you plan on applying for a work study/internship as a result of this class?	Yes	64%	27
	No	19%	8

cards provided a convenient way to pay for online transactions. The personal finance curriculum emphasized paying cash for a cheaper, used car instead of financing an expensive new car. As a result, 83% of the class reported that they would follow this advice and pay cash. Further, 90% stated that they would buy a used car, as suggested.

Early in the class, a demonstration of how investing even a small amount as a 20-year-old could easily make you a millionaire by retirement age. Differences were demonstrated between two students where one student started early and another started late. Students were amazed at how the student who started late,

never caught up to the savings of the student who started earlier. Therefore, 98% of students reported that they would start investing soon. Many students asked how to open an investment account and began to invest for retirement.

Students were informed that those who worked around 15 hours per week in a work study or internship program earned better grades. These students appeared to learn better time management skills which translated into better study habits and better grades. As a result, 64% of the class reported that they would apply for a part-time job. Seven students did not answer this question. The most likely case is these students already had a part-time or full-time job.

Table 5 provides survey results from insurance related questions. Many students were not aware that they could purchase renter's insurance. After learning about the importance of insuring their personal belongings, 67% plan on buying renter's insurance. Fourteen percent owned a home or lived at home, so the question was not applicable.

Table 5: Reported Attitude Changes Related to Insurance

Questions	Answer	π	n
1. Do you plan to buy renter's insurance?	Yes	67%	28
	No	19%	8
	NA	14%	6
2. Which type of life insurance will you purchase?	Whole	7%	3
	Term	74%	31
	Neither	7%	3
	Both	10%	4
3. Do you plan to buy identity theft insurance in the future?	Yes	62%	26
	No	33%	14
4. Do you plan to buy long-term disability insurance in the future?	Yes	52%	22
	No	17%	7
	Unsure	29%	12
	I have it	2%	1
5. Do you plan to buy long-term care insurance when you get close to 60 years old?	Yes	69%	29
	No	14%	6
	Unsure	17%	7

Differences between whole and term life insurance were explained. If students developed a lifestyle of saving, paid off their home mortgage early, and developed an emergency fund, then it makes sense to only purchase term life insurance. Whole life insurance, which is more expensive, would not be needed because students would become financially independent by the time that they are 20 to 30 years older. Therefore, 74% of the students claimed that they would purchase term life insurance.

Multiple types of identity theft insurance were introduced. Students were informed that it could take over 300 hours to resolve a stolen identity. As a result, 62% reported that they would purchases this type of insurance, while 33% did not feel it was necessary. In terms of long-term disability and long term care, 52% and 69% of students reported that they would obtain these, respectively.

Conclusion

Students struggle with financial management because no one ever taught them how to manage their money. The most rewarding aspect of teaching this class is that 42 college students saved and aggregate of $30,198 in one semester. The average savings per student was $719. Students who began with no emergency fund saved an average of $475 and students who had an emergency fund saved an average of $1,592. Further, the proportion of students who had an emergency fund increased by 48%. A handful of students anecdotally reported that their new emergency fund allowed them to pay for emergencies such as car trouble or a temporary reduction in pay. These same students also reported that they were able to stay in school because they had their emergency fund in place.

This course appears effective in actually changing student behavior because students reported evidence of learning how to modify their financial behavior in a series of simple steps. The class teaches students how psychology and emotions play an important role in financial spending behavior. This class is particularly motivating in several ways. First, students learn how saving and investing just a small amount of money as a young person can make them a millionaire in the future. The proportion of students who save regularly increased by 31% and almost 100% of students plan to start investing at a younger age. Second, students learn how to make the budget process a habit every month with the help of example financial forms and recommended budget percentages. As a result, more than half of the students began to budget regularly by the end of the semester. Third, students are encouraged to save and pay cash for expenditures instead of using debt as a tool to make impulse purchases with a credit card. Ninety percent of the class reported that they would buy a used car and 83% will pay cash for the car. Further, 48% of students decided that they would not open a credit card in the future because they felt the disadvantages were greater than the advantages. Fourth, students learn how to obtain their credit reports and which types of insurance they should obtain.

The results of this study have an important limitation. The study reports only one semester's results with a small sample size of 42 students. It is possible that a larger sample size and a longer time horizon could generate different results. The study could be improved if it were possible to track the financial literacy and behavior of these students over time. However, since these particular students were already juniors and seniors, it would have proven difficult to obtain an adequate response rate after graduation for comparison. Also, some of the survey questions could have been improved. For example, instead of asking if students knew that they could receive 3 free credit reports each year, it could have been more effective to ask the students to choose the correct answer from a list of options.

Despite the limitations of the study, the instructor could not have asked for better learning outcomes for the 42 students enrolled in the course. All of the course evaluation comments were positive and indicated sincere appreciation for the tools learned. One senior stated the following comment in the course evaluations: "I have already started paying off my student loans early. I have also tripled my savings since this course ended. I have started being more cautious when it comes to spending my money. I've also been sharing everything I know with my friends and family! I've kept my textbook for references when it comes to how I should use/save my money. This course is definitely one of my favorites throughout my college career!" The results in this study show that these students appreciated learning about how to manage their future financial behavior, live with dignity, and face life's financial challenges.

The numerous positive results of this study provide compelling motivation for colleges to seriously consider requiring a personal finance course for every enrolled student. Moreover, the results suggest that personal finance should be required for incoming freshman to educate students how to save, budget, and avoid debt in order to decrease the nation's student loan debt, prevent money problems, and increase student retention.

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Appendix A: Personal Finance Curriculum Pre- and Post-Course Survey

Instructions: Place an "X" by your chosen answer.
Gender: Male ____ Female ____
1. Do you currently make a written monthly budget? YES___ NO____
2. Do you think it is important to build up your FICO score by taking out credit cards and car loans? YES___ NO____
3. Do you feel that one of the most important factors to consider when choosing a career is income potential? YES___ NO____
4. Can you receive a free credit report once a year from each of the three major credit bureaus? YES___ NO____
5. Do you currently make a written monthly budget? YES___ NO____
6. Do you save money on a regular basis? YES___ NO____
7. Do you know how to protect your identity? YES___ NO____
8. Do you think having a credit card is necessary to build your credit? YES___ NO____
9. Do you know how to save money on car insurance? YES___ NO____
10. Do you think having renter's insurance is necessary when you rent an apartment or live in a college dorm? YES___ NO____
11. Do you think it is necessary to take out a student loan to go to college? YES___ NO____

Appendix B: End of Semester Survey

Instructions: Place an "X" by your chosen answer.
Gender: Male ____ Female ____
1. How much money did you have in your emergency fund before this class started? _____
2. How much money have you saved so far in your emergency fund? _____
3. Did you have a budget before this class? YES___ NO____
4. Have you worked on a budget as a result of this class? YES___ NO____ I plan to ____
5. Have you started to pay down any current debt? YES___ NO____ NA___
6. Have you checked your free credit report yet? YES___ NO____
7. Will you open a credit card account in the future? YES___ NO____ Unsure_____
8. Have you closed any credit card accounts this semester as a result of this class? YES___ NO____ NA____
9. Do you plan on paying cash for your next/first car? YES___ NO____
10. When you buy your next or first car, will you buy a used car or a new car? Used____ New____
11. Do you plan to buy renter's insurance? YES___ NO____ NA: because I own a home____
12. Which type of life insurance will you purchase? Whole_____ Term_____ Neither____ Both_____
13. Do you plan to buy identity theft insurance in the future? YES___ NO____
14. Do you think that it is wise to start investing early? YES___ NO____
15. Do you plan to start investing for your retirement sooner or later in life? SOONER____ LATER____
16. Do you plan on applying for financial aid/work study/internship as a result of this class? YES___ NO___ NA___

17. Do you plan to buy long-term disability insurance in the future? YES___ NO___ Unsure___ I already have it___
18. Do you plan to buy long-term care insurance when you get close to 60 years old? YES___ NO____ Unsure____