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Economics of the World beyond the Textbook: Two Methods for Teaching

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Abstract

Visiting historical sites, local markets, or businesses can help students in an economics class connect abstract ideas to three-dimensional realities. We relate our experience with two types of trips: one focused on regional history and one in which students visited representative businesses. With some guided questions, the students are able to identify the forces of supply and demand at work in their own lives and communities.

Introduction

Some students struggle to understand the concepts in economics principles classes. Even a student who can successfully answer typical test questions about the supply and demand model may not realize that it describes how prices form in the city he or she actually lives in. We suggest a method for helping students to see how the information and graphs on a two-dimensional textbook page connect to a three-dimensional world. There are two types of trips that we describe with examples. First, a teacher can help students see the economic forces that are at work in shaping the dominant local industry near their school. Second, any place of business or market that the students participate in outside of class can be examined through the lens of economics. We suggest questions and assignments that help students get the most out of visiting sites of economic importance.

The examples we provide are not courses that are commonly termed "study abroad", although there is a literature on international trips for economics classes. McCannon (2011) describes a trip to Austria which enhanced a course on Austrian Economics. Wright and Hind (2011) took students to Gambia to learn about the economics of the tourism industry. Smith (2007) describes "extended field trips" that closely match the scale and format of our excursions. Two other sources for learning by experience explain how to adapt museum trips to college economics classes (Das 2015) and how to buy real emissions allowance permits online with an environmental economics class (Lewis 2011).

The Economic History of Your City

Why is this city here? If this city was a country, what would we export in order to buy food?

Many communities can trace their origin back to an industrial or agricultural boom. Although that industry is often no longer the main source of income, the effect of shifts in population and construction are still visible. The forces of supply and demand impelled people and products across great distances and beat down roads where there used to be wilderness. Emigrants' surplus production was traded for consumer goods (that now make so many cities indistinguishable from each other). This epic story can be told using local landmarks in such a way that helps students appreciate the pervasive and powerful effect of market exchange and individual choice that shapes nations and allows people to better their lives.

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Our own experience with teaching students in Southern California about the Gold Rush should serve to illustrate the potential of this exercise. Please note that although we spent considerable resources on a week-long trip with the students, this technique does not require overnight stays or expensive outings.

History is not separate from economics, although they are usually taught in separate campus buildings. The history of a population center can be described as the movement toward a resource of value that was then traded with other population centers. In the case of the American West, this resource is especially easy to identify as gold.

If it weren't for the people going west to find gold and the financial surplus from the metals unearthed, the industrialization of the West would have occurred much more slowly. Students were surprised to learn that the best way to get rich during the Gold Rush was to move to California and start a store or a hotel that served the miners. The financing of mining operations and international trade illustrated timeless lessons about financing and international trade everywhere.

Economic development of California was rapid, colorful, and unusual. By 1848, after more than two centuries of growth and development, the American frontier had been moved less than 1200 miles west from the eastern seaboard to Independence, Missouri. After the gold discovery at Sutter's Mill, in only four years 120,000 people made the 1,800 mile overland journey from Missouri to California across some of the most forbidding terrain in North America. After the difficult journey, emigrants reached an isolated destination far from the sources of the products needed for their new homes and enterprises. We described the history[3] of this rapid and isolated economic development with first-hand accounts of the gold fields in 1848 and the emigration that followed as well as readings on the growth of agriculture, the transportation network, the development of new mining technology, and Californians' trade relations in the early years of statehood. Every regional economy has its own development patterns. Much can be learned about economic development by studying their histories.

First-hand historical accounts of people living in the state your university happens to be in are full of economic insights. We had the students read an account from Walter Colton (1850), a community leader in Monterey, California during the Gold Rush. His journal was both entertaining and educational. In the appendix, we provide a sample excerpt and questions we used to direct reading of Colton.

Travel courses at Chapman take place during "interterm," which is a 4-week course that typically starts on the first Monday after New Year's Day. Our course involved three weeks of classroom instruction on the economic principles that affected the development of California during the gold rush followed by a week-long trip through Death Valley National Park. There are several sites where we could see abandoned mining equipment and observe the local economy. The students enjoyed camping and experiencing a new place. It was also an economical way to conduct a travel course. Many travel courses at Chapman cost $5,000 plus airfare and meals, and involve exotic destinations such as the Galapagos Islands for a course on Darwin and *The Voyage of the Beagle* or a course on the London theatre. Our travel course was only $900 including all meals, which opened the opportunity up to many students who otherwise would never have taken one.

Trip planning was a considerable effort, but Chapman is committed to providing a rich educational experience to its students so faculty commitment to educational programs is valued. We began by taking the students on a hike in the San Bernardino Mountains prior to registration. This allowed us to determine whether they were prepared for physical challenges of the trip. We also required them to bring their backpacks and unload the contents during a class period prior to the trip to be sure that they had adequate gear for a week in the back country. The Center for Global Education at Chapman collects travel course fees which are used to cover expenses associated with the course. We used these funds to rent Jeeps, purchase meals, pay camping and other fees, and so forth. Planning and logistics may have required 80 hours of faculty time over the course of the semester prior to the course. Preparation of course materials required about 200 hours of reading over the course of a year, though much of that reading was interesting. Of approximately 2500 pages of reading material that we read to prepare for the course, we selected 400 pages for the students to read.

Economics at the Marketplace

Introductory microeconomics textbooks often use examples of large economic significance such as whether to open or close a factory. These examples affect the economy more than a personal decision to buy

[3] Sources we used for the history of the Gold Rush in the American West included Colton (1850), Fehrenbach (1968), Gates (1962, 1971), Hunt (1916), Hutchings' (1856), Lingenfelter (1986), Paul (1963, 1966), Rawls and Orsi (1999), and Schlissel (1982).

cute shoes or not, however they may be less relatable for undergraduates. The second type of travel course that worked well for us involved using a standard intermediate microeconomics curriculum combined with trips to high-profile local businesses and stores. We traveled for a week in school vans and gave the students a paper assignment along with several precise questions about the operation of markets in each location, but this could be a single day trip and simple assignment in any class. Lewis (2011) provides an example of how the internet allows students to interact with the world outside the classroom without even leaving the room. We offer the highlights of our itinerary as a source of ideas.

Our class was taught in Orange County, California. A nearby business with a huge local and global impact is the Port of Long Beach. With or without a pre-existing relationship, the manager of a site like this is often open to free student tours. Our students were treated to a presentation in the boardroom and then we drove them around the site using a self-guided tour that was free online. This kind of arrangement is easier to come by if the instructor has a relationship with a business owner either personally or through consulting or other types of work.

Our next stop as we traveled north was Venice Beach. Venice is a fun place to walk around and has many independent vendors. We asked students in pairs to interview a vendor and learn as much as they could about the costs and revenue to that store. We guided them toward understanding what average and variable costs look like in the real world. This can be easier to understand for a very small business. Venice is a particularly fun place to do research but every college would have a nearby market place where firms are small enough to do this kind of project. Vendors will not tell an unknown customer everything about their books, but there should be a lot to learn about every business with appropriate questions.

Most multi-day trips involve some free time or sightseeing. There were plenty of opportunities for that as we drove along the beautiful California coast. We took a hike and stayed in camp cabins instead of hotels when possible, which cut down the cost of the trip considerably. Nominal downtime and group meals provide opportunities for conversations about economic activity.

Our final destinations were to innovative technology firms in Silicon Valley that were at different stages of financing and development. Through personal contacts we arranged visits to Microsoft Research in Mountain View, California and to the headquarters of Pinterest[4] in San Francisco. Start-up companies that have a large user base, as we learned, do not need revenue if they have enough investors. We had valuable conversations about modern companies and the economics of the technology sector.

We arrived home in time for the students to finish the writing project based on the questions they answered during the trip. (See the Appendix for the questions we used.) We chose to do most of our lectures before the trip (and a few during) so that the students knew the terminology for the things we were asking about. However, it could also be useful to ask students to hunt down information at a mall early on in the class and use the data in a lecture on prices and cost.

Conclusion

At the end of this class, the students were excited and felt that they had learned information that was relevant to their society and their careers. Unfortunately, students do not always feel that way at the end of an economics class. We taught theory and graphical analysis, but we also provided three-dimensional examples. The final papers demonstrated insight and learning on the part of the students of a greater depth than that of typical final exams. We recommend leaving the classroom in order to find markets at work and observe prices that the students, as consumers, have helped to determine. Smith (2007) likewise presents successful anecdotes of trips with economics students. There are no studies on whether field trips improve measurable outcomes like exam scores.

Using laboratory games is another way to engage students in economic ideas (Holt 1999; Holt et al. 2001). There are studies on how those interactive exercises impact measurable learning outcomes. Rousu et al. (2015) find that experiments only improve test scores if the students are competing for actual money in the classroom games. Games played for imaginary points may give other benefits to students and increase enjoyment of the class, but may not increase exam scores. Cartwright and Stepanova (2012) also compare test scores of students who participated in classroom experiments. They find that test scores only improved for students who wrote a report on the in-class exercise.

It is speculative but not unreasonable to relate these findings on in-class lab experiments to trips outside the classroom. A well-planned trip will surely help students relate the material they are learning to the world

[4] Pinterest is a popular photo-sharing website and is free to users.

around them. However, it may be necessary to engage students with real stakes or a writing assignment (see the Appendix for examples) in order for them to retain the concepts that they learn, at least in such a way that impacts test scores.

References

Cartwright, Edward, and Anna Stepanova. 2012. "What do students learn from a classroom experiment: not much, unless they write a report on it." *The Journal of Economic Education* 43,1: 48-57.

Colton, Walter. 1850. *Three Years in California*. New York: A. S. Barnes, H. W. Derby & Co. Reprinted in 1949 by Stanford University Press and in 2005 by the University of Michigan Press.

Das, Satarupa. 2015. "Using Museum Exhibits: An Innovation in Experiential Learning." *College Teaching* 63, 2: 72-82.

Fehrenbach, T.R. 2000. Lone Star: A History of Texas and the Texans. Da Capo Press.

Gates, Paul W. 1962. "California's Embattled Settlers," *California Historical Society Quarterly* 41: 99-130.

Gates, Paul W. 1971. The California Land Act of 1851. *California Historical Quarterly* 50: 395 – 430.

Holt, Charles A. 1999. "Teaching economics with classroom experiments: A symposium." *Southern Economic Journal* 603-610.

Holt, Charles A., Susan K. Laury, and David Lucking-Reiley. 2001. "Classroom Experiments on the Internet." Journal of Economic Perspectives 13: 211.

Hunt, Nancy A. 1916. "By Ox-Team to California," *Overland Monthly* 317-326. Hutchings' California Magazine. 1856. "Packing in the Mountains of California," December 241–249.

Lewis, Lynne Y. 2011. "A Virtual Field Trip to the Real World of Cap and Trade: Environmental Economics and the EPA SO2 Allowance Auction." *Journal of Economic Education* 42, 4: 354-365.

Lingenfelter, Richard E. 1986. Death Valley and the Amargosa: A Land of Illusion. Berkeley: University of California Press.

McCannon, Bryan C. 2011. "Teaching Austrian Economics in Austria as a Non-Austrian: A Note." *Journal of Economics and Finance Education* 10, 2.

Paul, Rodman Wilson. 1963. *Mining Frontiers of the Far West*. New York: Holt, Rinehart, and Winston.

Paul, Rodman Wilson. 1966. *The California Gold Discovery: Sources, Documents, Accounts and Memoirs Relating to the Discovery of Gold at Sutter's Mill*. Georgetown, California: Talisman Press.

Rawls, James J. and Richard J,. Orsi. 1999. *A Golden State: Mining and Economic Development in Gold Rush California.* Berkeley, Calif: University of California Press.

Schlissel, Lillian. 1982. *Women's Diaries of the Westward Journey*. New York: Schocken Books.

Rousu, Matthew C., Jay R. Corrigan, David Harris, Jill K. Hayter, Scott Houser, Becky A. Lafrancois, Olugbenga Onafowora, Gregory Colson, and Adam Hoffer. 2015. "Do monetary incentives matter in classroom experiments? Effects on course performance." *The Journal of Economic Education* 46, 4: 341-349.

Schlissel, Lillian. 1982. Women's Diaries of the Westward Journey. New York: Schocken Books.

Smith, Mark G. 2007. "Case studies on location: taking to the field in economics." *The Journal of Economic Education*. 38, 3: 308-317.

Wright, R., and D. Hind. 2011. "International Field Trips-the Tourism and Entertainment Management Field Trip to the Gambia, West Africa." *Assessment, Teaching and Learning Journal (Leeds Met)* 11.

Appendix

The Appendix contains examples of class materials. First we present an example of what an economics teacher can highlight from a first-hand account of local history. Using Walter Colton's diary, we drew attention to entries that discuss supply and demand, as we show in the excerpt about an attempt to ban alcohol and the subsequent rise in price. Next are some questions we asked students to answer as they read a chapter about mining for gold from Colton's diary.

Last, we list questions that we asked student to thoroughly answer in their "journal" about the trip up the California coast.

Example entry reproduced from page 63 of Colton (1850):

> Sept. 28 - When Monterey was taken by our squadron, an order was issued by the commander-in-chief that all grog-shops should be closed. The object of this was to prevent disorder among the populace and among the sailors, whose duties as a patrol confined them to the shore. It was with great difficulty that this order could be enforced. All moderate fines failed to secure its observance. The price of aguardiente rose to four and five dollars the bottle, more than ten times its original cost: for such a premium the shopkeeper would run the hazard of the penalty.
>
> We searched for it as for hid treasures, but only in one instance found its hiding-place. This was in a chimney, hanging about midway from the top. When discovered, the shopkeeper laughed as loudly as they who made the search... An offer of four or five dollars from a customer never failed to bring down a bottle. He paid his fine of twenty-five dollars, but begged hard for the liquor.

Example Questions for a chapter in Walter Colton's diary:

a) What is the current market price of one oz. of gold?
b) See the diary entry on Wed. Oct 18th on page 292 in Colton to find how much gold the average miner found in a day.
c) If someone today found that much gold, how much would they be earning per day? Per year?
d) If you knew that you could make that much money by switching into mining, would you buy a truck, tools, and move to another country to take the job?

Students were assigned several "journal entries" to be answered as we traveled up the California coast.

General Assignments to Complete

1. Track a Price up the Coast (1 page, include a table)
Before you begin, choose an item that you expect to see in every city we visit. Food or tourist items would make good choices. Make sure that no other student has chosen the same good. Every day, find at least two posted prices for that good.
Posted Price - a listed price, literally a price tag or a sticker in a store that displays the price the seller is asking for that good. In America, posted prices are usually non-negotiable.
Every day, find two sellers who sell that item. Record the prices you find in a table organized by location. Write a paragraph about why the prices are different in different stores or why they are the same. Speculate about how that price came to be exactly what it is. Draw a graph for a reasonable market price and also write about the forces of supply and demand for each good.
Talk to two other students in the course on the last day and ask them how their prices changed. How do their results compare to yours?

2. Find a Monopoly Can you identify a firm in a city we visit that is a monopoly or close to a monopoly? Explain.

3. Create-Your-Own-Assignment (1 page, include a supply and demand graph)

Using the following assignments for inspiration, ask your own economic question about one of the places we visit. Answer it using observations from the trip and draw a supply and demand graph to illustrate your answer.

Place-Specific Assignments

4. Long Beach Shipping Port

Why do shipping ports tend to be large and few instead of many small ones all along the coast? (some ideas: cost minimization, economies of scale, geographical advantages)

Why do countries export and import? Transporting goods is costly, so why not just make and consume everything by yourself? (hint: economies of scale and comparative advantage)

How would you predict that an increase in the price of oil to Americans would impact the Long Beach Shipping Port. (hint: shifts in the demand curve)

5. Venice Beach and Boardwalk

Venice Beach boardwalk has a lot of small stores in tents along the sidewalk. They sell handmade jewelry and art, for example. Find two vendors who are willing and happy to talk to you about their business. Gather information that will help you estimate their cost curve or their supply curve. Observe their fixed costs that they would incur whether they sell products or not that day. Observe their variable costs that increase if they are selling more products. Bonus points for explaining the economic logic of what they choose to sell and why they pick the location they do. It would be interesting to compare the differences between the two vendors and explain why they are different and how they are the same. Presumably two vendors with a tent on the same road will have a lot of fixed costs in common.

6. Santa Barbara

What is the capital investment required to start a business in Santa Barbara? How much does land and property cost? Try to find a real estate office because they usually have prices of houses and land tracts on display in the window. Why would a profit-maximizing firm locate in Santa Barbara?

7. Dey Dey Farms

Using information from the farmer's presentation, explain how he makes a profit.

8. Hearst Castle

This lavish house is evidence of LARGE economic profits. How did Hearst make his fortune? What niche of the market did he fill? Describe the evolution of one or two supply curves that are involved in the story.

9. Brandman U. Lecture

Briefly describe the [Cournot duopoly] experiments and explain the economic phenomenon that they illustrate.

San Francisco and Silicon Valley

10. Microsoft Research

Apply the concept of monopolistic competition to Microsoft. Who do they compete with? How much power do they have to influence the market price of software? We understand you won't be able to find a lot of data for this question, but describe what kind of data would be helpful to answer the problem. (hint: demand curves are derived from utility functions and preferences)

11. Pinterest

How would Pinterest measure output quantity? Who are Pinterest's competitors? Is Pinterest currently making a profit? How does Pinterest get money to pay its employees and buy buildings? Estimate several prices that Pinterest would charge for their services if they decided to charge customers money, and use demand curves to illustrate.

Presenting Economic Sanctions in the Classroom: The Case of Iran

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ABSTRACT

The Iran Deal' ended long standing sanctions levied against Iran by the United States, European Union and United Nations in 2015 for dismantling its nuclear program. This paper presents an approach to teaching economic models of sanctions, and applies it in the context of lifting Iranian sanctions. We start with a simple production possibilities frontier approach to analyzing sanctions, followed by welfare analysis of import and export restrictions on US and Iranian economies. The paper provides a presentation and links to useful resources that can be used by instructors teaching undergraduate courses in introductory economics, intermediate microeconomics and international economics.

Introduction

On January 16, 2016, economic sanctions that crippled Iran's economy for years were lifted after world powers determined that the Islamic Republic had complied with a deal aimed at preventing it from building a nuclear bomb. Lifting of the sanctions meant that tens of billions of dollars would be available to Iran, as well as access to the international banking system and global market, for the sale of oil and natural gas. President Barack Obama immediately issued an executive order canceling some sanctions imposed by the United States, though others unrelated to Iran's nuclear program continued. With the removal of sanctions, Iran hopes to rejoin the global economy and end its pariah status. Supporters of sanctions characterize the deal as a victory for diplomacy in which economic sanctions played an important role in pressuring Iran to negotiate.

International economic sanctions have widely been viewed as a means by which the world community can force those countries that are perceived as pursuing disagreeable polices to modify them. Government officials often speak highly of the effectiveness of sanctions in achieving political goals. Economists, however, tend to exercise caution when approaching the question of whether and how sanctions work. Because there is no adequate macroeconomic model of sanctions, economists cannot predict their impact. However, economists can demonstrate some of the effects of sanctions and perhaps provide a convincing argument that the matter is not so simple.

The purpose of this paper is to apply economic tools, taught in university undergraduate economics classes, to the economic sanctions that have been imposed on Iran. Specifically, we employ standard microeconomic methods and present impacts of Iranian sanctions in the context of the production possibilities frontier, welfare analysis and empirical sanctions multiplier approaches. Thus, we circumvent more nuanced theories that are beyond the scope of many undergraduate students including game theory, offer curves and public choice theory, for a more simplistic presentation of the basic economics of sanctions. However, we hope that our presentation provides a valuable methodology that instructors can use when discussing sanctions in their courses such as Principles of Economics, International Economics, and Intermediate Microeconomics. To our knowledge, this is the first pedagogical paper to address the important issue of

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Iranian trade sanctions. The paper begins with a discussion of the nature and operation of economic sanctions and then applies this analysis to the case of Iran using the three aforementioned methodologies. It also includes Appendix A that provides a link to this paper's PowerPoint presentation and online video content about the Iranian sanctions.

What Are Economic Sanctions?

Economic sanctions are economic measures directed to political objectives. Sanctions consist of government mandated limitations on customary trade or financial relations with the target country. The goal of sanctions is to pressure a target government into a particular avenue of response. Among the goals of sanctions are the preservation of national security, reduction of nuclear proliferation, combatting international terrorism, setting compensation for property expropriated by foreign governments, and protecting human rights. The Export Administration Act of 1969, as amended, provides the President the authority to levy economic sanctions.

Proponents view sanctions as a means of reducing the welfare of the target country through economic deprivation. If welfare is sufficiently decreased, discontent will follow, eventually leading to political change. Sanctions have also been viewed as a way of making a political statement that the imposing country wishes to disassociate itself from the ruling regime of the target country. Therefore, sanctions could be rational even though they inflict no economic pain on the target country. The country initiating the economic sanctions for foreign policy objectives, the so-called imposing country, hopes to impair the economic capabilities of the target country to such an extent that the target country will succumb to the imposing country's objectives. The imposing country can levy several types of economic sanctions. First, trade sanctions can involve boycotts placed on imposing-country exports to the target country. The United States, for example, has used its role as a major producer of grain, military hardware, and high technology goods as a lever to win overseas compliance with its foreign policy objectives. Trade sanctions can also involve imposing countries placing import restrictions (quotas) on target country goods. Second, the most widely adopted economic sanction has been financial sanctions placed on target-country assets, including the reduction of foreign aid. For example, in 2014 the United States and its allies imposed financial sanctions against Russia because of its annexation of Crimea, part of the Ukraine. Compared to trade sanctions, financial sanctions tend to have the political advantage of facing less resistance among domestic workers and companies, as well as foreign allies who are harmed by the sanctions.

Economic sanctions can induce a number of costs upon target countries. Direct costs entail additional financial outlays, such as increased transportation costs or the loss of traditional export revenues, directly related to the imposition of sanctions. Indirect costs usually result from import scarcities of intermediate products or raw materials which disrupt domestic production and induce unemployment in non-trade sectors. If spare parts or other intermediate goods cannot be obtained, some factories may have to be abandoned, thus lessening the nation's output possibilities. Sanctions can also yield forgone costs in the form of the failure of the economy to grow as would otherwise have been the case.

However, sanctions can also inflict costs on the imposing country. Since trade is a two-way street, imposing countries are likely to find that they must shift to more costly and more distant suppliers, while on the revenue side, the demand for their exports will decrease. In general, however, the welfare loss to imposing countries is less than to the target country because imposing countries are economically larger and have a variety of substitute markets and suppliers with which to deal. The greater the number and economic importance of countries initiating sanctions, the higher the costs to the target country whose economy has been disrupted.

There are two traditional graphical approaches of analyzing the economic impact of sanctions: offer curves and welfare economics analysis. In the former case, researchers have studied the willingness of countries to trade at different terms of trade (Kaempfer and Lowenberg, 1988; 2007). While this approach is helpful with analyzing the impact of sanctions on the terms of trade, it does not provide estimates of total economic impacts. This, however, is the strength of the latter approach which allows us to relate changes in economic welfare to changes in value of trade (Torbat, 2005). Such multipliers, however, only provide us with an approximation of the welfare loss, since data on supply and demand elasticities are generally lacking. We use the welfare approach in this paper since we seek to demonstrate the practical use of welfare theory in estimation of the economic impact of sanctions. Applied economic research on sanctions suggests that only extensive and comprehensive sanctions have a large negative impact on trade (Caruso, 2003) and, while they may be effective in reducing target country income, they are complicated to implement, expensive, and come with substantial spillover effects (Canes, 2000; Kaempfer and Lowenberg, 1988, 2007). Such results give us confidence for focusing our pedagogical study of sanctions on Iran, as opposed to other cases, since

Iran's restrictions were both extensive and comprehensive.

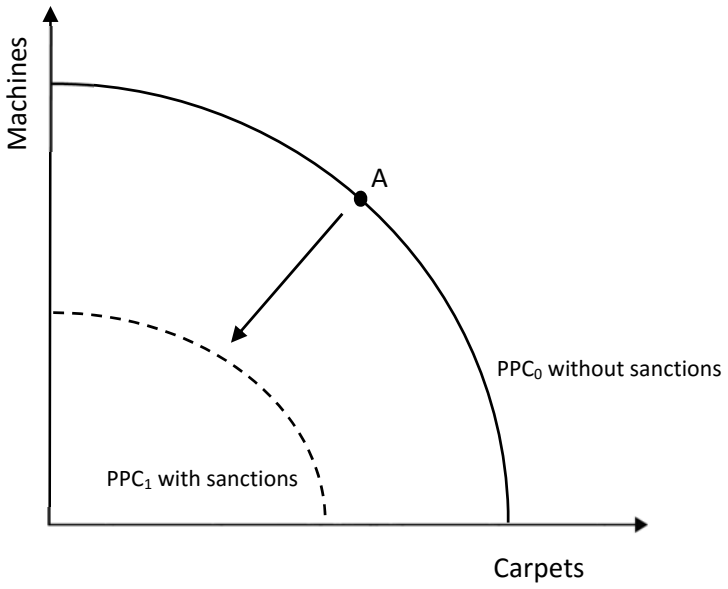
Sanctions Trade Models

At Central Washington University (CWU), we discuss economic sanctions in several lower-level classes that are typically taken by freshman and sophomores--Survey of Economics, Principles of Micro, Principles of Macroeconomics, and World Economic Issues—and two upper-level classes—Intermediate Microeconomics, and International Economics. We have found that the production possibilities diagram is a useful starting point to discuss sanctions. A more advanced presentation of sanctions involves microeconomic diagrams incorporating the concepts of consumer surplus and producer surplus, as discussed in the latter sections of this paper.

Production Possibilities Analysis of Sanctions

Figure 1 shows the hypothetical production possibilities curve of Iran for machines and carpets. Carpets are a major category of Iranian exports, while machinery has traditionally been the top Iranian import from developed countries. Prior to the imposition of sanctions, suppose that Iran is able to operate at maximum efficiency as shown by point A along production possibilities curve PPC_0. Now suppose that the United States and its allies levy sanctions to discourage Iran from developing nuclear weapons. Under the sanctions program, a refusal of the imposing nations to purchase Iran's carpets and machines leads to idle factories, and unemployed workers in Iran. Unused production capacity forces Iran to move inside PPC_0. If the imposing nations also levy export sanctions on productive inputs, and curtail equipment sales to Iran, the output potential of Iran would decrease. This is shown by an inward shift of Iran's production possibilities curve to PPC_1. Economic inefficiencies and reduced production possibilities caused by economic sanctions are intended to inflict hardship on the people and government of Iran. Over time, sanctions may cause a reduced growth rate for Iran. Even if short run welfare losses from sanctions are not large, they can appear in inefficiencies in the usage of labor and capital, deteriorating domestic expectations and reductions in savings, investment, and employment. Therefore, sanctions tend to reduce Iran's output potential over the long run.

Figure 1: Production Possibilities Analysis of Sanctions Against Iran



Besides being imposed on trade, economic sanctions may be levied on flows of factors of production. Imposing nations may choose to conduct disinvestment policies which withdraw foreign capital from the target country. Capital withdrawal is basically a long-run strategy which attempts to slow down the target country's growth rate. Such a policy works best when the target country is backward and heavily dependent on foreign capital and technology. Similar to trade sanctions, the amount of damage that investment sanctions inflict upon the target country depends on the ability of the target country to replace the foregone investment from domestic or foreign sources, or doing without. In Iran, this is referred to as the 'resistance economy'.

Proponents of disinvestment often talk of "pulling out". But they do not usually indicate how this can be achieved effectively. Imposing-nation firms cannot simply dismantle their plants in the target country and ship back the parts to the imposing country. In many cases, most of the personnel employed in the target country remain there, the country of their birth. Target country exchange control regulations can prevent the repatriation of foreign capital. If imposing-country investors were to sell their existing holdings in the target country, such sales might benefit new purchasers who could obtain stock at artificially depressed prices. The physical plant, the technology, and the personnel would remain in the target country, with only the ownership changing hands.

The use of the production possibilities diagram provides a useful introduction to the effects of sanctions. However, this model fails to address the welfare effects of sanctions. In the next two sections of this paper, we use partial equilibrium supply and demand curves to illustrate the static effects of an export quota and an import boycott, components of the arsenal of sanctions. We conclude with an empirical sanctions multiplier approach.

Effects of an Export Restriction

The below analysis considers the welfare effects of an export quota levied by Germany (and its allies) against Iran as well as restrictions on German investments in Iran (Carbaugh and Wassink, 1988). Figure 2 represents the market for machines in Germany and Iran. We choose machines for our hypothetical scenario since they tend to be a major German product export category to Iran (OECD, 2016). The case for machines if further supported by the European Union sanctions levied against Iran in 2012 which restricted many types of capital goods. Let the German and Iranian demand schedules for machines be denoted $D_{Germany}$ and D_{Iran} respectively. $D_{Germany.+Iran}$ denotes the sum of the German and Iranian demand schedules for machines, while $S_{Germany}$ represents the supply schedule of German machinery producers. Assume that all of Iran's machines come from Germany. With free trade, German machinery market achieves equilibrium at point A. Germany produces 14,000 machines at a price of $40,000 per machine. Of this quantity, 8,000 machines are exported to and purchased by Iranian buyers at $40,000 per machine. German export receipts total $320 million (8,000 x 40,000 = 320 million).

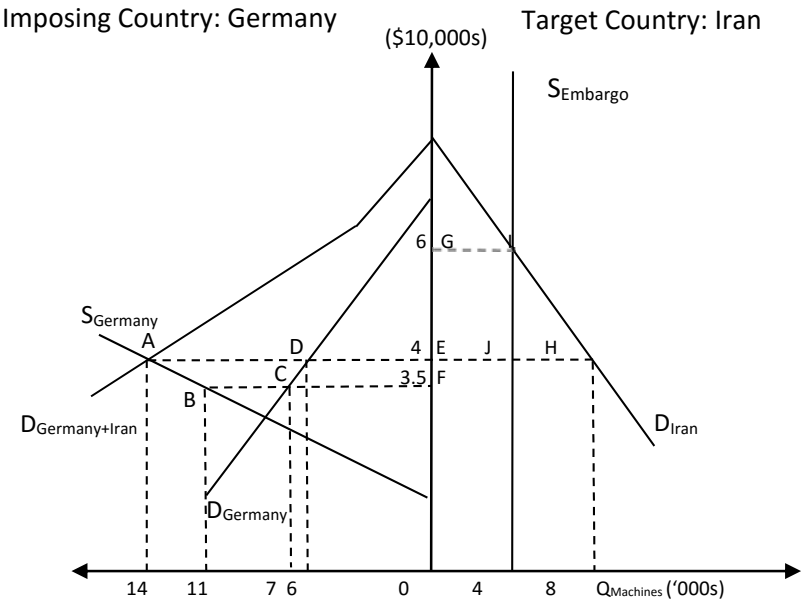
Suppose that Germany imposes a partial embargo on machinery exports to Iran, equal to 4,000 machines in Figure 2. The export restriction results in a vertical Iranian supply schedule, $S_{Embargo}$, at the embargo quantity. Excess demand forces Iranian machinery prices to rise to $60,000 per machine. Compared to free-trade equilibrium, the price of Iranian machinery rise by $20,000 per machine while consumption decreases by 4,000 machines (8,000-4,000=4,000).

Assuming that the German machinery exporters behave as monopoly sellers, they will capture the price increase as improved terms of trade. German export receipts total $240 million (4,000 x 60,000 = 240 million), down from the free-trade amount of $320 million. The $20,000 price increase results in Iranian consumer surplus falling by area GIHJE. Of this amount, area HIJ is not redistributed internally and constitutes a deadweight welfare loss (consumption effect). Reflecting the higher price applied to a smaller export volume, area EGIJ is captured by Germany as export revenue. The overall welfare loss to Iran resulting from the export quota consists of the sum of these effects (Carbaugh and Wassink, 1988).

For Germany, the export restriction results in an improvement in its terms of trade, as the foreign price of its export good rises, and an increase in its national welfare. But the export restriction reduces the volume of trade and results in an excess supply of machines for Germany totaling 4,000 machines, which causes the price of machines to fall to $35,000. The price reduction results in an increase in consumption from 6,000 machines to 7,000 machines and an increase in consumer surplus equal to area CDEF. The price reduction also results in a decrease in production from 14,000 machines to 11,000 machines and a loss of producer surplus equal to area ADEFCB. The German economy faces a net welfare loss equal to area ABCD, which represents the amount by which the loss in producer surplus exceeds the increase in consumer surplus. To determine the overall welfare effect on an export sanction, the benefits of improved terms of trade would

have to be compared against the costs of a lower volume of exports.

Figure 2: Export Quota Levied Against Iran



Export sanctions also affect the German level of employment in its export and export-supporting industries. If German producers realize strong demand for their goods, a reduction in exports need not generate higher unemployment. But when German producers face excess capacity, it is appropriate to assume that export sanctions induce higher unemployment. German employment may decrease still further due to the induced fall in exports to those countries whose exports are likely to decline because of their imposing sanctions on Iran. The above analysis suggests that export restrictions generate greater welfare losses, in terms of decreased consumer surplus, for Iran: (1) the greater its initial dependence on foreign-produced goods; (2) the more inelastic the Iranian demand schedule in the neighborhood of the initial equilibrium price, suggesting less flexible consumption preferences; (3) the more inelastic the Iranian supply schedule in the neighborhood of the initial equilibrium prices, suggesting a less flexible production structure and smaller range of production alternatives (Carbaugh and Wassink, 1988). Export sanctions tend to be most effective when they damage the target nation through the scarcity of critical products or resources.

As suggested above, the greater is the likely economic impact of sanctions the greater is the inelasticity of Iranian demand for German goods. Iranian demand tends to be more inelastic the: (l) greater the extent that some product or resource of vital importance is involved (necessity); (2) less available the supply of final goods, intermediate products, and raw materials from alternative suppliers not participating in the boycott; (3) shorter the time period in question, which limits the adjustments that Iran can make to a supply restriction. In the long run, export sanctions may cause a reduced growth rate for Iran. Even if short-run welfare losses of sanctions are not large, over time they can appear in inefficiencies in the usage of labor and capital, deteriorating domestic expectations, and reductions in saving, investment, employment, and foreign exchange. These effects result in an inward shift of Iran's production possibilities curve, as previously discussed, as economic growth deteriorates due to increased inefficiencies of capital and labor and decreased rates of saving and investment.

Short-run analysis implies that sanctions should be levied across the board and must reduce Iranian welfare quickly to be successful, since they are increasingly offset by long-run adjustments as elasticities of substitution in both production and consumption rise over time. The 2012 sanctions against Iran did not allow for such long run adjustment as many other countries joined the US in enforcing the trade ban, effectively making it binding. The outcome was a drop in exports across most product categories, especially oil.

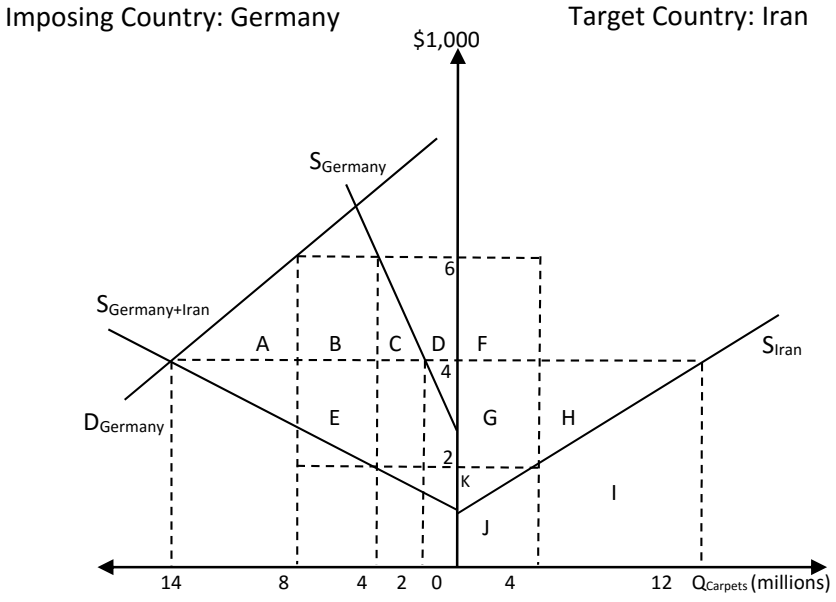
From the perspective of economic development, export sanctions levied against Iran may have a perverse outcome, as sanctions can provide the people of the Iran the resolve to initiate import-substitution programs required for domestic economic development and self-sufficiency, thus solidifying the existing economic and political positions in the country. However, progressive import replacement leaves the structure of Iran's economy less efficient and competitive, resulting in an inflationary bias. To the extent that government assistance is needed to maintain uncompetitive domestic industries, there occurs a reduction in government revenues which suggests increased taxes and a misallocation of resources to the public sector (Carbaugh and Wassink, 1988).

Effects of an Import Restriction

Complete trade sanctions also require the citizens of the imposing country to restrict the importation of goods produced by the target country. Figure 3 illustrates the trading position in carpets for Germany (imposing country) and Iran (target country). We choose carpets as a product in this hypothetical example since they are Iran's top non-oil export product; and prior to international sanctions against Iranian carpets in 2012, Germany imported 13 per cent of all Iranian carpet exports (in 2011), worth $112 million (United Nations, 2016). Although carpets were not directly targeted by sanctions, the financial sanctions imposed against Iran by the EU in 2012 had a generalized adverse effect on the economy, including carpets. While carpets vary in size, in this example we are assuming production of a standard 9'x12' hand woven Persian carpet.

In Figure 3, schedule S_{Iran} represents the supply of carpet exports (excess supply) for Iran, found by subtracting Iranian demand from Iranian supply at each price. For Germany, $S_{Germany}$ and $D_{Germany}$ represent the domestic supply and demand schedules of carpets respectively, while $S_{Germany+Iran}$ denotes the total supply of carpets including that offered by German and Iranian producers. Free-trade equilibrium occurs where the total supply of carpets equals the German demand. At the equilibrium price of $4,000 per carpet, German produces 2 million carpets and consumes 14 million carpets, while imports total 12 million carpets (Carbaugh and Wassink, 1988).

Figure 3: Import Quota Levied Against Iran



In order to inflict economic pain on Iran, suppose Germany enacts a quota that limits imports from Iran to 4 million carpets. The scarcity of carpets forces the price up to $6,000 for the German consumer. This results in an increase in German supply to 4 million carpets, a decrease in German demand to 8 million carpets, and a decrease in consumer surplus equal to area A+B+C+D. Deadweight losses of consumer surplus

equal the consumption effect, denoted by area A, and the protective effect, denoted by area C. Area D is redistributed to German producers as producer surplus.

The import quota can inflict economic pain on Iran via the trade volume effect and terms of trade effect. In Figure 3, Iran initially exports 12 million carpets to Germany at the free trade price of $4,000 per carpet. Export receipts of Iran are depicted by areas G + H + I + J + K. Under the quota, Iranian exports fall to 4 million carpets. The reduced trade volume results in export revenues decreasing by area H + I. It is possible, however, that this revenue loss is offset by a welfare gain due to the terms of trade effect. If Iranian exporters are able to operate as monopoly sellers, while German importers behave competitively, they can raise the export price to $6,000 per carpet and capture additional revenues as depicted by area B (which equals area F). But if German importers are able to operate as monopoly buyers, while Iranian exporters behave competitively, price will be forced down by $2,000 per carpet and Iranian exporters will lose area E (which equals area G). Like the case of bilateral monopoly, the outcome is theoretically indeterminate (Carbaugh and Wassink, 1988).

The analysis above suggests that a quota applied to Iran's carpet exports tends to reduce its export revenues. Although this decrease might initially be absorbed out of profits, it ultimately forces the contraction of production and induces higher unemployment for Iranian workers. For Germany, the sanction results in higher consumer prices and lost consumer surplus. German importers may be able to earn higher profits if they can capture the quota's terms-of-trade effect. To the extent that carpet imports are decreased, the German import-competing industry realizes higher sales, profits, and levels of employment. It is no wonder why the German import-competing industry might be most willing to support the "national interest" by calling for import sanctions levied against Iran.

Iran Sanctions

History of Sanctions

In this paper we focus on the impact of US, UN and EU sanctions on Iranian economy. Their chronology reveals a troubled history of Iranian relations with the Western countries in particular. At the onset of the Cold War, as the United States and Soviet Union jostled for Middle East regional influence. In this context, the United States supported the Iranian Shah Mohammad Reza Pahlavi whose regime was characterized by political oppression, pro-Western policies, corruption, and overall poor human rights record. In 1953, Iranian Prime Minister Mohammed Mossadegh was overthrown in a coup d'état that was orchestrated by western intelligence agencies in opposition to his nationalization of the Iranian oil industry and alleged communism. Instead, the National Iranian oil company was managed by an international consortium, extending western influence over the Iranian economy. Pahlavi's despotic rule finally came to a head in the 1979's Iranian Islamic Revolution that ushered the rise of the present-day Islamic Republic of Iran (Clawson, 2010; Ghaderi, 2015; Golliard, 2013).

In response to failing economic conditions, growing inequality, and Shah's repression, the revolution became vehemently anti-western and led by the Shia Muslim religious leader Ayatollah Khomeini. Then, in the chaos of revolutionary fervor, a group of students occupied the US Embassy in Teheran and took American personnel hostage. In response, President Jimmy Carter issued an executive order that blocked $12 billion in Iranian government assets and banned oil imports into the United States.

In 1980, US diplomatic relations with Iran were severed and sanctions were extended to travel and trade with Iran. Upon release of the hostages, the United States lifted the sanctions and returned property, only to again prohibit foreign assistance and arms sales this time due to Iran's involvement in the bombing of a US Marine barracks in Lebanon in 1984. Additional non-comprehensive sanctions continued to be assessed for the next decade as the relations between the countries further deteriorated.

In the 1990s, the United States became increasingly concerned over Iran's nuclear program and support for terrorism. Consequently, President Bill Clinton imposed comprehensive sanctions on all bilateral trade with Iran. Furthermore, the US Congress authorized the Iran-Libya Sanctions Act that penalized foreign company investments in Iran in 1996. While the embargo was temporarily eased during the presidency of a reformist Mohammad Khatami, the election of conservative President Mahmoud Ahmadinejad and restart of the uranium enrichment program provoked the strongest round of sanctions to date.

Nuclear Sanctions Against Iran

In 2002 the International Atomic Energy Agency (IAEA) accused Iran of pursuing weapons related nuclear activities, thus failing to meet its obligations as a signatory of the Nuclear Nonproliferation Treaty (NPT). The IAEA demanded suspension of such actions, and Iran proceeded to negotiate with US and European Union (EU) on alternative arrangements as all sides considered temporary and long term suspension of uranium enrichment, and supply and disposal of nuclear fuels. In 2006, the five permanent members of the United Nations Security Council plus Germany (known as the P5+1) proposed an agreement that would reaffirm Iran's right to pursue civilian uses of nuclear technology in conformity with the NPT, and support joint nuclear projects in Iran (light water reactors), in exchange for a suspension of all nuclear enrichment activities and cooperation with the IAEA. Iran rejected the offer proclaiming development of legitimate peacetime nuclear technologies and proceeded with expansion of their nuclear capacities. UN Security Council responded by adopting the P5+1 plan, banning transfers of nuclear technologies to Iran, arms exports, and sanctioning many Iranian entities and individuals. After several years of deteriorating relationship with the international community over the nuclear issue, Iran admitted to enriching uranium in 2009. This led to expansion of previous UN sanctions to additional individuals and institutions, shipping and military industries. In addition, President Obama signed several laws further expanding the sanctions, including: the Comprehensive Iran Sanctions, Accountability, and Divestment Act of 2010, the Executive Order 13590, the National Defense Authorization Act for Fiscal Year 2012 (section 1045), and the Executive Order 13599. These laws covered a wide range of activities including the military, shipping, financial transactions, central bank operations, and Iranian government assets. Importantly, in 2012, European Union (EU) joined the US in adopting further non-UN-mandated sanctions against Iran for the first time. They cited the growth and nature of the Iranian nuclear program as the main reason for extending the oil embargo, sanctioning the precious metals trade, pursuing central bank assets, restricting access to insurance and SWIFT electronic banking network services.

Iranian Economy and Sanctions Impact

The combined effect of the US, EU and UN sanctions put a significant strain on the already suffering Iranian economy. Iran transformed from a traditional agricultural economy to a modern centralized state run economy in the second half of the 20th century. The modernization started with the regime of Reza Pahlavi who used statist approaches to development of country's industries. It produced rapid growth, but it came at a cost of increasing economic disparities, leading up to the 1979 Revolution. Today, Iran is run by the political victors of the said revolution as a unique theocratic political system with some elements of democracy. It is a transition economy characterized by a large public sector. It is the second largest Middle Eastern country, with a population of 78 million people, 636,000 square mile area, and GDP of $393 billion, all in 2015 (World Bank, 2016). As a member of the OPEC, it is the world's seventh largest oil producer, accounting for 10 percent of the world's proven oil reserves and 15 percent gas reserves. Oil constitutes 80 percent of Iran's exports.

Currently, Iran's economy is plagued with high inflation, low growth, fiscal deficits, and a decrease in its current account surplus. This has been caused by low oil prices, decades of international political and economic isolation, and inefficient government policies such as subsidies and price controls. The direct effect of the 2012 sanctions was GDP that was 15%-20% smaller than it would have been had post-2010 sanctions not been imposed (Katzman, 2016). According to the Congressional Research Service (Katzman, 2016) these sanctions: drove Iran's crude oil sales down about 60% from 2011; the number of nonperforming loans held by Iranian banks increased; hard currency was inaccessible; the value of the rial, Iranian currency, declined more than 50%; estimated actual inflation rate was between 50% and 70%; lead to a decrease in manufacturing due to the lack of access to international markets. Sanctions have increased the prices of imported goods, gas, and currency, amongst others, leading to development of a significant black market for such products. Black market is estimated to be valued between 25% and 35% of the Iranian economy and some suggest it is largely run by the corrupted parts of the Iranian government (Business Insider, 2015). Such corruption tends to enrich the elites controlling the resources, while coming out of the expense of the larger population. The lower economic classes are particularly affected, as they often lack access to basic resources such as food, are suffering higher levels of unemployment, and lowering incomes.

'The Iran Deal' or the Joint Comprehensive Plan of Action (JCPOA)

The United States and Iran relations began to improve with the election of a moderate leader Hassan Rouhani, whose policies of rapprochement with the West have led to the first direct contact between the countries in more than 30 years. The following negotiations over Iranian nuclear development resulted in the signing of the Joint Comprehensive Plan of Action (JCPOA) on July 2015 between Iran, the five permanent members of the United Nations Security Council (China, France, Russia, United Kingdom, and United States), Germany and the rest of the European Union (Katzman, 2016). The so-called 'Iran Deal' lifts restrictions on Iran's nuclear industry through elimination of enriched uranium stockpiles, limitations on use of centrifuges, inspections by the International Atomic Energy Agency (IAEA), and other constructions bans. On January 16, 2016, the agreement was implemented after the IAEA verified that Iran had completed the nuclear program reductions stipulated in the JCPOA. This led to termination of most UN and EU sanctions, with no new sanctions to be imposed in the foreseeable future.

Several limiting factors may diminish the positive economic impacts of the JCPOA. First, the sanction relief is not immediately effective, as additional EU and US sanctions termination will occur eight years from the day the JCPOA is adopted. Secondly, JCPOA does not require the United States to lift all its sanctions against Iran. In particular, the United States has committed to eliminating secondary, nuclear-related, sanctions, while leaving most of the primary sanctions in place. Such secondary sanctions penalize non-US companies from doing business with Iran, while the primary sanctions prohibit US companies from dealing with them. In particular, US sanctions related to alleged missile development, human rights abuses and support of terrorism are not affected by the JCPOA. In the case of Iran violating the plan of action, so called 'snap back' provisions would set the previous sanction regime in place. In addition to international inspector site visits, this is the main enforcement mechanism of the agreement.

Empirical Evidence on Economic Impact of Iran Sanctions

JCPOA provides significant relief from previously imposed US, EU and UN sanctions in the oil, financial, and transportation industry sectors, access to $100 billion of previously frozen assets, and access to the international payment system (SWIFT). The lifting of sanctions thus creates positive shocks on export demand, terms of trade, and wealth. While the realized future economic impacts ultimately rest on the successful implementation of the plan of action, macroeconomic policy, and general economic conditions, the International Monetary Fund (2015) forecasts an increase in Iranian real GDP growth of up to 5.5 percent for the first two years of the agreement and 3.5-4 percent thereafter. The estimates, computed using a dynamic financial computable general equilibrium model, suggest that the most important contributor to Iran's growth will be the recovery in its oil business activities, and to a lesser extent from lower financial and trade transaction costs (Ianchovichina et al., 2016). Over the next five years, the Iranian economy is expected to experience a cumulative 15 percent increase in real GDP relative to a scenario of sustained sanctions (IMF, 2015).

Akbar Torbat (2005) estimates the cost of US export and import sanctions on Iran and calculates sanction multipliers from export and import elasticities. To estimate the size of the welfare loss, Torbat uses an analytic model developed by Gary Hufbauer et al. (1990) that depends on the elasticity of supply (E_s) and the elasticity of demand (E_d), so that the so-called $'\text{sanctions multiplier}' = \frac{1}{E_d + E_s}$. They find multipliers to range between 0.1 and 0.5. Torbat (2005) assumes that long-run supply and demand are elastic, thus ranging between 1 and ∞ and resulting in the average sanctions multiplier of 0.25. He finds the total sanctions cost to be $777 million (2000 USD) per year, which is within the range of prior studies. However, trade sanction costs are a fraction of financial sanctions cost in this study, which is less consistent with previous research.

Using the same welfare loss calculations as Hufbauer et al. (1990) and Torbat (2005), we first analyze the impact of export restrictions on German produced machinery, as presented in Figure 2; and import sanctions on Iranian carpets, as presented in Figure 3. In the former case, and according to the US Census, the value of machinery exports from Germany to Iran in 2011 amounted to $2.12 billion (OECD, 2016). While demand for such goods in Iran is inelastic in the short run, since machinery often has few substitutes, the demand becomes elastic in the long run as more substitutes are purchased or created. Thus, we use the sanctions multiplier of 0.25 and multiply it with the value of German machinery exports in 2011 to get a rough approximation of a welfare loss of $530 million. The data for total Persian carpets exports suggest that

in 2011, Iran exported more than $800 million worth of hand-woven and machine-made carpets (CBIRI, 2015; UN, 2016). Germany was the second largest importer of Iranian carpets, importing about 13 percent of all Iranian exported carpets, trade totaling $112 million in 2011 (UN, 2016). Using the sanction multiplier of 0.25, we calculate the welfare loss in the carpet market to be $28 million (2011 USD).

Conclusion

In 2015, the United States and its partners lifted trade and financial sanctions against Iran after international inspectors determined that the country had dismantled most of its nuclear program. JCPOA thus ended 36 years of on-and-off trade restrictions with Iran and ushered a new era of increased economic cooperation between the countries. This paper proposes an economic model of sanctions applied to Iran with a goal to help economics instructors wishing to present this case in their introductory economics microeconomics and macroeconomics courses, or upper level international trade and intermediate microeconomics courses. We discuss three separate approaches: production possibilities analysis of sanctions, and German export (machinery) and German import (carpets) restriction welfare economics models. The last two are useful in providing us with rough approximations of welfare losses due to sanctions. We provide graphical representation for each model in Figures 2 and 3, respectively. However, more precise estimates require better data on relevant demand and supply elasticities, which are unavailable to us. To estimate actual welfare losses in each case, we use the 'sanctions multiplier' approach, based on assumptions regarding elasticities of demand and supply, and proposed by Hufbauer et al. (1990) and previously applied to Iran by Torbat (2005). Our calculations suggest a welfare loss in the carpet market of $28 million and a welfare loss of $530 million in the machinery market, all in 2015 USD. Thus, repealing sanctions in the case of carpet imports and machine exports saves the world economy $24.2 million.

The proposed pedagogical approach may be used when teaching about economic impacts of other sanctions. The first section of the paper, discussing the economic theory of sanctions, can be applied to future cases of sanctions. The discussion of the Iran case is not applicable to other sanctions, but our approach in describing and analyzing the Iran sanctions may be a good starting point for researchers studying other economic sanctions. Specifically, the concept of 'sanction multiplier' can be used in most cases as a quick and rough approximation of the consequent actual welfare losses.

References

Saeed, Ghasseminejad (2015). "How Iran's Mafia-Like Revolutionary Guard Rules the Country's Black Market". Business Insider.

Canes, Michael E. 2000. "Country Impacts of Multilateral Oil Sanctions." *Contemporary Economic Policy* 18(2): 135-144.

Carbaugh, Robert and Wassink, Darwin. (1988). "International Economic Sanctions and Economic Theory" *International Review of Economics and Business* 35(3): 217-225.

Caruso, Raul. 2003. "The Impact of International Economic Sanctions on Trade: An Empirical Analysis." *Peace Economics, Peace Science and Public Policy* 9(2).

Central Bank of the Islamic Republic of Iran. 2015. "Economic Report and Balance Sheet for 2011/2012". Tehran, Iran.

Clawson, Patrick. (2010). "US Sanctions." The Iran Prime*r*, US Institute of Peace. Accessed March 28th, 2016. http://iranprimer.usip.org/resource/us-sanctions.

Ghaderi, Elnaz. 2015. "The Impact of the United States Sanctions on Iran's Trade Flows: A Gravity Model Approach." Unpublished master's thesis, Södertörns University.

Golliard, Mélanie. 2013. "Economic Sanctions: Embargo on Stage. Theory and Empirical Evidence." Unpublished master's thesis, University of Tampere.

Hufbauer, Gary C., Schott, Jeffery J. and Kimberly Ann E. (1990). Economic Sanctions Reconsidered: History and Current Policy, 2nd ed., Washington, D.C.: Institute of International Economics, 1990.

Ianchovichina, Elena, Shantayanan Devarajan, and Csilla Lakatos. (2016). "Lifting Economic Sanctions on Iran: Global Effects and Strategic Responses." *World Bank Policy Research Working Paper 7549*.

International Monetary Fund. 2015. "Regional Economic Outlook: Middle East and Central Asia". Washington, D.C.

"Iran: Country at a Glance", The World Bank, accessed April 2nd 2016, http://www.worldbank.org/en/country/iran .

Kaempfer, William H., and Anton D. Lowenberg. 1988. "The Theory of International Economic Sanctions: A Public Choice Approach." *The American Economic Review* 78(4): 786-793.

Kaempfer, William H., and Anton D. Lowenberg. 2007. "The Political Economy of Economic Sanctions." Handbook of Defense Economics 2: 867-911.

Katzman, Kenneth. 2016. "Iran Sanctions." Retrieved from Congressional Research Service. https://www.fas.org/sgp/crs/mideast/RS20871.pdf.

Organization for Economic Co-Operation and Development. 2016. "Bilateral Trade in Goods by Industry and End-use (BTDIxE), ISIC Rev.4." Retrieved Sept 1st, 2016.

PressTV. 2016. Iran Rugs Stacked for Global Markets. http://www.presstv.ir/Detail/2016/01/31/448108/Iran-carpets-sanctions-US-market-Kargar/ . Tehran, Iran.

Torbat, Akbar E. 2005. "Impacts of the US Trade and Financial Sanctions on Iran." *The World Economy* 28(3): 407-434.

United Nations. 2016. "UN Comtrade Database." http://comtrade.un.org/. Retrieved Sept 1st, 2016.

Appendix A

Additional Resources

PowerPoint Presentation including all the paper's facts and figures.

http://www.tonisipic.info/uploads/2/3/8/3/23839891/presenting_economic_sanctions_in_the_classroom_the_case_of_iran.pptx

Links to useful resources that can be incorporated in class discussions:

Enforcing Iran Sanctions Still Tangles Iranian-Americans in Spider Web of Laws (Date: 2-27-16; Duration: 9:46 mins)

New Iranian Sanctions Appear as Old Sanctions Lift for Nuclear Deal Compliance (Date: 1-18-16; Duration: 3:39 mins)

What's the Economic Impact of the Iran Deal? (Date: 1-17-16, Duration: 4:38 mins)

Economic Sanctions Have Tangible Consequences for Average Iranians (Date: 2-10-14; Duration: 8:49 mins)

Have Economic Sanctions Impacted Daily Life in Iran? (Date: 1-25-14; Duration: 10:34 mins)

Other Resources:

Bloomberg: Inside Iran: Sanctions and the Carpet-Sellers

Mehr News: Iran deploys 1st carpet shipment to US

Newsweek: The Persian Rug Trade is Back in Business

Teaching Collective Action Problems without Contextual Bias: The Red/Green Simulation

James R. Bruehler, Alan P. Grant, and Linda S. Ghent[1]

ABSTRACT

Collective action problems are at the heart of many economic issues. Often, students have trouble comprehending how society ends up with a less than optimal outcome, and may incorrectly assume that someone must want the outcome that occurs. Correcting this error is made difficult by the biases that students bring to these issues. The Red/Green simulation demonstrates the tension between self-interest and the social good in a context-free manner allowing students to see that these sub-optimal outcomes may not be desired by anyone, but instead can result from unhealthy systems of incentives.

Introduction

Many of the social issues we discuss in economics courses result from collective action problems. Students often have trouble understanding why society appears to choose options that make everyone worse off. Why do we deplete our resources? Why is there too much pollution? Why do we have to rely on the government to produce public goods? Often, students come into these classes believing that these problems are created by bad or greedy people who do not generally care about the welfare of others. Unfortunately, such biases have been shown to negatively impact reasoning ability (for example, see Kahan, Peters, Dawson, and Slovik 2013).

Ken Binmore highlights the pedagogical importance of stripping games of their context: "The more deeply we feel about issues, the more we need to strive to avoid being misled by wishful thinking. Game theory makes a virtue out of using the language of parlor games like Chess or Poker so that we can discuss the logic of strategic action dispassionately . . . it then becomes possible to follow the logic wherever it leads, without throwing up our hands in denial when it takes us somewhere we would rather not go." (Binmore 2007, p. 2). Similarly, instructors who use experiments as teaching tools may find it desirable to begin with an exercise stripped of context in order to focus on the strategic issues before wrapping them in the cloak of real world problems.

Red/Green is a game-theoretic simulation that can be used in introductory or intermediate economics courses to illuminate collective action problems in a context-free way. In the simulation, students are presented with a simple binary choice of choosing a "signature color" (either red or green) and receive payoffs that depend not only on their own choices, but also on the choices made by their fellow classmates.[2] Students are fully informed of these payoffs and how they are derived, but the formulas are structured to create tension between what is good for each individual student and what is good for the group as a whole. Because this simulation has no additional context, students experience this tension without bringing to bear any biases that they may already hold regarding any particular collective action problem such as environmental degradation, deforestation, or social welfare. This allows the students to focus on incentives, choices, and consequences. In addition, students are generally fascinated by the paucity of the outcome. Outcomes were available that everyone would have greatly preferred. All participants were fully informed. Their choices were simple. There was no apparent barrier to doing better, yet they did not do so. How could this be? The greater the

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[2] If you worry that using red and green may not be context-free, you may choose any two colors you would like.

motivation the instructor provides, the more unable the students are to achieve either the optimal collective outcome or a high individual performance, and the more fascinated the students are by that result.
Because this simulation assumes no knowledge of economic concepts or principles, it can be used early on in any economic class—even on the first day. The simulation only requires that students understand the payoffs offered and their own motivations. Thus, it is an effective way to get students thinking about an economic dilemma right from the start of the semester.

A Single Exemplar Round

For the moment, set aside any worries about the meaning of points in the context of this simulation. Imagine a class of 15 students being offered the following choice:

Anonymously choose red, which pays 1.36^R, or
Anonymously choose green, which pays $10 \times 1.36^{R+1}$,

where *R* is the number of students who choose red. Payoffs to various Red/Green outcomes are presented in Table 1.

Table 1: Payouts of Various Red/Green Distributions

# Choosing Red	# Choosing Green	Payoff to Each Red	Payoff to Each Green	Economic Pie
15	0	100	NA	1,500
14	1	73.6	1,000	2,030
13	2	54.1	736	2,175
12	3	39.8	541	2,101
11	4	29.3	398	1,915
10	5	21.5	293	1,680
9	6	15.8	215	1,435
8	7	11.7	158	1,203
7	8	8.6	117	993
6	9	6.3	86	810
5	10	4.6	63	654
4	11	3.4	46	524
3	12	2.5	34	417
2	13	1.8	25	330
1	14	1.36	18	260
0	15	NA	13.6	204

Clearly, starting from *R* equals zero, all payoffs rise as more students choose red. If all 15 choose red, the payoff to each red will be 100. However, choosing green always pays ten times as much as choosing red. A lone student choosing green in the class of 15 would earn 1,000, a gain of 900 (or 900 percent) over the red alternative. This presents each student the temptation to pick green even though it is clear that too many people picking green will drive everyone's payoffs downward. Ultimately, the payoff to each student in a uniformly green class is 13.6, less than 14 percent of the payoff to each student in a uniformly red class.

Students who experience this conundrum find it thought provoking. In the course of class discussions, some interesting themes tend to recur. Often students who choose green falsely identify themselves as having chosen red and berate the unidentified "greens" for their greed. They urge their classmates to pursue large collective payoffs by coordinating on red.

Using this technique, those choosing green sometimes maintain strong earnings for a number of rounds. Eventually, however, the students choosing red realize that they are incurring large opportunity costs, while the gains from their sacrifices are largely being captured by those choosing green. Consequently, many of the "reds" eventually switch to green. By the last round of play, typically more than 90 percent of students will choose green, quite close to the all-green outcome that is the theoretical equilibrium of the game.[3]

[3] *R*=0 is the theoretical Nash equilibrium under the assumption that payoffs map monotonically to outcomes.

Some readers may wonder why we have opted for a non-linear payoff structure. In 1977, Dawes, McTavish, and Shaklee asserted that published collective action games are almost all structurally identical "games in which payoffs for cooperation and defection are linear functions" of the number of cooperators. It seems to us that after almost 40 years this still remains largely true. Clearly, any of these linear experiments can demonstrate "the principle that profit for defection accrues directly to the defector while loss (which is greater than gain) is spread out equally among all players" (Dawes, McTavish and Shaklee 1977, p. 2).

Why have we departed from this convention? Let us look at Holt and Laury as reasonably representative of the alternative linear games. In their experiment, students select private (which pays 4) or public (which contributes 1 to the commons for each student in the class). Let us suppose a class size of 15 just as we did in our exemplar round. If the other 14 players chose public, then you as the marginal player could choose public as well and earn 15 or you can select private and earn 18 (Holt and Laury 1997). We can then construct an "index of temptation" by dividing the margin for defecting by the pay for cooperation. For the Holt and Laury experiment, it would range from 0.2 when everyone cooperates to 3.0 when everyone defects. If students are tempted away by the prospect of these extra three points, the whole class becomes worse off. If everyone defects, everyone earns 4; if everyone cooperates, everyone earns 15. Now we can construct an "index of infernality" by dividing the payoffs if everyone cooperates by the payoffs if everyone defects. In the Holt and Laury case, this would be 3.75. Larger class sizes would increase the index of infernality but would decrease the index of temptation. Raising the pay to defection would increase temptation but reduce infernality. With linear payoffs, nothing can be done to raise both indices simultaneously.

Our non-linear construction brings us two benefits. The first is that it standardizes the index of temptation across the payoff spectrum. In our exemplar round, green pays ten times what red pays; it does so when everyone cooperates and when everyone defects and everywhere in between. The second benefit of non-linear construction is that we can simultaneously produce high levels on both indices. In our exemplar round, the index of temptation is constant at 10 (beating the linear model by 7 to 9.8) and the index of infernality is 100 (beating the linear model by 96.25). "The mind is not a vessel to be filled but a fire to be kindled," said Plutarch. In our experience, the higher these indices, the more we light that fire.

Using Red/Green for Discussion and Illustration

As the game unfolds, the instructor is presented with some interesting opportunities for discussion and analysis.

Language and Perspective

This simulation provides an early opportunity to discuss language and perspective issues that often trip up students later in the semester. Ironically, one of the big lessons of this context-free simulation is that context matters.

From one viewpoint, those who choose green are capturing benefits for themselves while imposing costs on their neighbors. This view implicitly envisions red as the default choice. Consider the situation when the class moves from four to five greens (one student switches from what would have been the 11th red to being the fifth green). That student (call him Bernie) receives 293 for being the fifth green instead of the 29.3 that he would have gotten as the 11th red. The 10 students who chose red collect 21.5 each instead of the 29.3 they would have received had Bernie chosen red, a loss of 7.8 each. The four students who chose green received only 293 rather than 398, a loss of 105 each. Thus, Bernie's choice results in marginal benefits of 263.7 and marginal costs of 498. This move is bad from the social perspective but great from Bernie's perspective—he captures the benefits while the other 14 player bear the costs.

But very different words can describe those same alternatives if you think of green as the default choice. From that perspective, those who choose red are conferring benefits on their neighbors while incurring personal costs. Consider what happens when one student – Mary – switches from what would have been the fifth green to being the 11th red. Here, the 10 students who were already selecting red get 29.3 rather than 21.5 for a collective *gain* of 78, and the four remaining greens get 398 rather than 293 for a collective gain of 420. But, Mary's decision comes at a personal cost of 263.7: She now receives 29.3 rather than 293. Thus, Mary's choice results in marginal costs of 263.7 and marginal benefits of 498. This move is a winner from the social perspective but a loser from Mary's perspective because she bears all of the costs, while the other 14 players capture the benefits.

Some students can be confused about when one might consider something a cost and when one might consider it a benefit. This tendency can be exacerbated by discussions in which the instructor and more adept students move fluidly between perspectives and in so doing might refer to the same spread by both labels. Red/Green can be used to shed light on the distinction between benefits and costs in an environment that is free of the details that often muddy the waters. In Binmore's words, "[W]e seek to sweep away all the irrelevant clutter that typifies real-world problems, so that attention can be focused entirely on the strategic issues" (Binmore 2007, p. 2). Since there is no institutional detail to which students can spuriously attribute the differences, they are more likely to come to an understanding of those differences' true origins. If students can learn to move fluidly between these perspectives, they will have an easier time with the language of economics when they have institutional detail to deal with.

Externalities

The examples of Bernie and Mary demonstrate that Red/Green provides a straightforward, context-free way to discuss externalities. For example, as the instructor discusses Bernie's motive for switching from red to green, she can ask students to consider the external cost that Bernie's decision imposes on the rest of the class. Similarly, the instructor can speak of Mary as bearing private costs and conferring external benefits. This leads naturally to discussions about the distinctions between private costs and total costs and between private benefits and total benefits.

Students can begin to understand the ironic truth in collective action problems, that as individuals seek to maximize private benefits minus private costs, they may actually minimize total social benefits minus total social costs. This is a useful jumping-off point to argue that it is ill-advised to create social programs or policies that will work well only if much or most of the population is willing to forego private gains out of concern for social costs. The results from this simulation suggest that this condition is unlikely to be met, and therefore, that such programs are unlikely to succeed.

Economic Efficiency

Having made the distinction between private and social benefits and costs, the instructor can now talk about efficiency. Here, the context-free nature of the red/green simulation pays dividends. Students can approach questions about the desirability of efficiency as a social goal with a more open mind than they would likely have if the problem already contained the context of some problem such as resource depletion or environmental degradation. They may have already formed views and emotional commitments about these issues without the benefit of economic understanding. By observing the heart of the problem in a context-free way, students can analyze these problems without prejudice.

Consider Bernie's case: It is clear that he has a private incentive to move from red to green. After all, his payoff rises by almost 264. However, Bernie's move also imposes external costs of 498 on his classmates. From a social welfare standpoint, this move is inefficient; the size of the economic pie (shown in the last column of Table 1) decreases from 1,915 to 1,680. Mary, of course, faces the same choice from the opposite direction. From her perspective, choosing red would increase the size of the economic pie but it would decrease her personal payout so she is not likely to choose it.

As shown in Table 1, the most efficient outcome occurs when two students choose green and the remaining 13 select red. If students agree that they would like to try to maximize classroom welfare, this raises the question, "If there are only to be two students choosing green, who are they to be?" If there is not coordination on this point, does each student choosing green believe that she is the first or second green and therefore making a justified move since her benefits exceed the costs imposed on others? Do these students choose to believe that it is those other greens that are making a choice that imposes more in costs than it confers in benefits? If the class tries to achieve coordination, each student will want to be selected. Agreement may not be possible. Even if students agree that only two students should choose green, the structure of the problem gives the remaining students an incentive to cheat on that agreement and free ride on the restraint of others.

Greed and Notions of Fairness or Equity

Our general experience with Red/Green is that most students will choose green, but a few, especially in early rounds, will choose red. This gives the instructor the chance to explore the definition of what it means

to be "greedy." If the red students say that "greed" is wanting more points or caring too much about points, the instructor can observe that the very reason the students who selected red are angry is precisely because they also want more points: Perhaps it is *they* who care too much about points.

With a little guidance, students eventually begin evaluating one another not according to inferences about their motivations but rather by the consequences of their actions. Actions might be described as socially desirable if the sum of the gains they confer on people is greater than the sum of the losses they impose on people. "Greed" might then be defined as taking actions to capture net private benefits even though doing so will impose net social costs on the whole. Consider the first student choosing green; he captures 900 for himself, but imposes costs of only 369.6 on the rest of the class. Therefore, this choice does not meet this definition of greed—an observation that will be disquieting to most students. This permits a discussion of the tension that can exist between the social goals of efficiency and equity.

Once the third student chooses green, however, the losses imposed on the rest of the class by the choice of green outweigh the gains to the student, so the move can be unambiguously criticized on this now more rigorously defined criterion.

Fallacy of Composition, Dominant Strategies, and Prisoner's Dilemma

Red/Green is also an excellent way to demonstrate the fallacy of composition. It is clear that choosing green is always better for each individual student, and thus is a dominant strategy. But when all individuals follow their dominant strategies and choose green, the outcome is the worst possible outcome for the group as a whole. Moreover, it is also a poor outcome at the individual level. This is a clear example of a prisoner's dilemma. Students will often be amazed to find themselves in this worst-case scenario.

Individual Insignificance

In discussions with students, one theme that can be drawn out is individual powerlessness. Some students reason that if everyone else picks green, their own choice of red will not be enough to create a good outcome; they will be making a personal sacrifice for nothing. On the other hand, if many others pick red, their own choice of green does little harm, as all payoffs will still be quite high. Either way, choosing green has a big impact on the individual and little impact on the group.

Bringing this reasoning to the surface during the red/green exercise pays dividends when it comes time to talk about how people can continue to hunt magnificent whales or cut down trees in the Amazon. Without the background from the red/green exercise, it is too easy for students to believe that, in those circumstances, they would behave differently than the people they are studying. In so doing, they are attributing the problem to the personal failings of the individuals involved and missing the importance of the situation's incentives. By experiencing red/green first, they have already demonstrated to themselves that good people can produce a bad outcome when put in a bad situation. After all, they couldn't overcome these problems themselves. Having had this experience may help them view the actions of real people confronting such incentives more charitably. Understanding the systemic nature of the problem may lead them to look for a systemic solution rather than simply pointing the finger of blame at the people involved.

Building On Red/Green Later in the Semester

Binmore writes, "Nobody has ever solved a genuinely difficult problem without trying out their ideas on easy problems first. The crucial step in solving a real-life strategic problem nearly always consists of locating a toy game that lies at its heart. Only when this has been solved does it make sense to worry about how its solution needs to be modified to take account of all the bells and whistles that complicate the real world" (Binmore 2007, p. 3).

Once students have completed the Red/Green exercise, it is a simple matter to add context by wrapping the simulation in different packaging. Adding context back after students have seen the context-free version helps them set aside biases and focus on the economic forces that underlie genuine social problems. Many of those problems have the same fundamental structure as Red/Green, making it an ideal "toy game" to illustrate social problems:

- Tragedy of the Commons: Killing a whale (Green) is good for the fisherman but bad for the long-run sustainability of the fishery.
- Pollution: Polluting (Green) is good for the polluter, but bad for the people around him.
- Public goods: Contributing to or providing a public good (Red) is good for everyone, but less good for the contributors.
- The Politics of Special Interests: Rent seeking (Green) is good for the one seeking advantage, but bad for everyone else.
- Freedom: Suppression of civil liberties (Green) allows an oligarchy to remain in power and to extract a lion's share of the small economic pie. Permitting civil liberties (Red) allows the economic pie to grow, but may reduce the oligarch's power, wealth, and income.
- Communal Agriculture: Working hard (Red) is good for the community, but the costs of work are concentrated on the worker while the benefits are distributed across the community so shirking (Green) is the dominant choice.

Implementation and Integration into the Course

This classroom simulation can be performed in classes of any size. We have used this in a class as small as eight students; the incentives only improve with scale. Integrating Red/Green into a course involves four steps. First, the instructor must determine the payoffs for the simulation. The instructor must then translate those payoffs to meaningful units to the students. Third, the instructor must determine how many times to play the game. Finally, the instructor must choose a method for collecting student responses.

Determining Payoffs

Generally speaking, the formulas for the payoffs should be of the form

$$\text{Payoff to Red} = (1+x)^{\text{R}}$$
$$\text{Payoff to Green} = B \times (1+x)^{\text{R}+1}$$

We have published a helpful calculator online at http://tinyurl.com/km9wvrv. Enter the number of students that you expect[4], how many points you would like to go to each student in a uniformly red class and how many points you would like to go to a single defector (*B* is the ratio of these two selections). The program will calculate *x* and *B* for you and produce tables of payoffs and choices. You can then provide students with these tables if you do not want to require them to do these calculations on their own. You can also pick from one to five rounds and you can accelerate the payoffs from round to round if you wish.

You may choose the two targets to suit your preferences. It is important, however, that the stakes be sufficiently large for two reasons: First, the difference between red and green payoffs must, for at least a few students, be sufficiently large to outweigh the utility students generally derive from being cooperative and socially responsible. Second, the more students truly care about the outcome, the more engaged they will be. Increasing the stakes simultaneously increases the probability that the nature of collective actions problems will be revealed by the simulation and increases the interest of the students in the phenomenon that they are experiencing.

Translating Scores to Meaningful Units

There are a variety of ways in which an instructor can assign the "points" in this exercise. The instructor could simply use a cash payout, with each point translating to a particular dollar amount.[5] Likewise, the points earned in this exercise can be used as part of the students' grades (such as class participation, assignments, or extra credit on an exam). A word of caution about scoring is in order. Grading on a curve

[4] There is no need generally to create alternative payout tables that account for absent students. The instructor can publish a table of values based on the number of enrolled students and use those same numbers to administer the experiment, even if there are absent students. This is because the payoffs are generated by the number of students choosing red, and that number is generally low and consistent.

[5] It may be more difficult to overcome esprit dé corps using money than using points.

will prejudice the simulation, because if all students successfully cooperate and pick red every time, each would receive a C, which is exactly the same grade they would get if they all chose green. Such a grading system subverts the meaning of the exercise because there is no true motivation to cooperate. Whatever the transformation from experimental points to course points you choose, the rewards to full cooperation must be substantially greater than the rewards available when most students select green.

In the exemplar round described above, students choosing green are portrayed as being tempted to defect by the prospect of earning 1,000 points rather than 100 points. While it is true that, in a game theoretic sense, green is always the dominant answer, it is also true that students may care about more things than just points. At low point values, esprit dé corps might be of more value to students than the difference between one hundred and one thousand points.

Determining the Number of Rounds

While you may to choose to play this game just once, at least three rounds are recommended—one for students to figure out what is going on, and two further rounds to watch the game approach its theoretical equilibrium. More rounds will increase student understanding of the material. The number of rounds chosen will likely be determined by how the simulation is administered and by how much class time the instructor wants to devote to it.

Collecting Student Responses

Students should be given a copy of the rules for the simulation prior to the simulation so that they can crunch numbers and consider strategies under different scenarios. (An example of these rules can be found in Appendix A.)

In class, the instructor may wish to allow students to discuss their strategies with one another before administering each round. It is important, however, to allow the students to respond independently and anonymously, so that students feel free to follow their own self-interests without recrimination from their classmates.

Clickers or other polling devices are an efficient means to collect responses. You can also use paper ballots, but be sure to create a private polling space where students can fill out the ballots without being monitored. We have found that, for a manageable class size (30 students), paper ballots better engage the students in the results because the suspense builds as the ballots are read. Finally, if you are willing to extend the simulation briefly over a number of days, email can be used.[6] Accept student responses for one round, announce the results in class, and then open up responses for the next round.

Sample Empirical Results

In the fall of 2013, Red/Green was administered in a general education course titled *Economics of Social Issues*. Thirty-two students played five rounds of a modified version of the simulation using the following formulas:[7]

$$\text{Payoff to Red} = 10 \times (1.5)^R$$
$$\text{Payoff to Green} = 100 \times (1.5)^R$$

Table 2 presents the results from that class.

[6] Be sure to allow more than one email per student, with the rule that the student's final email is the one that counts. If you do not allow for more than one email, students may all go to a computer lab together to mail their votes simultaneously so they can check up one each other. Allowing for at least one additional email permits a student to anonymously choose self-interest over the group interest.

[7] This variation scaled the formulas to produce values that fit the particular instructor's class size and grading scheme. The fundamental structure of the experiment is the same as presented above.

Table 2: Sample Results From Red/Green Simulation

Round	# Reds	Payoff to Red (per student)	# Greens	Payoff to Green (per student)
1	16	6,568	16	65,684
2	9	384	23	3,844
3	1	15	31	150
4	4	51	28	506
5	2	23	30	225

These results are typical for this simulation. As a group, the class collected far less than what was possible. Thus students are presented with a conundrum that piques their interest: Why do 32 fully informed, intelligent, highly motivated people collect so little of what was available to them? Why did they individually leave so much money on the table? Those who missed out on the big 65,684 payoff to greens in the first round want to figure out how they can get in on that. Those who achieved that big payoff in the first round want to figure out how to replicate that result. As they struggle to achieve in spite of their circumstances, they begin to appreciate the power of this problem; it is not easily surmounted. Understanding this simple truth may lead them to seek systemic solutions for systemic problems rather than simply and erroneously blaming those involved.

Conclusion

Red/Green is an artificial social problem in which ordinary people struggle, and generally fail, to overcome the power of individual incentives in the interest of a collective outcome. Red/Green is designed to show students that collective action problems are not struggles of good against evil, but struggles against human nature itself.

Red/Green is a useful platform for discussions of efficiency, greed, and equity, as well as externalities and public goods. But most important, Red/Green lays a context-free foundation for the later discussion of weightier real-world collective action problems. By learning first that these real-world issues are the result of misaligned incentives, students are better prepared to discuss the true source of the problem rather than simply pointing fingers and casting blame.

References

Binmore, Ken. 2007. *Playing for Real: A Text on Game Theory*. New York: Oxford University Press.

Dawes, Robin M., Jeanne McTavish, and Harriet Shaklee. 1977. "Behavior, Communications, and Assumptions About Other People's Behavior in A Commons Dilemma Situation." *The Journal of Personality and Social Psychology* 35: 1-11.

Holt, Charles A. and Susan K. Laury. 1997. "Voluntary Provision of a Public Good." *The Journal of Economic Perspectives* 11: 209-215.

Kahan, Dan M., Ellen Peters, Erica Cantrell Dawson, and Paul Slovic. 2013. "Motivated Numeracy and Enlightened Self-Government." *Yale Law School, Public Law Working Paper No. 307*, available at SSRN: http://ssrn.com/abstract=2319992.

Appendix: Student Instructions

- You are a citizen of a model economy.
- Every year, each citizen is required to choose a signature color, Red or Green.
- Each citizen is then assigned benefits according to their color choice.
- The government will set the level of benefits received by any individual citizen based on the color choices made by the group.
- Specifically, the government will add up the # of citizens who chose red (R), and the number of citizens who chose green.
- Benefits will be assigned as follows:
  - If you choose Red, your payoff in points = (1.36^{R}).
- Therefore, if 8 citizens choose Red, the payoff to those who choose Red will be 11.7 points.
  - If you choose Green, your payoff in points = $10 \times (1.36^{R+1})$.
- Therefore, if 8 citizens choose Red, the payoff to those who choose Green will be 159 points.

Your job:

- You will play 5 years' worth of choices.
- You must choose a color in each year, or you will receive zero benefits. There is no penalty for choosing--please do so!

Shifts in Supply and Demand and the Corresponding Changes in Equilibrium Price and Quantity: Explaining the Process

Gary M. Galles[1] and Robert L Sexton[2]

Abstract

Most textbooks are incomplete or potentially confusing in their treatment of the dynamic process resulting from a change in demand or a change in supply. While they are not incorrect in their comparative statics results, they can leave students unclear about the process involved. The authors suggest an approach that addresses the deficiency.

"Pure economics has a remarkable way of producing rabbits out of a hat--apparently a priori propositions which apparently refer to reality. It is fascinating to try to discover how the rabbits got in; for those of us who do not believe in magic must be convinced that they got in somehow. The trouble is that economists too often fail to communicate to others their own knowledge about 'how the rabbits got in'." Sir John Hicks (1946)

Introduction

Many microeconomics textbooks at both the principles and intermediate level leave readers with an incomplete explanation of the process leading to the change in equilibrium price and quantity after a demand or supply shift.

One of three scenarios is typically presented. The first focuses on the comparative statics results. It implies that as a result of a change in demand or a change in supply, there is an essentially instantaneous adjustment to a new equilibrium price and quantity, leaving the process inadequately discussed. The second scenario shows how a change in demand or supply (holding the other curve constant) causes a shortage or a surplus at the old equilibrium price. This causes a change in quantity demanded, for a shift in supply, and a change in quantity supplied, for a change in demand, but it does not discuss the changes in both quantity demanded and quantity supplied that occur during the adjustment process. The third scenario, which most clearly explains the disequilibrium process, but is least frequently employed, finds that for an increase in demand, there is a shortage created at the initial equilibrium price, which leads to changes in both the quantity demanded and the quantity supplied until the market clears at the new higher equilibrium price and quantity. The same approach is used in the other curve shifting cases. Its clarification of the process makes it clearer that economists' explanation of social coordination is not pulling any rabbits out of a hat.

McCloskey (1982, 104) sums up the common approach: [T]o think clearly about how people behave in markets…usually all that is necessary is the diagram of supply and demand. Demand curves slope downward and supply curves slope upward. For many problems, that is all the economist knows on earth, all ye need to know…An astonishing range of economic problems reduces to the simple assertion that the market must clear, that is that the price adjusts to make quantities supplied and quantities demanded equal. The problem of predicting what will happen to the market price and quantity when supply or demand curves move is one example.

A sampling of top selling microeconomic textbooks were examined. The principles texts included Arnold (2014), Colander (2013), Mankiw (2014), McConnell, Brue and Flynn (2015), McEachern (2013), Miller

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(2014), Parkin (2014), Schiller, Hill and Wall (2013) and Sexton (2016). The intermediate texts included Besanko and Braeutigan (2014), Goolsbee, Levitt and Syverson (2013) and Pindyck and Rubinfeld (2013). In the following paragraphs, we will illustrate each approach.

The Comparative Statics Approach

Miller (2014, 77) writes: [I]n many situations, it is possible to predict what will happen to both equilibrium price and equilibrium quantity when demand or supply changes. Specifically, whenever one curve is stable while the other curve shifts, we can tell what will happen to both price and quantity. Consider the possibilities… the supply curve remains unchanged, but demand increases from D_1 to D_2. Note that the results are an increase in the market clearing price from P_1 to P_2 and an increase in the equilibrium quantity from Q_1 to Q_2. [Consider] a decrease in demand from D_1 to D_3. This results in a decrease in both the equilibrium price of the good and the equilibrium quantity. [Or consider] the effects of a shift in the supply curve while the demand curve is unchanged… [Consider when] the supply curve has shifted rightward. The equilibrium price of the product falls, and the equilibrium quantity increases. [Consider when] supply has shifted leftward—there has been a supply decrease. The product's equilibrium price increases, and the equilibrium quantity decreases.

McConnell, Brue and Flynn (2015, 66-67) similarly write: [S]uppose that the supply of some good (for example, health care) is constant and demand increases...As a result, the new intersection of the supply and demand curves is at higher values on both the price and the quantity axes. Clearly, an increase in demand raises both equilibrium price and equilibrium quantity. Conversely, a decrease in demand… reduces both equilibrium price and equilibrium quantity. (The value of graphical analysis is now apparent: We need not fumble with columns of figures to determine the outcomes; we need only compare the new and the old points of intersection on the graph.)

Pindyck and Rubinfeld (2013, 26-27) state: [Suppose] the supply curve has shifted from S to S'… perhaps as a result of a decrease in the price of raw materials… the market price drops (from P_1 to P_3), and the total quantity produced increases (from Q_1 to Q_3)… [Let's see] what happens following a rightward shift in the demand curve resulting from, say, an increase in income. A new price and quantity result after demand comes into equilibrium with supply… we would expect to see consumers pay a higher price, P3, and firms produce a greater quantity, Q_3, as a result of an increase in income.

Besanko and Braeutigan (2014, 36-37) write: [S]uppose that higher consumer incomes increase the demand for a particular good….represented by a rightward shift in the demand curve (i.e., a shift away from the vertical axis) … This shift indicates that at any price, the quantity demanded is greater than before. This shift moves the market equilibrium from point A to point B. The shift in demand due to higher income thus increases both the equilibrium price and the equilibrium quantity… suppose wage rates for workers in a particular industry go up. Some firms might then reduce production levels because their costs have risen with the cost of labor. Some firms might even go out of business altogether. An increase in labor costs would shift the supply curve leftward (i.e., toward the vertical axis)...This shift indicates that less product would be supplied at any price… The increase in the price of labor increases the equilibrium price and decreases the equilibrium quantity." (Besanko and Braeutigan, 2104).

Schiller, Hill and Wall (2013, 61) write: [A]ny of these determinants of demand could change. When one does, the demand curve has to be redrawn. Such a shift of the demand curve will lead to a new equilibrium price and quantity. Indeed, the equilibrium price will change whenever the supply, or demand, curve shifts.

The Incomplete Process of Adjustment

Goolsbee, Levitt and Syverson (2013, 30) write: [Suppose that a] change in tastes made consumers want to buy less of the product at any given price — that is, caused an inward shift in the demand curve. Remember, anything that changes how much consumers want to buy of a good at any particular price must shift the demand curve. At the same time, this change in tastes had no effect on how much producers wish to sell at any given price. It doesn't affect their costs of producing or their outside options. So, supply does not change, and the supply curve doesn't shift. However, the quantity supplied does change. It falls in response to the reduced demand. This change in quantity supplied is a movement along the supply curve. The only reason that the quantity supplied falls in this example is because the shift in the demand curve has made the equilibrium price lower, and at a lower price, suppliers produce less of the good. Therefore, a shift in the

demand curve causes a movement along the supply curve to the new equilibrium.

Mankiw (2014, 80-81) writes: [Suppose that] a hurricane destroys part of the sugarcane crop and drives up the price of sugar…the change in the price of sugar, an input for making ice cream, affects the supply curve…the supply curve shifts to the left…there is now an excess demand for ice cream, and this shortage causes the firms to raise the price…the shift in the supply raises the equilibrium price… and lowers the equilibrium quantity.

Arnold (2014, 82) writes: [Assume] demand rises (the demand curve shifts rightward from D_1 to D_2), and supply is constant (the supply curve does not move). As a result of demand rising and supply remaining constant, the equilibrium price rises from P_1 to P_2, and the equilibrium quantity rises from 10 to 12 units. Now let's see if you can identify what has happened to quantity supplied (not supply) as price has risen from from P_1 to risen from P_2. (Remember, quantity supplied changes if *price* changes.) As price rises from P_1 to P_2, quantity supplied rises from 10 to 12 units. We see this as a movement up along the supply curve from point 1 to point 2, which corresponds (on the horizontal axis) as a change from 10 to 12 units.

Parkin (2014, 68) writes: The original equilibrium price is $1.50 an energy bar, and the equilibrium quantity is 10 million energy bars a week. When demand increases, the demand curve shifts rightward. The equilibrium price rises to $2.50 an energy bar, and the quantity supplied increases to 15 million energy bars a week… There is an increase in the quantity supplied but no change in supply—a movement along, but no shift of, the supply curve.

The More Complete Process of Adjustment

Sexton (2016, 133-35) explains the temporary disequilibrium more completely: Suppose a new study claimed that two cups of coffee per day had significant health benefits. We would expect an increase in the demand for coffee. That is, at any given price, buyers want more coffee than before. We are assuming that this new study does not affect how much producers are willing and able to supply—that is, the supply curve does not shift. At the original equilibrium price, P_1, the market is no longer in equilibrium; a shortage occurs because consumers now want to buy Q_3 but sellers only want to sell Q_1… This shortage leads to competition among buyers for the limited quantity supplied, putting upward pressure on the price. As the price increases, the quantity demanded decreases (a movement up along the new demand curve, D_2) and the quantity supplied increases (a movement up along the supply curve) until quantity supplied and quantity demanded are equal again at Q_2. This process results in a new equilibrium, E_2, at a higher equilibrium price, P_2, and a greater equilibrium quantity, Q_2.

Sexton (2016, 133-35) uses the same analysis for a decrease in demand, an increase in supply and a decrease in supply. That is, the shifts in supply and demand cause shortages or surpluses at the original price; knocking markets out of equilibrium and in order for markets to clear there has to be adjustments in *both* the quantity demanded and quantity supplied, assuming downward sloping demand curves and upward sloping supply curve.

Colander (2013, 93) writes: Supply and demand are most useful when trying to figure out what will happen to equilibrium price and quantity if either supply or demand shifts…say that the demand for movie rentals increases from D_0 to D_1. At a price of $4.50, the quantity of movie rentals supplied will be 8 and the quantity demanded will be 10; excess demand of 2 exists. The excess demand pushes prices upward… decreasing the quantity demanded and increasing the quantity supplied. As it does so, movement takes place along both the supply curve *and the demand curve*. The upward push on price decreases the gap between the quantity supplied and the quantity demanded. As the gap decreases, the upward pressure decreases, but as long as that gap exists at all, price will be pushed upward until the new equilibrium price… and new quantity…are reached… Notice that the adjustment is twofold: The higher price brings about equilibrium by both increasing the quantity supplied… and decreasing the quantity demanded.

McEachern's (2013, 83-84) analysis is similar to Sexton and Colander but not as detailed.

Benefits from Employing the More Complete Process of Adjustment

There are several advantages from employing the complete process of adjustment to a change in supply or demand. The first advantage is that the complete process avoids a common confusion among students between changes in and movements along demand or supply curves. Economics principles teachers emphasize the distinction between a change in demand or supply and a change in quantity demanded or quantity supplied. But it is not unusual to hear a student say something like, "I thought that a change in

demand was different than a change in quantity demanded. But you just showed us that a change in demand causes a change in quantity demanded. I don't get it." Making the complete process clear addresses that confusion more effectively than the other two approaches.

The more complete process also avoids the confusion that can arise in the case of a shift in a relatively elastic demand curve or a shift in a relatively elastic supply curve. In those cases, after the shift in demand, it is actually the demanders' responses to market price changes that do most of the "work" of returning to an equilibrium quantity exchanged, and after the shift in supply, it is actually the suppliers' responses to market price changes that do most of the "work" of returning to an equilibrium quantity exchanged. If students' exposure to the comparative statics exercises make them focus only on suppliers as adjusting in response to a change in demand, and only on demanders as adjusting in response to a change in supply, student confusion can be made worse.

The second advantage is that explaining the complete process makes the usual move to equilibrium story of comparative statics more consistent with the presentation of price controls. Virtually every text shows the effect of price ceilings as both increasing quantity demanded and decreasing quantity supplied, as they force prices below equilibrium, and the effects of price ceilings as both decreasing quantity demanded and increasing quantity supplied as they force prices above equilibrium. This analysis reinforces student understanding when the supply and demand adjustment process is presented more completely. But if the supply and demand presentation emphasizes only the quantity supplied changing due to a shift in demand or only the quantity demanded changing due to a shift in supply, the different presentations can cause confusion.

The third advantage is similar to the second. In the application of supply and demand to taxes, the incidence is shown as depending on the relative elasticities of supply and demand. That is, it depends on whether consumers or producers can more easily alter their behavior to avoid the burden of the tax. But to avoid confusion, students need to already understand that people on both the supply and demand sides will alter their behavior due to a price change. The more complete presentation accomplishes that, but the other approaches can leave that point insufficiently clear, and confuse students as a result.

The fourth advantage is that presenting the complete process of adjustment to supply and demand changes better shows the power of market prices in enhancing social coordination. When students are shown that both quantity demanded and quantity supplied change in response to changes in supply and demand, the fact that participants on both sides of the market adapt means that market prices are more powerful in that a smaller change in price is required to re-establish equilibrium than would otherwise be the case.

Finally, since economics majors in particular will end up doing a large number of supply and demand analyses, making the process in every one of those varied markets clearer from the beginning can have a very large payoff over their academic careers.

Conclusion

As McCloskey (1984, 104), "the notion of supply and demand is the most useful instrument in economic analysis." However, some textbooks err on the side of incompleteness. Prices do not change magically out of thin air nor do markets adjust instantaneously. Since changes in demand and supply are constantly occurring, it is most accurate and least confusing to explain the whole process. The complete story is not really any more complicated. The shifts in supply and demand always follow the discussion of shortages and surpluses. The curious student might ask, what caused this price to be out of equilibrium? Of course, it's the constantly changing supply and demand curves.

Modern textbooks are clearly seeking greater brevity, but in many cases, it seems to be coming at the expense of students truly understanding basic concepts. This can happen when economists fail to communicate to others their own knowledge about "how the rabbits got in." Students will benefit from a greater understanding of the process of adjustment to the new equilibrium price and quantity.

References

Arnold (2014) Microeconomics 11 E 7th ed. Mason, Ohio: Cengage South-Western.
p. 82.

Besanko, D. and R Braeutigam. 2014. *Microeconomics*, 5th ed. Hoboken, NJ: John Wiley and Sons, Inc. p. 36-37.

Colander, D. 2013 *Economics*, 9th ed. New York: McGraw-Hill. P. 93.

Hicks, J. (1946) *Value and Capital* , 2nd ed.. Oxford, England: Oxford University Press, p.23.

Goolsbee, A., S. Levitt and C. Syverson, 2013. *Microeconomics*, New York, Worth Publishing. P. 30.

Mankiw, G. 2015. *Principles of Microeconomics*,7th ed. Mason, Ohio: Cengage South-Western. P. 80-81.

McCloskey, D. 1982. *The Applied Theory of Price,* New York: Macmillan Publishing Company. P 104.

McConnell, C. and S. Brue and S. Flynn. 2015. *Microeconomics*, 20th ed. New York: McGraw-Hill Irwin. P 66-67.

McEachern, W. 2013. *Economics: A Contemporary Introduction*, 10th Edition Mason, Ohio: Cengage South-Western. p 83-84

Miller, R.L. 2014. *Microeconomics Today*, 17th ed. Boston: Pearson Education, Inc.

Parkin, M. 2014. *Microeconomics*, 11th ed. Boston: Pearson Education, Inc.

Pindyck, R. and D. Rubinfeld, 2013. *Microeconomics*, 8th ed. Upper Saddle River, NJ: Pearson Prentice Hall. P 26-27.

Schiller, B., C. Hill, and S.Wall, 2013. *The Economy Today, 13th edition* New York: McGraw-Hill Irwin. P 61.

Sexton, R.L. 2016. *Exploring Economics*, 7th ed. Mason, Ohio: Cengage South-Western.
p. 133-35.

What Cosmo Kramer Can Teach Us About Optimal Stopping Times

Joshua R. Hendrickson[1]

Abstract

The real option literature on investment provides insights into firms' decisions to enter and exit markets. This literature emphasizes the role of fixed costs of entry, the salvage value of exit, and uncertainty. A major implication of this literature is that it is often optimal to wait. Nonetheless, since the overwhelming majority of this literature uses models with uncertainty, students are often unclear as to the role of each of these components in determining the value of the option to wait. In this paper, I explain the role of uncertainty and costs/salvage value by considering the question: "When is it optimal to stop telling the Bob Sacamano story?" In doing so, I provide a simple and entertaining example to illustrate the importance of uncertainty in the real options literature.

Introduction

The real options literature on investment examines irreversible investment decisions in the presence of fixed costs and/or salvage values and uncertainty.[2] This literature is important because it suggests that using the net present value criteria to evaluate investment projects can be misleading. In addition, the entry and exit decisions of firms generally differ from standard decisions in undergraduate textbooks for important reasons. Nonetheless, students often have the (incorrect) impression that the mere presence of uncertainty is the source of the unique implications of the real options approach. In addition, optimal stopping problems under uncertainty involve solving second-order differential equations and the analysis of comparative statics often involves numerical examples rather than analytical solutions. As a result, motivating intuition for students, especially those who are unfamiliar with option pricing models, can be difficult.

My purpose in this paper is to use an example of an optimal stopping problem from the television show *Seinfeld* to illustrate the role of uncertainty in the real options literature. The example is both relatively simple in the context of the literature and an enjoyable way to think about optimal stopping problems. I use this example to motivate and illustrate the difference between optimal stopping decisions in deterministic and stochastic environments. This comparison allows me to discuss the role of uncertainty in the real options approach in relatively simple and entertaining way. Using this example in class can help students to understand the implications of optimal stopping problems while also demonstrating the value of the economic way of thinking for understanding real world decisions. The paper therefore adds to existing examples that use *Seinfeld* to explain economic concepts (Ghent, Grant, and Lesica 2011; Dixit 2012). The paper also complements other attempts to use television shows more broadly to illustrate economic concepts and inspire interest in the subject (Hall 2005; Luccasen and Thomas 2010; Mateer, Ghent, and Stone 2011; Kuester, Mateer, and Youderian 2014; Tierney, et al. 2016)

The Bob Sacamano Story

In an episode of the television show *Seinfeld* ("The Van Buren Boys", Season 8, Episode 14), eccentric businessman J. Peterman asks Elaine to ghost write his autobiography. However, since the exciting stories from Peterman's life are documented in his company's catalog, he wants the autobiography to focus on his

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[2] For a textbook treatment, see Dixit and Pindyck (1994) and Stokey (2009).

everyday life. In an attempt to make his autobiography more interesting, Peterman offers to purchase stories from Kramer's life. Kramer agrees to sell Peterman the stories for $750.

When Kramer and Elaine go out to celebrate his new wealth, someone at the bar asks Kramer to tell his "Bob Sacamano" story. When he begins to tell the story, Elaine reminds him that he can no longer tell the story because it now belongs to Peterman. This causes Kramer to regret his decision and ultimately ask Peterman for his stories back.

Kramer's decision to sell his stories and then his decision to try to back out of the agreement suggest that he is either not optimizing or failed to take something into account in his initial attempt at optimization. The purpose of this paper is to show that Kramer's decision can be considered an optimal stopping problem. To understand why, consider the following. Suppose that Kramer generates utility from telling his stories, but the demand for his stories is falling over time (you can only tell the same stories to people so many times). Nonetheless, the stories have potential value beyond his utility because others might be willing to purchase them. Kramer's decision is to choose the optimal point in time to stop telling his stories.

Kramer's decision to ask for his stories back occurs after he receives an unexpected story request. Thus, it is argued that Kramer's initial decision to sell his stories and then his reversal can be understood by considering the difference in optimal stopping times when the demand for his stories is deterministic rather than stochastic. In the deterministic case, the option premium (the value of being able to tell stories in the future) is zero at the optimal stopping time. However, in the stochastic case, the option premium remains positive at the optimal stopping time since there is still a chance that demand will increase in the future. As a result, Kramer should wait longer before selling his stories when demand is stochastic rather than deterministic. This helps us to understand why Kramer changed his mind. When Kramer received the unexpected request to tell his story, he realized that the demand for his stories was stochastic and he had chosen the wrong point in time to sell his stories.

Kramer's Decision as an Optimal Stopping Time Problem

Suppose that there is some net demand for Kramer's stories, x. We will assume that markets clear and therefore that Kramer's supply of stories always equals demand. We will also assume that Kramer gets some utility from telling his stories. Let $U[x(t)]$ denote the utility that Kramer receives from telling x stories at time t. When Kramer ultimately decides to sell his stories, he receives some salvage value, S.
Let r denote the (constant) real interest rate. The value of Kramer's stories can be written as

$$\int_0^T e^{-rt}\, U[x(t)]dt + e^{-rT}S \tag{1}$$

where $\int_0^T e^{-rt}\, U[x(t)]dt$ is the utility generated from telling the stories from the beginning of time ($t = 0$) to the stopping time T and $e^{-rT}S$ is the present discounted value of receiving the salvage value S at time T. Kramer's decision therefore involves an optimal stopping problem. He must decide at what point in time it is optimal to stop telling his stories and to sell them for the salvage amount S. However, to solve this problem, we need to know something about the demand for Kramer's stories.

The Optimal Choice with Deterministic Demand

Let's first suppose that the demand for Kramer's stories are deterministic and the demand is decreasing over time:

$$x(t) = x_0 + \mu t$$

where $\mu < 0$ and $x(0) = x_0$ is the initial demand. Since the demand for Kramer's stories are decreasing over time, he will eventually reach a point at which he should stop telling the stories and should sell them for the salvage value, S.

Since x is deterministic, Kramer's problem is to choose T to maximize equation (1). The maximization condition is given as

$$\frac{U[x(T^*)]}{r} = S \tag{2}$$

for $T^* > 0$. Thus when the present value of the utility of telling x stories is greater than the value of selling the stories, Kramer should continue telling stories. Once the present value of utility of telling x stories falls to the salvage value, he should sell them.

The Optimal Choice with Stochastic Demand

Now suppose there there is some element of randomness associated with the demand for Kramer's stories. Suppose, for example, that

$$\frac{dx}{x} = \mu dt + \sigma dz \tag{3}$$

where dz is an increment of a Wiener process, σ is a standard deviation parameter, and $\mu < 0$.

Let $V(x)$ denote the value of Kramer's stories as a function of the demand for those stories. The Bellman equation for the continuation value of telling stories is given as

$$rV(x) = [U(x) + \frac{1}{dt} EdV] \tag{4}$$

where E denotes the expectation. In an uncertain environment we can no longer solve for the optimal point in time for Kramer to sell his stories. However, we can determine the optimal level of demand at which Kramer will sell his stories. We can do this by presenting Kramer's decision in the context of a stochastic control model.

Using Ito's Lemma and equation (3) we can re-write (4) as

$$rV(x) = U(x) + \mu x V'(x) + \frac{1}{2}\sigma^2 x^2 V''(x) \tag{5}$$

Let x^* denote the level of demand at which Kramer finds it optimal to sell his stories. We know that at the optimal stopping time, Kramer must be indifferent between telling stories and selling stories. Thus, the value of continuing to tell stories must be equal to the value of selling stories

$$V(x^*) = S(x^*) = S$$

Also, optimization implies that it must be true that the $V(x)$ and $S(x)$ meet tangentially at the optimal stopping point. Thus, it must be true that

$$V'(x^*) = 0$$

Finally, we will assume that

$$V(x_0) > S$$

This assumption ensures that it is not immediately optimal to sell the stories.

Since equation (5) is a second-order differential equation, we can get a solution with help from these boundary conditions. However, for our purposes, it will suffice to consider the following example. Given the boundary conditions, from (5), the equilibrium choice of x^* must be satisfy

$$U(x^*) + \frac{1}{2}\sigma^2 x^2 V''(x) = rS$$

Note here the difference between the deterministic and the stochastic case. In the deterministic case, $\sigma = 0$, since there is no uncertainty about the change in x over time. However, in the stochastic case, the fact that there is uncertainty implies that the equilibrium condition from the deterministic case is no longer applicable. Thus, what we want to know is whether confusion about this rule can actually explain why Kramer changed his mind. In other words, since x is decreasing over time, if Kramer sold too soon, this would imply that the demand for his stories was too high when he sold them.

It is straightforward to show that $V''(x) > 0$.[3] It follows that $U(x^*) < rS$ in the stochastic case. Thus, when the demand for his stories is stochastic, it pays for Kramer to wait until the demand has fallen below the optimal level for the deterministic case. The reason is that when $U(x) = rS$ in the stochastic case, there is still some chance that demand will increase whereas in the deterministic case there is not. In other words, there is an option premium associated with owning the stories. When Kramer owns the stories, he benefits from actually telling the stories, but also from having the option to tell the stories in the future. When the demand for his stories is stochastic, there is always some possibility that the demand for the stories could increase in the future. In contrast, in the deterministic case there will be a particular point in time when the demand for Kramer's stories goes to zero with certainty. This option to tell stories has value and this value is lost if Kramer decides to sell them. Since this option premium remains positive at $U(x) = rS$ in the stochastic case whereas it is not in the deterministic case, Kramer should wait longer to sell his stories when demand is stochastic. Thus, the observation of an unexpected request to tell the "Bob Sacamano story" and Kramer's subsequent rescinding of the sale of his stories, imply that Kramer failed to take this into account when he initially decided to tell the stories.

Discussion

It is important to note that in the example above the reason Kramer regrets his decision is that he thought the demand for his stories was deterministic and not stochastic.[4] For example, if Kramer had known that the demand was stochastic, then he would have known that there was a chance that he could see a positive shock to the demand for his stories when he went to the bar with Elaine. Had Kramer known that the demand was stochastic, the *mere possibility* of experiencing this positive demand shock would have been sufficient to convince him to wait longer before selling his stories (we know this by revealed preference in the episode). As a result, this example helps to illustrate that uncertainty serves to increase the value of the option to wait and sell his stories in the future.

This example illustrates another important point. In this literature, while uncertainty is important, uncertainty is not the sole reason for waiting. Even in the deterministic case, it was optimal for Kramer to wait as long as the utility he was getting from the stories was greater than the salvage value. The option to wait has value at higher levels of demand because Kramer knows that he is going to get more value from these stories than what someone is willing to pay for them. However, once demand declines to the point where he is indifferent between telling the stories and selling the stories, the option value is zero since he knows with absolute certainty that the utility he will get from telling stories will decline in the future.

In the stochastic case, the option to wait always has value at positive values of x since there is always some chance that there is a positive shock to the demand for his stories. The contribution of uncertainty to the real option approach is that it provides an incentive to wait *longer* than he would in the deterministic case. Uncertainty enhances the option value because in a world with uncertainty, there is always the possibility that things can always get better. Nonetheless, once Kramer reaches the optimal stopping time, even the possibility of a positive shock is no longer sufficient to convince him to wait.

This example helps to illustrate the role of uncertainty in the context of optimal stopping times, such as the optimal timing of entry and exit by firms. Consider an example analogous to Kramer's decision. Suppose that there is a firm that is experiencing a decline in the demand for its product. Due to the decline in the demand the firm wants to close one of its factories. If demand is following a deterministic downward trend, then the firm will find it optimal to wait until the present value of the flow of benefits to operating the factory is equal to the salvage value. However, if demand is stochastic, the firm will extend the period of waiting

[3] A formal proof is in the Appendix. For now, it will suffice to use a modified version of the George Constanza rule: it doesn't need to be proven as long as you believe it's true.

[4] It is important to note that I assume Kramer has rational expectations. If he knows he is in a stochastic environment, he also knows the time series process for demand. With rational expectations, he is completely aware of the probability distribution of the demand shock. As shown in the stochastic example above, the option to wait still has value when he exercises the option to sell because there is the possibility of a positive demand shock. Under optimal decision-making, if Kramer exercises the option then even the possibility of this positive shock is not sufficient to prevent him from selling his stories. Thus, when Kramer demonstrates regret for telling his stories, we cannot attribute this to a forecasting error. He must be unaware that he would experience random demand shocks. In other words he must think that demand follows a deterministic process.

beyond this point. In fact, the firm will wait until after the present value of the flow of benefits from operating the factory is below the salvage value.

Using This Example in Class

The real option theory of investment can be an important part of both intermediate- and graduate-level macroeconomic courses as well as financial management courses.[5] In macroeconomic courses, the standard neoclassical investment model does a good job of illustrating the relevant marginal analysis for investment decisions, but the standard textbook treatment leaves out certain characteristics that students often ask questions about, such as uncertainty or the role of fixed costs. The real option theory is useful because these characteristics are of primary importance for many real world investment decisions. The real option approach also allows for discussions of investment problems that are often absent from standard neoclassical stories, such as the decision of firms to enter or exit a market in the presence of uncertainty and when such behavior is costly.[6] In graduate courses, an understanding of these entry and exit decisions help students to later understand state-dependent pricing models. Similarly, at the undergraduate level, having some experience with the real option theory helps students to have an intuitive understanding of sticky prices when I reach the point of the course to discuss business cycles. As a result, I find the real option theory to be an important complement to the neoclassical theory of investment.

In my experience, students often immediately understand that there can be value in waiting before taking action, which is the central motivation of the real option theory. However, since there are a lot of (potential) moving parts in these problems, students are often unclear about the relative importance of each component of the theory. For example, does it matter how quickly the market price is falling for the firm's decision to exit? How do changes in uncertainty influence this decision? This difficulty is especially true of undergraduates, who are much less likely than graduate students to work through numerical examples on their own. Assigning students problem sets that require them to use software such as Excel or MATLAB to vary the parameters of the model helps to answer some of these questions. Nonetheless, it is my experience that once students have an understanding of how uncertainty affects firms' decisions in these models, they tend to attribute the option value solely to the role of uncertainty.

The example of Kramer's decision to sell his stories to J. Peterman is any entertaining way to discuss the roles of salvage values and uncertainty in a decision to exit a market. In my limited experience using this example, I have been fortunate to have students who had enough familiarity with *Seinfeld* that a simple description of the plot was sufficient to motivate this example. However, one challenge with continuing to use this example is that there has not been a new episode of *Seinfeld* since 1998. As a result, descriptions of the plot might not remain sufficient for long. Nonetheless, it is possible to use clips from the show.[7] In what follows, I will describe how to use these clips to teach this example.

There are five short clips that are sufficient to motivate the discussion in this paper.[8] The first clip is the scene in which Kramer describes his encounter with the Van Buren Boys. In the second clip, Elaine meets with J. Peterman to go over stories for his autobiography and happens to tell him Kramer's story. Peterman likes the story and wants to buy it to use in his autobiography. In the third clip, Peterman offers to purchase all of Kramer's stories for $750. In the fourth clip, Kramer tells Elaine the Bob Sacamano story and invites her out to celebrate. Finally, in the last clip, Kramer and Elaine are out celebrating with Kramer's friends and

[5] As an aside, I would highly recommend making the real option approach a part of the intermediate macroeconomic curriculum for anyone who does not already do so. It requires a bit of calculus, but nothing truly more daunting than students would see in a typical maximization problem. It seems especially useful when teaching students in business administration programs since first-hand accounts suggest that many firms incorporate this approach in their decision-making processes (Chevalier-Roignant and Trigeorgis (2011).

[6] Since entry and exit decisions are optimal stopping problems, they are directly applicable to this paper. Kramer's decision is similar to a firm's decision to exit a market.

[7] In a graduate course, the marginal benefit of showing clips is very unlikely to be worth the marginal cost of time. When *Seinfeld* disappears from the pop culture knowledge of graduate students, continuing to use this example for graduate students would therefore require viewing the episode outside the class. This may or may not be worth pursuing. Nonetheless, I think that showing the clips to undergraduates in an intermediate macroeconomics course would still provide a net benefit to the class. In fact, for the reasons stated above, I think this example is of much more value to undergraduates regardless of their prior knowledge of *Seinfeld.*

[8] The total runtime of these clips is a little under 7 minutes.

Kramer is asked to tell the Bob Sacamano story. Students can then be informed that Kramer regrets his decision and asks for his stories back.

Following the clips, pose the following question: Why does Kramer regret his decision? To illustrate the decision that Kramer faces, it is helpful to draw a binomial tree on the board and label some number of the lower final nodes as having values below S. This basic setup provides students with enough information to understand that the decision to exit the market is dependent not only on the path that demand has taken, but also the expected future path demand could take.[9] Note that the stochastic process that we assume Kramer faces in the equation (3) implies that there is some probability that demand increases and some probability that demand decreases at each node of the tree. Also, since μ in equation (3) is negative, Kramer knows that the probability of demand declining is greater than the probability of demand rising. This approach helps to motivate Kramer's decision in a discrete environment in which each stage of decision-making is well understood. It is also easy to see why a series of good shocks could keep Kramer in the market longer than a series of bad shocks. This approach helps to illustrate the fact that Kramer knows the odds associated with each possible outcome at each node.

Once students have an intuitive grasp of the decision that Kramer is making, pose a different question: Does Kramer regret his decision because he made a forecasting error? The answer is no since Kramer knows the probability and size of increases and decreases in demand at each node. This should be obvious to students following a careful discussion of the binomial tree. The negative answer therefore requires returning to the original question. Why does Kramer regret his decision? At this point, work through the deterministic and the stochastic examples and highlight the difference between the optimal stopping decisions.

Conclusion

This paper demonstrates an important conclusion from the literature on optimal stopping times by illustrating the differences in optimal stopping times in a deterministic environment and a stochastic environment. The use of the example from *Seinfeld* helps to motivate this problem by allowing students to think about optimal stopping decisions in both deterministic and stochastic environments. As a result, this example helps students to understand the role of uncertainty within this literature in an entertaining way.

References

Chevalier-Roignant, Benoit and Lenos Trigeorgis. 2011. *Competitive Strategy: Options and Games.*

Cambridge: MIT Press. Dixit, Avinash. 2012. "An Option Value Problem from *Seinfeld*." *Economic Inquiry*, 50(2): 563 - 5.

Dixit, Avinash K. and Robert S. Pindyck. 1994. *Investment Under Uncertainty.* Princeton: Princeton University Press.

Ghent, Linda S., Alan Grant, and George Lesica. 2011. "The Economics of Seinfeld." *Journal of Economic Education*, 42(3): 317 - 318.

Hall, Joshua. 2005. "Homer Economicus: Using The Simpsons to Teach Economics." *Journal of Private Enterprise*, 20(1): 166 - 77.

Kuester, Daniel D., G. Dirk Mateer, and Christopher J. Youderian. 2014. "The Economics of the Office." *Journal of Economic Education*, 45(4): 392.

Luccasen, R. Andrew and M. Kathleen Thomas. 2010. "Simpsonomics: Teaching Economics Using Episodes of The Simpsons." *Journal of Economic Education*, 41(2): 136 - 49.

Mateer, G. Dirk, Linda S. Ghent, and Misty Stone. 2011. "TV for Economics." *The Journal of Economic Education*, 42(2): 207.

[9] In other words, this makes it easy for students to recognize when Kramer has reached a point when there is no possible path back to a value above S.

Stokey, Nancy. 2009. *The Economics of Inaction.* Princeton: Princeton University Press.

Tierney, James E., Benny O. Smith, G. Dirk Mateer, Jadrian J. Wooten, and Wayne A. Geerling. 2016. "Bazinganomics: Economics of The Big Bang Theory." *The Journal of Economic Education*, Forthcoming.

Appendix

Suppose that Kramer is risk neutral such that $U[x(t)] = x(t)$. Any equation of the form (5) has a solution:

$$V(x) = V_p(x) + A_1 x^{R_1} + A_2 x^{R_2}$$

where V_p is a particular solution and $A_i x^{R_i}$ are homogenous solutions to the second-order differential equation (5). Here, A_1 and A_2 are positive constants and R_1 and R_2 are the characteristic roots of the equation

$$\frac{1}{2}\sigma^2 R^2 + \left(\mu - \frac{1}{2}\sigma^2\right) R - r = 0$$

Note that this equation implies that there is one positive root and one negative root. Let R_1 be the positive root.

This equation has the following economic interpretation. The particular solution, $V_p(x)$ represents the present value of the stories if the option to sell them is never exercised. It follows that the homogeneous solutions represent the value of the option to wait and sell the stories at a later point in time.

Given the functional form assumed for $U(x)$, the present value of the stories if they are never sold is given as

$$V_p(x) = \frac{x}{r - \mu}$$

Note that the value of the option to sell the stories will become worthless as the demand for the stories becomes infinitely large. Formally, this implies that

$$\lim_{x \to \infty} V(x) - V_p(x) = 0$$

This implies that it must be true that $A_1 = 0$.
It follows that

$$V''(x) = R_2(R_2 - 1)A_2 x^{R_2 - 2} > 0$$

Honor Codes and Perceptions of Cheating

Robert T. Burrus, Jr., J. Edward Graham, Adam T. Jones, and William H. Sackley[1]

Abstract

To reduce cheating and strengthen honor codes, penalties for violations and enforcement have been enhanced, but the outcomes of those actions are uncertain and academic dishonesty remains a concern. Research affirms widespread cheating and no clear remedy exists. We analyze how a change in an honor code can impact academic dishonesty. We find an increased awareness and vigilance to prevent cheating by students may lead to a reduction in cheating through an increase in the certainty of punishment. Moving from an honor policy toward a traditional honor code is only one step in creating a culture of honesty.

Introduction

Washington and Lee University and the University of Virginia extol the virtues of individual student efforts in the classroom; both schools frame much of their academic brands around their honor codes, where first offenses of cheating or plagiarism lead to expulsion from the universities. Similar and even more strident honor codes exist at the military academies, where even the unreported knowledge of cheating, much less cheating itself, can lead to a student's dismissal from the school. Table 1 provides a small sample of various honor codes and notable features including unproctored exams, mandatory reporting of violations, and even expectations of behavior outside the classroom. While no defensible research is circulating affirming the success of programs such as those at W & L or UVA, anecdotal comments from a broad informal sample of alumni from both schools suggest that cheating is rare. This anecdotal evidence is supported by McCabe et al.'s (1999) and Arnold et al.'s (2007) findings that suggest lower levels of academic dishonesty at institutions employing student-involved honor codes. Despite the efforts of administrators to strengthen honor codes, penalties, and enforcement, cheating on college campuses remains a substantial problem.

This study attempts to discern the impact for one university of moving from a *cheating policy* toward a more traditional *honor code*, using data on cheating, perceptions of cheating, and student impressions concerning the certainty and severity of punishment, before and after a change in the honor code at a midsize regional state university. The new code includes the implementation of an honor board for repeat offenders, signed honor pledges, and increased education about the new cheating policies. Our analysis provides evidence that the more stringent and student-inclusive code corresponds to a cultural shift and increased awareness among the students.

After examining some earlier studies of this issue, we describe the available data from the institution and provide some descriptive statistics. Employing data from before and after the adoption of new cheating policies, we model the importance of factors contributing to cheating before and after the new code went into effect. The closing pages report estimation results, provide a summary, suggest implications of our findings, and provide a couple ideas for subsequent research.

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Table 1: Sample Institutions with Notable Honor Codes

Institution	Notables
The Citadel	"A cadet does not lie, cheat, or steal, nor tolerate those who do." Failure to report a violation is considered a violation of the code.[1]
Baylor University	Requires all incoming students to pass an Academic Integrity Tutorial with a perfect score before registering for their first classes.[2]
Brigham Young University	Includes guidelines for appropriate dress, hair style, and sexual behavior in addition to academic standards.[3]
Davidson University	"Students benefit from a unique set of freedoms when they sign the Honor Code: from the prevalence of take-home tests and unproctored, self-scheduled final exams"[4]
Princeton University	Examinations are unproctored, students assume full responsibility.[5]
University of Virginia	Nation's oldest student-run honor system. Students will not "lie, cheat, or steal."[6]
Vanderbilt University	Included in description of honor code: "If we had to make a choice among human values we would choose Honor over learning, over skill, over understanding."[7]
Washington and Lee	Founded on rule that each student will "conduct himself as a gentleman."[8] Penalty for an offense is expulsion.

[1]: http://www.citadel.edu/root/honor-at-the-citadel/honor-education
[2]: http://www.baylor.edu/honorcode/index.php?id=44062
[3]: https://registrar.byu.edu/catalog/2010-2011ucat/GeneralInfo/HonorCode.php
[4]: http://www.davidson.edu/about/distinctly-davidson/honor-code
[5]: http://www.princeton.edu/pub/rrr/part2/index.xml#comp23
[6]: http://www.virginia.edu/uvatours/shorthistory/code.html
[7]: http://studentorgs.vanderbilt.edu/HonorCouncil/information-for-faculty/faculty-guide-to-the-honor-system/
[8]: http://www2.wlu.edu/x50129.xml

Background

Among the earlier studies, Singhal (1982) questioned students and faculty at Arizona State University. He found some disagreement between students and faculty on what, precisely, constitutes cheating (e.g., is copying homework "cheating?"). Respondents believed that "competition for grades" motivated cheating. Students allowed that greater awareness of cheating and monitoring during exams might reduce instances of cheating. However, Meade (1992) surveyed 15,000 students at 31 "top-ranked universities" and affirmed widespread cheating with self-admissions by discipline ranging from 63% to 87%. Furthermore, Premeaux (2005) uses survey data from multiple schools and finds that cheating may be more widespread at second-tier schools than top-tier schools as students at the second-tier schools are more likely to move beyond plagiarism and cheat on exams than students at top-tier schools.

Roig and Ballew (1992) note that students and faculty may disagree about which behaviors are "cheating." Barnett and Dalton (1981) and Graham et al. (1994) inventory a few instances where disagreements exist, such as using old exams to study or discussing an exam with someone who has not yet sat for the test. In more recent work, Burrus et al. (2007) underscore that definitions of cheating are not perfectly understood; they find greater self-reporting of cheating after students are provided a clear definition of academic dishonesty. However, the Burrus et al. results notwithstanding, a broad consensus on behaviors that constitute academic dishonesty suggests that simply clarifying language in honor codes and policies is unlikely to have a substantial effect on student behavior. McCabe (2005) warns that mere "monitoring" may not be adequate, finding that 41% of faculty acknowledge having ignored incidents of cheating, due primarily to the buden of proof required. The lack of action is not lost on many students and increases their willingness to cheat.

Academic dishonesty is not limited to the United States. Franklyn-Stokes and Newstead (1995) affirm the prevalence of cheating in Great Britain, with 60% of their undergraduate survey respondents admitting to cheating. Magnus, Polterovich, Damilov, and Savvateev (2002) find attitudes towards cheating to be more liberal in other countries. In their study, cheating was "tolerated" much more in Russia than the US; a result consistent with Grimes and Rezek's (2005) finding that levels of cheating are higher and vary more widely across transitional economies than in the US. Countries with greater levels of corruption were noted for their greater tolerance of the cheater in the Magnus et al. "Tolerance-to-Cheating Index." However, the interaction

of cultures has a mixed effect on the ethical behavior of students. Ledesma (2011) uses survey data from a Korean university and finds lower levels of cheating in courses taught by foreign instructors than Korean instructors but a higher level of cheating for classes taught in English than for those taught in Korean. One might assume the foreign instructors bring a different set of expectations, or at least uncertainty about the expectations, which may reduce cheating, but the difficulty of taking classes in a foreign language may encourage some of the ethically more marginal behaviors.

Cheating in college is not simply a problem in the academy. Using a survey of MBA students, Sims (1993) suggests that academic dishonesty is correlated with work-related dishonesty. Nonis and Swift (2001) follow up on Sims and confirm the relationship between academic dishonesty and workplace dishonesty using a larger sample across multiple universities. Clearly, identification of factors associated with academic dishonesty and correction of cheating behaviors and accepting cultures merits attention.

Factors associated with cheating, such as age, gender, and extracurricular activities, are but a few characteristics addressed in a large literature. Contextual matters – the environment in which cheating takes place – are of additional interest, especially to administrators and faculty. Bunn, Caudill, and Gropper (1992), Mixon (1996) and Greene and Saxe (1992) report that these factors include perceptions that others are cheating; Roig and Ballew (1992) highlight the emphasis placed upon academic integrity by the instructor. In a similar context, Franklyn-Stokes and Newstead (1995) underscore the importance of faculty members clarifying their own expectations by providing unequivocal definitions of what constitutes "cheating." This echoes Kibler's (1993) emphasis on the *certainty* of punishment and Mixon's (1996) consideration of the *severity* of punishment. Siniver (2013) surveys former students and finds both certainty and severity to be important factors in reducing the incidence of cheating. Williams and Hosek (2003) suggest that university processes for punishing cheaters must be evenly applied and fit within legal constraints; they suggest deterrence and prevention may be the best policy.

The importance of institutional context is demonstrated by McCabe and Trevino's (1997) finding that honor codes, as opposed to policies, reduce cheating through a culture of honesty. They conclude that administrative efforts should encourage a culture of honesty among the students. Bisping, Patron, and Roskelley (2008) find the determinants of misconduct vary across behaviors but that a student's perception of whether an act is dishonest universally affects behavior. Thus, reinforcing the suggestion that simple enforcement or strengthening of penalties is not enough to prevent cheating, a culture of honesty is required. Neville (2012) studies the incidence of academic cheating under high levels of income inequality and reports that honor codes may be particularly helpful as inequality fosters a lack of trust which honor codes can assist to overcome. However, the pressures and rationalizations to cheat may be best mitigated though the installation of a belief that cheating is unacceptable under any circumstance (Passow et al. 2006).

Beyond honor codes, Koh et al. (2011) emphasize the importance of curriculum design in the incidence of cheating. Unexpected academic time pressures are shown to have a negative impact on ethical decision making, which in many cases can be mitigated by more thoughtful course construction. Hrasky and Kronenberg (2011) suggest faculty bear some responsibility for eliminating plagiarism through curriculum design. They suggest using essay assignments that ask students to combine theory with supplied or personal examples, reducing the sources available to plagiarize. Furthermore, Hrasky and Kronenberg also suggest changing assignments each year to prevent campus groups from building a reservoir of previous assignments which could serve as a source for plagiarism. Green and van Kessel (2011) find evidence to suggest that supposedly clearly-written honor codes may be far from clearly understood by significant portions of students and Teh and Pauli (2013) reinforce the observation that students need *practical* training as to what is expected of them, especially for writing assignments in light of the omnipresence of internet sources.

Our analysis builds on the existing literature's suggestions that universities can strengthen education about academic dishonesty, plagiarism, citing sources, etc. and/or pursue a strategy of strengthening penalties and detection procedures such as electronic checks of submitted work. We find that, following the revision of a mid-sized university's honor code – with increased emphasis on the code and publicity by the university's administration – it remains the culture and actions of fellow students that are critical to deterring dishonesty. These results suggest that a program aimed at education of students about the importance of integrity must also emphasize the student's role in creating a culture of integrity and encouraging their peers to avoid questionable behaviors.

Institutional Setting

Our research examines a revision of the honor code at a medium-sized (over 10,000 undergraduate students), public institution in the southeastern US. Prior to the revision of its honor code, students were required to report cheating to faculty or administrators but there was little formal supervision or administration of cheating policies. Only limited emphasis was placed on the policy by students or administrators. There was no honor pledge, and no honor board. This effectively left the responsibility for "enforcement" to the faculty with little communication between faculty members. Prior to the revision, it was possible for students to be repeat offenders without anyone else knowing. Moving forward, the university wished to foster an atmosphere of academic integrity based on research such as McCabe and Trevino (1997). Shortcomings such as "allowing" a student's repeated offenses needed to be addressed.

As part of the university's efforts to address these shortcomings, students were surveyed in February of 2009, and again in March of 2011 after the honor code was revised. The objective was to determine the pervasiveness of and attitude toward cheating on campus, before and after the implementation of the revised honor code. Student perceptions of the certainty and severity of punishment were measured to objectively frame the culture of academic honesty at the university. Survey results from early 2009 encouraged the honor code revision. The new code was in place for the incoming freshmen and transfer students at the beginning of the fall 2009 semester.

Under the new code, students are expected to report honor violations, must sign an honor pledge during freshman orientation, and are educated about the code and possible infractions. In addition, an honor board was established that consists of four students and two faculty members. To convict, it takes a simple majority of the six people.

For a first offense, the faculty member decides the punishment that the offending student receives (assuming that the student admits guilt). For a second alleged offense (or for first offenses in which the student believes he or she is wrongly accused or, rarely, where the student objects to the punishment), the offending student is brought to trial before the honor board. If the instructor believes the student is guilty of cheating or plagiarism, he or she contacts the Dean of Students (DOS) to discern whether there are any prior offenses by the student. If there are, the case automatically goes to the honor board. If not, the instructor can broker a "private" resolution that is then reported to the DOS office. A case would also go to the board where the student and instructor cannot agree on a private resolution for an episode that is a "first offense." Given that most cases considered by the board are second offenses, the penalties are relatively stiff; a conviction generally results in a semester or year's suspension.

Data

A description of reported honor code violations since the installation of the new code is given in Table 2. As the university enrolls approximately 14,000 students, including graduate students, it appears that less than one half of one percent of students are reported to have cheated (or plagiarized) in a given semester. In the spring of 2012 for example, from the first column and second row of that table, we observe 40 honor code violations (27 for cheating and 13 for plagiarism) handled privately; only three cases were referred to the honor board, with all three resulting in "convictions" ("Responsible"). Twelve cases were referred to the honor board in the spring semester of 2013, with less than 20% (two out of 12) being convicted or held "Responsible" for an honor code violation. Other reports of cheating or plagiarism, and the results of those infractions, are revealed in Table 2 for other semesters since the summer of 2011.

Surveys were conducted before and after the installation of the new code. The pre- and post-revision surveys generated similar results across most of the questions; those results are presented below in Tables 3 and 4. Both surveys were administered electronically and sent to a random sample of students. We recognize that surveys such as these are subject to self-selection bias. Kerkvliet (1994) suggests that such bias is mitigated, as in our surveys, by "anonymous administration." Nevertheless, Caudill and Mixon (2005) suggest responses to direct questioning may still underrepresent the amount of cheating. The percentage of students self-reporting academic dishonesty in our surveys, 57%, is similar to prior studies at other institutions and between the survey and corrected values reported by Caudill and Mixon of 51% and 70% respectively.

Table 2: Honor Code Violations: Summer/Fall 2011 through Spring 2013

Semester	Private Resolutions	Cheating	Plagiarism	Honor Board	Responsible	Not Responsible
Summer/Fall 2011	51	27	24	12	9	3
Spring 2012	40	27	13	3	3	0
Summer/Fall 2012	63	28	35	4	4	0
Spring 2013	55	31	24	12	2	10

The first survey was sent to 5,000 students; 333 responses yielded 229 complete and usable responses, a usable response rate of 4.6%. The second survey in the spring of 2011 was likewise sent to 5,000 students; there was some indeterminate overlap between the respondents to the first and second surveys, an overlap for which we were unable to control, as the surveys were necessarily anonymous. With the second survey, a larger response by 756 students yielded 599 complete and usable responses, a usable response rate of just under 12%.[2] The higher response rate with the second survey likely resulted from the "press coverage" that the institution's honor code began to receive with the first survey two years earlier and with the new honor code in the fall of 2009.

On both surveys, students were asked about their perceptions regarding the extent of academic dishonesty on campus, the certainty and severity of punishment, and the efforts by faculty to prevent cheating. For example, students were asked to classify the "degree to which honor code violations occur at [the institution]" as major, moderate, minor or not a problem. Approximately five percent of students indicated they believed cheating is a major problem and over thirty percent indicated they believe cheating is a moderate problem. Because of the small number of students reporting cheating is a major problem, responses are aggregated to indicate whether students believe cheating is either a major or moderate problem (*cheating is a problem*). Students were also asked to describe the penalties they believed were assigned by most faculty members as severe, moderate, mild, or none. Student perceptions are again aggregated to indicate whether they believed faculty assigned moderate to severe penalties, or mild or no penalties (*penalties are severe)*.[3] In addition, because the value of the honor code rests on faculty members' efforts, students were asked to describe the faculty's vigilance toward both detecting (*faculty are vigilant*) and confronting (*faculty will confront*) academic dishonesty as: very vigilant, moderately vigilant, slightly vigilant, or not vigilant at all.

Table 3 provide sample statistics for demographic variables from the pre- and post-revision surveys, respectively. The average age of students in the surveys is 23.5 and 20.4 years, older than the population's average age of 22.3 years for the first survey and younger than the population's average age of 22.6 in the second survey. In both surveys, and consistent with the institution's gender mix, females made up the majority, around two-thirds, of the respondents. This is modestly, and statistically, more than might be expected given that women made up 59% and 60% of the student body for the pre- and post-survey semesters respectively.

The survey responses before and after the honor code change, shown in Table 3, are largely the same, with one notable exception: the university college – where underclassmen reside until being admitted to their respective colleges – provided 22% of the respondents to the earlier survey, and only 17% to the one after the honor code change. This suggests students in the second survey may be farther along in their college careers despite being younger in age. The other meaningful difference is the increase in the relative number of nursing students; this derives from the expansion of the nursing school over the past few years.

[2] Surveys were sent to only a sample of students to minimize the number of emails and requests from the Dean of Students Office being sent to the student population. As one might expect, each survey contained incomplete responses which were dropped from the samples.

[3] The results presented below are robust for disaggregated versions of *cheating is a problem* and *penalties are severe*. The aggregated version is presented for ease of interpretation and parsimony.

Table 3: Sample Statistics for Demographic Variables

		Full Sample				Cheaters	Non-Cheaters
Variable	**Description**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**Mean**
Before code:							
Age	Student age	23.54	5.26	17	36	22.87	24.48
Female	Percentage female*	.66	.47	0	1	.67	.65
Omitted	Not admitted to school*	.22	.41	0	1	.24	.19
Arts and sciences	Admitted to CAS*	.48	.50	0	1	.46	.51
Sch. of Business	Admitted to B school*	.17	.38	0	1	.18	.17
College of Nursing	Admitted to nursing*	.02	.15	0	1	.02	.052
College of Education	Admitted to Col. Of Ed*	.10	.31	0	1	.10	.12
After code:							
Age	Student age	20.40	3.85	17	36	19.5	21.55
Female	Percentage female*	.68	.47	0	1	.69	.67
Omitted	Not admitted to school*	.17	.37	0	1	.17	.16
Arts and sciences	Admitted to CAS*	.49	.50	0	1	.46	.52
Sch. of Business	Admitted to B school*	.11	.31	0	1	.10	.12
College of Nursing	Admitted to nursing*	.12	.32	0	1	.14	.08
College of Education	Admitted to Col. Of Ed*	.12	.33	0	1	.12	.13

*Binary Variables

Table 4 provides sample statistics and evidence concerning student behaviors, perceptions about cheating, and faculty efforts toward preventing it. Fifty-nine percent (59%) of the students in the pre-revision survey, and 56% in the post-revision survey, admitted to cheating; these admissions help validate our survey results and is consistent with the literature revealing a noteworthy degree of academic dishonesty.

The number of self-reported cheating behaviors, the second row in each panel ("Cheats") from Table 4, increased slightly following the honor-code revision. A two-sided *t*-test of the increase did not suggest the increase was statistically significant at the 90% confidence level. While the reasons for the increase are debatable, the impact of the new honor code in highlighting concerns with and what constitutes cheating may have played a role. The increase could owe to students gaining a more complete understanding of what constitutes "cheating" and becoming aware that prior behavior they might have excused was, on reflection, cheating. For example, paragraphs of self-diagnosed "paraphrasing" might have evolved to become actual plagiarism. This assertion is supported by Burrus et al. (2007) who find students self-report more cheating on surveys once provided a definition of dishonest behaviors. In this light, variables summarizing student beliefs about cheating suggest that students may now be more familiar with the definition of cheating, increasing, in turn, self-reports of cheating.

Table 4: Sample Statistics for Cheating and Perceptions, Survey Before Honor Code

		Full Sample				Cheaters	Non-Cheaters
Variable	**Description**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**Mean**
Before code:							
Cheater	Student has cheated in past	.59	.49	0	1	1	0
Cheats	Annual Cheats	.71	1.09	0	7	1.21	0
Severe	Believe penalties are modest or severe*	.66	.47	0	1	.62	.72
Cheating is a problem	Believe cheating is a moderate or major problem*	.38	.49	0	1	.40	.36
Cheating is Discussed	Academic honesty discussed at start of semester*	.86	.35	0	1	.87	.85
Faculty are Vigilant	Faculty are vigilant about detection*	.76	.43	0	1	.77	.76
Students are Vigilant	Peers vigilant about reporting*	.14	.35	0	1	.08	.23
Faculty will Confront	Faculty vigilant about confronting after detection*	.75	.43	0	1	.72	.8
After code:							
Cheater	Student has cheated in past	.56	.50	0	1	1	0
Cheats	Annual Cheats	.81	1.31	0	10	1.4	0
Severe	Believe penalties are modest or severe*	.69	.46	0	1	.70	.67
Cheating is a problem	Believe cheating is a moderate or major problem*	.35	.48	0	1	.41	.26
Cheating is Discussed	Academic honesty discussed at start of semester*	.88	.32	0	1	.88	.89
Faculty are Vigilant	Faculty are vigilant about detection*	.77	.42	0	1	.75	.80
Students are Vigilant	Peers vigilant about reporting*	.19	.39	0	1	.14	.25
Faculty will Confront	Faculty vigilant about Confronting after detection*	.83	.38	0	1	.81	.85

*Binary Variables

Varied conclusions can be drawn from the data observed in Table 4. First, the observation that fewer students believed cheating to be a problem following the revision, 38% down to 35%, suggests that the culture of honesty may have improved following the revision. Second, students seem to sense faculty are taking

cheating more seriously following the revision with students perceiving more faculty to be vigilant about confronting cheaters, 75% increasing to 83%, and a small increase in the perception that faculty are discussing cheating in their courses *(cheating is discussed*), 86% increasing to 88%. Third, while skeptical that their peers were watching, students reported that their peers were more vigilant about reporting cheating (*students are vigilant*), after the honor code revision than before; this variable increased from 14% to 19% after the revision. While only the increased perception that faculty will confront cheaters is statistically significant at conventional levels, the change in student responses suggests a moderate shift in student attitudes. Of particular note in Table 4 are the last two columns that break down responses by cheaters and non-cheaters; the non-cheaters before and after the honor code revision believed their fellow students were more likely to be vigilant than were the cheaters themselves.

Model

When analyzing cheating behavior, there are two related decisions made by students: first, a decision is made whether to cheat (the "extensive" decision) or not; second, if cheating is risked, a decision is made as to how broadly, regularly, or deeply to cheat (the "intensive" decision). The extensive and intensive decisions are modeled below.

Our primary research interest focuses upon whether the implementation of an honor code reduces cheating, with a secondary focus on the extent to which student behaviors are characterized by demographic variables. Given this focus, we estimate the following general model using different approaches to analyze the extensive and intensive margins. We measure first the likelihood that a student will cheat, as a function of our examined variables and the code revision, and we then examine the "intensity" of that cheating over a set of explanatory factors. The relationship between demographics, perceptions, and self-reported cheating behavior is modeled as follows:

$$\boldsymbol{cheat} = \propto + \boldsymbol{\beta D'} + \boldsymbol{\Gamma P'} + post\,(\gamma + \boldsymbol{\beta D'} + \boldsymbol{\Gamma P'}) + \boldsymbol{\Psi S'} + \boldsymbol{\varepsilon} \qquad (1)$$

where *cheat* is a vector of observations defined as the number of cheating incidents per year, the total number of cheating incidents, or a binary variable coded to one if a student admitted cheating for each student. The $\boldsymbol{\beta}$ and $\boldsymbol{\Gamma}$ terms in the model represent a vector of coefficients corresponding to $\boldsymbol{D}$ and $\boldsymbol{P}$, matrices of demographic and perception variables for each observation. Demographic variables include *age*, *female*, and *graduate student*. Student perceptions about academic honesty are represented by *penalties are severe*, *cheating is a problem*, *cheating is discussed*, *faculty are vigilant*, *students are vigilant*, and *faculty will confront* cheaters. The *post* term is a binary variable indicating the observations are from the post-code survey. Finally, $\boldsymbol{\Psi}$ and $\boldsymbol{S}$ are a vector of coefficients and matrix of variables for which school the student has been admitted to within the university, including the college of *arts and sciences*, *school of business*, *nursing college*, and *school of education* with students not yet admitted to a school serving as the omitted term for reference.

Considering first the likelihood of cheating, to analyze the extensive margin, we use a probit specification with a dependent variable, *cheater* = 1, for students who report at least one instance of cheating. To examine the intensive margin, the breadth of a student's cheating once the cheating has commenced, we estimate the model using an ordinary-least-squares specification to explain the dependent variable, cheats-per-year. However, because of the severe lower censoring (40% of the sample did not self-report cheating), OLS may produce inconsistent and biased coefficient estimates. To correct for this censoring problem, a Tobit model is also estimated. In addition, a negative binomial model is estimated to explain the total number of times a student has cheated during their academic career.[4] When estimating the model for the total number of cheating incidents over an academic career, the number of years enrolled is used as an exposure correction in the estimation process. We intuitively expect a student who takes more classes and spends more years in school to cheat more, if the student cheats in the first place; the exposure correction addresses this expectation. All reported standard errors are Huber-White standard errors and are robust to heteroscedasticity.

In accordance with the literature we expect *age, female*, and *graduate student* to have negative coefficients, reflecting a lower likelihood of cheating by older students, females and graduate students (see Stern and Havlicek 1986, Kerkvliet 1994, Newstead, Franklyn-Stokes and Armstead 1996). We also expect the certainty of punishment *faculty are vigilant*, *students are vigilant*, and *faculty will confront* as well as the

[4] A zero-inflated negative binomial yielded substantially similar results.

severity of punishment variable, *penalties are severe*, to be negative (Mixon 1996). These certainty and severity outcomes remind us of the lower incidences of cheating at such schools as UVA or W & L, where expulsion occurs with the first "conviction" for cheating.

Results

Estimation results are shown in Table 5 for the four models employed to discern the likelihoods and frequencies of cheating; those "likelihoods and frequencies" are measured relative to the demographic and academic factors included in Equation (1) above. The first column presents the estimation for the extensive margin – whether to cheat – and the second through fourth columns in Table 5 present the estimated models for the intensive decision – how much to cheat.

Column 1 in Table 5 examines the extensive margin, whether a student has engaged in cheating behavior and is estimated using a probit model. The first column presents the estimated marginal effects, at the mean, for the probit model. "Cheats per year" in the second column of Table 5 employs prosaic OLS estimation to measure the direction and significance of the modeled factors in describing the amount of cheating, measured as the number of self-reported incidents divided by the student's tenure at the university. However, because of the large number of students who do not self-report cheating in the survey responses, the censored data is also estimated using a Tobit specification to mitigate the problem. Finally, the model illustrated in the fourth column employs a negative binomial distribution for the total number of times (a discrete number) a student has cheated while at the university. For the negative binomial model, the length of time the student has been at the university is used as an exposure correction term. The fourth column presents the estimated marginal effects at the variable's mean for the negative binomial model.

Estimated coefficients for the demographic variables in columns two through four are largely consistent with the literature: older students tend to cheat less and are less likely to begin cheating as indicated by the coefficients on *age* and *graduate student* variables, while *female* has a consistently negative – but mostly insignificant – coefficient. These results are similar to those of McCabe and Trevino (1997), Burrus et al. (2013), and Simha and Cullen (2012) among others. When considering the interaction term, *age * post*, it appears that the older, potentially more mature students, had a larger response to the implementation of the honor code.

Following the code change, students who believe cheating is a problem are more likely to engage in cheating, as evidenced by the probit model in column 1, but the quantity of cheating is reduced when compared to the pre-code levels as evidenced by the negative coefficients on *cheating is a problem * post*. A student who indicates that cheating a "moderate or major" problem is likely to cheat one more time every other year than students who do not believe cheating is a large problem. While this result may seem inconsequential, Jordan (2001) finds cheaters' estimates of peer cheating to be significantly higher than estimates for non-cheaters and Kisamore, Stone, and Jawahar (2007) suggest the effect of perceived peer cheating may be most influential on the most at-risk students. While our data set does not contain data about the number of incidents witnessed, it is plausible that students who witness cheating also think it is a larger problem than those who are unaware of it. However, following the implementation of an honor code, the effect of a student believing *cheating is a problem* is potentially reduced and at least no worse than before the code as evidenced by the negative coefficient on *cheating is a problem * post*.

Based on Becker's (1974) examination of the economics of crime, the literature holds that there are two main "threads" in the reduced-cheating fabric: these are the "certainty" and "severity" of punishment. The depth of support for these threads is increased by this study's findings. With respect to the severity of punishment, students in the pre-code survey who believe penalties are severe are less likely to cheat. However, following the revision of the honor code, we see that students who believe penalties are severe are neither more nor less likely to cheat as evidenced by the opposing signs on *penalties are severe* and *penalties are severe * post.* A plausible explanation for this is that the non-cheaters, prior to the code revision, were afraid of the penalties for cheating, and after the code was revised all – or at least more of the – students are afraid of the penalties. But, the cheaters continued to cheat as evidenced by the summary statistics in Table 4. It is likely the case that students continued to cheat because they did not believe they would be caught. This explanation is supported by much of the empirical literature on the economics of crime which suggests the certainty of punishment is a greater deterrent.

Table 5: Model Results

Dependent Variable:	Cheater	Cheats Per Year	Cheats Per Year	Cheats Total
	Probit	OLS	Tobit	Neg. Binomial
Age	-0.0151**	-0.0283**	-0.0586**	-0.0883***
	(-2.01)	(-2.29)	(-2.35)	(-3.52)
Female	-0.00663	-0.112	-0.175	-0.442
	(-0.09)	(-0.73)	(-0.68)	(-1.55)
Graduate Student	-0.249**	-0.133	-0.673*	-0.398
	(-2.40)	(-1.05)	(-1.82)	(-1.27)
Penalties are Severe	-0.153*	-0.473**	-0.783***	-0.911***
	(-1.95)	(-2.54)	(-2.87)	(-2.75)
Cheating is a Problem	0.0154	0.401***	0.490**	0.678**
	(0.21)	(2.80)	(2.01)	(2.48)
Cheating is Discussed	0.0831	0.259	0.438	0.302
	(0.83)	(1.51)	(1.37)	(1.25)
Faculty are Vigilant	0.113	-0.0315	0.0711	-0.105
	(1.23)	(-0.13)	(0.21)	(-0.36)
Students are Vigilant	-0.298***	-0.508***	-1.196***	-0.888***
	(-3.20)	(-3.42)	(-3.13)	(-2.87)
Faculty will Confront	-0.0994	0.196	0.117	0.367
	(-1.10)	(0.84)	(0.36)	(1.52)
Age * Post	-0.0205**	-0.0619***	-0.129***	-0.170***
	(-2.11)	(-3.48)	(-3.56)	(-4.79)
Female * Post	0.0133	-0.00678	0.0308	0.214
	(0.15)	(-0.03)	(0.10)	(0.68)
Graduate Student * Post	0.113	0.306	0.740	1.738
	(0.95)	(1.57)	(1.54)	(1.62)
Penalties are Severe * Post	0.144	0.462**	0.778**	0.925***
	(1.55)	(2.08)	(2.37)	(2.84)
Cheating is a Problem * Post	0.139*	-0.228	-0.0267	-0.230
	(1.67)	(-1.27)	(-0.09)	(-0.88)
Cheating is Discussed * Post	-0.179	-0.608**	-0.998**	-0.718*
	(-1.59)	(-2.33)	(-2.36)	(-1.69)
Faculty are Vigilant * Post	-0.100	0.00652	-0.0986	0.000351
	(-0.95)	(0.02)	(-0.25)	(0.00)
Students are Vigilant * Post	0.148	0.221	0.589	0.653
	(1.44)	(1.11)	(1.32)	(0.87)
Faculty will Confront * Post	0.0788	-0.285	-0.241	-0.650*
	(0.70)	(-1.02)	(-0.61)	(-1.69)
Arts and Sciences	0.0396	-0.598***	-0.588***	-0.613***
	(0.76)	(-3.65)	(-2.67)	(-3.27)
School of Business	0.0328	-0.369*	-0.355	-0.295
	(0.49)	(-1.78)	(-1.21)	(-1.38)
Nursing College	0.206***	-0.666***	-0.417	-0.430*
	(3.09)	(-3.11)	(-1.39)	(-1.94)
School of Education	0.0902	-0.613***	-0.553**	-0.532***
	(1.31)	(-3.60)	(-2.17)	(-3.08)
Post		1.805***	3.013***	
		(3.18)	(2.96)	
Constant		1.784***	2.073***	
		(4.73)	(2.82)	
N	828	828	828	828
R^2	0.095	0.143	0.057	0.060

t statistics in parentheses, * p<.1, ** p<.05, *** p<.01 *Cheater* = 1 if student admitted to cheating. Omitted category is students not admitted to a specific school. All independent variables except age are binary variables.

Both before and after the revision, student beliefs about the vigilance of faculty had little effect on their cheating behavior as evidenced by the lack of significance of *faculty are vigilant, faculty will confront, faculty are vigilant * post, and faculty will confront * post* (in all cases except for *faculty will confront * post,* in the fourth column). However, one should note that following the implementation of the code, the belief that faculty are willing to confront cheaters, *faculty will confront * post,* begins to have a deterrent effect as evidenced by the negative, but statistically insignificant coefficients. The exception is the fourth column where statistical confidence in the reduction in cheating owing to faculty's willingness to confront cheaters reaches 90%. This reduction of over half a cheat per year, is equivalent to a reduction of a quarter cheat per year on average, approximately the same as the results in the second and third columns, when controlling for average years in school of 2.53. A quarter cheat reduction per year is sizeable when considering the average number of cheats is slightly over three-quarters of a cheat per year. The perception that faculty are more vigilant reduces cheating by 30%! These results are weak evidence that following the honor-code revision, students believe faculty members were taking cheating more seriously. However, students who perceived fellow students to be vigilant about detecting and reporting cheating, *students are vigilant,* were less likely to begin cheating and if they did cheat, were likely to cheat less. Yet this effect was attenuated by the implementation of the code, again suggesting that the culture and awareness on campus changed. The coefficient estimates suggest that students who believe peers are at least moderately vigilant about reporting offenses cheated approximately one less time per year, the marginal effect ranges from -0.5 to -1.2, prior to the code implementation. Following the implementation, the marginal effect is reduced to around a quarter of a cheat per year ranging from -0.235 to -0.607. However, more students now believe their peers are vigilant that before the implementation, evidence of a small step toward a culture of honesty. These results suggest that student perceptions of certainty of punishment may hinge more on expectations of fellow students than on faculty members.

The results presented suggest a change in attitude and culture toward a culture of honesty. An *F*-test of the interaction terms suggests a shift in culture across all four models with at least 99% confidence. The literature and these results suggest that revising honor policies or implementing an honor code may be less about the policy itself and more about instilling the belief that cheating is unacceptable under any circumstance as suggested by Passow et al. (2006).

Concluding Remarks

Reducing cheating is a necessary objective for universities to maintain the quality of the education they provide, and to protect and burnish their brands. Prior studies suggest that a traditional honor code, that puts the emphasis on a culture of honesty, is more effective than a broad set of honor policies and rules.
Those earlier studies anticipate some of our discoveries; we find that the implementation of a more traditional honor code resulted in an increase in self-reported cheating incidences, but not an increase in the number of students who cheat. This does not mean that the code causes more cheating, but that students admit to more cheating, possibly because of an elevated awareness of their actions. The new honor code helped to educate the student body about cheating.

We believe these results portray a heightened awareness of and vigilance in preventing cheating on the part of the post-code-change students. Barnard-Brak et al. (2013) suggest that reporting violations in accordance with a code and consequences handled at the university level may not be any more effective than individual faculty handling the violations. Their findings are in line with a broader literature on crime which suggests certainty of punishment, in this case by faculty or peer reporting, may be a better deterrent than the severity of a university system. The analysis presented here suggests that value of an honor code does not come through administrative reporting but through a change in perceptions and culture, a result in line with McCabe and Trevino (1997) who find peer disapproval, a culture of honesty, to be the strongest deterrent.

References

Arnold, Rodney, Barbara N. Martin, Michael Jinks, and Linda Bigby. 2007. "Is there a relationship between honor codes and academic dishonesty?" *Journal of College and Character* 8 (2): 1-20.

Barnard-Brak, Lucy, Marcelo Schmidt, and Tianlan Wei. 2013. "How effective is honor code reporting over instructor-implemented measures? A pilot study." *Journal of College and Character* 14 (3): 231-240.

Barnett, D.C., and J.C. Dalton. 1981. "Why college students cheat." *Journal of Political Economy* 22 (6): 545-551.

Becker, Gary S. 1974. "Crime and punishment: An economic approach." In *Essays in the Economics of Crime and Punishment*, by Gary S. Becker and William M. Landes, 1-54. UMI.

Bisping, Timothy O, Hilde Patron, and Kenneth Roskelley. 2008. "Modeling academic dishonesty: the role of student perceptions and misconduct type." *Journal of Economic Education* 39 (1): 4-21.

Bunn, D.N., S.B. Caudill, and D.M. Gropper. 1992. "Crime in the classroom: An economic analysis of undergraduate student cheating behavior." *Journal of Economic Education* 23 (Summer): 197-207.

Burrus, Robert T, Adam T Jones, William Sackley, and Michael Walker. 2013. "It's the students, stupid: How perceptions of student reporting impact cheating." *The American Economist* 58 (1): 51-59.

Burrus, Robert T, KimMarie McGoldrick, and Peter W. Schuhmann. 2007. "Self-reports of student cheating: Does a definition of cheating matter?" *Journal of Economic Education* 38 (1): 3-16.

Caudill, Steven B, and Franklin G Mixon. 2005. "Analysing misleading discrete responses: a logit model based on misclassified data." *Oxford Bulletin of Economics and Statistics* 67 (1): 105-113.

Franklyn-Stokes, A., and S.E. Newstead. 1995. "Undergraduate cheating: Who does what and why?" *Studies in Higher Education* 20 (2): 159-172.

Graham, M.A., J. Monday, K. O'Brien, and S. Steffen. 1994. "Cheating at small colleges: An examination of student and faculty attitudes and behaviors." *Journal of College Student Development* 35 (4): 255-260.

Green, M. & van Kessel, G. 2011. "Academic integrity as a university responsibility: What is the readabiliy of your policy?" *In Educational integrity: Culture and values. Proceedings 5th Asia Pacific Conference on Educational Integrity.* The University of Western Australia. 39-45.

Greene, A.S., and L. Saxe. 1992. "Everybody (else) does it: Academic cheating." *Presented at Annual Meeting of the Eastern Psychological Association.*

Grimes, Paul W, and Jon P Rezek. 2005. "The determinants of cheating by high school economics students: a comparative study of academic dishonesty in the transitional economies." *International Review of Economics Education* 4 (2): 23-45.

Hrasky, S. & Kronenberg, D. 2011. "Curriculum redesign as a faculty-centred approach to plagiarism reduction." *In Educational Integrity: Culture and values. Proceedings 5th Asia Pacific Conference on Educational Integrity.* the University of Western Australia. 46-58.

Jordan, Augustus E. 2001. "College student cheating: the role of motivation, perceived norms, attitutes, and knowledge of institutional policy." *Ethics and Behavior* 11 (3): 233-247.

Kerkvliet, J. 1994. "Cheating by economics students: A comparison of survey results." *Journal of Economic Education* 27 (2): 121-133.

Kibler, William L. 1993. "Academic dishonesty: A student development dilemma." *NASPA Journal* 30: 252-267.

Kisamore, Jennifer L, Thomas H Stone, and I M Jawahar. 2007. "Academic integrity: the relationship between individual and situational factors on misconduct contemplations." *Journal of Business Ethics* 75 (4): 381-394.

Koh. H.P., Scully, G. & Woodliff, D.R. 2011. "The impact of anticipation on accounting students' ethical decision making under time pressure." *In Educational integrity: Culture and values. Proceedings 5th Asia Pacific Conference on Educational Integrity.* The University of Western Australia. 66-81.

Ledesma, Rodolfo G. 2011. "Academic dishonesty among undergraduate students in a Korean University." *Research in World Economy* 2 (2): 25-35.

Magnus, Jan R., Victor M. Polterovich, Dmitri L. Danilov, and Alexei, V. Savvateev. 2002. "Tolerance of cheating: An analysis across countries." *Journal of Economic Education* 33 (2): 125-135.

McCabe, D., and L. Trevino. 1997. "Individual and contextual influences on academic dishonesty: A multicampus investigation." *Research in Higher Education* 379-396.

McCabe, Donald L., Linda K. Trevino, and Kenneth D. Butterfield. 1999. "Academic integrity in honor code and non-honor code environments: A qualitative investigation." *The Journal of Higher Education* 70 (2): 211-234.

Meade, J. 1992. "Cheating: Is academic dishonesty par for the course?" *Prism* 1 (7): 30-32.

Mixon, F.G. 1996. "Crimes in the classroom: An extension." *Journal of Economic Education* 27 (3): 195-200.

Neville, L. 2012. "Do economic equality and generalized trust inhibit academic dishonesty? Evidence from state-level search-engine queries." *Psychological Science* 23. (4.): 339-345.

Nonis, Sarath, and Cathy Owens Swift. 2001. "An examination of the relationship between academic dishonesty and workplace dishonesty: A multicampus investigation." *Journa of Education for Business* 77 (2): 69-77.

Passow, Honor J, Matthew J Mayhew, Cynthia J Finelli, Trevor S Harding, and Donald D Carpenter. 2006. "Factors influencing engineering students' decisions to cheat by type of assessment." *Research in Higher Education* 47 (6): 643-684.

Premeaux, S R. 2005. "Undergraduate student perceptions regarding cheating: tier 1 versus tier 2 AACSB accredited business schools." *Journal of Business Ethics* 62 (4): 407-418.

Roig, Miguel, and Carol Ballew. 1992. "Attitudes toward cheating by college students and professors." *Presented at Annual Meeting of the Eastern Psychological Association.*

Simha, Aditya, and John B Cullen. 2012. "A comprehensive literature review on cheating." *International Journal of Cyber Ethics in Education* 2 (4): 24-44.

Sims, Randi L. 1993. "The relationship between academic dishonesty and unethical business practices." *Journal of Education for Business* 68 (4): 207-211.

Singhal, A.C. 1982. "Factors in students' dishonesty." *Psychological Reports* 51 (December): 775-780.

Siniver, Erez. 2013. "Cheating on exams: the case of Israeli students." *College Student Journal* 47: 593-604.

Stern, E., and L. Havlicek. 1986. "Academic misconduct: Results of faculty and undergraduate student surveys." *Journal of Allied Health* 5 (2): 129-142.

Teh, E.C. & Pauli, M. 2013. "Reducing the prevalence of plagiarism: A model for staff, students and universities." *In Special Issue: teaching and learning in higher education: Western Australia's TL Forum. Issues in Educational Research* 23 (2): 283-298.

Williams, Melanie Stallings, and William R Hosek. 2003. "Strategies for reducing academic dishonesty." *Journal of Legal Studies Education* 21 (1): 87-107.

Financial Literacy in the Community College Classroom: A Curriculum Intervention Study

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Abstract

Urban Community College asked the Federal Reserve Bank of St. Louis to develop a financial literacy curriculum unit for its New Student Course. The unit was taught in 62 randomly selected sections, with 31 of those serving as the control group. We evaluated the effectiveness of the unit based on student pre-test and post-test scores. We found that student pre-test scores, academic ability, teacher experience, and participation in the unit were statistically significant predictors of student post-test scores. On average, students taught the financial literacy curriculum unit scored about 7 percentage points higher than students who were not.

Introduction

Today's young adults face increasingly complex financial decisions but often lack a basic understanding of financial terms and concepts, inhibiting their ability to make sound financial choices for themselves and their families (Lusardi and Mitchell 2014). Chen and Volpe (1998) and Shim et al. (2010) report a lack of financial literacy among college students in particular. The 2012 Financial Industry Regulatory Authority (FINRA) Foundation's National Capability Study reports survey findings about the financial knowledge and behaviors of U.S. adults. The study reports that 18 to 34 year olds scored lower on a financial literacy test than those in older age groups and their lack of financial knowledge correlates with poor financial behaviors (FINRA 2014).

Urban Community College (UCC) is the largest college in the state's 16 community college system. As of fall 2013, enrollment across UCC's six campuses (City Center, City South, Technology, County North, County South, and County East) was approximately 13,500 students. Because of rising student loan default rates and the perceived low financial literacy among its students, UCC asked the Federal Reserve Bank of St. Louis (St. Louis Fed) to help develop a financial education program for UCC students. After weighing various options, they together decided to incorporate financial education into the UCC New Student course (NSC).[3] The three-hour, graded, NSC is required for all incoming students to promote success in the college environment. The NSC, based heavily on the textbook *Focus on Community College Success* (Staley 2014), covers topics such as goal setting, study habits, and choosing a major. UCC invited the St. Louis Fed to develop, implement, and study a financial literacy curriculum unit as part of the NCS, which is the focus of this paper.

Specifically, the study addressed this question:

(1) What impact does including a financial literacy curriculum unit in the NSC have on student financial knowledge?

The paper proceeds as follows: We first review the related literature on financial education and financial literacy. Next, we explain the methodology used in the study, including its design and econometric

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[3] FRB also provides financial education programming to UCC's Single Parent Support Group and consultations services to UCC's Financial Literacy Committee, is a member of UCC's Student Loan Default Management Committee, and contributes articles to the school's Financial Literacy Newsletter.

techniques. We then introduce an additional research question that can be answered specifically by using hierarchal linear modeling. We then present the results of the study. The conclusion addresses policy implications, potential limitations of our research, and ideas for further study.

Literature Review

General Financial Education/Financial Literacy

Numerous studies and surveys find that the level of financial literacy in the United States is quite low (Lusardi, Mitchell, and Curto 2010; Lusardi and Mitchell 2009; and Mandell 2008). Other studies show that personal finance education contributes to more-informed financial decision-making. For example, Hilgert, Hogarth, and Beverly (2003) find a strong correlation between financial literacy and day-to-day money management skills. Carpena et al. (2011) find that financial education increases awareness of financial products and tools and changes people's attitudes about those products and tools. Chan and Stevens (2008) find that knowledge of retirement incentives is related to informed decision-making about retirement savings choices. In addition, they found that people misinformed about retirement-related financial options make poor choices about those options because they believe the misinformation to be correct. Other studies (e.g., vanRooj, Lusardi, and Alessi 2011; Yoong 2011; deBassa Scheresberg 2013; Almenberg and Deber 2011; Arrondel, Debbich, and Savignac 2012; Lusardi and Mitchell 2007 and 2011) indicate that the more financially literate people are, the more likely they are to participate in financial markets, invest in stocks, and plan for retirement—all presumed positive financial behaviors.

Financial Education/Financial Literacy Among Young Adults

In 2007, Shim, Serido, and Xiao (2011) began a longitudinal financial behavior study of first-year college students. By resurveying members of the cohort each year, the researchers study how early financial behaviors contribute to financial success and well-being into adulthood. Their 2011 survey finds that (1) high school and college students exposed to cumulative financial education show increases in financial knowledge and (2) increases in financial knowledge promote a sense of financial self-efficacy that drives increasingly responsible financial behavior into young adulthood. Early financial education increases the likelihood that students will pursue more financial education over time.

The FINRA (2014) study also offers evidence regarding the relationship between financial education and financial behaviors: Those with higher scores in financial knowledge and decision-making were more likely to plan for retirement, more likely to have a rainy day fund, and less likely to engage in costly credit card behaviors.

The College Savings Foundation's 2012 survey of college graduates 20 to 35 years of age found the following differences between those who graduated within the last year (recent grads) and those who graduated seven or more years earlier (older grads): 36 percent of recent grads lived with their parents longer than expected, compared with 24 percent of older grads; 70 percent of recent grads were employed, compared with 79 percent of older grads; and 40 percent of younger grads indicated that they were "definitely delaying buying a house for financial reasons", compared with 22 percent of older grads (College Savings Foundation 2012). Many of these survey results may be related to the 2007-09 recession. The crisis had a financial impact on the recent grads, and it likely raised their awareness of financial issues and made them more cautious regarding significant financial decisions such as marriage and buying a home. All of the results suggest that financial stress is a factor for recent grads and that financial literacy may help promote sound financial decision-making (Shim and Serido 2010)

Measuring the Effects of Financial Literacy/Education

According to Lusardi and Mitchell (2014), one way to determine the effects of financial literacy on economic outcomes is to use a field experiment, such as the one implemented in this study. In such experiments, a treatment group is exposed to a financial education program and their behavior is compared with those of a control group not exposed to the program. Collins and O'Rourke (2010) describe this as the "golden rule" of program evaluation. Walstad, Rebeck, and MacDonald (2010) conduct such an experiment to evaluate the use of a personal finance video series in high school classrooms. Their results show a

significant increase in personal finance knowledge among the students in the treatment group compared with those in the control group. Harter and Harter (2007) find evidence that using the Financial Fitness for Life (FFFL) with students in middle schools and high schools in Kentucky increased the financial literacy of those students. Butt, Haessler, and Schug (2008) conduct a study using FFFL as well and found a statistically significant increase in student scores from pre-test to post-test and that these students significantly outperformed the students in the control group.

Methodology

Study Design

The NSC is a 45-contact-hour course, of which UCC allotted 2.5 contact hours (plus homework time) to the new financial literacy curriculum unit.[4] To cover the most content possible within the time constraint, the St. Louis Fed selected lessons for the unit based on the *National Standards for Financial Literacy* (CEE 2013). All of the lessons come from existing St. Louis Fed material, which undergo a rigorous review process including classroom pilot testing. Some lessons were modified to accommodate the timeframe. (See the appendix for lesson information and modifications.)

In the fall of 2013, UCC offered 102 sections of the NSC across its six campuses. Because of the large offering, a UCC NSC course coordinator facilitates hiring course instructors, makes curriculum decisions, coordinates professional development, and handles all communication with the instructors regarding course logistics. The coordinator also teaches three sections of the course. Because she makes curriculum decisions, her sections were excluded from the study. Additionally, eight dual-credit sections with students from local high schools were excluded because these students might not have been of legal age to consent participation. Finally, one section was dropped at the end of the study because the instructor failed to complete the study requirements.[5] Thus, at the onset, the study included 93 sections of the NSC.

We randomly assigned sections, via randomized cluster assignment,[6] to one of two conditions: treatment or control. The treatment group included 62 sections with 37 instructors and 1,299 students, and the instructors taught the new financial literacy curriculum unit. The control groups include 31 sections with 15 instructors and 683 students, and the instructors taught the usual course with no changes. The Coalition for Evidence-Based Policy (2003), a subsidiary of the U.S. Department of Education, determined that studies that compare classrooms should include a minimum of 25 to 30 classes in each sample group. Thus, we were able to obtain this minimum threshold (with 31 classrooms in the control group), while simultaneously maximizing the number of students exposed to the treatment.

The lead researcher trained the treatment group instructors to use the new unit. The instructors could either take the two-hour training in-person during their UCC professional development day or via webinar. Participation was nearly equally distributed across the training types (53 percent in person v. 47 percent webinar).

The study used two instruments: a test for the students (given before and after the unit) and a survey for the instructors.[7] The test questions (hereafter pre-test and post-test) were taken from the Financial Fitness for Life (FFFL) High School examiners manual.[8] The advantage of using these questions is that they are from a nationally normed assessment. A possible disadvantage is that they were designed to accompany the FFFL curriculum, which was not used in this study. However, it is ultimately advantageous to use them over an assessment developed to "fit" the curriculum, which may bias the effect of the treatment because students are much more likely to perform well on it.

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[4] This is the equivalent to one week of a 15-week course.

[5] Participation in the study was required by UCC as a condition for teaching NSC; however, it was not possible to issue repercussions for failure to complete study components during the semester. Instead, instructors who failed to fully comply would not be considered eligible for rehire in subsequent semesters.

[6] The clustering agent was the instructor. Once a teacher was randomly assigned to a condition, all of that teacher's subsequent sections were assigned to that same condition. Sections per instructor ranged from one to five with an average of 1.75.

[7] Both instruments are available in the Appendix.

[8] We use a high school instrument for two reasons: 1. There is no nationally normed assessment for financial literacy at the college level (i.e. like there is with economics via the TUCE) and 2. Based on her knowledge student ability at UCC, the NSC Coordinator thought it would be ability appropriate.

To accommodate instructors who preferred to test during class time to help ensure student participation, the test instrument included only 10 questions. To provide content validity, the questions were chosen based on class time allotted to specific topics in the unit. For example, the 60-minute credit lesson comprised 40 percent of the unit; thus, four test questions covered credit. To accommodate varied cognitive levels, the test questions aligned with four level-one items, four level-two items, and two level-three items.[9] Pilot testing of the test instrument in two classes (a principles of microeconomics course at an area university and a local high school economics class comprising only seniors) resulted in an average test score of 43.6 percent.[10] Unfortunately, the test was not piloted with UCC students because of timing issues.

During the study, all UCC student testing was conducted through the St. Louis Fed's online course portal. Students were given unique usernames and passwords and assigned the pre- and post-tests as part of their course homework grade. However, this grade was based on completion only and not the actual scores on the tests. Test questions and answers were randomized so that no two students would see them in the exact order. Instructors were given three testing options: during class time in a computer lab, during class time on student devices, or on students' own time. Regardless of the option, students were required to complete both tests. Given that test questions were randomized, most instructors tested their classes in the computer labs (see Table 1), and that the score did not count towards their grade, we believe the students had little incentive to cheat on this assessment.

Students were able to take the pre-test from September 1 to September 30 and post-test from October 30 to November 30. This broad testing window served two purposes: First, although UCC instructors are required to cover certain core content, they may do so in almost any order. Treatment instructors were responsible for teaching the financial literacy curriculum after their students had pre-tested but before the post-testing period began. Second, the shortest amount of time that could elapse between pre-test and post-test was 30 days; thus, the post-test addressed both learning and retention. Of note, the randomization of the questions and time between testing likely lessened the possibility of practice effects.

The second instrument, the instructor survey, gathered the following instructor demographic characteristics: gender, race/ethnicity, education, major course of study, years of post-secondary teaching experience, and mode of pre- and post-testing students. Only the treatment instructors answered affective questions about the curriculum. Due to UCC policy, we were unable to gather demographic information at the student level but were able to aggregate student demographic data to the classroom level.

Table 1 below provides classroom-level summary statistics for the testing instruments across conditions for sections without missing data, $n = 86$. Differences in pre- and post-test scores across conditions are provided in Table 3 and discussed later. As the table shows, 80 percent of students took the pre-test, but participation dropped to 63 percent on the post-test. Students who dropped the course were removed from the study, so the loss is real in terms of student mortality on the post-test.[11] We expect the participation rate to be a predictor of student test scores by serving as a proxy for section motivation and/or engagement. The sections were located on the campuses as follows: 57 percent at the City Center campus, 20 percent at the City South campus, and the remaining 23 percent across the other four campuses. On average, the sections were 47 percent male, 29 percent black/African-American, 12 percent other minorities (which largely comprises Hispanics), and 59 percent white. The average student age is almost 24 years old. Sixty-five percent of the sections pre-tested as a whole group during class time in the computer lab; 69 percent post-tested in this manner. Finally, as shown in the section-level variables, the instructors rated 21 percent of their sections as having "below average" academic ability compared with the other sections they have taught previously.

[9] Cognitive levels were determined by the assessment authors, tested in the norming process, and provided in the examiners manual.

[10] This is consistent with the pre-test results across conditions, as shown in Table 1.

[11] Participation rates are calculated as the number of students testing divided by the number of students currently enrolled in the section. The average pre-test score of students who both pre- and post-tested is 42.52 percent. The average pre-test score of students who pre-tested but did not post-test is 41.66 percent. This difference is not statistically different (t-statistic –0.93, p-value 0.3522), thus we do not believe our model suffers from selection bias.

Table 1 - Classroom-Level Summary Statistics

Variable	n	Mean	Std Dev
Student-Level Variables (Aggregated to Classroom Level)			
Pre-Test Score	86	4.23	1.66
Post-Test Score	86	5.08	1.99
Pre-Test Participation Rate	86	0.80	0.13
Post-Test Participation Rate	86	0.63	0.20
Section-Level Variables			
Campus = City Center	86	0.57	0.50
Campus = City South	86	0.20	0.40
Campus = County South	86	0.03	0.18
Campus = County East	86	0.09	0.29
Campus = Technology	86	0.06	0.24
Campus = County North	86	0.05	0.21
% Male	86	0.47	0.15
% Black	86	0.29	0.20
% Other Minority	86	0.12	0.09
% White	86	0.59	0.24
Avg. Student Age	86	23.84	3.13
Pre-Tested in Computer Lab	86	0.65	0.48
Post-Tested in Computer Lab	86	0.69	0.47
Academic Ability (Below Avg. = 1)	86	0.21	0.41
Teacher-Level Variables			
Treatment	86	0.69	0.47
Male	86	0.23	0.42
White	86	0.69	0.47
Years of Teaching Experience	86	8.06	9.56
Education = Masters+	86	0.79	0.41
Received In-Person Training	59	0.53	0.50
Felt Prepared to Teach Unit (SA or A =1)	59	0.73	0.45
Excited To Teach Unit (SA or A = 1)	59	0.73	0.45
Thought Difficulty Level Was Appropriate (SA or A = 1)	59	0.56	0.50
Thought Unit Was Valuable (SA or A = 1)	59	0.78	0.42
Would Teach Unit Again (SA or A =1)	59	0.39	0.49

Notes: n = 59 represents questions asked of treatment group teachers only. SA; strongly agree. A; agree.

As shown in the teacher-level variables, 23 percent of the teachers were male and 69 percent were white. They have an average eight years of teaching experiences, and 79 percent hold a master's degree or higher. The treatment teachers answered the affective questions as follows: 73 percent either “strongly agreed” or “agreed” they were adequately prepared to teach the unit; 73 percent either “strongly agreed” or “agreed”

they were "excited or enthusiastic" to teach the unit, and 78 percent either "strongly agreed" or "agreed" that the content was "valuable or benefitted" their students. A little more than half of the treatment teachers either "strongly agreed" or "agreed" that the difficulty level was "appropriate" for their students. Finally, only 39 percent of the treatment teachers either "strongly agreed" or "agreed" that given the opportunity, they would use the curriculum again in the NCS course.

Models and Econometrics

We model post-test scores as a function of the independent variables using the education production function

$$\text{Post}_s = f(\text{Pre}_s, C_s, T_s) \quad (1)$$

where Post = Average student post-test score for section *s*;
Pre = Average student pre-test score for section *s*;
C = Vector of classroom-level characteristics (including aggregated student demographic information) for section *s*; and
T = Vector of teacher demographic characteristics for section *s*.

We use hierarchical linear modeling (HLM), a multi-level analysis method, to conduct our analysis. Although ordinary least squares (OLS) is still commonly used to process multi-level data for economic education research, aggregating the data using OLS can be problematic.

An underlying assumption of OLS modeling is independence of observations. With our data, this assumption does not hold—OLS regression produces standard errors that are too small. In addition, because outcomes are gathered at the individual level and other variables are gathered at the section or teacher level, we had to decide how to handle the cross-level nature of the data. One option was to aggregate to the section or instructor level. In this case, average classroom achievement would have been affected by the teacher or section—called aggregation bias. However, it is proposed that with aggregation bias "as much of 80-90% of the individual variability on the outcome variable is lost, which leads to dramatic over or under-estimation of observed relationships between variables" (Osbourne 2000, pp. 1). In addition, changing the outcome variable from individual achievement to average classroom achievement would have also been problematic. Therefore, because OLS modeling can produce misestimated standard errors, we alternatively use HLM.

Hierarchical Linear Modeling

HLM models are often referred to as multi-level linear models, or nested models, because individual units of study are grouped (or nested) within higher-level units. For example, patients nested within doctors, individuals nested within families, or, in the case of our data, students nested within sections and teachers. HLM is frequently used in education research because students exist in a hierarchical structure (classroom, instructor, and school); that is, students are nested within classrooms, classrooms are nested within schools, and schools are nested within districts (Sullivan, Dukes, and Losina 1999).

Accounting for the nested nature of the data is important because people within a hierarchy are more similar to each other than people randomly sampled from the population. For example, in this study, students in NSC classrooms at UCC are more similar to one another than a random sample of students from the population. Further, students who choose to attend UCC do so for similar reasons, such as geography, cost, admission standards, and types of programs offered. As a result, these students come from a community or a part of the community that are more homogeneous than the population (Osbourne 2000). Additionally, students within a particular NSC section share the same instructor, classroom environment, and in-classroom experiences. These similarities lead to more homogeneity as well. So, observations based on individual students are not fully independent. HLM alleviates these problems: To estimate standard errors, it incorporates a unique random effect for each organizational unit (i.e., students, sections, teachers) into the model and the variability of these random effects is taken into account when estimating standard errors (Raudenbush and Bryk 2002).

We use a three-level model (student – section – teacher) because a teacher is able to teach more than one section but all of the students are from the same school.[12] The model details follow by level.

Student-Level Model

$$Post_{ijk} = \pi_{0jk} + \pi_{1jk} Pre_{ijk} + e_{ijk,} \quad (2a)$$

where

$Post_{ijk}$ = The post-test score for student i, in section j, with teacher k;
Pre_{ijk} = Pre-test score for student i, in section j, with teacher k; and
e_{ijk} = Student-level random effect (assumed to be normally distributed, with a mean of zero and variance of σ^2).

Section-Level Model

$$\pi_{0jk} = \beta_{00k} + \beta_{01k} Treatment_{jk} + \ldots + \beta_{pk} S_{pjk} + r_{0jk} \quad (2b)$$
$$\pi_{1jk} = \beta_{10k,}$$

where

$Treatment_{jk}$ = A dummy variable equal to 1 if section j with teacher k was in the treatment condition and 0 otherwise;

$S_{pjk} = p = 1\ldots$, P section-level characteristics for section j with teacher k; and
r_{0jk} = Section-level random effect.

Teacher-Level Model

$$\beta_{00k} = \gamma_{000} + \ldots + \beta_{ppk} T_{ppk} + u_{00k} \quad (2c)$$
$$\beta_{pk} = \gamma_{ppk,}$$

where

$T_{ppjk} = pp = 01..,$PP teacher-level characteristics for teacher k; and
u_{00k} = Teacher-level random effect.

By substitution, the mixed model takes the form

$$Post_{ijk} = \gamma_{000} + \ldots + \beta_{ppk} T_{ppk} + u_{00k} + \beta_{01k} Treatment_{jk} + \ldots + \beta_{pk} S_{pjk} + r_{0jk} + \pi_{1jk} Pre_{ijk} + e_{ijk.} \quad (2d)$$

Using HLM allows us to answer an additional research question: How much of the variance in financial literacy achievement scores is attributable to students, sections, and teachers?

Results

The average pre-test score was 42.1 percent for the treatment condition and 42.5 percent for the control condition (rounded, and shown in the Table 2 below). Using a pooled-sample t-test, we find the difference in pre-test scores is not statistically significant (t-statistic 1.04, p-value 0.3026) and conclude that both

[12] UCC has six campuses, which could alternatively be the highest organizational level. However, each teacher teaches at only one campus (even if they have multiple sections) and the distribution of sections at campuses other than City Center is small (i.e., the City Center accounts for almost 60 percent of the sections, with the remaining approximately 40 percent distributed throughout the other five campuses), thus there would be very little within-campus variation.

conditions start with the same level of financial knowledge. On the post-test, the average score was 52.7 percent for the treatment sections and 47.0 percent for the control sections, with a statistically significant difference between the two (*t*-statistic –2.68, *p*-value 0.0090). The treatment group's post-test score increased approximately 11 percentage points and the control group's approximately 4 percentage points (or 26 percent and 9 percent), respectively. There is a small increase in the control condition between pre- and post-test scores because the existing NSC curriculum (i.e., the textbook *Focus on Community College Success* [Staley 2014]) dedicates a few (5 out of 345 content) pages to the concept of budgeting and credit. Thus, the increase in post-test scores is directly attributed to more students correctly answering question 10 (budgeting) and 7 (credit) correctly on the post-test as shown in the item analysis below. This was expected. The control students also scored statistically significantly better on questions 1 and 5 and worse on question 3 in the post-test for reasons that are unknown. In the treatment condition, post-test scores were statistically significantly higher than pre-test scores for every question. The largest gains were seen in questions 1 and 7. These are the same questions the control condition increased by the greatest statistically significant amount, which is likely because the treatment students received the financial literacy curriculum and textbook content. Thus, based on difference-of-means analysis, the financial literacy curriculum unit did increase student financial knowledge as measured by student test scores.

Table 2 - Proportion Correct by Question on the Pre- and Post-Test by Condition

		Treatment (n=692)			Control (n = 376)		
Question	Cognitive Level	Pre-Test	Post-Test	Difference	Pre-Test	Post-Test	Difference
1	1	0.36	0.57	0.21***	0.37	0.43	0.07**
2	1	0.49	0.57	0.08***	0.52	0.53	0.01
3	3	0.19	0.28	0.09***	0.26	0.20	-0.06*
4	3	0.28	0.34	0.06***	0.28	0.33	0.04
5	2	0.55	0.69	0.14***	0.58	0.65	0.07**
6	2	0.62	0.70	0.08***	0.59	0.59	0.00
7	1	0.09	0.26	0.17***	0.08	0.20	0.12***
8	2	0.61	0.72	0.10***	0.68	0.69	0.01
9	2	0.55	0.63	0.08***	0.50	0.49	-0.01
10	1	0.46	0.60	0.14***	0.48	0.57	0.10***
All	-	0.42	0.53	0.11***	0.43	0.47	0.04***

Notes: ***p<0.01, **p<0.05, *p<0.10, two-tailed paired-sample *t*-test. Cognitive levels determined by instrument authors where 1 = knowledge; 2 = comprehension; and 3 = application (Walstad and Rebeck 2006)

Table 3 shows the results from the HLM regressions using Models 2a-c. Column 1 shows the results from the unconditional model with no covariates. This information is needed to calculate the intraclass correlation coefficient (ICC), which measures the outcome variance between the two groups. For example, the ICCs for the teacher (*T*) and section (*S*) level are calculated as follows:

$$ICC_T = \frac{\sigma_T^2}{\sigma_e^2 + \sigma_T^2 + \sigma_S^2}$$

$$ICC_S = \frac{\sigma_S^2}{\sigma_e^2 + \sigma_T^2 + \sigma_S^2}$$

Column 2 shows the results from the HLM regression using observations at the student level with no missing data (at any level). Columns 3 and 4 shows results from the best-fitting conditional model with covariates at the section and teacher levels, respectively, with no missing data (at any level).

Table 3 - HLM Estimation of Post-Test Score, Students with Non-Missing Data Only

	-1-	-2-	-3-	-4-	-5-
Fixed Effects					
Intercept	5.04	3.19	3.34	2.57	2.77
	(0.12)	(0.18)	(0.49)	(0.24)	(0.32)
Pre_Test		0.44***	0.45***	0.45***	0.48***
		(0.03)	(0.03)	(0.03)	(0.04)
Treatment			0.75***	0.65***	-
			(0.23)	(0.24)	-
Academic Ability			-0.34*	-	-
			(0.21)	-	-
Teacher Experience				0.02*	0.03***
				(0.08)	(0.01)
Webinar Training					-0.49**
					(0.21)
Teacher Excitement					0.60**
					(0.24)
Error Variance					
Level-1	3.38***	2.78***	2.78***	2.78***	2.81***
	(0.14)	(0.12)	(0.13)	(0.13)	(0.16)
Intercept (Section)	0.22**	0.23**	0.21**	0.20**	0.36
	(0.10)	(0.10)	(0.09)	(0.09)	(0.12)
Intercept (Teacher)	0.34***	0.37***	0.25***	0.25***	-
	(0.13)	(0.13)	(0.10)	(0.10)	-
Model Fit					
AIC	4945.5	4293.8	4223.7	4223.3	2745.8
BIC	4953.3	4303.6	4237.2	4236.8	2760.5
n	1,068	1,068	1,068	1,068	692

Notes: ***p<0.01, **p<0.05, *p<0.10; Entries show parameter estimates with standard errors in parenthesis.

As shown in Column 1 for the unconditional model, all of the error variance coefficients are significant, meaning differences among the test score by section- and teacher-level are statistically significant. Additionally, the larger coefficient on the Level-1 (student) coefficient signals that more of the variation in post-test scores is attributable to students. Using the formulas presented above, we calculate the ICC at each level and, in fact, find this to be the case. Specifically, we find 8.7 percent of the variation in post-test scores attributable to teachers, 5.6 percent to sections, and 85.6 percent to students ($100 - ICC_T - ICC_S$).

The best-fitting conditional models for the entire sample with non-missing data are presented in Columns 2 through 4, which start with student-level covariates (Column 2) and build to include teacher-level (Column 3) and section-level (Column 4) covariates. Across all three specifications, student pre-test scores are a significant predictor of student post-test scores. This finding indicates the importance of controlling for existing levels of financial literacy knowledge when trying to determine the impact of a particular treatment. As expected, in specifications 3 and 4, which included this control, placement in the treatment condition is a positive, significant predictor of test scores. On average, students taught the financial literacy curriculum unit

scored about 6.5 to 7.5 percentage points higher (depending on the model) than students not taught the unit.[13] We also see that a section's academic ability (as described by the teacher) is statistically significant predictor of post-test scores. Specifically, in specification 3, a section's academic ability is a negative, significant predictor of its post-test scores. This finding indicates that sections with higher academic ability will score about 3.4 percentage points higher on the post-test. However, a section's academic ability is not a statistically significant predictor once we include the teacher-level covariates (and actually hinders model fit, so is left out of the specification 4 regression). In specification 4, the only significant teacher-level covariate was teacher experience. However, the coefficient estimate is very small—each year of teacher post-secondary teaching experience adds 0.02 percentage points to a student's post-test score.

The significant coefficients on the covariance parameter estimates in specifications 2 through 4 also indicate significant differences in average post-test scores across and between levels. Thus, we conclude that the course-wide intervention program did have a positive effect on student financial knowledge. Specifically, after controlling for existing knowledge based on pre-test scores (specifications 2 to 4), the section's academic ability (specification 3), and teacher experience (specification 4), the difference between the financial knowledge of students is statistically significantly.

Finally, we take the non-missing student sample (n= 1,068) and pair it down to the treatment sections (n = 692) only in order to examine any differences in training methods or affective questions from the survey. The best-fitting conditional model, with covariates at the section level (i.e. using Models 2a-b) and below, is presented in Column 5.We find some interesting results. Specifically, if a teacher attended training via webinar their students scored about 5 percentage points worse than students with teachers who received in-person training. This is a very important finding for providers of professional development such as us because it clearly shows that not all training is created equal. In this case, receiving the training in-person is better. As a result of this finding (coupled along with examination of the instructor survey results by training method) we recommended to UCC that training on this curriculum be done solely in-person.[14] With respect to the affective survey questions, we only found a significant relationship with respect to teacher excitement and student post-test scores. Students whose teachers strongly agreed or agreed they were excited or enthusiastic to teach the financial literacy unit as part of the NSC 100 course scored 6 percentage points better than students who did not have an enthusiastic teacher. Finally, as was the case with specification 4, teacher experience contributes a very small, but statistically significant amount to student post-test scores.

Conclusion

Our study examined whether a financial literacy curriculum unit within the New Student Course at Urban Community College, could positively influence student financial knowledge. Based on the pre-test, we found incoming UCC new students' existing financial knowledge low: They scored, on average, 42 percent on the 10-question pre-test. After the intervention, students scored, on average, about 7 percentage points (depending on the model) higher on the post-test. Thus, we conclude a positive impact on student financial knowledge from participation in the Federal Reserve Bank of St. Louis' financial literacy curriculum unit within the NSC.

We also examined the impact of instructor demographics on student financial knowledge based on instructor responses to survey questions. We find that teacher excitement/enthusiasm has a positive impact (6 percentage points) on student financial knowledge, and teacher experience has a very small (0.02 percentage points), positive impact on student financial knowledge.

Furthermore, while we see gains, we acknowledge that student *ex-post* knowledge remains relatively low. Ideally, students would score 80 percent or higher on the post-test. It is important to remember, however, that the gains realized resulted from only 2.5 classroom contact hours. We believe, and have made a recommendation to UCC accordingly, that more time dedicated to the financial literacy curriculum unit within the NSC will result in much larger gains.

[13] As a specification check, we also ran the models with the dependent variable as the gain score (i.e. Pre-Test Score – Post-Test Score) and found similar results, .60 and .72 respectively.

[14] UCC agreed, and in a second round of this study conducted in the Fall of 2014, that was the case. We use the results of the second round to discuss changes made the curriculum, training, along with instructor effects, in another manuscript currently in development.

Finally, we used hierarchical linear modeling to account for the nested nature of the data and alleviate potential cross-level issues presented with OLS. HLM also allowed us to attribute variation in student post-test scores to specific levels. We found 8.7 percent attributable to teachers, 5.6 percent to sections, and 85.6 percent to students.

For our results to be meaningful, limitations of our study must be acknowledged. First, and the biggest, our study lacks student-level demographic data due to UCC policy beyond our control. Should we pursue such a study again, we would like to include student-level data and possibly a student attitudinal survey. Second, this study is based on a specific curriculum at a specific community college. Caution is warranted if trying to apply these findings to other contexts.

References

Almenberg, Johan and Anna Dreber. 2011. "Gender, Stock Market Participation and Financial Literacy." *Working Paper Series in Economics and Finance 737*, Stockholm School of Economics, revised Aug. 16, 2011.

Arrondel, Luc, Majdi Debbich, and Frédérique Savignac. 2012. "Stockholding and Financial Literacy in the French Population." *International Journal of Social Sciences and Humanity Studies*, 4(2): 285-294.

Butt, Nicole M., Stephen J. Haessler and Mark C. Schug. 2008. "An Incentives-Based Approach to Implementing *Financial Fitness for Life* in the Milwaukee Public Schools." *Journal of Private Enterprise,* 24(1): 165-174.

Carpena, Fenella, Shawn Cole, Jeremy Sharpiro, and Bilal Zia. 2011. "Unpacking the causal chain of financial literacy." *World Bank Policy Research Working Paper 5798*, Sept. 2011.

Chan, Sewin and Ann Huff Stevens. 2008. "What You Don't Know Cannot Help You: Pension Knowledge and Retirement Decision-making." *Review of Economics and Statistics*, 90: 253-266.

Chen, Haiyang and Ronald P. Volpe. 1998. "An Analysis of Personal Financial Literacy Among College Students." *Financial Services Review*, 7(2): 107-128.

Coalition for Evidence-Based Policy. 2003. *Identifying and implementing educational practice supported by rigorous evidence: A user friendly guide.* Retrieved May 15, 2014, at https://www2.ed.gov/rschstat/research/pubs/rigorousevid/rigorousevid.pdf .

College Savings Foundation. 2012. *2012 Survey of Youth*. Retrieved May 1, 2014 at http://www.collegesavingsfoundation.org/pdf/YouthSurveyExecSummaryFinal2012.pdf.

Collins, J. Michael and Collin M. O'Rourke. 2010. "Financial Education and Counseling: Still Holding Promise." *Journal of Consumer Affairs*, 44(3): 483-489.

Council for Economic Education. 2013. *National Standards for Financial Literacy*, New York: The Council for Economic Education.

de Bassa Scheresberb, Carlo. 2013. "Financial Literacy and Financial Behavior among Young Adults: Evidence and Implications." *Numeracy*, 6(2), Article 5.

Financial Industry Regulatory Authority. 2014. *The Financial Capability of Young Adults—A Generational View*, based on data from the 2012 National Financial Capability Study. Retrieved May 1, 2014, from http://www.usfinancialcapability.org/.

Harter, Cynthia L. and John F. R. Harter. 2007. "Assessing the Effectiveness of Financial Fitness for Life in Eastern Kentucky." Retrieved May 10, 2014, from http://www.aeaweb.org/annual_mtg_papers/2007/0105_1015_1204.pdf.

Hilgert, Marianne A., Jeanne M. Hogarth, and Sandra G. Beverly. 2003. "Household Financial Management: The Connection between Knowledge and Behavior." *Federal Reserve Bulletin*, 89(7): 309-312.

Lusardi, Annamaria and Olivia S. Mitchell. 2007. "Financial Literacy and Retirement Preparedness: Evidence and Implications for Financial Education." *Business Economics*, January 2007: 35-44.

Lusardi, Annamaria and Olivia S. Mitchell. 2009. "How Ordinary Consumers Make Complex Economic Decisions: Financial Literacy and Retirement Readiness." *NBER Working Paper 15350.*

Lusardi, Annamaria and Olivia S. Mitchell. 2010. "Financial Literacy Among the Young." *Journal of Consumer Affairs*, 44(2): 358-380.

Lusardi, Annamaria and Olivia S. Mitchell. 2014. "The Economic Importance of Financial Literacy." *Journal of Economic Literature*, 52(1): 5-44.

Mandell, Lewis. 2008. "Financial Education in High School." In *Overcoming the Saving Slump: How to Increase the Effectiveness of Financial Education and Saving Programs*, Editor: Annamaria Lusardi. Chicago: University of Chicago Press: 257-279.

Marlin, James W. 1991. "State-mandated Economic Education, Teacher Attitudes, and Student Learning." *Journal of Economic Education*, Winter 22(1): 5-14.

Osbourne, Jason W. 2000. "Advantages of Hierarchical Linear Modeling." *Practical Assessment, Research & Evaluation*, 7(1). Retrieved May 19, 2014, from http://PAREonline.net/getvn.asap?v=7&n=1.

Raudenbush, Stephen W. and Anthony S. Bryk. 2002. *Hierarchical Linear Models: Applications and Data Analysis Methods*. 2nd ed. Sage Publications: Thousand Oaks, CA.

Shim, Soyeon, Bonnie L. Barber, Noel A. Card, Jing Jian Xiao, and Joyce Sherido. 2010. "Financial Socialization of First-Year College Students: The Role of Parents, Work, and Education." *Journal of Youth and Adolescence*, 39(12): 1457-1470.

Shim, Soyeon and Joyce Sherido 2010. "Arizona Pathways to Life Success for University Students Wave 1.5 Economic Impact Study: Financial Well-Being, Coping Behaviors and Trust Among Young Adults." Retrieved May 1, 2014 from shttp://aplus.arizona.edu/wave1_5_report.pdf

Shim, Soyeon, Joyce Serido, Jing Jian Xiao. 2011. "Young Adults' Financial Capability APLUS Arizona Pathways to Life Success for University Students Wave 2." Retrieved May 1, 2014 from http://aplus.arizona.edu/Wave-2-Report.pdf

Sullivan, Lisa M., Kimberly A. Dukes and Elena Losina. 1999. *Tutorial in Biostatistics: An Introduction to Hierarchical Linear Modeling*. Retrieved May 1, 2014, from http://www.stat.cmu.edu/~brian/763/week02/some%20nice%20papers/sullivan_hiermodel.pdf.

Staley, Constance. 2014. *Focus on Community College Success*. 3rd ed. Wadsworth, Cengage Learning: Boston.

Van Rooij, Maarten, Annamaria Lusardi, and Rob Allessi. 2011. "Financial Literacy and Stock Market Participation." *Journal of Financial Economics*, 101(2): 449-472.

Walstad, William and Kenneth Rebeck. 2006. *Financial Fitness for Life: High School Test Examiners Manual*. National Council on Economic Education: New York, NY.

Walstad, William, Kenneth Rebeck, and Richard MacDonald. 2010. "The Effects of Financial Education on the Financial Knowledge of High School Students." *Journal of Consumer Affairs*, 44(3): 336-357.

Yoong, Joanne. 2011. "Financial Literacy and Stock Market Participation: Evidence from the Rand American Life Panel in Financial Literacy." In *Implications for Retirement Security and the financial Marketplace.* Editors: Olivia S. Mitchell and Annamaria Lusardi. 76-97, Oxford and New York: Oxford University Press.

Appendix

Table A1 - Financial Literacy Curriculum Unit

Unit	Time (mins)	Lesson	Modifications
Income	30	It's Your Paycheck, Lesson 1 Invest in yourself	Omit procedure step 17
		(Homework) Page One Economics Article "Investing In Yourself"	Omit "For Further Discussion" section
Saving	45	It's Your Paycheck, Lesson 5: Savvy Savers	Omit Handouts 5.2 and 5.3 and corresponding procedure steps
		No-Frills Money Skills: Growing Money – Compound Interest – Episode 1	
Credit	60	Cards, Cars & Currency, Lesson 2: Credit Cards- A Package Deal	Procedure steps 1 – 8 only and use Handouts 2.4, 2.5 and 2.6 as a group work activity
		It's Your Paycheck, Lesson 7, Creditors' Criteria and Borrowers' Rights and Responsibilities	Procedure steps 1 – 5 only
		(Homework) Credit Cred Online Course	
Budgeting	15	It's Your Paycheck: Lesson 4 – Your Budget Plan	Procedure steps 1 – 5 only, Handout 4.6 + creating their own budget

Notes: Lessons referenced can be found at http://www.stlouisfed.org/education

Testing Instrument[15]

1. Human capital consists of:
a. knowledge and skills.
b. stocks and bonds.
c. plant and equipment.
d. savings and investment.

2. What is the difference between gross and net pay?
a. Net pay is gross pay minus saving.
b. Gross pay is net pay minus saving.
c. Gross pay is net pay minus deductions.
d. Net pay is gross pay minus deductions.

[15] Questions from the *Financial Fitness for Life: Test Manual, Grades 9-12*. Copyright © 2005 Council for Economic Education, New York, NY. Used with permission. All rights reserved. For more information visit www.councilforeconed.org or call 1-212-730-7007.

3. Charlie opens a savings account and deposits $500. If the savings account has a fixed annual interest rate of 5 percent, and he makes no additional deposits or withdrawals, what amount will Charlie have in his savings account at the end of two years?
a. exactly $505.
b. exactly $550.
c. less than $550
d. more than $550.

4. About how many years would it take for $1,000 to become $2,000 if $1,000 is deposited in a savings account with an interest rate of 7.2 percent?
a. 7.2
b. 10.0
c. 14.4
d. 20.0

5. What is the general relationship between risk and reward?
a. the higher the risk, the lower the potential reward.
b. the higher the risk, the higher the potential reward.
c. the amount of risk does not influence potential reward.
d. there is a relationship, but it is uncertain.

6. A key advantage of getting credit is that it can help people:
a. sell assets.
b. increase their net worth.
c. reduce risk when investing in stocks.
d. buy a good or service today and pay for it later.

7. Which three things do creditors consider to be most important when judging a person's creditworthiness to buy a house or a car?
a. marital status, gender, location
b. character, collateral, and capacity
c. length of loan, credibility, commissions
d. occupations, connections, income sources

8. What is the relationship between the interest rate charged an individual and a person's risk of nonpayment of a loan?
a. a relationship exists, but it can be either direct or indirect
b. the lower the risk of nonpayment, the higher the interest rate
c. the higher the risk of nonpayment, the higher the interest rate
d. no relationship exists between the interest rate and risk of nonpayment

9. Which type of financial institution typically charges the highest interest rate for loans?
a. credit unions
b. commercial banks
c. savings and loans
d. payday loan companies

10. Disposable income is the money that is:
a. spent or saved after deductions.
b. deducted from your paycheck.
c. budgeted for variable expenses.
d. saved and invested each month.

Survey Instrument

1. What is your gender?
a. Male
b. Female

2. Which of the following best describes your race/ethnicity?
a. White
b. Black or African American
c. Hispanic or Latino
d. Asian
e. American Indian or Alaska Native
f. Native Hawaiian or other Pacific Islander

3. Counting this year, how many years have you worked as a post-secondary teacher/instructor/professor? If less than 6 months total, enter "00"

4. What is the highest academic degree you hold?
a. High-school diploma or GED
b. Associate degree/vocational certification
c. Bachelor's degree
d. Master's degree
e. Education specialist or professional diploma based on at least one year's work past master's degree
f. Doctorate (e.g., Ph.D.)
g. Professional degree (e.g., M.D., L.L.B., J.D., D.D.S.)

5. For your highest academic degree, what was your major course of study?

6. For the student **pre-test**, what was the mode of testing?
a. Took students to computer lab during class time
b. Allowed students to take test in class on their own devices
c. Students took test on their own, outside of class

7. For the student **post-test**, what was the mode of testing?
a. Took students to computer lab during class time
b. Allowed students to take test in class on their own devices
c. Students took test on their own, outside of class

8. In general, how would you rate the academic ability of your students compared to other students at UCC? If you have multiple sections, answer considering all of your sections.
a. Above average
b. About the same or average
c. Below average

<For treatment instructors only questions 9 – 14>

9. I was adequately prepared to teach the financial literacy curriculum unit as part of the NSC 100 course.
a. Strongly Agree
b. Agree
c. Disagree
d. Strongly Disagree

10. I was excited or enthusiastic about teaching the financial literacy curriculum unit as part of the NSC 100 course.
a. Strongly Agree
b. Agree

c. Disagree
d. Strongly Disagree

11. The difficultly level of financial literacy curriculum material was appropriate for my students.
a. Strongly Agree
b. Agree
c. Disagree
d. Strongly Disagree

12. The financial literacy content was valuable or benefited my students.
a. Strongly Agree
b. Agree
c. Disagree
d. Strongly Disagree

13. If given the opportunity, I would use this curriculum again in my NSC 100 course(s).
a. Strongly Agree
b. Agree
c. Disagree
d. Strongly Disagree

14. We value your feedback. Please provide suggestions to help us improve the financial literacy curriculum materials and/or training going forward.

Using Bloomberg Terminal in Corporate Finance Courses

Qian Li and Jinghua Wang[1]

Abstract

In this paper, we explore the use of the Bloomberg Professional data service in teaching corporate finance subjects. Integrating the Bloomberg service with teaching enables corporate finance faculty to improve teaching effectiveness and helps business schools meet the Advance Collegiate Schools of Business (AACSB) standards. Following essential corporate finance topics outlined in frequently adapted textbooks, we present detailed information on how to collect useful information and data from Bloomberg to assist the teaching of these topics.

Introduction

The Bloomberg Professional service is an interactive network of financial information. It is a powerful platform for finance professionals to access real-time market data, news, and analytics. Over 2.5 million finance professions are using the Bloomberg Professional system, and business schools are catching up. According to Bloomberg.com, over 700 universities worldwide have subscribed to the Bloomberg service and set up finance labs equipped with Bloomberg Terminals. Compared to free internet resources such as finance.yahoo.com, cnbc.com, or the SEC's EDGAR website, the Bloomberg service has much broader and more comprehensive data coverage. The Bloomberg system can help students to develop research skills to access and evaluate market, industry and company information, as well as gain broad industry knowledge. It can also help students develop analytical skills and make decisions based on real events and real data. Overall, when finance programs use the Bloomberg system in their experiential learning design, students benefit from having the opportunities to develop skills and competencies highly demanded by today's business environment

The Association to Advance Collegiate Schools of Business (AACSB)'s 2015 standards of accreditation advocates the appropriate integration of academic and professional engagement and faculty' effort to pursue continuous improvement in educational programs. The application of Bloomberg in classes enables faculty to achieve high-quality learning outcomes and effective curricula. These enhanced faculty-student interactions, improvement in students' analytical and critical thinking skills, and improvement in students' use of information technology are allied with AACSB's standards and learning goals. Therefore, using Bloomberg in corporate finance classrooms can be considered a meaningful way to assist business schools in meeting the AACSB's standards by improving the following General Skill Areas proposed by AACSB: analytical thinking, information technology, and application of knowledge.

Since the Bloomberg Professional service is famous for providing historical and current security price and return data, business schools frequently adapt it in the design of their Investment, Trading, or Portfolio Management classes. Bloomberg also provides public and private company accounting data and corporate finance datasets, including the Global M&A and IPO database. In this article, we explore the practice of using Bloomberg data to assist teaching in corporate finance/financial management classrooms. Use of the Bloomberg Terminal should not be limited to a specific security analysis or portfolio management course or

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a small group of students such as the members of a student-managed investment fund. Especially for schools with limited financial resources and a small budget, more classes and students should use this service.
The rest of this article is organized as follows: we start with a brief review of literature in the use of the Bloomberg Professional service in teaching finance classes. We then present a list of essential corporate finance topics that ca n use the data from the Bloomberg system in the teaching of these topics. Next we present a detailed description of data provided by Bloomberg and how to access these data. We conclude the article in the last section of this article.

Literature Review

According to Siam (2005), having a trading center equipped by state-of-the-art technologies such as the Bloomberg Professional services can bring tremendous benefit for business schools. For example, it can help schools to establish a reputation for innovative teaching methodology, develop a new curriculum, and promote faculty and student research.

Schools subscribing to Bloomberg generally used it in the investment area, including the introductory level Investment class, more advanced Market Microstructure classes, or Portfolio Management classes. For example, Coe, Killc, and Isik (2007) discussed how the Bloomberg system, as part of Quinnipiac University's Financial Technology Center, helps in developing a market microstructure and trading course. Lei and Li (2012) described how to use data from the Bloomberg Service to prepare an analyst report in a security analysis and portfolio management course.

Coe (2007) provided an overview about how the Bloomberg Professional system can be used in many finance courses, including, but not limited to, those dealing with Financial Management, Investment, Derivatives, and Banking. To our knowledge, Coe (2007) is the only article in literature that briefly discusses how the Bloomberg system can be used in a corporate finance/financial management course, but his discussion in this area is limited in financial ratio analysis and WACC estimation. Therefore, our article can be viewed as an extension to Coe (2007) and it provides a thorough review of what we can do to incorporate Bloomberg in teaching corporate finance courses.

List of Essential Corporate Finance Topics

We propose to use Bloomberg to access information about the following essential corporate finance topics in class. We base this list on the topics selected in many widely-adapted corporate finance/financial management textbooks such as Brigham and Davis (2013, 11e) and Ross, Westerfield, Jaffe and Jordan (2014, 4e).

1. Financial (statement) analysis, including ratio analysis
2. Cost of Capital (WACC)
3. Firm valuation
4. Capital structure
5. Payout policy: dividends and stock repurchase
6. Mergers and acquisitions
7. Raising capital (IPO)

Corporate finance courses frequently cover topics such as bond valuation, and risk and return, including the introduction of asset pricing models such as CAPM. However, since they largely overlap with the coverage from a typical Investment or Portfolio Management class, we do not include these topics in this article.

In the next section, we illustrate the information provided by Bloomberg, including Bloomberg functions and screen examples that help us collect data and information crucial to corporate financial management. To better explain the process we will use the company Johnson and Johnson (ticker: JNJ) as an example throughout this paper, and demonstrate how instructors can guide students to collect relevant information from Bloomberg and conduct financial and valuation analysis based on the information collected.

Using the Bloomberg Professional Service in Teaching These Topics

In this section we present an introduction to the contents available on Bloomberg that can assist the teaching of essential and important topics in corporate finance/financial management classes.

Financial Statements and Financial Analysis

A corporate finance course typically starts with an introduction to financial statements and financial statement analysis, including financial ratio analysis. Financial statements are easily accessible from the Bloomberg service. Typing JNJ <US EQUITY> FA can lead us to the Financial Analysis screen (see Figure 1). From there, we can choose Tab 2) I/S to select the Income Statements, Tab 3) B/S for the Balance Sheets, or Tab 4) C/F for the Statement of Cash Flows. The data can be customized (annual or quarterly), and the observation periods can be specified for up to 10 years. As we mentioned in the introduction, the Bloomberg service excels in providing broader and more comprehensive coverage compared to some popular Internet resources. For example, if a student needs to obtain a company's balance sheet and download the balance sheet data into an Excel spreadsheet, he or she would find that Yahoo only provides balance sheet data for the most recent three years and the most recent four years from CNBC website. Bloomberg however provides up to 10 years of balance sheet data that is more detailed and is easily downloadable to a spreadsheet for further analysis.

Figure 1: Financial Analysis (Command: JNJ <US Equity> FA)

JOHNSON&JOHNSON Equity | FA | Related Functions | Menu | New Message

JNJ US $ C 105.78 -.60 T105.77 /105.78N 2 x 269
On 26 Feb d Vol 9,049,441 O 106.82T H 106.92N L 105.42T Val 959.496M

JNJ US Equity | 96) Actions | 97) Output | 98) Settings | Financial Analysis

ADJ Johnson & Johnson | Periodicity Annuals | Currency USD

1) Key Stats | 2) I/S | 3) B/S | 4) C/F | 5) Ratios | 6) Segments | 7) Addl | 8) ESG | 9) Custom

11) Adj Highlights | 12) GAAP Highlights | 13) Earnings | 14) Enterprise Value | 15) Multiples | 16) Per Share | 17) Stock Value

In Millions of USD	FY 2017 Est	FY 2016 Est	Current/LTM	FY 2015	FY 2014	FY 2013	FY 2012
12 Months Ending	12/31/2017	12/31/2016	01/03/2016	01/03/2016	12/28/2014	12/29/2013	12/30/2012
Market Capitalization			291,885.0	283,010.2	292,405.4	260,485.0	193,049.4
- Cash & Equivalents			38,376.0	38,376.0	33,089.0	29,206.0	21,089.0
+ Preferred & Other			0.0	0.0	0.0	0.0	0.0
+ Total Debt			19,861.0	19,861.0	18,760.0	18,180.0	16,165.0
Enterprise Value			273,370.0	264,495.2	278,076.4	249,459.0	188,125.4
Revenue, Adj	74,538.4	71,385.5	70,074.0	70,074.0	74,331.0	71,312.0	67,224.0
Growth %, YoY	4.4	1.9	-5.7	-5.7	4.2	6.1	3.4
Gross Profit, Adj	51,934.6	49,787.1	48,538.0	48,538.0	51,585.0	48,970.0	45,566.0
Margin %	69.7	69.7	69.3	69.3	69.4	68.7	67.8
EBITDA, Adj	26,617.2	25,186.2	23,046.0	23,046.0	25,032.0	23,061.0	20,698.0
Margin %	35.7	35.3	32.9	32.9	33.7	32.3	30.8
Net Income, Adj	18,795.7	17,948.3	16,630.1	16,596.3	17,105.0	15,840.3	14,345.0
Margin %	25.2	25.1	23.7	23.7	23.0	22.2	21.3
EPS, Adj	6.90	6.52	5.92	5.90	5.97	5.51	5.10
Growth %, YoY	5.8	10.5	-0.8	-1.2	8.4	8.0	2.0
Cash from Operations			19,279.0	19,279.0	18,471.0	17,414.0	15,396.0
Capital Expenditures	-3,436.2	-3,364.5	-3,463.0	-3,463.0	-3,714.0	-3,595.0	-2,934.0
Free Cash Flow	18,749.2	17,544.9	15,816.0	15,816.0	14,757.0	13,819.0	12,462.0

Zoom 100%

300) Edit Panel 301) Expand Panel

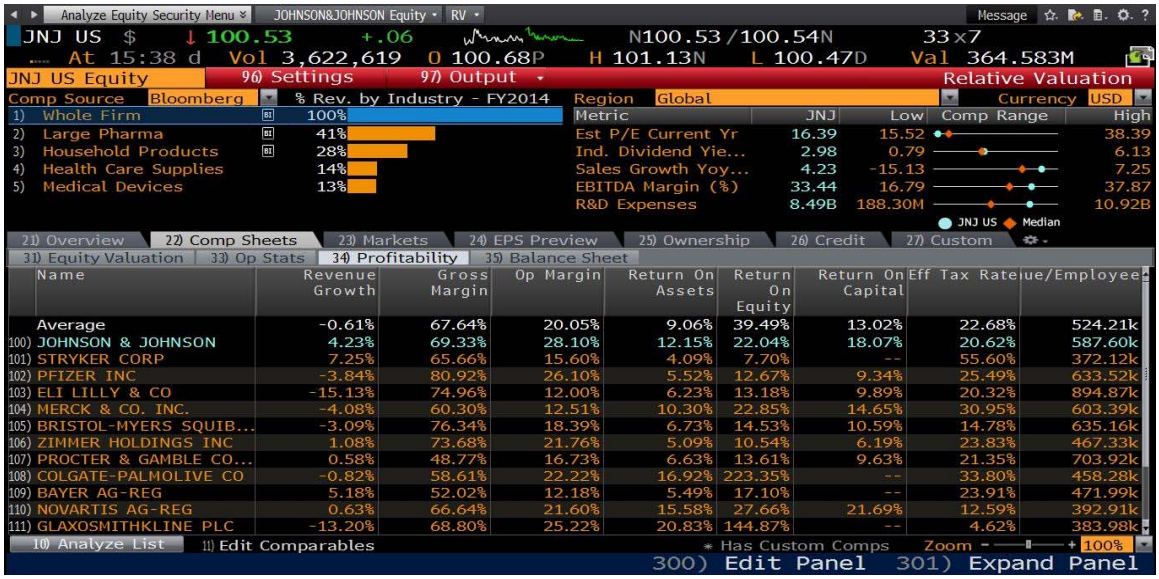
Tab 5) Ratios takes students to a screen that shows financial ratios in various categories for the company. Figure 2 demonstrates that the ratios provided by Bloomberg include profitability ratios, growth rates in various balance sheet and income statement accounts, credit (solvency) ratios, liquidity ratios, working capital management ratios, and ratios for yield analysis. In addition, there is a breakdown of the DuPont analysis. These categories and the ratios under each category are largely consistent with the categories and ratios introduced in major corporate finance textbooks.

Figure 3 provides a "Comp Sheet" that can be accessed by the RV (relative value) function. Contents included in the Comp Sheet are essentially a set of comparative analyses between the key financial ratios of JNJ and those of its peer companies such as Pfizer and Merck. Corporate finance textbooks emphasize both cross-sectional comparative analysis and time-series comparative analysis. The comp sheet enables students to conduct cross-sectional comparative analysis, while Figure 2 presents the time-series ratio comparisons.

Instructors may use the following discussion questions to encourage students to use the information collected from Bloomberg and analyze the company's financial condition:

Figure 2: Financial Ratios (Command: JNJ <US Equity> FA 5)

Figure 3: Comp Sheets (Command: RV, then select Tab 22)



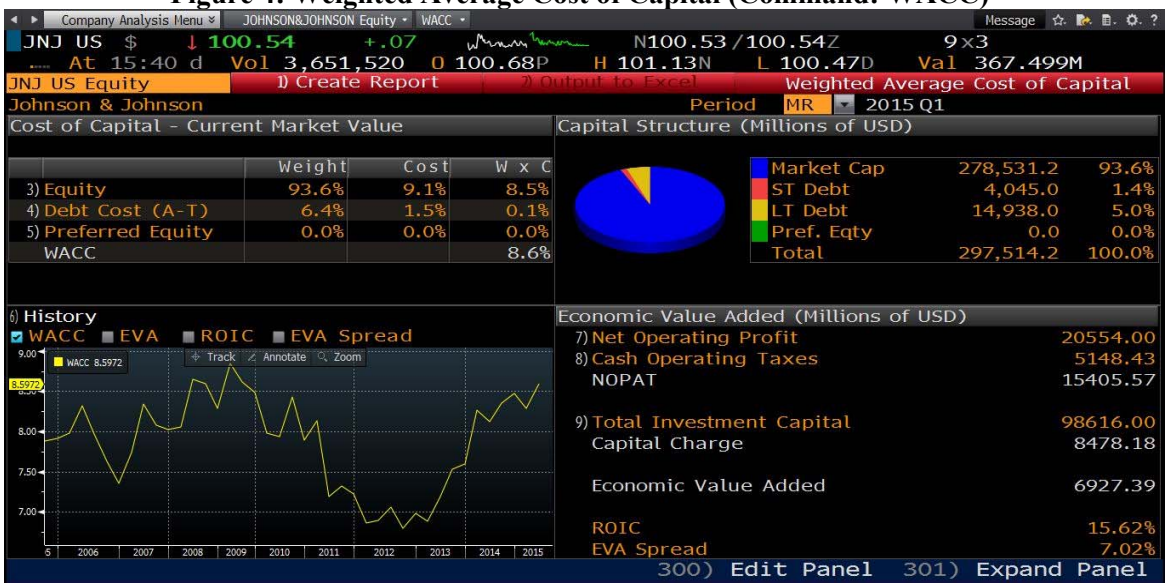
1. Over the most recent 3-5 years, how much do the company's total assets amount to? How much has the company's total asset value grown over these years?
2. What is the company's primary source of financing? Do you see any problem with the company's use of debt? What is your assessment about the company's liquidity and solvency conditions?
3. Over the most recent 3-5 years, how much has the company's revenue grown? What about the net profit and EPS? How does the company's profit margins and returns such as ROA and ROE compare to its competitors?
4. How much Free Cash Flows did the company generate in the most recent 3-5 years? Can you explain the changes in the Free Cash Flows over years?

Cost of Capital

The concept of Weighted Average of Cost Capital (WACC) is important in firm valuation and capital budgeting. From the firm valuation perspective, WACC is used as the discount rate to discount projected future free cash flows. From the capital budgeting perspective, we can use WACC as a benchmark to compare it with a project's IRR or modified IRR and evaluate the project.

Figure 4 presents Bloomberg's WACC estimation for JNJ. It shows a breakdown of the key variables used in the WACC estimation, including the cost of debt, cost of common equity, as well as the weights of debt and equity capital. This estimation follows the WACC formula introduced in major corporate finance textbooks and thus can reinforce students' understanding about the WACC formula from class lectures.

Figure 4: Weighted Average Cost of Capital (Command: WACC)



Since the WACC is used primarily to make investment decisions, textbooks typically suggest we use the marginal cost of new debt instead of using the historical or embedded interest rate a company has been paying. For example, Brigham and Daves (2013, pp 361-362) proposed to find the yield to maturity of the company's existing bonds, which is the return current bondholders expect to receive. It is also a good estimate of the return new bondholders would require. To obtain a company's bond yield data from the Corporate Bond section, students can press the F3 key from the Bloomberg keyboard, and then select 5) YAS Yield and Spread Analysis. Figure 5 presents yield data for a long-term (10-year) bond JNJ currently has outstanding, including the before-tax and after-tax yield. The instructor can also point out that, consistent with the survey results about the best practice among practitioners conducted by Bruner et al. (1998), the weights are calculated based on the market values, instead of the book values, of debt and equity capital. This is demonstrated on the panel at the right-hand side of Figure 4 next to the pie chart.

To further illustrate the process, the instructor can show students the cost of equity estimation provided by Bloomberg by clicking on the Cost of Equity number. Figure 6 shows the pop-out window for the cost of equity estimation under a CAPM framework. Furthermore, if the instructor plans to explain the *beta* variable used in this process, he or she can also show students the BETA function to access the *beta* estimation screen. In the Bloomberg system, *beta* is the coefficient estimated from the linear regression where the dependent variable is the stock return and the independent variable is the benchmark S&P 500 Index return. The instructor can also demonstrate that by changing the data range and the benchmark (independent variable), the *beta* result will be different.

It is important for the instructor to inform students that the inputs used to estimate a company's WACC, such as the cost of debt (interest rate) and the cost of equity, are subject to the analyst's biases and estimation errors. Students can change the input of the variables included in the process (such as the risk-free rate or the market risk premium) and observe the different results. To help students develop critical thinking skills, the

instructor can encourage students to comment on the validity of these inputs and discuss whether they should be adjusted to better reflect the market and business reality the company is facing.

Figure 5: WACC Component -- Bond Yield as Cost of Debt

Figure 6: WACC Component -- Cost of Equity

The instructor can give students an assignment to work through and summarize the steps used to calculate JNJ's WACC. The following questions can be used in the assignment:

1. What percentage of JNJ's capital comes from long-term debt, preferred stock, and common equity? To determine these percentages or weights, should we use the amount of debt and equity from the balance sheets, or should we use the market values? Why?
2. How do you estimate JNJ's cost of common equity under a CAPM framework? What are the variables used in the CAPM? How do you estimate JNJ's beta that is used in the CAPM? What is your estimate for the cost of equity in JNJ?
3. What approach would you use to estimate the cost of debt for JNJ? What data do you need to collect for this approach? Why is using the market/marginal interest rate more appropriate than using the historical interest rate? How do you calculate the after-tax cost of debt based on the before-tax cost of debt result?

4. Using all the information from the previous questions, what is your estimate of JNJ's WACC? If you change some assumptions used in this process, how would your WACC result change?

Firm Valuation

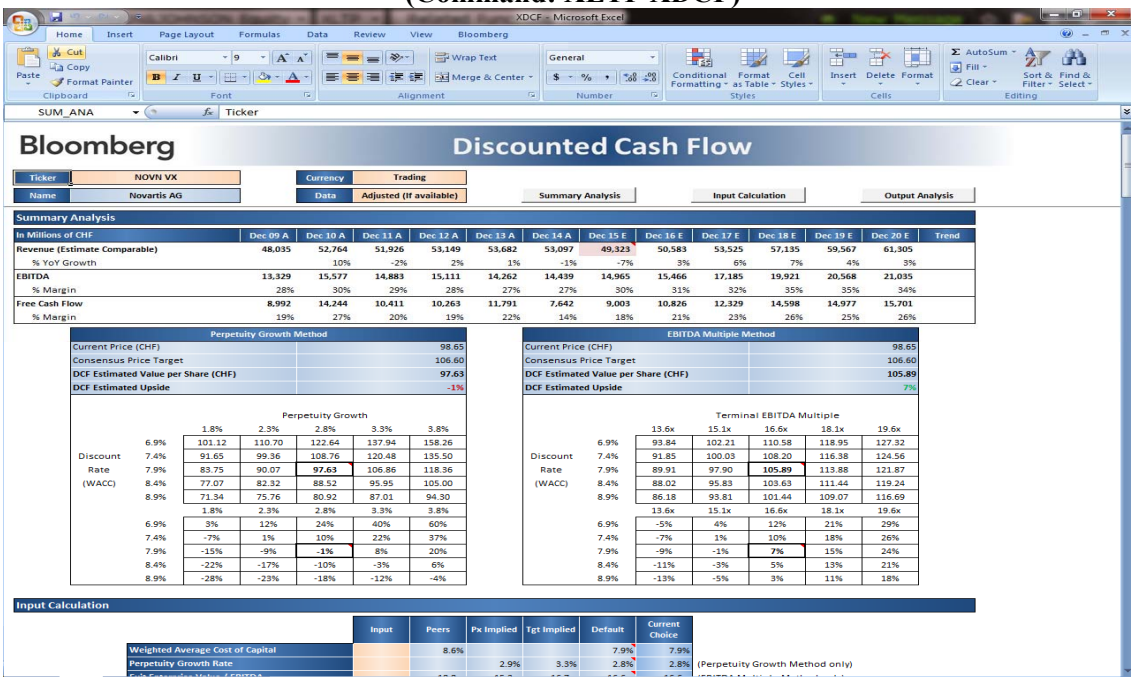
A typical corporate finance course organizes its topics around firm valuation and how a firm can improve or maximize its value. Models frequently introduced in textbooks include the dividend discount model (DDM) and the discounted free cash flow valuation model. In addition, textbooks also introduce a relative value model using the ratio of a firm's market value to certain accounting measures (such as the P/E multiplier or the P/EBITDA multiplier). The latter approach is also referred to as the price multiple model. Several templates from Bloomberg can help students gain intuition on how valuation models are constructed.
For the dividend discount model, the DDM function directs students to the Dividend Discount Model template, as Figure 7 shows. In this template, Bloomberg utilizes a three-stage dividend growth model to estimate the intrinsic stock prices where the three stages include the growth stage, the transition stage, and the mature stage. Dividends are assumed to grow at the *Long Term Growth Rate* (6.044% in the example shown in Figure 7) during the growth stage (for nine years as in the *Growth Years*), and the growth rate would gradually decline during the transition stage (of eight years as in the *Transitional Years*) to finally reach the *Growth Rate at Maturity* (4.932% in the example). This Growth Rate at Maternity is assumed to last indefinitely. The result under this Discounted Dividends Model is presented as the *Theoretical Price* ($77.317 in Figure 7).

Figure 7: Stock Valuation by Dividend Discount Model (Command: DDM)

For the free cash flow discount model and the relative value model, students can download an Excel spreadsheet for the Discounted Free Cash Flow valuation model from Bloomberg's Excel Template Library (XLTP). Students can access this spreadsheet by entering XLTP XDCF<Go> in the command line, and then click "Open" (see Figure 8). This template shows students a good example of constructing a valuation model in Excel. A closer examination of this template reveals that it contains three major sections. The first section is a "Summary Analysis" where past and estimated future revenue, EBITDA and FCF are presented, and the valuation results based on a "Perpetual Growth Method" and an "EBITDA Multiplier method" are summarized. The second section is the "Input Calculation", where the estimation about important input variables such as the WACC, the perpetual growth rate, the amount of future Free Cash Flows, and the value of the EV/EBITDA multiplier are explained. Detailed steps to calculate the FCFs each year are displayed, based on the idea that the FCF is the remainder after the investments in working capital and long-term capital

are deducted from a company's NOPAT. This process is highly consistent with the FCF estimate approach introduced in major textbooks, therefore provides a good illustration for students about how to calculate FCF using real numbers from a real company's financial statements.

Figure 8: Excel Template for Discounted Free Cash Flow Valuation (Command: XLTP XDCF)



The third section is the "Output Analysis" and it provides the valuation process and results. Under the Perpetual Growth Method, a perpetual growth rate is used to estimate the terminal value at the end of the terminal year (year 5 in this example), and the "current enterprise value" is the total present value of the first five years' free cash flows together with the present value of the year-5 terminal value. The difference between the EBITDA Multiple Method and the Perpetual Growth Method lies in the estimation method of the terminal value. In the EBITDA Multiple Method, the terminal value is the product of the terminal year's EBITDA and the assumed EV/EBITDA multiplier. The current enterprise value under the EBITDA Multiple Method is then also calculated as the total present value of the first five years' free cash flows together with the present value of the year-5 terminal value. The Output Analysis ends with a set of sensitivity analyses to show how the value results differ with the changes in the assumptions of WACC and the perpetual growth rate (or the EBITDA multiplier).

Due to the complexity of these models, we recommend instructors to incorporate the introduction into the class lecture and explain their setup before an assignment is given to students. Just as in Bloomberg's WACC model, instructors should point out that many inputs used in these templates, such as the growth rates in dividends/free cash flows and the WACC, stem from analysts' estimates and are subject to the analyst's biases and forecasting errors. The instructor can also ask the class to discuss the importance of the sensitivity analysis in the valuation process.

Capital Structure

To understand and evaluate a company's capital structure, we can start by collecting information about the company's leverage ratios, including debt ratio, long-term debt to asset ratio, and long-term debt to equity ratio. The access to these ratios was discussed in the previous section (see Figure 2). Additional information such as the company's credit rating (Figure 9) can also inform students about the company's financial health and risk. Detailed rating information, including ratings from different rating agencies, and ratings for different types of debt (for example, senior vs. subordinated debt) issued by the same company are provided. The instructor can also ask students to collect the rating data from peer companies and compare JNJ's rating with

the rating of its peer companies. Students who are interested can also be encouraged to click on the tab of "Company Tree Ratings" to check the credit ratings for several subsidiaries of Johnson & Johnson.

Figure 9: Credit Rating (Command: CRPR)

The difference between the cost of raising debt and the cost of raising equity could affect a company's capital structure decisions. For a comparison between the company's cost of debt and cost of equity, students can also visit the WACC screen (Figure 4) to explore the estimation of the company's cost of debt and cost of equity.

Payout Policy: Dividends and Repurchase

Intermediate or advanced level corporate finance courses usually discuss corporate payout policy, including a company's dividend or stock repurchase (buyback) decisions. The Bloomberg system provides abundant data to look at a company's payout history. To obtain data about historical dividend payout of the company, we can use the command "DVD" (see Figure 10).

Bloomberg can also search for a company's stock repurchase record by looking at the Corporate Action Calendar. To find the share repurchase history for JNJ, in the Corporate Action Calendar (CACT), from the "Source" drop-down menu, select the source of "Single Security", and type in the stock ticker JNJ. Then select "Action Types" at the top right of the page. From the "Available Actions" column, we select "Capital Change >> Stock Buyback >> Add >>Update". The date range for the Corporate Actions can be customized by entering the desired dates in the amber fields at the top right. Figure 11 shows the search results of the two most recent stock buyback events for Johnson & Johnson in 2012 and 2014.

After collecting the dividend payment and/or stock repurchase data, the instructor can lead student discussions on the pattern of a company's payback policy, and how theories and conjectures from the textbook can be applied to understand and interpret the incentives of adopting such a policy.

Mergers and Acquisitions

Mergers and acquisitions (M&As) are often discussed in Intermediate or advance level corporate finance courses. Topics related to M&As include the target valuation approaches, and the impact of M&A activities on both acquirers and targets. Information on M&A events can be easily obtained from Bloomberg with the MA function. Figure 12 shows the customized search results for completed M&A deals between 01/01/2013 and 13/31/2015 in the United States market.

Figure 10: Dividend History (Command: DVD)

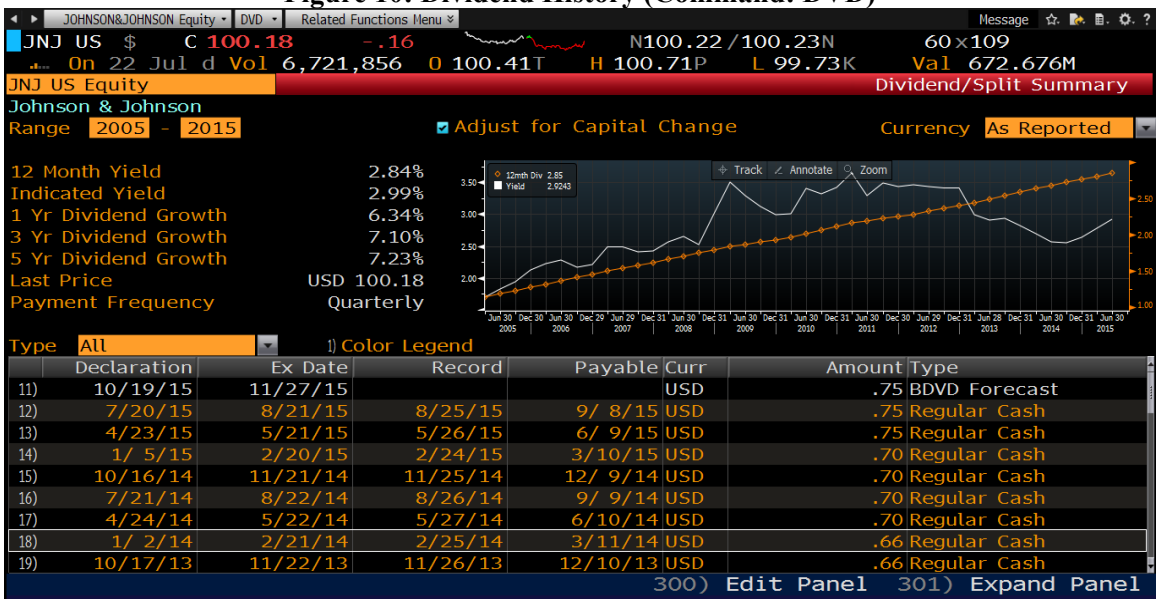


Figure 11: Search Results for Corporate Share Repurchase Events (Command: CACT)

If students click on the AT&T and DirecTV M&A from the Deal List that resulted from the search above, they get a screen with details regarding this deal (see Figure 13). The menu on the left of the screen in Figure 13 shows detailed data such as the summary and timeline of the deal, the parties involved in the merger, as well as the financial and valuation information. For example, if students choose 20) Financials, they find the revenue and profit for both the target and the acquirer, as well as a *pro forma* amount for the combined company. Other useful information include deal multiples (for example, the transaction value over target's EBIT), for the selected deal as well as other comparable ones, which students can find in 22) Deal Comps.

The instructor, therefore, can select an M&A case from Bloomberg and assign the class to work on a case report. Students can collect data from Bloomberg about the key inputs, such as the announcement date, completion date, percentage of ownership, and deal size. Students can also investigate the business backgrounds of the acquirer and the target, the names of advisors and investment banks hired, the amount and type of payment involved, and the impact of the deal on various parties such as the acquirer, the target

and their customers, as well as on their competitors. Using the AT&T and DirecTV deal as an example, the following list of discussion questions can be used as a guideline for the case report:

Figure 12: Search Results for Mergers & Acquisitions Events (Command: MA, then customize by select desired date range, Deal Status and Geographic region)

Figure 13: Details for M&A Deal Information

1. When did AT&T make the announcement that it would acquire DirecTV? What percentage of the ownership did AT&T seek in DirecTV? How did DirecTV's management and the board respond? When was the deal completed?
2. Why did AT&T want to acquire DirecTV? What kinds of synergies can this merger potentially create?
3. What was DirecTV's market value right before the merger, and how much did AT&T offer? How did AT&T plan to pay for this transaction?
4. Do you think AT&T's offer was a reasonable price? Why, or why not?

IPOs

The study of Initial Public Offerings (IPOs) is also an important part of intermediate and advanced corporate finance courses. In this article, for illustration, we explain the process of finding a list of IPOs in the equity market for a given period. Simply typing "IPO" in the command line can do this; Figure 14 presents the search output. One may notice that the search results include both IPO and additional offerings (Addl). Therefore, students can customize their search by checking "IPO" box only and further select the preferred geographic region and industry if needed.

Figure 14: Search for Initial Public Offerings (Command: IPO)

Among the search results from the Deal List, students can simply click on one deal and obtain more details about this particular IPO (Figure 15), including amount raised, information about the deal advisors, and amount of fees paid to them. The information provided by Bloomberg can help student understand the company's incentive in the public offering of their equity securities, the cost of public offerings, the IPO price determination, and the IPO underpricing phenomenon.

Conclusion

The Bloomberg system brings a more active form of education with effective hands-on learning that complements traditional education techniques. In this paper, we present a comprehensive summary and detailed illustrations of how a corporate finance faculty can use the Bloomberg Professional system as a one-stop shop to collect various types of financial and event data and enhance their teaching on a wide range of essential corporate finance topics. Incorporating Bloomberg in corporate finance classes enables faculty to improve the teaching effectiveness and helps schools meet or maintain AACSB standards.

Figure 15: Details for IPO Information

References

AACSB International. 2015. "Eligibility Procedures and Accreditation Standards for Business

Accreditation. Retrieved from http://www.aacsb.edu/~/media/AACSB/Docs/Accreditation/Standards/2013-bus-standards-update-jan2015.ashx

Brigham, Eugene F. and Phillip R. Daves. 2013. Intermediate Financial Management, 11th Edition, Cengage Learning. ISBN: 1111530262

Bruner, Robert F., Eades, Kenneth M., Harris, Robert S. and Robert C. Higgins. 1998. "Best practices in estimating the cost of capital: survey and synthesis." Financial Practice and Education 8: 13-28.

Bloomberg Professional. 2015.

Coe, Thomas S. 2007. "Using the Bloomberg Professional System for Finance Classes." *Journal of Financial Education* 33 (Spring 2007): 48-62.

Coe, Thomas, Oslan Killc, and Ihsan Isik. 2007. "Using and Academic Trading Room to Develop a Market Microstructure Course." *Journal of Financial Education* 33 (Winter 2007): 43-52.

Lei, Adam and Huihua Li. 2012. "Using Bloomberg Terminals in a Security Analysis and Portfolio Management Course." *Journal of Economics and Finance Education* 11: 17-33.

Siam, John J. 2005. "University Trading Centers and Their Role in Business Education." *Journal of Financial Education* 31: 1-23.

Ross, Stephen, Randolph Westerfield, Jeffrey Jaffe, and Bradford Jordan. 2013. Corporate Finance: Core Principles and Applications, 4th Edition, New York: McGraw Hill/Irwin. ISBN: 0077861655

Portfolio Optimization Incorporating the Capital Allocation Line: A Comprehensive Undergraduate Investments Course Project

Pamela M. LaBorde[1]

ABSTRACT

This paper covers a project in which beginning investment students collect price and dividend data and calculate various returns for five companies, a fund and the stock market. After forming a portfolio they calculate risk measures, determine Jenson's alpha, Sharpe and Treynor values and the return based on the Capital Asset Pricing Model. The students calculate two-stock frontiers and a frontier comprised of potentially all five stocks, incorporate the Capital Allocation Line (CAL) and determine the optimal portfolio. Finally, they calculate dollar amounts to invest in the riskless asset and risky stocks to accomplish dominant points on the CAL and determine if margin trading is necessary for a specific dominant portfolio.

Introduction

Investment textbooks spend a great deal of time explaining and graphing the frontier for a set of investments, in terms of calculating the return and standard deviation for the individual stocks, the correlation between the stocks, and the return and standard deviation for a portfolio of those stocks. Generally, textbooks demonstrate a two-stock portfolio with various weighting schemes to generate the frontier. Graphs typically incorporate the Capital Market Line (CML) after describing that the frontier can be drawn for a portfolio of all risky assets.

Students easily grasp the idea of the tangency point graphically and that adding the CML allows for a new investment opportunity set that dominates every portfolio on the frontier (except the tangency point). However, many students do not understand how to create a portfolio on the CML, even after the class lectures explaining that any portfolio on the CML is comprised of the tangency point weighting scheme in conjunction with either borrowing or lending at the riskless rate. Even though students can locate the tangency point on the graph and recognize that points on the CML dominate the frontier of risky assets, they do not conceptually grasp exactly how to create the CML from "scratch" given a set of investment choices. The students benefit from hands-on practice after the theoretical discussion in the classroom. Therefore, I have incorporated the project described here in my undergraduate beginning investments course that emphasizes learning by doing and helps the instructor determine whether the students are truly grasping the material.

The course-long project requires students to collect price and dividend data for five publicly traded companies, the Standard & Poor's 500, and an equity mutual fund or exchange-traded fund. The students combine the five companies' stocks into an equally weighted portfolio and calculate returns, risk measures, the portfolio frontier, and dominant points on the frontier relative to the original portfolio. Additionally, they include the CAL and determine the weights of the five individual stocks that comprise the tangency point. Lastly, the students determine two portfolios on the CAL that dominate their initial equally weighted scheme and calculate whether to buy on margin at the riskless rate to accomplish one of those points.

Several undergraduate investments projects have been provided in the literature. Kish and Hogan [2001] focus on asset allocation across specific indexes and the interpretation of output generated by a software package. The weighting schemes are recommended by the software, and require no inputs from the student.

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The project does have some similarities to the one in this paper, including a discussion of correlations, returns (arithmetic vs. geometric), dominant asset classes, risk, and Sharpe ratios. However, the project covered in this paper focuses on individual stocks (although it could easily be converted to mutual funds, ETFs or indices) and, rather than using software to determine returns and correlations, students must calculate the metrics to determine the optimal weighting scheme for their investment choices. Additionally, the instructor-provided macro generates output in a format identical to the treatment of the topic in many investment textbooks, making it easier for students to interpret the output and determine the optimal weighting schemes. Additionally, this project includes the CAL and relates it to margin trading. This project also has some similarities with a project developed by Kalra and Weber [2004], but their project focuses on a single company and does not include forming a portfolio and determining optimal weighting schemes.

The project is assigned and graded in four stages, allowing the instructor the opportunity to provide students with feedback and give them the chance to make corrections before continuing to the next stage. Knowing their calculations are accurate throughout each step not only eases their minds, but leads to better outcomes. If the students' calculations are incorrect at any point in the project, and they unknowingly continue with inaccurate data, the concepts covered in future stages of the project could be confusing. For example, the simple average standard deviation (SD) for the portfolio should be larger than the portfolio's actual SD, which may not occur if calculations were incorrect. The step-by-step nature of the project ensures correction at specific points. Finally, the instructor can cover different aspects of the project throughout the course via classroom lectures instead of waiting until near the end of the course to assign one large, cumulative project, which would result in stress for both the students and the instructor. All calculations are covered in the course lecture before assigning each stage of the project and relevant videos are also provided on the course website to guide the student.

The remainder of this paper covers the four stages of the project and highlights problem areas for the students, practical issues, and suggestions for future enhancements. Given that Stage 4 is complicated and creates a large amount of added value compared to projects in the literature, more discussion will be devoted to this stage.

Stage 1: Company/Fund Selection

In Stage 1 each student chooses five companies whose common stocks have been publicly traded for at least the previous two years. One (or more) of the companies must have paid a cash dividend at least once during this time. So that the students might gain insight on correlation coefficients, the instructor might suggest they choose two companies from the same industry and the remaining three companies from three different industries. I recommend that the students use Yahoo's finance website to determine whether a company has split its stock or paid a dividend. To avoid issues related to Yahoo's adjustments[2] to the close price for dividends and stock splits, the student cannot chose a company that has split its common stock during the previous two years.

The scenario begins with my having hired the student as my portfolio manager two years ago. At that time, I would have instructed them to invest $10,000 each in five different stocks or all $50,000 in one equity mutual fund or ETF. Therefore, the students are also to choose an equity mutual fund or ETF that has been in existence for at least the past two years. This fund will be referenced as "the Fund" throughout the paper. Finally, so that the students will have a benchmark for comparison, they evaluate the S&P500 via the SPDR S&P 500 ETF (SPY) since both price and dividend data is easily obtainable. While SPY may not be a suitable benchmark for most of the students' portfolios, it is convenient to have a common benchmark so that the instructor can provide check figures. Each student must complete the following table for the first stage of the project.

[2] Yahoo! explains its adjustment process at https://help.yahoo.com/kb/finance/historical-prices-sln2311.html.

Table 1. Company/Fund Selections

Full Company Name	Ticker Symbol	Stock Exchange	Does the Company Pay Dividends? (Y/N)
1. Ford Motor Co.	F	NYSE	Y
2. Perfect World Co., Ltd.	PWRD	NasdaqGS	Y
3. International Business Machines	IBM	NYSE	Y
4. Pandora Media, Inc.	P	NYSE	N
5. Corning Inc.	GLW	NYSE	Y
Fund Name/Ticker Symbol: Buffalo Small Cap (BUFSX)			

Most students choose large, popular companies. Occasionally a student will select a company that has only recently gone public and does not meet the two-year trading criterion. Requiring the students to submit their choices early in the course gives me a chance to inform them that a new choice must be made. Students tend to know very little about mutual funds or ETFs when they first start the course and can have difficulty selecting one.

Stage 2: Calculating Return Data

In the second stage of the project the students download price and dividend data from Yahoo! Finance (finance.yahoo.com) and calculate the total value of each company's (or fund's) position assuming dividends are reinvested at the end of the month received. The students must complete Table 2 for each company. In our example, Table 2 shows the information for Ford Motor Company (Ticker = F). After entering the ticker and time frame at Yahoo!'s finance website, a single click downloads the data and imports it into Microsoft Excel. A reminder to save the file as an Excel spreadsheet rather than a comma-delimited file (CSV) is helpful at this stage.

The assumption is that $10,000 was invested in shares of the company's common stock two years ago. All dividends are re-invested in shares of the company's stock at the price of the stock at the end of the month the dividends are received. Monthly Returns are calculated by determining the change in value for each month and dividing that change in value by the previous month's value. Return Relatives are calculated by adding 1 to Monthly Returns.

Tables similar to Table 2 must also be completed for the Fund and SPY. However, the starting value for each is $50,000 rather than $10,000. The students' client could have followed the students' recommendations two years ago and invested $10,000 in each of the five stocks or invested the entire $50,000 in either the Fund or SPY. Now that the two years have passed, the students are analyzing the performance and risk of the choices.

Stage 3: Forming a Portfolio and Calculating AM, GM, SD and Ending Weights

After receiving feedback and making any needed corrections to calculations, the students complete Stage 3 of the project. In this stage, the five stocks are combined into a portfolio and the students generate a table similar to Table 3 for the Portfolio by summing the Total Value columns for the five stocks to generate a Total Value column for the Portfolio. They also calculate the Monthly Returns and Return Relatives for the Portfolio.

Table 2: Company Price, Dividends, Total Value and Monthly Return (Ford Motor Company)

Ford Motor Company						
Date	Close Price ($)	Dividends ($)	# of Shares Owned	Total Value ($)	Monthly Return (%)	Return Relative (%)
Jun-14	17.24		1098.00	18,929	4.87	104.87
May-14	16.44		1098.00	18,051	1.80	101.80
Apr-14	16.15	0.13	1098.00	17,733	4.33	104.33
Mar-14	15.60		1089.57	16,997	1.36	101.36
Feb-14	15.39		1089.57	16,768	2.87	102.87
Jan-14	14.96	0.13	1089.57	16,300	-2.24	97.76
Dec-13	15.43		1080.54	16,673	-9.66	90.34
Nov-13	17.08		1080.54	18,456	-0.18	99.82
Oct-13	17.11	0.10	1080.54	18,488	2.02	102.02
Sep-13	16.87		1074.26	18,123	4.20	104.20
Aug-13	16.19		1074.26	17,392	-4.09	95.91
Jul-13	16.88	0.10	1074.26	18,133	9.76	109.76
Jun-13	15.47		1067.93	16,521	-1.34	98.66
May-13	15.68	0.10	1067.93	16,745	15.10	115.10
Apr-13	13.71		1061.16	14,549	4.26	104.26
Mar-13	13.15		1061.16	13,954	4.28	104.28
Feb-13	12.61		1061.16	13,381	-2.63	97.37
Jan-13	12.95	0.10	1061.16	13,742	0.77	100.77
Dec-12	12.95		1053.03	13,637	13.10	113.10
Nov-12	11.45		1053.03	12,057	2.60	102.60
Oct-12	11.16	0.05	1053.03	11,752	13.69	113.69
Sep-12	9.86		1048.335	10,337	5.57	105.57
Aug-12	9.34	0.05	1048.335	9,791	1.62	101.62
Jul-12	9.24		1042.753	9,635	-3.65	96.35
Jun-12	9.59		1042.753	10,000		

Notes: Price and Dividend data are downloaded from finance.yahoo.com. Remaining values are calculated in Microsoft Excel. Black cells should remain blank.

Table 3: Portfolio Returns

Date	Portfolio Value ($)	Monthly Return (%)	Return Relative (%)
Jun-14	94,404	8.00	108.00
May-14	87,410	1.24	101.24
Apr-14	86,341	-7.48	92.52
Mar-14	93,316	-6.68	93.32
Feb-14	99,997	7.91	107.91
Jan-14	92,665	10.63	110.63
Dec-13	83,764	-4.19	95.81
Nov-13	87,424	5.57	105.57
Oct-13	82,811	-0.48	99.52
Sep-13	83,211	10.46	110.46
Aug-13	75,332	-4.67	95.33
Jul-13	79,023	8.64	108.64
Jun-13	72,740	1.85	101.85
May-13	71,420	15.74	115.74
Apr-13	61,709	3.93	103.93
Mar-13	59,373	5.46	105.46
Feb-13	56,302	0.65	100.65
Jan-13	55,939	6.52	106.52
Dec-12	52,515	3.85	103.85
Nov-12	50,569	2.70	102.70
Oct-12	49,241	-5.55	94.45
Sep-12	52,135	1.58	101.58
Aug-12	51,327	8.81	108.81
Jul-12	47,171	-5.66	94.34
Jun-12	50,000		

Note: Black cells should remain blank.

Next, they complete the Summary Table (see Table 4) for each stock, the Fund, the Portfolio and SPY. Table 4 requires that the students calculate basic information such as annual returns (both with and without dividend re-investment), arithmetic and geometric means, and standard deviations. It is worth noting that rather than have the students calculate the annual SD using the two annual returns, they annualize the monthly SD.

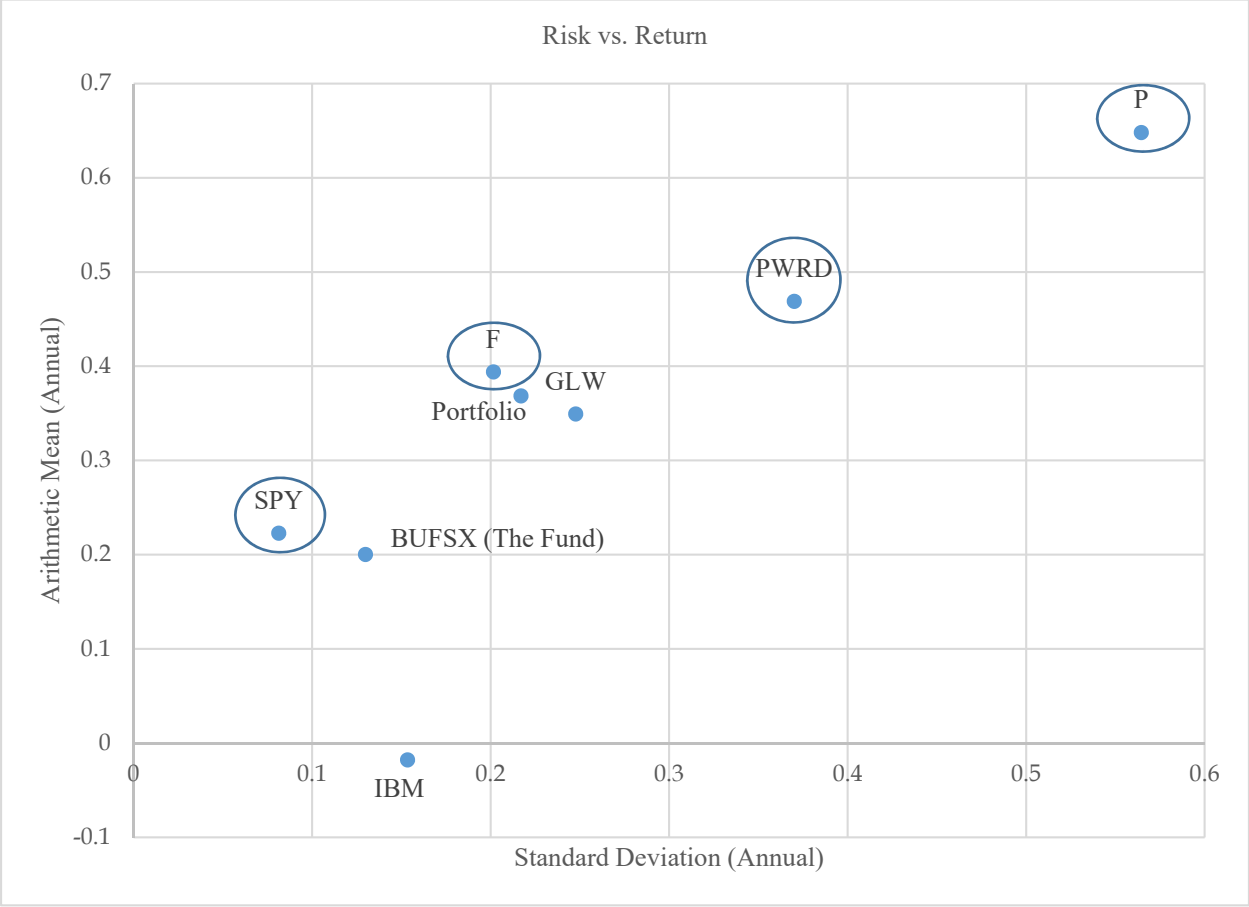
The final portion of the third stage is a Dominance Graph (see Figure 1) that represents the annual Arithmetic Mean and annual Standard Deviation of the five stocks, the Portfolio, the Fund and SPY. Students indicate which investments are dominant in risk-return space by circling the appropriate ticker.

Table 4: Summary Table (Part 1)

	F	PWRD	IBM	P	GLW	Portfolio	BUFSX	SPY
Annual Returns								
First Year (without dividend re-investment)	64.44	78.34	-0.50	69.27	12.80	44.87	24.24	20.32
Second Year (without dividend re-investment)	14.35	15.44	-3.08	60.33	57.06	28.82	15.79	24.24
First Year (with dividend re-investment)	65.21	80.38	-0.55	69.27	13.08	45.48	25.41	20.51
Second Year (with dividend re-investment)	14.58	15.59	-3.08	60.33	57.81	29.78	15.38	24.40
HPR for entire two years (without dividend re-investment)	87.59	105.19	-3.51	171.39	75.60	87.25	42.91	48.89
HPR for entire two years (with dividend re-investment)	89.29	108.51	-3.62	171.39	78.46	88.81	44.70	49.92
Geometric Mean (monthly)	2.69	3.11	-0.15	4.25	2.44	2.68	1.55	1.70
Arithmetic Mean (monthly)	2.85	3.62	-0.06	5.47	2.69	2.87	1.62	1.73
Geometric Mean (annual)	37.58	44.40	-1.83	64.74	33.59	37.41	20.29	22.44
Arithmetic Mean (annual)	39.40	46.89	-1.79	64.80	34.93	36.85	20.02	22.28
Standard Deviation (sample--monthly)	5.82	10.68	4.43	16.30	7.15	6.27	3.75	2.35
Standard Deviation (sample--annual)	20.16	37.01	15.35	56.46	24.77	21.71	12.99	8.14
Simple Weighted Standard Deviation (annual)						30.75		
Ending Value	18,929	20,851	9,638	27,139	17,846	94,404		
Ending Weight	20.05	22.09	10.21	28.75	18.90	100.00		

Notes: All numbers except Ending Value are percentages. Ending Values are dollar amounts. Black cells should remain blank. Gray cells should be averaged to determine the Simple Weighted SD (annual) for the Portfolio.

Figure 1: Dominance Graph



For Stage 3 the students must submit Table 3, Table 4, Figure 1 and the answers to the following questions [The answers to the sample project are in italics and underlined portions represent topics that tend to be difficult for the students.]:

1. Which investments are dominant? In other words, using hindsight, which investments were efficient (dominant) vs. inefficient (non-dominant)? *[Answer: The dominant (efficient) stocks are the ones that have no better investments in risk/return space. Pandora Media (P), Perfect World (PWRD) and Ford Motor Company (F) were the dominant stocks. SPY was a dominant portfolio. Dominance is indicated by the circled tickers in Figure 1. GLW is not dominant because, even though it produced a positive return, F generated a higher return coupled with lower risk than GLW.]*
2. Of the mean returns calculated, choose one that best reflects an accurate measure of your client's change in wealth assuming all dividends were re-invested. Explain why that measure of return is the best one. Is a monthly or annual measure more accurate? Briefly discuss how each investment performed in terms of that return measure. *[Answer: The best measure of my client's change in wealth is the Geometric Mean. It assumes that all dividends are reinvested and that wealth is compounded over time. Whether or not one uses monthly vs. annual geometric means is irrelevant since compounding the monthly geometric mean results in the annual geometric mean, although annual returns may make the best sense intuitively. IBM generated a negative annual geometric mean return of -1.83% over the course of the two-year period. The remaining stocks generated returns far exceeding those of the S&P500 ETF (22.44%) and the Fund (20.29%). GLW generated the lowest positive return of 33.59% while P generated the highest return of 64.74%.]*
3. Briefly discuss how the investments rank in term of total risk, as measured by annual standard deviation. *[Answer: For the individual stocks, P generated an annual Standard Deviation of 56.46%, followed by PWRD at 37.01%. GLW had an annual SD of 24.77% followed by F at 20.16% and IBM at 15.35%. Of the portfolios, SPY was the least risky with a standard deviation of 8.14%, followed by BUFSX with 12.99% and the five-stock Portfolio with the highest risk at 21.71%. It is worth noting that both F and IBM's SDs were lower than the overall Portfolio.]*
4. Choose the best mean return measure for comparing the annual performance of the securities. *[Answer: The best mean return measure for comparing the annual performance of the securities is the annual arithmetic mean.]*
   a. Did the riskiest investments (in terms of total risk as measured by annual SD) generate the highest returns? Should they have? *[Answer: At first glance it seems that the riskiest investments generated the highest returns. For instance, P was the riskiest stock and it generated the greatest return. IBM was the lowest-risk stock and generated the lowest return. However, the phenomenon is inconsistent, as F was riskier than GLW and generated a lower return. BUFSX (the Fund) had more risk than SPY but generated lower returns. GLW and the Portfolio had similar returns but GLW was more risky than the Portfolio. If we were evaluating ex ante returns and risk, we would require the higher-risk investments to offer sufficiently higher expected returns before we would select them as investments. However, since the returns are ex post, we may find that the higher-risk investments did not generate higher returns.*
   b. Ignoring risk, which of your stocks (if any) outperformed the benchmark based on the annual arithmetic mean? Did the Portfolio outperform the market? Did the Fund outperform the market? *[Answer: All the stocks except IBM outperformed SPY by significant amounts, as did the Portfolio. IBM underperformed SPY by a considerable amount (nearly 30%) and the Fund underperformed the market by about 2%.]*
5. Discuss the ending weights of each of the five stocks. Discuss how the ending weights relate to the stock returns. *[Answer: While each stock began the two-year period at 20% of the Portfolio, over the two years the weights changed based upon each stock's performance. The higher-returning (based on GM) stocks' weights rose, while the lower-returning stocks' weights fell. A stock does not have to generate a negative return to experience a decrease in weight. For example, GLW's weight dropped slightly even though it generated a positive return. Since P generated a high return relative to the other stocks, its weight rose the most—from 20% to 28.75%.]*

Stage 4 (Part 1): Calculating Betas, Sharpe Ratios, Treynor Indexes, Alphas, and Diversification Analysis

Students must determine the characteristic lines to calculate betas for the five companies, the Fund, and the Portfolio (as shown in Figure 2) and complete the second part of the Summary Table (as shown in Table 5). While students could calculate beta using the slope function in Excel, I find they could use more experience creating charts. Therefore, I have them graph the monthly SPY returns and stock returns via an X-Y scatter plot and insert trend lines to determine a stock's characteristic line. To ensure that the graph is not too crowded, the students set the "markers" to none.

Figure 2: Characteristic Lines

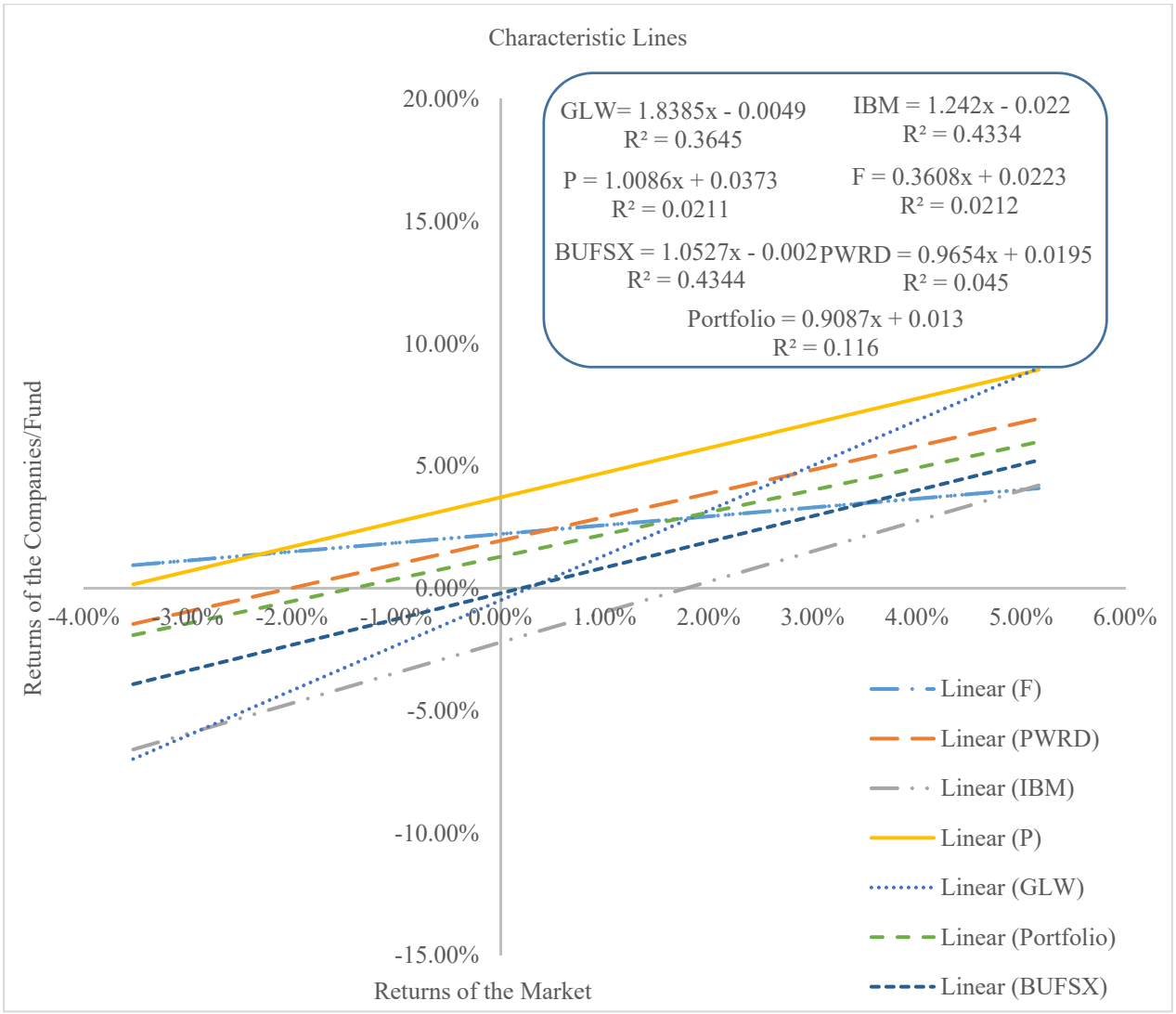


Table 5: Summary Table (Part 2)

	F	PWRD	IBM	P	GLW	Portfolio	BUFSX	SPY
Beta	0.36	0.97	1.24	1.01	1.84	0.91	1.05	1
Weighted Beta (Beginning)	0.07	0.19	0.25	0.20	0.37	1.08		
Weighted Beta (Ending)	0.07	0.21	0.13	0.29	0.35	1.05		
CAPM Required Return	8.08%	21.51%	27.65%	22.47%	40.90%	20.25%	23.45%	22.28%
Abnormal Return	31.31%	25.38%	-29.44%	42.33%	-5.97%	16.60%	-3.43%	0.00%
R-squared	2.12%	4.50%	43.34%	2.11%	36.45%	11.60%	43.44%	100.00%
Sharpe Ratio Calculation	1.95	1.27	-0.12	1.15	1.41	1.69	1.54	2.73
Sharpe Rank	2	6	8	7	5	3	4	1
Treynor Index Calculation	108.99%	48.50%	-1.50%	64.18%	18.96%	40.47%	18.95%	22.21%
Treynor Rank	1	3	8	2	6	4	7	5
Jenson's alpha (intercept)						1.30%	-0.20%	
Jenson's alpha (P-Value)						40.81%	78.84%	
Risk-free rate	0.07%							

Note: Black cells should remain blank.

To determine how the changing weights of the stocks can impact the overall systematic risk of the portfolio, the students must calculate the weighted portfolio beta twice—once using the initial 20% weights for the five stocks and again using the ending weights. To determine if the investments generated abnormal returns based on the Capital Asset Pricing Model (CAPM), they must calculate the ex post required return based on the CAPM (the annual risk-free rate is provided) and compare the required return to the investments' actual returns—the difference being the abnormal return shown in Table 5.

The students also calculate three risk-adjusted performance measures—the Sharpe Ratio, Treynor Index (along with rankings), and Jenson's Alpha. As Jenson's Alpha requires an interpretation of regression results and only the introductory statistics class is a pre-requisite for the course, the students generally have difficulty comprehending the results. Monthly risk-free returns are provided to the students via a downloadable spreadsheet (obtained from the Federal Reserve Economic Database [FRED] at http://research.stlouisfed.org/fred2/).

Once the students have completed the quantitative portion of Stage 4 they must answer the following questions.

1. Did each stock perform better, worse or as required by the CAPM? The Portfolio? The Fund? *[Answer: F, PWRD, P and the Portfolio generated positive abnormal returns indicating that they performed better than required by the CAPM. The Fund, IBM and GLW underperformed their ex-post CAPM required return.]*
2. Rank each of the eight investments based on annual SD from lowest to highest risk. Perform the same ranking use Beta. Did the investments rank identically using SD vs. Beta? Should SD and Beta provide the same rankings? Why or why not? *[The rankings by SD and Beta as shown below are quite different.*
3.

Ranking (lowest to highest)

SD	*Beta*
SPY	*F*
BUFSX	*Portfolio*
IBM	*PWRD*
F	*SPY*
Portfolio	*P*
GLW	*BUFSX*
PWRD	*IBM*
P	*GLW*

However, differences are to be expected. While both SD and Beta are risk measures, they do not evaluate the same types of risk. SD is a standalone measure of total risk, or the deviation of returns about the

AM. Beta is a relative measure of systematic risk—relative to the SPY ETF in this case. The beta of the overall market is 1.0. Companies with betas higher than 1.0 are considered more risky than the market.

4. Do the rankings provided by the Sharpe and Treynor calculations agree with the SD or Beta rankings? Should they? Why or why not? Did the Portfolio outperform the market according to the Sharpe Ratio? The Treynor Index? Did the Fund outperform the market according to the Sharpe and Treynor calculations? *[The rankings based on the Sharpe and Treynor risk-adjusted performance measures do not agree with the rankings based on risk measures alone, nor should we expect them to. Both the Sharpe and Treynor measures include performance in their calculations as well as risk; whereas SD and Beta are only risk measures, not performance measures*.

Risk Ranking (lowest to highest)		*Risk-Adjusted Performance Measure Rankings*	
SD	*Beta*	*Sharpe*	*Treynor*
SPY	*F*	*SPY*	*F*
BUFSX	*Portfolio*	*F*	*P*
IBM	*PWRD*	*Portfolio*	*PWRD*
F	*SPY*	*BUFSX*	*Portfolio*
Portfolio	*P*	*GLW*	*SPY*
GLW	*BUFSX*	*PWRD*	*GLW*
PWRD	*IBM*	*P*	*BUFSX*
P	*GLW*	*IBM*	*IBM*

Based on the Sharpe Ratio, the Portfolio underperformed SPY. Although the Portfolio generated a return of 36.85% compared to the market's 22.28%, the Portfolio was nearly three times as risky as the market, with a SD of 21.71% compared to the market's 8.14%. The higher return of the Portfolio was insufficient to overcome the much higher total risk compared to the market. The Sharpe Ratio incorporates this high standalone risk measure by using SD as the denominator. However, when using Beta as the risk measure, the Portfolio does outperform the market. The Portfolio has a slightly lower Beta than the market (0.91 vs. 1.0) but a much higher return (36.85% vs. 22.28%). The Treynor Index incorporates the return and the systematic risk measure when determining risk-adjusted performance.]

5. As the manager of the Portfolio, were you a superior, inferior, or average manager according to the Jensen's Alpha during the two-year time period at a confidence level of 90% or better? Was the manager of the Fund a superior, inferior or average manager according to the Jensen's Alpha during the two-year time period at a confidence level of 90% or better? Support your argument using the regression output. Find your Fund's three-year alpha on Morningstar.com. How does the Fund's alpha (as calculated by you) compare to the Morningstar alpha? Should the two values agree? Why or why not? *[I was an average manager according to the Jensen's Alpha during the two-year time period. Although the Portfolio generated a positive return, and a positive alpha of 1.3%, the P-value of 40.81% indicates that the positive performance is not significantly different from zero at the 90% (or better) confidence level. The Fund generated a loss over the two-year time period and a negative alpha of -0.2%. However, the P-value of 78.84% indicates that the loss is not statistically different from zero at the required confidence level of 90% or better. According to Morningstar.com, BUFSX's three-year alpha is -6.17%. I should not expect the Morningstar alpha to agree with the alpha I calculated, as Morningstar is using a three-year time period whereas I am using only a two-year time period. Also, I am using monthly return measures and Morningstar may be using a different interval (such as weeks or days) to calculate returns. For my calculation SPY was the benchmark index; however, Morningstar uses a fund's benchmark index, which may not be the S&P500. Finally, Morningstar deducts the fund's fees when calculating the fund's returns used to calculate alpha, while I did not deduct any fees charged by the fund.]*

6. Discuss how the market impacts the returns of your individual stocks as well as the returns of the Portfolio and the Fund. Is your portfolio well diversified based on the R^2 criteria? Is the Fund well diversified? How do you know? Did you expect the Portfolio or the Fund to be well diversified? Why or why not? *[R^2, the coefficient of determination, measures the influence the returns on the market have upon the returns of the security. The market has only minimal influence on F, PWRD and P, with R^2s less than 5%. The market has more impact on GLW, with an R^2 of 36.45% and IBM with an R^2 of 43.34%. Generally, one might expect the R^2 of the Portfolio to exceed that of the individual stocks because the Portfolio could potentially be more diversified than any individual stock within the Portfolio. However, in this case, it did not. The R^2*

for the Portfolio was only 11.60%, indicating that the Portfolio was not well diversified. A R^2 of 90% or better is used to indicate that a portfolio is "well-diversified." As such, BUFSX was not well diversified due to its relatively low R^2 of 43.44%.] NOTE: To address the question of whether they expected the Fund to be well diversified, the student must obtain some information about the Fund's holdings, via a website such as Morningstar.com. *[I did not expect the Portfolio to be well diversified as it only contains five companies. The Fund is far more diversified, with 55 stock holdings in eight of the eleven sectors listed on Morningstar.com. However, due to the fact that it contains only a small number of small cap stocks and it does not include all sectors, I do not expect the Fund to be well diversified.]*

7. Discuss for your specific stocks, the Portfolio, and the Fund, which measure of risk (standard deviation or beta) is the best measure to use? State under which conditions beta is the best measure and under which conditions standard deviation is the best measure of risk for assets in general. *[Beta is a better risk measure when systematic risk is the only risk that needs to be considered. This would be appropriate when evaluating a well-diversified portfolio or an individual stock you are considering adding to a well-diversified portfolio. If you are evaluating a poorly diversified portfolio or an individual stock based on its standalone risk, SD is the better risk measure. Given that the stocks are being evaluated individually and neither the Portfolio nor the Fund is well-diversified, SD is the better risk measure.]*
8. Discuss the impact of diversification on the Portfolio's SD and beta (compare the Portfolio's SD to the simple weighted SD and discuss those numbers in your report). Include an analysis of the correlation coefficients (rhos) in your discussion. *[The annual SD of the Portfolio when calculated using the STDEV function in Excel (applied to the monthly returns) and converting it to an annual measure, is 21.71%. However, when calculating the simple average of the five stocks' SDs, I obtained an annual Portfolio SD of 30.75%. This calculation assumes that all the correlation coefficients between unique pairs of stocks equal 1.0 and that the weights of each stock in the Portfolio remain at 20% each month. Both of these assumptions are false. I did not rebalance the Portfolio each month; rather, the weights were allowed to vary based upon the returns generated by each stock each month. Additionally, the correlation coefficients (shown in Table 6) were far less than 1.0. The highest correlation coefficient was 0.4743 (between P and PWRD) and the lowest was between P and F at -0.0372. Lower correlation coefficients result in better risk reduction and contribute to the smaller Portfolio SD of 21.71%compared to the simple weighted average Portfolio SD of 30.75%.]*
9. Discuss how the Portfolio's systematic risk (beta) changed during the two-year period based on the beginning weights vs. the ending weights. Specifically explain the reason for the change. NOTE: The students calculate the Portfolio's beta three different ways. First, they perform a regression to determine the beta shown in Table 5. Next, they calculate a weighted average Portfolio beta using the initial 20% weights for each stock and each stock's Beta—this is the Weighted Beta (Beginning) shown in Table 5. Finally, they calculated a second weighted average Portfolio beta using the ending weights for each stock and each stock's beta—shown as the Weighted Beta (Ending) in Table 5. *[Based upon the Portfolio's Weighted Beta calculation, the Beta of the Portfolio dropped slightly from 1.08 to 1.05 over the two-year period. This is mainly due to the large drop in weight for IBM coupled with IBM's beta of 1.24.]* NOTE: Many students state that the Portfolio beta changed because the individual stocks' betas changed. Rather, it is the changing stock weights that are making the weighted stock betas change.

Stage 4 (Part 2): Frontiers, Incorporating CAL, Determining Tangency Point and Optimal Weights

The remainder of the project focuses on generating a frontier for the five stocks, incorporating the CAL, and determining an optimal portfolio. To generate the frontier potentially containing all five stocks, students first calculate the correlations among the stocks. Microsoft Excel has an add-in available in Data Analysis that generates the correlations in the format shown in Table 6. Students sometimes provide the correlations for the Portfolio, the Fund and SPY even though they are not needed.

Table 6: Correlations

	F	*PWRD*	*IBM*	*P*	*GLW*
F	1				
PWRD	0.33	1			
IBM	0.10	0.02	1		
P	-0.04	0.47	0.01	1	
GLW	0.17	0.08	0.40	0.04	1

Next, the students use an instructor-generated spreadsheet with a macro to calculate the 10 two-stock frontiers and the "final frontier"—the leftmost frontier (possibly comprised of all five stocks) that dominates the 10 two-stock frontiers. As this process involves knowledge of both the Solver feature of Excel and Visual Basic for Applications (a programming language used to develop Excel macros), the instructor does not require that the students create the macro themselves as it is beyond the scope of the course. The students must copy/paste a few values from their spreadsheet (annual arithmetic means, annual standard deviations, and correlation coefficients) to the instructor-provided spreadsheet and run a macro. The spreadsheet generates a graph similar to Figure 3 as well as tabular data similar to Table 7 (without the highlighted rows). The "final frontier" in Figure 3 represents the Return and SD from Table 7.

Figure 3: Two-Stock and Final Frontiers

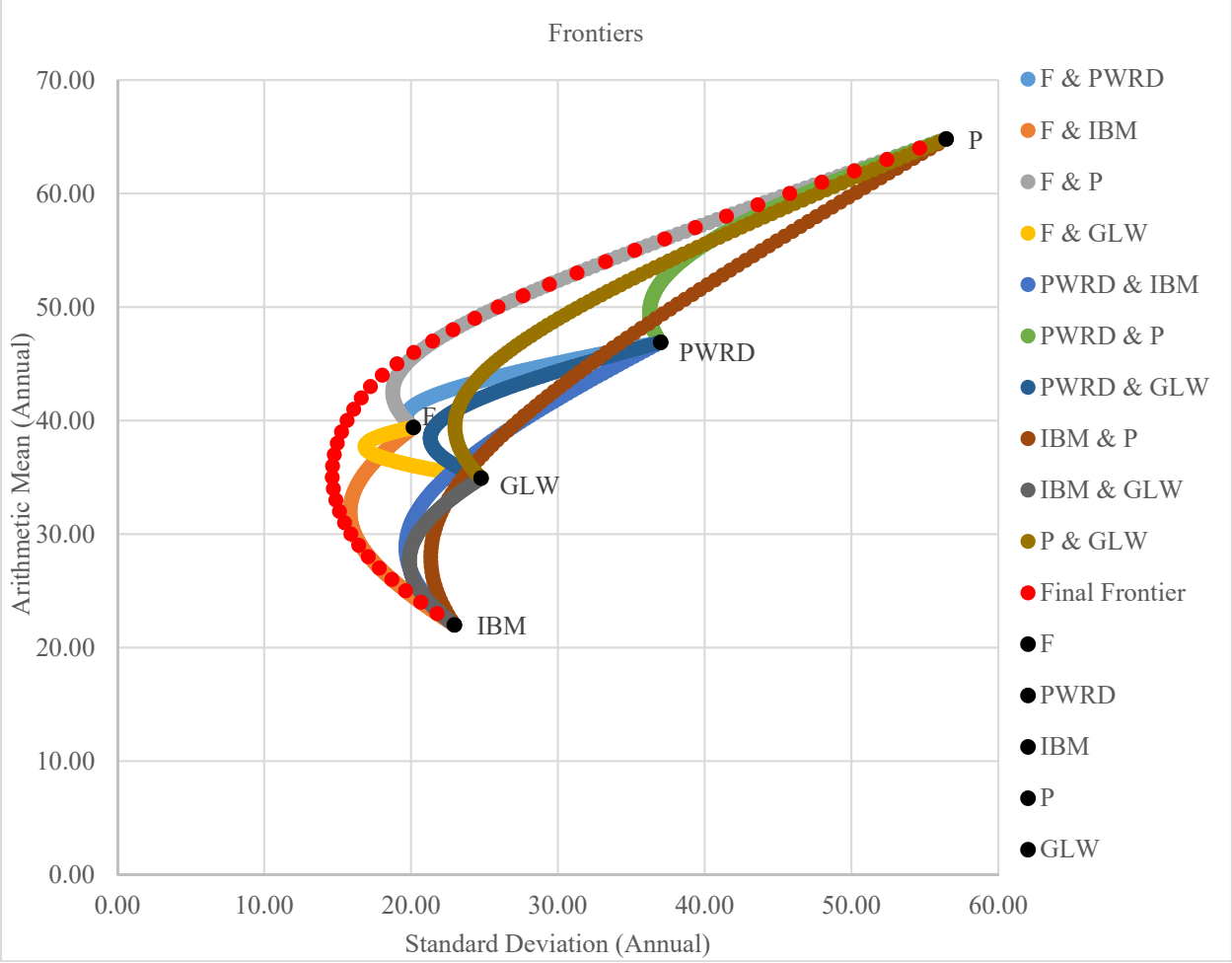


Table 7: Solver-Generated Data

	SD (%)	Return (%)	F (%)	PWRD (%)	IBM (%)	P (%)	GLW (%)
	22.96	22.00	0	0	100	0	0
	21.78	23.00	6	0	94	0	0
	20.67	24.00	11	0	89	0	0
	19.64	25.00	17	0	83	0	0
	18.70	26.00	22	0	77	0	1
	17.85	27.00	26	0	70	0	4
	17.09	28.00	30	0	64	0	6
	16.44	29.00	34	0	58	0	9
	15.91	30.00	36	1	52	0	11
	15.48	31.00	38	2	47	1	12
	15.14	32.00	40	2	43	2	13
	14.88	33.00	41	2	39	3	15
	14.72	34.00	43	2	35	5	16
	14.64	35.00	45	2	31	6	17
	14.66	36.00	47	1	26	7	18
Y	14.77	37.00	49	1	22	9	19
	14.98	38.00	51	1	18	10	20
T	15.27	39.00	53	1	14	11	21
	15.65	40.00	54	1	10	13	22
	16.10	41.00	56	1	6	14	23
	16.62	42.00	58	1	2	15	24
	17.24	43.00	59	0	0	18	22
	18.05	44.00	60	0	0	21	19
	19.04	45.00	60	0	0	25	15
	20.19	46.00	61	0	0	28	11
	21.48	47.00	61	0	0	31	7
X	22.87	48.00	62	0	0	34	4
	24.35	49.00	62	0	0	38	0
	25.93	50.00	58	0	0	42	0
	27.64	51.00	54	0	0	46	0
	29.43	52.00	50	0	0	50	0
	31.31	53.00	46	0	0	54	0
	33.25	54.00	43	0	0	57	0
	35.25	55.00	39	0	0	61	0
	37.29	56.00	35	0	0	65	0
	39.38	57.00	31	0	0	69	0
	41.49	58.00	27	0	0	73	0
	43.63	59.00	23	0	0	77	0
	45.80	60.00	19	0	0	81	0
	47.99	61.00	15	0	0	85	0
	50.20	62.00	11	0	0	89	0
	52.42	63.00	7	0	0	93	0
	54.65	64.00	0	0	0	100	0

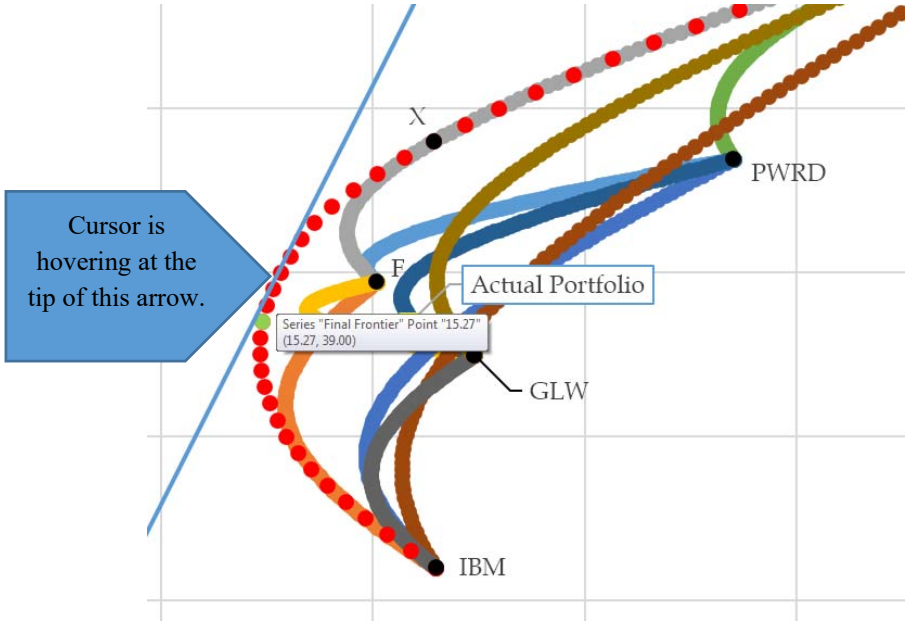
Once the students have generated Figure 3 they add the following points to the graph:

a. The Portfolio's actual annual AM and SD (labeled "Actual Portfolio") obtained from Table 4;
b. The annual risk-free rate (labeled "RF") provided by the instructor;

c. A point (labeled "X") on the "final frontier" that offers better return for the same risk achieved by the Portfolio—obtained by examining the output in Table 7 and finding a weighting scheme that generates approximately the same risk as the "Actual Portfolio" (highlighted in Table 7 as "Point X"); and
d. A point (labeled "Y") on the "final frontier" that would have generated a lower risk for the same return achieved by the Portfolio—obtained by examining the output in Table 7 and finding a weighting scheme that generates approximately the same return as the "Actual Portfolio" (highlighted in Table 7 as "Point Y").

Once the students plot the above points, they insert the Capital Allocation Line (beginning at the risk-free rate and drawn tangentially to the "final frontier"). While they could calculate the coordinates of the CAL, given the already complex nature of the project, they are allowed to use the INSERT/SHAPES/LINE feature of Excel to draw the tangency line. Thus, the CAL does not appear in the legend nor is it limited by margin restrictions. Next, the students determine the coordinates of the Tangency Point and add that point to the graph (labeling it "T"). By "eyeballing" the tangency point and placing the cursor in the appropriate spot on the graph, a "tooltip" appears, showing the coordinates for "T" (See Figure 4). The students examine Table 7 to determine the weighting scheme for the five stocks that accomplishes point "T" (highlighted in Table 7 as point "T").

Figure 4: Tooltip in Excel



Now that the CAL has been added and the tangency point determined the students add several more points to Figure 3:

a. A dominant point on the CAL that generated the same annual SD as the Actual Portfolio and point "X" (labeled "Super X"); and
b. A dominant point on the CAL that generated the same return as the Actual Portfolio and point "Y" (labeled "Super Y").

Once the students have added points "Super X" and "Super Y" to the graph, they must determine the correct weighting scheme to accomplish both points and allocate specific dollar amounts to each investment to complete Table 8.

Table 8: Weights and Investment Amounts

Final Frontier Information					
Point	**Annual AM (%)**	**Annual SD (%)**	**Weights (%)**		**Dollar Amounts**
Actual Portfolio	36.85	21.71			
X	48.00	22.87	F	61.89	30,946.96
			PWRD	0.00	0.00
			IBM	0.00	0.00
			P	34.49	17,245.08
			GLW	3.62	1,807.96
Y	37.00	14.77	F	48.83	24,416.46
			PWRD	1.30	647.85
			IBM	22.26	11,128.05
			P	8.73	4,366.91
			GLW	18.88	9,440.73
T	39.00	15.27	F	52.52	
			PWRD	0.99	
			IBM	14.01	
			P	11.43	
			GLW	21.05	
Super X	58.39	22.87	RF asset	-49.73	(24,865.00)
			Point T	149.73	74,865.00
				Individual Stocks	
			F	52.52	39,320.97
			PWRD	0.99	742.23
			IBM	14.01	10,487.64
			P	11.43	8,555.93
			GLW	21.05	15,757.76
Super Y	37.00	14.49	RF asset	5.13	2,564.38
			Point T	94.87	47,435.62
				Individual Stocks	
			F	52.52	24,914.53
			PWRD	0.99	470.29
			IBM	14.01	6,645.17
			P	11.43	5,421.21
			GLW	21.05	9,984.42

Note: Black cells should remain blank.

Completing Table 8 involves inputting the annual arithmetic means and standard deviations for the Actual Portfolio, X, Y, T, Super X and Super Y. The students must obtain the appropriate weights for points X, Y and T from Table 7 and input the weights calculated for the risk-free rate and point T to find points Super X and Super Y. Lastly, they must calculate actual dollar amounts for the final column of Table 8.

Stage 4 (Part 3): Calculating Weights and Dollar Amounts for "Super" Points

"Super X" lies on the CAL directly north of point X; therefore, both points have the same annual Standard Deviation of 22.87%. However, while point X is composed of about 62% in F, 0% in PWRD and IBM, 34% in P and 4% in GLW, point "Super X" is a mix of borrowing at the risk-free rate and investing the borrowed funds along with the original $50,000 in the tangency portfolio "T." $SD_X = 22.87\% = SD_{Super\ X}$ and

$$SD_{Super\ X} = \sqrt{w_{RF}^2 SD_{RF}^2 + w_T^2 SD_T^2 + 2 w_{RF} w_T SD_{RF} SD_T rho_{RF,T}} \quad (1)$$

where:
w_{RF} = weight in the riskless asset;
w_T = weight in the tangency portfolio (point "T");
SD_{RF} = standard deviation of the riskless asset (or zero);
SD_T = standard deviation of the tangency portfolio; and
$rho_{RF,T}$ = correlation coefficient between the riskless asset and the tangency portfolio (or zero).
Since $SD_{RF} = 0$, Equation 1 simplifies to

$$SD_{Super\ X} = w_T SD_T \quad (2)$$

We can insert the known variables into Equation 2 and solve for w_T:

$$0.2287 = w_T(0.1527)$$
$$w_T = 1.4977$$

If the weight of the tangency portfolio is 1.4977, the weight of the risk-less asset must be 1 – 1.4977, or -49.77%. Given our client's original $50,000, they would borrow 49.77% × $50,000, or $24,865 and invest a total of $74,865 in the Tangency portfolio. This would generate a weighted average return of:

$$Return_{Super\ X} = (w_{RF} \times Return_{RF}) + (w_T \times Return_T) \quad (3)$$
$$= (-0.4977 \times 0.0007) + (1.4977 \times 0.39) = 0.5839 \text{ or } 58.39\%$$

"Super Y" has the same return as "Y" of 37%. It is comprised of lending some amount by purchasing riskless securities and placing the remainder of one's $50,000 in the tangency portfolio "T." To determine the weight to place at the riskless rate and the weight to place in the tangency portfolio that would achieve point "Super Y", solve the following equation, given that the annual riskless rate was 0.07%:

$$Return_{Super\ Y} = (w_{RF} \times Return_{RF}) + (w_T \times Return_T) \quad (4)$$

The return of Super Y is 37% and the weight in the riskless asset is $(1 – w_T)$, resulting in:

$$0.37 = ((1 - w_T) \times 0.0007) + (w_T \times 0.39)$$

Solving for w_T gives 94.87%. The w_{RF} is 100% – 94.87%, or 5.13%. The $SD_{Super\ Y}$ is

$$SD_{Super\ Y} = w_T SD_T, \text{ or } 0.9487 \times 0.1527 = 0.1449 \text{ or } 14.49\%$$

The students can now complete Table 8 using the previous calculations for points Super X and Super Y, the weighting schemes for points X, Y and T from Table 7 and the portfolio information from Table 4. After incorporating the points, the students generate the Final Frontier with Points as shown in Figure 5 and answer the following questions:

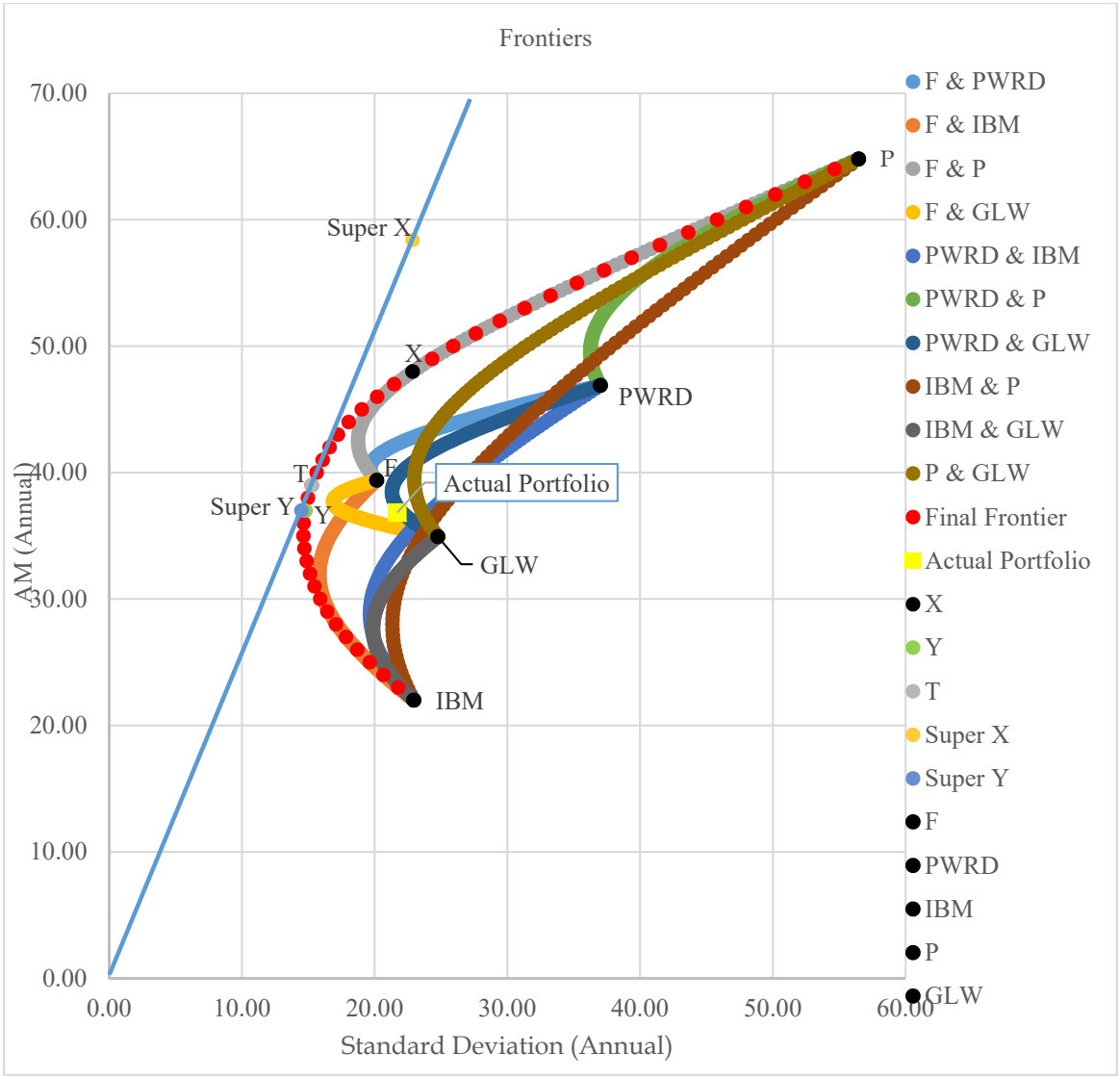
Discuss the optimal weight to place in each stock using point Super X compared to the simple equal-weighting scheme. Based on your Super X, should you have attempted to convince your client to buy on margin (assuming your client could borrow at the riskless rate)? Using hindsight there is a clear mathematical argument either for or against buying on margin at point Super X. Also, given the current limits to margin trading of no more than 50% margin on long transactions, would your client have suffered from this constraint? *[Super X recommends a far different weighting scheme than the original equally-weighted portfolio. F should make up a bit more than half the portfolio while PWRD should be only a small portion. Both IBM and P should contain less than the 20% original weight. Only GLW should contain a weight near the original 20%. Additionally, to obtain point Super X, my client should have bought on margin, borrowing $24,865 at the riskless rate, and placing $74,865 in the Tangency portfolio. The constraint of borrowing no*

more than 50% of the cost of the securities would not have caused a problem as $24,865 ÷ $74,865 = 33.21%.]

Practical Issues

A variety of practical issues exist with the project. First, the project involves only five stocks. Five additional stocks could easily be added without substantially increasing the complexity of the project. Having only five stocks does not quite show the impact diversification can have on a portfolio. The project also ignores transaction costs for trading securities. However, these costs are relatively small and would not significantly impact returns. Taxes are also not included, nor is short selling allowed. The idea is to keep the project "uncomplicated" by eliminating some possible variables in order to teach a complicated topic to undergraduates. Additionally, Jenson's Alpha and Treynor Index are not suitable for poorly diversified portfolios. Since the majority of the portfolios (and certainly the individual stocks) are poorly diversified, these measures are not viable measures of risk-adjusted performance. However, there is a benefit to having students calculate them anyway, in order to familiarize themselves with the tools.

Figure 5: Frontiers with All Points and Capital Allocation Line



Note: The blue CAL is drawn with the Insert/Shape feature in Excel and does not appear on the legend.

There are some issues related to the Frontier chart generated by the instructor-provided macro. First, the macro is only compatible with Windows versions of Excel 2013. If a student is using another spreadsheet program, he must complete this portion of the project in a campus lab or by some other suitable means. However, the students do not find this to be a serious constraint. Secondly, given the different versions of Microsoft Excel still in use, the macros require minor "adjustments." The macro is set to work with Excel 2013 and may not be compatible with earlier versions of the program.

Most students are able to plot an X, Y, Super X and Super Y. It is possible that, based on the shape of the "final frontier," a student might not have an X or Y, although everyone should have a Super X and Super Y, as those points are on the CAL. If the actual portfolio lies on the leftmost "final frontier," points X and Y do not exist. However, the likelihood of this occurring is small. Also, not everyone's experience is identical. For example, sometimes both Super X and Super Y fall to the left of the tangency point; therefore, some students do not experience the "buying on margin" situation. However, by demonstrating the project in class during accompanying lectures, the instructor can show multiple possibilities.

Dividends are assumed to be paid at the end of the month; therefore, the end-of-month stock price is the purchase price for the reinvested dividends. A more reasonable practice would be to reinvest the dividends the day after receiving them. However, switching to daily returns rather than monthly returns would add another level of complexity to the project and would detract from the overall project.

Finally, the project uses ex post data. The students are using hindsight to determine what they SHOULD have done if they had known the return, risk and correlations of the stocks beforehand (in terms of optimal weights). Realistically this information is not known before decisions concerning weighting schemes must be made. The students do not always grasp this.

Grading

Via a series of Visual Basic for Applications macros written by the author, the instructor can quickly and easily generate the tables and figures needed to grade the numerical aspects of each project. Prior to the development of the macros, I only spot-checked certain values in the tables. Now that I can easily review all the values in the Tables and Figures for each project, I am discovering more errors in the submitted projects and the grades now more accurately reflect the work. The reading of each of the students' responses, however, must still be done and it is time consuming. One option is to have the students complete the project in teams to reduce the overall number of projects to grade.

Enhancements

Several enhancements are possible. First, given the power of today's computers, doubling the number of stocks could greatly enhance the diversity of the portfolio—resulting in a higher Portfolio R^2 and a greater amount of risk reduction in terms of SD without substantially increasing the amount of work required by the students. Prior to creating the macros that calculate the check figures for each project I hesitated to add more stocks due to the extra grading required. However, since I have developed the grading macros, I no longer consider this a serious constraint. Grading a project that uses 10 stocks rather than five would take only a few more minutes, but the benefits to the students would be substantial as they could more clearly see the benefits of diversification. Secondly, I could have the students evaluate whether SPY is an adequate benchmark for their portfolio in terms of the types of stocks chosen. Finally, rather than allowing the students to draw the CAL using Excel's Insert/Shapes/Line feature, I could have them calculate the equation for the CAL and cap the rightmost point at the current maximum allowed initial margin rate of 50%.

Conclusion

The comprehensive project is well received by students and some have included it in their portfolio of projects to show potential employers. Not only does the project teach portfolio analysis skills, but it also helps students gain spreadsheet skills that are valued by employers. The students enjoy the opportunity to work with real-world data. The inclusion and use of the instructor-provided macros lets the students see how powerful Excel can be. While the project seems difficult (and it would be overwhelming if assigned all at once), by assigning it in increments, it is manageable and, to date, several thousand students have successfully completed the project. The Portfolio Optimization project has been in use, in various iterations, for the past

two decades at this university. While most students choose well-known companies, sometimes they choose obscure, unknown (by me) companies, which helps keep the project interesting. Additionally, the dynamic nature of the stock market leads to interesting situations for classroom discussion, such as the financial crisis beginning in 2007. The Portfolio Optimization Project for Undergraduates includes course materials and instructions, spreadsheet for grading, VBA macros, and explanatory videos and is available upon request from the author.

References

Kalra, Rajiv and Marsha Weber. Summer 2004. “A Comprehensive Stock Analysis Project for the First Course in Investments.” *Journal of Financial Education* 30: 44-55.

Kish, Richard J., and Karen M. Hogan. Fall 2001. "Linking Theory and Practice: An Asset Allocation Assignment." *Journal of Financial Education* 27: 76-87.

A Pedagogical Note on the Dynamics of Capital Market Efficiency for the Introductory Finance Course

John T. Rose[1]

Abstract

Introductory finance textbooks commonly address capital market efficiency from a largely static perspective with little or no attention to the dynamics that bring the price of a security into equality with its intrinsic value. This note offers a simple pedagogy to illustrate the process by which capital market efficiency will return a stock's price to equal its true value and simultaneously bring the expected rate of return on the stock into equality with the market's required return.

Introduction

Introductory finance textbooks typically address capital market efficiency from a largely static perspective. Specifically, textbooks commonly define an efficient market for a given security (stock or bond) as the state in which the market price of the security quickly, if not instantaneously, adjusts to any change in the security's intrinsic value brought on by new, relevant information. "Intrinsic, or true, value," in turn, is defined as the present value of the stream of cash flows expected from the security. The result of such a rapid adjustment in the market price of the security to surprise information is that the price effectively equals the security's intrinsic value at any point in time. Stated differently, an efficient market is one in which the security has a net present value (NPV) of zero, and the expected rate of return on the security equals the risk-adjusted return required by the market.

But what are the dynamics of capital market efficiency that bring the price of a security into equality with its true value when new, relevant information changes the security's intrinsic value? A review of thirteen introductory finance textbooks published (copyrighted) between 2008 and 2015 (listed in the References) revealed only two books that address this issue to any degree. Parrino, Kidwell, and Bates (2012, p. 33) note that if the market price of a security does not equal its present value, investors will buy or sell the security to bring the price into equality with its true value. Similarly, Gitman (2009, p. 343) addresses the adjustment process by focusing on the relationship between the security's required return and its expected return. As Gitman explains, if the required return exceeds the expected return, investors will sell the security, pushing the price down and the expected return up to equal the required return. And if the required return is less than the expected return, investors will buy the security, pushing the price up and the expected return down to match the required return.

But what triggers the initial inequality to generate the market efficiency adjustment? Clearly, it is new, publicly available information that alters investors' view of the security's present value, which, in turn, generates a dynamic response to bring the market price of the security back into equality with its intrinsic value. However, with the partial exception of the two textbooks noted above, none of the books reviewed adequately addresses this issue. Yet it is important for students to understand not only the static definition of capital market efficiency but also the dynamic process by which new information changes the present value of the security, triggering a price response to reestablish equality with the security's new intrinsic value.

This note offers a simple pedagogy to show the dynamics of capital market efficiency in the introductory finance course. The pedagogy uses the constant dividend growth (CDG) model and presents two scenarios

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of changes in the present value of a stock owing to exogenous changes in variables within the CDG model, in turn generating adjustments in the market price and expected return to reestablish market equilibrium. The objective is to provide numeric examples to enable students to understand the process that quickly, even instantaneously, brings the price of a security into equality with its intrinsic value in an efficient market. Additionally, the adjustment process is illustrated using a series of figures showing changes in the font size of the notation for the present value, market price, required rate of return, and expected return of a stock to demonstrate disequilibrium and the reestablishment of equilibrium in an efficient market. Understanding the dynamics of capital market efficiency should also help to cement students' appreciation of the linkage between a security's required return and its intrinsic value as well as between the security's price and its expected return. Based on the pedagogy presented, multiple-choice or open-ended questions may be drafted to test students' understanding of the equilibrating process.

Scenario 1: A Change in the Required Rate of Return (R_S)

Assume the CDG model, $V_S = [D_0 (1 + g)] / (R_S – g)$, for a given stock with the following values: $D_0 = \$2.30$, $g = 0.05$, and $R_S = 0.13$. (Pursuant to the model, R_S must exceed g.) In that case, $V_S = \$30.19$. Assume further that the market for the stock is initially in equilibrium so that the market price of the stock (P_S) equals V_S, and the expected return (K_S) {calculated as $K_S = [D_0 (1 + g) / P_S] + g$} equals R_S.

Next, suppose that new, publicly available information is introduced suggesting an increase in the riskiness of the stock such that the risk-adjusted required rate of return (R_S) jumps to 0.15, exceeding the current expected return (K_S) of 0.13. As a result, the intrinsic value of the stock (V_S) immediately falls to \$24.15, well below the current market price (P_S) of \$30.19.[2]

Upon recognizing that V_S is now less than P_S (and R_S is greater than K_S) investors should proceed to sell the stock and/or to refrain from buying it, thus pushing P_S downward from its initial price of \$30.19 to its new intrinsic value of \$24.15 and increasing the stock's expected return (K_S) from 0.13 to 0.15. The speed at which such an equilibrating adjustment occurs depends on the degree of market efficiency. The more efficient is the market the quicker will be the equilibrating process. In fact, with perfect market efficiency the process will be instantaneous, giving the static presentation of capital market efficiency as seen in most introductory finance textbooks.

This dynamic can also be demonstrated pedagogically in a classroom by using a visual presentation of changes in the font sizes of the notation for the four variables, V_S, P_S, R_S, and K_S. To illustrate, refer to Figure 1, which depicts the initial equilibrium situation in which the font size of V_S equals that of P_S, and the font size of R_S equals that of K_S:

Figure 1

$$\begin{array}{ccc} \mathbf{V_s} & = & \mathbf{P_s} \\ \uparrow & & \downarrow \\ \mathbf{R_s} & = & \mathbf{K_s} \end{array}$$

The arrows indicate the direction of influence, that is, R_S**,** the required rate of return, determines the intrinsic value of the stock, V_S, for an expected growth rate of dividends, while the market price of the stock, P_S, determines the expected rate of return, K_S, for that dividend growth rate.

[2] For students who are familiar with the Capital Asset Pricing Model (CAPM) the instructor might generate the higher required return (R_S) by using the CAPM. However, a review of the textbooks listed in the References shows that in most texts the CAPM is not addressed until after a discussion of capital market efficiency. Of the twelve books that discuss both the CAPM and market efficiency, eight address market efficiency prior to discussing the CAPM. (One of the texts makes no mention of market efficiency.) Thus, one may suppose that most students will not yet have encountered the CAPM when they are introduced to capital market efficiency.

Next, suppose that the required rate of return, R_S, suddenly increases due to new, publically available information reflecting an increase in the riskiness of the stock. The immediate effect should be to increase R_S above K_S and simultaneously to decrease V_S below P_S as shown in Figure 2 by the larger font size for R_S and smaller font size for V_S, relative to K_S and P_S, respectively:

Figure 2

$$\begin{array}{ccc} V_s & < & P_s \\ \uparrow & & \downarrow \\ R_s & > & K_s \end{array}$$

Note that by showing Figures 1 and 2 on a blackboard/whiteboard/screen the instructor can highlight in Figure 2 the increase in R_S using a larger font size and the decrease in V_S using a smaller font size relative to their original font sizes in Figure 1. In so doing the instructor can emphasize that if V_S is less (or greater) than P_S, then R_S is necessarily greater (or less) than K_S.

Upon recognizing that V_S is now less than P_S (and R_S is greater than K_S) investors should rush to sell the stock and/or to refrain from buying it, thus pushing P_S downward and increasing K_S until P_S and K_S again equal V_S and R_S, respectively. And the more efficient is the market for the stock, the more quickly will the equilibrating process occur, bringing P_S into equality with V_S at a lower dollar amount and raising K_S to equal R_S. The end result is depicted in Figure 3 by the smaller font size for $V_S = P_S$ and the larger font size for $R_S = K_S$ relative to their respective font sizes in Figure 1 and matching the font sizes for V_S and R_S in Figure 2:

Figure 3

$$\begin{array}{ccc} V_s & = & P_s \\ \uparrow & & \downarrow \\ R_s & = & K_s \end{array}$$

Note that this equilibrating process applies to an efficient market for a bond as well as a stock. In fact, it is instructive for students to see the process first for a bond and then for a stock since the effect of a change in the required rate of return, R_S, on V_S will be the same for both a bond and a stock.

Scenario 2: A Change in the Expected Growth Rate of Dividends (g)

Again, assume the CDG model with the same initial values of the several variables, D_0, g, and R_S, giving an initial intrinsic value of V_S = \$30.19, and equilibrium such that $V_S = P_S$ and $R_S = K_S$. Now assume that new information suggests an increase in the expected growth rate of dividends (g) from 0.05 to 0.07. As a result, the intrinsic value of the stock (V_S) immediately increases to \$41.02, significantly above the initial market price (P_S) of \$30.19. At the same time, with no change in P_S, the expected return (K_S) on the stock increases from 0.13 to 0.15 {again calculated as $K_S = [D_0 (1 + g) / P_S] + g$}.

Upon recognizing that V_S is now greater than P_S (and R_S is less than K_S) investors should proceed to buy the stock and/or to refrain from selling it, thus pushing P_S upward from its initial price of \$30.19 and decreasing K_S until P_S and K_S again equal V_S and R_S, respectively. And again the speed at which such an equilibrating adjustment occurs depends on the degree of market efficiency. The more efficient is the market the quicker will be the equilibrating process.

This dynamic, too, can be demonstrated pedagogically by using a visual presentation of changes in the notation for the font sizes of the four variables, V_S, P_S, R_S, and K_S. To illustrate, refer back to Figure 1, which depicts the initial equilibrium situation in which the font size of V_S equals that of P_S, and the font size of R_S equals that of K_S.

Next, suppose that the expected growth rate of dividends, g, suddenly increases due to new information made available to the market. The immediate effect should be to increase K_S above R_S and simultaneously increase V_S above P_S as shown in Figure 4 by the larger font size for both K_S and V_S, relative to that of R_S and P_S, respectively:

Figure 4

$$\begin{array}{ccc} \mathbf{V_s} & > & \mathbf{P_s} \\ \uparrow & & \downarrow \\ \mathbf{R_s} & < & \mathbf{K_s} \end{array}$$

As a result, upon seeing that V_S is greater than P_S investors should rush to buy the stock and/or to refrain from selling it, thus pushing P_S upward and reducing K_S until P_S and K_S again equal V_S and R_S, respectively: And the more efficient is the market for the stock, the more quickly will the equilibrating process occur, bringing P_S into equality with V_S at a higher dollar amount and returning K_S to its original level before the rise in g. This response is depicted in Figure 5 by the larger font size for $V_S = P_S$, matching the font size for V_S in Figure 4, and a return to the original font size for $R_S = K_S$ in Figure 1:

Figure 5

$$\begin{array}{ccc} \mathbf{V_s} & = & \mathbf{P_s} \\ \uparrow & & \downarrow \\ \mathbf{R_s} & = & \mathbf{K_s} \end{array}$$

Possible Exam Questions

Based on the pedagogy presented above, exam questions may be formulated to test students' understanding of the dynamic process associated with capital market efficiency. For example, an instructor might present a scenario in which $V_S > P_S$ and then ask how investors in an efficient market would respond and the resulting effects on V_S, P_S, R_S, and K_S. Alternatively, the instructor might pose a scenario in which $R_S < K_S$ and again ask how investors would react and the resulting effects on V_S, P_S, R_S, and K_S. In both scenarios such a question could be framed in either an open-ended or multiple-choice format using a numeric example with the CDG model or a figure showing initial discrepancies in the font size of the notations for the several variables.

Summary

Introductory finance textbooks commonly address capital market efficiency from a largely static perspective with little or no attention to the dynamic process that brings the price of a security into equality with its intrinsic value. This note offers a simple pedagogy using changes in the intrinsic (present) value of

a stock to show the process by which market efficiency will return a stock's price to equal its true value and simultaneously bring the expected rate of return on the stock into equality with the market's risk-adjusted required return. Using both the constant dividend growth model with numeric examples and a series of figures showing changes in the font size of the notation for the present value, market price, required rate of return, and expected return of a stock, the note illustrates disequilibrium and the reestablishment of equilibrium in an efficient market. Additionally, the pedagogy should help to cement students' understanding of the relationship between a security's required return and intrinsic value and between the security's market price and expected return. Finally, the note suggests how the instructor might formulate exam questions to test students' understanding of the equilibrating process.

References

Berk, Jonathan, Peter DeMarzo, and Jarrad Harford. 2009. *Fundamentals of Corporate Finance*. Boston: Pearson Education, Inc.

Block, Stanley B. and Geoffrey A. Hirt. 2008. *Foundations of Financial Management*, 2nd edition. New York: McGraw-Hill/Irwin.

Brigham, Eugene F. and Joel F. Houston. 2015. *Fundamentals of Financial Management*, concise 8th edition. Mason, OH: South-Western, Cengage Learning.

Brooks, Raymond M. 2013. *Financial Management: Core Concepts*, 2nd edition. Boston: Pearson Education, Inc.

Gallagher, Timothy J. 2012. *Financial Management: Principles and Practice*, 6th edition. Minneapolis: Freeload Press.

Gitman, Lawrence J. 2009. *Principles of Managerial Finance*, 12th edition. Boston: Pearson Education, Inc.

Keown, Arthur J., John D. Martin, and J. William Petty. 2014. *Foundations of Finance: The Logic and Practice of Financial Management*, 8th edition. Boston: Pearson Education, Inc.

Lasher, William R. 2014. *Practical Financial Management*, 7th edition. Mason, OH: South-Western, Cengage Learning.

Megginson, William L. and Scott B. Smart. 2009. *Introduction to Corporate Finance*, 2nd edition. Mason, OH: South-Western, Cengage Learning.

Melicher, Ronald W. and Edgar A. Norton. 2014. *Introduction to Finance: Markets, Investments, and Financial Management*, 15th edition. Hoboken, NJ: John Wiley & Sons, Inc.

Moyer, R. Charles, James R. McGuigan, and Ramesh P. Rao. 2015. *Contemporary Financial Management*, 13th edition. Stamford: CT: Cengage Learning.

Parrino, Robert, David S. Kidwell, and Thomas W. Bates. 2012. *Fundamentals of Corporate Finance*, 2nd edition. Hoboken, NJ: John Wiley & Sons, Inc.

Ross, Stephen A., Randolph W. Westerfield, and Bradford D. Jordan. 2014. *Essentials of Corporate Finance*, 8th edition. New York: McGraw-Hill/Irwin.