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The Term Structure of Interest Rates and Unconventional Federal Reserve Monetary Policy

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ABSTRACT

The term structure of interest rates argues that a fundamental determinant of the Treasury yield curve is expected future short-term interest rates. In early 2013 it is possible to construct a predicted yield curve based on future expectations, and compare it to the actual yield curve. Due to the unconventional Federal Reserve policies that began in 2008, the actual yield curve lies well below that predicted by the term structure theory. Our research indicates that the cumulative impact as of January 2013 of the unconventional Fed monetary policies is to decrease the 10-year Treasury yield by about 80 basis points.

Key words: Federal Reserve, monetary policy, term structure of interest rates, quantitative easing.

Introduction

The term structure of interest rates is a well-established theory of how the Treasury yield curve is determined, emphasizing the role of expected future short-term interest rates in determining the average yield on Treasurys. A typical finance textbook examines the term structure in detail, but does not demonstrate how to derive an actual yield curve from existing market expectations about future short-term rates. In addition, little attention is paid to the role of monetary policy in influencing the yield curve. For example, Bodie, Kane and Marcus (2008) includes a detailed examination of the term structure of interest rates, with no discussion of monetary policy. Fabozzi (2007) includes a very short discussion of monetary policy, but does not directly link this to the Treasury yield curve. In a similar manner, macroeconomics and money and banking textbooks cover monetary policy in detail, but typically do not relate this directly to the yield curve. Gordon (2012), a leading macroeconomics textbook, discusses monetary policy in detail, with only a brief mention of the Treasury yield curve. More interestingly, Mishkin and Eakins (2012) and Cecchetti and Schoenholtz (2011) both have separate chapters on the term structure of interest rates and monetary policy, but do not discuss in detail the relationship between these two topics.

This paper examines the direct relationship between monetary policy and the yield curve, filling a gap in many commonly-used textbooks. The focus here is a real world example and application that students and professors can update in the future. The analysis can be used to examine the theory of the term structure of interest rates in various market settings. We develop one way of constructing a predicted yield curve based on information related to market expectations of the path of future short-term interest rates, and compare this to the actual yield curve. The analysis complements other methods used for examining the actual yield curve, e.g. more complicated econometric models, which may be beyond the grasp of a typical undergraduate student.

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Also, the work here provides a different approach than the existing literature regarding the quantitative impacts on Treasury yields of the recent unconventional monetary policy of the Federal Reserve (the "Fed").[2] Our research obtains results consistent with previous studies that have employed event study models or more complex econometric frameworks. We focus on the expected path of the future federal funds rate in January 2013 and examine what is likely to occur as the Fed eventually unwinds its unusual highly accommodative monetary policy.

The analysis developed here can only be applied in periods when markets have a clear indication of the pattern of future short-term interest rates. The present time is one of these periods, as the federal funds rate has been cut essentially to zero in response to the very slow recovery from the Great Recession. All market participants recognize that future short-term rates will be greater than today's short-term rate, although the exact timing of the Fed's exit from the extraordinary accommodative policies is not known. As the Fed is unlikely to raise the federal funds rate until sometime in 2016, instructors and students can update this analysis as events unfold in the near future. It will be an especially interesting exercise when the Fed begins a tightening cycle once the economic recovery has become firmly established.

The rest of the paper is organized as follows. The next section provides an overview of the unconventional Federal Reserve monetary policies that began in 2008. Next, we turn to a brief review of key elements of the term structure of interest rates that are particularly relevant to our research. This leads to developing a method to construct what the yield curve would look like in January 2013 in the absence of the unconventional Fed policies. This predicted yield curve is compared to the actual yield curve to estimate the quantitative impact of the Fed programs on Treasury yields. The main result is that the cumulative impact as of January 2013 of the unconventional Fed policies is to decrease the benchmark 10-year Treasury yield by about 80 basis points.

Unconventional Federal Reserve Monetary Policy

When the "credit crunch" arrived in the summer of 2007, the Fed moved aggressively by cutting the federal funds rate, its main monetary policy instrument. It soon became clear that the economy was going into a recession. When the financial crisis arrived September 13-15, 2008 (signified by the collapse of Lehman Brothers and the rescue of AIG) the Fed had lowered the federal funds rate to 2%. As events unfolded and more negative economic news arrived, the Fed recognized that the U.S. had entered into the Great Recession. Due to the severity of the economic downturn, the Fed took the unprecedented step of setting the federal funds rate target to 0-25 basis points.

The Fed uses a model based on a so-called Taylor Rule in deciding on the appropriate level of the federal funds rate. This model relates the federal funds rate target to the goals of the Fed regarding inflation and unemployment, and the actual values of these two key macroeconomic variables. Not surprisingly, the large increase in unemployment during the Great Recession called for very accommodative monetary policy. When the Fed undertook their Taylor Rule analysis in 2009, the model indicated that the appropriate federal funds rate was about -5%.[3] Obviously this is not possible.

Faced with a situation of hitting the zero lower bound on the federal funds rate, in 2008 the Fed began to undertake two extraordinary actions in order to lower other interest rates besides short-term rates.[4] First,

[2] The existing literature includes Christensen and Rudebusch (2012), D'Amico and King (2013), D'Amico, *et al.* (2012), Gagnon, *et al*. (2012), Hamilton and Wu (2011), Krishnamurthy and Vissing-Jørgensen (2011), Li and Wei (2012), Swanson (2011), Swanson and Williams (2013), and Williams (2012).

[3] See Rudebusch (2009).

[4] See Joyce, *et al* (2012) for a comprehensive overview of unconventional monetary policies, and Williams (2012) for a summary of the Fed's unconventional policies.

the Fed bought large quantities of Treasurys and mortgage-backed securities (MBS). It turns out that this was the first of (to date) four programs of "Large-Scale Asset Purchases" (LASPs), more commonly referred to as "Quantitative Easing" (QE). The buying of bonds by the Fed drives up bond prices, which results in lower yields (i.e. lower market interest rates). As long as the Fed continues to hold these bonds, market supply is reduced and bond prices remain high, i.e. interest rates remain low. The goals of the Fed were to drive down Treasury yields, recognizing that all other market interest rates would also decrease, and to decrease mortgage rates in order to provide support to the residential real estate sector. Table 1 contains a summary of the Fed's actions as of August 2013.

Table 1: Fed Large-Scale Asset Purchases

Policy	Time Period	Actions
QE1	November 2008 and March 2009, ended March 2010	Purchase $300 billion of Treasurys, $1.25 trillion of MBS and $170 billion of agency debt
QE2	November 2010 to June 2011	Purchase $600 billion of Treasurys
Maturity Extension Program ("Operation Twist")	September 2011 to December 2012	Sell $670 billion of short-term Treasurys and buy long-term Treasurys
QE3	September 2012 to present (on-going as of August 2013)	Purchase $45 billion of Treasurys and $40 billion MBS monthly

The second new policy of the Fed regards the "forward guidance" of the likely level of the federal funds rate in the future. In August 2011 the Fed made a significant change in its forward guidance by announcing it anticipates there will be "exceptionally low levels for the federal funds rate at least through mid-2013."[5] The nature of the forward guidance has since evolved, but in its present form it is very similar to the announcement of specific dates by the Fed.[6] The forward guidance has provided much greater certainty to bond market participants regarding future short-term interest rates. As investors now expect to earn very little if they undertake a series of short-term investments over the next couple of years, investors are induced to buy higher yielding longer-maturity bonds. For example, consider a bond investor with a two-year perspective. The return on a two-year Treasury or two one-year investments is about 10-15 basis points per year. Instead, an investor can buy a 10-year Treasury with an average yield of around 1.90% (on January 25, 2013) and sell in two years, at which time it is expected that interest rates and the bond price will be about the same as when the investment was undertaken. The increased demand for medium- and long-term Treasurys drives up prices, which leads to lower Treasury yields and market interest rates. So, the forward guidance has the same impact as the LSAPs.

Figure 1 shows the main aspects of the Fed's actions. The final result of the LSAP's and the forward guidance is greater demand for Treasurys ($D_2 > D_1$) and a smaller supply ($S_2 < S_1$.) So, Treasury prices are higher ($P_3 > P_1$) and the long-term Treasury yields are lower than without the unconventional Fed policies. The LSAP's and the forward guidance can be seen as a type of market segmentation, as there is unusual

[5] Board of Governors of the Federal Reserve System (2011).

[6] See the Appendix for the revised forward guidance in the FOMC Statement of December 12, 2012.

buying by both the Fed and investors. In addition, in the near-term the effective supply is reduced due to the unusual holding of Treasurys by the Fed.

Review of the Term Structure of Interest Rates[7]

When examining the term structure of interest rates, it is necessary to consider two possible market settings. The first is *market segmentation*, where there are separate markets within the Treasury market, i.e. separate sets of supply and demand for different maturities. In this situation, information cannot be deduced about expected short-term interest rates from the yield curve. The second possibility is *market integration*, where the majority of Treasury traders and investors are considering all maturities and all possible investment strategies. For example, an investor with a 3-year time horizon would consider the following strategies: three consecutive one-year investments; a one-year investment, then a two-year investment; a two-year investment, then a one-year investment; or buy a three-year bond.[8] The investor would then choose the strategy that has the greatest average yield over the three-year holding period.

In applying the term structure analysis at any given time, it is necessary to examine the market in order to determine whether there is market segmentation or market integration. The underlying assumption of the term structure theory is that market integration holds unless there is clear evidence indicating otherwise. Usually it is straightforward to observe a situation of market segmentation, with early 2000 providing a good example. The U.S. government had achieved a budget surplus, and this was projected to continue for a number of years. In addition, the Treasury Department announced plans to use the existing surplus to buy back some long-term Treasurys. Bond market participants quickly realized that the existing and future supply of long-term Treasurys would significantly decrease, and investors began to buy long-term bonds. Long-term yields fell below short-term yields, and the yield curve became inverted. Due to this market segmentation, it was not possible to get information about expected short-term interest rates during this particular period.[9]

It is much more common to have market integration, and in this situation it is possible to obtain information about expected future short-term interest rates from the yield curve. In this setting, the first step is to set up the model under an assumption of perfect certainty. A no arbitrage assumption indicates that for any given investment horizon, all possible strategies must have the same return. As is common in many textbooks, for simplicity we will ignore compounding and use the arithmetic average. Therefore, the results will be (close) approximations of the actual correct values. Today's short-term Treasury rate is observed at i_1, and each future short-term Treasury interest rate beginning in year 2 is represented by i_t. The no arbitrage assumption indicates the following must hold for any investment period of *n* years:

$$y_n = [i_1 + i_2 + i_3 + \ldots\ldots + i_n] \div n. \qquad (1)$$

The next step is to drop the unrealistic assumption of perfect certainty regarding the path of future short-term interest rates. It now must be the case that the bond market applies exactly the same thinking as above, but uses *expected* future short-term interest rates in constructing the yield curve. In this case, we replace equation (1) with:

$$y_n = [i_1 + E(i_2) + E(i_3) + \ldots\ldots + E(i_n)] \div n. \qquad (2)$$

[7] As professors and students would have already seen the standard treatment of the term structure of interest rates, only a brief review will be provided here.

[8] For simplicity, it is assumed that the future is made up of periods of one year in length. The analysis is exactly the same for periods of any length.

[9] See Greenwood and Vayanos (2010) and Wall Street Journal (2000) for a further discussion of this period.

This is the familiar ***pure expectations hypothesis***, proposing that the yield curve is determined completely by today's one-year interest rate and expected future short-term interest rates.

However, as the future is unknown market participants will demand a risk premium to compensate them for the uncertainty regarding future short-term interest rates. Standard bond pricing and duration analysis indicates that interest rate risk increases with maturity. In the term structure analysis, the compensation for this risk is called the "liquidity premium" *(LP*). It remains the case that expectations are the main determinant of bond yields, but the liquidity premium must also be incorporated. This is the ***liquidity preference hypothesis*** of the term structure of interest rates, and the yield for any maturity is now given by:

$$y_n = \{[i_1 + E(i_2) + E(i_3) + \ldots\ldots + E(i_n)] \div n\} + LP_n. \qquad (3)$$

At this point in the typical textbook, the discussion now turns to calculating the inferred expected future short-term interest rates from the existing yield curve. This can be done using either (2) or (3) above. The focus is on obtaining information from the Treasury market regarding the expected future short-term interest rates compared to the existing short-term interest rate. One of the more interesting situations is when the yield curve is inverted, i.e. a significant part of the yield curve has a negative slope. Equations (2) and (3) indicate that some expected future short-term interest rates are below the existing short-term interest rate. This is often interpreted as a situation where bond market participants are expecting an economic slowdown. An oft-cited fact is that the last seven U.S. recessions have been preceded by an inverted yield curve.[10]

Constructing a Predicted Yield Curve

Our analysis of the yield curve takes a different approach by focusing directly on expectations. We propose that the Treasury market would at present be characterized by the usual situation of market integration in the absence of the unconventional Fed policies. By examining (2) above, if somehow we could get direct information on the pattern of expected future short-term interest rates and we believe that the pure expectations hypothesis is correct, it is possible to construct a predicted yield curve. As explained below, the current market situation is one of the times when this information exists, so we focus on constructing a predicted yield curve based upon the pure expectations hypothesis. It is then possible to compare the predicted yield curve with the actual yield curve to examine the impacts of the unconventional Fed policies.

When this type of analysis is undertaken, a key concept is the *term premium*. For any maturity, this is defined as the additional yield required by investors to hold a long-term bond rather than a series of short-term bonds.[11] For our analysis, the term premium is the difference between the actual yield curve and the yield predicted by the pure expectations hypothesis. The term premium can be examined in either a situation of market segmentation or market integration. If there is a situation of perfect market integration, then according to equation (3) the term premium must be positive and is equal to the liquidity premium.

We propose that at the present time the term premium will be significantly negative due to a lowering of the Treasury yield curve as a result of the unconventional Fed policies.

In order to construct a predicted yield curve, it is necessary to obtain estimates of the market's expectations for future short-term Treasury rates. It can be established analytically and empirically that the federal funds rate is a very close proxy for the short-term Treasury rate. The analytical argument relates to the open market operations the Fed undertakes in the federal funds market. Fed lending (repurchase agreements or repo's) and borrowing (reverse repo's) in the federal funds market includes a short-term

[10] See Hudson (2007), which also shows that the 2007-2009 Great Recession was also preceded by an inverted yield curve.

[11] See Swanson (2007).

Treasury or another very low risk security as collateral. Therefore, a federal funds market loan (investment) must have approximately the same risk as a short-term Treasury. It follows that the federal funds rate must be approximately equal to the short-term Treasury rate. This argument is confirmed empirically by the data in Figure 1, which shows the very close relationship between the federal funds rate and the three-month Treasury rate.

These arguments have two key implications. First, the Fed determines the intercept of the yield curve when it sets the existing federal funds rate. Second, the relevant short-term interest rates used in constructing the Treasury yield curve are very closely related to the expected federal funds rate in each future period. Therefore, it is possible to construct a predicted yield curve based on expected future federal funds rates. The analysis here proposes to get information on expected future rates from existing Fed policy, Fed communications and standard macroeconomic analysis regarding short-term rates over the long run. The technique used here to construct a predicted yield curve is only applicable in periods like early 2013 where there is a relatively clear path of future short-term interest rates.

As the Fed currently has set the federal funds rate at 0-25 basis points, there is only one way for the federal funds rate to change in the future. Through its forward guidance (see Appendix), the Fed has given fairly specific information regarding the expected federal funds rate in the near future. Specifically, the Fed has indicated that the federal funds rate is likely to stay at 0-25 basis points at least until early 2016. That is, there is relatively reliable information regarding expected short-term interest rates over the next three years.

Once the Fed begins raising the federal funds rate, a key question is: Where will the Fed stop? The answer is that interest rates will be increased to the natural rate of interest (NRI), the level of the federal funds rate that is neither accommodative nor contractionary. The "Economic Projections of Federal Reserve Board Members and Federal Reserve Bank Presidents, December 2012" includes each FOMC member's estimate of the "longer run target federal funds rate", i.e. the NRI. The average FOMC estimate is 4.25%, which is consistent with other estimates of the NRI.[12] When the Fed ends the tightening cycle, the federal funds rate is likely to remain at the NRI for a couple of years. So, the FOMC projections provide good information regarding the expected federal funds rate over (approximately) 2016-2018.

Finally, it is necessary to obtain information about expected short-term rates after 2018. Besides relying on the FOMC opinions, a common way to estimate the NRI is to examine historical data. The idea is that over time, as the economy moves through the business cycle, the actual federal funds rate will sometimes be above the NRI (when inflation is high), below the NRI (when economic growth is slow) and at the NRI (when the macroeconomic situation is satisfactory). The statistical best estimate of any federal funds rate for any year "significantly far away" from today is therefore the NRI. As it is impossible to have any good idea about the expected short-term rate far out in the future, the average expected rate, the NRI, is used to construct the medium and long end of the yield curve.

The Predicted Yield Curve in January 2013

Based on the previous discussion, it is possible to construct a predicted yield curve in January 2013.[13] The analysis is undertaken based on the following.

1. Use monthly data of the expected federal funds rate [$E(i_j)$].

2. Project that the federal funds rate will increase to 0.25% in June 2016.

[12] Yellin (2012) has indicated she believes the NRI is 4%, and that this is the estimate of "most dealers" (see Appendix).

[13] Jordà (2005) undertook a similar analysis in May 2005 when the Fed began a tightening cycle from a then record-low federal funds rate target of 1.00%. He found that the predicted yield curve based on the pure expectations hypothesis was a very close fit to the actual yield curve.

3. After June 2016, project that the federal funds rate will be gradually increased until it equals the NRI of 4.25% in September 2018.

4. Project that the federal funds rate will *on average* be equal to the NRI of 4.25% from September 2018 until January 2043.
5. Assume the pure expectation hypothesis holds. This assumption might be closely approximated today, i.e. the liquidity premium may be very close to zero, due to the significant certainty the Fed has provided regarding the future federal funds rate. In any event, our predicted yield curve is an underestimate of the yield curve according to the liquidity preference theory. Therefore, if we find a negative term premium based on the pure expectations hypothesis, this is an underestimate of the impacts of the unconventional Fed policies.

6. Calculate the yield for each period with equation (2):

$$y_n = [i_1 + E(i_2) + E(i_3) + \ldots\ldots + E(i_n)] \div n.$$

The predicted yield curve and actual yield curve are shown in Figure 3. The actual yield curve lies well below the predicted yield curve, and there is a large negative term premium. By comparing the actual yield curve and the pure expectations predicted yield curve, the term premium in January 2013 is about negative 80 basis points for both the ten-year and twenty-year Treasury. Without the Fed's unconventional actions, the actual yield curve should be very close to the yield curve predicted by the pure expectations hypothesis.

There could be other explanations of the unusually low medium- and long-term rates such as permanently reduced expectations of future inflation, a global saving glut, or weak economic growth. However, to the degree that these factors are important, they came into play well before the Fed's unconventional policies were implemented. Bernanke discussed these factors a number of years ago, and Greenspan famously recognized the "conundrum" of unusually low long-term U.S. interest rates back in 2005.[14] Given the significant degree of information regarding the path of the future federal funds rate, it is hard to find any reason other than the Fed for the difference between the predicted and actual yield curve. As the Fed's actions are so large and the results clearly predictable, there is widespread agreement that the unconventional policies are the reason for the historically low post-crisis Treasury yield curve.[15]

The actual yield curve in January 2013 must be incorporating all aspects of the various Fed programs. The analysis undertaken here indicates that the cumulative impact of the Fed's actions have reduced long-term yields by at least 80 basis points. The actual impact is likely to be greater than 80 basis points, as the predicted yield curve does not include the liquidity premium. The results obtained here are consistent with other research, which has found that the impact of the Fed's actions on the 10-year Treasury yield has been about 80 to 120 basis points.[16]

The predicted yield curve is based upon specific projections as to when the Fed will begin to tighten monetary policy, the pace at which the federal funds rate will be increased to the NRI, and the value of the NRI. The difference between the predicted yield curve and the actual yield curve is so large that small changes in the projections would not noticeably impact the key overall result that the unconventional Fed policies have significantly lowered medium-term and long-term Treasury yields.

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[14] See Greenspan (2005) and Wall Street Journal (2006).

[15] See Bernanke (2012a), Williams (2011), and Joyce, *et al* (2012).

[16] See Bernanke (2012a), Christensen and Rudebusch (2012), D'Amico and King (2013), D'Amico, *et al.* (2012), Gagnon, *et al.* (2012), Hamilton and Wu (2011), Krishnamurthy and Vissing-Jørgensen (2011), Li and Wei (2012), Swanson and Williams (2013), and Williams (2012).

There are two other points to note related to the relationships in Figure 3. First, the predicted yield curve has an S-shape on the short-end. This results directly from the projections regarding the future path of the federal funds rate and the algebra in constructing the predicted yield for any maturity. The inflection point in the predicted yield curve is a result of assuming the near-term federal funds rate is constant at 0-25 basis points, then rises steadily, and then is assumed to be constant at the NRI of 4.25%. Second, the actual yield curve lies above the predicted yield curve at the short end. This may indicate there is a short-term liquidity premium demanded by investors due to the uncertainty as to when the Fed will actually start to increase the federal funds rate.

Summary and Conclusions

The majority of textbooks on "Macroeconomics", "Financial Markets" and "Investments" do not consider in detail the relationship between the term structure of interest rates and monetary policy. One purpose of the analysis undertaken here is to bridge this gap by demonstrating that the federal funds rate is a good proxy for the relevant short-term Treasury rate when analyzing the yield curve. In addition, in some market settings it is possible to get good estimates of the expected future federal funds rate. Using market information and data in January 2013, we construct a predicted yield curve based on the term structure of interest rates, which is then compared to the actual yield curve. The significant difference between the predicted yield curve and the actual yield curve in early 2013 does not necessarily indicate that the term structure of interest rates theory is incorrect. The existing yield curve is consistent with the type of market segmentation that is observed at present due to the Fed's unconventional monetary policy.

The second key point of our research is to use a different method than previous research to quantify the impact of the unconventional Fed policies on Treasury yields. The analysis indicates that the Fed's actions have reduced long-term Treasury yields by at least 80 basis points. The results are consistent with other research that quantifies the impact of the recent Fed policies on medium-term and long-term interest rates. Our research is important as it contributes to the on-going analysis of the impacts of unconventional central bank monetary policies.

The analysis undertaken here can be updated by students and professors in the next few years as the Fed moves closer to its exit strategy from the unconventional programs and very accommodative monetary policy. The large negative term premium found in early 2013 should disappear as the market returns to the more common situation of market integration. A good "test" of the term structure of interest rates will be when the Fed begins a clear tightening cycle. The analysis indicates that at this point of time the pure expectations predicted yield curve should be very close to the actual yield curve. In addition, when the Fed increases the federal funds rate to the NRI and pauses for some time, the difference between the actual yield curve and the predicted yield curve will provide estimates of the liquidity premium for different maturities.

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Appendix: Selected Key Fed Statements

The following statements from the FOMC and two of its members provide a significant degree of certainty regarding short-term federal fund rates in the near future.

The Fed's forward guidance from the FOMC Statement, September 13, 2012:

> "……the Committee expects that a highly accommodative stance of monetary policy will remain appropriate for a considerable time after the economic recovery strengthens. In particular, the Committee also decided today to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that exceptionally low levels for the federal funds rate are likely to be warranted at least through mid-2015".

The Fed's forward guidance from the FOMC Statement, December 12, 2012:

> "In particular, the Committee decided to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that this exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6-1/2 percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored. The Committee views these thresholds as consistent with its earlier date-based guidance."

Ben Bernanke's Press Conference following the FOMC meeting, December 12, 2012:

> "The change in the form of the Committee's forward guidance does not in itself imply any change in the Committee's expectations about the likely future path of the federal funds rate since the October meeting.

Janet Yellin, Speech on November 13, 2012:

"The optimal policy to implement this "balanced approach" ……. involves keeping the federal funds rate close to zero until early 2016, about two quarters longer than in the illustrative baseline, and keeping the federal funds rate below the baseline path through 2018."

"The (Federal Reserve's primary) dealers assumed it (the federal funds rate) would remain near zero through the first half of 2015, consistent with the guidance the Committee subsequently provided. Beyond 2015, the federal funds rate is assumed to gradually rise to 4 percent, the long-run value expected by most dealers as well as most FOMC participants. I have assumed in the baseline that this process is largely completed within four years."

Figure 1: Unconventional Fed Policies

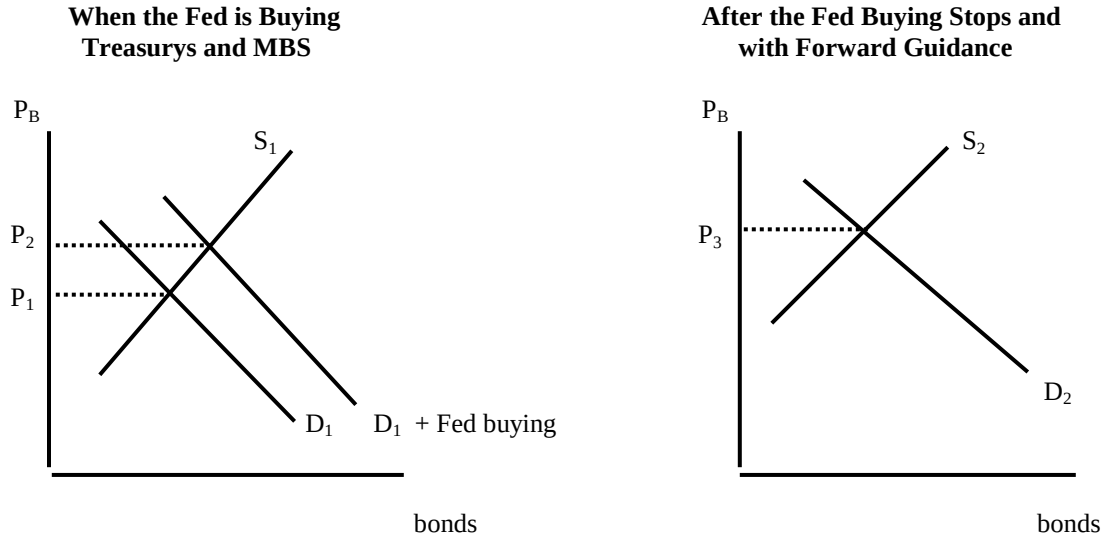
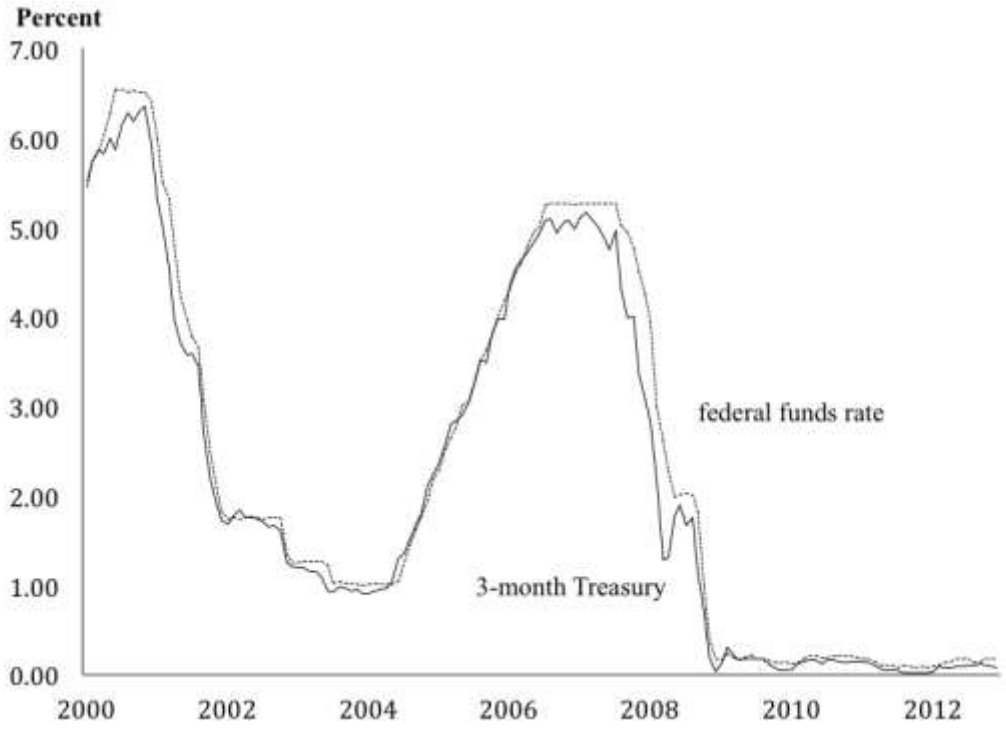
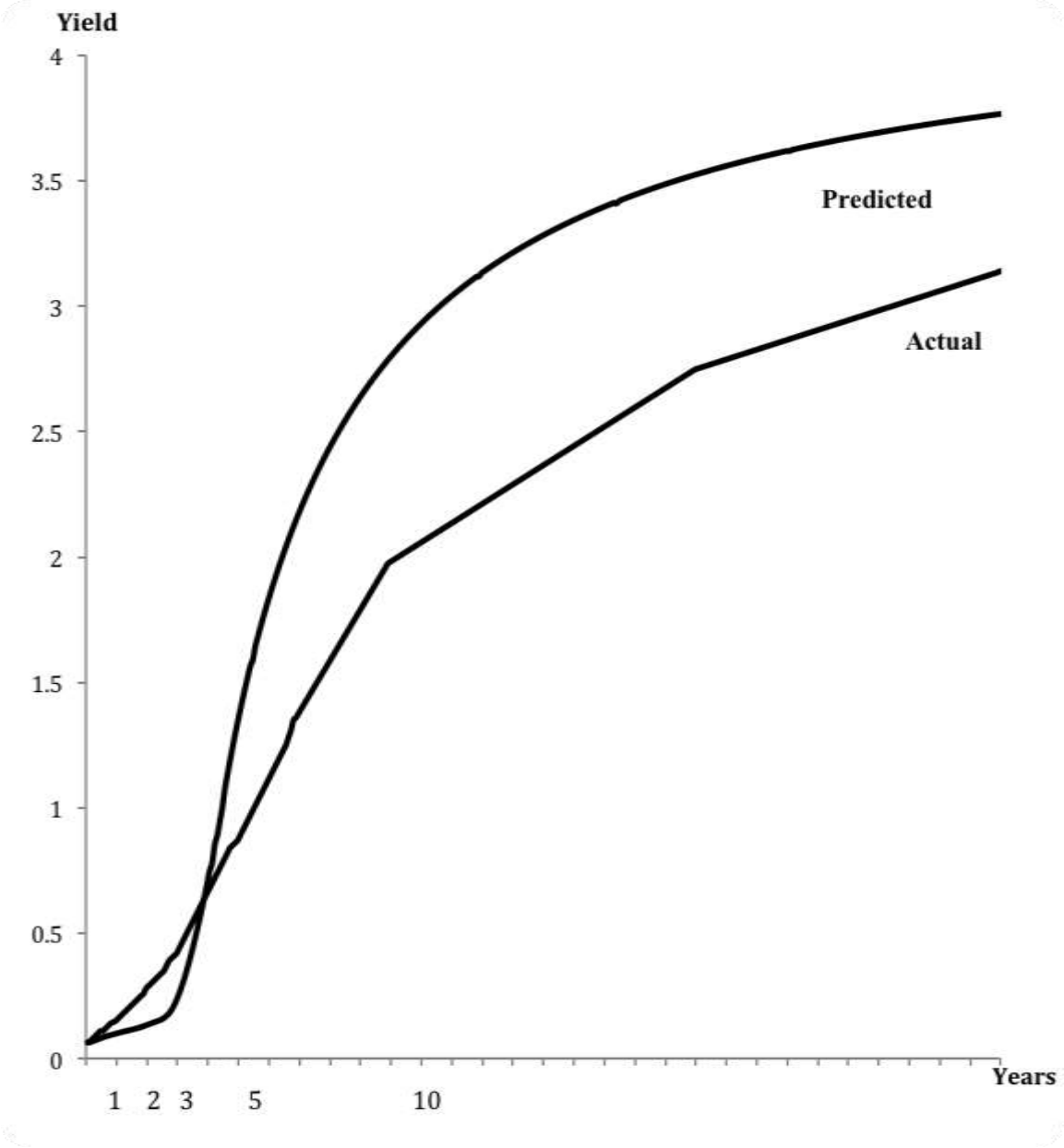


Figure 2: Federal Funds Rate and Three-month Treasury Rate



Source: Federal Reserve System.

Figure 3: Actual and Predicted Treasury Yield Curve, January 25, 2013


Yield
4
3.5
3
2.5
2
1.5
1
0.5
0
Predicted
Actual
Years
1
2
3
5
10

Using Videoconferencing to Solve a Business Finance Problem: Challenges and Lessons Learned from a Transatlantic Experience

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ABSTRACT

This study presents a transatlantic project that requires business students to use videoconferencing to solve a real world business finance problem. We discuss the project's design and delivery, the usefulness of videoconferencing in this context, and the challenges and lessons learned in the cross-cultural setting by instructors and students on each side of the Atlantic. A post-project survey reveals both German and U.S. students regard the transatlantic project to be a valuable experience, though the U.S. students view the project more favorably than did their German counterparts. The project also reveals some interesting transatlantic differences in higher education pedagogies.

Introduction

Over the last few decades, globalization has significantly changed the business world, thus forcing business schools to realize that their programs need to be more tailored to this changing business environment, while also being more appealing to today's business students. According to Ortiz (2004), providing a true international experience to business students is one of the biggest challenges that institutions of higher education face. In an effort to cope with this challenge, many schools have strengthened their business curriculums by offering more internationally-oriented business courses, separate majors in international business, student exchange and study abroad programs, and international internships.[5]

While the number of students that partake in a real world global experience is steadily increasing, especially in selected schools and programs within the U.S., the global experience for most business majors is limited to courses with an international emphasis. This, arguably, may restrict these students' international exposure to primarily theoretical knowledge. Moreover, many schools in the U.S. must cope with severe budget cuts, which jeopardize expensive curricula such as study abroad programs. Consequently, the vast majority of business students often graduate without a true practical global experience.

In order to address the above mentioned issue, faculty at a midsize College of Business and Economics in the U.S. were recently asked to develop ideas on how to provide an inexpensive real world global experience to the general population of business students. One proposal that gained momentum was the development of real world business problems which could be collaboratively solved by transatlantic groups of students using technology, such as videoconferencing.

The concept of videoconferencing has been largely applied through distance learning programs, which are offered by the overwhelming majority of higher education programs in the U.S. However, the benefits of communication technology need not be limited to domestic distance learning programs. The technology provides students with the opportunity to discuss and solve business issues with fellow students from

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[5] According to the U.S. Department of Education, about 15% of students with a bachelor's degree experienced a study abroad program in 2007 to 2008, with 20% of U.S. study abroad students majoring in business administration.

around the world, which in turn allows them to develop cross-cultural communication and interpersonal skills (Chinnammai, 2005). As Iwasiw et al. (2000) point out, videoconferencing lends itself as an effective tool for an interactive and international educational experience. In short, the current array of communication technologies allows any faculty to introduce a practical global business experience to all students without spending excessive funds to leave the typical classroom setting. What is needed, however, is commitment and creativity from at least two faculty members in two different countries who are willing to align their teaching schedules and to allow for such an exchange of ideas.

The literature provides ample studies that discuss and evaluate the usefulness of videoconferencing in areas such as nursing and healthcare distance learning. Most studies focus on the general usefulness of videoconferencing in conventional domestic distance learning programs (e.g., Chandler and Hanrahan, 2000; MacIntosh, 2001; Beason, 2005; Birden and Page, 2005; Telles, 2008; and Hart-Tipton et al., 2011). In a move away from the traditional distance learning delivery, Alavi et al. (1997) discuss the design, delivery, and the lessons learned from collaborative teaching two graduate management classes during an entire semester at two locations within the U.S. The lectures discussed in their paper took place in two electronic classrooms at the two different universities, each institution employing sophisticated videoconferencing equipment. They conclude that this approach enhances student learning and faculty development as it provides synergies by utilizing the expertise of two faculty, different student perspective,s and technology resources. Finally, Waddell et al. (1999), Iwasiw et al. (2000), and Robertson et al. (2005) stress the effectiveness of videoconferencing in collaborative transatlantic teaching experiences in health care education.

The literature, however, is scarce with respect to studies that discuss the application, challenges, and lessons learned of videoconferencing in business education--and especially rare are those studies addressing a collaborative cross-cultural setting. Representing one of these studies, Doyle and Brown (2000) discuss the experience of administering a business simulation to 30 graduate students at three remote locations within Ireland, France, and the US. The simulation involved the use of in-class videoconferencing to discuss the simulation outcomes. While they provide some useful lessons with respect to the international experience and the videoconferencing, the focus of this paper is on the skill development and application of the simulation. Lawson et al. (1998) discuss the design of a business simulation that was solved cooperatively by French and British students using technologies such as videoconferencing, email, telephone, and fax. To allow students to get to know each other, videoconferencing was used as the initial communication tool when groups made their first decisions, but subsequent decisions were made via telephone, fax, and/or email.[6] The technology was used for in-group communication, and at the end of the project the French students traveled to the British university and presented their strategies. They report some challenges and lessons learned with respect to the technology and the international aspect of the project, such as cultural differences, as well as difficulties with communication and logistics.[7]

While the above studies mention some lessons learned, each one's focus is more on the design of the project (e.g., business simulation), rather than providing a detailed guide dealing with the specific challenges and lessons learned from a cross-cultural project involving videoconferencing. This paper adds to the literature by filling this void, while also addressing the following questions: (1) How can videoconferencing be used more easily and flexibly in and outside the classroom to provide a low cost real world global business experience for students separated by long distances?; (2) What is the best approach for selecting a project that lends itself for such a transatlantic experience?; (3) What are the challenges and lessons learned by the faculty in such a collaborative transatlantic teaching and learning experience?; and, (4) How did the students perceive the transatlantic experience and what did they learn?

Based on the research questions above, we discuss the application and setting of videoconferencing technology via Skype as the primary communication tool between students on each side of the Atlantic as they jointly attempt to solve a real world asset valuation problem (section 3). The study discusses the faculty members' and students' experiences from the transatlantic project (see section 4). This includes the selection of an appropriate project (section 3.2), the challenges (see section 4.1) and lessons learned (see

[6]The student survey at the end of the project revealed that students evaluated videoconferencing as the most effective communication tool.

[7]They observed different learning approaches, where the French students were more result oriented and the British students more interested in the learning process. Other difficulties related to language differences, the required discipline when communicating via videoconferencing, and time pressure.

section 4.3) from the project, which, taken as a whole, may provide a useful and detailed roadmap to faculty who want to introduce a similar project to their students. Finally, the transatlantic experience was administered in fall 2010 as a pilot project and a second iteration was administered in fall 2011. This two-fold approach sets us apart from other studies provided in the literature, and allows for a more valuable discussion of the lessons learned, as some of the pitfalls were addressed in the second trial of the transatlantic experience.

In line with Dolye and Brown (2000) and Lawson et al. (1998), a post-project survey (discussed in section 4.2) indicates both German and U.S. students regard the transatlantic project to be a valuable experience. Interestingly, however, we find that the U.S. students view the project more favorably than did their German counterparts. Finally, while indicating the benefits of videoconferencing as an effective educational tool, the project also exposes some interesting transatlantic differences in higher education pedagogies (see section 4.4).

Literature Review

Laurillard (1993, page 166) defines videoconferencing as follows: "one-to-many medium, making it a sensible way to provide access for many sites to a remote academic expert." Chinnammai (2005) points out, that with the emergence of the internet and videoconferencing, the barrier of long-distances is fading away rapidly and students certainly do not need to be in physical proximity to a presenter in order to learn (see also Alavi et al., 1995, 1997).

Telles (2008) discusses a "step-by-step guide" on how to successfully apply videoconferencing in distance learning; and Brade (2007) provides a comprehensive literature review of active learning strategies when employing videoconferencing, as well as suggestions for effective videoconferencing planning.

Hart-Tipton et al. (2011) point out that videoconferencing allows educational access to students in rural areas and educationally underserved regions. Freeman (1998) reports the results from a survey of students who experienced a mass lecture at two metropolitan campuses utilizing video conferencing. While participating students indicated the perceived benefit of equal treatment and access to experts, they also stressed that videoconferencing did not enhance learning activities and interactions relative to traditional classroom settings. Alavi et al. (1997) find no difference in student learning between face-to-face and videoconferencing lectures, but that students evaluate their learning experience through videoconferencing as positive. On the other hand, Knipe and Lee (2002) provide evidence that students at remote videoconferencing sites experience a lower quality of learning than the local students. Thus, one may conclude there is not universal agreement that the nondescript usage of videoconferencing as a one-fits-all long distance learning approach is prudent, and may suggest that this tool should be utilized more wisely in situations where it clearly enhances the learning experience (e.g., a true global in-classroom experience).

As pointed out by MacIntosh (2001, page 265), "educators should choose videoconferencing when it fits the nature of the course," which is mainly the case when it fosters active discussions and interaction in real time. Briden and Page (2005) emphasize that videoconferencing enhances learning only if the focus is on the educational content and not on the technology. Benbunan-Fich (2002) stresses that IT tools such as videoconferencing can not only be useful in the "objectivist" model of knowledge transmission (whereby students attempt to assimilate material put forth by the professor), but also in the "constructivist" paradigm (in which knowledge is gleaned from peer interaction, evaluation, and cooperation). Along those lines, several authors in nursing have stressed the educational benefits from using videoconferencing as a tool to provide a collaborative transatlantic learning experience (e.g., Waddell, 1999; Iwasiw et al., 2000; and Robertson et al., 2005). Specifically, Iwasiw et al. (2000) report on the positive effect of a transatlantic videoconferencing project between Canadian and Norwegian nursing students even though the students connected only one time via video.

There is a consensus in the literature that for optimal student learning to occur, it is essential that the faculty is comfortable with the videoconferencing technology (MacIntosh, 2001). Moreover, Lawson et al. (1998), Doyle and Brown (2000), and Dudding and Justice (2004), stress the importance of technical support if one wants to successfully utilize videoconferencing in the classroom, with the ideal situation of having a technician close by (Hart-Tipton, 2011). However, the studies mentioned above primarily discuss the classic videoconferencing setting, whereby it is used in teaching students in remote areas. This study differs from the traditional applications of videoconferencing discussed previously, in that

videoconferencing is used only as a supplemental communication tool as students solve a real world business finance problem in a cooperative transatlantic experience.

The Project Design and Delivery

Videoconferencing Technology

The faculty has two options when introducing videoconferencing into the classroom. One can use a room that is equipped with a videoconferencing system, for example the Polycom H.323[8] system usually ensures a very high connection quality. However, it may raise some logistical issues as it requires that the room, which has the technology installed, is available during the scheduled time and that the faculty is familiar with the technology or that technical assistance is present. Additionally, the "lecture" will take place outside the usual classroom environment and time, which does not allow for any flexibility with respect to the scheduled times of the transatlantic connections. Furthermore, students would not be able to use the same technology for any out-of-class connections with their transatlantic counterparts.

A second approach is to use free downloadable software, such as Skype. This approach minimizes the logistical issues, as Skype allows for more flexibility with respect to the scheduled in-class connections, and it provides a cheap and easy tool for the students' out-of-class connections with their counterparts at other locations. Additionally, using a technology such as Skype increases the likelihood that students would be comfortable with the videoconferencing technology, as they may already have used it in their personal lives. However, the primary drawback of a tool of this nature is lower audio and video quality which, however, can be mitigated somewhat by advance preparation. In fact, one point that is stressed in most studies on videoconferencing is planning ahead (e.g., MacIntosh, 2001; and Briden and Page, 2005). Hence, it becomes imperative that both sides use and test a portable camera and microphone before the actual connection, which was done for the projects discussed in this study. Before the first official in-class connection, the professors on both sides of the Atlantic connected via Skype and tested different portable cameras with the help of technical support, as well as their positioning in the classroom. The camera used on the U.S. side was a Logitech HD Pro C910, which has a high-definition camera and a superb microphone.

Design of the Transatlantic Business Finance Project

The project was developed by two finance professors on separate sides of the Atlantic and administered cooperatively as a "transatlantic project" to their business students.

In the summer of 2010, a faculty member from the U.S. university traveled to a midsize university in Germany in an effort to initiate a transatlantic project that would require students on both sides of the Atlantic to cooperatively solve real world business problems. A finance faculty member from each university agreed to develop and administer a pilot project during the Fall semester of 2010, which was repeated in the Fall semester of 2011. The project involved 45 students (23 students from Virginia and 22 students from Germany) during the latter semester.

Selecting a project that lends itself to the "transatlantic experience" became a challenge in itself due to several constraints, such as different educational levels and limited overlapping semester schedules. While it would be easier to discuss, evaluate, and grade the project using one specific methodology for the project, it became apparent from the discussion among the faculty that such a static setting could lead to frustration, as students on both sides of the Atlantic have different educational background information. Moreover, a static setting would defeat the purpose of a real world experience, where solutions are not as clear-cut as presented in theory. Consequently, it became clear that any chosen topic should accommodate the different academic levels of the student groups and leave room for flexibility.

The professors decided to use the general topic of stock evaluation for the "transatlantic project," which has the advantage of faculty and students being able to choose a methodology that they have been exposed to in their curriculum and they are most comfortable with. Moreover, it allows students to experience the difference between the real world and theory, as different methodologies may lead to different conclusions.

[8] H.323 defines the standard protocols to provide audio-visual communication sessions.

The resulting project required students to work cooperatively within a group of six (three students from each university) and entails a collection of real world financial data used to analyze chosen multinational corporations. Within each group, students were required to exchange information and communicate regularly via Skype and email. Eight groups of students participated during each of the two fall semesters, with two groups analyzing the same company.

Working cooperatively within each group has the noted advantage that students across the Atlantic were exposed to the different cultures during the duration of the project and not just at the day of the final presentations. Additionally, students possibly learned a new valuation methodology from their transatlantic counterparts.

During the first "transatlantic experience," the American students chose to provide a ratio analysis and the German students decided to perform a technical analysis. The ratio analysis included a time-series evaluation of the company over the last three years, as well as a benchmark analysis of the industry. The technical analysis included the calculation of simple moving averages (SMA) as well as exponential moving averages (EMA) and a discussion of the generated crossover signals between relatively short and long moving averages, such as the moving average convergence/divergence (MACD). Finally, the students evaluated the Wilder relative strength indicator (RSI). All calculations were done in Excel and presented via PowerPoint at the final in-class video conference. Each group then submitted a written report including an explanation of the chosen methodology, as well as a discussion of the main findings and implied investment decisions.

During the second "transatlantic experience," both student groups brought a greater supply of advanced knowledge to the table, so an asset valuation based on the capital asset pricing model and the dividend discount model was added to the project. Students obtained and calculated all relevant variables of the chosen multinational company, including the dividend growth rate, betas, risk-free rate, market rate, etc. Finally, the students determined, based on the equilibrium stock price, if the stock is overvalued and undervalued and provided a "buy" or "sell" recommendation.

Applying alternative theoretical models to actual company data in a transatlantic setting taught the students an important lesson with respect to the learned theory and real world application. First, applying different methodologies to the same company can lead to different investment decisions. Second, the investment conclusions occasionally differ even when the same valuation model (e.g., CAPM) is applied. Depending on the student's country of origin, students chose different measures for the risk-free rate and the expected market rate, which caused a very interesting and valuable discussion during the final videoconferencing presentation.

The In-Class Videoconference Setting

During a 90 minute in-class final transatlantic videoconference, one group presented the results, while the other group, which had analyzed the same company, provided a discussion of the presented findings. Briden and Page (2005) point out that a good videoconference is one in which students actually forget that the technology is present. To better achieve such a setting, Andrews (2002) and Gill et al. (2005) recommend that a facilitator, as well as technical support, should be present or on call on each site. Based on the Andrews and Gill suggestions, the transatlantic connection was conducted with the faculties serving as both the facilitators and moderators at the two remote universities, and a "technical support" person at each site was taking care of the screen switching and audio quality during the presentations and discussions.

In general, Skype does not allow for high quality classroom discussion and requires that students position themselves close to the camera and microphone. Consequently, four of the eight groups were chosen by the professors to present their results using a PowerPoint presentation, while the four remaining groups were assigned to discuss the findings. To provide a meaningful discussion, the presenting groups were required to submit a written report of their results two days before the presentation to the group assigned to discuss their results. Each presentation was scheduled to last 12 minutes and each discussion to span 7 minutes. To simplify the presentations, each transatlantic group had to decide if the German or the American group members wanted to present. However, if the American group presented the results, the German group members representing the other group would provide the discussion and vice versa. At the beginning of each presentation and discussion, the videos of each classroom were shared. But whenever one group presented or discussed, their PowerPoint presentation was shared using the screen sharing function in Skype. This screen sharing feature allows any text and images to be easily readable for the

persons at the remote location. The groups that were not presenting or discussing were told to listen quietly to the presentations/ discussions, and were invited at the end of each discussion to come forward to the positioned camera and microphone to provide additional comments.

Results and Findings

The pilot project administered in fall 2010 turned out to be a huge success, as all participating students expressed that it had allowed them to gain an international exposure that they would have not obtained otherwise. However, the pilot project revealed several cultural, operational, and technical pitfalls that one needs to be aware of when administering a collaborative transatlantic experience. Some of the lessons learned from the pilot project were addressed in the second iteration of the transatlantic project administered during the fall of 2011. This section discusses the general challenges that such a transatlantic project entails, as well as the lessons learned and how some of the issues were addressed in the second run of the project.

Challenges

This section describes some of the challenges that were encountered during the development and the administration of the project. The main challenges with a transatlantic project of this nature are finding *equally excited professors* who have *students at similar education levels* and who face *similar lecture topics*. Additionally, the academic calendars across the Atlantic do not match, which provides a *limited time window* during which a transatlantic project can be administrated. In the case of the U.S. and Germany, that means a possible time window of only six weeks from mid-October to the beginning of December. This small time window puts *tremendous time constraints and pressure on the students* and was one of the main negative issues raised (see Results from a Student Survey, Section 4.2 below). Moreover, the students in the U.S. have been in session for almost two months when the project begins, while the German students are just starting their semester. Lawson et al. (1998), who discus a project between French and British students, also stress the logistical problem of having different semester starting and ending times, which reduces the available time window and puts additional stress on the students on both sides of the Atlantic.

Especially the different educational backgrounds and the limited time window point out to another challenge: the *selection of an appropriate topic for the transatlantic experience* (see discussion in section 3.2). This vital point in making a cross-cultural experience successful, however, receives little attention in the literature.

Additionally, the classes are usually not scheduled during the same day and time, and even if they are, one has to deal with the *time difference between the U.S. and Europe*.[9] This provides several logistical problems for the in-class connections, as well as for the students in their attempts to connect outside of the classroom. Both professors need to find a room and time that is convenient for each faculty member and the students participating in the project. This makes it particularly difficult to utilize a room that has a videoconferencing system installed. Thus, to have more flexibility, we chose to use Skype as a tool for the videoconference, as it can be used in any available classroom; however, that also meant a tradeoff with respect to quality of the connection. The choice of Skype was an easier decision to make given it was the primary tool used in the students' out-of-class connections.

Furthermore, the *grading systems often differ* between countries. While American professors have a high level of flexibility with respect to the projects, assignments, and exams that they require of their students, other countries, such as Germany, may have more stringent rules which do not allow that professors make a specific project mandatory. Hence, although the project had already been developed, there was some likelihood that an insufficient supply of German students would sign up for the transatlantic project. Motivating students to participate in a non-mandatory project also is another important

[9] Alavi et al. (1997) also mentioned the issue of dealing with time differences when teaching collaborative courses via videoconferencing across two time zones within the U.S., as well as the issue of different beginning and ending semester schedules among American universities.

consideration that does not receive much attention in the literature, but needs to be taken into consideration when planning a transatlantic project.[10]

It became obvious that students needed to overcome the initial fear and reluctance to communicate with persons whose economic, educational, and cultural backgrounds are presumed to be different, but cannot be estimated reliably before the connection. This seems to have caused some anxiety among students from both sides of the Atlantic. Moreover, it required students be prepared for an encounter with unknown, perhaps unfamiliar ways of thinking. This anxiety caused some groups to delay their initial in-group connection, which in turn reduced their time window and increased the pressure towards the end of the project even further.

Students on each side of the Atlantic have their own *academic background*, due to specific characteristics of learning and different teaching methodologies.[11] These differences had not been found to be severe but they were present and, strangely enough, they had a stimulating effect. In view of a clearly defined problem to be solved, each student population presented their own way of problem solving, reflecting the background of their academic life. Thus, it became clear from the beginning that there existed multiple ways of solving the problems confronted. Students learned that problems can be addressed differently, and that these differing styles can still result in accurate problem solving. They also learned that problem solving is a multi-dimensional and, for that matter, multi-optional phenomenon, destroying the tendency for students to claim that theirs is the only possible correct answer and theirs is the only method for obtaining that answer. The transatlantic intellectual interchange made clear beyond any doubt that each party can learn from the other as long as both parties are ready to share knowledge and are prepared to discuss alternative arguments and methods open-mindedly.

C*ultural and language differences* posed additional challenges to the professors and the students. During the initial pilot project in fall 2010, the project assignments were merely handed out to the students at the beginning of each class, and the students were required to connect with their transatlantic counterparts outside of classroom hours. Although the assigned project specified that the students had to work cooperatively within a group of six (three students from each university), some German student groups were under the impression that they were competing with their American counterparts, and were thus initially reluctant to share any information. This miscommunication may have been exacerbated by the highly competitive German culture, and indicated that cultural idiosyncrasies need to be addressed in future projects.[12] It also became clear to the professors that the project kick-off needed to be done differently, with the inclusion of more precise instructions (section 4.4 provides a more in debt discussion with respect to the Transatlantic Educational Differences).

While students were highly encouraged to use videoconferencing as the main communication tool outside the classroom, most groups relied heavily on email to converse with their group members. This seemed due primarily to two factors: 1) the time difference, which made it hard for both student groups to find a regular time to meet via Skype, and, 2) the language barriers, which apparently had some of the German students feeling more comfortable discussing issues via email. This experience seems to be in contrast to what is reported by Lawson et al. (1998), since they find that students evaluated videoconferencing as the most effective communication tool in comparison to, for example, email. The different results may be explained by the fact that students in 1998 were not as familiar with email communication as today. Moreover, their student groups did not need to cope with a significant time difference, as experienced in this transatlantic project.

Using the *appropriate technology and handling it comfortably* provided to be a challenge. As discussed above, the trade-off is between flexibility and quality, and we chose the higher level of flexibility, yet still attempting to provide a satisfactory video connection quality. An additional issue related to quality is that Skype does not allow for a general class discussion, which is a consideration with respect to the final connection and the large number of people involved (see discussion in section 3.1).

[10] Lawson et al. (1998) also stresses the logistical difficulties when dealing with different class sizes.

[11] Other studies also find that cultural difference and educational background matter in the problems solving process. For example, Lawson et al. find that cultural differences matter with respect to the decision process as well as the learning approach between French and British students. Doyle and Brown (2000) report different student perspectives among student groups from France, Ireland, and the U.S. when approaching a business simulation.

[12] Lawson et al. (1998) reports a similar observation between French and British students, where the French students were working towards "the best performance in a competitive environment", while the British students "were more interested in the learning process rather than trying to be the team with the best results".

Below, we provide a summary of the challenges we discussed above, and in the section "lessons learned" we address some specifics about what we discovered during the transatlantic experience.

List of challenges during the transatlantic project:

1) *Finding equally excited professors on each side of the Atlantic*
2) *Having similar educational levels of enrolled students and similar lecture topics*
3) *Limited overlapping lecture time during the academic year, which causes tremendous time constraints and pressure on students*
4) *Selection of an appropriate topic for the transatlantic experience*
5) *Time differences*
6) *Different grading systems (mandatory versus voluntary participation)*
7) *Overcoming initial fear and reluctance to communicate*
8) *Different academic backgrounds*
9) *Cultural and Language differences*
10) *Technology and quality of the connection*

Results from a Student Survey

A post-project survey was administered to assess the students' opinions about the transatlantic experience. The sample included 22 students from Germany and 21 students from the US who participated in the second transatlantic project.[13] We utilized a 5-point Likert scale in the survey and asked the following questions:

1) *How beneficial do you believe this project is in meeting the course objectives?*
2) *To what degree would you recommend this project to other students?*
3) *How valuable is the international experience of the project in general?*
4) *How valuable is the general knowledge you have obtained by working on this specific project?*
5) *How valuable are the international experiences in this project as compared to other international experiences you had in other classes?*

The Likert scale is labeled for question 1 from "not very beneficial" (1) to "very beneficial" (5), for question 2 from "not recommended" (1) to "highly recommended" (5) and for questions 3 to 5 from "not very valuable" (1) to "very valuable" (5). The detailed responses of the German and the American students are provided in the appendix. The survey results, which are presented in table 1 below, are based on a two-sample t-test in combination with a Levene-Test of equal variance. In general, the results show that the students (both, the German and the U.S. students) viewed the transatlantic project as a positive and valuable experience, as the mean of all five questions is higher than 4.0, with an exception of the German response to question 3, which is on average a 3.91.

Both student groups state the project was beneficial for them and would recommend it to others (see questions 1 and 2). Moreover, the German and the U.S. students view the international experience of the project and the knowledge that was obtained as valuable (questions 3 and 4). Finally, both groups perceived the international aspect of the transatlantic project as more valuable than former international experiences they have encountered in other classes (question 5). This seems to be consistent with the findings by Lawson et al. (1997) and Doyle and Brown (2000), who also report the international exposure in this type of project is valued by students. Interestingly, however, the two-sample t-test shows there is a statistically significant difference in the positive perception of the transatlantic project with respect to all five questions. While both groups responded extremely positively to all questions, there is statistically significant evidence that the U.S. students were more positive than the German students. The finding that U.S. students perceive a transatlantic experience via video conferencing to be relatively more valuable seems to be new to the literature, and may be explained by the fact that German students have more international exposure due to the location of Germany in the center of Europe, which makes traveling to foreign countries and experiencing foreign cultures much easier.

[13] One student form the U.S. and one student from Germany did not return the survey.

Table 1: Statistical Results from Student Survey

Questions	Countries	Sample	Mean	Std.	T-test	P-value
Q1: How beneficial do you believe this project is in meeting the course objectives?	Germany	21	4.19	0.96	-2.11	0.041
	US	22	4.68	0.57		
Q2: To what degree would you recommend this project to other students?	Germany	21	4.19	0.85	-1.98	0.054
	US	22	4.64	0.66		
Q3: How valuable is the international experience of the project in general?	Germany	21	4.14	0.80	-2.53	0.015
	US	22	4.68	0.48		
Q4: How valuable is the general knowledge you have obtained by working on this specific project?	Germany	21	3.9	0.81	-4.73	0.00
	US	22	4.77	0.39		
Q5: How valuable are the international experiences in this project as compared to other international experiences you had in other classes?	Germany	19	4.26	0.79	-2.63	0.013
	US	22	4.82	0.59		

Note: The results are based on a two-sample t-test in combination with a Levene-Test of equal variance. The survey utilized a Likert scale, which labels the scales for question 1 from "not very beneficial" (1) to "very beneficial" (5), for question 2 from "not recommended" (1) to "highly recommended" (5) and for questions 3 to 5 from "not very valuable" (1) to "very valuable" (5).

Lessons Learned

In this section, we discuss some of the lessons learned from the transatlantic project as well as the perceptions from the two faculty members that developed and administered the project. One of the main lessons learned from the initial pilot project was that it is essential to have the project include at least two in-class connections; that is to say, *an initial kick-off connection* and a *final connection* in which the results are presented and discussed.

Based on the experiences with the two administered transatlantic projects (fall 2010 with only one final connection and in fall 2011 with a kick-off and final connection), we can report the following advantages that were associated with the implementation of an initial in-class kick-off videoconference. First, the assignment is explained to the two student groups simultaneously and the cooperative aspect of the project can be better stressed. Second, the students have a chance to get to know each other before they start their out-of-class connections. Third, it reduces the idle time until the student groups get connected. Fourth, it makes students more comfortable in using Skype for their out-of-class connection.

Another lesson learned is the importance of setting up *a test connection* to ensure the technology and the classrooms are appropriate for the videoconference. Alavi et al. (1997) and Doyle and Brown (2000) emphasize on the general importance of having sufficient preparation time, from the perspective of both the faculty and the students, when utilizing videoconferencing. Using Skype as the videoconferencing tool, however, seems to minimize any preparation time for the students in their out-of-class connections, as they are quite familiar with the technology. Yet, with respect to the in-class connection via Skype, the video and audio quality can be improved if one tests several cameras in the room while the actual connection is taking place. Prior to the fall 2011 final connection, the professors linked up with each other using the help of the

technical support to test several cameras, as well as the best positioning of the camera and microphone within the room.

A *good personal relationship between the two professors* at the two universities is very helpful to ensure a smooth execution of the project. In the case detailed here, the American professor visited the university in Germany in the summer of 2010 and the summer of 2011 to discuss the idea of the transatlantic project. While such an approach means additional costs, face-to-face communication with the other professor helps tremendously in advocating the benefits of the transatlantic experience and in building a good personal relationship. Moreover, it allows for discussing the different levels of educational background among the two student groups, as well as setting a general framework with respect to the assigned real world business problem. The costs, however, were kept to a minimum in this case, as the American professor was a German citizen who was regularly visiting his relatives in Germany during the summer. Thus, one way to foster transatlantic projects is by utilizing the international faculty of a university who are visiting their home countries during the summer break, hence providing an easy and inexpensive method to establish foreign relationships.

Although the assignment during the pilot project in fall 2010 was limited to financial topics, it became apparent that cultural differences led to several challenges during the initial project. These cultural differences did cause some frustration on both sides, but also enhanced the experience. To augment the cultural aspect of the experience, we added an additional part to the beginning of the second project—a requirement that each group interview their transatlantic counterparts about cultural dimensions. To prepare for the interview on cultural dimensions, the students were required to study Chapters Two and Three of the House et al. (2004) book, "Culture, Leadership, and Organizations: The GLOBE Study of 62 Societies." This exercise helped to increase the *cultural awareness* of the student groups at the outset of the project and broadened the global experience for everyone involved. Thus, we suggest that any international project, regardless of its technical nature, should include a cultural part. This was a very interesting finding for the finance faculty involved in the project and was not apparent from the cross-cultural videoconferencing literature.

Doing business or communicating effectively on a global level depends crucially on the human factor. An effective global exchange of goods, services, and ideas is not just a matter of "hard facts", but essentially relies on "soft factors" such as communicative abilities, mutual understanding, and acceptance of cultural differences. These "soft factor" qualifications cannot be trained just by reading books; they must be learned by actively communicating with persons of a different cultural heritage. The project clearly helped to increase the awareness for such "soft factors" effectively and inexpensively. This perception of the faculty seems to be confirmed by the administered survey, as it revealed that the students believe the transatlantic project provides a *valuable international experience* and is in line with what is reported by Lawson et al. (1998) and Doyle and Brown (2000). However, in contrast to the past literature, the survey also helped us assess whether the two groups of students perceived the project's benefits differently. We discovered that U.S. students seem to perceive the transatlantic experience as more favorable than their German counterparts. This type of comparison has not been, as far as we can tell, expressly tested for in an international exchange of this type.

The students report that the *time constraints and pressure* under which they had to accomplish the project made things extremely stressful. While this point is well understood by the professors, it is also outside of their control, as this is due to the limited overlapping lecture time between the two countries during the respective academic years. However, the survey also showed that some of the students underestimated the workload and time that was necessary and, hence, they faced immense time pressure at the end of the project. This might be solved by the professors better explaining the *comprehensive dimension of the assignment* at the outset of the project. In short, getting the students to fully buy into the project and to ensure that it runs smoothly necessitates the professors provide a clear set of requirements and a timeframe for completion of each requirement. On way this problem was mitigated in the second iteration of the project in fall 2011 was the requirement that students had to submit sub-results as they went along with the project.

After the second transatlantic project in fall 2011, a *survey administered to both groups of students* revealed some valuable information with respect to future in-class global experiences. It became clear from the surveys that *one way to motivate completion of the project and a post-project survey would be to provide a certificate to students* upon completion of these tasks. While a certificate was given to the German students after the pilot project in fall 2010, the American students did not receive such a document. Some of the graduating American students mentioned that the transatlantic project was discussed during

their subsequent job-interviews, and it gave them the opportunity to talk about a real world global business experience. Hence, during the second transatlantic project, the American students were also handed a certificate for successful completion of the transatlantic project. Since the information about the certificate was conveyed to the students at the onset of the project, it seemed to enhance their motivation towards the assignment.

Given that the language of the project was English, several U.S. students were concerned that the *language differences* would present a problem in communicating with their German group members. Lawson et al. (1998) also mention that language differences provided some obstacles for the British and French students in their study. However, the students in our study were all surprised to learn that the language barrier was not an issue at all. The only apparent symptom of the language differences was that some German groups, again, seemed to have preferred email communication over Skype conferencing. However, this may also have been due to the time difference, which made it more difficult for the students to meet in cyberspace.

Chandler and Hanrahan (2000) indicate that students feel *uncomfortable talking into a microphone while a room camera is directed at them*. While that might be true in a general class setting, in which students are required to answer questions about general lecture topics, our experience indicated that students are less reluctant to use such technologies when they are leading the discussions and/or presentation to solve real world business problems. Of course, another explanation is that this generation of students may simply be more comfortable with this type of technology than the students from fifteen to twenty years ago.

List of lessons learned:

1) *Have an initial kick-off videoconference at the outset of the project*
2) *Good preparation via initial test connection*
3) *Importance of a good personal relationship between the transatlantic faculties*
4) *Incorporating a cultural part into the assignment*
5) *Valuable international experience for students ("soft factors")*
6) *U.S. students perceive the experience as being more favorable than their transatlantic counterparts*
7) *Understanding time constraints*
8) *Explain the comprehensive nature of the project*
9) *Support from the professors*
10) *Survey the students*
11) *Provide a certificate for the participation in the global experience*
12) *Language differences are not typically an issue*
13) *Use of microphone and camera does not necessarily make students feel uncomfortable*

Dealing with Transatlantic Educational Differences

The professors also noted differences in course delivery between the two cultures. It is possible that these differences are quite indicative of the types of cross-cultural issues commonly present in any project of this nature. For instance, while U.S. students find themselves typically confronted with a rigorous and structured syllabus, German students are accustomed to be left alone in determining the details as to how course objectives are achieved. These pedagogical differences can likely be traced back to underlying cultural differences between the U.S. and Germany, yet these non-trivial variations in course delivery and overall attitude toward structure only became apparent as the professors became more fully involved in this project. It is clear that German students traditionally are left to fend for themselves much more often than students in the U.S., whereas the professional guidance with respect to the covered fundamental knowledge provided to U.S. students is often missing from German course syllabi and individual projects.

While the U.S. pedagogy appears to provide a more strict road map and timetable for students, guaranteeing a more orderly and professional solution of the project, it places limits on the development of individual responsibility and mental independence. On the other hand, the German approach is based on the arguably idealistic idea of developing responsible and self-organized individuals. In practice, however, only a few students demonstrate the necessary amount of self-discipline for achieving outstanding results without relying on a helping and guiding hand by the instructors.

Based on the above observations, the transatlantic project revealed to the instructors one of the real challenges of modern academic teaching. That is to say, conveying fundamental knowledge in an organized, disciplined way on the one hand and developing individual responsibility and mental independence on the other hand.

Conclusion

Given the difficulties faced by higher education of providing a meaningful international experience to business students, this study shares an account of a collaborative transatlantic project which required business students on both sides of the Atlantic to connect via videoconferencing. Additionally, the paper discusses and lists the challenges and the lessons learned from the project, thus providing a detailed guide of the transatlantic experience for any faculty who wants to introduce a similar project to the classroom, but strives to prevent similar initial mistakes.

The transatlantic project required an in-depth and competitive solving of selected real world financial problems, an enhanced mutual understanding of different teaching cultures, and a collaborative team-based determination to achieve some predetermined goals within a strictly limited timeframe. The transatlantic experience promoted the cross-cultural understanding of both student groups, which is so essential in today's global business environment, but hard to deliver in a strict theoretical classroom setting. All students indicated that the transatlantic project provided them a very valuable international experience.

The project not only provides a valuable learning experience for the students, but also for the faculty, as it enhances their cooperative teaching experience and mutual understanding of different teaching cultures. Finally, this type of project fosters additional joint endeavors, such as research projects, between the participating faculties.

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Appendix

Survey responses from German and U.S. Students

1) How beneficial do you believe this project is in meeting the course objectives?

	Not very Benefical				Very Beneficial		
Country	**1**	**2**	**3**	**4**	**5**	**Total**	**Mean**
Germany	*1*		*2*	*9*	*9*	*21*	*4.19*
U.S.			*1*	*5*	*16*	*22*	*4.68*

2) To what degree would you recommend this project to other students?

	Not recommend				Very Beneficial		
Country	**1**	**2**	**3**	**4**	**5**	**Total**	**Mean**
Germany		*1*	*3*	*8*	*9*	*21*	*4.19*
U.S.			*2*	*4*	*16*	*22*	*4.64*

3) How valuable is the international experience of the project in general?

	Not very valuable				Very valuable		
Country	**1**	**2**	**3**	**4**	**5**	**Total**	**Mean**
Germany		*1*	*2*	*11*	*7*	*21*	*4.14*
U.S.				*7*	*15*	*22*	*4.68*

4) How valuable is the general knowledge you have obtained by working on this specific project?

	Not very valuable				Very valuable		
Country	**1**	**2**	**3**	**4**	**5**	**Total**	**Mean**
Germany		*1*	*5*	*10*	*5*	*21*	*3.90*
U.S.				*5*	*17*	*22*	*4.77*

5) How valuable are the international experiences in this project as compared to other international experiences you had in other classes?

	Not very valuable				Very valuable		
Country	**1**	**2**	**3**	**4**	**5**	**Total**	**Mean**
Germany			*3*	*8*	*8*	*19*	*4.26*
U.S.			*2*		*20*	*22*	*4.82*

Perfectly Competitive Model and Finance: Changes in the Value of the Firm During Competitive Adjustment to a Shift of Demand

Trevor Coombes and John Tippett[1]

ABSTRACT

This paper explores the adjustment process of the perfectly competitive model from the perspective of finance theory and argues that finance theory (in unsophisticated form) is implicitly woven into the model's adjustment process. Making this explicit allows students of elementary economics and finance to bring the two disciplines together.

Keywords: Competitive Model, Finance Theory, Adjustment and the Value of the Firm, Entry

Introduction

The emergence of economic profit in the perfectly competitive market cannot be sustained over the long run. Unencumbered by barriers, such profit is competed away as new firms enter the industry and profits return to normal. However, this textbook adjustment process (expressed in Section 2) does not openly refer to changes in the value of the firm and the effect of such changes on the incentive to enter the perfectly competitive market. Analysing the adjustment process in the perfectly competitive model from the perspective of finance theory allows us to explore more deeply the effect finance has on the incentive to enter the perfectly competitive market (Section 3). We suggest that (basic) finance theory complements, and enriches, explanation of the adjustment process in the perfectly competitive model that hitherto has remained hidden (in Microeconomics texts).[2]

Adjustment in the Perfectly Competitive Model

Key tenets of the perfectly competitive model are that firms are homogeneous price-takers and entry into the market is free. In this model an increase in demand gives rise to economic profit. In Figure 1 such an increase causes the demand function (D) to shift to the right and the market to adjust from point *a* to point *b*. The subsequent increase in the product price (P) from P_1 to P_2 provides the incentive for each incumbent firm to increase its output as marginal revenue (MR = P) rises above marginal cost (MC). The incentive dissipates as firms expand their output, resulting in an industry-wide increase in output (of Δq) and a rise in MC, and short-run equilibrium at point *b*.

Point *b* is not the end-point of the adjustment process, because firms are now earning economic profits – average revenues (AR) are greater than average costs (AC) – and such profits attract entrants to the market[3]. Entry into the market is in the form of new firms, whereby the construction of new capacity shifts supply (S) to the right, from S_1 to S_2.

The scenario outlined here assumes a constant-cost industry – new entrants place zero pressure on wages and other resource costs and hence unit cost curves (both AC and MC) faced by individual firms

[1] Lecturers, Victoria University, Melbourne, Australia. The genesis of this paper was the insight of Dr. Trevor Coombes.

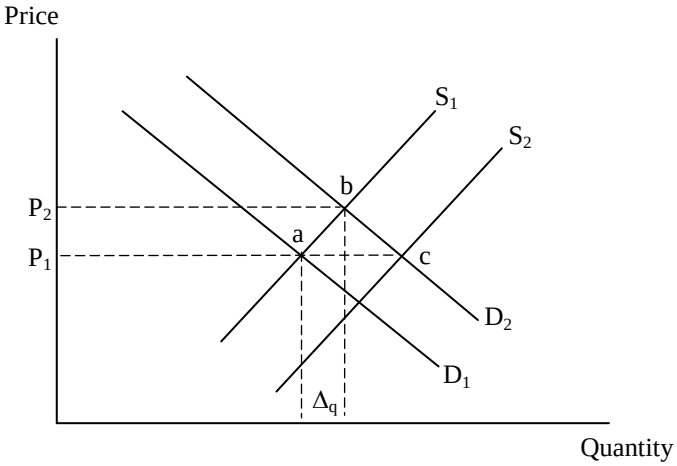
[2] See for example, Gans et al. (2009), ch. 14 pp. 304 – 307.

[3] Dixit (1992) points out that in practice firms invest in projects only if they can expect to earn a return in excess of a required or "hurdle" rate. Adjustment in the perfectly competitive model says nothing about a hurdle rate.

do not move upwards. The end-point of the adjustment process is then *c*, with price having been brought back to its original level (P_1**)** and incumbents have reduced their outputs to where they were at point *a*. Long-run equilibrium is at point *c* where both incumbents and new entrants earn normal profits.

The adjustment process from the perspective of an individual firm is shown in Table 1. Initially (point *a* in Figure 1) the *n*th firm is earning an accounting profit of $10,000 that equates to zero economic profit, because the opportunity cost (the return elsewhere) is $10,000 (i.e. 10% on the historical cost of $100,000).

Figure 1



Should accounting profits increase from $10,000 to $15,000, as a result of an increase in price (P_2 – P_1), which gives rise to an economic profit of $5,000 (point *b*), new firms enter the market. In the long-run economic profits are returned to zero (point *c*); and with an accounting profit of $10,000 (zero economic profit) the *n*th firm is returning 10% p.a. Thus any potential entrant would be willing to pay up to $100,000 for the *n*th firm (should it be available for sale) – equivalent to the historical cost of the firm.

Table 1: **The *n*th firm's profit. Historical (sunk) cost $100,000**

Accounting Profit (*y*)	**Opportunity Cost (return elsewhere**: ***r* = 10% p.a.)**	**Economic Profit**
$10,000	$10,000	zero
$15,000	$10,000	$5,000

The perfectly competitive model has – by definition – the dimension of time as a basic feature. All factors may change in the long-run; fixed factors (e.g. new capital to the market) increase *only* with the passing of time. The dimension of time in the perfectly competitive model is embodied in a two-stage adjustment process: a one-off jump from point *a* to *b* and a second from point *b* to *c*. Another feature of the model is that shifts in demand are structural (i.e. shifts in any of the determinants of demand are permanent), so that the emergence of point *b* (and increased profit flow) is not stochastic and exists for more than an instant. It exists until new firms enter the market – until there is a shift in supply to the right – which, of course, takes time.

However, if the value of incumbent firms remains unchanged with the earning of economic profits (at point *b*), potential entrants would simply purchase incumbents. All that changes then is ownership (no new firms enter the market), which stands in contrast to the competitive model and raises the question: would potential entrants ever consider entering the market in the form of new firms?

Finance Theory, Value of the Firm and the Adjustment Process

It is well understood in finance theory that the value of a firm is directly dependent upon its profitability and the discount rate, and is sensitive to changes in either of these two variables. The

measure of profitability is expected profit flows and the discount rate is the risk-adjusted rate of interest. The value of any firm (VF), assuming perpetuity for simplicity, is the expected profit (y) divided by the discount rate (r): VF = y/r.[4]

Now the value of incumbent firms increases with any increase in profit and incumbents would not sell their firms for anything less than y/r. Accordingly, upon an increase in profit from \$10,000 to \$15,000, the market value of the nth firm (Table 2) increases from \$100,000 at point a in Figure 1 to \$150,000 at point b (i.e. \$15,000/0.10).[5] Incumbents would not sell for anything less than \$150,000.

Table 2: **An increase in the value of the *n*th firm**

Accounting Profit (y)	**Opportunity Cost (return elsewhere: r = 10% p.a.)**	**Economic Profit**	**Value of firm**
\$10,000	\$10,000	zero	\$100,000
\$15,000	\$10,000	\$5,000	\$150,000

Finance theory tells us that the value of incumbent firms at point b in Figure 1 is greater than at point a (VF equals \$150,000 at point b and \$100,000 at point a).

Microeconomics texts do not identify openly the simple finance principle that changes in profit alter the value of incumbent firms. This finance principle requires a rethink of the adjustment process from two perspectives: one perspective from inside the market and the other from outside the market.

Point b in Figure 1 is associated with two perspectives regarding the level, or type, of profit: one which we will term internal to the market and which is profit from the perspective of existing firms, and the other external to it and which is profit from the perspective of potential entrants. Based on historical cost value of firms (VH), incumbents earn economic profits that are internal to the market. The rate of return for the nth incumbent firm is 15% p.a. (\$15,000/\$100,000). However, from the perspective of potential buyers, who are external to the market, the profit at point b is normal, it is not an economic profit. The rate of return they face (at b) is 10% p.a. (\$15,000/\$150,000), because the value of the firm moves *pari passu* with profit (i.e. VF = y/r). Prospective entrants would have to pay \$150,000 to buy the nth firm, not the historical cost of \$100,000.

Expectations are that the flow of profits realised at point b persist as long as the underlying conditions that brought about point b are *structural*. The finance principle, where the value of the firm adjusts in accordance with movements in profit, explains why potential entrants cannot earn economic profits by acquiring incumbents. The adjustment process in the perfectly competitive model does not make this reasoning explicit. Potential entrants thus contemplate entering the market in the form of new construction.

Now, entering the market in this way requires that the cost of constructing new firms (VC) be less than the value of incumbent firms (VF). Without this assumption entry would not take place, because, from the perspective of potential entrants, an increase in VF eliminates the possibility of economic profit: potential entrants would not be able to buy existing firms at historical cost (VH). The only form of entry available to potential entrants is to establish new firms.

Only when VC < VF do potential entrants act to enter the market (at point b) and construct new firms. Such activity (entry) shifts supply to the right, causing product price and profits to fall. The fall in profit occasions a fall in the value of incumbent firms. The market brings VF into line with VC as product prices fall. Given a constant-cost industry, the market settles at point c where VC = VF (= \$100,000) and the incentive for further entry (additional construction) no longer exists. If potential entrants decide to rent new premises, instead of building them, they will compare the discounted value

[4] Of course the discount formula that assumes finite time can be used to convert a set of profit flows (at point b) into present value. However the perpetuity formula (y/r) allows us to quickly identify changes in the value of the firm in simple fashion, but it is not meant to infer that profits at point b flow in perpetuity.

[5] Equilibrium is established at point b as a one-off jump adjustment (to point b). Moving the analysis away from a one-off adjustment process, production and profit would grow *incrementally* between a and b. Given the standard assumption that production functions exhibit diminishing returns to labour, profits grow at a diminished rate as marginal costs accelerate. Incremental profit flows (Δy) and the commensurate increase in the value of the firm can be captured by the discount formula: $\Delta VF = \Delta y_0 + \Delta y_1/(1+r) + \Delta y_2/(1+r)^2 + \ldots \Delta y_t/(1+r)^t$, where $\Delta y_0 > \Delta y_1 > \Delta y_2 > \ldots \Delta y_t$. *Crucially*, as the market adjusts to point b the value of incumbent firms increases.

of rents (RD) with VF. Entry into the market occurs as long as RD is less than VF. Again, entry would cease at point *c* when RD = VF.

Conclusion

The principle of finance – that the value of the firm changes with the earning of economic profit – and the condition VC < VF have always been woven into the adjustment process in the perfectly competitive model in terms of impacting the incentive to entry. But they have never been consciously identified – until now. Finance theory and the adjustment process in the perfectly competitive model have always been married, but unknowingly so.

The perfectly competitive model has built into it, implicitly, the notion that the value of incumbent firms changes with the earning of economic profit. If the value of the firm did not change, potential entrants would simply purchase incumbents at historical cost and there would be no shift in supply. It follows that potential entrants consider entering the market in the form of new construction and this happens when VC < VF.

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Repeat After Me: An Experiment in Learning

Robert Stonebraker[1]

ABSTRACT

Generations of students have stumbled over the distinction between moving along and shifting a demand curve. Simple verbal repetition seems to help cement this difference. In classroom experiments, students who stood and recited the concept aloud performed better on a subsequent exam question than other students. Moreover, the difference persisted onto the final exam even after controlling for differences in student ability and exam preparation. While other active-learning methods might produce similar results, verbalization requires almost no time or instructor effort. It takes only a few seconds and there is nothing to read or grade.

Introduction

Repeat after me. My elementary school teachers frequently invoked the command as a teaching tool. Was it effective? If so, would it work with college students today?

We know that involving students in active learning can improve outcomes, but many active methodologies are difficult to employ in large sections and repeated surveys show that we continue to rely on chalk and talk in our principles of economics courses (Watts and Becker 2008, Watts and Schaur 2011). We know that relatively quick processes such as one-minute papers are effective tools (Chizmar and Ostrosky 1998, Das 2010, Stead 2005), but even these can impose significant time costs on instructors of large sections. However, if the written word can help seal learning; why not the spoken word as well? Perhaps something as simple as having students recite concepts aloud could be effective.

Like many other instructors, I have experimented with a variety of approaches to help students pin down the difference between moving along and shifting a demand curve. I explain the concepts verbally. I develop numerical examples to illustrate. I write out definitions of changes in demand versus changes in the quantity demanded in detail on the board. I have students work through examples in class and I assign more examples on outside-of-class problem sets. I even use the dreaded "you must know this for the exam" threat. And still they fail. Few elementary economic concepts create as much frustration.

My first exam always includes a true-false-explain question about whether a change in the price of a good causes its demand curve to shift. Every semester I tell myself that almost every student will correctly answer that price is not a demand shifter. Yet, every semester it turns out to be one of the most-missed questions on the exam. It usually trips up more than one half of the class. It is depressing.

Two years ago, exasperated and sensing another imminent failure, I suddenly blurted "stand up and repeat after me," and proceeded to have the class recite the concepts aloud. Surprisingly, it seemed to work. The results on the subsequent exam seemed better than in previous semesters and encouraged me to design a more controlled experiment. The results of that experiment are promising. Students that repeat the concepts aloud show small, but statistically significant, gains in performance that seem to persist through the semester.

Literature

Repetition has a long and honored history. It has been used and studied most extensively in language instruction, especially foreign language instruction. For example, Crevecoeur (2011) finds that almost 100

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percent of English as a Second Language (ESL) instructors report using oral repetition in all or most of their classes, although he also repeats the warnings of others that too much reliance on such strategies can be counterproductive. Suwannarat and Tangkiengsirisin (2012) report that repetitive drills are commonly used to teach English in Thailand, and Yang and Dai (2012) find it is popular in China as well. Liu (2010) reports that over 80 percent of students learning English in Chinese independent colleges use oral repetition. He finds that students rate it as the second most helpful learning strategy, ranking just behind written repetition. Similarly, Amir and Noor (2009) write that most Malaysian ESL students agree that repetition is an effective way to learn vocabulary.

However, despite its widespread use in language instruction, research presents mixed results on its effectiveness. Some language teachers sing its praise. Jones (2007) notes that while choral repetition might appear childish to some, it, nonetheless, has worked wonders in his classroom. Bremner (2008) found that having her UK students repeat French words with their meanings helped them keep their focus and increased their word retention. Oberg (2012) cites a variety of studies showing that verbal repetition can increase both the acquisition and retention of vocabulary, and Wahlheim et al. (2012) and Larsen-Freeman (2012) concur that repetition improves rote learning.

Others raise doubts. Richards and Theodore (1986) argue that words learned by repetition soon are forgotten and that the strategy does not effectively improve long-term memory. Kiewra (2002) agrees that material learned by rote repetition is not retained. Abbs et al. (2007) conclude that overt repetition might help with second languages, but shows no benefit in learning first-language vocabulary.

Much less research on the role of repetition has been published in other fields. Sterling et al. (1997) report that oral repetition improved the acquisition and retention of health facts for fourth grade special education students and DiBlasi (2009) found similar results for elementary math with students with learning disabilities. However, Glass et al. (1989) found that verbal repetition had no effect on students' ability to recall strings of digits. Rock (1957) concludes that repetition cannot help students form associations, but can be effective in helping them strengthen associations that already have been made.

Of the research that has been published, very little deals with college-aged students and I can find none that test its effectiveness in learning economics.

The Experiment

I often teach back-to-back sections of a one-semester survey course in economics for non-business majors. Each section enrolls about 40 students.

After covering demand I hand out worksheets for students complete in pairs. They must identify substitutes and complements, distinguish between normal and inferior goods, and determine whether a demand curve will shift to the left, to the right or neither in response to a variety of changes -- including a change in the price of the good itself. We discuss the answers in class and, invariably, many students have mistakenly answered that a change in the price of the good would shift its curve. In the past I would point out the error, re-emphasize the concept, explain that they will be expected to differentiate between shifts and movements along on the next exam, and then move on.

Recently, I have chosen one of the two sections each semester using a random coin flip and experimented with forcing its students to recite the concept aloud. After explaining their error on the class exercise, I ask students in chosen section to stand up. They look at me quizzically, but most are so tired of sitting and listening that they stand without complaint. I then ask them to repeat after me: "If the price of a good changes". Here the quizzical looks intensify, but they comply. I continue with: "we move along the existing demand curve," and motion for them to repeat that as well. I keep going, saying that the demand curve already shows the effect of a change in price on the quantity people are willing to buy, and that curve will shift only if there is a change in a factor other than the price of the good that affects willingness to buy. The class repeats each phrase after me.

By this point in the semester most are willing to humor me. Yet student reactions vary widely. Some repeat the phrases loudly and enthusiastically; others mumble quietly. Some laugh while others scowl. Many give their neighbors a "he's really gone off the deep end this time" look. I explain that yes, this seems silly, but that it might just work. And I move on to supply.

Results

Does it work? The results are encouraging. Over the three semesters studied, I included a true-false question on the first exam of the form: "An increase in the price of hot dogs will cause the demand curve for hot dogs to shift to the left." In addition to answering true or false, students must explain why the statement is true or false.

As shown in Table 1, students that participated in the repeat aloud (RA) exercise have performed better than those in the control sections that did not. Students in RA groups were 15 percentage points more likely to get the answer correct. While the 56 percent correct record of the RA group should not excite us, it is 34 percent higher than the 42 percent correct rate of the control group. A method that can raise scores by a third deserves at least a few kudos.

Moreover, the difference in performance is statistically significant. Using a standard t-test to compare proportions in two samples we can reject the hypothesis that students in the control group performed at least as well as those in the stand recite group with 95 percent confidence. The calculated z-statistic is 2.23.

Table 1: Percent of Correct Answers on First Exam

	N	*Percent Answering Demand Question Correctly*	*Percent Score on Other Identical Questions*
RA students	112	56.25%	68.6%
Control students	129	41.86%	67.8%
All students	241	48.55%	68.2%

Of course, other plausible explanations for the differential scores exist. For example, even though the demand material in all sections was taught using exactly the same examples and, as far as possible, exactly the same explanations and wording, students in the RA sections might have scored higher because they were brighter or because they studied more effectively rather than because of the verbal repetition.

To test whether student ability and/or effort might have varied systematically across sections, scores on other exam questions were compared. Between 30 and 40 percent of the exam questions given to the RA sections were identical to those given to the control sections. If students on the RA sections were more able or better prepared, their scores on other identical questions should also be higher. But, they were not. Students in the control sections performed just as well on these other identical questions as did the students in the RA sections. The control students averaged 67.8 percent while RA students averaged 68.6 percent on the identical questions (see Table 1). The difference is not statistically significant and there is no reason to suspect that the students in the two groups differed in terms of ability or study effort.

As a second test, a probit regression was run of the form:

$$Correct = a + b(Repeat) + c(Othersame)$$

where:

Correct is a dummy variable = 1 if true-false question on demand is correct
Repeat is a dummy variable = 1 for RA participants
Othersame is the percent grade on other identical exam questions

Because better and more prepared students should perform better on both the demand question as well as other similar parts of their respective exams, the coefficient on the *Othersame* variable should be positive and should capture differences in student ability. As expected (see Table 2), *Othersame* is positively and significantly correlated with answering the demand question correctly. More importantly, the *Repeat* coefficient also is positive and statistically significant. Students in the RA sections outperformed those in the control sections on the demand question even after controlling for differences in student ability and exam preparation.

Table 2: Probit Regression Results for First Exam

Variable	*Coefficient*	*Standard Error*	*Z-Statistic*
Repeat	0.379	0.166	2.27
Othersame	1.188	0.456	4.13
Constant	-1.494	0.334	-4.47

N = 241

Persistence

The RA group did better on the relevant first-exam question, but does the difference persist? Would the difference still be apparent more than two months later at the end of the semester?

Although the final exam consists mostly of questions from the last section of the course, students are given a list of one dozen concepts covered on earlier exams that they should review and be ready to discuss on the final. In the last two semesters students were told to review "factors that cause demand and supply curves to shift" and then the identical true-false question from their first exam on price shifting the demand curve was repeated on the final.

Table 3 lists the results. While the percent answering the question correctly on the final exam dropped slightly for both groups, the gap between the two was almost as large. The 50 percent correct rate for RA students is almost 40 percent higher than the 35.8 percent rate for the control students. The RA group outperformed the control students by 14.39 percentage points on the first exam and by 14.2 percentage points on the final. Despite the smaller sample size, the difference again is statistically significant at the 95 percent confidence level (one-tail test).

Table 3: Percent of Correct Answers on Final Exam

	N	*Percent Answering Demand Question Correctly*
RA students	66	50.00%
Control students	81	35.80%
All students	147	41.50%

A probit regression model for the final exam scores yields similar results (see Table 4). The coefficients on both *Repeat* and *Othersame* are almost identical to those estimated for the first exam model (see Table 2) and, although the z-statistics are a bit lower, both coefficients remain significant at the 95 percent level. Even after controlling for differences in student performance on other material, students in the RA sections did significantly better on the demand question even three months after they participated in the verbal repetition exercise.

Table 4: Probit Regression Results for Final Exam

Variable	*Coefficient*	*Standard Error*	*Z-Statistic*
Repeat	0.381	0.215	1.77
Othersame	1.800	0.552	3.26
Constant	-1.543	0.394	-3.91

N = 147

Conclusions and discussion

We know that simply asking students in class if they understand a concept often elicits little but silent stares. We also know that if students do nothing to internalize the material, it soon will vanish, even from those students that do understand it.

Many studies have concluded that techniques which force students to write short summaries and explanations of concepts positively impact learning and retention. In these experiments, verbal recitation generated similar results. Even after controlling for differences in ability and exam preparation, students that stood and recited aloud the difference between moving along and shifting a demand curve were more likely to answer a relevant question correctly on the next exam than those that did not. And, since a similar difference in performance occurred months later on the final exam, the learning gap seemed to persist.

Some might speculate that having students stand and recite the concept simply sends a signal to students that they need to know the concept for the exam. Consequently, the learning gap might be the result of the signal rather than the repetition itself. While such an interpretation is plausible, alternative signals were less effective. For example, students in the control sections were told explicitly that they needed to know this for the exam, yet they still were significantly less likely to answer the relevant questions correctly. Perhaps signaling is the key. But, even if that turns out to be the case, repetition seems to be more successful than other signals we send our students.

While repetition will not turn a "C" student into an "A" student, the more-than-30 percent improvement found in answers to this single demand question is rather impressive. Perhaps just as importantly, the method requires almost no time or effort. The verbalizations take only a few seconds and, unlike one-minute papers, there is nothing to read or grade.

Variations on the approach might even be more effective. For example, instead of asking students to repeat phrases verbatim, I have begun presenting students with a hypothetical question to test their understanding of a concept just covered and ask them to think briefly about how they might answer it. After about 30 seconds I ask students to volunteer a single point they think a good answer should include. Once the key ideas have been raised, I ask students to turn to the person beside them and verbalize a complete answer. Students respond favorably to the approach. They say that reciting an answer helps them to clarify things in their own mind and that hearing another student's explanation gives them a deeper understanding of that same concept.

Additional studies of the effectiveness of repetition on alternative topics might give more insight into whether such an old-fashioned method can enhance student learning outcomes.

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The Influence of Aggregate Demand Elasticity On The Federal Budget Deficit

Ben L. Kyer and Gary E. Maggs*

ABSTRACT

This paper examines the implications of aggregate demand elasticity for the federal budget deficit when macroeconomic shocks occur. We obtain two results with the graphical analysis. First, and for an adverse change to short-run aggregate supply, the decrease in real gross domestic product and the resulting increase in the budget deficit is larger the more elastic is aggregate demand with respect to the general price level. Second, and when a negative shock to aggregate demand occurs, the decrease in real gross domestic product and the consequent increase in the budget deficit is larger the smaller is the price level elasticity of aggregate demand.

Introduction

The analysis of the federal government budget deficit has become rather standard in economics pedagogy. Indeed, examinations of federal deficits are consistently present in textbooks for principles of macroeconomics, intermediate macroeconomics, and public finance.[1] As part of this discussion and in order to differentiate between automatic stabilization and discretionary fiscal policy, it is common to distinguish between the cyclical and structural components of the total federal deficit. A potentially important but neglected element in the analysis of federal budget deficits is the price level elasticity of aggregate demand.[2] For any given negative shock to either aggregate demand or aggregate supply, assuming that the structural component of the deficit is not affected by changes in real gross domestic product, the resulting decrease in real GDP and therefore the increase in both the cyclical and total budget deficit is influenced by the elasticity of aggregate demand with respect to the price level. The purpose of this paper then is to modestly extend the standard pedagogical approach and demonstrate, with a graphical analysis appropriate for undergraduate students, the implications of aggregate demand elasticity for the federal budget deficit.

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[1] Examples of these texts include Froyen (2013), Gordon (2012), Krugman (2013), Mankiw (2012), McConnell (2012) and Samuelson (2010).

[2] Indeed, the elasticity of aggregate demand has received little attention generally. In separate papers, Havrilesky (1975) and Purvis (1975) derived expressions for the price level elasticity of aggregate demand within the standard price-flexible IS-LM model. Using an expanded IS-LM framework to distinguish between the Pigou and Keynes effects, Kyer and Maggs (1992) also derived an expression for the price level elasticity of aggregate demand. Kyer and Maggs have also shown the relevance of aggregate demand elasticity for the validity of supply-side economics (1994 and 1996) and for various monetary policy rules when aggregate supply shocks occur (1995). Kyer and Maggs also demonstrated that the inclusion of inflation indexed bonds in real wealth decreases the price level elasticity of aggregate demand (2009).

The paper proceeds as follows. Section II presents the analysis which examines the role of aggregate demand elasticity for federal budget deficits when both aggregate demand and aggregate shocks occur. Section III concludes the paper with a summary of the results and recommendations for future research.

The Analysis

The analysis is founded on three main assumptions. First, while the aggregate demand for final goods and services is assumed to relate inversely to the price level, its elasticity with respect to the price level may take different values. The assumption that aggregate demand is negatively sloped is customarily justified theoretically with the real wealth effect, the interest rate effect, and the international effect, and the strength of these in turn may serve to intuitively explain different price level elasticities of aggregate demand. With respect to the real wealth effect, also called the real balance effect and the Pigou Effect, aggregate demand will be more elastic for any change in the price level the more responsive is consumption spending to the resultant change in real wealth. Gambs (1974) demonstrated that the Classical school, from its emphasis on the quantity theory of money, implied that aggregate demand was unit elastic with respect to the price level. For the interest rate effect, known also as the Keynes Effect, aggregate demand is more elastic with respect to the price level the more responsive is investment spending to changes of the interest rate. Keynes (1936) and some of his early followers believed that aggregate demand could be perfectly price level inelastic when a liquidity trap occurred. Finally, and regarding the international effect, alternately known as the net exports effect, the balance of trade effect, and the Mundell-Fleming Effect, aggregate demand is more elastic the more responsive are exports and imports to changes in the price level.[3]

The second assumption is that the government expenditure and tax revenue functions within this "reduced form" aggregate demand curve are assumed to be constant or stable. Therefore, any demand shock to the macroeconomy must originate from the remaining components of the commodity and money markets, i.e., consumption, investment, exports, imports, money demand, and money supply. Finally, we assume that the aggregate supply of final goods and services depends positively on the price level. This assumption frames the analysis within the neoclassical synthesis where there exists some nominal wage or price rigidity in the economy. With these assumptions the relevance of aggregate demand elasticity for budget deficits is analyzed for adverse shocks both to aggregate demand and aggregate supply.

An Adverse Aggregate Supply Shock

We explore first the effect of aggregate demand elasticity on the federal budget deficit when a negative aggregate supply shock occurs. Panel A of Figure 1 contains two aggregate demand curves of different price level elasticities. Because the curves pass through the common point E_0, the flatter of the two has the greater point elasticity with respect to the general price level and is thus labeled $AD^{ELASTIC}$. The relatively inelastic aggregate demand is shown as $AD^{INELASTIC}$. The original short-run aggregate supply curve $SRAS_0$ is drawn to intersect both aggregate demand curves at E_0 to establish a beginning equilibrium real gross domestic product. For simplicity, this equilibrium real GDP is assumed to be the full-employment or natural level and is therefore labeled $Q^{NATURAL}$.

Panel B of Figure 1 shows the two components of the federal government budget. Given the progressivity of the personal income and corporate profit taxes and the proportionality of the payroll tax, total tax revenue R is given as a positive function of real GDP or income. Total expenditure S, which is comprised of both government consumption and investment and transfer payments, is shown as a negative function of real GDP since transfer payments such as unemployment benefits and food stamps increase as real GDP decreases. With the economy in equilibrium at full-employment we assume, again for simplicity, that revenue and expenditure are equal, $Q^{NATURAL}A$, the federal budget is balanced and the cyclical and structural deficits are zero. Now suppose that short-run aggregate supply decreases to $SRAS_1$.

With a negatively sloped aggregate demand curve, any adverse shock to aggregate supply will decrease real gross domestic product and consequently increase the budget deficit. The magnitudes of the decrease in real income and increase of the deficit, however, depend in part on the price level elasticity of aggregate

[3] These conclusions regarding the relationships between the real wealth effect, interest rate effect, the international effect and the price level elasticity of aggregate demand are easily demonstrated to undergraduate students through the IS-LM diagram.

demand. Referring to Figure 1, if AD is relatively elastic, the negative aggregate supply shock decreases real GDP to Q_1 and increases the budget deficit to BC. Alternatively, if aggregate demand is less elastic with respect to the price level, both the decrease of real income, from $Q^{NATURAL}$ to only Q_2 and the resulting deficit, now YZ, are smaller. The unambiguous conclusion is that for a given negative aggregate supply shock, the decrease of real GDP and therefore the increase of the budget deficit is larger the more elastic is aggregate demand with respect to the general price level.

An Adverse Aggregate Demand Shock

Perhaps the more common and contemporary cause of real gross domestic product declines is negative shocks to aggregate demand. Such a leftward shift of aggregate demand with a positively sloped aggregate supply curve will result in a lower real GDP and a higher deficit. The magnitude of the decline in real income and thus the impact on the budget deficit depends rather importantly on the price level elasticity of aggregate demand.

In Panel A of Figure 2 we again draw two initial aggregate demand curves with different price level elasticities, labeled as before. The short-run aggregate supply intersects both of these aggregate demands to establish equilibrium at full-employment such that in Panel B the budget is balanced and the cyclical and structural deficits are again zero. Now suppose a negative aggregate demand shock occurs and shifts both aggregate demand curves the horizontal distance E_0X.

If aggregate demand is relatively inelastic with respect to the price level, the aggregate demand shock decreases real GDP to Q_1 and results in the budget deficit equal to BC. On the other hand, if aggregate demand is more elastic, the same shock to aggregate demand decreases real GDP by less, to $Q_{2,}$ with the consequently lower budget deficit of YZ. The conclusion is again unambiguous: when adverse aggregate demand shocks occur, ceteris paribus, the decrease of real income and therefore the increase of the budget deficit is larger the less elastic is aggregate demand with respect to the general price level.

Summary and Conclusion

This paper has shown with a graphical analysis the influence of aggregate demand elasticity on the federal budget deficit when aggregate supply and aggregate demand shocks occur.[4] Two distinct conclusions were obtained. First, when an adverse aggregate supply shock occurs, the decrease in real GDP and resulting increase in the budget deficit is larger the larger is the price level elasticity of aggregate demand. Second, when a negative aggregate demand shock happens, the decrease in both real gross domestic and the resulting budget deficit are greater the less elastic is aggregate demand with respect to the general price level.

While the theoretical conclusions reached in this paper are important in their own right, the actual relevance of aggregate demand elasticity for changes in real gross domestic product and the federal budget deficit when shocks occur remains an empirical issue. Unfortunately, estimates of the price level elasticity of aggregate demand are as uncommon as their theoretical counterparts. Nevertheless, a few studies which suggest that aggregate demand in the United States is inelastic with respect to the price level were derived by investigating the IS-LM cores of various large-scale macroeconomic models are found in Klein (1991). Apergis and Elestheriou (2000) estimated this elasticity for Greece. Therefore, additional and more current estimates of aggregate demand elasticity may be an avenue for future research. Moreover, a simulation of the underlying structural model presented in this paper based on different assumed values of the price level elasticity of aggregate demand would assist students in gaining a more comprehensive understanding of the importance of aggregate demand elasticity, changes in real income, and the resulting variations in the federal budget deficit when negative aggregate demand and aggregate supply shocks occur.

[4] While this paper has focused solely on the relevance of aggregate elasticity for negative shocks and budget deficits, the analysis is of course symmetric. A useful exercise for students may be to demonstrate this symmetry for the implications of aggregate demand elasticity for the effects of positive shocks on the federal budget.

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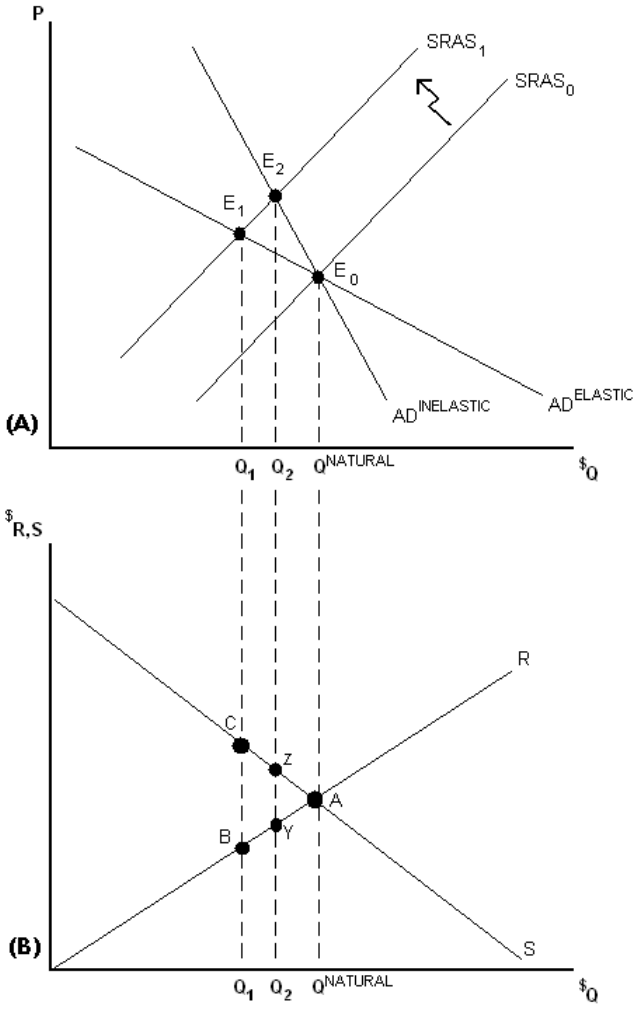
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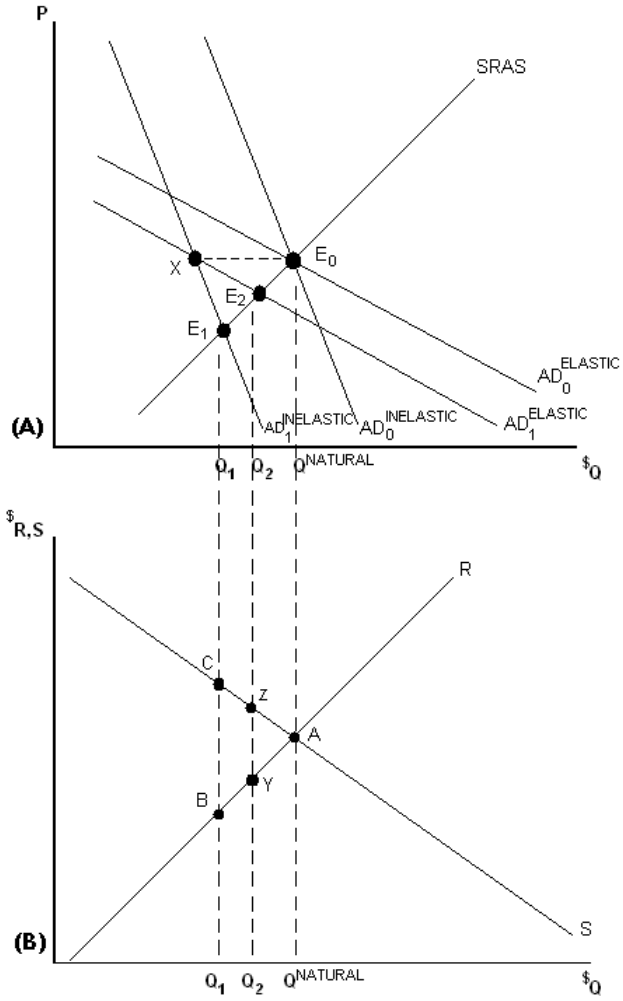
Figure 1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QNATURAL
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Figure 2

Help Your Students Realize Their Retirement Dreams by Quantifying the Cost of Procrastination

Jonathan K. Kramer[1], John S. Walker[2], and Jonathan R. Peters[3]

ABSTRACT

In this paper we discuss the details of a dollar-a-day investment plan that professors can use when teaching a course in finance or economics. The goal is to explain the power of compounding and to illustrate the opportunity cost of procrastination. Our hope is that the narrative and examples will not only help students to understand these concepts but also motivate them to begin a modest investment regimen while in college. We also use the Shiller dataset to find an optimal look-back period that can be applied to making projections for the size of future retirement nest eggs.

Introduction

Because of the nature of compounding, it is very important to begin saving early in life for retirement. This is not a new idea nor is it a well-kept secret. Many textbooks contain examples of how saving a few thousand dollars a year, starting in your twenties, can translate into a sizable nest egg by retirement. Nevertheless, it is often difficult for young adults to relate to saving several thousands of dollars per year at a time when their net worth and income are at or near the lowest they will be in their adult lives. So while most individuals understand the logic of these types of examples, they often do not see the applicability to themselves. As a result, it is easy for them to delay starting an investment regimen until they feel they have surplus resources. However, with the opportunity to consume so many goods and services that offer instant utility, for many the surplus never materializes, or does so at a point in life when they have already missed out on the benefits of long-term compounding. In the first section of this paper we present a simple, yet powerful example that illustrates the importance of starting to invest early in life. We then use this example to quantify the cost of procrastination over time. Since the cost of procrastination is highest in the early years this should encourage students to begin saving early in life.

The example we present in the first section of this paper entails saving a dollar a day (or $30 each month), beginning at age 20 and culminating at the traditional retirement age of 65. Popular books like *The Millionaire Next Door* (1996), *The Wealthy Barber* (1998), and *The Automatic Millionaire* (2004) all contain similar examples. However, one of the practical concerns of such examples is that they are very sensitive to the rate of return assumption. We discuss and illustrate this issue in the second section of the paper.

In the third through fifth sections of the paper we use historical data and statistical analysis to determine the optimal look-back period to use when calculating rate of return assumptions for these types of

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examples. In the concluding section of the paper we discuss some caveats of using historical data and present ideas for future research.

A Simple, Yet Powerful Example

The example we currently present to students in our personal financial planning course[4] begins with the assumptions that:

- A 20-year-old student begins a savings plan by saving $1/day,
- Invests $30/month ($16,200 total) earning an 8% annual return, and
- Continues this savings plan for 45 years until he retires.

This strategy results in a nest egg of $144,173 by the end of the accumulation period (see Table 1). See the Appendix I for discussion on converting an effective annual rate of return assumption into a monthly rate of return assumption, which is needed for this calculation.

Table 1
Investing $30/month @ 8% Rate of Return Starting at Age 20

# of years investing	10	15	20	25	30	35	40	45
Age	30	35	40	45	50	55	60	65
Year	2023	2028	2033	2038	2043	2048	2053	2058
Amount Invested ($)	3,600	5,400	7,200	9,000	10,800	12,600	14,400	16,200
Value ($)	5,404	10,128	17,070	27,270	42,257	64,277	96,632	144,173

There are several takeaways from this example. First, by starting to invest early in life, even modest amounts of savings ($16,200) can grow considerably over the long run. (We also show in class that $3/day ($48,600) grows to $432,519 over 45 years at 8%.) Second, there is a substantial cost to delaying your savings plan. The numbers in Tables 1 and 2 quantify the "cost of procrastination" when it comes to starting a plan.

If we assume an average annual rate of return of 8%, someone who waits until age 25 to begin saving for retirement at age 65 can expect to accumulate a 33% smaller nest egg ($96,632 versus $144,173) than someone who begins at age 20 and has 45 years to save. The five years lost means that starting at age 25 gives the saver a 40-year investment horizon rather than 45 years. This represents an 11% shorter savings period that yields a staggering 33% smaller nest egg for a 3.0 ratio between the nest egg reduction and the horizon reduction (see Table 2).

Table 2
The Impact of a Reduction in the Investment Horizon from a Base of 45 Years
(Assuming $30/month invested at 8%)

Horizon Reduction (years)	Horizon Reduction (%)	Nest Egg Reduction (%)	Reduction Ratio (x)
5	11	33	3.0
10	22	55	2.5
15	33	71	2.2
20	44	81	1.8
25	56	88	1.6
30	67	93	1.4
35	78	96	1.2
40	89	98	1.1

[4] Personal financial planning is one of seven required finance courses for students pursuing a BSBA with a major in finance at Kutztown University. This example would also be suitable for a one semester investments course when we discuss compounding, annuities, and historical returns on various asset classes.

The reason the reduction ratio is so large is that the investor loses the compounding benefit of early investing. If the saver elects to delay the start of a savings plan until age 25, he will deposit $1,800 or 11% less principal into his retirement account during the savings period and accumulate a nest egg that is $47,541 smaller than what would have accumulated over the full 45-year period. The reduction in principal represents just 4% of the overall decrease in the nest egg, meaning that the other 96% represents lost interest, both simple interest and interest on interest, that would have been earned on that principal. Thus, we explain to the students that whatever they spent the $1,800 on in their early 20s better have had a great deal of utility to compensate for the significant reduction in their standard of living later in life.

Table 2 illustrates that a young person has a very high cost of procrastination and should be highly motivated to begin his savings program immediately. However, often young people look at 45 years until retirement as an eternity and do not feel a sense of urgency. In contrast, an older investor, for example someone who is 50 and has not started saving for retirement, might feel very compelled to begin investing for retirement because he sees retirement staring him in the face. Yet, ironically, his cost of procrastination is not nearly as significant by the time he reaches 50 years of age because he has foregone so many years of compounding. Once students become aware of this contradiction between perception and reality it should help spur them to action. However, even if they don't immediately run out and open an individual retirement account (IRA), this example still makes it clear that what they are about to learn in the course is relevant to them *now*, and not at some yet-to-be-determined point in the future.

The Importance of the Rate of Return Assumption

When presenting this example, we stress that this is not some idealized investing strategy. It is simply one example that is designed to clearly present the cost of procrastination and to motivate the initiation of a savings plan at an early age. It is not a substitute for a comprehensive investing strategy that takes a person's goals, risk tolerance, and risk capacity into consideration. Nevertheless, we can think of no other single example that resonates as much with our current and former students as this one. However, one of the practical concerns we have always had about this example is that it is very sensitive to the rate of return assumption. Figure 1 illustrates the exponential increases to the projected nest egg as the rate of return assumption increases. While we want to inspire students to begin investing early in life, we also don't want to oversell the concept and have people be disappointed when actual results do not meet expectations. So what is a realistic rate of return to use in such an example?

[Insert Figure 1 here]

In published examples similar to the one above, we find a wide range of rate of return assumptions. On the low end the personal financial planning video titled *Your Money, Your Life: Empowering Young Adults to Get Their Money Right* (Films Media Group, 2009), uses a 7% rate of return assumption. On the high end, Chilton (1998) uses 15% as the rate of return assumption in his best-selling book *The Wealthy Barber*. In between, Brigham and Houston (2012) use 12% in their textbook Integrated Case, and Bach (2004) uses 10% in his bestseller *The Automatic Millionaire*. As Table 3 shows, the differences in the projected nest egg, holding the principal contributions and investment horizon constant, are substantial.

Table 3
Projected Nest Egg from Investing $30/Month over 45 Years Using Different Rate of Return Assumptions

Publication	Return Assumption (%)	Projected Nest Egg ($)
Your Money, Your Life	7	106,130
The Automatic Millionaire	10	270,464
Financial Management	12	515,306
The Wealthy Barber	15	1,377,140

With such a wide range of assumptions used in published sources, and no certainty regarding future returns, it leaves instructors guessing what rate of return assumption to use. While we cannot claim any certainty regarding future returns, in the remainder of this paper, we try to take some of the guesswork out of what rate of return to use in this example.

The Data

We use data provided by Robert J. Shiller (retrieved 2012). Shiller's data consists of monthly stock market returns (including dividends) from January 1871 through June 2012. Shiller (2005) terms the data series the "Standard & Poor's Composite Index," although it is now more commonly known as the S&P 500. The reason that he uses the older name is that this historical index did not always contain 500 stocks.

When presenting the dollar-a-day example, we assume that the person investing would invest all of his funds in a well-diversified portfolio of equities and continue to do so over the entire 45-year period. We also ignore transaction costs and taxes. While these are simplifying assumptions that ignore some of the intricacies of retirement planning, we do not think this is a serious problem for several reasons. First, since we use this example during the first week of class, the students have not yet been introduced to the finer points of long-term investing. Trying to incorporate considerations such as asset allocation, portfolio rebalancing over time, risk tolerance, risk capacity, transaction costs, and taxes at this point in the course would likely lead to confusion and make the example so complex that many would tune it out. Second, while we do not incorporate these finer points of investing into the example itself, we do mention that they are valid considerations, that they are important, and that they will be introduced later in the course. Finally, while we are using a simplifying assumption, it does not detract from the primary goals of the example which are to demonstrate the cost of procrastination and to show the relevance of the course material to younger people who generally have little in terms of income and financial net worth.

However, even with the employment of these simplifying assumptions we are still left with the question of what rate of return to forecast for a well-diversified portfolio of equities. Published examples, like those listed in Table 3, usually use historical average rates of return. A second method, popular among practitioners, is to use simulation analysis.[5] However, Nawrocki (2001) argues convincingly against using simulation when historical data is available. Since historical return data is readily available, we conclude that the most practical way to project returns for an example such as this is to use past returns as a proxy for future returns. An additional advantage of using historical averages is its simplicity. Instructors wishing to utilize this example would not need any specialized knowledge of simulation analysis or time series forecasting techniques. The question then becomes what period of past returns should be used? In this paper we attempt to answer this question using historical data.[6]

Methodology and Results

We use Shiller's data to estimate expected rates of return over varying look-back periods and to test the accuracy of those expected rates of return ex post. For example, if a professor standing in front of a class at the end of June 1967 would have used a 45-year look-back period to estimate her rate of return assumption for the next 45 years, according to the historical record, she would have used 10.73%. Assuming a consistent investment of $30/month, the professor would have projected a nest egg of $341,719 by June

[5] A third method could be to use an autoregressive forecasting model to predict future returns. However, the investment horizon in this example is long, and utilizing the Dickey-Fuller test on the Shiller data, we find no discernible long-term patterns in stock market returns. While short-term trends are identifiable, further research is needed to determine if and for how long they might persist.

[6] Another mathematical aspect to making an estimate of the future value accumulated from a savings plan is the calculation itself, whether it's completed on a handheld calculator or in Excel using the future value financial function. Typically, rate of return data are what are termed "geometric time-weighted averages" or more simply "effective annual rates." Appendix I provides the details needed for a student to understand the difference between an effective annual rate, a nominal interest rate, and a periodic rate. In this paper, we look at savings plans that are monthly annuities; thus, it is necessary to transform effective annual rate assumptions into periodic rates, which is not a trivial task. Students taking a course on personal financial planning or investments should be able to successfully estimate the size of a nest egg given a return assumption using a financial calculator or Excel.

2012. Next, using the realized returns between 1967 and 2012 we measure the ex post deviation from the expected nest egg. That is, if a student took the example literally and invested as prescribed, the data allows us to calculate that he would have accumulated $216,549 by June 2012. The reason for this negative deviation is that the realized return over the 1967–2012 period turned out to be only 9.30%, resulting in a nest egg $125,170 (37%) less than expected.

With monthly data extending back to 1871, we are able to replicate this type of example numerous times, where *t* is the length of the look-back period and *N* is the total number of replications, beginning with *n* = 1, 2, …, *N*. For example, when a 60-year look-back period is used, *N* is equal to 438. In contrast, when the look-back period is just 10 years, *N* is 1,038. For each look-back period (*t*) there is a unique number of replications (*N*) which enable us to calculate the *mean absolute error* (*MAE*) of the forecast:

$$MAE_t = \frac{\sum_{n=1}^{N} |Realized\ Nest\ Egg_n - Estimated\ Nest\ Egg_n|}{N} \quad (1)$$

For example, the $MAE_{10\text{-}year\ look\text{-}back\ period}$ is found by using the average returns for 10-year intervals, beginning in 1871, to project the future value of a 45-year monthly annuity (the projected nest egg value), and then finding the absolute value of the difference between the estimated and realized nest egg and averaging these differences across all observations. The number of replications (*N*) of each *MAE* calculation depends on the starting point and the ending point for the data series (January 1871 through June 2012), and the length of the look-back period. For the $MAE_{10\text{-}year\ look\text{-}back\ period}$, the first term is based on the average 10-year return from January 1871 to January 1881, which we use to make a 45-year projection from January 1881 to January 1926. The next term uses the next 10-year look-back period from February 1871 to February 1881 to make a 45-year projection from February 1881 to February 1926 and so on. The final term in equation (1) is based on the average 10-year return from June 1957 to June 1967 to make a 45-year projection from June 1967 to June 2012.

Some people may argue that a shorter look-back period is appropriate when making projections because recent structural changes to the economy will heavily influence the near future and even longer. Others may argue that a longer look-back period will cancel out some of the noise in stock returns and therefore provide a better forecast. In this study, we find the look-back period that minimizes the *mean absolute error*. We vary the look-back period from 10 years to 60 years in one-year increments, holding the investment horizon constant at 45 years. The resulting *MAE*s for the range of look-back periods are shown graphically in Figure 2 and the numbers are provided in Appendix II.

[Insert Figure 2 here]

Confirming the Optimal Look-Back Period by Difference of Means Testing

The optimal look-back period coincides with the minimum *MAE*, which can be found numerically (see Appendix II) or graphically (see Figure 2). The minimum *MAE* occurs with a look-back period of 36 years. Using *MAE*s, we tested to see if numerical differences between 36 years and other look-back periods could be verified statistically, given that the generation of the *MAE*s is a statistical process. We examine inferences regarding the difference between two population means μ_1 and μ_2, where σ_1 and σ_2 are unknown. The sample variances found in our analysis are similar; however, the pooled sample variance procedure is not used because of significant differences in sample sizes. Instead, we use the separate-variance t-test. We start with the errors for the 35-year look-back period and compare them to the errors for the 36-year look-back period to see if the greater MAE ($199,336) generated by the 35-year look-back period is statistically greater than the MAE ($195,996) for the 36-year look-back period. The hypotheses tested are:

$$H_0: \mu_1 - \mu_2 \leq 0$$

$$H_a: \mu_1 - \mu_2 > 0$$

where: μ_1 is estimated by the *MAE* generated using a 35-year look-back period, and

μ_2 is estimated by the MAE generated using a 36-year look-back period.

The μ_1 is the population *MAE* for the look-back period tested, in this case the 35-year look-back period, relative to the population *MAE* for the 36-year look-back period (μ_2), the apparent optimal look-back period for our dataset.

Thus, H_a is the alternative or research hypothesis and we are trying to determine if the data support the rejection of the null hypothesis in support of the research hypothesis. For this upper-tail test, we find that the *t*-statistic is 0.447 and the critical value is 1.646 (*df* = 1,462), so we cannot reject the null hypothesis using a significance level of 5%. (In Table 4 we summarize the hypothesis tests conducted in our analysis.) By not rejecting the null hypothesis, we are saying that the difference between $199,336 and $195,996, which is 3,340, while numerically different than zero, is not *statistically* different from zero when we consider the variance in the errors for the 35-year and 36-year look-back periods. Thus, we cannot assert that the use of a 36-year look-back period is any better than using a 35-year look-back period for the projections.

Table 4
Summary of Hypothesis Testing ($\alpha = 0.05$; $t_{critical} = 1.646$)[7]

Look-Back Period (in years)	*MAE* ($)	Difference ($)	*t*-Statistic	*p*-Value	Reject Null?
29	210,265	14,269	1.895	0.029	Yes
30	207,142	11,146	1.529	0.063	No
31	209,459	13,463	1.802	0.036	Yes
32	212,328	16,332	2.161	0.015	Yes
33	208,977	12,981	1.724	0.042	Yes
34	204,051	8,055	1.075	0.141	No
35	199,336	3,340	0.447	0.327	No
36	195,996	-	-	-	-
37	199,115	3,119	0.415	0.339	No
38	203,661	7,665	1.017	0.155	No
39	207,438	11,442	1.515	0.065	No
40	211,075	15,079	1.982	0.024	Yes

The next step is to continue to test the *MAE*s on either side of the minimum *MAE* associated with the 36-year look-back period. For the 34-year and 35-year look-back periods, both shorter than the 36-year look-back period, and the 37-year, 38-year, and 39-year look-back periods, all longer than the 36-year look-back period, the null hypothesis cannot be rejected when comparing them to the seemingly optimal 36-year look-back period. However, the 33-year (a *t*-statistic of 1.724 versus the critical value of 1.646) and 40-year (a *t*-statistic of 1.982 versus the critical value of 1.646) look-back periods *do* provide sufficient differences that enable us to reject the null hypothesis. Thus, this suggests that the optimal look-back period for our 45-year projections falls in the range of 34 to 39 years. The *MAE*s on either side of the 36-year look-back period between 34 and 39 years are greater than the *MAE* for 36 years, but the differences cannot be shown to be statistically greater than zero.

However, inspection of Table 4 (or Appendix II) finds that the *MAE*s do not monotonically increase on both sides of the 36-year look-back value of $195,996. For shorter look-back periods, the *MAE* decreases as you move from the 32-year ($212,328) to the 31-year ($209,459) and then to the 30-year ($207,142) look-back period. Likewise, as the look-back period extends, a reduction occurs to the *MAE* for both the 47-year and 48-year look-back periods (see Appendix II). Yet, for longer look-back periods, the lack of monotonic increases is not a problem because the *MAE*s for the 47-year and 48-year look-back periods ($223,372 and 222,259, respectively) are greater than for the 40-year look-back period ($211,075). Thus, all look-back

[7] While $t_{critical}$ depends on the *df* and the *df* change across hypothesis tests, the *df* are so large for all the tests conducted that the $t_{critical}$, to three significant figures, does not change.

periods from 40 years and longer produce *MAE*s that are both numerically and statistically greater than the *MAE* for the 36-year look-back period.

In contrast, the test of the difference between the means for the 30-year and 36-year look-back periods gives a *t*-statistic of 1.529 versus the critical value of 1.646. Thus, we cannot reject the null hypothesis and conclude with the research hypothesis, even though the *MAE* using the 30-year look-back period is greater than the *MAE* using the 36-year look-back period. The implication of this finding is that we need to modify our earlier conclusion to say that the *MAE*s on either side of the 36-year look-back period between 34 and 39 years, as well as the 30-year look-back period, are greater than the *MAE* for 36 years, but the positive differences cannot be validated statistically, i.e., we cannot conclude the alternative hypothesis for these look-back periods. However, for look-back periods spanning 31, 32, and 33 years, the MAEs *are* statistically greater than for the 36-year look-back period. Thus, it would be appropriate for a finance professor choosing a look-back period based on historical data to use the 36-year look-back period because its *MAE* is the lowest. We are not saying that projections using a 30-year or 34- through 39-year look-back periods are equally good, because we have not accepted the null hypothesis (nor attempted to control for a Type II error); rather, we have failed to reject the null hypothesis, which is different than accepting it. While the chance that we are making a Type I error is 5%, we can conclusively say that look-back periods 29 years and shorter, 40 years and longer, and 31 to 33 years produce poorer projections, based on the historical data and the *MAE*s associated with these look-back periods.

Conclusion and Ideas for Future Research

One of the most valuable lessons taught in a course on personal finance or investments is the power of compounding. The numerical examples presented in this paper illustrate the exponential growth that compounding generates and the opportunity cost of delaying a savings and investment plan. In addition to teaching their students about compound interest, ambitious professors will likely want to motivate their students to take action while in college to begin saving and investing at a young age. We show that the cost of procrastination when an investor is young is substantial.

While examples of compounding are ubiquitous in finance textbooks and books found in the popular press, they often use returns of 12% and higher. Yet, most of these examples leave the reader wondering where returns of these levels can be achieved. What if a professor wants to make a realistic projection using a rate of return that is easy to calculate and supported by past data? This leads to the question: how many years of past data should be used to make a projection—is a 1-year, a 10-year, or a 50-year look-back period more accurate? Common sense might suggest a shorter look-back period using the assumption that we are under a "new normal" for returns. Others might argue that using the maximum look-back period based on available data provides the most informed projection. Our numerical and statistical approach supports a 36-year look-back period. In other words, a professor standing in front of her class today making a 45-year projection for 20-year-old students should use a rate of return based on the last 36 years of return data as a best guess.

While the numerical approach to identifying the optimal look-back period for making a 45-year projection points to 36 years as being "the best," statistical means testing shows that the volatility in the return data makes identification of the optimal look-back period less precise. Indeed, we report that the optimal look-back period is not 29 years or shorter, 40 years or longer, nor between 31 to 33 years. As for the other look-back periods, i.e., the 30-year, 34-year, 35-year, 37-year, 38-year and 39-year look-back periods, we are unable to conclude statistically that any of these is inferior to using a 36-year look-back period. Likewise, we do not accept the hypothesis that they are as accurate as using the 36-year look-back period. Moreover, if we return and repeat our analysis in 140 years from now, with a new 140-year dataset, there is no assurance that a 36-year look-back period will again appear to be the optimal look-back period.

In this paper we do not provide a point estimate for a suitable rate of return to use because the appropriate rate of return assumption will change over time depending on when the instructor presents the example. For example, we calculate that rate of return assumptions using a 36-year look-back period range from 5.09% to 13.93% (with a mean of 9.02% and a median of 9.38%) for the period 1916-2012. The

highly stochastic nature of investment returns—also underscored by the high *MAE*s found—makes it difficult to make reliable projections; this paper will help students understand that reality.

Our analysis is done using nominal dollars, but a professor could easy modify the example to include a discussion about inflation and the real value of a nest egg at the time of retirement. Another extension to the discussion is to talk about the mechanics involved in implementing a disciplined investment regimen with limited resources.

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APPPENDIX I: THE DISTINCTION BETWEEN DIFFERENT RATES OF RETURN

When financial planners or finance professors are teaching students about the power of compounding and the importance of beginning a savings plan early in life, there are important distinctions that need to be made regarding what are termed the "periodic interest rate" (I_{PER}), the "nominal interest rate" (I_{NOM}), and "effective annual rate" (EAR). (See Ch. 5 for further discussion in Brigham and Houston's *Fundamentals of Financial Management: Concise Seventh Edition*, 2012.) In addition, when we examine historical return data, for example, for stocks or bonds, a distinction between geometric and arithmetic returns is also important.

Typically, when we analyze return data, we look at the annual total returns over many years. For example, author Burton G. Malkiel in his well-known book *A Random Walk Down Wall Street* (p. 201, 2012)[8] presents geometric means and arithmetic means for large company stocks, U.S. Treasury bills, and several other asset classes for the period 1926–2009. Malkiel's book is targeted at mainstream readers, not academicians, so you have to wonder how many readers of his book know the difference between a geometric mean versus an arithmetic mean. Probably very few people who finish reading his 490-page tome could explain the difference between calculating a geometric mean and an arithmetic mean. Yet, the values can be very different. For example, for large company stocks Malkiel reports a geometric mean of 9.8% and an arithmetic mean of 11.8%, 2% higher on an absolute basis. If I'm an investor, I'd much rather earn 11.8% than 9.8%!

[8] Malkiel, Burton G. 2012. *A Random Walk Down Wall Street* (11th ed.). New York, NY: W. W. Norton & Company, Inc.

The classic example used by finance professors is to ask students, "What's the return if you invest $100 and it drops to $50 in year one for a 50% loss and then in year two the $50 grows to $100 for a 100% gain in the second year?" The geometric mean, also termed the "geometric average," is 0%, while the arithmetic mean, also termed the "arithmetic average," is 25%. Usually the geometric average is less than the arithmetic average. Moreover, the calculation to find the geometric average (GA) is quite different than the calculation done to find the arithmetic average (AA). Suppose an investor is analyzing the annual total returns shown in Table A1 for a five-year period. To find the arithmetic average, he would simply sum the five years of annual returns (the sum is 25%) and divide by five. In this example, the arithmetic average is 5%.

Table A1
Sample Geometric and Arithmetic Return Calculations

Year	Return (%)	$1 + R_i$
1	10	1.10
2	–6	0.94
3	7	1.07
4	0	1.00
5	14	1.14
	$\Sigma = 25$	$\Pi = 1.26$
	AA = 5%	GA = 4.75%

Calculating the geometric average is more complicated. Each year's return needs to be transformed into a factor by converting the return into decimal form and adding one; for example, the year one return of 10% gives a factor of 1.10 (see Table A1). If $100 grows by 10%, that's the same as multiplying $100 by 1.10 to give $110. To find the geometric average for the five-year period, you (1) find the product of all five years' of factors, which is 1.26, then (2) find the fifth root of that product, and then (3) subtract one. In this example, the fifth root is found because the time series of returns spans five years. The root taken is always equal to the number of periods (N) in the time series. A general formula for finding the geometric average return is provided by Jordan, Miller, and Dolvin (p. 28, 2012):[9]

$$\text{Geometric Average Return} = [(1 + R_1) \times (1 + R_2) \times \cdots \times (1 + R_N)]^{1/N} - 1 \quad (1)$$

In this paper, we use Shiller's historic return dataset to generate growth projections for investments made on a monthly basis. Our scenarios assume daily savings that are aggregated and invested at the end of each month consistently until retirement at age 65. To find the projected future value of the nest egg, the monthly investment cash flows are treated as an ordinary, monthly annuity. Students learning about annuities typically see examples based on *annual* cash flows. However, an annuity's payments can be made yearly, semiannually, quarterly, monthly, or even more frequently. By definition, an annuity's cash flows are equal and made at fixed intervals. An annuity starts and ends at known points in time. And lastly, a present value or future value annuity calculation is based on a specific interest rate that does not change during the annuity period.

For the future value projections in our paper, we use 45 years of past return data to posit an average expected return for the next 45 years. The Blume's formula shows that the appropriate returns to use in the projections are the geometric averages rather than the arithmetic averages.[10] Suppose the geometric average used for a projection is 10%. This is the effective annual rate denoted as EAR in keeping with the notation used by Brigham and Houston (2012). This pedagogical paper is an excellent opportunity to teach students, or reinforce, the difference between I_{NOM}, I_{PER}, and EAR, as well as how to correctly use Excel's future value function. To use Excel's financial function =FV(rate,nper,pmt,pv,type) to estimate the future value of

[9] Jordan, Bradford D., Thomas W. Miller, Jr., and Steven D. Dolvin. 2012. *Fundamentals of Investments: Valuation and Management* (6th ed.). New York, NY: McGraw-Hill Irwin.

[10] Blume, Marshall E., 1974. "Unbiased Estimates of Long-Run Expected Rates of Return." *Journal of the American Statistical Association, 69*(347), 634–638.

a savings plan, for example, $30 each month for the next 45 years, you need to input the five arguments shown for the function. If the EAR assumption for the monthly annuity is 8%, as used in the example shown in Table 1 earlier in the paper, then the rate for the Excel function is not 8% nor is it 8%/12; we'll return to this input in a moment. The nper is 45 × 12 = 540 months of savings; the pmt is $30, as this is the amount invested each month for 540 months; and the pv = $0 as we assume there is no initial balance in the account. The type = 0 as we assume the investment occurs at month's end; thus, this is treated as an ordinary annuity rather than an annuity due.

Now let's return to discuss the correct rate to use in the Excel function. You would not insert 8% in the function as that would apply 8% per month when you mean to grow at an effective 8% *per year*. Alternatively, if you insert 8%/12 as the periodic rate, then the 8% is being treated as the nominal rate (I_{NOM}) when it's the effective annualized rate. The Excel function would apply monthly compounding to each cash flow and the resultant EAR would be 8.30%, 30 basis points higher than the intended EAR of 8%. In order to arrive at the correct periodic interest rate to insert into the Excel function, the following equation given in Brigham and Houston (p. 167, 2012) showing the relationship between EAR and I_{NOM} can be used:

$$\text{Effective Annual Rate} = (1 + I_{NOM}/M)^{M} - 1 \quad (2)$$

where M is the number of compounding periods. The term I_{NOM}/M inside the brackets is equivalent to the periodic rate to use in the Excel function in order to apply an EAR of 8% to all of the monthly investments made during the 45-year investment horizon. If we substitute an EAR of 8% (in decimal form) and an M of 12 into equation (2), we have:

$$0.08 = (1 + I_{PER})^{12} - 1$$

To solve for I_{PER}, 1 is added to both sides of the equation, and then the 12^{th} root is taken of both sides to clear the exponent, and finally 1 is subtracted from both sides to find $I_{PER} = 0.6434\%$:

$$I_{PER} = (1 + 0.08)^{1/12} - 1 = 0.006434 \text{ or } 0.6434\%$$

This is the value that would be used for the rate variable in the Excel function in order to apply the desired 8% effective annualized return to all of the $30 monthly investments. Once all the variables are inserted into the future value Excel function, the value found is $144,173.01. This represents the future value of a monthly ordinary annuity of $30 earning an effective (geometric) rate of return of 8%, and is the value shown earlier in Table 1 in the column labeled "45" for the number of years investing.

When using the future value Excel function, it's easy to take an annual rate and divide it by the number of periods per year, but this can lead to a mistake. This would not be a mistake if the annual rate is I_{NOM}, but when we use the geometric rate from the Shiller data, the interest rate is an EAR not I_{NOM}. In the above example, if the periodic rate used was simply 8%/12, then I_{PER} would have been incorrectly calculated to be 0.6667%. This is 0.0233% higher than the correct number of 0.6434%, which, seemingly, is not a substantial mistake. Nevertheless, as the investment horizon lengthens, the error is compounded over time. If we use the incorrect I_{PER} of 0.6667%, the future value estimate for the nest egg that is generated by saving $30 per month for 45 years is $158,236.20 rather than the correct estimate of $144,173.01. Thus, the error in the future value estimate is 9.8%; this is a significant error. Because of the mathematics behind compounding, errors in return estimates grow exponentially over time rather than linearly.

APPENDIX II: MEAN ABSOLUTE ERRORS FOR VARIOUS LOOK-BACK PERIODS

Look-Back Period (in Years)	Mean Absolute Error (MAE)	N	Look-back Period (in Years)	Mean Absolute Error (MAE)	N
10	558,594	1,038	36	195,996	726
11	508,974	1,026	37	199,115	714
12	465,669	1,014	38	203,661	702
13	433,192	1,002	39	207,438	690
14	415,050	990	40	211,075	678
15	381,654	978	41	214,852	666
16	349,698	966	42	217,421	654
17	326,100	954	43	221,236	642
18	300,314	942	44	222,692	630
19	276,643	930	45	223,644	618
20	260,797	918	46	223,876	606
21	256,823	906	47	223,372	594
22	255,132	894	48	222,259	582
23	253,824	882	49	223,927	570
24	249,808	870	50	225,194	558
25	237,605	858	51	225,785	546
26	226,591	846	52	225,433	534
27	219,004	834	53	223,290	522
28	212,714	822	54	221,678	510
29	210,265	810	55	223,441	498
30	207,142	798	56	227,054	486
31	209,459	786	57	230,778	474
32	212,328	774	58	234,803	462
33	208,977	762	59	239,065	450
34	204,051	750	60	247,210	438
35	199,336	738			

Figure 1
Future Value of Investing $30/Month at Varying Rates of Return

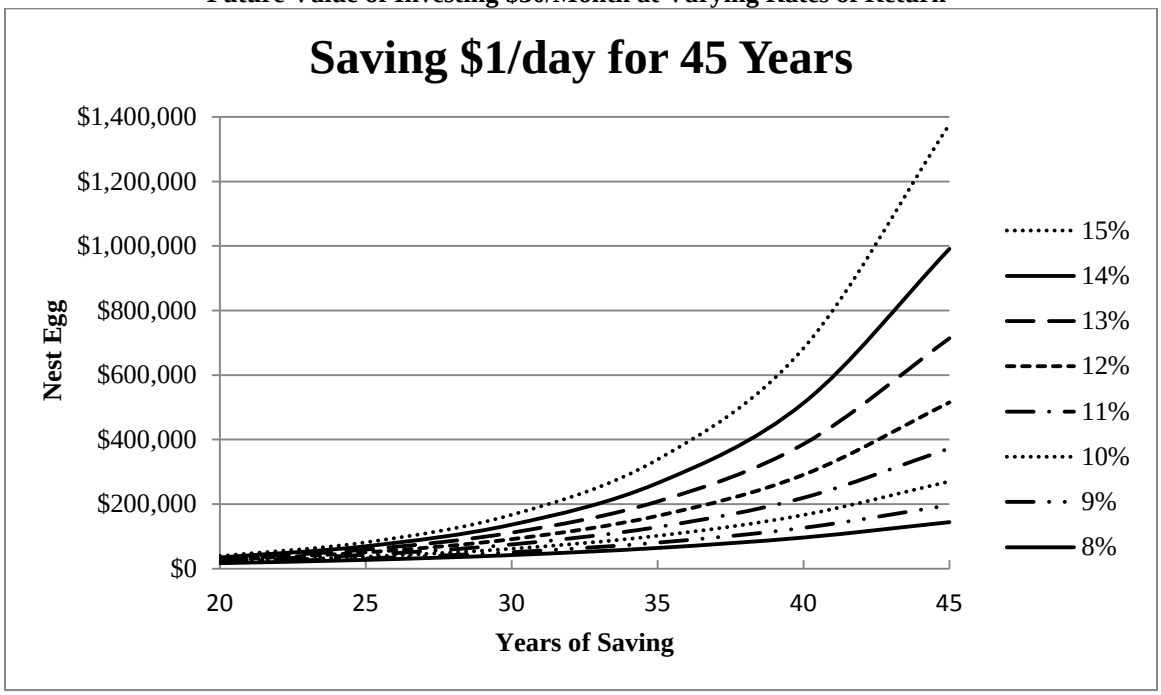
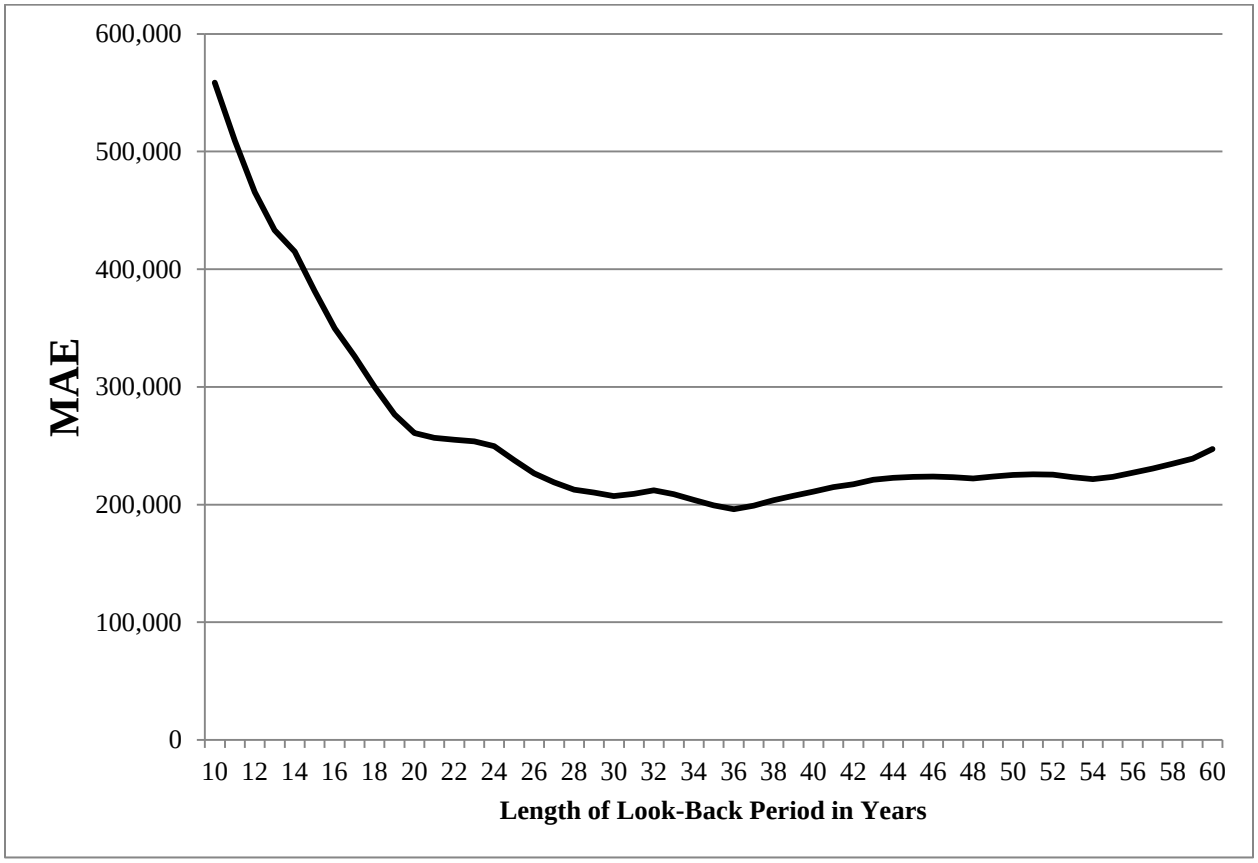


Figure 2
The Mean Absolute Errors from 45-Year Forecasts Using Look-Back Periods Ranging from 10–60 Years



Student Managed Investment Fund Performance: A Look at Equity Portfolio Data

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ABSTRACT

Research on the performance of student managed investment funds (SMIFs) is needed in the literature. Using data from a SMIF at a university in Florida, this paper provides some evidence of this performance while noting the importance of active portfolio management within the SMIF. The results underscore two points: 1.) University officials can rely on students to manage actual investment monies, with proper oversight. 2.) Active management of the SMIF can add value. The goal of this paper is to encourage schools to begin SMIFs and help convince university officials that active portfolio management by students is a good idea.

Keywords: student managed funds, SMIF, SMIP

Introduction

Student Managed Investment Funds (SMIFs), which allow undergraduate and graduate students to manage actual investment portfolios, have grown extensively in the past few decades. Internationally, Lawrence (2008) notes that student managed funds total more than 300, with undoubtedly many more created since this study was published. He states that only 14 student managed funds were in existence in 1980. Such funds, are an important aspect for many universities and business schools. Many schools even devote "trading rooms," stocked with computer terminals and Bloomberg machines, dedicated for students' investment research.

The growth of SMIFs is likely due, in part, to the performance of student's versus professional portfolio managers. Lawrence (2008) notes that limited evidence shows that SMIFs have preformed as well and sometimes better than portfolios managed by professionals. This is stated by Lawrence, and also observed by the authors of this current paper, to be partially due to the fact that SMIFs do not charge management fees. Evidence about the performance of SMIFs is sparse and needed in the literature. Haddad and Redman (2006) is one of the few papers that examine actual SMIF performance. They look at the performance of the equity portfolios of nineteen universities that participated in the TVA (Tennessee Valley Authority) Investment Challenge and note that thirteen schools outperformed the Standard and Poor's 500 (S&P 500) over the period 1992-2002.

This present study examines one SMIF, from a university in Florida (hereafter "the University"), and adds to the limited evidence of SMIF performance. This study is unique in that it analyzes actual data, since inception, of a student managed equity fund and provides evidence of the performance of this fund. The following sections compare the performance of this fund's actively managed equity portfolio to its passive benchmark, the S&P 500. In addition, the equity portfolio is analyzed year-by-year to determine whether the students' active portfolio management approach outperformed the benchmark on an absolute and risk-adjusted basis.

Background of the Fund

The SMIF at the University began in 2005. At this time, the fund at the University joined a number of equivalent programs established in the state of Florida, all of which were preceded by Stetson University, which began its SMIF in 1981 (Mallett, et al., 2010). Like many SMIFs, the University places most of the investment decisions in the hands of the students who make up the SMIF course. The lack of professional experience of the students is noted, and a finance faculty member teaches and oversees the course, while the University's foundation finance committee maintains investment guidelines that the students must follow.

When the SMIF began, in 2005, the students were allocated $200,000, with half going in an equity portfolio and half in a fixed income portfolio. The students were limited to investing in individual common stocks and bond issues rated investment grade. Specific restrictions of the SMIF are as follows:

- The equity portfolio must only invest in equities traded on three principal U.S. Stock Exchanges: NYSE, AMEX, and NASDAQ.
- The use of American Depository Receipts (ADRs) or American Depository Shares (ADSs) in domestic equities is limited to 10% of the equity portfolio.
- Equity investments must be made in corporations with at least one billion in market capitalization.
- Investment in any single corporation's stock shall not exceed 10% of the total market value of the equity portfolio.
- The investment in any individual market sector shall not exceed 150% of the market weight, as measured by the S&P 500 on the close of each quarter.
- In addition, the students are discouraged (by the University foundation) from investing in exchange traded funds (ETFs).

The student managed equity portfolio is effectively an "enhanced index fund," with the aforementioned criteria requiring students to invest in a diversified portfolio of equity securities but limiting the portfolio's divergence from the S&P 500. As a result, the focus of the students' attention is on sector allocation and the analysis of individual equities to include in the portfolio. The overall goal of the equity portfolio is to achieve returns above its S&P 500 benchmark, while controlling risk and being cognizant of a three-to-five year investment horizon. Clinebell (2013) uses this same three-to-five year investment horizon for the fund described in his study of SMIFs. Although the students in the SMIF course change each semester, ultimate goal of each class is to create a portfolio that the next semester's class will not want to change. With this goal in mind, students can have a longer-term investment horizon, while only taking the course over a single semester. The SMIF course used in this paper is not offered over the summer, and the portfolio is not as actively managed during this time as the fall and spring semesters. However, the students do place stop-loss and buy limit orders for equities to possibly be executed over the summer. In addition, proceeds from equities sold over the summer are often placed in an exchange traded fund that tracks the S&P 500 (the only ETF used).

Methodology

The results below use actual data from the University's student managed equity fund, since its inception, in spring semester (January) 2005, through spring semester (April) 2013. This data set is unique, in that it includes all holdings and transaction data over this time period. During this period, there were fifteen SMIF classes that managed the equity portfolio, since for the first two years of the fund, there were only spring semester classes. Over the course of these fifteen classes, the students in the course had discretion over the equity portfolio, subject to the restrictions noted above and the oversight of the professor. This period gives a sufficient timeframe to examine whether or not the students, via active management, performed better than the benchmark (S&P 500) and if so, by how much and with what level of risk.

In order to examine the performance of the student equity fund, we compute the returns, standard deviations, and Sharpe ratios for the fund and the S&P 500 for each year. In addition, abnormal returns and

alpha of the fund is computed, each year, using the Capital Asset Pricing Model (CAPM). The beta of the portfolio at the beginning of each annual period is computed and used to determine the expected return of the portfolio over the subsequent year. This expected return is then compared to the actual return of the student portfolio and the alpha of the portfolio is then computed. In order to compute the beta of the portfolio at the beginning of a given year, each annual period begins at the end of the respective academic year (May 1) and goes through the end of the next academic year (April 30). Therefore, the first annual period 2005-2006 begins on May 1, 2005 and goes through April 30, 2006.

For each time period, dividends and interest (on cash in the fund) is included in the returns. There was no cash inflow or outflow of the student fund over the period(s) examined. The standard deviations for each portfolio are computed from the monthly returns and annualized. The annualized 90-day Treasury bill rate is used as the risk-free rate, and the actual return of the S&P 500 over each respective year is used as the return of the market.

In the following section, we highlight the results of the analysis. All periods end on April 30 of the ending year. The cumulative return is measured from the inception of the fund, January 2005, through April 2013.

Results

Figure 1 illustrates the returns of the student managed equity fund versus the S&P 500 since the fund began in 2005 through April 2013. The fund had higher absolute returns than the market for its first year (2005). After this first year, the fund began to lag the market until March 2008, after which its returns were mostly even with the market, until October 2008. The fund did not suffer as much of a loss as the market from this crash, and since then, the fund has been outperforming the S&P 500.

As noted in Table 1, the actively managed equity fund had higher returns than the benchmark in four out of the eight years examined. Overall, the student fund had a higher cumulative return than the S&P 500 for the eight years, in total. There was only one year, 2008-2009, where the (mean) return of the student fund was statistically significantly different than that of the benchmark. During this year, the fund outperformed the market, or in reality had a much lower drop than the market. The remaining seven years, the (mean) returns of the student fund were not statistically different from those of the market. These results show that the students did no worse than the market overall (statistically speaking) but better in absolute terms.

Table 1: Returns and Risk of Student Managed Portfolio ("SMP") versus S&P 500 ("Index")

End of Year	SMP Return	Index Return	Return Diff.	SMP σ	Index σ
2005-2006	5.80%	13.29%	-7.49%	8.56%	6.17%
2006-2007	12.66%	13.11%	-0.45%	7.89%	7.22%
2007-2008	-1.92%	-6.53%	4.61%	12.55%	11.92%
2008-2009	-28.91%	-37.01%	8.10%*	23.07%	27.92%
2009-2010	35.47%	35.96%	-0.49%	10.99%	11.53%
2010-2011	15.35%	14.91%	0.44%	13.12%	18.16%
2011-2012	9.30%	2.52%	6.78%	13.74%	16.69%
2012-2013	11.03%	14.28%	-3.26%	9.94%	10.31%
Cumulative	53.60%	31.82%	21.78%	13.41%**	15.58%

Notes: "End of Year" is end of academic year (May of one year to end of April of the next). *Mean return of portfolio during this year is *significantly* different (5% level) from S&P 500. Remaining return difference are *insignificant* from S&P 500. **Standard deviation of Student Managed Portfolio *significantly* lower than S&P 500 at 10% level.

When comparing total risk, or standard deviation, of the student fund with the benchmark, Table 1 shows that the student fund had greater standard deviation in the first three years of existence, and a lower standard deviation than the benchmark during the last five years. Cumulatively, the student fund had lower

standard deviation than the S&P 500, and this is statistically different than that of the market at the 10% significance level. The standard deviation for each year, individually, is not statistically different from that of the benchmark. Thus, there is slight evidence that the students, overall, took less risk than the benchmark, and when combined with the returns analysis, indicates that the fund did at least as well as the market, statistically speaking.

Table 2: Sharpe Ratios and CAPM Expected Return/Alpha of Student Managed Portfolio ("SMP") versus S&P 500 ("Index")

End of Year	SMP Sharpe	Index Sharpe	Beta	CAPM *E*(r)	Alpha
2005-2006	0.35	1.70	1.09	14.24%	-8.44%
2006-2007	1.02	1.18	1.14	14.30%	-1.64%
2007-2008	-0.54	-0.96	0.95	-5.96%	4.04%
2008-2009	-1.31	-1.37	1.03	-38.16%	9.25%
2009-2010	3.21	3.11	1.03	37.04%	-1.57%
2010-2011	1.16	0.81	1.05	15.65%	-0.30%
2011-2012	0.67	0.15	1.09	2.74%	6.56%
2012-2013	1.10	1.38	1.02	14.57%	-3.54%
Cumulative	0.28	0.11			

Notes: "End of Year" is end of academic year (May of one year to end of April of the next).

Comparing the reward-to-volatility of the student fund to the benchmark, using the Sharpe ratio, Table 2 illustrates that the student fund did worse than the S&P 500 for the first two years, then better for the next five and under performed the benchmark again in 2012-2013. The cumulative Sharpe ratio of the student fund, however, is over double that of the benchmark. Thus, overall, the students generated higher return and took on less risk than the S&P 500.

The systematic risk of the student fund was overall slightly above the market, with an average beta of 1.05. Thus, a priori, one would expect the fund to earn returns higher than the S&P 500. We computed the expected return of the student fund for each year using the annualized T-bill rate and return of the S&P 500 over the period and the betas of the fund, as of the beginning of the measurement period. Inputting these into the CAPM shows that the students outperformed the benchmark and generated positive alpha for three of the eight years. The other five years, the students did not earn a return commensurate with the systematic risk that they took.

These performance statistics provide evidence of added value in students actively managing equity portfolios. While the differences in returns of the student fund for each year (with the exception of one year) were not statistically different from the market, the students did return higher than the market half of the time. The standard deviation year-to-year was not statistically different from the benchmark, but the students were able to achieve lower risk in five out of eight years. Most importantly, the cumulative returns of the fund were higher, and the standard deviation lower, than the S&P 500. Also, the Sharpe ratio of the student fund was over double that of the benchmark. In addition, the students generated positive alpha in three of the eight years of active management. Faculty and others can use these results as evidence to promote existing SMIFs and persuade university officials in creating new SMIFs at university that may not have such a program. This evidence illustrates that students have the ability to outperform benchmarks and can likely add performance through active management.

Conclusion

Student managed investment funds (SMIFs) are becoming increasingly prevalent at universities across the country. This paper provides an example of the performance of the equity portfolio of one such SMIF, at a university in Florida, and demonstrates that students can, and often do, outperform their benchmark, on an absolute basis, and not reduce value/significantly underperform, from a statistical perspective. The unique data set in the paper (which includes all holdings data since the inception of the fund) allows the

authors to provide this example and highlight two points: 1.) University officials can rely on students to manage actual investment monies, with proper oversight and guidelines. 2.) Active management and ongoing analysis of the student managed investment fund is important and adds value. Not only do SMIF courses give students the opportunity to apply investment analysis techniques learned in the classroom, they also allow universities to reap the benefits of students performing well.

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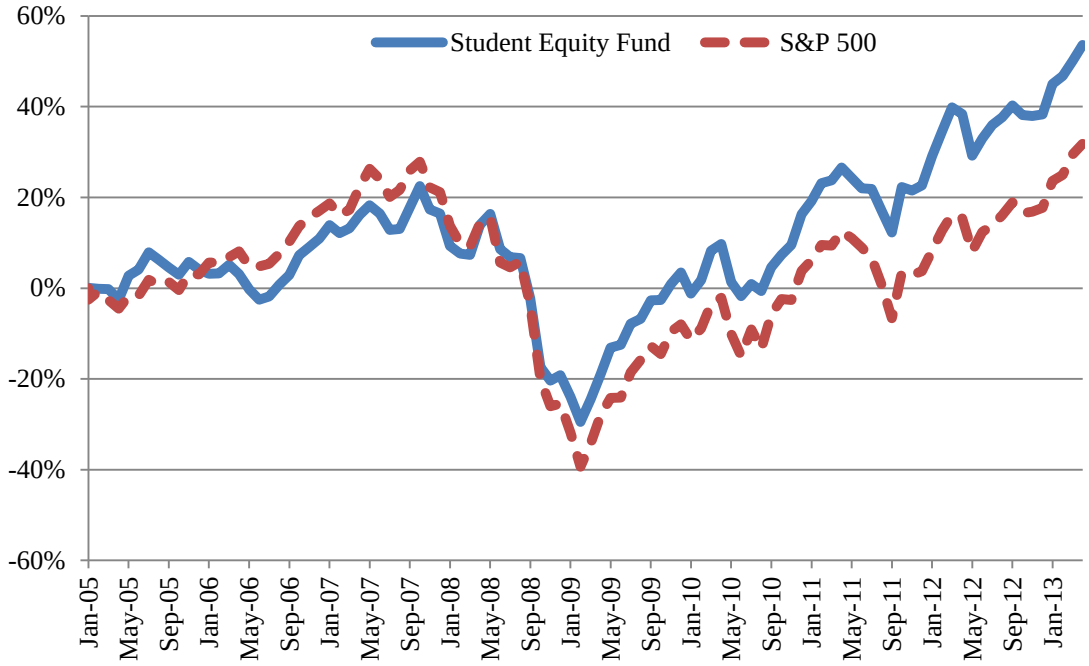
Figure 1: Performance of Student Managed Portfolio versus S&P 500



The Classroom as Policy Laboratory: Using a Classroom Simulation to Experience Macroeconomic Policy

Alan Green[1]

ABSTRACT

This paper describes a classroom economic simulation. The simulation is similar to classroom experiments but is repeated, which allows for a less deterministic structure and gives students time to experience multiple roles. Students run the economy, from hiring their classmates to producing goods and buying them. Students also elect a class congress, which allows them to choose policies and experience the effects. As the simulation progresses, additional economic concepts and measurements are incorporated, including but not limited to GDP (real and nominal) unemployment, poverty, inequality, economic growth, investment, money supply, inflation and macroeconomic shocks.

This paper describes a classroom simulation of a simple economy. The goal of the simulation is for students to make economic choices in realistically structured markets and experience the consequences. They take ownership of the economy by running the companies and the government and thus directly experience the effects of various policies and events. The simulation has a simple basic structure that allows flexibility for instructors to use it for a few periods or extensively throughout the semester. The basic markets works well for studying supply and demand and government policies; the circular flow setup also allows for coverage of most topics in macroeconomic principles including GDP and inflation, growth, unemployment, macroeconomic shocks and policy responses.

The use of active learning techniques, most commonly experiments, is now widespread in economics and social sciences more broadly (Mitchell, et al. 2009, Lantis et al. 2010). The motivation for these techniques is well summarized in Lantis, et al. (2010 page 6): "creating memorable experiential learning events that tap into multiple senses and emotions." There is evidence that experiments improve student achievement and retention in economics principles classes (Dickie 2006, Durham, McKinnon and Schulman 2007, Emerson and Taylor 2004), although they have not been shown to increase the number of students majoring in economics (Emerson and Taylor 2010). Active learning techniques may engage different types of learners and help some students more than others (Emerson and Taylor 2007, Durham, McKinnon and Schulman 2007). However, the overall effect is either neutral or beneficial (Durham, McKinnon and Schulman 2007). Experiments have also been shown to be beneficial in large principles courses, although implementation there may rely on technology that is not widely available (Ball, Eckel and Rojas 2006).

Economics instructors today can easily incorporate a series of experiments into their courses, each corresponding to topics covered. This simulation, while similar in motivation to such experiments, has two key differences. First, this simulation is intentionally less deterministic than most market experiments. Traditional classroom experiments provide students with reservation prices and exact costs of production, which insures the desired outcome but also may limit the realism of the experiment and give the students the impression that the equilibrium price is "rigged." In the simulation described here students set the price

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level and find market equilibrium on their own; they are not given reservation prices and suppliers have some control over their costs. This open-ended setup allows students to experience how markets find equilibrium in a more realistic way, even if it takes multiple periods.

The second difference with this simulation is that it is carried out through the whole semester, thus providing opportunities to cover many concepts and allowing students to develop confidence in the structure of the exercise and learn through repeated interactions. Having the same basic structure allows students to engage more deeply in various roles and saves instructors time by reducing the need for new instructions for every experiment. The simulation has been run in principles classes ranging in size from 30 – 70 and could be run in larger sections as well.

Simulation Structure

Unit 1: Supply, Demand and Equilibrium

The basic setup of the simulation is simple. A small number of students (5-8) volunteer to be CEOs and are given an initial amount of money in their "company account" ($100) and taught how to keep records in a Google docs spreadsheet.[2] CEOs are expected to bring a laptop to each simulation and enter their records into the class spreadsheet, which helps the instructor aggregate class data. Each CEO must decide initially if they will produce food or non-food products. All products are imaginary, but if they are a "food" producer, they have to advertise something edible (and the reverse for "non-food" producers). The rest of the students are workers. The simulation begins with a labor market. The CEOs use their initial money to hire workers. They get five "products" per worker, so every worker is equally productive. The actual activity is for the CEOs and workers together to come up with a product and advertise it on the board. This takes 30-40 minutes the first time it is done, but usually goes much faster in subsequent periods. Once all companies have finished hiring and completed their ads the "work day" is over and all workers are instructed to sit down.

The next step is the product market. Each worker has an index card on which their CEO marked their wage; this card works as their "debit card" for simulation (no cash is used). They can spend their money at any company. Workers go shopping and buy any of the available products in the market. CEOs continue to keep records, now recording sales in their spreadsheets. Workers are required to purchase at least three food products to be able to work in the next period. This requirement makes food products a necessity and leads to a much higher initial demand for food products over non-food products. After all the workers have finished buying products the simulation day is over.

The simulation economy thus consists of three markets – food products, non-food products and labor - and the instructor can track and discuss each market with the students using supply and demand tools. Typically the food market has high demand and either clears or has a shortage initially. Some CEOs are very aware during the simulation and raise prices accordingly if there is a shortage; others do not change prices until the next round. In either case, the students can identify that there is strong demand and that prices are likely to increase. The non-food market tends to start very slowly with prices much too high and very little demand. The non-food CEOs invariably lose money on the first day and have to subsequently make large adjustments. Here the students are asked to identify the surplus of non-food products in the market and predict that the price of non-food products will drop. Non-food companies are able to carry over their excess inventory to the next period; excess food inventory is lost (the instructor "perishes" it after each simulation).

[2] See https://sites.google.com/a/cornell.edu/alan-green/online-eg-online-game-stuff for a spreadsheet template. Spreadsheets from Spring 2013 simulations are also available at https://docs.google.com/spreadsheet/pub?key=0AkZn_TiA49l9dHZhd3R4aURtOWF3V1FOZFlZT3M3RkE&single=true&gid=8&output=html and https://docs.google.com/spreadsheet/pub?key=0AkZn_TiA49l9dGhzcERpYWU3elJkQW1sWlFsVG1WUlE&single=true&gid=8&output=html

The differences in food and non-food markets are stark and provide good material for discussion and analysis with the students. Non-food producers and workers often complain of the low demand and even ask their congress to require people to buy non-food products. Food markets, on the other hand, find it easy to sell with high demand but are often subject to fierce competition. The result is one market, non-food, where CEOs must be creative and effective marketers to sell at all and another, food, where the marketing is mostly irrelevant and success comes from keeping costs and prices low. Workers very quickly find the cheapest three food products they can and purchase them, regardless of how they are marketed.

The initial labor market usually has a wide range of wages even though all workers are equally productive, which is very interesting to examine with the students. In the first simulation different CEOs simply start at different wage levels and workers do not always go to the company that pays the most. Subsequently, food companies have more success and thus pay higher wages, whereas the non-food companies struggle and have to lay off workers and/or lower wages. Despite these trends, workers at non-food companies are sometimes hesitant to switch jobs as aggressively as one might expect. This leads to a discussion of frictions in labor markets and also how CEOs and workers should adjust.

The setup of the markets in this simulation is more open-ended than in most classroom experiments. In many supply/demand experiments, for example, students are given reservation prices and minimum sale prices by the instructor. The instructor then "predicts" the equilibrium that the students inevitably find, which exemplifies the model. While useful, the deterministic nature of these experiments can lead to a sense of them being "rigged" by the instructor. For this simulation, the instructor only sets the initial money supply by giving money to firms and workers at the beginning of simulation. Students then find equilibrium on their own, and different class sections have different price levels. It may take several periods to find an equilibrium, especially if there are adjustments made before it is reached. However, this type of market adjustment is more realistic for the students. It also allows for a more practical use of the supply/demand model. Students are asked to focus on how markets move towards equilibrium and to identify what sort of pressure is put on market participants by surpluses and shortages.

The first and second simulations (and sometimes the third) are useful for considering how supply and demand work and also for illustrating the circular flow of the economy, which is easily shown with the labor and product markets in simulation. Usually the economy settles into an equilibrium after two or three periods, but occasionally it takes longer if the CEOs over-adjust. CEOs are allowed to shift their companies from non-food production to food production, but they must pay a cost of transition (set at $10). In one case, after the non-food market was weak on the first day every CEO switched to food production, which led to oversupply of food and a relative shortage of non-food products.

The next step in simulation is to introduce government. Students elect a class congress of either 3, 5 or 7 people (depending on the size of the class and how many candidates there are). Elections can be done in class or on online; a petition with five signatures on it is required for a candidate to get on the ballot. Initially, congress has no money and is not allowed to print money (although that can change later on). The class congress has broad regulatory and taxing authority; the challenge is for the students to use it effectively. Students are presented with a simple class constitution (see appendix) to lay the groundwork for congress. It provides for equal protection (no laws targeting specific individuals or companies), outlines the class "real estate" (chalk boards, dry erase boards, projectors, chairs and desks) and clarifies that congress cannot pass laws that affect class grades. Congress completes the basic setup of a market economy with a government so that students can then consider what policies they need to put into place.

Within this basic framework, additional opportunities related to concepts covered in class are introduced; other class concepts are reinforced by applying them to simulation (e.g. measuring class GDP and unemployment). The Google Docs spreadsheet keeps the company data in one place where the instructor can aggregate it and use it for assignments. The following units denote additional concepts that can be incorporated into simulation. Instructors have plenty of flexibility to incorporate some units and not others or to add their own.

Unit 2: Price Controls and Taxes

The first policies congress considers are typically the ones discussed early on with the supply / demand framework: price controls and taxes. The class congress does not usually hesitate to try different things. Minimum wages are common; interestingly, if the minimum wage is the only policy it may move the labor market towards equal pay by becoming the wage for every worker. It can then effectively set the price level for the entire economy because CEOs realize that workers must make enough money to eat. However, minimum wages are often used with price controls, usually on food products, which can sometimes be problematic. In one instance, congress put a minimum wage at $7.50 and a price ceiling on food products of $1.00, which meant that food companies were necessarily losing at least $2.50 on every worker (the congress adjusted their price controls after some class debate and discussion with the instructor). Students are often quick to implement price controls despite being lectured on their inefficiency; however, the simulation experience then can drive home what the lecture sometimes does not.

Class governments can tax, and they have tried both sales taxes and corporate income taxes with some success. They also have the power to confiscate class real estate and then charge for use. They typically are successful at raising some revenues and most commonly they use the money to help those who are unemployed and to give themselves a wage for being in congress. This unit helps the class congress gain confidence in their role and also lends itself to discussion and assignments on government intervention in markets (see appendix for assignments from each unit).

Unit 3: Unemployment

The biggest problem the congress usually faces is unemployment. Initially there is often a shortage of food, so congress' first task is to try to increase food production. This presents an opportunity to discuss with students the merits of direct government intervention versus letting the market correct itself. The latter often happens while the discussion is still underway. However, the economy can also end up with a long term unemployment problem, especially if there is an over adjustment to the initial food shortage. This results in oversupply of food and a somewhat harsh lesson on the nature of competition. The firms then lose money and either cut wages or let workers go. Workers for their part tend to only buy food and nothing else, which lends itself to an introduction to the concept of aggregate demand. Students and/or class congress can be charged with measuring unemployment (which is complicated due to absences) and then finding effective policies to address it. Some form of unemployment insurance is commonly introduced in class congress, and most classes return to something close to full employment fairly quickly.

Unit 4: Measuring GDP

The simulation lends itself well to measurement of nominal and real GDP with both income and expenditure approaches. The instructor can use the class economy to show how GDP is measured and the differences between real and nominal GDP. Since prices take a few periods to come to equilibrium, nominal GDP is highly volatile in the beginning of the simulation, while real GDP should be flat since all workers are equally productive. However, there are usually some complicating factors such as unemployment that do lead to fluctuations in real GDP. The data is easy to aggregate from the spreadsheet, and the instructor can make it available to all students and assign them with the task of measuring class GDP. It is informative for the students to see the fluctuations in nominal GDP and then identify if the class economy has actually been growing or shrinking dramatically. This discussion helps facilitate the explanation of real GDP, which is sometimes difficult for students to grasp.

Unit 5: Productivity and Economic Growth

The discussion of real GDP leads to economic growth. The simulation economy initially has a clear maximum level of production (5 products per worker) and the economy cannot actually grow. It is helpful to have students draw a food / non-food production possibilities frontier for the class showing this maximum level of production. The instructor can subsequently introduce investment in "physical" and "human" capital to exemplify productivity increases and real economic growth. There are many options for

allowing investment; technology can be simulated with a roll of the dice that costs some amount of money. CEOs can invest in it and if they are lucky increase productivity for all of their workers. Physical capital can be sold by the instructor or the instructor can create a capital market and allow the students to produce and sell it to firms.

Human capital can be introduced through worksheets that provide another opportunity for students to practice economic models and concepts. The instructor can make available "bachelor's degree," "master's degree" and "doctoral" worksheets that students can complete. If they are successful, they are labeled as educated and become more productive. For example, a worker with a bachelor's degree produces 7 items each day and one with a master's produces 9. This option also changes the labor market since more productive workers should earn higher wages.

Unit 6: Poverty and Inequality

There can be poverty in the simulation. A worker who misses a day or does not eat due to a shortage of food cannot work in the next period. If they have no money, they can potentially become trapped in poverty and unemployment. These workers usually complain effectively to their members of congress, who look for some way to help them either with cash or by directly giving them food so they can subsequently work. There are not typically long-term problems with poverty, but it is a good problem for the congress to address. Students can be asked to determine a class poverty line (the cost of three food items works well) and then count the number of people below it.

Inequality is easy to measure in the simulation and is usually quite low. The instructor can discuss the "natural" level of inequality, which is effectively zero at the beginning of the simulation since all workers are initially equally productive. It is also fairly easy to graph a Lorenz curve for the class from the spreadsheet data. Inequality that is present can then be discussed in terms of fairness. Usually workers at successful companies are paid more even though they produce at the same level as workers at less successful firms. This problem is also a good one for congress to wrestle with. If human capital is introduced inequality should exist in the class economy, which also can be discussed. Once again, the instructor has a range of options from showing the students inequality and discussing it or having them measure it themselves with the simulation data.

Unit 7: Banking, the Money Supply and Inflation

Since the simulation is repeated, usually every week, it is possible to introduce banks. Students can start banks by simply accepting deposits and keeping records; they can then make loans to other students who may want to start a business or to companies looking for money to invest. Interest can be earned from week to week. Typically some students are willing to start banks, but the margins are relatively small and the banking sector tends to stay small as well. It is possible, however, that banks may have an impact on the simulation money supply.

The initial money supply is set by the instructor at the beginning of simulation. The simulation starts with CEOs having some money. Giving workers an initial amount (usually $10) makes the initial few periods run more smoothly by giving them resources to buy food if they make a low wage or miss a day, which is good and bad. It helps them get more comfortable, but it also is beneficial sometimes for them to deal with major unemployment problems. The overall price level is determined in the market and/or through government controls. Inflation can be measured easily and should not be large initially. The students can be asked to define a reasonable "basket" of goods to form the class CPI, which is calculated from spreadsheet data. The instructor then has the option of giving congress the power to "print" money by simply declaring that they have it. Given that power, congress tends to use it and start giving money to firms and/or individuals. These events lend themselves well to a discussion of fiscal stimulus and the money supply. Somewhat surprisingly, inflation is rare in the class economy even with significant increases in the money supply. The form of the stimulus seems to be the determining factor. Money given to firms tends to be much less inflationary – they may gradually raise wages but have a hard time raising prices if

people don't have the money to spend. High inflation has been experienced when the government gave everyone a large amount of money.

Unit 8: International Trade

If there are multiple sections of the same class running simulations, the instructor(s) can allow for "international" trade between them. Since different sections have different price levels, CEOs can be given the opportunity to "export" by setting aside a certain number of products and naming the minimum price they will accept. The instructor can take this information to another section and offer individuals the opportunity to act as brokers and sell the "imports." The brokers can profit by selling the products for any price above the minimum and some have been quite successful. The class congress can, of course, impose tariffs as well. Even with a single class section, the instructor could offer the opportunity to import or export at different prices than those prevailing in the class economy. Students can then be asked to show the gains from trade in terms of production and consumption possibilities for the economy. A possible extension would be to allow for different "currencies" between sections as well.

Unit 9: Macroeconomic Shocks

There are several ways the instructor can provide shocks to the class economy; perhaps the most straightforward is simply to declare that a financial crisis has destroyed all of the workers' wealth. Students save money on their index cards; the instructor can simply declare that it is all gone. Congress is then asked to respond and the ensuing discussion should incorporate possible Neoclassical and Keynesian responses to such a shock. With the class congress having the ability to print money, they have broad fiscal and monetary stimulus measures available. The impact of any response on GDP and inflation is informative. For example, in Spring 2013 two sections experienced a financial crisis. One congress opted to let the economy adjust on its own while the other chose a dramatic intervention by increasing the money supply by even more than what was lost due to the crisis. A comparison of the results provided excellent assignments and discussion for both classes. The first section experienced a recession and deflation while the second class had very high growth and massive inflation.

Additional Units

This simulation was originally used in a macroeconomic principles class, hence the focus on macro concepts. However, one could easily incorporate micro concepts as well through a more complex production process that includes fixed and variable costs and through experimentation with different market structures (for instance monopolies could be introduced and regulated in the simulation). The basic setup is designed to be simple and flexible so other concepts are easy to add and instructors and use only the units they find helpful.

Reflections on Simulation

The benefits of the simulation are that it gives students another way to approach economics. It allows for more experiential learning and forces the students to make economic and policy decisions and then face the consequences. At its best, the simulation gets students who otherwise would not be active in economics class to take an active role either in congress or as a CEO and thus wrestle with economic issues that they might otherwise ignore. It also helps students directly understand class concepts; they tend to understand price controls and monetary policy better once they have created mass unemployment or widespread inflation through poor policies. Students also enjoy the opportunity to do an activity and be creative in the classroom. For these reasons the simulation is a worthwhile addition to macro principles courses.

This simulation, like many experiments, improves with practice and implementation. The instructor may need to consider various incentives to motivate students; either grade them on simulation itself or offer extra credit points for simulation success or both. Simulation homework assignments are also excellent tools for helping students link the simulation with class concepts. These can be written

assignments or added to an online homework platform. The class spreadsheets can be published to the web and referenced for assignments as well. Congress can also be tasked with addressing problems of motivation and attendance and may be more effective at convincing their classmates to come.

The preparation time required for instructors is similar to what is required for most experiments. This simulation may require more work for the initial period, especially in getting the CEOs ready to use the class spreadsheet. However, subsequent periods typically take less preparation than most experiments since the basic rules and structure are already established. The simulation can be used for anywhere from three to ten class periods. I have used it typically once per week except for weeks that include a break or an exam. There is clearly a significant opportunity cost of using 8-10 class periods. I think that cost is similar to the cost of using experiments; the instructor sacrifices breadth of coverage for more depth and deeper learning of core concepts.

The simulation has been used in macro principles classes ranging from 30-70 students at Lander University, which is a small public teaching university of just under 3,000 students. With smaller classes it is easier for everyone to take on more roles than just being a worker. However, the markets may be less competitive and the economy has more problems if students, particularly CEOs or members of congress, are absent on simulation days. The classes of 60-70 tend to run more smoothly on the whole but some students may become disengaged if they do not have a role beyond being a worker. I have found that the simulation works best with 35-40 students.

The simulation ends with a time for reflection and assessment. Assessments can range from group sessions to individual writing assignments that ask students to reflect on simulation and also show what they have learned. Students on the whole are positive about the experience and the ones that invest heavily in it naturally seem to get the most out of it. Survey results indicate that they enjoy simulation and a majority felt that it was beneficial educationally and the best use of class time. Anecdotal evidence from students is positive as well.[3] After using this simulation for several years older students would often comment about what it was like when they had simulation. It stood out to them as a memorable experience in class.

Conclusion

This simulation gives students another perspective on economics and hopefully increases both their interest in and their understanding of the concepts covered in class. The simulation has continued to evolve since its beginnings, but the overall goal is still the same: to use it as an experiential learning tool. It is broader and less deterministic than most classroom experiments, which offers a more realistic experience for students where their economic decisions have clear effects. Many students who may not be as strong academically are willing to get involved in simulation and thus learn more from the class. However, simulation is not remedial economics. It has a basic setup that is very simple but also true to basic economic principles; a creative and committed instructor can do many things within that setup.

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[3]The following quote (which came unprompted from a student via email) is a good example: "I really enjoy simulation days and I'm fairly sure everyone else in class does too. I always find myself wishing that simulation class days lasted longer than 1 hour, because it seems impossible for our classroom economy to work out the kinks or reach an equilibrium in one hour, but that's how much I enjoy simulation days. Even though economy is still a mysterious balancing act to me, I have fun pretending we have another life and I feel like I'm learning a lot from it. I'm anticipating the ways the government can fix the food shortages and unemployment rate. If I do get voted into that government, I hope I can come to you with ideas and issues…"

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Appendix: Instructions and Assignments for a 10-period class simulation

Following are instructions, a schedule and assignments for a 10 period class simulation with the units discussed in the text. Assignments are listed with each unit, but instructors should use them as they see fit. For example, I have used some assignments for human capital worksheets in the past. Instructors should also feel free to change, drop or add other units as they see fit.

Instructor:

1. Go to https://sites.google.com/a/cornell.edu/alan-green/online-eg-online-game-stuff and follow the link to the Simulation spreadsheet. Click on "File," "Make a Copy" to copy the Spreadsheet for your class.
2. Determine how many companies you will start out with. I recommend at least 4 and roughly one for every 10 students. The spreadsheet is set up for 8 companies; you can ignore the sheets you do not need, but I recommend not deleting them in case you have students start companies later on. You will need to identify your initial CEOs and give them instructions. Before the first class they should set up a Gmail account so that you can give them access to the spreadsheet. Once you have done so, I would recommend locking each firm's sheet so that only the CEO can edit it. You may also want lock the economy and government sheets.
3. Prepare for the first simulation. Your CEOs will need laptops with working internet access. You will need to bring index cards for everyone to keep track of wages and purchases. I would recommend giving the CEOs written instructions but not the workers. You can just read the instructions to them before you start. Following are instructions for workers and CEOs and a suggested schedule with eight units covering concepts that can be introduced in simulation along with assignments.

Instructions for workers before first labor market: (to be read by instructor)

You are a worker in our class economy. Your first task is to find a job. You can seek employment at any firm; it is up to you and the CEO to agree on a wage for each simulation day. Your CEO will mark your wage on your index card. You each produce five imaginary products for your company. The actual work you will be doing is deciding what to call your "products" and advertising them. The only rule is that food producers must advertise edible products and non-food producers must advertise inedible products.

You can only have one job per simulation day, but you are free to quit your job any day and seek employment at another company, especially if you think your wage is unfair. I will call an end to the "work day" once all ads are completed.

Instructions for workers before the first product market: (to be read by instructor)

The work day is over and now it is time to go shopping! You can spend any money that you have on your index card at any company. There is one important rule to remember: you must consume at least 3 food items to be able to work in the next simulation day. Also remember that you are under no obligation to shop where you work.

C*EO Instructions*

Congratulations, you are now the manager of your own company! You will be given $100.00 initially. You will use this money to hire workers. Each worker you hire produces five imaginary products. Your task (along with your workers) is to decide what your "products" are and advertise them on the board. You will then sell them to your classmates. Your objective is to make profits through effective advertising and sales. Products can be anything; the only distinction is between food and non-food products. You must decide initially if you are a food producer or a non-food producer (you can switch later at a cost of $10). If you choose food, you must advertise edible products. Workers are required to eat, but any excess food perishes at the end of the simulation day. If you choose non-food, you must advertise inedible products. Non-food inventory can be carried over from day to day.

You will use a laptop computer to keep your records in the class economy Google Docs Spreadsheet. Your instructor will share the spreadsheet with you through your Gmail account. For each labor market, you should record the names of your workers, their wages, and 5 products for each of them. Be sure to record them again separately for every day; do not ever delete records from your spreadsheet. You re-hire workers every day and you are free to fire them whenever you like. You can list yourself as a worker as well. Wages are automatically subtracted from your cash flow, which is shown at the top right side of the screen. Your cash flow cannot be negative, so negotiate wages accordingly. Production is automatically added to your inventory so you can see how many products you have to sell.

During each product market, you will need to record sales. Enter the buyer, the number of items bought and the total amount spent for each sale. The number sold will automatically subtract from your inventory and the amount spent will add to your cash. Be sure to never directly change the cash flow or inventory cells in the spreadsheet as this will delete the formula. The spreadsheet will save automatically, so simply enter in all your data and log out when you are through.

Remember, your goal is to make profit. Be creative with your ads and have fun!

Suggested Simulation Schedule (11 days total)

Day	1	2	3	4	5
Unit	Unit 1	Unit 1	Unit 2	Unit 3	Unit 4
To do:	Setup Spreadsheet and share with CEOS	Petitions for Congress, election	Read/Post Class Constitution	Allow new businesses to start	Allow Banks to start
Assignment		Markets – shortages, surpluses and equilibrium	Markets – Price ceilings and floors, taxes	Measuring unemployment	Measuring GDP

6	7	8	9	10	11
Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Reflect
Allow Investment in Capital and Technology	Allow Congress to change money supply	Allow International Trade			Discuss Reflection
PPF and Growth	Measuring Poverty and Inequality	Measuring Inflation and Money Supply	Gains from Trade	Response to Crisis	

Unit 1: Supply and Demand: markets, surpluses and shortages, labor market frictions and searches

I suggest two days for this initial unit to get students comfortable in simulation. You can discuss with them the simulation markets and what is happening. Hopefully all three markets are moving towards equilibrium. On the second day, have students fill out petitions (5 signatures required) if they want to run for class congress. You also need to decide if you want a 3 or 5 person congress.

Assignment for Unit 1:

a. Using the supply / demand model, graph the food market below. Where was the initial price level in this market in simulation? Draw this on the graph. Did the market initially clear (meaning no shortage or surplus)? If not, was there a shortage or a surplus? What adjustments were made in subsequent simulations and what happened in the market?
b. Using the supply / demand model, graph the labor market below and show the predicted equilibrium wage. Does everyone in simulation earn the same wage? Why or why not? If not, what do you think prevents this market from moving to equilibrium?
c. Using the supply / demand model, graph the non-food market below. Where was the initial price in this market? Did the market clear? If not, what was the situation? What were the subsequent adjustments and where is this market today?

Unit 2: Government: elections, taxes, price ceilings and floors.

Class constitution:

a. Any law passed must be clearly written. The Professor will keep records of all passed legislation and make them available to the class.
b. Laws will be passed by a simple majority vote.
c. Congress may not pass laws that target any individual, any one business or any single product. Laws may target workers, businesses or classes of products.
d. Initially, the government has no revenue and members of congress serve on a volunteer basis.

e. The government may tax and / or subsidize workers, businesses or classes of products. The government may also confiscate real estate and then sell it or rent it. Real estate in the classroom includes all seats, the chalkboard, the table and the projector.
f. Congress will be given access to the class spreadsheet and must keep records of all revenues and expenditures there.
g. The Instructor will help with enforcement of laws when possible, but congress may need to consult with the Instructor about the enforcement of proposed laws.
h. The Instructor retains all grading authority; therefore any laws that affect grades are subject to veto.

Assignment for Unit 2:

I recommend tailoring this assignment to specifically assess whatever it is the class congress decides to do. If they put in a minimum wage, for example, students should be asked to predict the impact using the supply/demand model.

Unit 3: Unemployment

On this day tell students that they are free to start their own businesses if they are interested. They will have to put in their own money as initial cash and choose either food or non-food production. Remind them of this periodically throughout the rest of the simulation.

Simulations have varying degrees of unemployment problems. At the very least, some workers will miss class one day and thus be unable to work the next day. Discuss with them whether such a person counts as "unemployed" or not.

Assignment for Unit 3:

Give the students access to the spreadsheet data (share it on the web in view only mode) and ask them, possibly in groups, to define and measure unemployment in the class economy and then to propose policies that might alleviate it.

Unit 4: GDP – expenditure and income approaches, measuring real GDP

On this day tell students that they have the option of starting a bank if they are interested. They simply need to take deposits and negotiate any interest offered. They then can make loans to other students or to companies. Clear records of deposits and loans should be kept. I usually have not covered banking at this point in the course, but introducing it in simulation here gives it time to develop and thus facilitates discussion later on.

Assignment for Unit 4:

Using the "economy" sheet on the Simulation Spreadsheet, calculate the following:

a. Nominal GDP by expenditures for each simulation day
b. Nominal GDP by income for each simulation day
c. Real GDP for each simulation day (using day 3 as the base)

Unit 5: Productivity and Growth: physical and human capital, investment in technology

On this day the following options are available:

a. Companies may invest in technology. For $5, the CEO may role a six-sided die (provided by the instructor). A one or a two indicates success, which increases the production of every worker at the firm by one.
b. Physical capital can be formed from non-food products. Any company can convert 5 non-food products into a machine. A machine, when coupled with a worker, provides 2 extra products.

c. Workers can get further education as an investment in their own human capital. The instructor will provide worksheets for Bachelor's, Master's and Doctoral Degrees. Successful completion of the worksheets leads to greater productivity. A worker who has completed the Bachelor's worksheet produces 7 items; a worker with a Master's degree produces 9 items and a worker with a Doctoral degree produces 11 items.

I have used the Unit 1 assignment for the Bachelor's worksheet and the Unit 5 assignment for the Master's worksheet. The Doctoral Sheet is below.

Doctoral Worksheet

Earning a Doctoral degree requires research. Your task is to pick a research question having to do with the class economy, gathering evidence/data that is relevant to it, applying economic theory to it and then giving your best answer. Good luck.

Unit 5 Assignment:

The class economy has a set number of workers and these workers can initially produce either 5 food or 5 non-food products. If there are 40 workers, draw the PPF for the class with food and non-food products.

1. Where was the economy initially in terms of the PPF?
2. For 40 workers, how much food needs to be produced for them all to eat each day?
3. What happens (in terms of the model) if food production is less than this number and some workers cannot eat? Where will production be in the next period?
4. Plot three points: an initial level of production with not enough food, a secondary point where some workers cannot work due to starvation and a third point where the economy goes next.
5. Is the economy at full employment? How is this shown on the PPF?
6. Some workers are now becoming educated and more productive, how will this be shown in the PPF? What effect will it have on real GDP?

Unit 6: Poverty and Inequality

On this day, inform congress that they now have the power to "print" money and encourage them to use it wisely. They will inevitably print some, which will give you something to discuss when you get to the money supply and inflation next week.

Poverty is possible in the simulation but usually rare. Inequality is somewhat more common, usually due to shortcomings in the labor market. I distinguish between "natural" inequality, which stems from productivity differences, and other inequality that comes about due to a number of causes ranging from bad luck to outright discrimination.

Unit 6 assignment:

a. Determine a poverty line for the class economy. Remember that poverty is defined as the inability to afford basic necessities. Once the line is determined, use the spreadsheet data to determine the percentage of workers in poverty for each simulation day.
b. Using spreadsheet data on wages, plot Lorenz curves for each simulation day. Is there inequality in the class economy? Is it natural inequality? What do you think should be done about it?

Unit 7: Banking, the Money Supply and Inflation

On this day allow for international trade either by allowing exports to another section of the same class or by offering imports and exports at prices different than those prevailing in the class economy. Once again this sets up the discussion of trade for next week.

Hopefully some students took the initiative to start banks. If not, encourage them again to do so. Discuss how banks and congress can impact the money supply and ask the students if they think there has been an inflation problem in the class economy.

Unit 7 assignment:

a. Determine a "basket of goods" that the average worker consumes on an average simulation day.
b. Determine the cost of this basket on each simulation day.
c. Construct a CPI for the class economy.
d. Determine the inflation rate for each simulation day.
e. Is there a problem with inflation? Why or why not? If so, what should congress do about it?

Unit 8: International Trade

Discuss any experience the class has had with international trade. Has it been good or bad for the class economy? What are the perspectives of the CEOs? The workers?

Unit 8 assignment

a. Draw a PPF for the class economy with food products on the horizontal axis and non-food products on the vertical axis, assuming that each worker can produce 5 products.
b. What is the average price ratio of the price of food products to the price of non-food products in the class economy? (use spreadsheet data if needed)
c. Suppose there is another class with the same number of workers but that each worker there can produce either 2.5 non-food products or 10 food products. Draw their PPF.
d. Is the price ratio of food to non-food products for this other class likely to be higher or lower than our class? Why?
e. Given the difference in price ratios, what might we want to export to and import from the other class?
f. What would happen to total consumption in our economy if we import and export as suggested in the previous question?
g. Do you think class congress should restrict trade? Why or why not?

Unit 9: Macroeconomic Shocks

Write "financial crisis" on the board before class. Tell the students that all of their savings are gone, meaning that they have no money on their cards. They can still work if they ate last period and the companies still have money, but any savings are gone. Congress should then meet and discuss options for fiscal and monetary policy and then choose a course of action.

Unit 9 assignment:

Refer to the class spreadsheet to answer the following questions.

1. What happened after the financial crisis and the class congress' response?
   a. A severe recession and deflation.
   b. A recession with fairly stable prices.
   c. A stable economy: moderate growth and steady prices.
   d. Moderate growth with high inflation.
   e. Strong growth with low inflation.
   f. High growth and high inflation.
2. How effective was the class congress' response to the crisis?
   a. Ineffective. They failed to prevent a recession.
   b. Highly effective. They avoided a severe downturn while maintaining stable prices.
   c. Too effective. They over-stimulated the economy, resulting in high inflation.

3. Does there seem to be a tradeoff between inflation and unemployment / growth in the class economy?
   a. Yes, high inflation was present along with high growth and low inflation occurred when growth was low or negative.
   b. There was not evidence of a clear tradeoff.
   c. There was only clear evidence of a tradeoff on day 8.
4. Was there a link between the money supply and inflation in the class economy?
   a. Yes, when the money supply increased inflation followed every time.
   b. There was no clear link. Prices fluctuated without much change in the money supply.
   c. Small changes in the money supply did not seem to impact prices, but large changes did lead to inflation.
5. What best explains the link (or lack thereof) between the money supply and inflation in the simulation economies?
   a. Every time the money supply was increased inflation followed because there was more money circulating.
   b. Most of the small increases in the money supply were not directly circulated; people seemed to save the money so it did not impact prices (the multiplier effect was very small).
   c. The multiplier effect was large because the economies were nearly always at full capacity.

Reflection

As the simulation comes to a close it is important to have students reflect on their experience. I have put them in groups by role (congress, CEO or worker) and had them answer the following questions. Students that had more than one role can choose which group to join. I then use their responses to facilitate a class discussion about the simulation experience.

Class Congress Group Assignment:

1. What were the main problems you felt that congress had to deal with in the class economy?
2. What were the main difficulties in dealing with these problems?
3. Could you relate the problems you faced in congress to concepts you learned in class?
4. Please specifically discuss the following issues in detail: describe the extent of the problem, what you did about and how effective your policies were.
   a. Unemployment.
   b. Managing the Money Supply
   c. Any other policies you implemented that were not discussed in detail in class.
5. What do you think were the best and worst parts of the simulation?

CEO's group assignment:

1. Discuss the labor market and wages:
   a. How did you initially set your wages? Were they too high or too low?
   b. The supply and demand model says that wages should equalize across all companies since all workers in the class economy are equally productive. Did this happen? Why or why not? Specifically, why did some of you pay higher wages and some lower wages?
   c. To what degree did you see workers comparing wages and quitting if the wage was too low?
   d. Did you support a minimum wage? Why or why not?
2. Pricing strategies:
   a. How did you decide what prices to charge on the first day? On subsequent days? How much flexibility did you have in setting your own price?
   b. How difficult was it to be profitable? What would you do differently if you were starting over today?
3. The role of government:

a. What did you think of your class congress? Were their policies helpful or harmful to your business? Do you think they acted appropriately or not?
b. What do you think were the best and worst parts of the simulation?

Worker's group assignment:

1. Circular Flow
    a. How does the simulation illustrate the circular flow of an economy?
    b. How did the events in one market, non-food products for example, impact other markets like the labor and food markets?
2. Employment
    a. How difficult was it to find and keep a job? What did you do if you found yourself unemployed? How helpful was the class congress?
    b. Do you think you earned a fair wage? Each of you produced 5 products per day and had to consume at least 3, so in theory you should earn at least enough money to buy 3 products but no more than enough money to buy 5 products. Was this true? Were your wages closer to the cost of 3 products or 5 products?
    c. Did you feel like you could negotiate with your CEO over wages? Were you willing to quit your job if the wages were too low? Why or why not?
3. Congress
    a. Did you feel that congress represented your interests well?
    b. Was your congress effective in addressing problems in the economy? Why or why not?
    c. Did elections work to keep congress accountable for their decisions?
4. Economic Growth
    a. Did the economy grow steadily? Why or why not? How was growth measured in the class economy? Did this help you to understand class concepts?
5. Inflation
    a. Did the economy experience inflation? Why or why not? How was inflation measured in the class economy? Did this help you to understand class concepts?
6. What were the best and worst parts of the class simulation?