Volume 14   SUMMER, 2015   Number 1

Academy of Economics and Finance

Portfolio Performance Evaluation Benchmark: A Note

Adam Y.C. Lei and Huihua Li[1]

ABSTRACT

Jones and Swaleheen (2014, this journal) examine the performance of an equity portfolio in a student managed investment fund and document the outperformance of the portfolio relative to the S&P 500 index on an absolute basis. We show that the apparent outperformance of the portfolio is due to using the index without its dividend component. Once we use the S&P 500 total return as the benchmark, the outperformance of the equity portfolio disappears. We explain why the S&P 500 total return should be used in this case, and propose and justify two alternative proxies for the S&P 500 total return.

Introduction

Jones and Swaleheen (2014, this journal) examine the actual performance of an equity portfolio in a student managed investment fund from January 2005 to April 2013, using the return of the S&P 500 index as the performance benchmark. While they find mixed evidence on the outperformance of the portfolio relative to the benchmark on a risk-adjusted basis (by the Sharpe ratio and the portfolio alpha), they find the outperformance of the portfolio on an absolute basis. Specifically, they report that the portfolio earns the cumulative return of 53.60% with an annualized return standard deviation of 13.41% from January 2005 to April 2013. The S&P 500 index, on the other hand, earns the cumulative return of 31.82% with an annualized return standard deviation of 15.58% over the same period. The higher cumulative return and the lower return standard deviation of the portfolio relative to those of the S&P 500 index, if true, would indeed suggest that the portfolio outperforms its benchmark in absolute terms.

In this note we show that the equity portfolio examined in Jones and Swaleheen (2014) does not outperform its benchmark in absolute terms. The detailed information provided in Jones and Swaleheen (2014) allows us to trace the documented outperformance to the use of the performance benchmark without its dividend component. Specifically, although "dividends and interest (on cash in the fund) is included in the returns" for the portfolio in Jones and Swaleheen (2014, p. 60), we verify that the return of the S&P 500 index used as the benchmark is without dividends. Once we use the appropriate S&P 500 total return, which includes the return from dividends, as the performance benchmark, the outperformance of the equity portfolio disappears: The S&P 500 total return index earns the cumulative return of 56.90% with an annualized return standard deviation of 15.57% from January 2005 to April 2013. The equity portfolio therefore has a lower cumulative return and a lower return standard deviation than those of the appropriate benchmark over the entire period.

Given the availability of the data on the S&P 500 total return index, we also propose and examine two alternative proxies for the S&P 500 total return: The total return of the SPDR S&P 500 ETF Trust (symbol: SPY) and the total return of the iShares Core S&P 500 ETF (symbol: IVV). Both SPY and IVV attempt to replicate/track the performance of the S&P 500 index and have high levels of liquidity. Our analyses suggest that the total returns of SPY and IVV are reasonable proxies for the S&P 500 total return: Their monthly returns and return variance are statistically identical to those of the S&P 500 total return from

January 2005 to April 2013 and for longer periods. We also show that the effect of ignoring the dividends in the benchmark return lies largely on benchmark return level instead of its return variance. Assuming the return variance as a risk measure, this finding suggests that potential biases of using a benchmark without its dividend component likely come from the underestimation of the benchmark return rather than the under- or overestimation of the benchmark risk.

The rest of this note is organized as follows: In the following section we review the relevant standards in portfolio performance reporting and evaluation, and explain why the total return of the performance benchmark should be used. We provide the details on the S&P 500 total return index and introduce the two alternatives next. We then illustrate our data and methods, followed by our empirical results. We conclude in the last section. The appendix provides the institutional details on the SPDR S&P 500 ETF Trust and the iShares Core S&P 500 ETF.

Portfolio Performance Reporting and Evaluation

Under SEC Rule 205-1 (promulgated under the Investment Advisers Act of 1940), both the investment performance of an investment company and the investment record of an appropriate index of securities prices should be defined on a total return basis, for which the total return includes both capital gains (losses) and cash distributions. In the widely followed Global Investment Performance Standards of the CFA Institute (2010), Provision 2.A.1 on the requirements of calculation methodology specifies that "TOTAL RETURN MUST be used" (capital letters as in the original provision). Provision 5.A.1.e on the requirements of presentation and reporting specifies that "the TOTAL RETURN for the BENCHMARK for each annual period" "MUST be presented in each COMPLIANT PRESENTATION." In addition, "the BENCHMARK MUST reflect the investment mandate, objective, or strategy of the COMPOSITE." In this case the composite is defined as "an aggregation of one or more portfolios managed according to a similar investment mandate, objective, or strategy."

Following those standards, the performance evaluation benchmark for a portfolio not only should be appropriate to the specific portfolio (see, e.g., Reily and Brown, 2012, p.992 for the characteristics of an appropriate benchmark), but also should include returns from both capital gains (losses) and cash distributions. In the case of an equity portfolio, the return of the benchmark should include both capital gains (losses) and dividends. The rationale for using the total return of the benchmark is intuitive: As the return of a portfolio being evaluated commonly includes both capital gains (losses) and cash distributions, the benchmark return should also include both components to provide a fair evaluation. In addition, Constable (2011) shows that cumulative returns that reflect only capital gains (losses) but not dividends are often misleading. Zewig (2011), nonetheless, reports several instances in which the S&P 500 index return without dividends is incorrectly used as the performance benchmark in practice.

S&P 500 Total Return Index and Alternatives

The S&P 500 index (Bloomberg symbol: SPX) is a market value-weighted stock index of 500 large-capitalization firms in the U.S., provided by S&P Dow Jones Indices LLC. As of June 30, 2004, the market capitalization of the constituents ranges from $3.77 billion to $560.34 billion, with a median (mean) of $18.11 ($36.81) billion (S&P Dow Jones Indices LLC, 2014). This index is widely circulated and often cited as a portfolio performance evaluation benchmark because of its large coverage of the total U.S. market value. However, the S&P 500 index is a price index and not a total return index: A return calculated from the change of the index level reflects only the return of the index constituents from capital gains (losses) but not from dividends.

The S&P 500 total return index (Bloomberg symbol: SPXT), on the other hand, is the total return version of the S&P 500 index also provided by S&P Dow Jones Indices LLC. A return calculated from the change of the total return index level reflects both the return of the index constituents from capital gains (losses) and the return from dividends. However, unlike the S&P 500 index for which the index level is widely available, the availability of the data on the S&P 500 total return index is more limited. For

instance, although the Center for Research in Security Prices (CRSP) stock database includes the S&P 500 index data, the S&P 500 total return index data from CRSP are available only to its indexes subscribers.

Because of the limited availability of the data on the S&P 500 total return index, we propose two alternative proxies for the S&P 500 total return: The total return of the SPDR S&P 500 ETF Trust (symbol: SPY) and the total return of the iShares Core S&P 500 ETF (symbol: IVV).[2] SPY starts its trading in 1993 and IVV in 2000. Both SPY and IVV have high levels of liquidity (e.g., average daily dollar trading volume in 2013 more than $19 billion and $703 million, respectively), and both of them attempt to replicate/track the performance of the S&P 500 index, despite using different strategies. We summarize their institutional details in the appendix. The suitability of those alternatives is of particular interest to portfolio managers who use the Bloomberg terminal to evaluate their portfolios: Although the Bloomberg terminal provides the data on the S&P 500 total return index, only the S&P 500 index but not the S&P 500 total return index is available as a performance benchmark in its automated portfolio evaluation functions without an additional subscription charge. Portfolio managers, however, can specify a security as the performance benchmark in those functions (see, e.g., Lei and Li, 2012).

Data and Methods

We obtain the data on the S&P 500 index and the S&P 500 total return index from the Bloomberg terminal, and the data on the SPDR S&P 500 ETF Trust and the iShares Core S&P 500 ETF from the Center for Research in Security Prices (CRSP) database. As in Jones and Swaleheen (2014), the entire sample period is from January 2005 to April 2013. Each annual period starts in May and ends in April of the following year. Unlike Jones and Swaleheen (2014), however, we define the Sharpe ratio of a performance benchmark as the average monthly excess return of the benchmark relative to the one-month T-bill rate, divided by the monthly return standard deviation of the benchmark. Using the monthly excess return preserves the information available at the monthly frequency, and the return matches the interval for which the return standard deviation is calculated. We obtain the one-month T-bill rates from the Fama/French research factors provided by Kenneth R. French.

Results

Table 1 shows the returns and return standard deviations (annualized) of the different performance benchmarks from January 2005 to April 2013. We reproduce the returns and return standard deviations of the equity portfolio (i.e., the student managed portfolio, SMP hereafter) and the index examined in Jones and Swaleheen (2014) from their Table 1.

From Table 1, it is clear that the index return used as the performance benchmark in Jones and Swaleheen (2014) is the return of the S&P 500 index without dividends, as their reported index returns and return standard deviations match exactly the returns and return standard deviations of SPX. The larger cumulative return (53.60%) and the lower annualized return standard deviation (13.41%) of SMP relative to those of SPX (31.82% and 15.58%, respectively) lead to their conclusion of the SMP outperformance on an absolute basis. On the other hand, once we use the appropriate S&P 500 total return (SPXT) as the performance benchmark, SMP no longer outperforms the benchmark in absolute terms. The cumulative return and the annualized return standard deviation of SPXT from January 2005 to April 2013 is 56.90% and 15.57%, respectively. SMP therefore has a lower cumulative return and a lower return standard deviation than those of the appropriate benchmark over the entire period. We also notice that within the annual periods, SMP has a higher return than the benchmark only when the benchmark performs poorly (column SMP–SPXT shows the return differences between the two). For instance, SMP has a return higher than the S&P 500 total return from 2007 to 2008 (-1.92% vs. -4.68%), from 2008 to 2009 (-28.91% vs. -35.31%), and from 2011 to 2012 (9.30% vs. 4.76%). This finding is consistent with SMP having lower return and lower risk than the benchmark overall.

---

[2] Vangard S&P 500 ETF (symbol: VOO) also attempts to track the performance of the S&P 500 index. Due to its shorter history (i.e., launched on September 7, 2010 and began trading on September 9, 2010), we do not consider it here.

Table 1: Returns and Return Standard Deviations of Different Performance Benchmarks from January 2005 to April 2013

| Jones and Swaleheen (2014) | | | Total Returns | | | | | | | SMP |
Year	SMP	Std	SPXT	Std	SPY	Std	IVV	Std		–SPXT
2005-2006	5.80	8.56	15.42	6.20	15.61	6.90	15.51	6.67		-9.62
2006-2007	12.66	7.89	15.24	7.13	14.86	7.19	14.90	7.06		-2.58
2007-2008	-1.92	12.55	-4.68	11.92	-4.96	11.60	-4.81	11.97		2.76
2008-2009	-28.91	23.07	-35.31	27.93	-35.10	27.85	-35.14	27.74		6.40
2009-2010	35.47	10.99	38.84	11.65	38.63	11.86	38.68	11.83		-3.37
2010-2011	15.35	13.12	17.22	18.09	17.12	17.98	17.12	18.06		-1.87
2011-2012	9.30	13.74	4.76	16.67	4.67	16.67	4.58	16.41		4.54
2012-2013	11.03	9.94	16.89	10.23	16.70	10.21	16.85	10.25		-5.86
Cumulative	53.60	13.41	56.90	15.57	56.18	15.54	56.50	15.52		-3.30
Sharpe			0.092		0.091		0.091			

| Jones and Swaleheen (2014) | | | Returns without Dividends | | | | | | |
Year	Index	Std	SPX	Std	SPY.X	Std	IVV.X	Std	
2005-2006	13.29	6.17	13.29	6.17	13.58	7.13	13.74	6.86	
2006-2007	13.11	7.22	13.11	7.22	12.79	7.18	12.83	7.04	
2007-2008	-6.53	11.92	-6.53	11.92	-6.76	11.54	-6.65	11.89	
2008-2009	-37.01	27.92	-37.01	27.92	-36.77	27.62	-36.74	27.52	
2009-2010	35.96	11.53	35.96	11.53	35.91	11.92	35.98	11.86	
2010-2011	14.91	18.16	14.91	18.16	14.83	17.80	14.84	17.87	
2011-2012	2.52	16.69	2.52	16.69	2.52	16.91	2.44	16.64	
2012-2013	14.28	10.31	14.28	10.31	14.16	9.94	14.38	9.99	
Cumulative	31.82	15.58	31.82	15.58	32.11	15.51	32.60	15.48	
Sharpe			0.053		0.053		0.054		

Notes: Both returns and return standard deviations (annualized) are shown in percentage (%). Column SMP for the returns of the student managed portfolio, column Index for the returns of the S&P 500 index, and the associated return standard deviations are reproduced from Jones and Swaleheen (2014) Table 1.

Table 1 also shows that using the total return of the SPDR S&P 500 ETF Trust (SPY) and the total return of the iShares Core S&P 500 ETF (IVV) as alternative proxies of the S&P 500 total return produces similar results. In contrast, the results from using the return of the SPDR S&P 500 ETF Trust without dividends (SPY.X) and the return of the iShares Core S&P 500 ETF without dividends (IVV.X) are similar to the results using the return of SPX. Over the entire period from January 2005 to April 2013, the S&P 500 total return is 25.08% higher than the S&P 500 return without dividends, and the S&P 500 total return has a higher Sharpe ratio of 0.092 than the 0.053 of the S&P 500 return without dividends. The annualized return standard deviations, nonetheless, seem to be similar regardless of whether the return is measured by total return or return without dividends. For instance, the annualized return standard deviation from January 2005 to April 2013 is 15.57% for SPXT and 15.58% for SPX. We formally test whether the total return and the return without dividends are same at the monthly interval, and whether they have the same variance next.

Table 2 shows the p-values on testing the monthly return differences between the different performance benchmarks from January 2005 to April 2013. The results suggest that the S&P 500 total return (SPXT), the total return of the SPDR S&P 500 ETF Trust (SPY), and the total return of the iShares Core S&P 500 ETF (IVV) are statistically the same over the entire period. For instance, the p-value for rejecting the null hypothesis that the monthly return difference between SPXT and SPY is zero is 0.801. In addition, the S&P 500 return without dividends (SPX), the return of the SPDR S&P 500 ETF Trust without dividends (SPY.X), and the return of the iShares Core S&P 500 ETF without dividends (IVV.X) are also statistically the same. The difference between the total return and the return without dividends, however, is significantly different from zero in all cases. For instance, the p-value for rejecting the null hypothesis that the monthly return difference between SPXT and SPX is zero is smaller than 0.000.

Table 2: *P*-values on Testing the Monthly Return Differences between Different Performance Benchmarks from January 2005 to April 2013

	SPXT	SPY	IVV	SPX	SPY.X
SPY	0.801				
IVV	0.859	0.896			
SPX	0.000	0.000	0.000		
SPY.X	0.000	0.000	0.000	0.976	
IVV.X	0.000	0.000	0.000	0.894	0.811

Table 3 shows the *p*-values on testing the equality of return variances between the different performance benchmarks from January 2005 to April 2013. The results suggest that the S&P 500 total return (SPXT), the total return of the SPDR S&P 500 ETF Trust (SPY), the total return of the iShares Core S&P 500 ETF (IVV), the S&P 500 return without dividends (SPX), the return of the SPDR S&P 500 ETF Trust without dividends (SPY.X), and the return of the iShares Core S&P 500 ETF without dividends (IVV.X) all have the same variance over the entire period. For instance, the *p*-value for rejecting the null hypothesis that SPXT and SPY (SPXT and SPX) have the same return variance is 0.989 (0.991). Assuming the return variance as a risk measure, the results from Table 2 and Table 3 collectively suggest that potential biases of using a benchmark without its dividend component likely come from the underestimation of the benchmark return rather than the under- or overestimation of the benchmark risk.[3]

Table 3: *P*-values on Testing the Equality of Return Variances between Different Performance Benchmarks from January 2005 to April 2013

	SPXT	SPY	IVV	SPX	SPY.X
SPY	0.989				
IVV	0.976	0.986			
SPX	0.991	0.981	0.970		
SPY.X	0.973	0.984	0.997	0.964	
IVV.X	0.956	0.967	0.981	0.948	0.984

Conclusion

We reexamine the outperformance of an equity portfolio documented in Jones and Swaleheen (2014) relative to the S&P 500 index on an absolute basis. We show that the apparent outperformance of the portfolio is due to using the S&P 500 return without its dividend component as the performance benchmark. Once we use the S&P 500 total return, the outperformance of the equity portfolio disappears. We explain why the S&P 500 total return should be used in this case and propose two alternative proxies for the S&P 500 total return: The total return of the SPDR S&P 500 ETF Trust (symbol: SPY) and the total return of the iShares Core S&P 500 ETF (symbol: IVV). We show that the total returns of those two ETFs are reasonable proxies for the S&P 500 total return. We also show that ignoring the dividends in the benchmark return affects largely the benchmark return level instead of its return variance. Our results collectively highlight the importance of using the appropriate benchmark return on portfolio performance evaluation.

References

BlackRock, Inc. 2013. *2013 Propectus iShares Core S&P 500 ETF*. Jersey City, NJ.

CFA Institute. 2010. *Global Investment Performance Standards*. Charlottesville, VA.

---

[3] Our results are statistically the same using the monthly (total) returns of the SPDR S&P 500 ETF Trust since its inception (i.e., from February 1991) and the monthly (total) returns of the iShares Core S&P 500 ETF since its inception (i.e., from June 2000) to December 2013.

Constable, Simon. 2011. "Price Charts Can Mislead." *Wall Street Journal*, December 5, available at
http://online.wsj.com/news/articles/SB10001424052970204443404577054332688164006.

Johnston, Michael. 2012. *Closer Look At S&P 500 ETF Options*. Available at
http://etfdb.com/equity-etfs/closer-look-at-sp-500-options.

Jones, Travis L., and Mushfiq Swaleheen. 2014. "Student Managed Investment Fund Performance: A Look
at Equity Portfolio Data." *Journal of Economics and Financial Education* 13: 58-63.

Lei, Adam Y.C., and Huihua Li. 2012. "Using Bloomberg Terminals in a Security Analysis and Portfolio
Management Course." *Journal of Economics and Finance Education* 11: 72-92.

NASDAQ Stock Market. 2014. *Exchange Traded Funds by Net Assets*. Available at
http://www.nasdaq.com/investing/etfs/etf-list.aspx?selectedtype=size.

PDR Services, LLC. 2014. *SPDR S&P 500 ETF Trust Prospectus Dated January 22, 2014*. New York,
NY.

Reilly, Frank K., and Keith C. Brown. 2012. *Investment Analysis & Portfolio Management*. Mason, OH.

S&P Dow Jones Indices LLC. 2014. *S&P 500® - S&P Dow Jones Indices*. Available at
http://us.spindices.com/indices/equity/sp-500.

Zweig, Jason. 2011. "Here's One Way to Beat the Market." *Wall Street Journal*, June 4, available at
http://online.wsj.com/news/articles/SB10001424052702304563104576363892725584866.

APPENDIX: SPDR S&P 500 ETF TRUST (SPY) AND ISHARES CORE S&P 500 ETF (IVV)

SPDR S&P 500 ETF Trust (SPY)

The SPDR S&P 500 ETF Trust (symbol: SPY) is a unit investment trust that "seeks to provide investment results that, before expenses, correspond generally to the price and yield performance of the S&P 500 Index" (PDR Services, LLC, 2014, p. 1). Commonly referred to as the first ETF in the U.S., this trust was launched by State Street Global Advisors on January 22, 1993 and began trading on January 29, 1993. As a unit investment trust (and unlike other more recent ETFs), this trust has a stated termination date of January 22, 2118. More importantly, this trust has a high level of liquidity that renders it a viable investment alternative and performance benchmark: Its average daily (dollar) trading volume is 121.54 million shares ($19.88 billion) in 2013. As of June 30, 2014, this trust has the net assets of $168.46 billion and a net expense ratio of 0.0945%.

iShares Core S&P 500 ETF (IVV)

The iShares Core S&P 500 ETF (symbol: IVV) "seeks to track the investment results of the S&P 500 (the underlying index)" (BlackRock, Inc., 2013, p. S-2). This ETF was launched by Barclays Global Investors on May 15, 2000 and began trading on May 19, 2000. BlackRock, Inc. later acquired Barclays Global Investors and the associated iShares ETFs in December 2009. This EFT also has a relatively high level of liquidity: Its average daily (dollar) trading volume is 4.25 million shares ($703.99 million) in 2013. As of June 30, 2014, this ETF has the net assets of $57.76 billion and an expense ratio of 0.07%. In July 2014, it is the second largest ETF in the U.S., preceded only by the SPDR S&P 500 ETF Trust (NASDAQ Stock Market, 2014).

Further Differences between SPY and IVV

Although both the SPDR S&P 500 ETF Trust and the iShares Core S&P 500 ETF are listed on NYSE Arca and attempt to replicate/track the performance of the S&P 500 index, there are still fundamental differences between the two that could affect their returns. First, the SPDR S&P 500 ETF Trust effectively uses a full replication strategy in order to replicate the performance of the S&P 500 index.[4] The iShares Core S&P 500 ETF, on the other hand, uses a representative sampling strategy.[5] Second, while the SPDR S&P 500 ETF Trust does not hold or trade futures or swaps, the iShares Core S&P 500 ETF could invest in futures and swaps. In addition, the iShares Core S&P 500 ETF could lend securities up to one-third of its total assets. Finally, dividends received by the SPDR S&P 500 ETF Trust from its securities holdings are held as cash in a non-interest bearing account until paid as quarterly dividends to its shareholders. The iShares Core S&P 500 ETF, in contrast, has no such requirement of holding the received dividends in cash until quarterly payout. Johnston (2012) suggests that holding the received dividends in cash may lower the return of the SPDR S&P 500 ETF Trust in up markets but increase it in down markets, relative to that of the iShares Core S&P 500 ETF.

---

[4] Specifically, "the Trust seeks to achieve its investment objective by holding a portfolio of the common stocks that are included in the Index (the "Portfolio"), with the weight of each stock in the Portfolio substantially corresponding to the weight of such stock in the Index." "At any time, the Portfolio will consist of as many of the Index Securities as is practicable" (PDR Services, LLC, 2014, p. 2).

[5] Specifically, this strategy "involves investing in a representative sample of securities that collectively has an investment profile similar to the Underlying Index. The securities selected are expected to have, in the aggregate, investment characteristics (based on factors such as market capitalization and industry weightings), fundamental characteristics (such as return variability and yield) and liquidity measures similar to those of the Underlying Index. The Fund may or may not hold all of the securities in the Underlying Index" (BlackRock, Inc., 2013, p. S-2).

Delta Gamma Hedging and the Black-Scholes Partial Differential Equation (PDE)

Sudhakar Raju[1]

ABSTRACT

The objective of this paper is to examine the notion of delta-gamma hedging using simple stylized examples. Even though the delta-gamma hedging concept is among the most challenging concepts in derivatives theory, standard textbook exposition of delta-gamma hedging usually does not proceed beyond a perfunctory mathematical presentation. Issues such as contrasting call delta hedging with put delta hedging, gamma properties of call versus put delta hedges, etc., are usually not treated in sufficient detail. This paper examines these issues and then places them within the context of a fundamental result in derivatives theory - the Black-Scholes partial differential equation. Many of these concepts are presented using Excel and a simple diagrammatic framework that reinforces the underlying mathematical intuition

Introduction

The notion of delta hedging is a fundamental idea in derivatives portfolio management. The simplest notion of delta hedging refers to a strategy whereby the risk of a long or short stock position is offset by taking an offsetting option position in the underlying stock. The nature and extent of the option position is dictated by the underlying sensitivity of the option's value to a movement in the underlying stock price (i.e. option delta). Since the delta of an option is a local first order measure, delta hedging protects portfolios only against small movements in the underlying stock price. For larger movements in the underlying price, effective risk management requires the use of both first order and second order hedging or delta-gamma hedging. In some cases, a third order approximation (delta-gamma-speed hedging) may also be required.

The objective of this paper is to examine the notion of delta-gamma hedging using simple stylized examples and to illustrate these concepts using Excel. Even though the delta-gamma hedging concept is among the most challenging concepts in derivatives portfolio management, standard textbook exposition of delta-gamma hedging usually does not proceed beyond a perfunctory mathematical presentation of delta hedging with calls. See Chance and Brooks (2010), Hull (2008), Kolb and Overdahl (2007), Chance (2003), Jarrow and Turnbull (2000).

---

[1] Professor of Finance, Rockhurst University, Kansas City, MO 64110, sudhakar.raju@rockhurst.edu

Issues such as delta hedging with puts, contrasting delta hedging with calls versus delta hedging with puts, gamma properties of call versus put delta hedges, etc. are usually not treated. This paper examines these issues and then places them within the context of a fundamental result in derivatives theory - the Black-Scholes partial differential equation (PDE). Many of these concepts are presented using a simple diagrammatic framework that highlights and reinforces the underlying conceptual and mathematical intuition.

Option Greeks

Delta hedging is based on the notion of insulating portfolios from small movements in the underlying asset price by taking an offsetting option position. The option position is dictated by the sensitivity of the option value to underlying movements in the asset price. As the underlying stock price changes, the option's delta changes and the hedge must be re-calibrated to maintain its effectiveness. (See Hull (2008, pp.363-366) for a detailed example of dynamically hedging against a short call position). The option's sensitivity to a change in the underlying variables such as the stock price, volatility, time to option maturity and the risk free rate is therefore crucial in hedging against different types of risk. These option sensitivities or option greeks can be derived from a standard, non-dividend paying, European type, Black-Scholes model of the form:

$$C = S\,N(d_1) - X\,e^{-r_f t}\,N(d_2) \qquad (1)$$

where C and S are the current values of the call and stock, $N(d_1)$ and $N(d_2)$ are cumulative unit normal probability distribution values, X is the exercise price, r_f is the risk free interest rate and t is the time to option maturity. The explicit form of $N(d_1)$ and $N(d_2)$ are given by:

$$d_1 = \frac{\ln\,(S/X) + r_f\,t}{\sigma\sqrt{t}} + \frac{1}{2}\sigma\sqrt{t}\;;\;\; d_2 = d_1 - \sigma\sqrt{t}$$

where σ is the standard deviation of the continuously compounded asset return. The current value of a put (P) can be determined by applying put-call parity. Thus:

$$P = S\,[N(d_1) - 1]\, - X\,e^{-r_f t}\,[N(d_2) - 1] \qquad (2)$$

Now (1) implies that:

$$C = C\,(S, \sigma, r_f, t) \qquad (3)$$

Using a third order Taylor series expansion, (3) can be written as:

$$dC = \frac{\partial C}{\partial S}dS + \frac{\partial C}{\partial \sigma}d\sigma + \frac{\partial C}{\partial t}dt + \frac{\partial C}{\partial r_f}dr_f + \frac{1}{2}\frac{\partial^2 C}{(\partial S)^2}(dS)^2 + \frac{1}{2}\frac{\partial^2 C}{(\partial \sigma)^2}(d\sigma)^2 + \frac{1}{2}\frac{\partial^2 C}{(\partial t)^2}(dt)^2 +$$

$$\frac{1}{2}\frac{\partial^2 C}{(\partial r_f)^2}(dr_f)^2 + \frac{\partial^2 C}{(\partial S)(\partial t)}(dS)(dt) + \frac{1}{6}\frac{\partial^3 C}{(\partial S)^3}(dS)^3 + \frac{1}{6}\frac{\partial^3 C}{(\partial S)^2(\partial \sigma)}(dS)^2(d\sigma) + \frac{1}{6}$$

$$\frac{\partial^3 C}{(\partial S)^2(\partial t)}(dS)^2(dt) \qquad\qquad (4)$$

These derivatives or option greeks are easily derived from (4) as follows: Delta = $(\partial C/\partial S) = \Delta$; Vega = $(\partial C/\partial \sigma) = \nu$; Theta = $(\partial C/\partial t) = \theta$; Rho = $(\partial C/\partial r_f) = \rho$; ☐Gamma = $(\partial^2 C/(\partial S)^2) = \Gamma$. One can define equivalent terms for put options[2]. These option greeks are crucial in the construction of hedging strategies. Their use is analyzed in the subsequent sections.

Delta Hedging

Consider the following stylized example:

Current Price of Option 1 (S)	=	$100
Exercise Price of Option 1 (X)	=	$100
Risk Free Return (r_f)	=	5% p.a.
Time to Maturity (t)	=	91 days or 91/365 = 24.93%
Volatility (σ)	=	20% p.a.

The resulting Black-Scholes call and put prices for Option 1 are $4.61 and $3.37, respectively[3]. These prices, as well as the standard option greeks, are shown for two options – Option 1 and Option 2. (See Tables 1a and 1b. The Excel commands used to generate the values in Table 1a are shown in Table 1b). Both Option 1 and 2 are on the same stock but differ in their exercise prices. In the succeeding analyses, Option 1 values are used. Option 2 values are used in the subsequent section on delta/gamma hedging.

    Suppose now that a portfolio manager wanted to delta hedge 1000 shares of a long stock position on ABC stock using Option 1 calls. Assume that we are looking at the hedge immediately after it has been instituted. Thus, time, volatility and the risk free rate are constant. The delta of this stock/call portfolio (Δ_p) is then given by:

$$\Delta_p = \eta_s \Delta_s + \eta_c \Delta_c \qquad\qquad (5)$$

---

[2] Other less common option greeks are: Charm = $(\partial^2 C/\partial S\partial t) = (\partial \Delta/\partial t)$; Speed = $(\partial^3 C/\partial S^3) = (\partial \Gamma/\partial S)$; Volga = $(\partial^3 C/\partial S^2\partial \sigma) = (\partial \Gamma/\partial \sigma)$, Color = $(\partial^3 C/\partial S^2\partial t) = (\partial \Gamma/\partial \tau)$. The terms Charm and Speed are borrowed from names used in quantum physics for sub-atomic particles. See Chapter 8 in Neftci (2004) for a detailed treatment of the option greeks.

[3] In Table 1, Theta is computed on a per annum basis. Thus, call theta for Option 1 per day is given by: (-10.4852)/ (365) = -.0287.

where η_s refers to the number of shares in the stock portfolio, Δ_s is the delta of the stock (which is 1 since the value of the stock varies one to one with the stock price), η_c is the number of calls to be determined and Δ_c is the call delta which is equal to .5694. Setting the delta of the portfolio in (5) equal to zero creates a portfolio that is hedged against first-order movements in the underlying stock price.

Table 1a: Black-Scholes & Option Greeks

	A	B	C
1			
2		OPTION 1	OPTION 2
3	CURRENT STOCK PRICE	$100.00	$100.00
4	EXERCISE PRICE	$100.00	$110.00
5	RISK-FREE RATE	5.00%	5.00%
6	TIME TO MATURITY (91 Days)	24.93%	24.93%
7	VOLATILITY	20.00%	20.00%
8			
9	D1	0.1748	-0.7796
10	D2	0.0749	-0.8795
11			
12	N(D1)	0.5694	0.2178
13	N(D2)	0.5299	0.1896
14			
15	CALL PRICE	$4.61	$1.19
16			
17	PUT PRICE	$3.37	$9.82
18			
19			
20	CALL DELTA	0.5694	0.2178
21	CALL GAMMA	0.0393	0.0295
22	CALL VEGA	19.6179	14.6991
23	CALL THETA	-10.4852	-6.9255
24	CALL RHO	13.0464	5.1343
25			
26			
27			
28	PUT DELTA	-0.4306	-0.7822
29	PUT GAMMA	0.0393	0.0295
30	PUT VEGA	19.6179	14.6991
31	PUT THETA	-5.5471	-1.4936
32	PUT RHO	11.5763	21.9507
33			
34	CALL & PUT SPEED	0.0001	-0.0002
35			
36			
37	BLACK-SCHOLES PDE (CALL OPTION)	0.0000	0.0000
38	BLACK-SCHOLES PDE (PUT OPTION)	0.0000	0.0000
39			
40	NOTE: Theta is an a per annum basis. Thus, call theta for Option 1 per day is given by: (-10.4852)/ (365) = -.0287.		
41			

Table 1b: Excel Commands used to Generate Table 1a

	A	B	C
1			
2		OPTION 1	OPTION 2
3	CURRENT STOCK PRICE	100	100
4	EXERCISE PRICE	100	110
5	RISK-FREE RATE	0.05	0.05
6	TIME TO MATURITY (91 Days)	=91/365	=91/365
7	VOLATILITY	0.2	0.2
8			
9	D1	=((LN(B3/B4) + B5*B6) / (B7*SQRT(B6))) + (0.5*B7*SQRT(B6))	=((LN(C3/C4) + C5*C6) / (C7*SQRT(C6))) + (0.5*C7*SQRT(C6))
10	D2	=B9-(B7*SQRT(B6))	=C9-(C7*SQRT(C6))
11			
12	N(D1)	=NORMSDIST(B9)	=NORMSDIST(C9)
13	N(D2)	=NORMSDIST(B10)	=NORMSDIST(C10)
14			
15	CALL PRICE	=B3*B12-B4*EXP(-B5*B6)*B13	=C3*C12-C4*EXP(-C5*C6)*C13
16			
17	PUT PRICE	=B3*(B12-1) + B4*(EXP(-B5*B6))*(1-B13)	=C3*(C12-1) + C4*(EXP(-C5*C6))*(1-C13)
18			
19			
20	CALL DELTA	=B12	=C12
21	CALL GAMMA	= (1/SQRT(2*PI())) * EXP(-0.5*B9*B9) * 1/(B3*B7*SQRT(B6))	= (1/SQRT(2*PI())) * EXP(-0.5*C9*C9) * 1/(C3*C7*SQRT(C6))
22	CALL VEGA	= B3 * SQRT(B6) * (1/SQRT(2*PI())) * EXP(-0.5*B9*B9)	= C3 * SQRT(C6) * (1/SQRT(2*PI())) * EXP(-0.5*C9*C9)
23	CALL THETA	=-((B3*EXP(-0.5*B9*B9)*B7) / (2*SQRT(2*PI()*B6))) - (B5*B4*EXP(-B5*B6)*B13)	=-((C3*EXP(-0.5*C9*C9)*C7) / (2*SQRT(2*PI()*C6))) - (C5*C4*EXP(-C5*C6)*C13)
24	CALL RHO	=B4 * B6* EXP(-B5*B6) *B13	=C4 * C6* EXP(-C5*C6) *C13
25			
26			
27			
28	PUT DELTA	=B12-1	=C12-1
29	PUT GAMMA	= (1/SQRT(2*PI())) * EXP(-0.5*B9*B9) * 1/(B3*B7*SQRT(B6))	= (1/SQRT(2*PI())) * EXP(-0.5*C9*C9) * 1/(C3*C7*SQRT(C6))
30	PUT VEGA	= B3 * SQRT(B6) * (1/SQRT(2*PI())) * EXP(-0.5*B9*B9)	= C3 * SQRT(C6) * (1/SQRT(2*PI())) * EXP(-0.5*C9*C9)
31	PUT THETA	=-((B3*EXP(-0.5*B9*B9)*B7) / (2*SQRT(2*PI()*B6))) + (B5*B4*EXP(-B5*B6)*(1-B13))	=-((C3*EXP(-0.5*C9*C9)*C7) / (2*SQRT(2*PI()*C6))) + (C5*C4*EXP(-C5*C6)*(1-C13))
32	PUT RHO	=-B4 * B6* EXP(-B5*B6) *(B13-1)	=-C4 * C6* EXP(-C5*C6) *(C13-1)
33			
34	CALL & PUT SPEED	=((B9 + B7*SQRT(B6))/(B3))*B21	=((C9 + C7*SQRT(C6))/(C3))*C21
35			
36			
37	BLACK-SCHOLES PDE (CALL OPTION)	=$B$23-($B$5)*($B$15) +($B$5)*($B$3)*($B$20) + (0.5)*($B$21)*($B$7)*($B$7)*($B$3)*($B$3)	=$C$23-($C$5)*($C$15) +($C$5)*($C$3)*($C$20) + (0.5)*($C$21)*($C$7)*($C$7)*($C$3)*($C$3)
38	BLACK-SCHOLES PDE (PUT OPTION)	=$B$31-($B$5)*($B$17) +($B$5)*($B$3)*($B$28) + (0.5)*($B$29)*($B$7)*($B$7)*($B$3)*($B$3)	=$C$31-($C$5)*($C$17) +($C$5)*($C$3)*($C$28) + (0.5)*($C$29)*($C$7)*($C$7)*($C$3)*($C$3)
39			
40			

The number of long/short calls to be traded to create a delta-neutral hedge for a 1000 share portfolio can be easily solved from (5) thus:

$$0 = (1000)(1) + (\eta_c)(.5694)$$
$$\eta_c = -1756$$

Thus, 1756 Option 1 calls need to be sold in order to hedge a 1000 share portfolio or equivalently a short call position of 1756 calls can be hedged using a long stock position of 1000 shares[4]. The performance of this delta-neutral hedge with calls is shown in Table 2 and graphed in Figure 1[5].

---

[4] Suppose the stock price declines to $99 (see Table 2). At $99, the stock portfolio has lost (-$1)(1000 shares) or -$1000. The short call portfolio has gained about $965 since 1756 calls were sold at $4.61 and purchased back at $4.06 (the Black-Scholes call value at a stock price of $99). The net change in the portfolio is thus -$35. The call and delta neutral portfolio values in Table 2 are generated using Excel's What-If Analysis and Data Table function.

[5] We assume an instantaneous change in stock prices from the initial value of $100. This enables one to focus on the effect of stock price changes keeping constant the effect of a change in other variables such as volatility or option maturity. For instance, we could easily analyze hedge performance after the lapse of a week. The delta hedge will, of course, perform worse than the reported results here since theta risk now becomes a factor.

Table 2: Delta Hedging with Calls

					VALUE OF THE DELTA
			STOCK PRICE	**CALL VALUE**	**NEUTRAL PORTFOLIO**
CURRENT STOCK PRICE	$100.00		$85	$0.27	-$7,375
EXERCISE PRICE	$100.00		$86	$0.35	-$6,519
RISK-FREE RATE	5.00%		$87	$0.45	-$5,696
TIME TO MATURITY (91 DAYS)	24.93%		$88	$0.57	-$4,911
VOLATILITY	20.00%		$89	$0.72	-$4,170
D1	0.1748		$90	$0.89	-$3,477
D2	0.0749		$91	$1.10	-$2,836
N(D1) [CALL DELTA]	0.5694		$92	$1.34	-$2,253
N(D2)	0.5299		$93	$1.61	-$1,732
PUT DELTA	-0.4306		$94	$1.92	-$1,275
CALL PRICE	$4.61		$95	$2.27	-$886
PUT PRICE	$3.369		$96	$2.65	-$566
LONG SHARES IN THE PORTFOLIO	1000		$97	$3.08	-$317
SHORT CALLS REQUIRED FOR HEDGING	1756.3397		$98	$3.55	-$140
PORTFOLIO DELTA	0		$99	$4.06	-$35
INITIAL VALUE OF STOCK PORTFOLIO	$100,000		$100	$4.61	$0
INITIAL VALUE OF SOLD CALLS	$8,093		$101	$5.20	-$34.21
CALL Z (d^2)	0.0153		$102	$5.82	-$135
CALL / PUT GAMMA	0.03934		$103	$6.49	-$300
PORTFOLIO GAMMA	-69.10069		$104	$7.19	-$527
PORTFOLIO THETA	18,415.4941		$105	$7.92	-$810
			$106	$8.68	-$1,147
			$107	$9.47	-$1,534
			$108	$10.28	-$1,967
			$109	$11.12	-$2,441
			$110	$11.98	-$2,952
			$111	$12.86	-$3,497
			$112	$13.76	-$4,073
			$113	$14.67	-$4,675
			$114	$15.60	-$5,300
			$115	$16.53	-$5,946

Figure 1
Performance of Call & Put Delta Neutral Portfolios
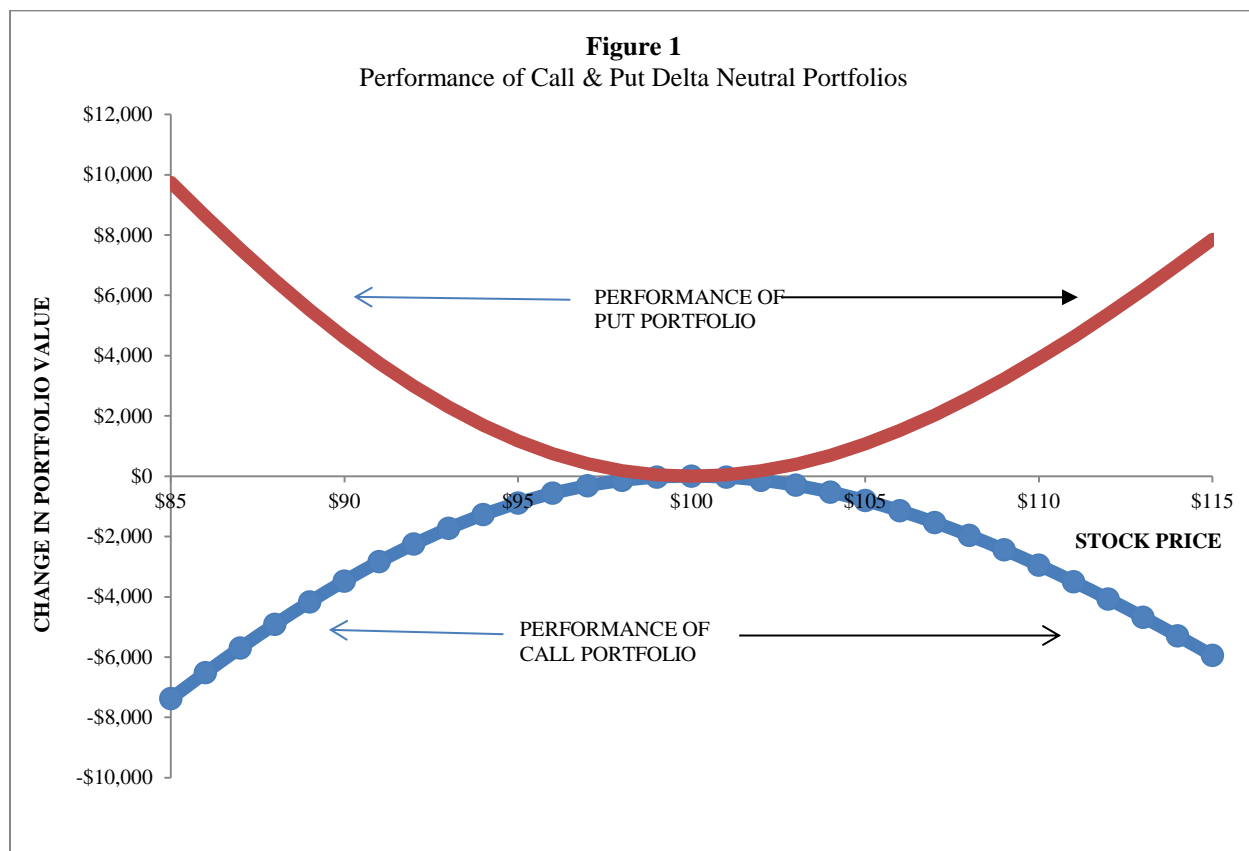
Notice that the hedge performs increasingly poorly the further the stock price moves away from the initial stock price of $100. This is not difficult to understand given that a long stock position is being hedged using a short call position. As the stock price declines, the stock position incurs higher and higher losses. At the limit at a stock price of $0, the stock position loses $100,000. The maximum gain on the short call position can however never exceed ($4.61)(1756 calls) or $8093. The asymmetric nature of the return on the short call position ensures that it performs poorly for large deviations away from the initial stock price.

Gamma Hedging

It is also instructive to consider the portfolio gamma of the long stock/short call portfolio. The gamma of the call option is the second derivative of (1) with respect to the stock price. Thus:

$$\frac{\partial^2 C}{\partial^2 S} = \frac{\partial^2 P}{\partial^2 S} = \frac{1}{\sqrt{2\Pi}} \ [e^{(-d_1^2/2)}] \ \frac{1}{S\sigma\sqrt{t}} \qquad (6)$$

The symmetry of the unit normal distribution ensures that call and put gammas are identical. The portfolio gamma [Γ_p] of the long stock/short call portfolio is then given by:

$$\Gamma_p = \eta_s \, \Gamma_s + \eta_c \, \Gamma_c \qquad (7)$$

where Γ_s is the gamma of the stock (equal to zero) and Γ_c is the gamma of the call (equal to .0393; see values for Option 1 in Table 1). The portfolio gamma is then equal to:

$$\Gamma_p = (1000)(0) + (.0393)(-1756) = -69$$

The negative convexity of the long stock/short call portfolio provides the underlying rationale for the delta neutral portfolio function described by Figure 1. The negative convexity of this portfolio explains its poor hedging performance.

The next case to be considered is delta hedging with puts. Following a procedure similar to the above and noting that the put delta on Option 1 is -.4306, we can determine that the number of puts to be purchased to create a delta neutral hedge for 1000 shares is about 2322 puts. The long position in puts offsets the decrease in portfolio value as the stock price declines. The performance of the delta neutral hedge with puts is shown in Table 3 and Figure 1. It is immediately apparent that this hedge performs considerably better than the hedge with short calls. The intuitive reason is that as the stock price declines the long put position moves deeper and deeper into the money. At the limit, when the stock price is $0, the stock portfolio loses $100,000 whereas the put position gains $98.75 per put or about $229,298 for the entire put position[6]. The same notion is reinforced by examining the gamma of this portfolio which is given by:

$$\Gamma_p = (1000 \text{ shares}) \ (0) + (2322 \text{ puts}) \ (.0393) = 91$$

The positive gamma of this portfolio, made evident in the put portfolio function depicted in Figure 1, reinforces the superior performance of the delta neutral hedge with puts as compared to the delta neutral hedge with calls. For any price deviation from the initial price of $100, the delta hedge with puts would clearly be a superior choice.

---

[6] At a stock price of $0, the value of the put at option maturity equals its exercise price of $100. The discounted present value is equal to [$100] [(e^{-(.05)(.2493)}] = $98.76.

Table 3: Delta Hedging with Puts

CURRENT STOCK PRICE	$100.00		STOCK PRICE	PUT VALUE	VALUE OF THE DELTA NEUTRAL PORTFOLIO
EXERCISE PRICE	$100.00		$85	$14.03	$9,751
RISK-FREE RATE	5.00%		$86	$13.11	$8,618
TIME TO MATURITY (91 DAYS)	24.93%		$87	$12.21	$7,530
VOLATILITY	20.00%		$88	$11.33	$6,493
D1	0.1748		$89	$10.48	$5,513
D2	0.0749		$90	$9.65	$4,597
N(D1) [CALL DELTA]	0.5694		$91	$8.86	$3,750
N(D2)	0.5299		$92	$8.10	$2,979
PUT DELTA	-0.4306		$93	$7.37	$2,290
CALL PRICE	$4.61		$94	$6.68	$1,686
PUT PRICE	$3.37		$95	$6.03	$1,171
LONG SHARES IN THE PORTFOLIO	1000		$96	$5.41	$748
LONG PUTS REQUIRED FOR HEDGING	2322.1572		$97	$4.84	$419
PORTFOLIO DELTA	0		$98	$4.31	$186
INITIAL VALUE OF STOCK PORTFOLIO	$100,000		$99	$3.82	$46
INITIAL VALUE OF PURCHASED PUTS	$7,823		$100	$3.37	$0
CALL Z (d^2)	0.0153		$101	$2.96	$45
CALL / PUT GAMMA	0.0393		$102	$2.58	$179
PORTFOLIO GAMMA	91.36		$103	$2.25	$397
PORTFOLIO THETA	-12,881.2310		$104	$1.95	$696
BLACK-SCHOLES PORTFOLIO PDE	0.0000		$105	$1.68	$1,071
			$106	$1.44	$1,517
			$107	$1.23	$2,028
			$108	$1.04	$2,600
			$109	$0.88	$3,227
			$110	$0.74	$3,903
			$111	$0.62	$4,624
			$112	$0.52	$5,385
			$113	$0.43	$6,181
			$114	$0.36	$7,007
			$115	$0.29	$7,861

Delta-Gamma Hedging

The portfolio considered above is clearly not hedged against all types of risk. In addition to large movements in the stock price it is susceptible to changes in volatility and the risk free rate. The time decay of the option introduces another source of risk. If the underlying asset exhibits wide price swings, both first order (delta) and second order (gamma) movements need to be taken into consideration. Suppose we now extend the previous example of a delta hedge with calls to delta-gamma hedging with calls. The parameters of the option we analyzed earlier [Option 1] were as follows: Call Delta = .5694; Call Gamma = .0393. To create a delta-gamma hedge, we need a second option on the same stock. Let the exercise price of this second option [Option 2] be $110 with all other parameters being the same as Option 1. The call delta and gamma of Option 2 can be determined to be .2178 and .0295, respectively (see Table 1). To make a 1000 share portfolio ($\eta_s = 1000$) delta-gamma neutral, the following set of simultaneous equations needs to be solved where the first equation imposes delta neutrality and the second equation imposes gamma neutrality.

$$\Delta_p = \eta_s\,\Delta_s + \eta_1\,\Delta_1 + \eta_2\,\Delta_2 = 0 \qquad\qquad (8)$$

$$\Gamma_p = \eta_s\,\Gamma_s + \eta_1\,\Gamma_1 + \eta_2\,\Gamma_2 = 0 \qquad\qquad (9)$$
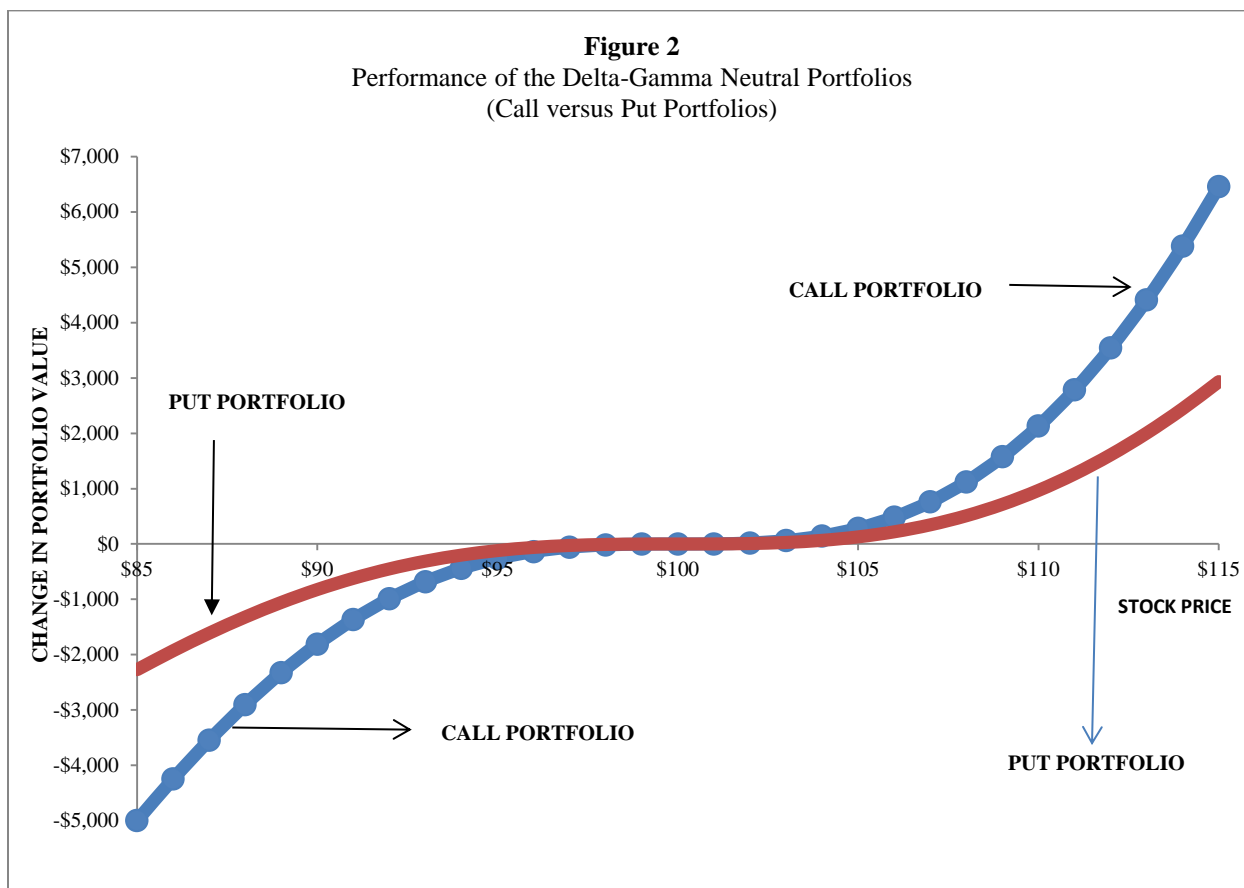
The 1 and 2 subscripts refer to Option 1 and Option 2 values. Solving simultaneously yields $\eta_1 = -3588$ and $\eta_2 = 4789$. Thus, to ensure delta-gamma neutrality for this portfolio, sell 3588 of Option 1 calls and buy 4789 of Option 2 calls. The performance of this portfolio at different stock prices is reported in Table 4[7]. Using a similar procedure, it can be easily shown that delta-gamma neutrality using puts requires selling 1630 of Option 1 puts and buying 2176 of Option 2 puts.

The performance of both the call and put delta-gamma neutral portfolios are compared in Figure 2. Figure 2 provides good intuitive insight into the conceptual notion behind delta-gamma hedging. When comparing Figures 1 and 2, it is immediately evident that delta-gamma portfolios preserve values for much larger swings in the underlying stock price as compared to delta neutral portfolios. For instance, at a stock price of $90, the value of the delta neutral portfolio with calls decreases by $3477 but the delta-gamma neutral portfolio with calls decreases by about half as much or $1811. For relatively small deviations from the initial stock price of $100, both the delta- gamma neutral call and put portfolios perform in a fairly similar manner. However, for larger deviations in the underlying price the performance of the delta-gamma call and put portfolios differ significantly.

---

[7] The change in portfolio value is calculated thus. At a stock price of $95 (see Table 4), the loss on the stock portfolio is ($95-$1000) (1000 shares) = $5,000. The profit/loss on the Option 1 trade equals ($4.61-$2.27) (3588 calls) = $8396. The profit/loss on the Option 2 trade equals ($.42-$1.19) (4789 calls) = -$3688. Thus, the approximate net change in portfolio value equals -$292. The exact value calculated in Table 4 equals -$261.

Table 4: Delta-Gamma Hedging with Calls

	OPTION 1	OPTION 2		ENDING STOCK PRICE	CALL VALUE OF OPTION 1	CALL VALUE OF OPTION 2	CHANGE IN THE VALUE OF DELTA NEUTRAL PORTFOLIO
CURRENT STOCK PRICE	$100.00	$100.00		$85	$0.27	$0.02	-$4,998
EXERCISE PRICE	$100.00	$110.00		$86	$0.35	$0.03	-$4,246
RISK-FREE RATE	5.00%	5.00%		$87	$0.45	$0.04	-$3,547
TIME TO MATURITY (91 DAYS)	24.93%	24.93%		$88	$0.57	$0.06	-$2,904
VOLATILITY	20.00%	20.00%		$89	$0.72	$0.08	-$2,324
D1	0.1748	-0.7796		$90	$0.89	$0.11	-$1,811
D2	0.0749	-0.8795		$91	$1.10	$0.15	-$1,365
N(D1) [CALL DELTA]	0.5694	0.2178		$92	$1.34	$0.20	-$989
N(D2)	0.5299	0.1896		$93	$1.61	$0.26	-$682
PUT DELTA	-0.4306	-0.7822		$94	$1.92	$0.33	-$441
CALL PRICE	$4.61	$1.19		$95	$2.27	$0.42	-$261
PUT PRICE	$3.37	$9.82		$96	$2.65	$0.53	-$136
CALL Z (d^2)	0.0153	0.3039		$97	$3.08	$0.66	-$59
CALL / PUT GAMMA	0.039344	0.029479		$98	$3.55	$0.81	-$18
				$99	$4.06	$0.98	-$2
1000 LONG SHARES	1,000			$100	$4.61	$1.19	$0
SELL 3588.2811 OF OPTION 1 CALLS	3,588			$101	$5.20	$1.42	$2
BUY 4789.0392 OF OPTION 2 CALLS	4,789			$102	$5.82	$1.68	$18
DELTA OF THE PORTFOLIO	0.00			$103	$6.49	$1.98	$61
GAMMA OF THE PORTFOLIO	0.00			$104	$7.19	$2.31	$145
THETA OF THE PORTFOLIO	4,457.37			$105	$7.92	$2.68	$282
VALUE OF PORTFOLIO	$89,148			$106	$8.68	$3.08	$484
BLACK-SCHOLES PORTFOLIO PDE	-0.002			$107	$9.47	$3.52	$762
				$108	$10.28	$4.00	$1,124
				$109	$11.12	$4.52	$1,578
				$110	$11.98	$5.07	$2,130

Figure 2
Performance of the Delta-Gamma Neutral Portfolios
(Call versus Put Portfolios)

It is evident from Figure 2 that the delta/gamma call portfolio has a significantly greater upside but also a far greater downside as compared to the delta/gamma put portfolio. The unlimited upside potential of long calls combined with the limited downside protection offered by short call positions explains the delta-gamma call function. The delta-gamma put portfolio combines the limited upside offered by short puts with the significant downside protection offered by long puts. The delta-gamma put function thus has less upside value but significantly greater downside protection as compared to the delta-gamma call function.

The Black-Scholes Partial Differential Equation (PDE) and Delta-Gamma Hedges

In this section, the discussion on first and second order hedges are placed within the context of a fundamental result in derivatives theory – the Black-Scholes PDE - and the analysis shows explicitly the manner in which this fundamental relationship is satisfied. The B-S PDE demonstrates the manner in which an asset that is delta hedged by buying and selling the

underlying option in just the right proportions results in a risk free portfolio. The Black-Scholes PDE can be written as:

$$\theta_p - r_f\, C_p + r_f\, S\, \Delta_p + \frac{1}{2}\Gamma_p \sigma^2 S^2 = 0 \qquad (10)$$

where θ_p (theta of a call portfolio given by $\eta_c\, \theta$), Γ_p (gamma of a call portfolio given by $\eta_c\, \Gamma$) and C_p (Call plus Stock portfolio given by: $\eta_s\, S + \eta_c\, C$). A delta hedged portfolio implies that $\Delta_p = 0$. Thus, (10) can be rewritten as:

$$r_f = \frac{\eta_c[\theta + (1/2)\Gamma\sigma^2 S^2]}{\eta_c[C + \dfrac{\eta_s}{\eta_c}S]} \qquad (11)$$

Delta hedging implies that for every share ($\eta_s = 1$), the number of calls (η_c) is given by the proportion $-(1/\Delta)$. Thus,

$$r_f = \frac{[\theta + (1/2)\Gamma\sigma^2 S^2]}{[C - S\Delta]} \qquad (12)$$

In essence, the equation above states that if each share of stock is delta hedged the portfolio is riskless and will hence earn the risk free rate of return. Using values from Table 1a it can be easily confirmed that the above is satisfied for calls and a similar relationship is satisfied for puts.

For delta-gamma neutral portfolios, $\Delta_P = \Gamma_P = 0$. Thus (10) reduces to:

$$r_f = [\theta_P / C_P] \qquad (13)$$

A delta/gamma neutral portfolio requires a short call position involving 3588 Option1 calls and a long position involving 4789 Option2 calls to hedge a 1000 share portfolio. The theta of this portfolio then equals θ_P = [(-3588)(-10.4852) + (4789)(-6.9255)] = 4455. The value of the call portfolio, C_P = [(-3588)($4.61) + (4789)($1.19)] = $89,158. Thus, r_f = [4455/89,158] = 5% implying that a delta/gamma neutral portfolio is riskless and thus earns the risk free rate of return.

Conclusion

The delta-gamma hedging concept is among the more challenging concepts in derivatives portfolio management. However, standard textbook exposition of delta-gamma hedging usually

does not proceed beyond a perfunctory mathematical presentation of delta hedging with calls. Issues such as delta hedging with puts, contrasting delta hedging with calls against puts, gamma properties of call versus put delta hedges, etc. are usually not presented. The objective of this paper is to examine and illustrate these notions using simple stylized examples. These issues are then placed within the context of a fundamental result in derivatives theory - the Black-Scholes PDE. Concepts such as delta-gamma hedges and convexity of portfolio positions are presented using a simple diagrammatic framework. This approach complements the purely mathematical approach in many textbooks while clarifying and reinforcing the underlying intuition.

References

Chance, Don and Robert Brooks. 2010. *An Introduction to Derivatives and Risk Management*, 8th ed. Mason, OH: Thomson South-Western.

Chance, Don. 2003. *Analysis of Derivatives for the CFA Program,* AIMR, Baltimore, MD: United Book Press.

Hull, John. 2008. *Option, Futures & Other Derivatives,* 7th ed. Upper Saddle River, NJ: Prentice Hall.

Neftci, Salih. 2004. *Principles of Financial Engineering,* 2nd ed. New York: Elsevier Academic Press.

Jarrow, Robert and Stuart Turnbull. 2000. *Derivative Securities,* 2nd ed. Cincinnati, OH: South Western.

Kolb, Robert and James Overdahl. 2007. *Futures, Options and Swaps,* 5th ed. Malden, MA: Blackwell Publishing.

Black-Scholes Option Pricing: Implementing a Hands-On Assignment Using Excel

Christi Wann[1]

ABSTRACT

Demonstrating the complete Black-Scholes option pricing formula in a traditional classroom setting presents several challenges due to its complex nature. Therefore, there are several educational benefits to requiring an interactive Excel assignment that engages students in formula programming to observe instantaneous price changes in calls and puts. Students gain job-transferable Excel skills and learn how the major components of the option pricing formula affect the resulting option price. Additionally, the educator benefits from the introduction of a simple macro function that expedites grading complex formulas.

Key Words: Black-Scholes Option Pricing, Finance Education, Computer Modeling

Introduction

The option pricing formula derived by Black and Scholes (1976) and Merton (1973) is an arduous formula for students to calculate. The act of calculating the European-style option value takes a significant portion of class time and leaves students overwhelmed. Therefore, it is often difficult students to absorb the relationship between option prices and the six major determinants of option values without going through lengthy example calculations. For example, an educator informs students that ceteris paribus, when the dividend yield is greater, then the call option value is lower. Most likely, students will memorize rather than interact with this information.

This paper proposes an Excel-based assignment that results in three primary benefits to students and the educator. First, student learning is reinforced by requiring the use of Excel to input the Black-Scholes option pricing formula through cell referencing (Black and Scholes, 1976). This allows individual hard-coded variables to be changed so that students instantly see the new option value. Further, students are required to utilize data tables to observe how changes in the six major determinants of option values affect call and put prices. Second, this assignment forces students to gain meaningful experience in Excel which enhances their job market "hard skills." Third, the educator can facilitate grading by creating a simple macro function that reveals specific cell formulas created by each student. This macro function enables the instructor to quickly determine if a student receives credit or does not receive credit. A student receives credit for correctly completing the individual formulas to obtain the numerical answers. The function will inform the educator when a student should not receive credit due to a hard-coded numerical answer that lacks the required formula. The numerical answer could be obtained from other students who already successfully answered the question during class.

Motivation

The major motivation for this particular teaching method is two-fold. The catalyst for this teaching tool came out of a discussion with students. Students in an *Investments I* course requested assignments that would require Excel in the subsequent course in order to graduate with relevant job skills. Holden and Womack (2000) express that it "is probably safe to say that there is no finance function in a post-college job in the year 2000 that does not use a spreadsheet like Excel regularly." According to the New York Times (Browning, 2013), highly

---

[1] Department of Finance, University of Tennessee at Chattanooga

qualified graduates who have obtained impressive jobs on Wall Street lack "nuts-and-bolts skills like spreadsheet building…which are not part of university curriculums." Firms such as Goldman Sachs and the Blackstone Group send new hires to take courses in Excel modeling and financial analysis from Training the Street and Wall Street Prep at an expense that can exceed $1,000 per day (Browning, 2013). And, undergraduate students with an extra $3,000 can take a four-day Undergraduate Wall Street Boot Camp in New York that teaches basic financial modeling, valuation and analysis (Browning, 2013). Many of these basic skills can be incorporated in many college finance courses at no additional cost to the student.

A second and equally important motivation for this spreadsheet-based assignment is that Excel enhances concept retention as an alternative, more engaging learning opportunity. This idea is consistent with the "constructivist" learning approach where knowledge is acquired, or "constructed," by spreadsheet modeling which leads to feelings of empowerment and user control (Boethel and Dimock, 1999; Maddux, Johnson, and Willis, 1997). Hess (2005) advocates the "hands-on" use of spreadsheet modeling in the classroom to enhance understanding, retention, and employability. Further, surveys report that finance faculty and business schools are urged to use more technology in the classroom by the business community to prepare students for the workforce (Bailey and Heck, 2002; Gitman and Vandenberg, 2003).

Excel assignments are currently required for all calculation-based chapters taught in *Investments II* during designated class periods held in a computer lab. The feedback from students reflects that they understand the classroom lectures better after completing the Excel assignments. Students initially behave in a frustrated manner, then become ecstatic when the correct answer is obtained. Additionally, students appear more confident and empowered after completing their most recent Excel assignment. This effect is consistent with a small sample survey of students assigned an excel-based finance problem which found increased feelings of self-actualization and self-competence (Ghani and D'Mello, 1993).

The creation of Excel assignments is warranted, however there is a legitimate concern as to verifying individual student completion of each assignment. Although instructors typically oversee lab assignments, it is necessary to obtain proof that a student did not hard code an answer by consulting a friend instead of manually typing the complex formulas. Excel does not have a function that extracts the formulas contained in a cell. Therefore, a simple macro was written to replicate the needed formula. A separate "Print" tab for the Excel assignment contains three columns. The columns contain a list of each question's cell formula, the student's numerical answer from the same cell, and the correct numerical answer. The correct numerical answer column is displayed so that students can check their answers as they work through the assignment. This method appears to give students confidence as they obtain correct answers.

Spreadsheet Construction

This paper presents a portion of a spreadsheet assignment that models the Black-Scholes option pricing formulas for calls and puts (Black and Scholes, 1976). The traditional classroom lecture includes a discussion of the binomial option pricing model, the Black-Scholes option pricing model, the Put-call parity theorem, and arbitrage opportunities (Bodie, Kane, and Marcus, 2013). The author created an Excel assignment for each of these topics, however the Black-Scholes model is the focus of the chapter and offers many benefits for students as a required Excel assignment.

The Excel spreadsheet is structured according to the Black-Scholes option pricing model (Black and Scholes, 1976) with an adjustment for dividend-paying stocks. The value of a call option is equal to

$$C_0 = S_0 e^{-\delta T} N(d_1) - X(e^{-rT}) N(d_2)$$

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + (r - \delta + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

and the value of the put option is equal to

$$P_0 = X(e^{-rT})[1 - N(d_2)] - S_0 e^{-\delta T}[1 - N(d_1)]$$

Where:

C_0	= Theoretical call value
S_0	= Current stock price
e	= Base of the natural log
δ	= Annual dividend yield on the stock
T	= Time until expiration in years
N(d)	= Probability that a random draw from a normal distribution will be less than d
X	= Exercise price
r	= Risk-free interest rate (annualized)
σ	= Annual standard deviation of continuously compounded stock returns
P_0	= Theoretical put value

Call and put option calculations are first calculated by students during a pencil and paper assignment in order to learn the mechanics of the formula before completing the Excel assignment. The answer key spreadsheet should be constructed by the educator before the student assignment spreadsheet is created. Exhibit 1 shows the first portion of the Excel answer key.

Exhibit 1. Call and Put Option Values Assignment Key

Students must take the numerical data from the question and type the data in the designated yellow-shaded cells. Question 1 asks for the value of the call option. Students must solve for parts "1.a" through "1.f" before solving the Final Answer, "1.g." The Black-Scholes option pricing formula was divided into parts "1.a" to "1.g" due to its complexity. The parts also allow the educator to quickly pinpoint a cell where a referencing or syntax error has occurred. All yellow-shaded areas must have formulas that consist of cell references to the hard-coded numerical data. This requirement allows the Final Answer, "1.g," to dynamically change if the student desires to see the effect of altering the original data assumptions. The answer to question "2.a," the value of the put option, is calculated by cell-referencing the hard-coded numerical data, $N(d_1)$, and $N(d_2)$. Again, this allows students to see the effect of changing the original data assumptions on the put option value, "2.a."

The next purpose of the assignment is that students generate the implied relationships of the determinants of call and put option values in Excel. The following determinants of call and put option values are discussed in

the course's required textbook, *Essentials of Investments* (Bodie, Kane, & Marcus, 2013). All else equal, as the value of the stock price increases, the call (put) option value increases (decreases). As the value of the exercise price increases, the call (put) option value decreases (increases). Higher standard deviation and longer time to expiration increase call and put option values. As interest rates increase, the right to buy (sell) at a fixed price in the future becomes more (less) valuable due to time value of money effects. Higher levels of dividend payouts reduce capital gain potential. Therefore, call option values are reduced while put option values are increased. These relationships are summarized in Table 1.

Table 1. Determinants of Call and Put Option Values

All else equal, if this variable is larger	Then the value of the call option is	Then the value of the put option is
Stock Price	Larger	Smaller
Exercise Price	Smaller	Larger
Standard Deviation	Larger	Larger
Time to Expiration	Larger	Larger
Risk-free rate	Larger	Smaller
Dividend Yield	Smaller	Larger

The second portion of the answer key spreadsheet contains data tables for each of the six determinants of call and put option values. Therefore, there are six call and six put data tables that will allow the student to observe relationships described in Table 1. Additionally, graphs are created for each determinant that display both of the effects on call and put values. The following three screenshots in Exhibits 2, 3, and 4 illustrate the data tables and graphs which represent questions three through fourteen. The Excel data table feature is found on the "Data" tab under the "What-If Analysis" drop down menu. Since only column information varies per table, the "column input" choice is used within the data table feature.

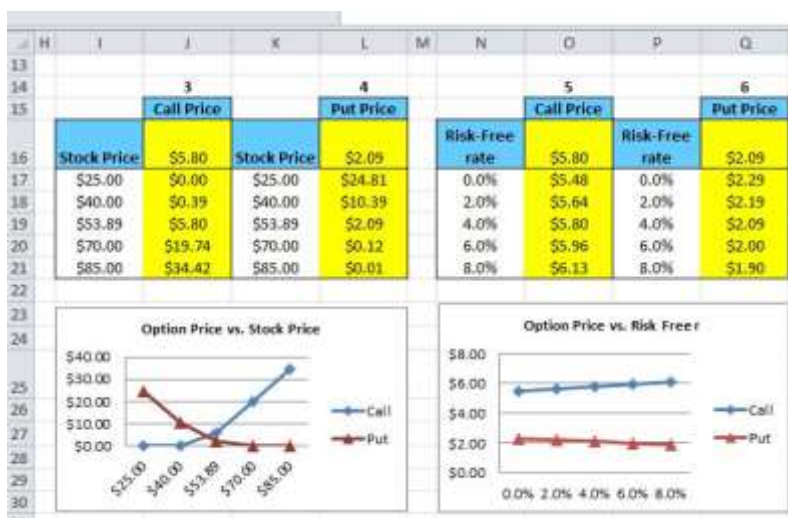**Exhibit 2. Call Price and Put Price Relationships with the Stock Price and Risk-free Rate**

Exhibit 3. Call Price and Put Price Relationships with the Standard Deviation and Strike Price
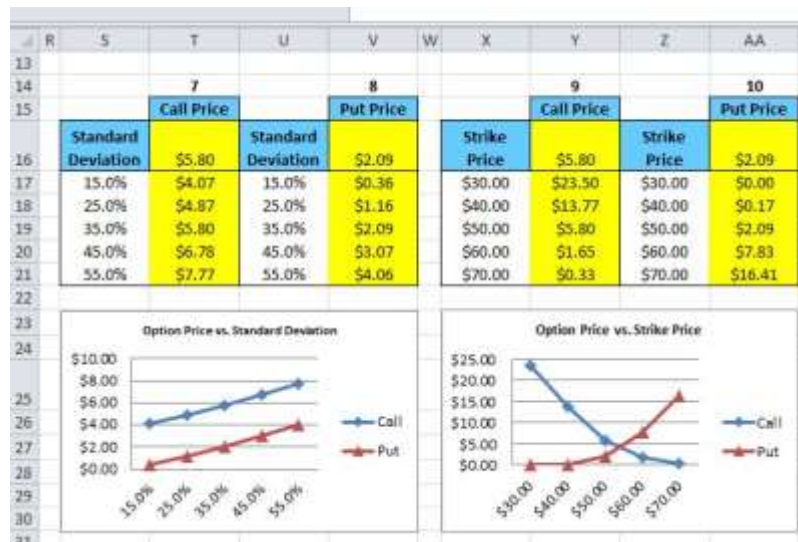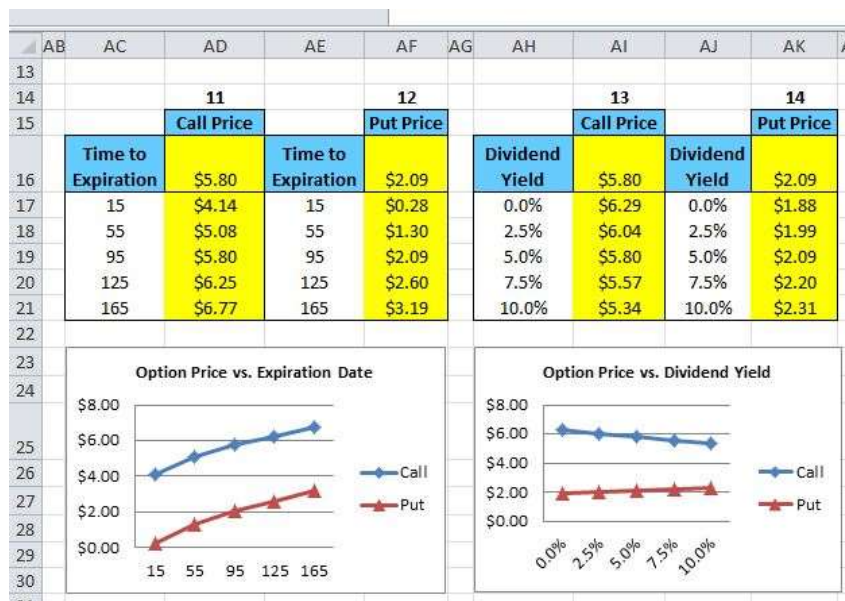
Exhibit 4. Call Price and Put Price Relationships with the Time to Expiration and Dividend Yield

The next step involves creating a simple macro function that shows specific cell formulas for grading purposes. A quick Google search for the keywords "Convert formula to text string with VBA" will lead you to example VBA code for Excel (ExtendOffice, 2014). In Excel, go to the Developer tab and click on View Code. A new window titled, Microsoft Visual Basic for Applications will appear. From the top line, click on Insert and choose Module. Then, copy and paste the following code from Exhibit 5 into the new white box in the middle of the screen.

Exhibit 5. Excel Macro Code to Create the Function "CellFormula"

```
Function CellFormula(Rng As Range) As String
    CellFormula = Rng.Formula
End Function
```

Click the save button and close this window. Also, click the save button in the original file and a prompt to save the file as a macro-enabled file with the ".xlsm" extension will arise. Save the file as a macro-enabled file

with the ".xlsm" extension. Each time the educator and students open the file, the "Enable Macros" button at the top of the screen must be clicked. Otherwise, the "CellFormula" function will not work. If a student mistakenly works in the file without enabling the macros, the student should save and close the file. Next, the student should reopen the file and enable the macros. The student should not lose any previously completed work in the file.

The next phase for the educator is to implement the new "CellFormula" function in a newly created tab within the Excel file. This tab, which the author labeled "Answers Only," is still part of the answer key Excel file. The following screenshot in Exhibit 6 shows the correct way to use the newly created "CellFormula" function. Notice that across each row in Column B and Column C of the answer key the same cell reference such as "$F16" is used. However, the function used in Column B is "CellFormula" in Column C just the numerical value of the cell is referenced. In Exhibit 6, note that the author labeled the Answer Key Tab, "Ch. 16 Toolkit ANSWERS."

Exhibit 6. Demonstration of "CellFormula" References in Answer Key Tab

	A	B	C
1		Formula	Answer
2	1		
3	a	=CellFormula('Ch. 16 Toolkit ANSWERS'!$F16)	=('Ch. 16 Toolkit ANSWERS'!$F16)
4	b	=CellFormula('Ch. 16 Toolkit ANSWERS'!$F17)	=('Ch. 16 Toolkit ANSWERS'!$F17)
5	c	=CellFormula('Ch. 16 Toolkit ANSWERS'!$F18)	=('Ch. 16 Toolkit ANSWERS'!$F18)
6	d	=CellFormula('Ch. 16 Toolkit ANSWERS'!$F19)	=('Ch. 16 Toolkit ANSWERS'!$F19)
7	e	=CellFormula('Ch. 16 Toolkit ANSWERS'!$F20)	=('Ch. 16 Toolkit ANSWERS'!$F20)
8	f	=CellFormula('Ch. 16 Toolkit ANSWERS'!$F21)	=('Ch. 16 Toolkit ANSWERS'!$F21)
9	g	=CellFormula('Ch. 16 Toolkit ANSWERS'!$F23)	=('Ch. 16 Toolkit ANSWERS'!$F23)
10	2		
11	a	=CellFormula('Ch. 16 Toolkit ANSWERS'!$F27)	=('Ch. 16 Toolkit ANSWERS'!$F27)

Exhibit 7 shows the results of using the "CellFormula" function and the simple cell reference to the numerical answer. Keep in mind, this is the answer key. In the student Excel assignment, there are only two tabs. There is a tab for completing the assignment and a "Print" tab. The "Print" tab shows the results of the "CellFormula" function, the student's answer, and the correct answer in columns B, C, and D, respectively. The "Print" tab is the only item needed by the educator for grading purposes.

Exhibit 7. "CellFormula" Function Results in Answer Key Tab

	A	B	C
1		Formula	Answer
2	1		
3	a	=LN(F8/F11)+((F9-F13+(F10^2/2))*(F12/365))	0.08826
4	b	=F10*((F12/365)^0.5)	0.17856
5	c	=F16/F17	0.49429
6	d	=NORM.S.DIST(F18,TRUE)	0.68945
7	e	=(F18-(F10*(F12/365)^0.5))	0.31573
8	f	=NORM.S.DIST(F20,TRUE)	0.62390
9	g	=F8*(EXP(-F13*(F12/365)))*F19-F11*(EXP(-F9*(F12/365)))*F21	$5.80
10	2		
11	a	=F11*(EXP(-1*F9*(F12/365)))*(1-F21)-F8*(EXP(-F13*(F12/365)))*(1-F19)	$2.09

Exhibit 8 shows what a correctly completed Excel assignment should look like. When reviewing this printed page for grading, only two things need to be checked. First, check that each answer contains a formula without hard-coded answers. For example, a student that did not enter the functions but knew the correct numerical answer could have typed "$2.09" in the "FINAL ANSWER" box on the main Excel worksheet. The educator would see "$2.09" in column in B, C, and D. This student would not receive credit for this question because the calculation was not performed. Second, check that the Student Answer value equals the Answer Key value. The

educator does not need to check the intricacies of the entire formula because if the numerical answer in Column C is correct and there is a formula in Column B, then the formula is correct by default. Again, the answer in Column C is the numerical value that the formula in Column B produced. Note that some cells do have "365" or "1" hard-coded. This is fine, as these numbers are an inherent part of the Black-Scholes formula. It did not seem necessary to create additional cells that contained "365" and "1" just for the sake of additional cell referencing.

Exhibit 8. Sample Portion of Student "Print" Tab Results Graded by Instructor

A	B	C	D
	Formula	Student Answer	Answer Key
2 1			
3 a	=LN(F8/F11)+((F9-F13+(F10^2/2))*(F12/365))	0.08826	0.08826
4 b	=F10*((F12/365)^0.5)	0.17856	0.17856
5 c	=F16/F17	0.49429	0.49429
6 d	=NORM.S.DIST(F18,TRUE)	0.68945	0.68945
7 e	=(F18-(F10*(F12/365)^0.5))	0.31573	0.31573
8 f	=NORM.S.DIST(F20,TRUE)	0.62390	0.62390
9 g	=F8*(EXP(-F13*(F12/365)))*F19-F11*(EXP(-F9*(F12/365)))*F21	$5.80	$5.80
10 2			
11 a	=F11*(EXP(-F9*(F12/365)))*(1-F21)-F8*(EXP(-F13*(F12/365)))*(1-F19)	$2.09	$2.09
12 3			
13	='Ch. 16 Toolkit'!$F$23	$5.80	$5.80
14	=TABLE(,F8)	$0.00	$0.00
15	=TABLE(,F8)	$0.39	$0.39
16	=TABLE(,F8)	$5.80	$5.80
17	=TABLE(,F8)	$19.74	$19.74
18	=TABLE(,F8)	$34.42	$34.42
19 4			
20	=F27	$2.09	$2.09
21	=TABLE(,F8)	$24.81	$24.81
22	=TABLE(,F8)	$10.39	$10.39
23	=TABLE(,F8)	$2.09	$2.09
24	=TABLE(,F8)	$0.12	$0.12
25	=TABLE(,F8)	$0.01	$0.01

Exhibit 8 reveals that there are four Excel functions that students are required to learn and utilize. First, the "LN" function returns the natural logarithm of a number. This function is required when calculating d_1 from the Black-Scholes equation (Black and Scholes, 1976). Second, the "NORM.S.DIST" function returns the standard normal distribution value. Since the Black-Scholes formula for $N(d_1)$ requires the cumulative distribution value, the formula contains the qualifier labeled "TRUE" (Black and Scholes, 1976). Third, the "EXP" function produces "e", the mathematical constant that is the base of the natural logarithm, raised to the power of a given number. This function is required in the final calculation of call and put option values. Fourth, the function "TABLE" represents the data table calculation available on the "Data" tab under the "What-If Analysis" drop-down menu. Questions 3 and 4 are data tables that show how changes in the variable "Stock Price" affect the call and put option values. The values of the variable "Stock Price" are presented to the student in a column. Therefore, the "column input" choice is used within the data table function. This results in the formula "=TABLE(,F8)" where the comma comes before the original cell containing the Stock Price.

The student assignment is structured like the answer key shown in Exhibits 1 through 4. The answers in the yellow-shaded and green-shaded input cells are cleared. Exhibit 9 shows an example portion of the file received by the student during a lab assignment.

Exhibit 9. Sample Portion of Student Excel Assignment
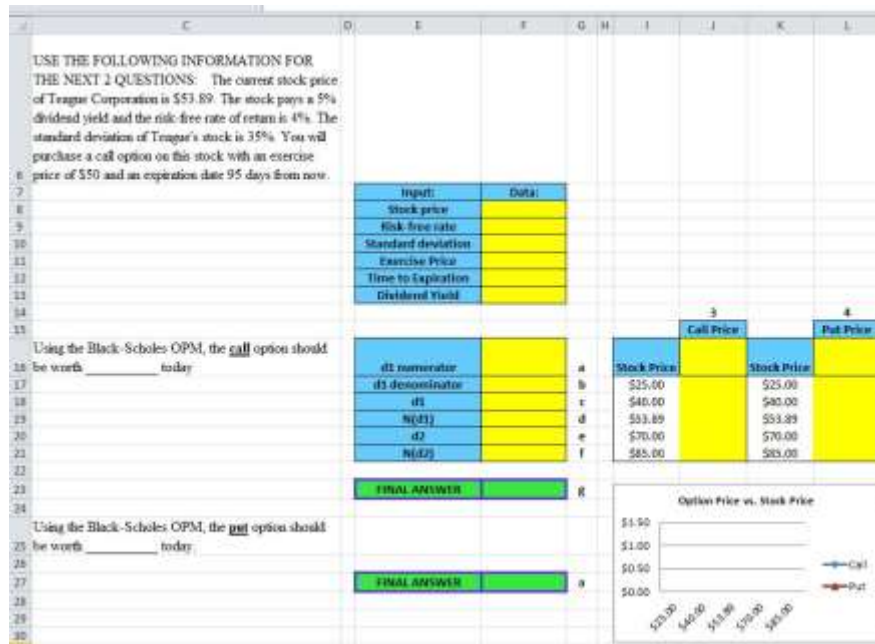
Conclusion

This paper demonstrates how educators can create an Excel-based Black-Scholes option pricing assignment (Black and Scholes, 1976). This particular teaching method contains several benefits for both students and the instructor. Students obtain enhanced comprehension of the major determinants of call and put option values. Further, students gain valuable hard skills and much needed experience in Excel. The educator is equipped to use a simple macro that helps with grading a complex assignment. This macro can be extended for use in any Excel-based assignment where lengthy or complex formulas are involved. The Excel file exhibited in this article may be requested by contacting the author.

REFERENCES

Bailey, Barrie A. and Heck, Jean L. 2002. "Finance Faculty Perceptions of Business Schools' Preparation for the Technological Revolution." *Journal of Financial Education* 28: 41-52.

Black, Fisher, and Myron Scholes. 1973. "The Pricing of Options and Corporate Liabilities." *Journal of Political Economy* 81: 637-659.

Bodie, Zvi, Alex Kane, and Alan J. Marcus. 2013. *Essentials of Investments* (9th ed.). New York: McGraw-Hill.

Boethel, Martha, and K. Victoria Dimock. 1999. *Constructing Knowledge with Technology: A Review of the Literature*. Austin, Texas: Southwest Educational Development Laboratory.

Browning, Lynnley. May 30, 2013. Wall Street Turns to 'Boot Camps' to Train New Workers. *The New York Times*. Retrieved June 25, 2014 from http://dealbook.nytimes.com/2013/05/30/wall-street-turns-to-boot-camps-to-bring-new-workers-up-to-speed/?_php=true&_type=blogs&_r=0

ExtendOffice. 2014. "How to convert formula to text string in Excel?" Retrieved April 2, 2014 from http://www.extendoffice.com/documents/excel/822-excel-convert-formula-to-text-string.html

Ghani, J. A., and J. P. D'Mello. 1993. "Spreadsheets in Financial Education: Balancing the Challenges." *Financial Practice & Education,* 3: 65-71.

Gitman, Lawrence and Pieter A. Vandenberg. 2003. "The Future of Corporate Finance: A Survey of Practitioner and Academic Opinions." *Journal of Financial Education* 29: 23-42.

Hess, Kurt. 2005. "Spreadsheet-Based Modeling for Teaching Finance and Accounting Courses." Available at SSRN: http://ssrn.com/abstract=378680 or http://dx.doi.org/10.2139/ssrn.378680

Holden, Craig W., and Kent L. Womack. 2000. "Spreadsheet Modeling in Finance and Investment Courses." *FEN Educator*, Vol. 5 No. 5. Also available at SSRN: http://ssrn.com/abstract=241708

Maddux, C. D., D. L. Johnson, and J. W. Willis. 1997. *Educational Computing: Learning with Tomorrow's Technologies* (2nd ed.). Boston: Allyn and Bacon.

Merton, Robert C. 1973. "Theory of Rational Option Pricing." *Bell Journal of Economics and Management Science* 4: 141-183.

Market-Dependent Domestic Production Set

Henrik Egbert[1] & Nadeem Naqvi[2]

ABSTRACT

A remarkable feature of the 21st century is extremely rapid international capital mobility compared to considerably sluggish annual FDI flows in the last quarter of the 20th century. If this empirically significant assumption of internationally footloose capital is adopted, an economy's production set, and its boundary, the production possibility frontier, are, under this assumption, rendered market dependent insofar as domestic commodity price variation causes a swift relocation of the production frontier, contrasted with the market-invariant frontier in standard theory. Other conclusions of economic analysis are, in general, also modified, rendering this change in assumption materially relevant to economic theory.

Keywords: PPF, production possibility frontier, market-invariant PPF, market-dependent PPF

Introduction

The economic crisis of 2008 hit the world economy with remarkable vigor. Economists – by and large – failed to predict the crisis adequately. One consequence of the crisis was that it sparked an intensive discussion on the usefulness of models used in economic textbooks (e.g., Krugman 2009; Blinder 2010; Shiller 2010; Stiglitz 2011). In fact, Stiglitz (2011, p. 594) writes:

> Because any model is a simplification, an idealization, of reality, it is not a [legitimate] criticism to suggest that some aspect of reality has been left out. But it is a [valid] criticism if what is left out is essential to understanding the problem at hand, including the policy responses.

Taking precisely such an approach to methodology, we address the fundamental concept of a Production Possibility Frontier (PPF) and argue that indeed the world has changed and that our teaching of the model needs to undergo a corresponding modification. We do *not* argue that this concept as found in textbooks today[3] is inadequate for communicating to students such important ideas as scarcity in a two commodity world, or the crucial concept of opportunity cost of producing a commodity. We do claim, however, that conveying to students of economics, perhaps inadvertently, the additional message that *in any given year a PPF remains more or less stationary in its location and that economic policy changes do not displace its location*, would fail to take account of recent, dramatic changes in the character of modern-day economies. Indeed, if this practice in teaching were to be allowed to persist, it would be a disservice to students of economics, because such information is not merely inaccurate, but it also leads to inaccurate conclusions based on economic analysis that is predicated on such an empirically invalid assumption.

The principal result of this paper is that we, as economists, draw a PPF assuming a given amount of resources—such PPFs are to be termed *market-invariant.* In doing so, we gloss over the possibility that the levels of resources in a country in any given year are not 'given' as if by an act of God. The levels of resources are in fact determined by a country's policies, especially in the present times when capital is immensely mobile. Policies that

---

[1] Professor of Economics, Anhalt University of Applied Sciences, Strenzfelder Allee 28, D-06406 Bernburg, Germany, h.egbert@wi.hs-anhalt.de.

[2] Professor of Economics, KIMEP University, Valikhanov 212/4 Abai Avenue, 050010 Almaty, Kazakhstan, naqvi@kimep.kz.

[3] For examples of recent textbooks, see Baumol and Blinder (2012, pp. 37-41), Varian (2010), Krugman and Wells (2013, pp. 27-34), Goolsbee et al. (2013, pp. 590-592). For an experimental teaching example of a PPF see Carson and Tsigaris (2011). Cf. additionally Olson (1997) who addresses shortcomings of a Consumption Possibilities Frontiers in textbooks.

change the domestic return to capital may change a country's capital stock by attracting capital from abroad and consequently change its production set.[4] A country's domestic production set contains all of that country's feasible net output vectors for a given state of technology and given quantities of primary factors of production, and its boundary is known as the production possibility frontier, or PPF. Naturally, foreign capital inflows (or outflows) would displace the location of a country's PPF. So a country's domestic production set and thus its PPF are, in fact, *market-dependent*, in the age of unhindered, rapid international capital mobility.[5]

This is important because there is now strong empirical evidence to support the claim that there has occurred a uniquely *historic* change in cross-country capital flows. While many authors have made contributions, the culmination of this empirical effort has resulted in the defining work of Razin and Sadka (2007), which is a very careful analysis that not only separates foreign portfolio investment (which is quite volatile) from foreign direct investment (which is considerably more resilient), but also establishes conclusively that the post-2005 annual inward FDI flows are seven-fold greater than the pre-1990 corresponding flows. Of course, the greater the amount of capital that relocates, the larger is magnitude of the shift in the boundary of an economy's domestic production set in any given period of time.[6]

Does this have any operational significance for economic theory? To examine this issue, take a recent example. Acemoglu *et al.* (2012), develop "A Dynamic Theory of Resource Wars" in which they investigate the pre-war histories of a country *A* that decides to devote a scarce resource to the production of arms to declare war (with a positive probability) on a resource-rich country *S* at a later date to acquire a fraction of *S*'s exhaustible resource. The incentives for going to war, and thus the results of their investigation, would undergo modification if internationally-mobile capital were also included in their model, which (a) is an empirically significant fact, according to Razin and Sadka (2007), and would (b) render each country's domestic production set market dependent, and lead (c) country *A* to destroy some of its own citizens' capital (thereby diminishing their income) by going to war against *S*, simply because some of the capital owned by *A*'s citizens would be located in *S* due to foreign direct investment. In effect, these citizens of *A* whose capital is located in *S* would have an incentive to oppose *A*'s invasion of *S*, which is a matter that could have been legitimately ignored in the period 1878 to 1918 referred to in the resource-wars study, but which needs to be taken into account now, though it is not by Acemoglu *et al.* (2012).

Since the above argument demonstrates that replacing the standard assumption by the claim that countries are characterized by "endogenous international capital mobility" does, in fact, lead to a modification of conclusions in economic theory, it follows that the empirical change does have operational significance both for economics and its teaching.

Section 2 is devoted to the new concept that is introduced in this paper, namely, *market-dependent production set*, to be distinguished from a *market-invariant production set*. Section 3 contains the Specific Factors model with international capital mobility, and contrasts market-invariant and market-dependent domestic production sets. Section 4 outlines consequences for teaching and the final section contains concluding remarks.

Conceptual Foundations

An issue of some significance is that the concept of a production set is so foundational to economics that much care needs to be taken to define the concepts of market-invariant and market-dependent domestic production sets of a country. This is not merely a matter of taxonomy, but also, and more importantly for economic analysis, it is one of avoiding epistemological errors that could arise from using one name to describe two materially distinct concepts. Some terminology pertaining to this distinction proves helpful.

---

[4] For policy effects on PPF shifts in an international context see Marktanner (2004).

[5] We are grateful to an anonymous referee for such a succinct statement of our purpose in a manner that commutes our ideas most effectively.

[6] Azariadis and Pissarides (2007) conduct a very careful empirical analysis that bears out the theoretical conclusions of Neary (1985), and, in fact, extend this work to demonstrate that "as more international capital mobility takes place, unemployment responds faster and with more amplitude to shocks [to total factor productivity], so over long periods of time both unemployment and workers' incomes are more volatile than in an economy without international capital mobility (2007, 29)." They also argue (2007, p. 27) that "[o]ne of the most striking recent changes in the world economy is the speed with which the capital markets of industrial countries have become integrated."

As noted above, a country's production possibility frontier, or PPF, is the *boundary* of its economy's domestic production set in the net output space, which consists of feasible net output vectors, and is parametrically dependent on an exogenously given state of technology of transforming inputs into outputs, and on fixed factor supplies of primary factors of production.[7] If changes in domestic relative equilibrium prices have no influence on the country's domestic production set, we call its boundary a *market-invariant PPF*. The classic treatment of such a case is Koopmans (1957), and the properties of a market-invariant PPF are well known. Specifically, it entails a *unidirectional* causal relationship between a PPF and markets: exogenous PPF changes affect a Walrasian competitive general equilibrium, but relative market price changes, whether or not driven by government policy, have no effect at all on the shape of the economy's domestic production set.

However, if capital is internationally mobile, policy-induced relative commodity price changes in a country can alter the value of marginal product of capital domestically, which would induce capital flows into or out of a country. By changing the quantity of capital located in a country, this, in turn, would alter the shape of the country's domestic production set. The domestic production set of an economy would then actually be influenced by relative commodity price changes. If so, we shall call it a *market-dependent domestic production set*, and the associated boundary the *market-dependent PPF*. On theoretical grounds the concept of such a domestic production set also needs to be investigated. The causal relationship in this case would be *bidirectional* insofar as relative market price changes *also* alter a country's feasible production possibilities, unlike the case of a market-invariant PPF.

Arrow and Debreu (1954, p. 281) deal in Theorem 2 with the existence of a Walrasian competitive general equilibrium with one primary factor of production in an economy with exactly such a domestic production set that is characterized by a market-invariant PPF. However, a very significant feature of international capital mobility is that, if a country becomes part of an integrated world capital market, the quantity of capital that locates in that country, whether domestic or foreign capital, becomes free to be endogenously determined by market forces, including being affected by the rental rate of capital that it takes as parametrically determined on the world capital market. Any economic policy that jostles the domestic rental rate of capital up above the world rate will induce an inflow, but if it pushes it below the world rate, an outflow of productive capital occurs. Therefore, economic policy changes the set of feasible net output vectors for the country.

Since the pioneering work of Mundell (1957) on international capital mobility, this literature got the next shot in the arm from Neary (1985), from whose contribution a large theoretical literature on international capital mobility has emerged. Neary considers an economy with a finite number of commodities and primary factors of production. His is a general equilibrium model of a small open economy that admits of both intermediate goods and joint production. In such a framework, Neary shows that as factor-price rigidities are introduced, possibly due to international capital mobility, the responsiveness of general equilibrium output supplies to changes in commodity prices becomes more pronounced in terms of magnitude, and so is the case with the responsiveness of inverse factor-demand functions and thus of the magnitude of change in factor prices due to changes in supplies of those factors that are exogenously fixed.

Implications of these properties are, among others, that international capital mobility raises the cost of tariff protection, as shown by Neary and Ruane (1988). Neary (1988) extends this work to the case of quotas and voluntary export restraints (VERs). The large country case with international capital mobility is contained in Neary (1995). Chandra and Naqvi (1997) extend Neary's results for tariffs, quotas and VERs in a small open economy to an economy that exhibits external increasing returns to scale in some sectors. Franck (1999) considers tariff reform with pre-existing quotas and quota reform with pre-existing tariffs under international capital mobility, and Bezmen (2006) extends Neary's (1995) work on the large country to external increasing returns to scale. Lal (1995) introduces international capital mobility in the Harris-Todaro model of the specific-factors type. Blanchard (2009) demonstrates that the well-known Lerner's symmetry result between import and export taxes is overturned by international capital mobility, but restored if a tax on remittances is also introduced.

While very valuable insights have emerged from this theoretical literature, including from contributions by many others, surprisingly none of these authors have made a case for embracing a market-dependent domestic

---

[7] Among other restrictions imposed on this set are that it is (a) non-empty, (b) compact (closed and bounded) and (c) convex.

production set. This could be possibly because these results are interesting in themselves, whereas a distinct strand of the literature asses the empirical relevance of international capital mobility.

At the methodological level our purpose is to demonstrate the theoretical *existence* of a market-dependent domestic production set. Therefore, it is harmless for us to take a particular parameterization, so that we employ the Specific Factors model to prove this existence result.

Model: Market-Dependent Domestic Production Set

When a country moves from free-trade to a tariff on a good, the relative price of the two goods changes in a two sector, specific factors model. In this section we show that as a consequence of imposing an import tariff, a country's production point in response to such a change moves from P_1 to P_2, where P_2 is unambiguously not on the same market-invariant PPF as is P_1 (see diagram below). This is in contrast with the standard model in which we would expect production points P_1 and P_2 to be on the same traditional (market-invariant) PPF. Why? This is entirely the result of capital flows. Thus, the supplies of resources a country has are determined endogenously by changes in a country's *polices*, and not merely by exogenous events such as technological progress. Policies that change the domestic return to capital may change a country's capital stock by attracting capital from abroad and consequently change its production set, which has become a more important phenomenon, especially in the last quarter of a century. This is what we mean by *market-dependent production set.*

Consider the standard Specific Factors model, as in Jones (1971). Let all economic activity in an economy be divided into two parts: Manufactured goods, *M* and Services, *S*, produced by the technology embodied in the following production functions.

$$M = F(\bar{L}, K_m) \tag{1}$$

$$S = G(\bar{H}, K_s), \tag{2}$$

where $\bar{L}$ is the fixed quantity of unskilled labor and K_m the endogenously determined quantity of capital employed in the manufacturing sector of the economy, whereas $\bar{H}$ and K_s are the number of skilled workers and the amount of capital employed in service-sector production. Here $F(\bar{L}, K_m)$ and $G(\bar{H}, K_s)$ are *concave* production functions that are characterized by (i) the Inada conditions, including indispensible inputs, (ii) constant returns to scale, and (iii) the law of diminishing returns, which together imply that (iv) inputs are co-operative.[8]

Let this be a small open economy. Both commodities are internationally traded, insofar as services can be outsourced, and manufactures can also be traded. Further, let p_m and p_s be the exogenously specified *domestic* prices of the manufactured goods and of services, which in free trade are respectively equal to p_m^* and p_S^* that are taken to be the *world* prices of these commodities, which this economy takes as parametrically determined on the world markets of these commodities.

Additional relationships that hold are

$$p_m F_K(\bar{L}, K_m) = r^* \tag{3}$$

$$p_S G_K(\bar{H}, K_s) = r^* \tag{4}$$

Equations (3) and (4) assert that the values of marginal product of capital equal the world rental rate of capital, r^*, in each sector. Since the country is also small in the world capital market, and is integrated in this market, it takes r^* as exogenously fixed. From (3) alone, the amount of capital employed in manufacturing is endogenously determined uniquely as $\hat{K}_m = K_m(\bar{L}, p_m, r^*)$, and from (4), capital employed in Services is determined as $\hat{K}_s =$

---

[8] The cross partial derivatives of the two production functions are both positive. Intuitively this means that more capital increases the marginal productivity of unskilled labor in manufacturing, and conversely. Also, more capital employed in the service sector raises the marginal productivity of skilled labor, and conversely.

$K_S(\bar{H}, p_S, r^*)$. Substituting for $\hat{K}_m$ and $\hat{K}_s$ in the production functions (1) and (2), we see that the equation of the PPF is

$$S = f(M; \bar{L}, \bar{H}, r^*, p_m, p_S). \tag{5}$$

While the quantities of skilled and unskilled labor employed in the economy are constant in the initial general equilibrium, based on the argument contained in the previous paragraph, $\hat{K} = \hat{K}_m + \hat{K}_s = K(\bar{L}, \bar{H}, r^*, p_m, p_S)$ is the *endogenously* determined quantity of capital that is located and employed in the economy in general equilibrium in the presence of endogenous international capital mobility. The model is complete. The exogenous variable or parameters are: $\bar{L}, \bar{H}, p_m, p_S$ and r^*. The endogenous variables are: K_m, K_s, M, S, w_L and w_H.[9]

The question arises: should (5) even be called the equation of the PPF? It is precisely because this PPF is not the same sort of relationship that is standardly called a PPF that necessitates the terminology of market-dependent domestic production set, contrasted with the traditional PPF that is market-invariant. *The endogeniety of the quantity of capital located and thus employed in the economy under international capital mobility renders the relationship between the maximal output of one commodity for a given output of another commodity parametrically dependent on commodity prices and the world rental rate of capital.* Hence, under international capital mobility, a country's domestic production set is not stationary in the net output space insofar as it is, in fact, not invariant to domestic commodity or factor price changes.[10]

To see this, consider *Figure 1*, which is drawn under the price-normalization assumption that the domestic-price vector (p_m, p_S) belongs to the unit simplex, or $p_m + p_S = 1$, as in Debreu (1959).

When life begins, the factor endowments are $\bar{L}$ and $\bar{H}$, the commodity prices are $p_m = p_m^*$ and $p_S = p_S^*$, and r^* is the world rental rate of capital. This is a small open economy both in commodity and capital markets, so that it takes p_m^*, p_S^* and r^* as exogenously determined on world markets.[11] These exogenous variables uniquely determine, in general equilibrium, $\hat{K}_m = K_m(\bar{L}, p_m, r^*)$ from (3) as capital employed in manufacturing and $\hat{K}_s = K_S(\bar{H}, p_S, r^*)$ from (4) as the capital employed in Services. Substituting for $\hat{K}_m$ and $\hat{K}_s$ in the production functions (1) and (2), we obtain M_1 and S_1 in *Figure 1* as the output pattern corresponding to P_1 on the initial PPF, at which *Line 1*, with a slope of $-p = -(p_m/p_S)$ equals the slope of the strictly concave PPF, which, by definition, is the marginal rate of transformation of services into manufactured goods ($MRT_{SM} = \frac{dS}{dM} | Technology$).

---

[9] Once the values of $\hat{K}_m$ and $\hat{K}_s$ are determined (in terms of exogenous variables) from (3) and (4) respectively, substituting these values in the values of marginal product of unskilled and skilled labor also determine the general equilibrium values of the unskilled and skilled wage rates thus: $\hat{w}_L = p_m F_L(\bar{L}, K_m)$ and $\hat{w}_H = p_S G_H(\bar{H}, K_m)$. However, the general equilibrium values of these wage rates are not material to the argument we develop here.

[10] It is well known, as in Jones (1971), that for such an economy with exogenously determined supply of capital also, the PPF, defined as the maximal output of S for different feasible outputs of M, can be derived solely from the production functions (1) and (2), and the three factor-supply constraint, including $K_m + K_s = \bar{K}$, as $S = \varphi(M; \bar{L}, \bar{H}, \bar{K})$, with the property that $dS/dM < 0$ and $d^2S/dM^2 \le 0$, so that given the technology and fixed factor supplies, *the location of the PPF is stationary in the output space insofar as it is invariant to changes in commodity or factor prices*, and a higher output of one sector is possible only with a lower output of the other sector. Clearly, $\varphi(.)$ is not the same sort of PPF as $f(.)$ in (5). We do not deal with the details of the exogenously fixed capital model here simply because its treatment is quite standard and available in most texts.

[11] We do not entertain here the case of a large country simply because, aside from the issues arising from the Metzler paradox (a higher tariff may lead to a lower domestic relative price of the imported good), no additional insight is gained with regard to the matter of central interest here, which is the invariance or otherwise of the domestic production set to domestic commodity price changes.
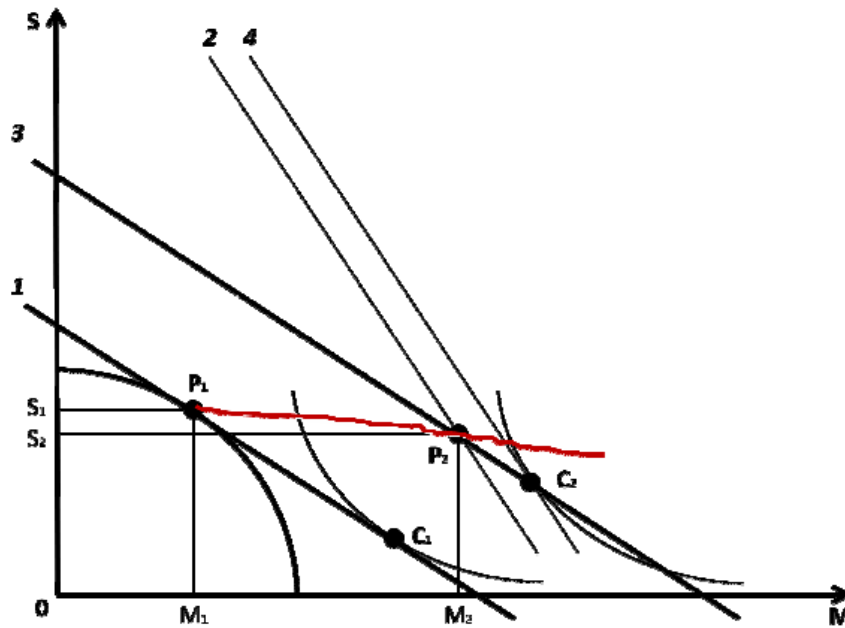
Figure 1

Line 1 is also the country's consumption possibility frontier, or CPF, because foreigners are willing to trade with this country at the rate of exchange of p units of services per unit of the manufactured goods. Depending upon the preferences of the residents of this country, consumption pattern could be anywhere on *Line 1*, such as at C_1, where a strictly convex community indifference curve is tangent to the CPF insofar as the marginal rate of indifferent substitution, MRS_{SM}, of services for manufactures, which is the consumers' psychological valuation of a unit of manufactures in terms of services, equals the same price ratio, $-p = -(p_m/p_S)$. Of course, no social welfare connotation is being ascribed to such an indifference curve.[12] Suppose next that the government imposes an import tariff on the imports of manufactures (clearly, the society is consuming more manufactures than it produces, if one compares C_1 with P_1). Now, $p_m = p_m^* + t$, where $t > 0$ is the import tariff, so that, given the normalization, the domestic price of manufactures is now higher than before, and the domestic price of services is lower than in the initial Walrasian general equilibrium, $p_S < p_S^*$. These new prices are reflected in the slope of the steeper *Line 2*. Given well-behaved, upward rising, general equilibrium supply curves (implied by the conditions imposed on the production functions), the output of M will be higher, and that of S lower, simply because, with a higher p_m, the LHS of (3) is higher, and equilibrium can only be restored by a lowering of the marginal product of capital in manufacturing, which, given the law of diminishing returns, can only be accomplished by an increase in K_m, so that the employment of capital in manufacturing must be higher. With a given employment of unskilled labor in manufacturing at $\bar{L}$, from (1) it is clear that manufacturing output will necessarily be higher at M_2.

Conversely, due to a lower domestic price of the service sector output, its capital employment will be lower, and with the fixed supply of skilled labor employment, its output will necessarily be lower, at S_2. Thus, $(M_2,S_2) = P_2$ is the new production pattern in this economy, at a positive tariff. The new consumption pattern is C_2 on a different CPF given by *Line 3*, at which another community indifference curve is tangent to the tariff inclusive domestic price ratio, given by the absolute value of the slope of *Line 4*, which is parallel to *Line 2*.

---

[12] Group behavior of consumers may be *described* (representable) by that of a single (community) indifference map if personal preferences are identical and homothetic for all persons, but this constitutes no basis for declaring that such a representation should, or ought to, have any social welfare significance if interpersonal incomes are not also perfectly equal, except on the basis of a distributional value judgment that equal weights *ought* to be attached to persons' (poor and rich alike) consumption bundles despite non-identical incomes, which would be fine, if explicitly acknowledged as a value judgment. Otherwise, everyone in society would also have to have exactly the same income, in addition to identical and homothetic preferences, so that it would effectively be a Robinson Crusoe economy, without man Friday; an economy would, in such a case, be indistinguishable from a person. We make no such claim.

Of course, at world prices, p_m^* and p_S^*, it is possible that $p_m^* (M_2 - M_1)$, which is the increase in the value of manufactured output at world prices, may be greater than, or less than, $p_S^* (S_1 - S_2)$, which happens to be the fall in the value of the service sector output. If $p_m^* (M_2 - M_1) > p_S^* (S_1 - S_2)$, at world prices the GDP of the country rises (which is the case presented in Figure 1); it falls otherwise, except in the unusual event that it remains constant.

However, does P_2 lie on a different PPF? It certainly does not lie on the same market-invariant PPF as does P_1. Can we say that P_2 lies on a distinct market-invariant PPF? We could, but, that would be off target from the message of this paper, because the rest of the points on any such hypothetical market-invariant PPF are operationally irrelevant for the economy. Thus the crucial point is that, under endogenous international capital mobility, which in the post-crisis world is a statistically significant phenomenon in most countries (both developed and developing), the production pattern gets endogenously shifted from P_1 to P_2, by the choice of government policy, which is here a positive import tariff, so that the consumption pattern can be anywhere on *Line 3* through P_2. However, P_2 does *not* lie on the same market invariant PPF. Instead, the bold red *curve connecting P_1 and P_2 that is monotonically decreasing constitutes the endogenous, market-dependent path of production pattern of this economy that is predicated parametrically on the value of the tariff that lies between zero and the prohibitive level.*

It is important to note that extending the curve above or below P_2 to force it to lie on another PPF would be an error because these additional points will never be realizable by the country. While the boundary of the new domestic production set still exists, it does not constitute a frontier simply because any output pattern other than P_2 on this boundary is simply not producible by this economy, and thus does *not* constitute a *production* possibility. This is due to the fact that market forces, in response to a different value of the tariff, will alter the boundary of the domestic production set yet again, and the new production patter, P_3 say, will lie on the boundary of yet another market-invariant domestic production set, but not lie anywhere else on the boundary of such a domestic production set through P_2. Such is the nature of dependency of the domestic production set on market forces.

Both Shiller (2010) and Stiglitz (2011), among others have called for endogenizing some variables that were in the pre-crisis world taken to be exogenously specified in economic models. Our work presented here is in the spirit of the direction suggested by Shiller and Stiglitz with respect to endogenizing the PPF so as to convert the unidirectional relationship, from exogenous PPF changes influencing market equilibrium prices, but not vice versa, to a bidirectional relationship, in which market price changes affect the production pattern of the economy *by altering its domestic production set*. Thus the size and shape of the economy's domestic production set actually shrinks or expands, certainly its shape changes, in response to market price changes, which, in turn may be policy induced. This possibility is entirely precluded in the traditional literature in economics and in general equilibrium theory, all the way from Haberler (1930), to Arrow and Debreu (1954), Koopmans (1957), and Debreu (1959), right up to the present time, as in Baumol and Blinder (2012), and Varian (2010), among others.

Implications for Economics Education

What are the implications of the argument of this paper for economics education? We do not want to suggest that the concept of a PPF, as it is found in every economics textbook, should be abandoned in teaching economics. Rather, it is a highly useful pedagogic devise to illustrate ideas like scarcity, opportunity costs, or efficiency. So the PPF should remain an essential component of the traditional curriculum in economics.

Nevertheless, students with more training in economics, especially in modern economic reality of the 21st century, ought not to be misled into believing that a PPF remains stationary and rooted to one location. Nor indeed, should the students be told that *only* errant exogenous shocks, rather than changes in the behavior of decision making units in an economy, private or public, shift the PPF. On the contrary, teaching of economics must also take into account the effects of active policy intervention on the alteration of a countries production set, which are unambiguously endogenous, as we have shown with the concept of a market-dependent PPF.

Moreover, as noted above, this issue is important to understand because the properties of an economy with a market-dependent PPF are radically different from those of an economy with a market-invariant PPF. First, this is due to the fact that, in addition to the commodity flows into or out of a country, international capital flows back and forth constitute an additional channel of quantity adjustments for the attainment of a new equilibrium consequent upon a policy-induced commodity-price shock. Second, the consequent domestic production set changes can magnify the consequences of relative commodity price changes, leading to greater volatility in GDP and

unemployment of labor. Third, such changes in the domestic production set also induce additional income and growth (or contraction) effects, which are positive for countries that are net recipients of FDI, and negative for countries that experience a net outflow of FDI.

Therefore we suggest the following modifications to the teaching of economics:

(1) After introducing the concept of a PPF early in the course, and after its discussion, the students should be made aware that this PPF is of one type, but that the issue is deeper, and shall need further investigation later in the course. In particular, the changed character of modern economies of the early 21st century calls for a distinction to be made between two distinct types of PPFs—market-invariant *versus* market-dependent. These however, will be discussed in detail when the chapter on general equilibrium with production is taught.

(2) The instructor must also communicate early on that the PPF may have in the past been a relatively stationary curve during a given year, which is the typical period of interest insofar as GDP etc. are annual flow concepts. However, due to swift capital relocation across countries, such stillness is no longer empirically true today.

This can be discussed informally at early stages of the curriculum, but would need to be given a fuller treatment later in the course, based on the marginal productivity of capital, the law of diminishing returns, and the role they play in determining the cross county allocation of capital. Possible chapters, where this could be taken up are: international trade and capital mobility, comparative advantage, and general equilibrium with production.

Concluding Remarks

The conclusions we have reached have very substantial consequences for economic theory, general equilibrium theory and for macroeconomics. For, policy-induced or external-shock-provoked changes in domestic relative prices do not merely change the points of tangency of the price hyper-planes with the PPF, but they also alter that shape of the domestic production set, and thereby change the production pattern, both due to (1) resource reallocation effects and (2) production-set change effects. With significantly more rapid international capital mobility, conclusively demonstrated by Razin and Sadka (2007), a single-minded obsession with the consequent *movements along a pre-existing* PPF due to commodity price changes will fail to capture the full effect, since such movements completely ignore the effects of induced domestic production set changes. With the consideration of a market-invariant PPF, attention gets unduly focused exclusively on resource reallocation among industries, which is a consequence solely of substitution effects (the matrix of factor-price derivatives of factor-demand functions is negative definite, see Neary (1985)), while the actual income effects that arise due to changes in the quantity of capital that locates in the country are utterly disregarded.

We do not claim that trade-offs in the production of alternative commodity combinations are irrelevant. Indeed they remain perfectly relevant. We merely point out that these substitution effects are only part of the story, and that *there exist circumstances* under which they may well be much less significant, particularly if they are overwhelmed by the magnitude of endogenous domestic production set changes stimulated by international capital mobility, in turn provoked by changes in domestic relative market prices that are engineered by government policy.

An implication is that, with regard to the effects of market price changes on an economy's domestic production set, the traditional separation in general equilibrium theory as well as in macroeconomics between technology and factor supplies on the one hand, and market-determined prices of commodities and factors, on the other hand, is no longer a valid assumption to make. Technology of production and supplies of factors of production, and the markets in which they connect with other markets, including of final goods, are all inextricably connected. This is one salient feature of economies that is captured by a market-dependent domestic production set, though disregarded by a standard market-invariant PPF in the extant literature. Just as general equilibrium market prices are not invariant to exogenous changes in the domestic production set, so the shape and size of an economy's domestic production set is not invariant to changes in market prices.

The straightforward and implementable implications of our argument for economics education have been spelled out in the previous section. It is our hope that teachers of economics will benefit from our contribution.

References

Acemoglu, D., M. Golosov, A. Tsyvinski, and P. Yared. 2012. "A Dynamic Theory of Resource Wars." *Quarterly Journal of Economics* 127(1): 283-331.

Arrow, K.J., and G. Debreu. 1954. "Existence of an Equilibrium for a Competitive Economy." *Econometrica* 22(3): 265-290.

Azariadis, C., and C.A. Pissarides. 2007. "Unemployment Dynamics with International Capital Mobility." *European Economic Review* 51(1): 27-48.

Baumol, W.J., and A.S. Blinder. 2012. *Economics: Principles and Policy,* 12th edition. Mason: Cengage.

Bezmen, T.L. 2006. "Foreign Aid under Quantitative Restrictions: Welfare Effects and International Factor Mobility." *Review of International Economics* 14(4): 709-721.

Blanchard, E.J. 2009. "Trade, Taxes and International Investment." *Canadian Journal of Economics* 42(3): 882-899.

Blinder, A.S. 2010. "Teaching Macro Principles *after* the Financial Crisis." *Journal of Economic Education* 41(4): 385-390.

Carson, N., and P. Tsigaris. 2011. "Illustrating Enviromental Issues by Using the Production-Possibility Frontier: A Classroom Experiment." *Journal of Economic Education* 43(3): 243-254.

Chandra, V., and N. Naqvi. 1997. "Protection and the Shadow Price of Foreign Exchange with Increasing Returns and International Capital Mobility." *Canadian Journal of Economics* 30(4a): 959-967.

Debreu, G. 1959. *Theory of Value: An Axiomatic Analysis of General Equilibrium*. New Haven: Yale University Press.

Franck, D. 1999. "Tariff and Quota Reform with International Capital Mobility." *Southern Economic Review* 66(1): 132-143.

Goolsbee, A., S. Levitt, and C. Syverson. 2013. *Microeconomics*. New York: Worth Publishers.

Haberler, G. 1930. "Theory of Comparative Costs and Its Use in the Defense of Free Trade." In *Selected Essays of Gottfried Haberler*, editzed by A.Y.C. Koo. Cambridge, MA: MIT Press 1985.

Jones, R.W. 1971. "A Three-Factor Model in Theory, Trade and History." In *Trade, Balance of Payments and Growth: Papers in International Economics in Honor of Charles P. Kindleberger*, edited by J.N. Bhagwati, R.W. Jones, R.A. Mundell, and J. Vanek. Amsterdam: North-Holland.

Koopmans, T.C. 1957. *Three Essays on the State of Economic Science*. New York: McGraw-Hill.

Krugman, P. 2009. "How Did Economists Get it so Wrong?" *New York Times Magazine*, Sept. 2, 2009. http://www.nytimes.com/2009/09/06/magazine/06Economic-t.html?pagewanted=all (accessed August 29, 2011).

Krugman, P., and R. Wells. 2013. *Microeconomics*, 3rd edition. New York: Worth Publishers.

Lal, A.K. 1995. "Increasing Returns, Urban Unemployment, and International Capital Mobility: A Trade Policy Analysis." *Journal of Development Economics* 46(1): 181-193.

Marktanner, M. 2004. "Externalities, International Policy Cooperation and System Competition." *Global Business & Economics Review* 6(1): 171-182.

Mundell, R.A. 1957. "International Trade and Factor Mobility." *American Economic Review* 47(3): 321-335.

Neary, J.P. 1985. "International Factor Mobility, Minimum Wage Rates, and Factor-Price Equalization: A Synthesis." *Quarterly Journal of Economics* 100(3): 551-570.

Neary, J.P. 1988. "Tariffs, Quotas and Voluntary Export Restraints with and without Internationally Mobile Capital." *Canadian Journal of Economics* 21(4): 714-735.

Neary, J.P. 1995. "Factor Mobility and International Trade." *Canadian Journal of Economics* 28(Special Issue): S4-S25.

Neary, J.P., and F.P. Ruane. 1988. "International Capital Mobility, Shadow Prices, and, the Cost of Protection." *International Economic Review* 29(4): 571-585.

Olson, T.L. 1997. "Construction of Consumption Possibility Frontiers in Principles Textbooks." *Journal of Economic Education* 28(1): 76-81.

Razin, A., and E. Sadka 2007. *Foreign Direct Investment*. Princeton, NJ: Princeton University Press.

Shiller, R.J. 2010. "How Should the Financial Crisis Change How We Teach Economics?" *Journal of Economic Education* 41(4): 403-409.

Stiglitz, J.E. 2011. "Re-thinking Macroeconomics: What Failed, and How to Repair It." *Journal of the European Economic Association* 9(4): 591-645.

Varian, H.R. 2010. *Intermediate Microeconomics,* 8th edition. New York: W.W. Norton & Company.

Swansonomics: Using "Parks and Recreation" to Teach Economics

L. Brooke Conaway and Christopher Clark[1]

ABSTRACT

Based on a first-year multidisciplinary course, Swansonomics is a class where students examine the libertarian beliefs espoused by the character Ron Swanson from the television series *Parks and Recreation*. The show provides great examples of rent seeking, fiscal policy issues, social policy issues, and bureaucratic incentive structures. These *Parks and Recreation* video clips can be used in any class to cover a variety of issues. Examples of topics include the expected economic consequences of specific political or economic philosophies, unintended consequences of policies, various systems of taxation, public and private incentive structures, and varying degrees of capitalism and government intervention.

Introduction

This paper is based on a first-year multidisciplinary course taught at a liberal arts university. The course covers a variety of topics, with particular emphasis on different economic systems, varying degrees of capitalism, government intervention, and public choice issues. It is meant to introduce students to economic concepts through the use of the popular TV show, *Parks and Recreation*, and in particular the character Ron Swanson. An example syllabus for the course is provided in the appendix and we discuss how this particular class was taught; however, the paper is organized so that these *Parks and Recreation* video clips and quotes can be used as tools for teaching economic concepts to undergraduates in any class.

To improve student application of economic concepts, several innovative pedagogical methods have been explored. Tinari and Khandke (2000), Mateer and Rice (2007), Hall and Lawson (2008), Hall et al. (2008), and Krasnozhon (2013) suggest ways to use music to teach economic concepts. Willingham (2009) noted that students tend to remember everything they see on television, but do not remember lecture material. The role of visual media in information retention has led to the increasingly popular pedagogical approach of using video clips in the classroom.

Ghent et al. (2010) show how episodes of *Seinfeld* can be used to teach economic concepts, Luccasen and Thomas (2010), Gillis and Hall (2010), and Hall (2014) show that the same can be done with episodes from *The Simpsons*, and Kuester et al. (2014) use episodes from *The Office*. Leet and Houser (2003) illustrate how classic films and documentaries can be used to teach principles courses, while Mateer and Stephenson (2011) discussed film clips that can be used to teach public choice. Based on this previous work and thanks to the newfound fame of Ron Swanson of *Parks and Recreation*, we believe there is a way to wrap the topics covered in various economics courses in a culturally relevant shell that will help solidify the application of economic concepts.

Who is Ron Swanson?

Parks and Recreation is a television show on NBC created by Greg Daniels and Michael Schur. This mockumentary comedy series follows the lives of those working in the Parks and Recreation Department of

---

[1] Conaway: Assistant Professor of Economics, Department of Economics & Finance, Georgia College & State University, Milledgeville, GA 31061, brooke.conaway@gcsu.edu. Clark: Associate Professor of Economics, Department of Economics & Finance, Georgia College & State University, Milledgeville, GA 31061, christopher.clark@gcsu.edu.

Pawnee, Indiana. Nick Offerman plays Ronald "Ron" Ulysses Swanson, the director of the department, who is known for outwardly professing to be a libertarian and for his humorous quotes related to government, meat, and general manliness. The irony of his character is that he works for the government, yet would like to see all of it, including the Pawnee Parks and Recreation Department, privatized and the money returned to taxpayers. He particularly enjoys using his job as a way to limit the reach and spending of the Pawnee local government.

Ron Swanson's initial small cult following has ballooned into a mainstream phenomenon since the show recently ended its sixth season. Now many college students recognize his trademark mustache and deadpan humor. This recognition is the catalyst to get students to look at economic concepts in a new light with an interesting pop culture twist. Though his character rarely shows emotion and his political philosophy is vilified by many, he has managed to become a break out star and fan favorite. Ron has many admirable qualities that provide some common ground for those with differing political views. [2] We hope his humor and outlook on life will be good facilitators for discussions on relevant political issues, particularly how his libertarian ideas might play out in the real world.

Video clips from the show can be shown through a Netflix account, which currently hosts seasons 1 – 6. Ron's quotes, season and episode numbers, and starting and ending times for each clip are included in Table 1.

[Please see table 1 on the following page]

Other clips from the show that can be shown in conjunction with the original Ron quote are also provided in Table 1. The quotes are divided into three general headings with specific concepts that can be covered using each quote. Articles covering real world issues related to each topic, as well as other video clips, can be used in the discussion to illustrate application of concepts. Links for real world application articles that supplement these quotes are provided in Table 2, which is located in the appendix. The remainder of the paper includes a discussion of these quotes, and the topics, video clips and real world application articles related to each.

---

[2] Chaney (2012)

Table 1.   **Ron Swanson Quotes and Economic Content**

Episode	Quote	Economic Concepts
Topics in Principles Courses		
Season 5 Episode 16 "Bailout"	"I'll have the #9." "Sir, that's a party platter. It serves 12 people." " I know what I'm about, son." (17:15 – 18:29; Season 5 Episode 1 "Ms. Knope Goes to Washington" 1:30-2:40)	Consumer preferences, legislation based on the idea of irrational consumer preferences
Season 3 Episode 6 "Indianapolis"	"Just give me all the bacon and eggs you have. Wait...wait. I worry what you heard was: Give me a lot of bacon and eggs. What I said was: Give me all the bacon and eggs you have." (19:29 – 20:00)	Consumer preferences, obesity and moral hazard
Season 2 Episode 15 "Sweetums"	"The whole point of this country is if you want to eat garbage, balloon up to 600 pounds and die of a heart attack at 43, you can! You are free to do so. To me, that's beautiful." (11:00 – 11:20; Season 5 Episode 2 "Soda Tax" 4:11 – 5:20)	Fat tax, large soda bans, obesity problem, role of government, substitution, inferior goods
Season 2 Episode 15 "Sweetums"	"I call this turf 'n' turf. It's a 16 oz. T-bone and a 24 oz. porterhouse. Also, whiskey and a cigar. I am going to consume all of this at the same time because I am a free American." (18:11 – 19:50)	Regulations concerning drugs, smoking, abortion, prostitution, etc.
Season 2 Episode 18 "The Possum"	"You've got hazardous chemicals over there." "Yeah, which only I am breathing. It's the same liberty that gives me the right to fart in my own car. Are you going to tell a man he can't fart in his own car?" (5:19 – 6:20; 6:50 – 7:18; 10:58 – 12:00; 17:57 – 18:50)	Protecting people from themselves, externalities, allocation of common resources under private vs. public ownership
Season 2 Episode 22 "Telethon"	"Give a man a fish and feed him for a day. Don't teach a man to fish…and feed yourself. He's a grown man. And fishing's not that hard." (11:10 – 12:00; Season 5 Episode 1 "Ms. Knope Goes to Washington" 0:00-1:09)	Tragedy of the Commons, overfishing, genetically modified food, environmental issues
Season 2 Episode 9 "The Camel"	"I got my first job when I was 9 working at a sheet metal factory. In two weeks, I was running the floor. Child labor laws are ruining this country." (2:50 – 3:19)	Sweatshops, child labor, minimum wage and safety regulations, monetary and non-monetary wages, fair trade goods
Season 3 Episode 10 "Soulmates"	"I love Food and Stuff. It's where I buy all of my food and most of my stuff." (12:45-13:10; 5:50-6:28)	Wal-Mart vs. mom and pop shops, competition , predatory pricing, unionization
Season 2 Episode 8 "Ron and Tammy"	"On my death bed my final wish is to have both my ex-wives rush to my side so I can use my dying breath to tell them both to go to hell one last time. Would I get married again? Absolutely. If you don't believe in love, what's the point of living?" (3:30 – 4:20; Season 2 Episode 1 "Pawnee Zoo" 6:40 – 8:20)	Enforcing voluntary contractual agreements, marriage equality debate
Season 5 Episode 17 "Partridge"	"Do you know if one can pay court ordered settlements in gold? … I'm not sure how much money I have, but I know how many pounds of money I have." (16:48 – 17:10)	Commodity backed vs. fiat money, inflation tax, monetary policy, bitcoin

Notes: Running times for each clip are provided in parentheses. Some quotes also include additional clips from the show that are relevant to the corresponding concepts.

Table 1. Continued	**Ron Swanson Quotes and Economic Content**	
Episode	Quote	Economic Concepts
Topics in Comparative Economic Systems and Institutions		
Season 4 Episode 19 "Live Ammo"	"I have so many ideas. Some are simple like take down traffic lights and eliminate the post office. The bigger ones will be tougher, like bring all this crumbling to the ground." (3:47 – 4:23)	The difference between anarchy and libertarianism, an introduction to the various economic philosophies
Season 5 Episode 16 "Bailout"	"The free market is a jungle; it is beautiful and brutal and should be left alone. When a business fails it dies and a new business takes its place. Just let business be business, and let government be government." (17:19 – 18:29)	Capitalism, competition, creative destruction, economic freedom, rule of law
Season 1 Episode 4 "Boys' Club"	"My idea of a perfect government is one guy who sits in a small room at a desk, and the only thing he is allowed to do is decide who to nuke." (18:00 – 18:39)	National defense, public goods, the size of government as a % of GDP
Season 3 Episode 1 "Rainy Day"	"Capitalism: God's way of determining who is smart and who is poor." (4:23 – 5:19; Season 4 Episode 17 "Campaign Shake-up" 1:30 – 2:40, 10:08 – 11:06, 11:22 – 11:58, 15:08- 17:09, 17:56-20:22)	Progressive income tax, transfer programs (e.g. Social Security, Medicare, ACA, etc.), income inequality, redistribution, degrees of capitalism
Season 5 Episode 16 "Bailout"	"Capitalism is the only way, Leslie. It's what moves our country forward. It's what makes America great and England okay and France terrible." (17:15 – 18:29)	Public vs. private incentives, rent seeking vs. creative destruction, degrees of capitalism
Season 6 Episode 1 "London Part 2"	"Just thought you needed some fresh air…even if that air is filled with the foul stench of European socialism." (26:49 – 28:30; Season 5 Episode 16 "Bailout" 7:50 – 9:38)	Socialism, communism and Marxism, government monopolies and production
Topics in Public Choice		
Season 5 Episode 19 "Article Two"	"There are only three ways to motivate people: money, fear, and hunger." (10:08 – 11:09)	Incentives and the idea of self-interest, bureaucratic self-interest, public vs. private charity
Season 1 Episode 2 "The Reporter"	"I like Tom. He doesn't do a lot of work around here. He shows zero initiative. He's not a team player. He's never wanted to go that extra mile. Tom is exactly what I'm looking for in a government employee." (19:00 – 19:10; Season 5 Episode 18 "Animal Control" 0:00 – 1:20; Season 5 Episode 16 "Bailout" 0:00 – 1:40; Season 2 Episode 23 "The Master Plan" 8:39 – 11:40)	Public vs. private incentives, public vs. private pay, inefficiencies of government
Season 1 Episode 5 "The Banquet"	"I enjoy government functions like I enjoy getting kicked in the nuggets with a steel toed boot." (5:38 - 18:15)	Politics and rent seeking, post office vs. UPS store, public school monopolies
Season 5 Episode 5 "Halloween Surprise"	"Am I interrupting anything important?" "Impossible, I work for the government." (0:00 – 0:08)	Inefficiency, public unions vs. private unions

Notes: Running times for each clip are provided in parentheses. Some quotes also include additional clips from the show that are relevant to the corresponding concepts.

Table 1. Continued	**Ron Swanson Quotes and Economic Content**	
Episode	Quote	Economic Concepts
	Topics in Public Choice Continued	
Season 1 Episode 1 "Pilot"	"I think that all government is a waste of taxpayer money. My dream is to have the park system privatized and run entirely for profit by corporations, like Chuck E. Cheese. They have an impeccable business model." (15:48 – 16:19)	Public, common, club and private goods
Season 2 Episode 15 "Sweetums"	"I think the entire government should be privatized. Chuck E Cheese could run the parks – everything operated by tokens. Drop in a token, go on the swing set. Drop in another token, take a walk. Drop in a token, look at a duck." (2:38 – 3:00)	Privatization of parks, roads and other goods and services
Season 1 Episode 2 "Canvassing"	"There's a new wind blowing in government, and I don't like it. All of a sudden there's all this federal money coming in and Paul, the city manager, is telling us to build parks, start new community programs. It's horrifying." (9:05 – 10:00)	Government spending on public goods, free rider problem
Season 5 Episode 15 "Correspondents' Lunch"	"I have a joke for you. The government in this town is excellent and uses your tax dollars efficiently." (2:00 – 3:00)	Inefficiencies, rent seeking and government spending
Season 2 Episode 23 "The Master Plan"	"Once a year every branch of government meets in a room and announces what they intend to waste taxpayer money on. For a libertarian such as myself, it's philosophically horrifying." (4:44 – 5:20; Season 5 Episode 21 "Swing Vote" 0:00-1:10, 6:29-8:29, 10:55- 12:00, 13:30-14:40, 16:20-17:20, 18:09-19:30, 20:00-21:00)	Government spending, political incentives, budget cuts and fiscal policy
Season 5 Episode 21 "Swing Vote"	"I believe in cutting useless government projects. I also believe in cutting useful projects, future projects and past projects. The Hoover Dam is a travesty." (0:00 – 1:10)	Concentrated benefits and dispersed costs problem, government debt
Season 3 Episode 1 "Go Big or Go Home"	"Cursing: there is only one bad word – taxes." (4:23 – 5:19) *Note: Ron does not actually say this, it is on his Swanson Pyramid of Greatness	Progressive income tax, Fair Tax, flat tax, VAT, sin taxes
Season 3 Episode 14 "Road Trip"	"It's never too early to learn that the government is a greedy piglet that suckles on a taxpayer's teat until they have sore, chapped nipples." (4:29 – 4:50; 6:04 – 7:00; 10:32 – 11:10; 17:02 – 17:50; 20:50 – 21:21)	Taxes of all forms, who pays taxes (1% vs 47% discussion), the Tea Party, Atlas is Shrugging, interest groups and rent seeking for tax breaks
Season 5 Episode 16 "Bailout"	"The government should not prop up a failed business. That would be like giving food to a mortally wounded animal." (8:00 – 9:40; 6:09 – 7:10; 11:00 – 12:19; 13: 40 – 15:09)	The bailouts and stimulus, bailouts and moral hazard, the cost of saving certain jobs

Notes: Running times for each clip are provided in parentheses. Some quotes also include additional clips from the show that are relevant to the corresponding concepts.

Evaluating Ron's Views: The Structure of the Class

The Swansonomics course was designed as an introductory course on comparative economic systems meant for students who are primarily freshmen non-majors. Our aim was to make the subject more interesting to modern students by linking it to *Parks and Recreation*, and in particular Ron Swanson. This course places a major focus on alternative capitalist systems, including significant coverage of public choice issues as they relate to this comparison. Djankov et al. (2003) argue that comparative economics is not dead, but rather the focus should be shifted to a comparison of alternative capitalist systems as most of the world moves away from the traditional socialism of Eastern Europe and the Soviet Union. Economic educators can use the format of this Swansonomics class as a way to generate interest in what Djankov et al. (2003) call "the new comparative economics."

Because the topics we cover in Swansonomics vary broadly across fields, we have tried to format this paper in a way that makes it easy for educators to incorporate these video clips into a variety of classes. When using these clips, it would be worthwhile to remind students that they are designed to get them to think about the economic concepts rather than making them fans or opponents of individual *Parks and Recreation* characters. Video clips can be integrated into lessons in a variety of ways, such as showing the clip after a lecture as an example of application and as a way to facilitate a discussion. Alternatively, video clips can be shown in the middle of lectures to solidify a concept and break up the monotony of lecture-style teaching.

As another example, we structured the Swansonomics course in the following way. Students were first introduced to the topic with a relevant *Parks and Recreation* video clip. This seemed to make students more excited to learn about and discuss the concepts covered. Also, the show's humor helped to grab their attention at the beginning of the class. Next, the relevant lecture material was covered and students were expected to give feedback during the lecture. For example, students may be asked, "Why do you think Ron hates taxes?" and later asked, "Why are tax revenues important?" This provides a good segue into covering the different types of taxes and their various effects, costs and benefits.

Relevant current event articles and other video clips were used after the information was covered to reinforce concepts and illustrate real world applications. Students were then given time outside of class to find relevant articles to bring to the next class period. They were expected to turn in written assignments evaluating these articles using economic concepts learned in the previous class period. Each student was also expected to present the information to the rest of the class. Using legitimate economic concepts, students then argued for or against what they thought Ron's position would be concerning the article's content. This generated interesting class discussions and critical evaluation of different points of view. It also forced the students to work on concept application. Overall, the class was structured so that the amount of time spent on application and debate was about the same as the amount of time spent on presenting the material to the students using lectures and video clips.

As a means of reinforcing concepts, students were also expected to turn in policy memos. These are short 2-3 page memos advocating for specific changes to particular government policies. Students were allowed to choose the specific government policies they thought should be changed. They were expected to turn in written assignments presenting concise arguments for specific changes, including research and using economic concepts to support their recommendations. Students also presented their memos to the rest of the class.

This informal method of student presentation and discussion obviously works best with smaller classes, but larger classes could be divided into groups and expected to engage in a more formal debate. Each group could be assigned to one side of an issue and expected to prepare arguments outside of class before engaging in a formal debate with another group assigned to the opposite side. These debates could be held periodically throughout the semester or at the end of the semester once all lecture material has been presented, and the number of debates could be limited to one or two issues chosen by the instructor. Economics courses are not known for requiring group work, so this could be a way to incorporate a group project into any class.

An example syllabus for the Swansonomics course is provided in the appendix, and examples of relevant articles that can be used for real world application and concept reinforcement are provided in Table 2, also in the appendix.

Ron Swanson Quotes, Relevant Discussion Topics, and Article Application Examples

Below is a discussion of the quotes and relevant *Parks and Recreation* video clips from Table 1, as well as relevant topics that can be covered for each. The quotes have been grouped into three categories for ease of integration into various courses. Links for application examples for each topic are provided in Table 2 in the appendix next to the corresponding Ron quote.

Topics in Principles Courses

The following quotes apply to issues typically covered in principles courses, but they can be used in upper level courses as well. The quotes primarily concern consumer preferences, mutually beneficial exchange, and externalities. Each provides a good set up for discussing economic concepts as applied to various highly politicized issues. We often find that students enjoy using economics to analyze interesting controversial topics.

1) *"I'll have the #9. " "Sir, that's a party platter. It serves 12 people." "I know what I'm about, son."*

   "Just give me all the bacon and eggs you have. Wait…wait. I worry what you heard was: give me a lot of bacon and eggs. What I said was: give me all the bacon and eggs you have."

Many times legislation is passed under the assumption that consumers make irrational decisions. Legislation regarding incandescent light bulbs and energy efficient clothes dryers are good examples. These quotes help motivate a discussion on rationality, consumer preferences and legislation intended to alter consumer behavior. They can also be related to the topic of moral hazard. For example, students may consider how Ron's diet might change if he were not covered by health insurance.

These quotes can also be used in conjunction with the next quote (2) and related to regulations meant to encourage healthy food choices. In the episode "Ms. Knope Goes to Washington," Ron is responsible for throwing the annual parks department barbeque. He makes his rules explicitly clear – there will be no vegetables at this barbeque. This video clip can be used to initiate a discussion on healthy food regulations for public schools, particularly Michelle Obama's Healthy, Hunger-free Kids Act.

1) *"The whole point of this country is if you want to eat garbage, balloon up to 600 pounds and die of a heart attack at 43, you can! You are free to do so. To me, that's beautiful."*

Here, the role of government in the obesity problem can be discussed. In addition to Ron's quote, a clip from the episode "Soda Tax" can be shown, which explores government regulations meant to lower obesity rates. In the clip, Leslie Knope is trying to pass a soda tax in Pawnee, which has a growing obesity problem. She decides to target sodas because of the large sizes offered by a local fast food restaurant. The owner of the restaurant argues that the large sodas offer a huge amount of value for the consumer, yet Leslie argues that no one needs a 512 oz. "child size" soda (roughly the size of a small child).

The ideas of demand and consumer surplus, substitution, inferior and normal goods, regressive taxes and the role of government in policing individual choices can all be discussed. Students may enjoy coming up with examples of inferior food goods and comparing the nutrition in those goods to the nutrition of foods that are considered normal goods. To motivate application, students can be asked the following question, "Based on what you know about inferior goods, why might Mississippi (or, the South in general) have the highest rate of heart disease?" They can then infer why taxes on sodas and junk food might be paid primarily by the poor. Students can also relate this quote to the problem of moral hazard when people

are covered by health insurance, and how behavior might change if more people are insured as a result of the Affordable Care Act.

2) *"I call this turf 'n' turf. It's a 16 oz. T-bone and a 24 oz. porterhouse. Also, whiskey and a cigar. I am going to consume all of this at the same time because I am a free American."*

"You've got hazardous chemicals over there." "Yeah, which only I am breathing. It's the same liberty that gives me the right to fart in my own car. Are you going to tell a man he can't fart in his own car?"

These quotes provide a starting point for discussing the role of government in what people choose to do with their bodies. Asking the students to think about the extent to which government should protect people from themselves is a great way to generate a lively discussion. Various topics, such as regulations making drugs illegal, cigarette and alcohol taxes, prostitution, smoking bans, and abortion, can be explored. Here students can discuss the different incentives for buyers and sellers in black markets compared to legal ones. A good current topic to discuss with students would be marijuana legalization in Colorado and Washington.

Another interesting topic would be government bans on smoking in private establishments and the newly emerging laws regarding e-cigarettes in private establishments. In discussing these bans, students can learn about the problem of negative externalities. Ron's quote concerning his car provides a great example of a situation where there are no negative externalities created by his behavior. Students can contrast that situation with others where externalities are created, the government's role in the presence of externalities, and resource allocation under private ownership compared to public ownership.

3) *"Give a man a fish and feed him for a day. Don't teach a man to fish…and feed yourself. He's a grown man. And fishing's not that hard."*

This quote can be used to motivate discussions concerning environmental issues, like the tragedy of the commons. By not teaching a man to fish, Ron may get more fish for himself. This could be used as an illustration of the incentives of private individuals when using commonly owned resources, and students can think about why we would see overfishing in public waters if "fishing's not that hard."

In the episode "Ms. Knope Goes to Washington," Leslie is in D.C. trying to get federal funding to clean up the Pawnee River. Here, students can consider the incentives for citizens to take care of public property compared to their own private property. In this clip, Leslie gives Andy a tour guide book to help with navigating the city, but then immediately tells him to throw it away because she will be his guide to D.C. Andy then throws the book directly into the Lincoln Memorial Reflecting Pool; Leslie, of course, makes him get the book out of the pool. Here students can consider how public property would be treated if each person had to clean up his own mess, like Andy, compared to a situation when city workers are responsible for cleaning it up. This clip is a great introduction to the tragedy of the commons, pollution, and the government's role in the presence of environmental externalities.

4) *"I got my first job when I was 9 working at a sheet metal factory. In two weeks, I was running the floor. Child labor laws are ruining this country."*

Sweatshops and child labor in poor countries are often pointed to as negative effects of freer international trade. Students will likely want to talk about the impact on poor countries from developed nations whose economic systems rely on free trade policies. They can discuss whether people in poor countries are being exploited or benefited when rich countries buy goods produced with such controversial labor. Here, the difference between non-monetary wages (e.g. safety) can be contrasted with monetary wages. The effects of buying fair trade goods can also be covered.

A few current examples can be used here, such as Raveena Aulakh's undercover report on a sweatshop in Bangladesh and the Rhana Plaza collapse. The students can also read Nicholas Kristof's article on the impact of sweatshops in Africa. A report on the use of sweatshop and child labor to make goods for

Walmart from the Global Labour and Human Rights Committee can be covered, which provides a good segue into the next topic.

5) *"I love Food and Stuff. It's where I buy all of my food and most of my stuff."*

This is clearly a reference to Walmart and serves as an opportunity to discuss the debate surrounding the effects, both good and bad, of the way Walmart does business. This is also an opportunity to discuss the concepts of economies of scale, predatory pricing, consumer welfare, payment schemes, and minimum wage. Students may also want to address arguments made against Walmart by websites like www.walmart1percent.org and the expected effects on various groups if Walmart were to allow unionization.

6) *"On my death bed my final wish is to have both my ex-wives rush to my side so I can use my dying breath to tell them both to go to hell one last time. Would I get married again? Absolutely. If you don't believe in love, what's the point of living?"*

Here the concept of voluntary contractual agreements can be discussed, particularly in the context of the marriage equality debate. Students can consider whether people should be free to make voluntary contractual agreements as long as all parties involved understand the terms. They can also consider the role of government in enforcing these contracts. The "Pawnee Zoo" episode examines this debate in an entertaining way. Leslie thinks it would be cute to spend public funds to have a penguin wedding at the local zoo. Unbeknownst to her, both penguins are male, and this public display results in criticism from the members of the Society for Family Stability Foundation.

The foundation spokeswoman asks Leslie to resign from her public position for using tax dollars to take a public stance in favor of gay marriage. While Leslie's intent was merely to be cute, she runs with this stance to garner support from Pawnee's homosexual population. Students can discuss the role of government in marriage, legal definitions of marriage, enforcement of contractual agreements, and tax incentives or disincentives for marriage.

7) *"Do you know if one can pay court ordered settlements in gold? ... I'm not sure how much money I have, but I know how many pounds of money I have."*

This is an opportunity to introduce the concept of money, how it functions, and its various forms. The differences between commodity backed and fiat money can be discussed here, which leads naturally to a discussion of the Federal Reserve System and monetary policy. Students may benefit from applying what they learn about monetary policy to real examples, such as the Great Depression and the Great Recession. In addition, Zimbabwe always provides a particularly good example of the problems with hyperinflation. Students can discuss why Ron might want to hold gold over dollars and why inflation acts as a tax on savings. We find that students also like to discuss private currencies, like bitcoin.

Topics in Comparative Economic Systems and Institutions

Given that most students do not major in economics, we can safely assume that most graduate without ever having taken a comparative economic systems class. Yet, those graduates will often hear the terms socialist[3], Marxist[4], capitalist[5], communist[6], or similar terms in their everyday lives. Comparative economic systems classes were once very popular, due in large part to the cold war debate between capitalism,

---

[3] DeCoursey (2008)

[4] Ferrara (2012)

[5] Rensin (2012)

[6] Farah (2014)

socialism, and communism; however, even those majoring in economics have become increasingly unexposed to comparative economic systems classes.

Siegfried and Wilkinson (1982) showed that in 1950, 59% of economics programs offered comparative economics courses and 63% were offering the course by 1980. Siegfried and Bidani (1992) found that 66% of programs in liberal arts colleges and 55% of programs in colleges of business offered comparative economic systems courses in 1980. But, according to Petkus, et al. (2012) those courses have become significantly less popular. Only 34.6% of economics programs offered comparative economic systems courses in 2012.

The debate between different economic systems is still going on, particularly over the government's role in mixed economies, and we want our students to be able to critically evaluate this information. Unfortunately, most students do not want to sign up for a course called Comparative Economic Systems. Because the demand for these classes is relatively low, one way to increase student exposure to the concepts would be to work this discussion into other more popular classes, such as Public Choice or Economic Growth.

These Ron Swanson quotes and video clips provide an interesting way to expose students to topics from comparative economics systems. The following quotes provide a structure for discussing the spectrum of economic systems, from pure market economies to pure command economies, which can be condensed down and integrated into a variety of classes. If students don't want to sign up for comparative classes, maybe we can bring some of the material to them. We discuss many relevant examples in this section, and as in the previous section, links to these examples are provided in Table 2 in the appendix.

8) *"I have so many ideas. Some are simple like take down traffic lights and eliminate the post office. The bigger ones will be tougher, like bring all this crumbling to the ground."*

Students should recognize terms like capitalist, socialist and communist, but are probably not able to correctly define or describe the specific philosophies. They are unlikely to know the difference between an economic philosophy and a political one, or the links between the two. Students may also be willing to tell you where they fall in the political/economic spectrum, despite the fact that they just admitted they can't define what those positions actually mean. It is at this point that it may be time to show them a paper by Klein and Buturovic (2011) that indicates individuals do a pretty bad job correctly answering economic questions that force them outside of their political comfort zones.

The above quote is a good way to incorporate a basic introduction to the various political and economic points of view, and how political philosophies are linked to economic philosophies. Most of the Swansonomics course was devoted to studying varied degrees of capitalism, but we think it's worth spending a brief amount of time explaining the two ends of the spectrum – anarchy and communism. This quote in particular is a nice set up for the discussion of anarchy and the different types of anarchist views.

Comedian Andy Cobb made a video depicting Somalia as a libertarian paradise. His video clip can be shown as an example of someone who doesn't know the difference between a pure market economy and anarchy. Ron Swanson is generally described as a libertarian, and that is how he refers to himself, but some of his views lean a bit more toward anarchy. Here, it would be useful to define anarchy and give some examples, so that students do not think of the two philosophies as synonymous.

The 1997 Albanian rebellion can be discussed as an example of the disorder that can result from a lack of stable institutions. Students can also read about medieval Iceland as an alternative example, and they can discuss Iceland's competing chieftains and voluntary associations as a means of rule enforcement. Students can also study the 1991 government collapse in Somalia. Leeson (2007) provides an interesting comparison of economic indicators under General Barre's "scientific socialism" and those indicators after the government collapse. Students can also be introduced to the tradeoff between disorder and dictatorship, as outlined by Djankov et al. (2003).

9) *"The free market is a jungle, it is beautiful and brutal and should be left alone. When a business fails it*

dies and a new business takes its place. Just let business be business, and let government be government."

This quote provides a good opportunity to discuss how markets function when some basic rules are in place, such as the protection of private property rights, impartial contract enforcement, and rule of law. Here the specifics of a free market, the definition of capitalism, and how a pure market economy would function can be covered. This is also an opportunity to discuss the benefits of competition, the role of incentives and the importance of profit, loss, and pricing signals. Leonard Read's *I, Pencil* should help students understand the complexities of the market in meeting the needs of consumers. It is also worth discussing how capitalism as people perceive it in practice appears to differ from what many endorse as an economic philosophy.

Students should be able to discuss the differences between capitalism, as endorsed by Ron, and cronyism, what we generally see in practice. Holcomb and Castillo (2013) have written a short overview of various crony systems compared to the ideals of classical liberalism that Ron seems to admire. At this point students could be introduced to some basic public choice issues, such as bureaucratic incentive structures and rent seeking. Other *Parks and Recreation* examples that can be used here are provided in the *Topics in Public Choice* section of this paper.

This is also a good opportunity to introduce some of the problems that arise in a pure capitalist system. For example, a *Salon* article discusses how a for-pay fire department in Tennessee allowed a man's house to burn down because he did not pay for firefighting services. This will allow the students to contrast the benefits and costs of limited government rules, and the tradeoffs associated with additional government services.

10) *"My idea of a perfect government is one guy who sits in a small room at a desk, and the only thing he is allowed to decide is who to nuke."*

Here, public goods can be introduced and this quote can be linked to something Ron seems to think is a legitimate function of government – national defense. In particular, public goods and the free rider problem can be covered. This is also an opportunity for students to discuss what they feel are legitimate functions of government. Should the government spend more or less on defense, healthcare, transfer programs, education? If a student feels, for example, that spending on education should be increased, ask the student how he would fund this additional spending. Increased taxes? Cutting spending on other programs? This really drives home the opportunity cost concept.

11) *"Capitalism: God's way of determining who is smart and who is poor."*

Students can now begin to think more about outcomes under varying degrees of government intervention and capitalism. Several topics can be discussed here, including economic freedom, poverty, and wealth inequality. A major political concern is wealth inequality, and showing the "Wealth Inequality in America" video is a way to generate discussion on this issue. Students can be exposed to issues such as income mobility, income levels and shares, and various ways to measure inequality. For example, a paper by Stevenson and Wolfers (2008) can be introduced to show that the experience gap between the rich and poor has fallen in the US over time, though measures of wealth and income inequality have risen.

Discussing the differences between inequality created in markets and inequality created by government intervention can help students think about some of the reasons inequality exists. The change in intergenerational inequality over time in the US is an interesting example, and programs like Social Security and Medicare can be covered. Clips from the "Campaign Shake-up" episode can be shown to illustrate how policy may be influenced to favor the old over the young.

In this episode, Leslie Knope is trying to get elected to the city council. She knows in order to do this she needs the "gray vote," or the vote of the elderly population in Pawnee. To get their vote she starts the Ramp Up Pawnee initiative, which would force all buildings in Pawnee to provide wheelchair ramps. Her election opponent, Bobby Newport, offers a competing initiative called Rise Up Pawnee, which would put

an electric chair lift on every outdoor staircase in town. These clips provide a good example of why spending on the elderly makes up such a large percentage of federal spending and the rent seeking that occurs when government distributes resources to specific groups.

These programs can be covered as examples of government distribution of resources compared to market distribution of resources. Programs like Medicare and Social Security are often used in countries that are considered capitalist, so students can be introduced to the *Economic Freedom of the World Report*, by Gwartney et al. (2013), as a way to measure varying degrees of capitalism. From this report, students can see that the US may not be as capitalist as they originally thought. Many often think of Canada as less capitalist than the United States, in part, because of Canada's health care system. Yet, the United States ranks nine places behind Canada in overall economic freedom. The correlation between low economic freedom scores and poverty can also be illustrated using this report.

Once students have had a chance to look at the economic freedom index rankings, they can begin to think about the various policies that would impact this score. As alternative capitalist systems are compared, topics such as taxation, health care, education, and regulatory burden can be explored. From here students should begin to think about the size of government and its effect on the economy. How big should the government be? What effect does government size have on economic growth? Students can also consider the effects of large government debt and the effects of big cuts in government spending. Examples of clips concerning fiscal issues and government spending cuts are provided in the *Topics in Public Choice* section of this paper.

12) *"Capitalism is the only way, Leslie. It's what moves our country forward. It's what makes America great and England okay and France terrible. "*

"Just thought you needed some fresh air…even if that air is filled with the foul stench of European socialism."

The bulk of the Swansonomics course was spent on mixed economies and varying degrees of capitalism; however, a brief overview of command economies was provided at the end. As mentioned earlier, students are unlikely to be able to define words like socialism, communism, or Marxism. Here, students learn the definitions of these words as well as the arguments for and against such institutions. Holcombe and Castillo (2007) provide a discussion of these terms, cover the differences between them, and provide real world examples of each.

It may also be worthwhile to explore various government actions that many refer to as socialist by using the following clip. In the episode "Bailout," Leslie initiates a plan to prop up a failing video rental business. She argues that, "The Pawnee Video Dome is a place with tremendous community value where people gather to expand their horizons." Ron's response to this is to announce at a public hearing that, "This action by Councilwoman Knope is nothing more than a thinly-veiled government bailout and I for one refuse to let her turn this town into a socialist hellscape." Students can discuss the definition of socialism as applied to this example and then relate this discussion to other real world policies that many consider socialist.

Topics in Public Choice

The following quotes are most relevant to public choice topics, specifically the efficiency of the public sector compared to the private sector and the different incentives faced by each. The Swansonomics course incorporated these public choice topics into the above discussion of varying degrees of capitalism. We feel these topics helped to drive home the issues of rent seeking and problematic incentive structures. But, any class covering public choice issues could incorporate these *Parks and Recreation* examples.

As discussed by Mixon (2010), video clips can be beneficial for teaching public choice concepts given the rarity of specialized undergraduate public choice textbooks. Others such as Burgess et al. (2010) and

Mateer and Stephenson (2011) have explored inventive ways of teaching public choice to undergraduates. Mateer and Stephenson (2011) note that film clips used in conjunction with textbook readings may work best for public choice issues covered in introductory classes, while clips accompanying influential public choice papers may be more beneficial for upper level courses. As in the previous two sections, links to the relevant examples discussed below are provided in Table 2 in the appendix.

13) "There are only three ways to motivate people: money, fear, and hunger."

This quote provides an introduction to the idea of incentives and self-interest. We find that students often relate self-interest to greed and think of the two as synonymous. To clarify the definition of self-interest it may be helpful to discuss Leslie Knope and Ron Swanson as two individuals who are equally self-interested, but have different preferences.

Ron is usually portrayed as someone who is self-interested in the sense that he is primarily concerned about himself, his family, and his close friends. Leslie, on the other hand, is often portrayed as someone who is happiest when working tirelessly to help others, even strangers. To the non-economist she may seem anything but self-interested, but to the economist she merely has a different utility function than Ron. It is also important to point out to students that self-interest holds not just for business owners and consumers, but also for government officials. This is an interesting way to introduce students to one of the fundamental concepts in public choice.

14) "I like Tom. He doesn't do a lot of work around here. He shows zero initiative. He's not a team player. He's never wanted to go that extra mile. Tom is exactly what I'm looking for in a government employee."

This quote works as an introduction to the incentive problems that plague governments. In addition to the clip of Ron's thoughts on Tom, two other video clips can be shown to help explain the problem of incentives. In the episode "Animal Control," Leslie Knope tries to find out why stray animals are running wild through the town and is introduced to the incredibly incompetent Animal Control Department.

In conjunction with this, a clip from the episode "Bailout" can be shown. Here, Tom Haverford has recently opened a new business in Pawnee and he hired his best friend's sister to work there. It is clear from the clip that she's a terrible employee. After showing these clips, the incentives of public and private entities can be discussed. In these clips, the incompetent government employees get fired, but the incompetent private employee does not. The costs of not firing incompetent public employees, like the ones working at Animal Control, can be contrasted with the costs of not firing incompetent private employees, like Mona Lisa Saperstein.

A relevant current event can be added by discussing the activities of employees of the Securities and Exchange Commission (SEC). Mark Calabria outlines the SEC's response to the question, "Why can't we fire failed regulators?" Clear shirking during the 2008 financial crisis was discovered, yet the SEC Chair Mary Schapiro said that to fire these employees "would harm the agency's work."

Another clip from the episode "The Master Plan" can be shown to illustrate bureaucratic behavior. Here, two state budget auditors have to determine where budget cuts can be made and Ron is excited that he gets to see these budget cuts first hand. In typical bureaucratic fashion, Leslie defends every penny spent as necessary – even the job of Jerry Gergich, the butt of all office jokes, who is routinely portrayed as being terrible at doing everything. This is a good example of the budget maximization incentive outlined by Niskanen (1975).

15) "I enjoy government functions like I enjoy getting kicked in the nuggets with a steel toed boot."

In the episode "The Banquet," Leslie's mother is receiving a lifetime achievement award for government service – the Tellenson Award. Here, Leslie is trying to impress a zoning board member in order to get zoning approval to build a new park. After unapologetic flattery and schmoozing seem to fail, Leslie's mother tells her it's time to resort to blackmail. At first Leslie refuses by saying, "I want to win a

Tellenson Award someday. They don't give lifetime achievement awards to people who do things like that." Her mother responds, "Sweetheart, they only give lifetime achievement awards to people who do things like that." Her mother then describes the top government bureaucrats at the dinner as "the nastiest, most diabolical people you'd ever want to meet," and explains how each gained such powerful government positions. Students may often associate such tactics with private businessmen, and not with local or state government officials, but this provides a great example of rent seeking within government. This can also be related to rent seeking by private businesses to gain favor from powerful bureaucrats.

Besides government functions, this quote can also be applied to the feeling many get when dealing with government offices like the DMV. The importance of customer satisfaction and competition can be discussed in terms of the long lines experienced at the post office, the DMV, and bread lines under socialism. Richard Velotta (2010) provides a good example of bureaucracy limiting the ability of the DMV in Las Vegas to respond to higher consumer demand. Other related topics that can be discussed include increased competition for the post office due to FedEx and UPS, or Lysander Spooner's private post office. Competition for public schools due to increased school choice can be used as an alternate topic.

Here, government created monopolies can be contrasted with monopolies generated under capitalism. Leonard Read provides a good example of the differences between government monopolies and monopoly power under capitalism by using Standard Oil as an example. Rent seeking for government granted monopoly power can also be covered.

16) *"Am I interrupting anything important?" "Impossible, I work for the government."*

This quote provides a good opportunity to discuss unions, both public and private. The relatively recent controversy of public union protests against Wisconsin Governor Scott Walker can be discussed. The Hostess shut down of Twinkie production, in part due to private union protests, can also be discussed as a current event. This would also be a good opportunity to talk about teachers' unions in public school systems.

When discussing unions, the students may be asked about their opinions on whether Ron would support unions. As an interesting side note, the students could read an article detailing the public union support of Leslie Knope's run for city council on the show. The American Federation of State, County and Municipal Employees is publicly endorsing the fictional character, Leslie Knope, in her fictional run for city council on the show. Students can discuss why they think Ron would not support unions, but Leslie might – although neither says as much on the show. Students may be asked to read *The Communist Manifesto* and discuss Marx's theory of labor compared to labor compensation and competition in a capitalist economy.

17) *"I think that all government is a waste of taxpayer money. My dream is to have the park system privatized and run entirely for profit by corporations, like Chuck E. Cheese. They have an impeccable business model."*

"I think the entire government should be privatized. Chuck E. Cheese could run the parks – everything operated by tokens. Drop in a token, go on the swing set. Drop in another token, take a walk. Drop in a token, look at a duck."

Here students can be introduced to the differences between pure public goods and goods people tend to consider as public simply because they are publicly provided. Students can also explore the idea of privatizing public services, such as the management of Central Park in New York. An interesting point to discuss with students is how well they think government adapts to the ever-changing and varied preferences of its people compared to private businesses.

Another interesting case study deals with the Pennsylvania Liquor Control Board. Currently in Pennsylvania only state run liquor stores may sell alcohol, but grocery stores, drug stores and gas stations want the ability to sell beer and wine. To prevent a bill from passing that would allow the privatization of alcohol sales, the United Food and Commercial Workers Local 1776 union began airing a commercial that

claims the privatization of alcohol sales would kill children. Students can watch the commercial and discuss the motivations of this union and the effects of privatization.

18) *"There's a new wind blowing in government, and I don't like it. All of a sudden there's all this federal money coming in and Paul, the city manager, is telling us to build parks, start new community programs. It's horrifying."*

"I have a joke for you. The government in this town is excellent and uses your tax dollars efficiently."

"Once a year every branch of government meets in a room and announces what they intend to waste taxpayer money on. For a libertarian such as myself, it's philosophically horrifying."

These quotes can facilitate a discussion on fiscal policy and government budgets. Once video clips of the above quotes have been shown, students can discuss what they think the federal government spends most of its money on. We find that students often have been given incorrect information about spending, especially military spending. There are a number of clips from the episode "Swing Vote" that can also be shown to stimulate discussion of government spending and budget cuts. This episode shows Ron and Leslie fighting over budget cuts for the local mini-golf course. The course was getting $9000 a year in subsidies from the city government and Ron wants to cut this program. To stop the cuts, Leslie panders to a city councilman by taking him to the mini-golf course and buying him things. This is a great example of rent seeking on Leslie's part.

Students can be shown a relevant real world example of this behavior in Prichard, Alabama. The city still funded a public golf course, even in the face of bankruptcy. The topic of government spending can also include why governments might pay more for things than private individuals who are spending their own money, such as the $98,670 outhouse in Alaska or the $400,000 camel statue in Pakistan.

19) *"I believe in cutting useless government projects. I also believe in cutting useful projects, future projects and past projects. The Hoover Dam is a travesty."*

Here students can be introduced to the concept of concentrated benefits and dispersed costs. LearnLiberty has published a video, "Why Politicians Don't Cut Spending," that provides a good description of these ideas as they relate to budget cuts. This is a good opportunity to discuss why most voters are rationally ignorant when it comes to government policies, and why we might see government policies that are unpopular with average voters from both major parties continue to remain in place (e.g. subsidies given to large corporations).

Students have likely heard that the federal government has a large debt, but they may not know how large the debt is or the difference between a deficit and a debt. This would also be a good place to discuss the effects of large debts and the debate on how to reduce the debt. Real world examples can be introduced, including the Canadian experience from the 1990s as outlined by Veldhuis et al. (2011). Smith (2014) discusses various methods used to address debt problems, their effectiveness, and their political feasibility.

20) *"Cursing: there is only one bad word – taxes."*

"It's never too early to learn that the government is a greedy piglet that suckles on a taxpayer's teat until they have sore, chapped nipples."

This is an opportunity to discuss the various approaches to taxation, including progressivity, consumption taxes (the Fair Tax), flat taxes, value added and excise taxes, sin taxes, the "death" tax, and negative income taxes. This is also the point at which tax burden can be introduced using several clips from the episode "Road trip." In this episode, Ron explains to an elementary school student how taxes work. A young girl on a field trip to the parks department is supposed to find an employee to interview so that she can write an essay on why government matters. She interviews Ron, who eats half of the girl's lunch to illustrate income and capital gains taxes.

At the end of the episode the girl's mother marches into Ron's office to complain about the essay her daughter wrote after interviewing Ron. In her essay, the girl answered the question of why government matters very succinctly – "It doesn't." Ron later talks to the girl and tells her that for now she should listen to her teachers and read all the books she can, but that when she turns 18 she can drink, gamble and become a libertarian. The girl reminds him that the drinking age is 21, to which Ron replies, "I know…another stupid government rule." These clips provide a humorous way to introduce the effects of various taxes.

Students are likely to bring up the occupy movement and the question of who pays most of the taxes. An interesting article related to this question concerns Mitt Romney's statement that 47% of Americans do not pay income taxes. This is also a point at which progressivity in various countries could be compared. A relevant current event to discuss would be the problem that France is experiencing where higher taxes are driving people out of the country. Greg Mankiw also has a blog post comparing corporate tax rates in the United States to rates in other OECD countries.

21) *"The government should not prop up a failed business. That would be like giving food to a mortally wounded animal."*

Here the business cycle can be introduced and the Great Recession can be covered, which should naturally lead to a discussion of the bailouts, stimulus spending, and fiscal policy, in general. Several clips from the episode "Bailout" can be shown. In this episode, Leslie wants to save a local video rental store – the Pawnee Video Dome. The business is failing because of cheaper substitutes offered online and because the owner does not try to meet the demands of his consumers. Rather than having videos like *Finding Nemo* available for rent, he mostly has obscure dramas and foreign documentaries. As a member of the city council, Leslie tries to get the Pawnee Video Dome declared a historical landmark, which would exempt the business from certain taxes.

Ron calls this a government bailout and vehemently opposes it. The clips provided in the table will take the students through the process of the bailout and show a best-case-scenario where the business uses the bailout as an opportunity to better meet consumer needs. In the end the Pawnee government effectively owns a successful pornographic video rental business. A history of US government bailouts is provided at Propublica and the students can go through some of these examples to see how bailouts work in the real world, what businesses do after bailouts, and the opportunity costs of such policies. A piece in *US News* discusses the importance of the moral hazard problem and bailouts.

Conclusion

We initially designed the Swansonomics course as a way to expose freshman, primarily non-majors, to basic economic principles and topics in comparative and public choice economics. The course was set up as a comparative systems course with a particular focus on public choice and policy analysis in mixed economies. The clips discussed in this paper were meant to serve as hooks to engage students who would then learn the economic concepts that drive the political debates occurring all over the world.

In our experience, students taking the first run of the class were much more engaged in learning the concepts than in traditional "chalk and talk" classes; lack of participation was never an issue. Because the class was offered during the summer, classes were two and a half hours long, which is a testament of the ability of these clips to maintain student interest throughout a class period. Because the lectures were broken up by entertaining and engaging video clips, as well as lively debates and discussions, student attention was maintained for a longer period of time. When leading discussions it was clear that students had paid attention to the material. The challenge became less about getting them to pay attention, and more about teaching them application. Interestingly, there were a few students who had never seen *Parks and Recreation* prior to taking the class, yet the feedback they provided was positive and they enjoyed the clips although they had never seen the show.

In setting up this course we thought these clips and examples may be useful not just for our class, but for any class covering these concepts, and that they could be adapted to fit in nearly any economics class, not just in the areas where we've placed them. Given the popularity of *Parks and Recreation* and its ability

to highlight important viewpoints concerning economic/political systems and public policy issues in an entertaining and engaging way, we believe students will find the examples effective and lasting. We feel Swansonomics is a way to pique the interest of modern students, regardless of major, by making the core concepts more interesting and relevant to their lives.

REFERENCES

Associated Press. 2014. "Colorado fourth graders caught selling grandparents' marijuana at elementary school." *Syracuse*, 23 April. http://www.syracuse.com/news/index.ssf/2014/04/marijuana_elementary_school_fourth_graders_selling_pot.html

Aulakh, Raveena. 2013. "I got hired at a Bangledesh sweatshop. Meet my 9-year-old boss." The clothes on your back, *The Star*, The Star, 11 October. http://www.thestar.com/news/world/clothesonyourback/2013/10/11/i_got_hired_at_a_bangladesh_sweatshop_meet_my_9yearold_boss.html

Bender, Andrew. 2014. "Marijuana tourism bringing big bucks to Colorado, or is it?" Lifestyle, *Forbes*, 4 April. http://www.forbes.com/sites/andrewbender/2014/04/19/marijuana-tourism-bringing-big-bucks-to-colorado-or-is-it/

Benjamin, Daniel. 2002. "Is free trade good for the environment?" Property and Environment Research Center Report, 20 (1). http://perc.org/articles/free-trade-good-environment

Benson, Guy. 2013. "After Walker reforms, Wisconsin workers kick government unions to the curb." *Town Hall*, 23 July. http://townhall.com/tipsheet/guybenson/2013/07/23/thanks-to-walker-reforms-wisconsin-workers-abandon-government-unions-n1647166

Boccia, Romina. 2013. "Booze, pole dancing, and luxurious hotels: top 10 examples of government waste in 2013." Economy, *The Daily Signal*, 30 December. http://blog.heritage.org/2013/12/30/mb-1230-booze-pole-dancing-luxurious-hotels-top-10-examples-government-waste-2013/

Burgess, Cara A., Franklin G. Mixon, and Rand W. Ressler. 2010. "Twitter and the Public Choice Course: A Pedagogical Vignette on Political Information Technology." *Journal of Economics and Finance Education* 9: 6-9.

Calabria, Mark A. 2011a. "SEC employees hard at work during the financial crisis." *Cato at Liberty*, Cato Institute, 16 March. http://www.cato.org/blog/sec-employees-hard-work-during-financial-crisis

Calabria, Mark A. 2011b. "Firing incompetent employees 'would harm the agency's work,' SEC chief says." *CNS News*, 15 November. http://cnsnews.com/blog/mark-calabria/firing-incompetent-employees-would-harm-agency-s-work-sec-chief-says

Centers for Disease Control and Prevention (CDC). 2014. "Heart disease fact sheet." 20 August. http://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_heart_disease.htm

Chaney, Jen. 2012. "Nick Offerman of 'Parks and Recreation' on the appeal and meme-ability of Ron Swanson." Celebritology Blog, *Washington Post*, 25 April. http://www.washingtonpost.com/blogs/celebritology/post/nick-offerman-of-parks-and-recreation-on-the-appeal-and-meme-ability-of-ron-swanson/2012/04/25/gIQAeBw6gT_blog.html

Cobb, Andy. 2009. "Somalia: Libertarian Paradise." Comedy, *Huffington Post*. 6 June. http://www.huffingtonpost.com/2009/05/06/somalia-libertarian-parad_n_197763.html

Couri, Rick. 2014. "American taxpayers foot bill for $400k camel statue in Pakistan." National Govt & Politics, *The Atlanta Journal-Constitution*, 2 April. http://www.ajc.com/news/news/national-govt-politics/taxpayers-foot-bill-400000-camel-statue-pakistan/nfQx2/

Cowen, Tyler. 2008. "Public goods." *The Concise Encyclopedia of Economics* 2nd edition, Library of Economics and Liberty. http://www.econlib.org/library/Enc/PublicGoods.html

DeCoursey, Matthew. 2008. "What do Americans mean when they say 'Socialist'?" Rootless Cosmopolitan Blog, *Open Salon*, 23 October. http://open.salon.com/blog/matthew_decoursey/2008/10/23/what_do_americans_mean_when_they_say_socialist

Delingpole, James. 2012. "Capitalism has not failed. Capitalism has not recently been tried." Politics, *The Telegraph*. 10 June. http://blogs.telegraph.co.uk/news/jamesdelingpole/100163955/capitalism-has-not-failed-capitalism-has-not-recently-been-tried/

Delsol, Jean-Philippe. 2012. "Can the last taxpayer leaving France please turn out the lights?" Opinion, *Forbes*, 18 December. http://www.forbes.com/sites/realspin/2012/12/18/can-the-last-taxpayer-leaving-france-please-turn-out-the-lights/

Djankov, Simeon, Edward Glaeser, Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer. 2003. "The New Comparative Economics." *Journal of Comparative Economics* 31(4): 595-619.

Edelman, Susan. 2010. "Rubber room's 'dirty' old man." *New York Post*, 26 December. http://nypost.com/2010/12/26/rubber-rooms-dirty-old-man/

Farah, Joseph. 2014. "Why they call it 'Communist News Network'." Between the Lines, *World Net Daily*, 10 January. http://www.wnd.com/2014/01/why-they-call-it-communist-news-network/

Ferrara, David. 2009. "Prichard council fears using golf course as collateral could add to debt." Alabama Media Group, 16 November. http://blog.al.com/live/2009/11/prichard_council_fears_using_g.html

Ferrara, Peter. 2012. "Is President Obama really a Socialist? Let's analyze Obamanomics." *Forbes*, 20 December. http://www.forbes.com/sites/peterferrara/2012/12/20/is-president-obama-really-a-socialist-lets-analyze-obamanomics/

Gayer, Ted and W. Kip Viscusi. 2012. "Energy regulations: Protecting 'irrational' consumers from themselves." Mercatus Center George Mason University, 1 August. http://mercatus.org/publication/energy-regulations-protecting-irrational-consumers-themselves

Ghent, Linda, Alan Grant, and George Lesica. 2010. *The Economics of Seinfeld*. http://yadayadayadaecon.com

Gillis, Mark T., and Joshua Hall. 2010. "Using the Simpsons to Improve Economic Instruction through Policy Analysis." *American Economist* 55: 84-92.

Gilroy, Leonard. 2010. "Local government privatization 101." *Reason Foundation*, 16 March. http://reason.org/news/show/local-government-privatization-101

Goodyear, Lucille J. 1981. "Spooner vs. U.S. postal system." *American Legion Magazine*, January. http://www.lysanderspooner.org/STAMP3.htm

Gwartney, James D., Robert Lawson, and Joshua Hall. 2013. *Economic Freedom of the World: 2013 Annual Report*. Fraser Institute. www.freetheworld.com

Hall, Joshua. 2014. *Homer Economicus: The Simpsons and Economics*. Stanford: Stanford University Press.

Hall, Joshua, and Robert Lawson. 2008. "Using Music to Teach Microeconomics." *Perspectives in Economic Education Research* 4: 23:36.

Hall, Joshua, Robert Lawson, and G. Dirk Mateer. 2008. "From ABBA to Zeppelin, Led: Using Music to Teach Economics." *Journal of Economic Education* 39: 107.

Harrington, Elizabeth. 2014. "1M kids stop school lunches due to Michelle Obama's standards." The Washington Free Beacon, *The Washington Times*, 6 March. http://www.washingtontimes.com/news/2014/mar/6/1m-kids-stop-school-lunch-due-michelle-obamas-stan/?page=all

Holcombe, Randall G., and Andrea M. Castillo. 2013. *Liberalism and Cronyism: Two Rival Political and Economic Systems*. Arlington: Mercatus Center, George Mason University.

Hopkins, Mark, Mike Wheately and Mellisa Tolentino. 2014. "Ask Dr. Bitcoin: Does bitcoin need banks?" *Silicon Angle*, 6 May. http://siliconangle.com/blog/2014/05/06/ask-dr-bitcoin-does-bitcoin-need-banks/

"In dollars they trust." *The Economist*, April 27, 2013. http://www.economist.com/news/finance-and-economics/21576665-grubby-greenbacks-dear-credit-full-shops-and-empty-factories-dollars-they

Kernaghan, Charles. 2006. "Child labor is back: Children are again sewing clothing for major U.S. companies." The National Labor Committee, October. http://www.globallabourrights.org/reports/200610-IGLHR-Child-Labor-Is-Back.pdf

Klein, Daniel B., and Zeljka Buturovic. 2011. "Economic Enlightenment Revisited: New Results Again Find Little Relationship Between Education and Economic Enlightenment but Vitiate Prior Evidence of the Left Being Worse," *Econ Journal Watch* 8(2): 157-173.

Koba, Mark. 2013. "Have Twinkies killed the union movement?" Executive Edge, *CNBC*, 26 April. http://www.cnbc.com/id/100678728

Krasnozhon, Leonid. 2013. "Using Popular Music to Teach Principles of Economics: Beyoncé's Take on Demand and Quantity demanded." *Journal of Private Enterprise* 28(2): 139-149.

Kristof, Nicholas. 2006. "In praise of the maligned sweatshop." Opinion, *The New York Times*, 6 June. http://www.nytimes.com/2006/06/06/opinion/06kristof.html?_r=2&

Kuester, Dan, Dirk G. Mateer, and Chris Youderian. 2014. *The Economics of the Office*. http://economicsoftheoffice.com

Leal, Donald. 2010. "Helping property rights evolve in marine fisheries." Property and Environment Research Center Report, 28 (2), 1 June. http://perc.org/articles/helping-property-rights-evolve-marine-fisheries

Leeson, Peter T. 2007. "Better off stateless: Somalia before and after government collapse." *Journal of Comparative Economics* 35: 689-710.

Leet, Donald, and Scott Houser. 2003. "Economics Goes to Hollywood: Using Classical Films and Documentaries to Teach an Undergraduate Economics Course." *Journal of Economic Education* 34(4): 326-332.

"Leslie Knope gets endorsement from real life Parks and Rec union." *Laughspin*, March 12, 2012. http://laughspin.tumblr.com/post/19178712403/leslie-knope-gets-endorsement-from-real-life-parks-and

Long, Roderick T. 2002. "Privatization, Viking style: Model or misfortune?" *Lew Rockwell*, 6 June. https://www.lewrockwell.com/2002/06/roderick-t-long/the-vikings-were-libertarians/

Luccasen, R. Andrew, and M. Kathleen Thomas. 2010. "Simpsonomics: Teaching Economics Using Episodes of *The Simpsons*." *Journal of Economic Education*, 41(2): 136-149.

Lusk, Jayson. 2014. "Tax a cola, spend more money without meaningful benefits." The Blog, *Huffington Post*, 28 March. http://www.huffingtonpost.com/jayson-lusk/tax-a-cola-spend-more-mon_b_5042672.html

Mankiw, Greg. "Tax fact of the day." *Greg Mankiw's Blog*. February 23, 2011. http://gregmankiw.blogspot.com/2011/02/tax-fact-of-day_23.html

Marx, Karl, and Friedrich Engels. *The Communist Manifesto*. Translated by Paul M. Sweezy. New York: Monthly Review Press, 1964.

Mateer, Dirk G. and Andrew Rice. 2007. "Using Music Synchronized with Lyrics to Teach Economics." *Perspectives on Economic Education Research* 3: 53-64.

Mateer, Dirk, and E. Frank Stephenson. 2011. "Using Film Clips to Teach Public Choice Economics." *Journal of Economics and Finance Education* 10(1): 28-36.

Mixon, Franklin G. 2010. "More Economics in the Movies: Discovering the Modern Theory of Bureaucracy in Scenes from *Conspiracy* and *Valkyrie*." *Journal of Economics and Economic Education Research* 11(1): 101-113.

Moorhead, Molly. 2012. "Mitt Romney says 47 percent of Americans pay no income tax." Politifact, *Tampa Bay Times*, 18 September. http://www.politifact.com/truth-o-meter/statements/2012/sep/18/mitt-romney/romney-says-47-percent-americans-pay-no-income-tax/

Murray, Iain. 2010. "Burn baby burn?" Competitive Enterprise Institute. 5 October. http://cei.org/op-eds-and-articles/burn-baby-burn-0

Nankin, Jesse and Krista Kjellman Schmidt. 2009. "History of U.S. gov't bailouts." *Propublica*, 15 April. http://www.propublica.org/special/government-bailouts

Nishimoto, Ryan. 2002. "Marriage makes cents: How law and economics justifies same-sex marriage." *Boston College Third World Law Journal,* 2002-2003, p. 379. https://www.bc.edu/dam/files/schools/law/lawreviews/journals/bctwj/23_2/06_TXT.htm

Niskanen, William. 1975. "Bureaucrats and Politicians." *Journal of Law and Economics* 18: 617-643.

Stevenson, Betsey, and Justin Wolfers. 2008. "Economic Growth and Subjective Well-being: Reassessing the Easterlin Paradox." NBER Working Paper No. 14282.

Passell, Peter. 1997. "Competition at every turn has post office on the run." Archives, *The New York Times*, 15 May. http://www.nytimes.com/1997/05/15/business/competition-at-every-turn-has-post-office-on-the-run.html

Pareene, Alex. 2010. "For-pay fire department lets man's house burn." *Salon*, 4 October. http://www.salon.com/2010/10/04/libertarian_fire_department/

Petkus, Marie, John Perry, and Bruce Johnson. 2012. "Breadth and Depth in the Economics Major." Working Paper.

Phillips, Kelly. 2014. "Union: privatizing the sale of alcohol will kill children, lower tax revenue." Taxes, *Forbes*, 4 May. http://www.forbes.com/sites/kellyphillipserb/2014/05/04/union-privatizing-the-sale-of-alcohol-will-kill-children-lower-tax-revenue/

"Public choice: why politicians don't cut spending." YouTube video, 2:19, posted by "LearnLiberty," April 19, 2011. https://www.youtube.com/watch?v=6uR4lqa7IK4

Read, Leonard. 2010. *I, Pencil 50th Anniversary Edition*. New York: Foundation for Economic Education.

Reed, Lawrence W. 1980. "Witch-hunting for robber barons: the Standard Oil story." The Freeman, Foundation for Economic Education, 1 March. http://fee.org/the_freeman/detail/witch-hunting-for-robber-barons-the-standard-oil-story

Reed, Lawrence W. 2010. "Good economists, bad economists, and Walmart." *The Freeman*, Foundation for Economic Education, 29 June. http://fee.org/the_freeman/detail/good-economists-bad-economists-and-walmart#axzz2v054YtNp

Rensin, Emmett. 2014. "'The Lego Movie' isn't just anti-capitalist. It's anti-Fox, too." *New Republic*, 11 February. http://www.newrepublic.com/article/116575/lego-movie-anti-capitalist-fox-business-says-theyre-right

Ritterman, Jeff. 2013. "Tax a cola, improve life for San Francisco's children." The Blog, *Huffington Post*, 2 April. http://www.huffingtonpost.com/jeffrey-ritterman/tax-a-cola-improve-life-f_b_5052455.html

Romanska, Magda. 2012. "How I survived socialism: a self-help guide for worried Americans." *Cosmopolitan Review* 4 (1), 22 April. http://cosmopolitanreview.com/how-i-survived-socialism/Siegfried, John J., and Benu Bidani. 1982. "Differences between Economics Programs Located in Liberal Arts Colleges and Business Schools." *The Journal of Economic Education* 23(2): 181-188.

Seymour, David. 2009. "Lack of competition threatens public education system's survival." *Troy Media*, 21 May. http://www.troymedia.com/2009/05/21/lack-of-competition-threatens-public-education-systems-survival/

Siegfried, John J., and James T. Wilkinson. 1980. "The Economics Curriculum in the United States: 1980." *The American Economic Review* 72(2): 125-138.

Slavov, Sita. 2013. "The hidden cost of bank bailouts." Economic Intelligence Blog, U.S. News & World Report, 26 September. http://www.usnews.com/opinion/economic-intelligence/2013/09/26/study-shows-bank-bailouts-are-an-incentive-to-be-reckless

Smith, Lisa. 2014. "Successful ways that governments reduce federal debt." *Investopedia*. http://www.investopedia.com/articles/economics/11/successful-ways-government-reduces-debt.asp

Smith, John. 2013. "Prop 8 and DOMA: The only way to marriage equality is to eliminate state marriage licenses." Policy, *Mic*, 26 March. http://mic.com/articles/31107/prop-8-and-doma-the-only-way-to-marriage-equality-is-to-eliminate-state-marriage-licenses

Stossel, John. 2010. "Making parks decent again." *Creators.com*, 2 December. http://www.creators.com/opinion/john-stossel/making-parks-decent-again.html

Sullivan, Gail. 2014. "When the FDA said it would regulate e-cigarettes, the reaction was swift." Morning Mix, *The Washington Post*, 24 April. http://www.washingtonpost.com/news/morning-mix/wp/2014/04/24/when-the-fda-said-it-would-regulate-e-cigarettes-the-reaction-was-swift/

"The benevolence of self-interest." *The Economist*. December 10, 1998. http://www.economist.com/node/179495

Tinari, Frank D., and Kailash Khandke. 2000. "From Rhythm and Blues to Broadway: Using Music to Teach Economics." *Journal of Economic Education*. 31(3): 253-270.

"Top reasons the Walton family and Walmart are NOT 'job creators'." *The Walmart 1 Percent*. March 14, 2014. http://walmart1percent.org/issues/top-reasons-the-walton-family-and-walmart-are-not-job-creators/#

Veldhuis, Niels, Jason Clemens, and Milagros Palacios. 2011. *Budget Blueprint: How Lessons from Canada's 1995 Budget Can Be Applied Today*. Vancouver: Fraser Institute. http://www.fraserinstitute.org/uploadedFiles/fraser-ca/Content/research-news/research/publications/BudgetBlueprint.pdf

Velotta, Richard. 2010. "DMV has long line of excuses for delays." The Road Warrior Blog, *Las Vegas Review-Journal*, 21 March.
http://www.reviewjournal.com/road-warrior/dmv-has-long-line-excuses-delays

Veuger, Stan. 2014. "When a public good is all bad." Economic Intelligence Blog, *U.S. News & World Report*. 25 September.
http://www.usnews.com/opinion/economic-intelligence/2014/09/25/americans-dont-learn-the-true-costs-of-public-investment

"Wealth inequality in America." YouTube video, 6:23, posted by "politizane," November 20, 2012.
https://www.youtube.com/watch?v=QPKKQnijnsM

Wikipedia contributors. n.d. "Progressivity in United States income tax." *The Free Encyclopedia*,
http://en.wikipedia.org/wiki/Progressivity_in_United_States_income_tax (accessed October 10, 2014).

Wilkinson, Tracy. 1997. "Foreigners by the hundreds flee anarchy in Albania." *Los Angeles Times*, 15 March.
http://articles.latimes.com/1997-03-15/news/mn-38531_1_southern-albania

Willingham, Daniel T. 2009. *Why Don't Students Like School?* San Francisco: Jossey-Bass.

Wines, Michael. 2006. "How bad is inflation in Zimbabwe?" World, *The New York Times*, 2 May.
http://www.nytimes.com/2006/05/02/world/africa/02zimbabwe.html?pagewanted=all

"Winter is coming and the Soviet cupboard is bare." Businessweek Archives, *Businessweek*, November 3, 1991.
http://www.businessweek.com/stories/1991-11-03/winter-is-coming-and-the-soviet-cupboard-is-bare

APPENDIX

Sample Syllabus for Swansonomics – Relevant Sections

Objective: Upon successfully completing the course, students will be able to apply economic reasoning, critically evaluate a government policy, critically evaluate the economic consequences of the various political philosophies, evaluate how incentives influence decision making, and identify unintended consequences.

Texts: All of the following texts can be found for free online. PDF versions are also posted on GA View.

Reed, Leonard - *I, Pencil* (http://www.econlib.org/library/Essays/rdPncl1.html)

Marx and Engels – *The Communist Manifesto*
(http://www.marxists.org/archive/marx/works/download/pdf/Manifesto.pdf)

Holcombe and Castillo – *Liberalism and Cronyism*
(http://mercatus.org/sites/default/files/Holcombe_Cronyism_web.pdf)

Relevant articles for each topic will also be assigned and available on GA View.

Article evaluation and debate: Part of your grade in this class will be based on article debates. You will be required to bring in articles that are relevant to class topics. You should use legitimate economic concepts to write a brief 1-2 page evaluation of the article content and turn this in along with a copy of your article. Also, you will present the article's content to the class and then argue for or against what you think Ron's position would be on this issue. If you fail to bring in an article and join in the class discussion, you will not receive credit for that day's article assignment. Your grade will depend on your written evaluations of these articles (15%) and the quality of your participation and arguments made during class debates (5%).

Policy memos: You are expected to complete 2 policy memos this semester. Each memo must be a maximum of 3 pages long. These memos should follow this general format: Choose a government policy that you think should be changed, explain the specific changes you would make, and support your position. You will be graded on your spelling and grammar, your ability to effectively convey your position and address opposing arguments using economic concepts, your ability to support your position with legitimate evidence (preferably from a peer reviewed academic journal article or equally reputable source), and on your ability to properly cite that evidence. You are required to restrict the length of your memos to a maximum of 3 pages long in order to help you learn to make concise and focused arguments. You may not do the same topic as another student; therefore, you must get approval from me on your topics.

At the end of the semester you will present one of your revised memos to the rest of the class. You may choose which of your two memos you would like to present, and you will be given time to make improvements to that original memo before you present it. After your presentation, there will be a general discussion where you will address any questions or concerns from the rest of the class about your proposed changes. The quality of your arguments in this presentation and your participation in the discussion of other memos will be graded. Each memo will count for 7% of your grade, and your presentation and discussion participation will count for 6% (i.e. memo one 7% + memo two 7% + presentation/discussion 6% = 20%).

The remainder of your grade will be determined by three exams, each worth 20%.

Course outline: A general course topic outline is provided below. Each section starts with a quote from Ron Swanson and the general topics covered in that section are listed next to the quote. All required readings, including current even articles related to each quote, will be posted on GA View.

1)   "I have so many ideas. Some are simple like take down traffic lights and eliminate the post office. The bigger ones will be tougher, like bring all this crumbling to the ground." – **Anarchy**

a) "There are only three ways to motivate people: money, fear, and hunger." – **What does it mean to be self-interested?**

b) "I'll have the #9." "Sir, that's a party platter. It serves 12 people." " I know what I'm about, son." – **Consumer preferences and rationality, defining value**

c) "I call this turf 'n' turf. It's a 16 oz. T-bone and a 24 oz. porterhouse. Also, whiskey and a cigar. I am going to consume all of this at the same time because I am a free American." – **No rules for consumers or producers: how do black markets operate? Examples: illegal drug markets, prostitution, abortion, etc. How might this resemble resource allocation under anarchy? Resource allocation, contract enforcement, and real world examples of anarchy.**

d) "I think that all government is a waste of taxpayer money. My dream is to have the park system privatized and run entirely for profit by corporations, like Chuck E. Cheese. They have an impeccable business model." – **Other problems with anarchy, tragedy of the commons and the importance of private property rights**.

2) "The free market is a jungle; it is beautiful and brutal and should be left alone. When a business fails it dies and a new business takes its place. Just let business be business, and let government be government." – **Capitalism**

a) "You've got hazardous chemicals over there." "Yeah, which only I am breathing. It's the same liberty that gives me the right to fart in my own car. Are you going to tell a man he can't fart in his own car?" – **Introducing some basic rules: solving the tragedy of the commons with private property rights, incentive to invest when property rights are protected**

b) "On my death bed my final wish is to have both my ex-wives rush to my side so I can use my dying breath to tell them both to go to hell one last time. Would I get married again? Absolutely. If you don't believe in love, what's the point of living?" – **voluntary contractual agreements and contract enforcement, incentive to invest when contracts are enforced by legal means**

c) "The whole point of this country is if you want to eat garbage, balloon up to 600 pounds and die of a heart attack at 43, you can! You are free to do so. To me, that's beautiful." – **How do markets work? Supply and demand, inferior vs normal goods, substitutes and complements, etc. How do markets respond to well-intended regulations? Minimum wage and rent control, soda/"fat" taxes, Affordable Care Act**

d) "Just give me all the bacon and eggs you have. Wait...wait. I worry what you heard was: Give me a lot of bacon and eggs. What I said was: Give me all the bacon and eggs you have." **Moral hazard and adverse selection**

3) "My idea of a perfect government is one guy who sits in a small room at a desk, and the only thing he is allowed to do is decide who to nuke." – **Public goods**

a) "There's a new wind blowing in government, and I don't like it. All of a sudden there's all this federal money coming in and Paul, the city manager, is telling us to build parks, start new community programs. It's horrifying." – **Besides setting up basic institutions, what else might we want government to do? Public goods and the free rider problem.**

b) "I think the entire government should be privatized. Chuck E Cheese could run the parks – everything operated by tokens. Drop in a token, go on the swing set. Drop in another token, take a walk. Drop in a token, look at a duck." – **Public goods compared to club, common and private**

goods; public provision of goods vs. private provision of goods, privatization of publicly provided goods and services

4) "Capitalism: God's way of determining who is smart and who is poor." – **Problems that might arise in capitalist economies**

   a) "Cursing: there is only one bad word – taxes." – **How do we pay for a government to enforce basic institutions, provide public goods, etc.? Various forms of taxation**

   b) "It's never too early to learn that the government is a greedy piglet that suckles on a taxpayer's teat until they have sore, chapped nipples." **Wealth inequality, income mobility, the rationale for redistribution, Social Security and Medicare examples**

   c) "Give a man a fish and feed him for a day. Don't teach a man to fish…and feed yourself. He's a grown man. And fishing's not that hard." – **Tragedy of the commons and externalities, overfishing, pollution, the difficulty of assigning private property rights over some resources.**

   d) "I love Food and Stuff. It's where I buy all of my food and most of my stuff." – **Monopolies, predatory pricing, wage disparities, unions**

   e) "I got my first job when I was 9 working at a sheet metal factory. In two weeks, I was running the floor. Child labor laws are ruining this country." – **Sweatshops and child labor during economic development, are poor countries exploited by the rich when we rely primarily on capitalism to allocate resources? Which countries rely on capitalism the most and how does that affect economic growth? Economic Freedom of the World Report and economic well-being**

5) "Capitalism is the only way, Leslie. It's what moves our country forward. It's what makes America great and England okay and France terrible." **Public choice issues and increased government involvement**

   a) "Am I interrupting anything important?" "Impossible, I work for the government." – **Profit motives vs political incentives, self-interest in government, efficiency, public unions**

   b) "I like Tom. He doesn't do a lot of work around here. He shows zero initiative. He's not a team player. He's never wanted to go that extra mile. Tom is exactly what I'm looking for in a government employee." – **Profit motives vs political incentives, rent seeking vs wealth creation**

   c) "Once a year every branch of government meets in a room and announces what they intend to waste taxpayer money on. For a libertarian such as myself, it's philosophically horrifying." – **Rent seeking and government spending, interest groups and political incentives**

   d) "I have a joke for you. The government in this town is excellent and uses your tax dollars efficiently." – **Inefficiencies in government spending, budget maximization incentive, lack of competition**

   e) "I believe in cutting useless government projects. I also believe in cutting useful projects, future projects and past projects. The Hoover Dam is a travesty." – **Federal government debt vs deficits, cutting government spending, problem of concentrated benefits and dispersed costs, effects of large debts vs raising taxes and/or cutting spending**

   f) "Do you know if one can pay court ordered settlements in gold? … I'm not sure how much money I have, but I know how many pounds of money I have." – **Inflation and the incentive to finance**

government spending in the short run, the gold standard, fiat money, central bank independence, private currencies

6) "Just thought you needed some fresh air…even if that air is filled with the foul stench of European socialism." – **Moving away from capitalism**

   a) "The government should not prop up a failed business. That would be like giving food to a mortally wounded animal." – **Market distortions, The Great Recession, causes, proposed solutions, bailouts, stimulus spending, rent seeking and politically connected industries, the opportunity cost of saving certain jobs, Broken Window fallacy**

   b) "I enjoy government functions like I enjoy getting kicked in the nuggets with a steel toed boot." – **Corruption and rent seeking, government created monopolies and monopoly power (e.g. public schools, post offices), government production of goods (e.g. the Trabant or food provision under socialism), definitions of socialism, communism and Marxism (costs and benefits)**

Table 2. Ron Swanson Quotes and Relevant Examples

Quote	Citation	Links to Applicable Examples
Topics in Principles Courses		
1) "I'll have the #9..."	Gayer et al. (2012)	http://mercatus.org/sites/default/files/Energy-Regulations-Protecting-Irrational-Consumers-From-Themselves.pdf
"Just give me all the bacon and eggs.…"	Harrington (2014)	http://www.washingtontimes.com/news/2014/mar/6/1m-kids-stop-school-lunch-due-michelle-obamas-stan/?page=all
2) "The whole point of this country is…"	Lusk (2014) Ritterman (2013) CDC (2014)	http://www.huffingtonpost.com/jayson-lusk/tax-a-cola-spend-more-mon_b_5042672.html http://www.huffingtonpost.com/jeffrey-ritterman/tax-a-cola-improve-life-f_b_5052455.html http://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_heart_disease.htm
3) "I call this turf 'n' turf…"	Bender (2014)	http://www.forbes.com/sites/andrewbender/2014/04/19/marijuana-tourism-bringing-big-bucks-to-colorado-or-is-it/
"You've got hazardous chemicals…"	Assoc. Press (2014)	http://www.syracuse.com/news/index.ssf/2014/04/marijuana_elementary_school_fourth_graders_selling_pot.html
	Sullivan (2014)	http://www.washingtonpost.com/news/morning-mix/wp/2014/04/24/when-the-fda-said-it-would-regulate-e-cigarettes-the-reaction-was-swift/
4) "Give a man a fish …"	Leal (2010) Benjamin (2002)	http://perc.org/articles/helping-property-rights-evolve-marine-fisheries http://perc.org/articles/free-trade-good-environment
5) "I got my first job when…"	Raveena (2013)	http://www.thestar.com/news/world/clothesonyourback/2013/10/11/i_got_hired_at_a_bangladesh_sweatshop_meet_my_9yearold_boss.html
	Kristof (2006) Kernaghan (2006)	http://www.nytimes.com/2006/06/06/opinion/06kristof.html?_r=1& http://www.globallabourrights.org/reports/200610-IGLHR-Child-Labor-Is-Back.pdf
6) "I love Food and Stuff…"	Reed (2010)	http://www.fee.org/the_freeman/detail/good-economists-bad-economists-and-walmart#axzz2v054YtNp
	"Top reasons…" (2014)	http://walmart1percent.org/issues/top-reasons-the-walton-family-and-walmart-are-not-job-creators/
7) "On my death bed my final wish…"	Smith (2014)	http://mic.com/articles/31107/prop-8-and-doma-the-only-way-to-marriage-equality-is-to-eliminate-state-marriage-licenses
	Nishimoto (2002)	https://www.bc.edu/dam/files/schools/law/lawreviews/journals/bctwj/23_2/06_TXT.htm
8) "Do you know if one can pay …"	Wines (2006) "In dollars…" (2013)	http://www.nytimes.com/2006/05/02/world/africa/02zimbabwe.html?pagewanted=all http://www.economist.com/news/finance-and-economics/21576665-grubby-greenbacks-dear-credit-full-shops-and-empty-factories-dollars-they
	Hopkins et al. (2014)	http://siliconangle.com/blog/2014/05/06/ask-dr-bitcoin-does-bitcoin-need-banks/

Table 2. Continued   Ron Swanson Quotes and Relevant Examples

Quote	Citation	Links to Applicable Examples
Topics in Comparative Economic Systems and Institutions		
9) "I have so many ideas.…"	Cobb (2009) Wilkinson (1997)	http://www.huffingtonpost.com/2009/05/06/somalia-libertarian-parad_n_197763.html http://articles.latimes.com/1997-03-15/news/mn-38531_1_southern-albania
10) "The free market is a jungle…"	Long (2002) Delingpole (2012) Pareene (2010) Murray (2010)	https://www.lewrockwell.com/2002/06/roderick-t-long/the-vikings-were-libertarians/ http://blogs.telegraph.co.uk/news/jamesdelingpole/100163955/capitalism-has-not-failed-capitalism-has-not-recently-been-tried/ http://www.salon.com/2010/10/04/libertarian_fire_department/ http://cei.org/op-eds-and-articles/burn-baby-burn-0
11) "My idea of a perfect government…"	Veuger (2014) Cowen (2008)	http://www.usnews.com/opinion/economic-intelligence/2014/09/25/americans-dont-learn-the-true-costs-of-public-investment http://www.econlib.org/library/Enc/PublicGoods.html
12) "Capitalism: God's way …"	"Wealth inequality…" (2012)	https://www.youtube.com/watch?v=QPKKQnijnsM
13) "Capitalism is the only…" "Just thought you …"	"Winter is coming…" (1991)	http://www.businessweek.com/stories/1991-11-03/winter-is-coming-and-the-soviet-cupboard-is-bare
Topics in Public Choice		
14) "There are only three …"	"The benevolence…" (1998)	http://www.economist.com/node/179495
15) "I like Tom. He doesn't do a lot…"	Calabria (2011a) Calabria (2011b)	http://www.cato.org/blog/sec-employees-hard-work-during-financial-crisis http://cnsnews.com/blog/mark-calabria/firing-incompetent-employees-would-harm-agency-s-work-sec-chief-says
16) "I enjoy government functions…"	Romanska (2012) Velotta (2010) Passell (1997) Goodyear (1981) Seymour (2009) Reed (1980)	http://cosmopolitanreview.com/how-i-survived-socialism/ http://www.reviewjournal.com/road-warrior/dmv-has-long-line-excuses-delays http://www.nytimes.com/1997/05/15/business/competition-at-every-turn-has-post-office-on-the-run.html http://www.lysanderspooner.org/STAMP3.htm http://www.troymedia.com/2009/05/21/lack-of-competition-threatens-public-education-systems-survival/ http://www.fee.org/the_freeman/detail/witch-hunting-for-robber-barons-the-standard-oil-story

Table 2. Continued   Ron Swanson Quotes and Relevant Examples

Quote	Citation	Links to Examples
Topics in Public Choice Continued		
17) "Am I interrupting anything…"	Benson (2013)	http://townhall.com/tipsheet/guybenson/2013/07/23/thanks-to-walker-reforms-wisconsin-workers-abandon-government-unions-n1647166
	Koba (2013)	http://www.cnbc.com/id/100678728
	Edelman (2010)	http://nypost.com/2010/12/26/rubber-rooms-dirty-old-man/
	"Leslie …" (2012)	http://laughspin.tumblr.com/post/19178712403/leslie-knope-gets-endorsement-from-real-life-parks-and
18) "I think that all government…" "I think the entire government…"	Gilroy (2010)	http://reason.org/news/show/local-government-privatization-101
	Stossel (2010)	http://www.creators.com/opinion/john-stossel/making-parks-decent-again.html
	Phillips (2014)	http://www.forbes.com/sites/kellyphillipserb/2014/05/04/union-privatizing-the-sale-of-alcohol-will-kill-children-lower-tax-revenue/
19) "There's a new wind …" "I have a joke for you…" "Once a year …"	Ferrara (2009)	http://blog.al.com/live/2009/11/prichard_council_fears_using_g.html
	Boccia (2013)	http://blog.heritage.org/2013/12/30/mb-1230-booze-pole-dancing-luxurious-hotels-top-10-examples-government-waste-2013/
	Couri (2014)	http://www.ajc.com/news/news/national-govt-politics/taxpayers-foot-bill-400000-camel-statue-pakistan/nfQx2/
20) "I believe in cutting …"	"Public Choice…" (2011)	https://www.youtube.com/watch?v=6uR4lqa7IK4
	Smith (2014)	http://www.investopedia.com/articles/economics/11/successful-ways-government-reduces-debt.asp
21) "Cursing: there is only one bad word..." "It's never too early to …"	Moorhead (2012)	http://www.politifact.com/truth-o-meter/statements/2012/sep/18/mitt-romney/romney-says-47-percent-americans-pay-no-income-tax/
	Wikipedia "Progressivity…"	http://en.wikipedia.org/wiki/Progressivity_in_United_States_income_tax
	Delsol (2012)	http://www.forbes.com/sites/realspin/2012/12/18/can-the-last-taxpayer-leaving-france-please-turn-out-the-lights/
	Mankiw (2011)	http://gregmankiw.blogspot.com/2011/02/tax-fact-of-day_23.html
22) "The government should not prop…"	Nankin and Schmidt (2009)	http://www.propublica.org/special/government-bailouts
	Slavov (2013)	http://www.usnews.com/opinion/economic-intelligence/2013/09/26/study-shows-bank-bailouts-are-an-incentive-to-be-reckless

Teaching the Law of Supply Using Karaoke

Wayne Geerling [1] *and G. Dirk Mateer* [2]

ABSTRACT

This paper describes an active-learning strategy for teaching the law of supply using karaoke. Unlike the law of demand, which is second nature by the time students reach college, the law of supply is less familiar. If you are unsure about this claim, poll your class to see how many students have tangible experience running a business. Due to this lack of familiarity, we deploy karaoke to illustrate the fundamental nature of the supply curve, along with the difference between movements along the supply curve and supply shifters. We also provide extensions and a number of variations of this method for interested educators. This work is similar to Kraznoshon's (2013) use of Beyonce's *Irreplaceable* to help students learn the law of demand.

JEL Codes: A21, A22, D01

Keywords: supply schedule, supply curve, law of supply, active learning

Non-Traditional Teaching Methods in Economics

Economics, as a discipline, has been conservative in adopting innovative approaches to teaching (Becker and Watts, 1996 and 2008). The traditional mode of 'chalk and talk' is still prevalent in many classrooms and often reinforces a teacher-centered, passive student-learning environment. The worst example of this is colloquially known as 'PowerPoint karaoke', where an instructor simply reads custom-made lecture slides (provided by a publisher) verbatim. *"Learning results from what the student does and thinks and only from what the student does and thinks. The teacher can advance learning only by influencing what the student does to learn."* (Ambrose et al. 2010)

Overcoming Perceptions

Economics has a (generally) well-deserved reputation for poor teaching and this has seeped into popular culture. Economists using 'chalk and talk' were immortalized in two films: *Ferris Bueller's Day Off* (1986) and *Back to School* (1986). In *Ferris Bueller*, Ben Stein plays a high school economics teacher who famously puts his class to sleep while droning on about macroeconomics. The teacher ends up pleading for student input, repeatedly uttering, 'Anyone?' to try to get a response. In *Back to School*, Paxton Whitehead plays a college lecturer (Dr. Phillip Barbay) who attempts to explain how firms operate by using a simplified model where widgets are sold. Then, an adult learner (Thornton Melon), played by Rodney Dangerfield, interrupts him pointing out that the lecturer's example is not very realistic. More recently the film, *Larry Crowne* (2011) features an economics professor, Dr. Ed Matsutani, (George Takai) who painfully teaches his classes with PowerPoint.

---

[1] Wayne Geerling: Senior Lecturer, Department of Economics, Pennsylvania State University, University Park, PA 16802, UNITED STATES OF AMERICA. Tel: +1 8148673300 Email: wag11@psu.edu

[2] G. Dirk Mateer: Senior Lecturer and Gerald Swanson Chair of Economic Education, Department of Economics, 401J McClelland Hall, The University of Arizona, UNITED STATES OF AMERICA. +1 5206216224 Email: dirkmateer@email.arizona.edu The authors wish to thank Charity-Joy Acchiardo, Abdullah Al-Bahrani, Austin Boyle, Bill Goffe, Kim Holder, Dan Kuester, Gary Magee, Laura Moate, Darshak Patel, Michael Smiddy and Jadrian Wooten.

More broadly, economists are seen as being embarrassingly dry. This perception was reinforced in a 2009 U.S. television commercial staring Catherine Zeta-Jones, where a group of economists in suits go door-to-door trying to sell new mobile phone coverage. People hide from the economists, squirt them with garden hoses, and slam doors in their faces. Then, we see Zeta-Jones approach a door and ask the homeowner if he would like a 'mobile makeover.' Startled by his good fortune, he responds: 'I believe I do.' The focus of this paper, using karaoke to teach the law of supply, is a small part of a classroom makeover. Like other active learning techniques, karaoke enhances learning and engagement.

Promoting Learning

Students have different learning preferences. While those with a background in science or mathematics may have a comparative advantage in understanding the quantitative aspects of economics, other students learn abstract, new and novel concepts more easily when they are presented in both verbal and visual form (Willingham 2009). A genuine interactive learning environment prompts two-way interaction between the lecturer and students, allowing students to take greater control over the direction of their learning (Bransford, Browning and Cocking 2000).

Another problem with introductory courses is that most try to cover too many concepts, with the result that insufficient time and attention is devoted to mastering the important threshold concepts (Frank 2007). The idea that less is better in the teaching of economics is not new (Becker 2004). One approach, favored by Frank, is to begin with a well-articulated short list of principles, and then illustrate and apply each principle in the context of simple examples drawn from familiar settings (Frank 2006).

In this paper, we provide a simple activity designed to inspire our students. If we succeed in motivating student learning, more students will take advanced courses, creating a positive externality in the form of higher retention rates and a greater pool of economic graduates. More broadly, the ultimate beneficiary is society, because students who develop an intuitive understanding of core economic principles make better voters. Even those students who do not take another economics course will, at the very least, have a stronger grasp of how economics works and applies to their lives. "What Do College Seniors Know About Economics?" (Walstad and Allgood 1999) is especially relevant reading on this subject.

While much has been written about economic instruction, the majority of this literature focuses on the macro landscape, or big-picture innovations that can transform a learning environment. Comparatively little has been written at the micro-level. One especially useful micro-level pedagogical article is Kraznoshon's (2013) use of Beyonce's *Irreplaceable* to help students learn the law of demand. Interested readers looking for micro-level materials should also access the online resource called *Starting Point: Teaching and Learning Economics* (2011). This website contains 17 different teaching modules, each with a handful of micro-level examples to help instructors teach more effectively. Last, but not least, The *Ultimate Guide to Teaching Microeconomics* (Geerling and Mateer 2014) and The *Ultimate Guide to Teaching Macroeconomics* (Geerling et al 2014) contain over 800 teaching tips, including more than 70 demonstrations which could be used to transform any principles level Macro- and Microeconomics course.

An added implication for audience engagement is that introductory economics is typically comprised of non-majors. We concentrate on imparting the 'big ideas' for everyday life (Salemi and Siegfried 1999). To be sure, models, theory and problem solving play a crucial role in understanding economics, but for a non-major it is more important to provide exposure to the ideas and concepts that frame good decision-making.

Using Karaoke to Teach the Law of Supply

How the Activity Works

Ask your students what it would take to get them to sing karaoke at the front of class. If you have not covered willingness to sell in your course provide a short definition. We prefer the following: "Your willingness to sell is the smallest amount that you would be willing to accept to sing karaoke." After ten seconds or so ask: "Does everyone have a price in mind?" Then indicate that you are willing to pay someone to sing karaoke but that you want to find out who will sing for the least.

The hook here is offering a high price to start so that you can reveal the supply schedule. We like to begin at $1M. Most students have a willingness to sell in the hundreds or thousands of dollars, so the extremely high starting price gets their attention. Ask anyone who is willing to sing karaoke for $1M to stand up and remain standing as long as the price you are offering is above their willingness to sell. All students typically stand.

Now drop the price you are willing to pay. Use increments of $100K until you reach $100K. At that point, pause and note the number of students still standing. Most students will still be standing up. Now use $10K increments until you reach $10K. Again, pause and note the number of students still standing. A minority of the class will now be sitting. From $10K, drop your price in increments of $1K until you reach $2K. By the time you reach $2K, about half the class will be seated. From $2K, drop your price in $250 increments until you reach $500. Now, the remaining students will be looking around at each other. From $500, drop the price in $50 increments until you arrive at $100. Now, most of the students will be seated but anticipation will be high. From $100, drop the price in $10 increments until you reach $20. Very few students will remain standing at this point. Continue your countdown until only one student remains standing and then stop. Invite the student with the lowest willingness to sell to the front of the room.

At this point, everyone wants to see the winning student sing karaoke so provide the student with a wireless microphone. It is up to you whether you reveal your song selection in advance but we recommend that you don't. Queue up your selection and ask the student to sing for 1-2 minutes. There are thousands of great karaoke songs available for free on the Internet. Our approach is to pick a song that is currently popular or a slightly older song that most students will immediately recognize. Here are some examples that we recommend: Carly Rae Jepson, *Call Me Maybe*; Katy Perry, *Dark Horse*; Adele, *Someone Like You*; Pharrell Williams, *Happy*; Britney Spears, *Baby One More Time*; NSYNC, *Bye Bye Bye*; Drake, *Started From the Bottom*; Journey, *Don't Stop Believing*; Miley Cyrus, *Party in the USA*. We have had great singers, lousy ones, awful ones and everywhere in between. It's karaoke! Sometimes the worse it is, the better it is for the audience. Don't be surprised if students video the karaoke and distribute it though social media (e.g. Vine, Twitter, and Instagram), which ends up engaging students who aren't even in the class and even our former students. When the karaoke is complete, be sure to thank the student who participated, pay them, and ask the class to give them a round of applause.[3]

The Supply Schedule and Supply Curve

Be sure that you take note of the approximate number of students standing at each key price point noted in the previous section. To make the data collection easier and help the activity run smoother, you can ask a student or teaching assistant to collect the data for you or use a personal response system to collect the data. Enter the data into a spreadsheet to create the supply schedule. Use the graphing capabilities of your spreadsheet to illustrate the corresponding supply curve.

From a teaching standpoint, it is very important to do two things: (1) Note that the supply schedule and supply curve are two different ways of representing the data every student observed firsthand. (2) There is a fundamental relationship between the price being offered and the number of individuals willing to supply karaoke. In other words, the best time to define the law of supply is after students have observed it firsthand. Reflecting on the karaoke demonstration, they easily see the law of supply as the direct

---

[3] Sometimes students want to volunteer so badly that they will pay you to sing. More generally, expect to pay the student somewhere $5-10. The most we have ever had to pay is $20 (and that was in a small class). Finally, it is worth noting that if the lowest willingness to supply is still more than you'd rather pay that you can sing the karaoke yourself!

relationship between the price and the number of individuals/firms willing to sell at that price. This relationship is captured by the positively-sloped supply curve.

We have utilized this activity over a dozen times. What follows is a representative supply curve and corresponding supply schedule, so that you can get a sense of what to expect.

Figure 1
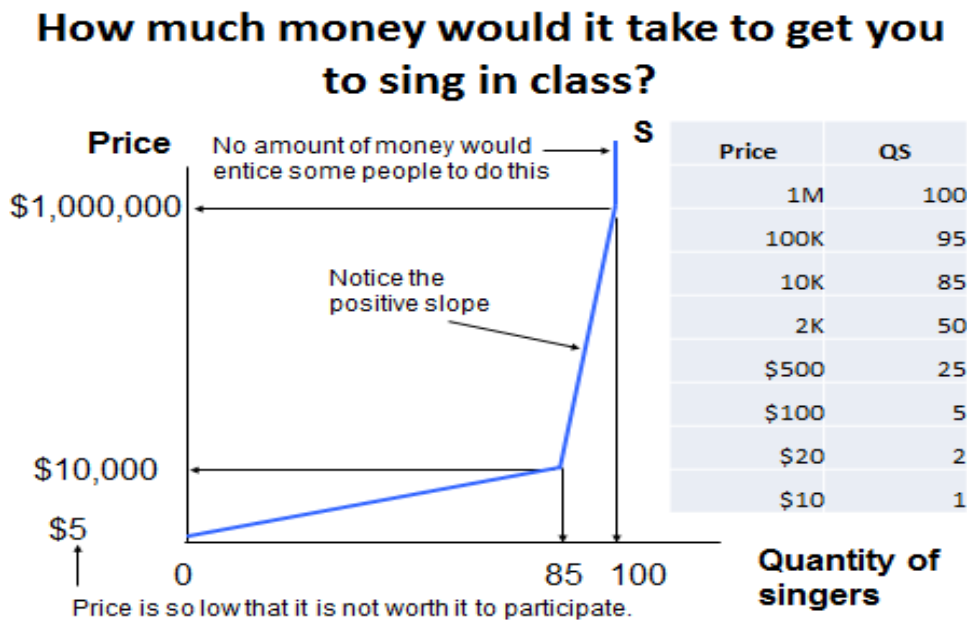
You should stress that the increasingly steep nature of the supply curve reflects that the fact that the quantity supplied is quite insensitive to price at high prices but quite sensitive when the price is lower. Since you probably don't want to directly introduce the concept of price elasticity here, you can do what we do and note the three regions described in the figure above.

Using karaoke is quick, memorable and provides a hook. The entire activity requires less than 10 minutes and it can be run in any class size. We have run this experiment in large classes of up to 700 students, small classes of less than 50 students and in a professional workshop at the National Conference on Teaching and Research in Economic Education. Our personal experience is that bigger classes work best since very small classes (< 20 students) may lack sufficient size to guarantee that you will find a volunteer willing to sing in front of the class at a low price.

There are several advantages in using karaoke to teach willingness to sell and the law of supply. First, as noted above, the activity takes less than 10 minutes to run, so the opportunity cost is not that high. Second, in contrast to a traditional lecture where the flow is one way, karaoke offers both a memorable teaching moment and a low cost visualization which will stay with students beyond the course. As an alternative, a combination of lecture with a think pair share to test comprehension, would take up more class time without necessarily providing students with a practical example of how willingness to sell and the law of supply work in the real world.

Shifts Versus Movements Along the Supply Curve

Another advantage of using this approach is that it allows the instructor to also discuss shifts versus movements along the supply curve. A change in the quantity supplied occurs when the price changes but all

other variables are held constant. This is exactly what the demonstration is designed to show. Students will immediately recognize that lower prices result in fewer people standing up and that more people stood when the price offered was high. In econ-speak, we see that there is a movement along the supply curve resulting in a lower quantity supplied when the price falls and a higher quantity supplied when the price rises.

Many students fail to appreciate what causes the supply curve to shift. Now we hold the price constant and allow other factors that influence the quantity supplied to vary. Our demonstration is designed to make this point in a memorable way.

Consider places other than class that would raise the willingness to sell of most students. This is a great place to solicit answers. The next figure shows two popular answers that are often mentioned. While singing karaoke in class is embarrassing for all but the most extroverted students, the idea of singing karaoke on television is downright terrifying. Changing the location has the effect of shifting the entire supply curve inward. In other words, at every price fewer students are standing. Invariably someone will respond with "jail" or "prison." This answer draws a few laughs but it allows you to show a circumstance where there is essentially no willingness to sell.

Figure 2
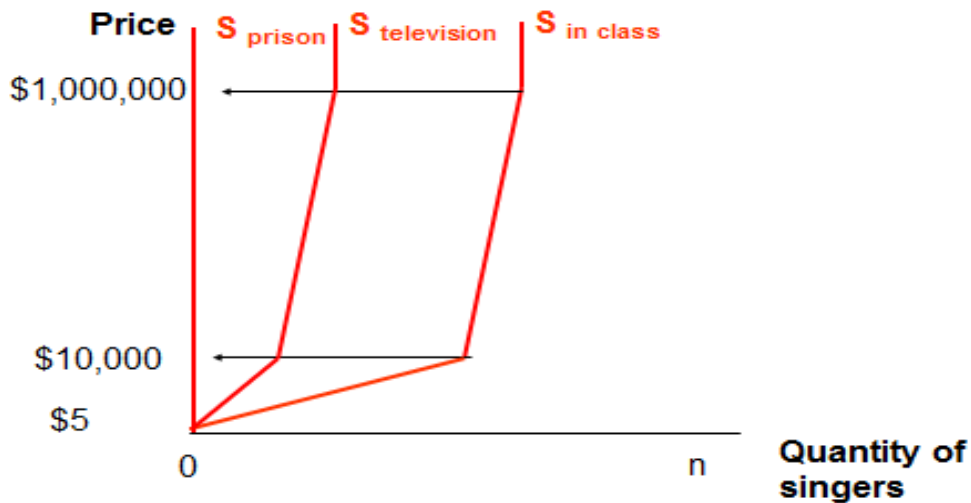
In a similar manner you can ask students what locations would make them more willing to sing. We have highlighted two common responses—in the shower and in the car—in the next figure. In both cases, the entire supply curve shifts outward along the horizontal axis. Note that the price is held constant here, so the only thing that makes students more willing to sing is that both locations are less embarrassing. In addition, we now have many students who are willing to sing without receiving any compensation. In other words, they enjoy singing in the shower and car and they do not require any extra payment to do so.

Figure 3

Changes That Make It Easier to Sing
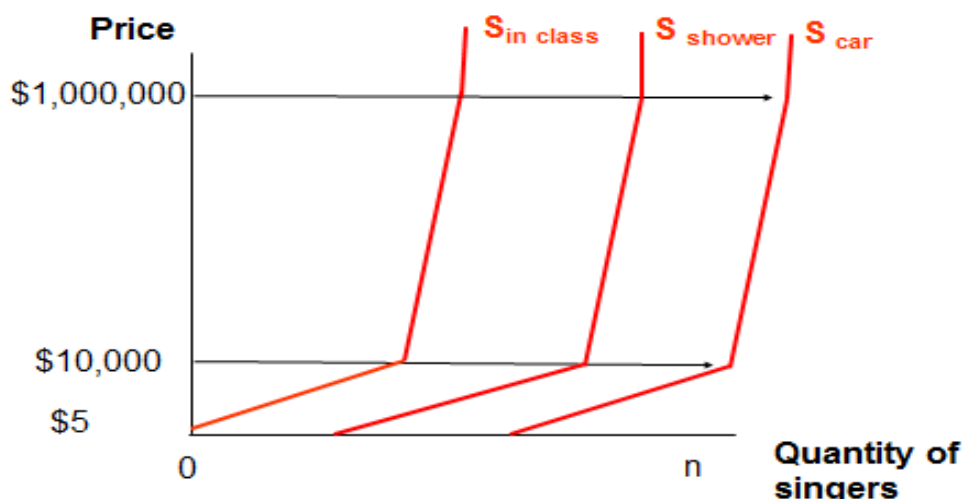
The use of karaoke provides a memorable way of learning the law of supply, differentiating between movements along the supply curve and shifts in the curve, and elasticity of supply. More importantly, it provides students with a hook that they can recall when they begin to get confused.

Feedback

Still not convinced? You don't have to take our word that this works. Here are comments from faculty who have decided to deploy the karaoke demonstration in their courses:

"Using this demonstration is a great way to get the entire class involved in creating and visualizing a supply curve. It's easy for them to look around and see that fewer and fewer students are willing to sing as the price goes to zero. Afterwards, they have a lot of fun watching their friends sing in front of the class. Many pull out their phones and record the performance to share with friends later. Those volunteering to sing for the lowest price (often $0) usually belt out the song, regardless of their ability, while the whole class cheers. This is the most simple, effective method I've come across for getting students interested in and excited about the concept of supply." *Charity-Joy Acchiardo*, Lecturer, University of Arizona

"In the past I used a different demonstration which was effective but not as hands on. What I liked about the karaoke demonstration is that it connected the law of supply to an activity most students are familiar with. It was easy for them to determine the price they would accept in return for singing in class. I also found that the classroom environment changed after the demonstration. Students were excited and eager to find the connection between the karaoke activity and economics. I had a captive audience. It couldn't have worked any better." *Abdullah Al-Bahrani*, Northern Kentucky University

The karaoke demo is perfect because I actually get students to perform and actually pay them money. This helps me build credibility through the rest of the semester that my students can believe what I tell them when I play other in-class demos with them. I also see a lot of enjoyment in the class when we do the karaoke. People pull out their phones and start taking video. Sometimes it can be very enjoyable and the whole class starts singing along. This environment makes students more comfortable in the classroom and

74

seems to increase their willingness to participate and ask questions as the semester moves on. *Austin Boyle*, Penn State University

"I had a student approach me after the karaoke experiment today and thank me for making the class fun and memorable. I think my sincerity meter is pretty accurate and I am quite confident this was a sincere sentiment. This is the first time I can recall students recording my lecture for Instagram or Vine or something like that! Both of my classes had a fun and memorable experience that I think will really reinforce the difference between a change in supply and a movement along the supply curve and it only cost me seven bucks total! Money well spent, I'd say." *Dan Kuester*, Roger Trenary Chair for Excellence in Economic Instruction, Kansas State University

Another faculty member teaching an online course modified the demonstration by collecting data beforehand:

"It went very well. I asked them to answer a simple Survey in ANGEL or on a Google Form with the question:

This weekend, a single student will sing karaoke and post a video on YouTube. They will sing a portion of one of the following songs (their choice): Taylor Swift's new song "Shake It Off," Meghan Trainor's "All About That Bass," Carly Rae Jepsen's "Call Me Maybe," or Journey's "Don't Stop Believing." What is the least amount of bonus points on the exam you would need to receive to sing karaoke in front of a webcam and post it to YouTube?

The nice thing about using the survey first was that I could take their responses and construct a supply curve before the actual auction in class. Both classes had large elastic portions followed by very inelastic switch. In case you're curious, see Figure 4. This really sank in with them." *Jadrian Wooten*, Lecturer, Penn State University

Figure 4

Willingness to Sing Karaoke In Class
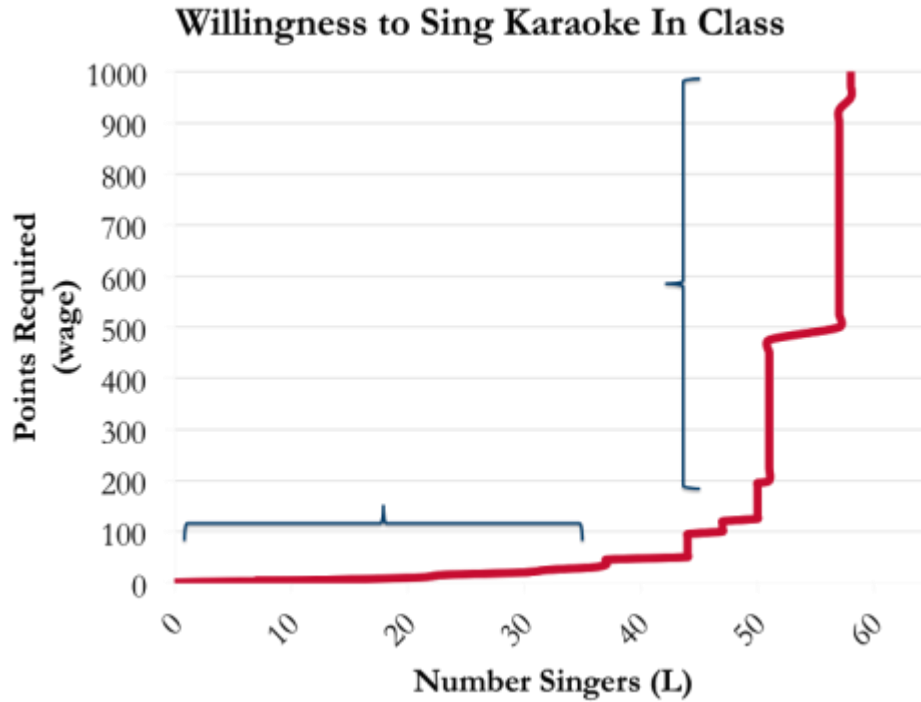
Variations

The use of karaoke to teach supply is a variation of "What's Your Price?" (Geerling and Mateer 2014). The point we wish to make here is that the real magic of this active-learning approach involves having students stand up when they participate. We are instructors who are quite uninhibited when we teach and instead of using karaoke, we have asked students in the past: "What price would you require to strip in front of the entire class?" The demonstration works exactly the same way that karaoke does, but you get a much livelier audience…and the students do not *actually* take off their clothes.

Likewise, standing up can be used to reveal the law of demand. Here the question we prefer to ask is: "What is the most you would pay to see your favorite musical artist perform and you had front row seats?" Here, we reveal the willingness to pay and the law of demand. The only difference is we start with a low price in order to get everyone standing and then we slowly raise the price and observe how quickly students sit down. It is not common for at least a few students to be willing to pay $500 or more − a fact that surprises the majority who think $100 is an outrageous price for a ticket.

The point is that you can choose to utilize karaoke, or be creative and choose a question that suits your personality. Either way, the key to making any active learning strategy work is owning whatever decision you make and having fun facilitating the learning environment.

Conclusion

We encourage you to use karaoke to teach the law of supply. Employing karaoke is an active-learning approach that emphasizes the intuition behind the supply curve, differentiates between shifts and movements along the supply curve, and also provides a memorable learning experience. It is also especially gratifying to use a technique that transforms passive student-learners into advocates who leave the class wanting to share what they learned in economics with their friends.

References

Ambrose, Susan A., Michael W. Bridges, Michele DiPietro, Marsha C. Lovett, and Marie K. Norman. 2010. *How learning works: Seven research-based principles for smart teaching*. San Francisco: Jossey-Bass.

'*Back to School*'. 1986. http://www.youtube.com/dmateer#p/f/7/YlVDGmjz7eM

Becker, William E., and Michael Watts. 1996. "Chalk and Talk: A National Survey of Teaching Undergraduate Economics." *American Economic Review: Paper and Proceedings* 86: 448–54.

Becker, William E. 2001. "How to Make Economics the Sexy Social Science." *Chronicle of Higher Education* 7 December: B10–B11.

Becker, William E. 2004. "Economics for a Higher Education." *International Review of Economics Education* 3 (1): 52–62.

Becker, William E. and Michael Watts. 2008. "A Little More than Chalk and Talk: Results from a Third National Survey of Teaching Methods in Undergraduate Economics Courses." *Journal of Economic Education* 39 (3): 273-286.

Bransford, John, Ann Brown, and Rodney Cocking. 2000. *How People Learn: Brain, Mind, Experience and School: Expanded Edition*, Washington, DC: National Academy Press.

'*Ferris Bueller's Day Off*'. 1986. YouTube. 'Boring Economics Teacher'. http://www.youtube.com/watch?v=dxPVyieptwA

Frank, Robert. 2006. "The Economic Naturalist Writing Assignment." *Journal of Economic Education* Winter: 58–67.

Frank, Robert. 2007. *The Economic Naturalist: In Search of Explanations for Everyday Enigmas*, New York: Basic Books.

Fryer, Roland, Jacob Goeree, and Charles Holt. 2005. "Experience-Based Discrimination: Classroom Games." *Journal of Economic Education* 36 (2): 160–70.

Geerling, Wayne. 2012. "Bringing the 'Dismal Science' to Life: Teaching Economics through Multimedia." *International Review of Economics Education* 11(2): 81-90.

Geerling Wayne and G. Dirk Mateer. 2014. A Spoonful of Sugar Helps the Medicine Go Down: Why Good Content is Never Enough, *New Developments in Economic Education*, Edited by Franklin G. Mixon Jr and Richard J. Cebula, Edward Elgar: Cheltenham: 1-20.

Geerling, Wayne and G. Dirk Mateer. 2014 *The Ultimate Guide to Teaching Microeconomics*, W.W. Norton & Company: New York.

Geerling, Wayne, Lee Coppock, Kim Holder, and James Tierney. 2014 *The Ultimate Guide to Teaching Macroeconomics*, W.W. Norton & Company: New York.

Greenlaw, Steven. 2003. "Using Writing to Enhance Student Learning in Undergraduate Economics" *International Review of Economics Education* 1 (1): 61-70.

Hall, Joshua C. 2005. "Homer Economicus: Using The Simpsons to teach economics." *Journal of Private Enterprise* 20: 166-77.

Hall, Joshua C., Rodney A. Lawson, G. Dirk Mateer, and Andrew Rice. 2008 "Teaching Private Enterprise Through Tunes: An Abecedarium of Music for Economists." *Journal of Private Enterprise* 23 (2): 157-166.

Larry Crowne. 2011. http://www.youtube.com/watch?v=Cg2WOb4_kVo

Pashler, Harold, Mark McDaniel, Doug Rohrer, and Robert Bjork. 2008. "Learning Styles: Concepts and Evidence." *Psychological Science in the Public Interest* 9: 105-119.

Salemi, Michael K. and John J. Siegfried. 1999. "The State of Economic Education." *American Economic Review* 89 (2): 355-61.

Starting Point: Teaching and Learning Economics. 2011. http://serc.carleton.edu/econ/index.html

'T-Mobile Commercial'. 2009. http://blogs.wsj.com/digits/2009/05/20/t-mobile-brings-catherine-zeta-jones-back/

Walstad, William and Sam Allgood. 1999. "What Do College Seniors Know About Economics?" *American Economic Review* 89 (2): 350-54.

Wheelan, Charles. 2002. *Naked Economics: Undressing the Dismal Science*, New York: W.W. Norton & Company.

Willingham, Daniel T. 2009. *Why Don't Students Like School?* San Francisco: Jossey-Bass.

Using Bloomberg Real-time Data and Analytics to Teach Economics and Finance

Hossein S. Kazemi[1]

ABSTRACT

This paper shows the benefits of incorporating the Bloomberg terminal in teaching economics and finance classes. The Bloomberg terminal differs from traditional teaching methods by bringing students into the laboratory of the real world through the use of real-time data and news to reinforce and to apply his/her knowledge of theory and institutions. A methodical way of using this technology in teaching economics and finance electives is discussed. Results suggest that using the Bloomberg terminal makes student comprehension of theoretical and applied material deeper. Moreover, their performance in other classes, internships and jobs suggests that this approach improves retention.

Keywords: Economic Education; Teaching of Economics

Introduction

This article illustrates the use of the Bloomberg Professional platform in the teaching of economics and finance in a variety of introductory to upper level undergraduate and graduate courses in Macroeconomic Theory, Money and Banking, Monetary Policy, International Finance, Impact of News on Financial Markets, Capital Markets and Investments, Investments and Portfolio Analysis, Money and Financial Markets, Fixed Income Analysis, and Portfolio Management. In addition, this paper extends Kazemi (2013), the author's previous work on the subject, by illustrating a methodology for incorporating Bloomberg in lectures and coursework via several detailed examples. Throughout the article, emphasis is placed on Bloomberg's unique utility in easily accessing and analyzing an extreme range of financial and economic data in real-time for a variety purposes, such as investment or policy analysis. Concurrently, the author establishes that integrating Bloomberg into the classroom better prepares students for future careers in finance and related fields. Through this approach students absorb the material much quicker, and retain what is covered better and longer and in addition are able to use it in other classes, internships, and at work. The author's hope is to be able to encourage others to give this approach a try, as it is a great complement to the traditional teaching methods in economics and finance.

The Paper is organized as follows. The next section provides a brief review of the literature on the use of "technology" in the classroom followed by a five-step methodology for using the Bloomberg technology to teach economics and finance courses. The following section presents applications of the methodology. The final section summarizes the benefits of using the Bloomberg platform and concludes.

---

[1] Hossein S. Kazemi is a Professor of Economics at Stonehill College in Easton, Massachusetts, 02357, email: kazemi@stonehill.edu, Phone: (508) 565-1276, Fax (508) 565-1276.

Review of the Literature

Murray (1999) discusses the benefits of using Monte Carlo simulations in teaching Econometrics. Murray concludes that there are caveats but that computer use is beneficial. Walbert and Ostrosky (1997) indicate that use of Mathcad in a one-semester undergraduate mathematical economics course resulted in test scores that were approximately 11 percent higher than scores earned by students who did not use Mathcad, an increase of more than one letter grade. They also show that Mathcad could allow the teacher to cover topics or introduce techniques that were formerly considered too advanced. Becker and Watts (2001) discuss how economists typically use passive teaching techniques and how this may be causing a decrease in enrollment in economics courses. They further argue that economists have not adopted active teaching. Saunders (1998) argues that learning (with technology) is more efficient if linked to material students have previously learned.

Salemi (2002) makes a strong case for active learning techniques by outlining numerous benefits that stem from their inclusion in the classroom. He gives an example of active learning. Active learning according to Salemi, is neither a panacea nor a free good. He suggests a strategy through which students gain lasting understanding of important economic concepts. Hawker (1986), Heid (1988), and Judson (1988) found evidence that students using computer algebra systems perform as well as or better than students in traditional business calculus courses. Palmiter, (1991), in a broader study, compared the performance of university students taught engineering calculus using a computer algebra system to the performance of students using paper-and-pencil computations. Both groups received lectures as a primary means of instruction throughout the semester, though the computer algebra system group also spent time engaged in active learning in computer-oriented labs. Empirical results indicated that students who used the computer algebra system scored higher on tests covering both their conceptual knowledge and their ability to do computations. Galbraith and Pemberton (2001) found a strong correlation between confidence and motivation after integrating Maple into undergraduate mathematics courses in Australia. Boyd (1998) showed that Maple allowed students to focus more on economics and less on mathematics. Cahill and Kosicki (2000) suggest that using Excel to illustrate economic models may lead to improvements. Owen (2007) presents evidence that suggests that students enjoy economics courses more when they are taught in a way that more actively engages them in the material.

King and LaRoe (1991) show that a laboratory based curriculum results in significant increases in TUCE test scores. Kendrick, Mercado, and Amman (2006) provide examples from a number of fields of economics, and discuss how they can be used to develop opportunities for students to learn about, and then modify, these computational models. Elliott (2003) and Lass et al. (2007) reported improvement in students' performance and in their enjoyment of lectures after introducing a Personal Response System.

Brown and Liedholm (2002) found, however, that students' performance in virtual courses was inferior to that of students who took live or 'hybrid' classes where face-to-face lectures were integrated with a variety of online material. Palocsay and Stevens (2008) did not find any significant difference between the performance of students who had been assigned a variety of web-based homework and students who had been assigned traditional textbook-based homework. Dufresne et al. (2002) and Lass et al. (2007) found that online homework did lead to higher exam performance. Lei and Li (2012) demonstrate the use of Bloomberg in a security and portfolio analysis course. In this article the author takes a broader approach by demonstrating how Bloomberg can be used to discuss and teach economics and finance in a more general setting.

As illustrated below, many features of the Bloomberg technology are consistent with the literature's accepted practices for improving students' learning experience. Bloomberg provides simulations, interactive learning, and a personal response system. Furthermore, using real-time data available through Bloomberg, as the literature above shows with other active learning techniques, provides the instructor with the opportunity to cover more complex topics at a significantly greater degree of depth.

Methodology

For many years, the Wall Street Journal, Barron's, and the Economist were useful tools in the author's teaching of economics, giving the students a better sense of the connection between what they learned in the classroom and the real world. The stories in these publications often perfectly complemented what was discussed in class a day or two earlier and gave students the ability to fully comprehend the topics. However, as useful as utilizing these publications was, it lacked the effectiveness that a real-time tool could provide. This led to a rethink and retool strategy, as a result of which Bloomberg technology was introduced by the author in teaching of economics and finance.

Started in 1982, Bloomberg is now the industry-leading platform for news, economic and financial data, and research and analytical tools in the global markets. Bloomberg for Education gives colleges and universities around the globe the ability to introduce this powerful tool to students. The skills students develop through utilization of Bloomberg and its inclusion in the curriculum deepens their understanding of the fundamental theoretical framework of topics covered in the classroom, enhances their research horizons and capabilities, and further provides them with the confidence and advantage they need to compete in a competitive job market. The benefit of integrating Bloomberg into the classroom is bringing in a real-time, relevant, robust tool, which is used by thousands of financial professionals on a daily basis. Teaching with a transparent, relevant tool like Bloomberg brings current and salient financial events to the forefront of the economics and finance classrooms and shows students how world events impact financial markets. The author has used this technology to teach introductory through advanced level undergraduate and graduate economics courses, including Microeconomic Principles, Macroeconomic Principles, Impact of News on Financial Markets, Macroeconomic Theory, Money and Banking, Monetary Theory and Policy, International Finance, Investments, Portfolio Management, and Fixed Income Analysis.

A five-step approach is used to incorporate Bloomberg (to varying degrees) into each of these classes. Using Bloomberg in the classroom, students are presented with the market reaction to headline news and data in real-time[2], without the delays associated with other data sources such as Yahoo! Finance or the Federal Reserve Bank of St. Louis's FRED database. In Microeconomics, the focus is more on the different types of markets and supply and demand. In Macroeconomics, more time is spent on statistical releases of economic variables and the examination of their trends. In courses such as The Impact of News on Financial Markets, Money and Banking, and Monetary Theory and Policy the reaction of financial markets as well as the Central Bank to economic data, as the government and other private sources disseminate them, are considered. In International Finance the reaction of the foreign exchange market to domestic, global economic and financial markets news is studied. In Investments, Portfolio Management, and Fixed Income Analysis, a variety of technical and analytical tools are utilized together with the real-time data that Bloomberg provides in order to show students how fundamental or technical decisions are made in the equities or fixed income instruments' markets.

The following are each of the five steps that are used in applying Bloomberg:
1. Show students the tools in the discipline
2. Use Bloomberg to crunch the numbers and see how things work at the technical level
3. Use Bloomberg to show the interaction between economic news and financial markets
4. Have students follow up the lecture and Bloomberg presentation with CNBC, WSJ, Barron's, and the Economist
5. Have students produce a report that highlights what they have learned and its connection with what they have seen and read in the media

The next section provides examples of how Bloomberg can be used in the classroom.

---

[2] Most market data out there are at best delayed by 20 minutes. When the author refers to real time data, he is referencing live market data with no delays. Furthermore, Bloomberg charts are very dynamic as any portion of them can be expanded to highlight different points of significance in the direction of the markets. For example by clicking on any point on most Bloomberg charts, the instructor could access many useful information as pop ups such as the precise measure of the variable at that point, date and most importantly any relevant news article on the day of the event that might have contributed to the movement of the variable.

Ways Bloomberg Helps

In Money and Banking, Investments, Portfolio Management, and Fixed Income Analysis students are required to run and manage a portfolio of different financial instruments such as equities, fixed income instruments, commodities, and foreign currencies. The required fundamentals and background necessary to help them understand these areas of the markets are covered through conventional lectures. The specific tools and analytics in Bloomberg pertaining to each topic are then discussed. Students are shown examples of how to search for stocks and how to set criteria to select stocks that they find of interest. Bloomberg's analytical investment tools are presented to students as a way of helping them with the buy, sell, and hold decisions. Further research tools and technical indicators are also included in the presentation made to students.

Treasury Actives and Yield Curve

Two very helpful examples of Bloomberg's usefulness as a pedagogical tool are its "Treasury Securities" and "Yield Curve" tools. Students in the courses listed above spend a good deal of time trying to understand the term structure of interest rates and the analysis of the yield curve. Bloomberg provides a nice set of tools that clarify these topics for students. The following are examples of a few useful Bloomberg screens that can be used to present these topics to students in the above courses or in other courses that typically require coverage of this type of material. Using Bloomberg and the following charts, one could make the concept of term structure and yield curve very intuitive for students. In addition, it is substantially easier to construct these diagrams using Bloomberg's built-in functions compared to more conventional methods, which will be illustrated below.

## Figure 1. Treasury Actives (PX1) on May 17, 2013

Source: Bloomberg Professional

Figure 1 above illustrates Bloomberg's command PX1. It presents the most active Treasury instruments Curve trades, and a list of real-time values for a few other market instruments. PX1 page of Bloomberg gives students a clear and complete sense of the term structure of interest rates and the differences between short-term, medium-term, and long-term financial instruments. The inclusion of the TIPs on this page helps students distinguish between real and nominal interest rates from which the discussion of the "Fisher Equation" and the "Fisher Effect" arises. Students are fascinated when they see that investors in TIPs are willing to settle for a negative rate of return, possibly for an unknown period of time, for the sake of having protection against inflationary build-ups that may or may not occur. The sacrifice in yield that most banks have accepted in the past few years, in anticipation of rates going back to the levels of the late 1970s and early 1980s, is another example where students can see the willingness of individual and institutional investors to give up yield (albeit short term in their mind) to pick up handsome rewards in the medium and longer terms.

Another great application of the screen shown in Figure 1 is the utilization of PX1 to construct the yield curve. Furthermore, there is an international version of this page, which can be reached using Bloomberg commands BTMM (for the data on pricing and yields) or IYC that permits construction of a multi-country yield curve, which is handy in a variety of courses such as Investments, International Finance, Portfolio Management, and Fixed Income Analysis.

The next two figures highlight these features by providing a yield curve for the US Treasury securities as of May 17, 2013, and a comparison of Yield Curves for the US, Japan, the UK, and the Euro zone. These figures found with simple Bloomberg commands and the PX1 page help students truly appreciate the meaning and significance of the Yield Curve.

Figure 2. US Yield Curve for May 17, 2013
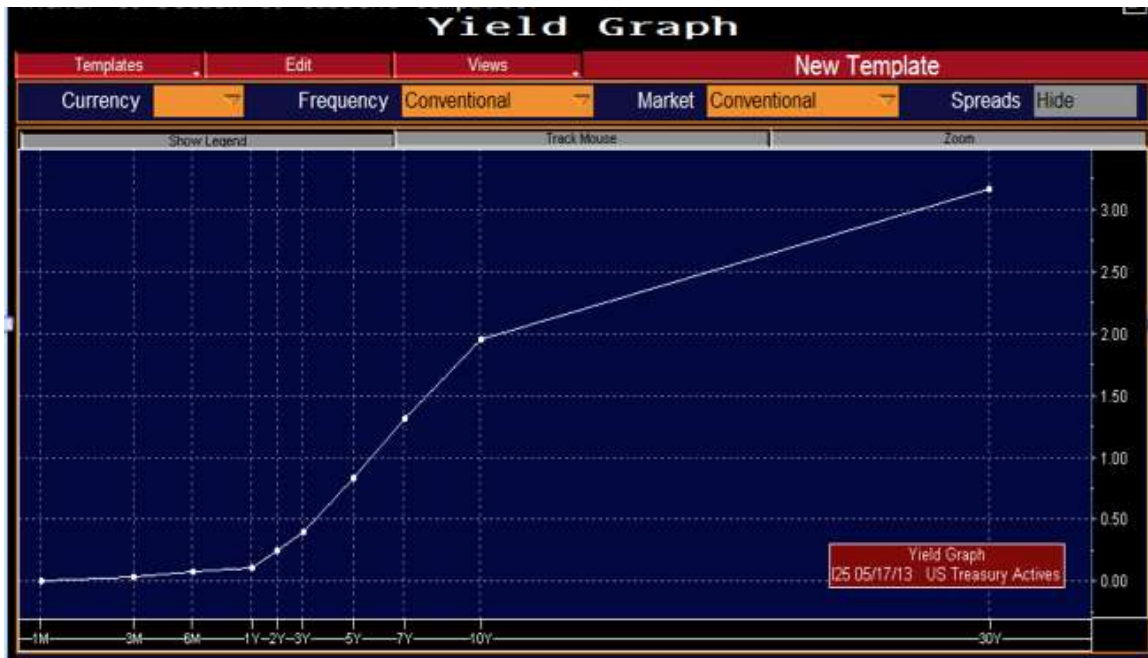
Source: Bloomberg Professional

Figure 3. International Yield Curve for May 17, 2013

Source: Bloomberg Professional

Figure 3 shows an international yield curve that compares the term structure of interest rates for Japan, the United Kingdom, the Euro zone, and the United States. The four specific curves in the chart are derived from the following:

I25	US Treasury Actives Curve for 05/17/2013
I13	EUR Euro Benchmarks Curve for 05/17/2013
I22	GBP United Kingdom Sovereign Curve for 05/17/2013
I18	JPY Japan Sovereign Curve for 05/17/2013

The chart and its colorful nature make it easy to follow, and thereby help students gain a better understanding of interest differentials. Through this students learn further about the slope of the yield curve and where they can pick up the most yield reward by extending the maturity of their investment instruments. Often, the yield pick up is difficult for most students to digest, though thanks to the ease of getting instantaneously drawn yield curves the concept becomes quite clear for them.

The Impact of Federal Open Market Committee (FOMC) Rate Decision and Directive on Financial Markets

This section demonstrates how students can learn more about macro, monetary policy, and financial markets through an exercise using Bloomberg. The exercise comprises of analyzing a FOMC statement and its immediate impact on financial markets. Although the June 20th 2012 FOMC announcement and its impact on the markets was not among the more exciting ones we have seen recently, it still serves as an example to give the reader, an idea of the types of benefits students may reap from this approach to teaching monetary policy. Students are alerted as to the meeting of the Fed. They are also apprised of the market's expectations of the effects that the Fed's decision pertaining to the Federal Funds Rate and FOMC's directive will have on the economy. Additionally they, at the very least, have read and been presented with the main points of the previous "FOMC Statement". At this point the author has the following Bloomberg window projected on the screen (Figure 4), which captures the pulse of the markets live and in real-time as of that moment, open in front of the classroom.

A white board is used to project the screen. This allows the author to write notations and commentary right on the charts as necessary. Putting a mark on each of the indexes as shown in Figure 4, right at the moment the Fed announces its decision, helps students to recognize and remember where the markets were before the Fed's announcement and where they will go after. As markets review the statement, digest, and respond to it, students observe the movements in the indexes on the four screens, instantaneously and in

real-time, right in front of them. The type of reaction, whether positive or negative, and its lightness or severity, gives students further reasons to think about how events impact the indexes and are correlated to the markets. When there is a news conference by the Chairman of the Board of Governors, we watch that on one screen and the market's reaction to his speech live on another. Following the announcement of the Fed's decision, we immediately proceed to downloading the side-by-side statement of the Fed, which shows their assessment of economic conditions and their course of action for the meeting next to the same for the previous meeting and read it carefully. From this statement students learn the Fed's main issues of concern as of the most recent FOMC meeting, and furthermore, how those concerns may have changed over time.

Figure 4. Major Market Indexes and Volatility Index (VIX) June 22, 2012

Source: Bloomberg Professional

This simple approach teaches students about the way monetary policy decisions are made, and how the Central Bank goes about conducting its job of fostering maximum employment while achieving price stability and highlights the market's reaction to these decisions. Figure 5, shows the impact of the three phases of Quantitative Easing (QE) and Operation Twist on the DOW industrial average through May 7, 2014. Further examination of these policies reveals a very similar pattern of performance with regards to S&P 500 as well. As Figure 5 shows, Fed's first policy round of QE or QE1 during the period of 11/25/2008 to 3/31/2010 resulted in a 28.58% of an increase in the value of DOW Industrial (an annualized appreciation of 20.50%). Through QE2, the Fed conducted further monetary easing during 11/3/2010 through 6/30/2011. During that eight-month period DOW Industrial appreciated by 10.69% which equals to an annual appreciation of 16.78%. Operation Twist was conducted during 9/21/2011- 12/31/2012. During this time DOW Jones Industrial appreciated by 17.79% or an annualized rate of 13.65%. The third round of QE or QE3 started on 9/13/2012 and through May 7th 2014 has resulted in a 16.91% (an annualized 13.44%) appreciation of the DOW since it started.

Figure 5. Dow Jones Industrial Average During QE1, QE2, OT, and QE3

Source: Bloomberg Professional

It should be noted that what is attempted here is to show how quickly we can measure the performance of market indexes, using Bloomberg real-time data. The author is no way is trying to dispute or ignore other micro, macro, industry specific, or political waves that might have contributed to the trends exhibited here rather is presenting how the DOW performed during each phase of QE. What the author *is* trying to demonstrate is the advantages Bloomberg provides in presenting this material. While much of the data provided in these figures are easily available via other, public sources, they are only available with a significant delay. In addition, the figures presented above and throughout this paper are easily constructed and manipulated with simple Bloomberg commands, while similar exercises using other sources can be considerably more cumbersome. Finally, many students who enter the realm of finance and similar fields will be required to perform similar analyses – in all likelihood – using Bloomberg. These sorts of presentations thus introduce students to the type of work they will be expected to perform in their future careers.

At his May 22nd 2013 testimony before the Joint Economic Committee of the Congress, Fed Chairman Ben Bernanke articulated the Central Bank's thinking regarding the potential paring of asset purchases by as early Labor Day. This testimony caused a bond market reaction of more than a point of a drop in the price of the 10-Year and 1-20/32 point of a decline for the 30-Year bond. The DOW, which was up 151 points before the Bernanke's testimony, dropped 80 points by the end of the day. At their June 19th meeting the FOMC's confirmation of the Chairman's previous statements caused a 20% increase in volatility[3], resulting in a drop in the DOW of 659 Points from June 19 to 24th. Figure 6 shows how the 2⅞% 30-year US Treasury dropped by 13% (42.79% annualized) in response to May 22nd testimony of the Fed Chairman and the June 19th announcement of FOMC from May to August 2013. The Fed surprised the markets on September 18th when it decided not to taper its asset purchases. This resulted in a spike of 217 points in the

---

[3] As measured by Chicago Board Options Exchange's (CBOE) Volatility Index

DOW in one hour, as shown in Figure 7. Students are fascinated to see how quickly and easily they can look at the effect of these likely measures of monetary policy on financial markets. Bloomberg financial and real-time data bank at the fingertip of the instructor in the classroom brings a typical conventional lecture to a totally different level that makes the connection between the theory and practice for students crystal clear.

Figure 6. 2⅞% 30-Year U.S. Treasury Price for Period 5/22/2013-8/21/2013

Source: Bloomberg Professional

Figure 7. The Fed's decision not to taper on September 18th, 2013, resulted in an increase of the DOW of 217 points or 1.45%, in one hour.

Source: Bloomberg Professional

Bond Market Transactions

This short section illustrates how Bloomberg can be used to instruct students how to engage in security transactions. The following graphs are used to show students bonds market transactions. Figure 1 is the PX1 page of Bloomberg that contains most Treasury Active instruments. For illustration purposes, let's assume we were to purchase the 2 7/8% 30-year US Treasury bond that matures in May of 2043 as seen on line 51 in Figure 1. This bond shows a bid price of 94-11/32+ with an asking price of 94-12/32. The + sign next to the bid price refers to ½ of 1/32. Each point is equal to $10 and each 1/32 is equal to 1/32 of $10. So the buyer is willing to pay $943.59375 (94 X $10 + 11.5/32 X $10) and the seller is asking for $943.75 (94 X $10 + 12/32 X $10). The buyer in this case is paying the asking price, and 3.167% is the Yield-to-Maturity on this instrument. In Money and Banking, Investments, Portfolio Management, and Fixed Income Analysis classes, students are given a sum of mock money to invest. In fact, it is important for students to feel comfortable with this screen and the one that follows this section (Figure 8), as they need them both to show their transactions in the bonds market. For an investor who wants to purchase the 30-year 2⅞% bond, the next Bloomberg screen is then used to calculate the invoice price, income, profit, and, finally, Yield-to-Maturity (YTM). From this page students learn about the inclusion of accrued interest in calculating bond prices and hence "Clean" and "Dirty" Price measures for bonds. Other concepts such as yield to maturity, holding period return, bond duration, and convexity are presented using this chart.

Figure 8. Yield Analysis for May 17, 2013

Source: Bloomberg Professional

Rules versus Discretion Discussions in Macro and Monetary Policy

This section demonstrates how Bloomberg can be used for monetary policy analysis in a variety of macro-based courses. Students are assumed to have prior knowledge of topics such as inflation, potential employment, natural unemployment, nonaccelerating inflation rate of unemployment (NAIRU), Okun's Law, the Federal Funds Rate, and discretionary vs. rule-based monetary policy. The Taylor Rule command of Bloomberg (TAYL <GO>), becomes a great example that covers many of the above topics, and does it

all in one diagram. For instance, Figure 9 shows students, with just the click of a key on the Bloomberg terminal, how the Taylor Rule is calculated. The significance of this in students' learning can be seen in terms of the number of key concepts learned from other courses that are all contained in this one diagram. Based on this formula, the Taylor Rule's estimate of the Federal Funds Rate (FFR) is found.

According to the Taylor Rule, the Federal Funds rate is a function of the neutral real rate of interest (2%), the core personal consumption expenditures deflator (PCE) or 1.13%, the gap between actual and target inflation as set by the Fed (PCE = 2%), and a fraction (50%) of the unemployment gap as measured by the difference between NAIRU (5%) and the actual (U3) unemployment rate (7.5%). As can be seen below, the Taylor Rule estimates FFR, as of May 17, 2013 to be 0.20%. One year earlier this would have been calculated as 0.65%, which was 40 basis points higher than the high end of the Fed's target then and now. Accordingly, students recognize that the economic outlook around May of 2012 was more positive than it was in May of 2013. This helps students learn to apply Taylor's Rule to estimate how changes in economic conditions affect the Federal Funds Rate. The level of engagement and involvement students show when utilizing this formula through Bloomberg, combined with the excitement generated among them as they come up with their own forecasts, are the type of benefits that this approach to teaching offers students. The following Bloomberg figure calculates Baseline Taylor Rule for 5/17/2013 as follows:

Taylor Rule Estimate = Neutral Real Rate of Interest + Core PCE + [Alpha *(Inflation – Target Inflation)] + [Beta * Okun Factor *(NAIRU - U)]

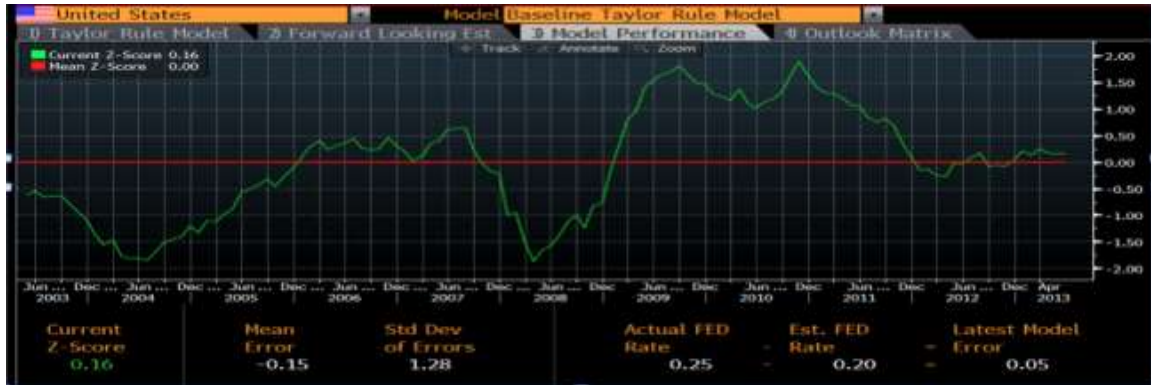*Taylor Rule Estimate = 2.00 + 1.13 + [0.50 *(1.13 - 2.00)] + [0.50 * 2.00 *(5.00 – 7.50)] = 0.20*

Figure 9. Taylor Rule Base Line Model, May 17, 2013

Source: Bloomberg Professional

Figure 10. Taylor Rule Base Line Model Performance, June 2003 - May 2013

Source: Bloomberg Professional

As an alternative, students are also presented with two additional models of the Taylor Rule as used in the industry: the Stone & McCarthy Model, and the Deutsche Bank Model. According to these two models, and as shown in Figures 11 and 13, the FFR should have been set at -0.93% and -1.93% respectively at the May 2013 meeting of the FOMC.

Figure 11. Taylor Rule, Stone & McCarthy Model, May 17, 2013

Source: Bloomberg Professional

Figure 12. Taylor Rule, Stone & McCarthy Model Performance, June 2003 - May 2013

Source: Bloomberg Professional

Figure 13. Taylor Rule, Deutsche Bank Model, May 17, 2013

Source: Bloomberg Professional

Figure 14. Taylor Rule, Deutsche Bank Model Performance, June 2003 - May 2013

Source: Bloomberg Professional

Following the presentation of this material, students often contemplate what monetary policy would have been like if conducted as to follow a strict Taylor Rule. Through the use of Bloomberg Model Performance command, they are presented with the performance of the Baseline Taylor Rule model over the past several years (10 years in this case) as shown in Figures 10, 12, and 14. These figures show the mean FFR against the current Z-Score for the past ten years. This gives students the ability to see instantaneously, which model performs better. The easy access to these powerful analytical tools of Bloomberg makes the connection between the theoretical framework of monetary policy learned in the classroom and the real world of central banking remarkably clear for students. Students recognize that the differing values of the Federal Funds Rate as estimated by each of these models is a function of the Neutral Real Rate and the coefficient beta used for the unemployment gap. The simple recognition of the sources of discrepancy in the Federal Funds Rate as calculated based on the three models above is of great academic and professional value to students. Furthermore, student evaluations indicate that this approach combines the disparate lessons from different facets of the discipline into a unified framework and fosters a deeper understanding of the course material.

Conclusion

This real-time approach to teaching of economics and finance is an effective way of incorporating theory with practice in the classroom. As mentioned earlier, economics and finance majors do not have the same opportunities to practice their craft in a laboratory setting as students do in other sciences. Many finance and economics courses are taught passively in a very abstract and theoretical manner with very little application. This active approach utilizes Bloomberg Technology with real-time data to exhibit

theoretical material in an applied manner. Directly observing the reaction of markets to world events enforces the theoretical material described during conventional lectures. Observation of students performance on their assignments and projects whether in class or at home, the quality of the answers on their exams essays, and the level of depth and understanding of theories and concepts covered in their research papers, prove they have a substantially more clear understanding of the fundamentals in the discipline.

Although these conclusions are preliminary, the evidence provided by students through their comments in their evaluations, their internship supervisors, and managers at work confirm the significance of their learning and their ability to apply what they have learned quite effectively. Further empirical analysis of the effectiveness of this approach is in the works for future dissemination. For now, increased enrollment in classes using this approach as Becker and Watts (2001) argued, might be an indication of the effectiveness of an active teaching strategy in attracting students to the economics major. This teaching approach further supports Saunders' (1998) point regarding the efficiency of new learning with technology. Furthermore, its effectiveness becomes an evidence of what Salemi (2002) made a strong case for by presenting active learning techniques as a strategy through which students gain lasting understanding of important economic concepts.

Replacing the conventional methods of teaching with this approach is not recommended. Using Bloomberg to complement the traditional teaching methods in economics and finance is. However, the challenges faced in promoting this type of pedagogy are significant. The first is administrative. The administration needs to sign on and team up with the faculty to provide the financial and moral support to engage in this type of endeavor. Budgetary constraints and priorities are the main issue here. The second challenge is in enlisting the faculty to invest their time in learning the platform. In this paper, the intent was to show that learning the Bloomberg platform can potentially be transformative in how we teach, and in how our students learn, economics and finance and how to get them ready and better prepared for the job market and the real world.

References

Becker, William E. and Michael Watts. 2001. "Teaching economics at the start of the 21st century: Still chalk-and-talk". *The American Economic Review* 91(2): 446–451.

Boyd, David W. 1998. "On the use of symbolic computation in undergraduate microeconomics instruction". *The Journal of Economic Education* 29(3): 227–246.

Brown, Byron W. and Carl E. Liedholm. 2002. "Can web courses replace the classroom in principles of microeconomics?" *The American Economic Review* 92(2): 444–448.

Cahill, Miles and George Kosicki. 2000. "Exploring economic models using excel". *Southern Economic Journal*, 66 (3): 770–792.

Dufresne, Robert, Jose Mestre, David M. Hart, and Kenneth A. Rath. 2002. "The effect of web-based homework on test performance in large enrollment introductory physics courses". *Journal of Computers in Mathematics and Science Teaching*, 21(3): 229–252.

Elliott, Caroline. 2003. "Using a personal response system in economics teaching". *International Review of Economics Education*, 1(1): 80–86.

Galbraith, Peter and Mike Pemberton. 2001. "Digging beneath the surface: When manipulators, mathematics, and students mix". A presentation at 2001 Annual Meeting of the American Educational Research Association.

Hawker, Cheryl M. 1986. "The effects of replacing some manual skills with computer algebra manipulations on student performance in business calculus". PhD thesis, Illinois State University.

Heid, M.K. 1988. "Resequencing skills and concepts in applied calculus using the computer as a tool". *Journal for research in mathematics education*, 19(1): 3–25.

Judson, Phoebe T. 1988. "Effects of modified sequencing of skills and applications in introductory calculus". PhD thesis, University of Texas at Austin.

Kazemi, Hossein S. 2013. "Using Bloomberg to teach economics". *International Advances in Economic Research*: 19(3): 311-312.

Kazemi, Hossein S. and Croushore, Dean. 2013. "Teaching Courses in Macroeconomics and Monetary Policy with Bloomberg Analytics". Working paper, presented at the Federal Reserve bank of St Louis Conference in St Louis, St Louis, Missouri, November 8, 2013.

Kazemi, Hossein S. 2013. "Use of Real Time Data to Teach Economics". Presented at the 2013 American Economic Association (AEA) National Conference on Teaching Economics and Research in Economic Education. Cosponsored by the *Journal of Economic Education* And Federal Reserve Bank of Chicago, Chicago, Illinois, May 29, 2013.

Kazemi, Hossein S. 2013. "The Power of Bloomberg in the Classroom and Curriculum". Presented at the Bloomberg for Education Symposium in New York, New York, August 16, 2013.

Kendrick, David A., P. R. Mercado, and Hans M. Amman. 2006. "Computational economics: help for the underestimated undergraduate". *Computational Economics,* 27(2): 261–271.

King, Paul G. and Ross M. LaRoe. 1991. "The laboratory-based economics curriculum". *The Journal of Economic Education*, 22 (3): 285–292.

Lass, Daniel A., Bernard J. Morzuch, and Richard T, Rogers. 2007. "Teaching with technology to engage students and enhance learning". *University of Massachusetts Amherst Working Paper*, No. 2007-1.

Lei, Adam Y.C. and Huihua Li. 2012. "Using Bloomberg Terminals in a Security Analysis and Portfolio Management Course". *Journal of Economics and Finance Education*, 11(1): 72-92.

Murray, Michael P. 1999. "Econometrics lectures in a computer classroom". *The Journal of Economic Education*, 30(3): 308–321.

Owen, Ann L. 2007. "Integrating computer applications into economics electives". *International Review of Economic Education*, 6(1): 77–92.

Palmiter, Jeanette R. 1991. "Effects of computer algebra systems on concept and skill acquisition in calculus". *Journal for Research in Mathematics Education*, 22(2): 151–156.

Palocsay, Susan W. and Scott P. Stevens. 2008. "A study of the effectiveness of web-based homework in teaching undergraduate business statistics". *Decision Sciences Journal of Innovative Education*, 6(2): 213–232.

Salemi, Michael K. 2002. "An illustrated case for active learning". *Southern Economic Journal*, 68(3): 721–731.

Saunders, Phillip. 1998. "Learning theory and instructional objectives", in W.B. Walstad and P. Saunders (eds), *Teaching undergraduate economics: A handbook for instructors*, New York: Irwin/McGraw-Hill, 85–108.

Walbert, Mark S. and Anthony L. Ostrosky. 1997. "Using mathcad to teach undergraduate mathematical economics". *Journal of Economic Education*, 28(4): 304–315.

Financial Performance Measures: A Review and Synthesis

H. Kent Baker[1] and Prakash Deo[2]

ABSTRACT

This paper examines financial performance measures in both a single-period and multi-period world, discusses the theoretical linkages among these measures, and where possible attempts to provide an integrated analysis. In a single-period world, the measures originate from the same economic model of investment and production theory of a firm and are thus related. These relationships hold in the multi-period world assuming a constant growth and using a popular valuation model. Because no single measure fully captures the broadness that is firm value assessment, multiple measures provide a fuller picture of a firm's performance.

Introduction

The finance literature generally agrees that a firm's goal should be to maximize shareholder wealth as reflected in the market price of the firm's stock (Baker and Powell, 2005). Although shareholder wealth creation itself is achieved through stock price maximization, firms typically do not have direct control over their stock price. Yet, they can influence share price through their current and expected performance. Therefore, designing effective performance evaluation measurements linked to the firm's market performance is critical to creating shareholder wealth. Developing a single measure of performance that captures the complex dynamics underlying a firm's value creation process is likely to be difficult. Not surprisingly, a vast literature of financial performance measures is available.

The purpose in this paper is to compare financial performance measures and examine their theoretical linkages, not to introduce new measures. Although others provide reconciliations of various performance measures, this paper is timely because it incorporates lessons learned about their usefulness and investigates the fundamental economic relationships among these measures without extensive accounting derivations. We also investigate how individual measures or a combination of them can be useful in financial planning and analysis. Finally, we provide specific recommendations about the usefulness of each measure so that students, academics, and practitioners can understand how firms can more accurately evaluate management's marginal contribution to a firm's value.

This paper has two main contributions. First, it provides a review and synthesis of popular financial performance measures and discusses divergence viewpoints among academicians and practitioners. Hence, this pedagogical paper may serve as a tutorial for those interested in the subject. Second, the paper examines a model of investment and production theory in a single-period world that provides a common foundation to link these financial measures from an economic perspective. The remainder of this paper consists of three sections. The next two sections provide a brief overview of the literature related to financial performance measurements and the relationships among these measures. The final section provides our conclusions.

---

[1]University Professor of Finance, American University, Kogod School of Business, Washington, DC 20016. Email: kbaker@american.edu

[2]Associate Professor of Finance, University of Houston – Downtown, College of Business, Houston, Texas 77002.
Email: deop@uhd.edu

Literature Review

The finance literature contains extensive discussions of financial performance measures. Many authors such as Clinton and Chen (1998), Martin et al. (2005), Arzac (2007), and Estridge and Lougee (2007) provide a critique of some of these measures. Stewart (1991), Rappaport (1998), Young and O'Bryne (2001), and Koller et al. (2010) offer insights into the various performance measures. Their work includes shareholder valuation based on free cash flow (FCF), return on invested capital (ROIC), economic value added (EVA), and market value added (MVA) measures of financial performance. Copeland and Dolgoff (2006) evaluate the pros and cons of various performance measures and recommend an expectations-based management measure.

Others contributing to the evaluation of financial performance measures include Bacidore et al. (1997) and Ferguson and Leistikow (1998), who agree with Jensen and Murphy (1990), Milbourn (1996), and Rappaport (1999) that the main metric for judging firm performance is stock price. Bowen and Wallace (1999) advocate identifying key drivers of shareholder value for each level of the organization and incorporating them in a balanced scorecard that includes key measures such as new orders, quality, cycle time, operating up-times, inventory levels, on-time delivery, parts simplification, and new product development.

The theory of agency costs plays an important role in setting financial goals for a firm. For instance, Lambert et al. (1985) explain three major conflicts discussed in agency literature. First, shareholders want their management team to maximize their financial return, but executives may derive "non-pecuniary" benefits or perquisites ("perks") from their control of corporate resources. Second, management and shareholders may differ in their attitudes toward the risk of potential investment strategies. Third, shareholders and managers may conflict on the appropriate decision-making time horizon.

Popular financial measures of shareholder value maximization include free cash flow to the firm (FCFF), net present value (NPV), ROIC, EVA or MVA. For example, Graham and Harvey (2001), Mulford and Comiskey (2005), Nurnberg (2006), Penman (2006, 2007), and Zenner et al. (2009) discuss cash flow measures. We review each of these popular measures.

Free Cash Flow to the Firm

Free cash flow to the firm (FCFF) equals operating cash flow less capital reinvestment to support its operations and growth. Therefore, FCFF represents a cash flow that the firm is free to distribute to its investors without impairing its future earnings power and jeopardizing its long-term well-being. Equation 1 provides the components of FCFF.

$$\text{FCFF} = \text{Operating income} - \text{Capital expenditures} - \text{Requirements for working capital} \\ + \text{Depreciation} - \text{Cash taxes paid} \qquad (1)$$

Analysts can derive FCFF using information from a firm's financial statements. Because the FCFF measure is inherently volatile, it should not be used as a short-term measure for business units that have a large asset base and are less susceptible to surges in cash sources. FCFF is also inappropriate for uses associated with individual projects. A firm's expected FCFF over the long term is what ultimately determines its value to investors.

Net Present Value

The net present value (NPV) of a project is the sum of the expected project free cash flows (FCFs) discounted at a risk-adjusted discount rate. As a valuation measure, discounting multi-year FCFs to derive the total value is an important long-term measure. Given its long-term focus, NPV encourages identifying

key value drivers and renders itself useful for resource allocation. Besides measuring incremental cash flows over a multi-period time frame, NPV considers the returns required by all suppliers of capital as embedded in the after-tax weighted average cost of capital (WACC). NPV is the recommended choice as the dollar measure of wealth because it is consistent with shareholder value maximization. Not surprisingly, NPV serves as a major decision rule in selecting projects (Baker et al., 2011).

Return on Invested Capital

ROIC measures how much investors earn on the capital invested in the firm. This measure gives a sense of how well a company is using its funds to generate returns. Several formulas are available for calculating ROIC such as dividing net operating profit after taxes and depreciation (NOPAT) by average invested (operating) capital. NOPAT is a firm's earnings before interest and taxes (EBIT) multiplied by 1 minus the tax rate. Operating capital consists of notes payable, long-term bonds, preferred stock, and common equity. Calculating operating capital involves adding the average debt liabilities to the average stockholder's equity. Comparing a firm's ROIC with its WACC reveals whether it is using invested capital effectively. A firm creates value when ROIC exceeds its WACC. ROIC is useful as both a short- and a long-term measure.

Some researchers point out deficiencies in this rate-based measure. For instance, Clinton and Chen (1998) contend that ROIC can provide a moving target on assumptions about reinvestment that may or may not be true. This problem is not present with residual-based models in dollars such as NPV or EVA. Dillion and Owers (1997) maintain that managers acting in a self-interest mode may reject investments that have an acceptable percentage return for the firm overall because the return is less than what the business unit is currently earning.

Economic Value Added

According to Brealey et al. (2004), income that is measured after deducting the cost of capital is often known as economic profit or residual income. This is an over simplification because economic profit and residual income differ primarily due to differences in methodologies used in calculating these measures (Pinto et al., 2010; Stowe and Gagne, 2013). Brealey et al. also refer to economic profit as economic value added (EVA). Stern Stewart & Company devised this trademarked concept called EVA, which indicates the profitability of a firm's projects and reflects management performance. The idea behind EVA is that businesses are only truly profitable when they create wealth for their shareholders (Young and O'Bryne, 2001). EVA can be calculated as follows:

$$\text{EVA} = \text{NOPAT} - (\text{Invested capital x WACC}) \qquad (2)$$

where NOPAT is net operating profit after taxes; invested capital is the amount of money used to fund a particular project; and WACC is the weighted-average cost of capital. Multiplying invested capital by WACC provides a charge for using the invested capital. This charge is the amount that investors as a group need to make their investment worthwhile. A positive EVA indicates that the firm more than covers its cost of capital.

The EVA measure helps to link shareholder expectations to both the income statement and balance sheet transactions. Thus, EVA encourages managers to think about both assets and expenses in their decisions. EVA uses economic book value rather than accounting book value of capital and adjusts the traditional accounting measures with book accounting values to generate proxies for economic based measures.

One of EVA's purported strengths is that it provides a single statistic indicating the value created above all financial obligations. EVA measures shareholder value for a single period and is not predictive of future performance. Consequently, it helps to identify initial impact and serves as a short-term measure. The single-period EVA is generally different from FCF for the same period. EVA measures progress towards

the all-period (multi-year) shareholder value and serves as a complementary measure to the discounted cash flow (DCF) valuation. EVA also attempts to correct for a key deficiency in other performance measures such as earnings and earnings per share (EPS) by applying a capital charge. Managers can use EVA as an operational metric to help clarify how they create value.

EVA is not without its shortcomings. To some, this performance metric basks in a mystique of complexity that results in numerous adjustments and inconsistent calculations (Young, 1999). Because the EVA calculation depends heavily on invested capital, it is most applicable to stable, asset-intensive companies. Baker et al. (2009) examine 11 major concerns about EVA in three different categories: computational, measurement, and effectiveness.

Market Value Added

Another long-term measure of value is market value added (MVA). As Equation 3 shows, MVA is the sum of the expected EVAs discounted at a risk-adjusted discount rate or WACC.

$$MVA = \sum_{t=1}^{\infty} \frac{EVA_t}{(1+c)^t} \qquad (3)$$

As a measure of value, MVA depends on the market's collective and forward-looking view. Thus, MVA is EVA's corresponding wealth metric.

Relationship among Financial Performance Measures

As previously discussed, the literature is replete with different financial performance measures. Choosing an appropriate measure can be challenging given that the popularity of some measures rises and falls over time. Various authors including Copeland and Dolgoff (2006) and Jensen and Meckling (2009) discuss the pros and cons of using various financial measures. For example, according to Jensen and Meckling, the choice of a performance measure requires a theory that predicts when one performance measure will provide more reliable incentives to maximize value than another.

Dodd and Johns (1999) maintain that using a single financial measure to manage a firm's operations makes no sense in today's environment. Martin et al. (2009, p. 111) point out, "attempts to define 'the best' measure of performance have given rise to 'metric wars' among competing consulting firms attempting to sell their particular approach to 'value-based management'." Yet, academicians and practitioners have attempted to define a measure of periodic performance that, at least in theory, captures the outcomes of current management actions on the value of future cash flows (Financial Management Association, 2006).

Dillion and Owers (1997) examine the evolution of the performance measures and provide insight into the relationship between EVA and NPV. Hartman (2000) and Shrieves and Wachowicz (2001) investigate via derivations of algebraic expressions the relationship among the financial performance measures using accounting relations and the definitions of financial measures. For instance, Hartman suggests that the EVA procedure allows for consistent results with NPV analysis by showing that EVA and NPV measures are equivalent for all methods of depreciation. Stewart (1991) explains the impact of a firm's ROIC on its valuation using of an algebraic expression rather basic economic theory.

Practitioner interest in shareholder value management has increased dramatically over the past few decades partly in response to headlines in the news media and demands from discontented shareholders owing to the failure of prominent firms, excessive executive compensation, and the ensuing regulations. Opportunistic consulting firms have achieved commercial success in marketing competing in-house performance measures. As a result, practitioners' interest and their subsequent embracing of these measures that claim to reflect management's contribution to a firm's value have outstripped the academic interest. In turn, academicians have responded with exhaustive theoretical and empirical investigations of these

performance measures. Unfortunately, results of these studies have led to deep-rooted disagreements among participants.

To deploy these economic or cash flow based measures in practice, the actual computations of these measures are accomplished using accounting information such as revenues, costs, and expenses from the income statement and various asset and liability items from the balance sheet. Each measure uses a subset of accounting information and makes specific adjustments to comply with the definition of that measure. This has led to divergence in view points and interpretations. Unfortunately, the reconciliation efforts to address the disagreements among these measures have also been addressed mainly using accounting relationships and algebraic equations.

Financial Measures in a Single-Period World

The capital markets allow trade between investment today and expected cash flow in the future. Figure 1 shows the relationship between present investment and future cash flows. The horizontal axis shows the investment that can be made today (period 0) and the vertical axis shows the next year's (period 1) cash flows from today's investment. Therefore, capital stock or endowment of I at time 0 invested at a rate k results in the next year's value of $I(1 + k)^1$. Alternatively, performing the inverse operation results in the present value of $I(1 + k)^1$ to be delivered in period 1 as $I(1 + k)^1/(1 + k) = I$, where $1/(1 + k)$ is the "present value factor" at rate k. The future sum $I(1 + k)^1$ to which the present I accumulates at the rate k is indicated by the intercept on the period 1 axis of a line drawn through the point I with slope equal to (minus) the accumulation factor of $-(1 + k)$. In the other direction, passing the line through a point such as $I(1 + k)^1$ gives the present value (the intercept) on the period 0 horizontal line.

In Figure 2, the transformation or production function demonstrates the production opportunity set available to the firm at time 0. The firm must make production decisions that maximize shareholder value. Fama and Miller (1972) provide an in-depth discussion and insights on this subject. The transformation function $(V, I) = 0$ or $TF(I, R) = 0$ depicts the maximum amounts of expected value at period 1 that can be obtained with different amounts of investment of capital stock or endowment at time 0. The term I represents the current investment or capital at period 0; the expected market value (V) at period 1 is denoted by V_1; and R represents the rate of return on investment in real assets or a business opportunity. The exact shape and position of T depends on the nature of the opportunity.

The opportunities available to a business unit may reflect its industry segment, level of vertical integration, sales mix such as domestic versus international or growth versus stable industry sub-segments, the expected growth rate of the industry, market share, incremental capital intensity, and regulatory climate. Therefore, the shape of a transformation function is unique for each business unit. A firm's opportunity set reflects the consolidation of the transformation functions of all of its business units/divisions with due considerations to synergies, overlapping functions or any sharing of factors of production (from an economic point of view) or any sharing of assets (from an accounting point of view).

For simplicity assume that V or cash flow is strictly a concave function of I. Therefore, the slope of the transformation function, which is the marginal rate of transformation of initial capital stock or endowment into future values, falls steadily in absolute value when moving along the curve from the horizontal axis to the vertical axis. The return "R" (specifically, the internal rate of return (IRR)) on the "first" project or first portion of initial investment of an endowment will be substantially higher than the returns (k) in the capital market, so that the slope of the tangency line will be initially very steep. However, the IRRs or marginal return on capital on subsequent projects will progressively decline leading to increasingly flatter tangency lines. In short, wealth is maximized by investing a portion of the initial endowment (AG) in real assets until the marginal return (R) on investment falls to the rate of interest (k), and the investment of the remainder of the initial endowment earns a return k in the capital market. The tangency of the present value line to the transformation function (i.e., where the slope of the transformation curve is $-(1 + k)$) indicates the dominant investment policy.

Figure 3 is the combination of the Figures 1 and 2 with an additional parallel line indicated by DKC. This combination of the production objective with the outcomes from the asset-pricing model helps explain the opportunity cost of production and provides some decision rules.

The optimal point is where the marginal single-period IRR on investment (R) equals the single-period market rate of interest or cost of capital (k) for the firm's productive activities. In order to maximize the value of its portfolio of investment opportunities in real assets and capital markets, a firm will invest in business opportunities or projects as long as R > k. When R = k, the firm is indifferent. This is the optimum investment or tangency point K in Figure 3. That is, the slope of the tangency line DKC is the same as the slope of the capital market line AB, which is –(1 + K). The maximum period 1 value from investment of the entire initial endowment OA or point A in the capital market alone is OB or point B. Also, the maximum period 1 value from investment of entire initial endowment of OA in real assets is OE. As previously discussed, the optimal investment in real assets is a portion of the initial endowment AF, which is expected to generate period 1 value of OG (equal to FK) is shown on the vertical axis. The remainder of the initial endowment OF (equal to GK) upon investment (or lending) in the capital market is expected to generate period 1 value of GD leading to a total period 1 value of OD (OG + GD). This amount is greater than (1) OB, which is achievable via investment solely in capital markets and (2) OE, which is achievable via investment solely in real assets.

We use this exposition to derive relationships among the various financial measures. That is, using a single-period model and assuming the existence of an equilibrium condition in a perfect capital market results in obtaining the future and present values of cash flows needed to derive the performance measures that provide the basis for accounting and financial measurements and applications. Assume the following notations: the current endowment or initial capital stock at period 0 is denoted by I (line OA); the expected value via investment solely in the capital market at period 1 is denoted by $V_{1,C}$ (line OB); and its present value at period 0 is $P_{0,C,}$

The expected value of investment at time 1 equals $V_{1,C} = I(1 + k)$ and its present value (line OA) at period 0 equals as shown in Equation 5:

$$P_{0,C} = V_{1,C}/(1 + k) = I(1 + k)/(1 + k) = I \tag{4}$$

Assume that a portion I*, which is an optimal investment amount and portrayed by the line AF, of the total initial endowment I is invested in real assets and the remainder portion I_0 is invested in the capital market. That is $I = I_0 + I^*$. As Equation 6 shows, the value of the investment opportunity at time 1 via investment in real assets portrayed by the production or transformation function equals $V_1^* = I^*(1 + R)$ and is depicted by line OG and its present value (line AF) at period 0 equals

$$P_0^* = V_1^*/(1 + k) = I^*(1 + R)/(1 + k)$$

$$\tag{5}$$

Laughton et al. (2008) provide further discussion of the valuation of real assets.

The value of the remainder investment I_0 at time 1 equals $V_1 = I_0 (1 + k)$ as portrayed by line GD and its present value (line OF) at period 0 as shown in Equation 6 equals:

$$P_0 = V_1/(1 + k) = I_0(1 + k)/(1 + k) = I_0 \tag{6}$$

The total, which is also the maximum, period 1 value V_{max} is the sum of V_1^* and V_1 and equals $V_{max} = I^*(1 + R) + I_0(1 + k)$ as portrayed by line OD and its present value (line OC) at period 0 in Equation 7 equals:

$$P_{max} = P_0 + P_0^* \tag{7}$$

$$P_{max} = I_0(1 + k)/(1 + k) + I^*(1 + R)/(1 + k) \tag{8}$$

$$P_{max} = I_0 + I^*(1 + R)/(1 + k) \tag{9}$$

As Equation 10 shows, the difference between Equations (9) and (4) is the value created at period 0:

$$
\begin{aligned}
NPV \quad &= P_{max} - P_{0,C} = [I_0 + I^*(1 + R)/(1 + k)] - I \\
&= [I^*(1 + R)/(1 + k) + I_0] - (I_0 + I^*) \\
&= I^*(R - k)/(1 + k) \tag{10}
\end{aligned}
$$

Because the cost of capital and the return on capital are the same, the investment I_0 in the capital market does not create any incremental value or NPV = 0. Thus, the investment I_0 in the capital market does not create any positive NPV.

Equation 11 shows that the incremental value created at period 1 (or ΔEVA_1) equals:

$$
\begin{aligned}
\Delta EVA_1 \quad &= (V_{max} - V_{1,C}) = [I^*(1 + R) + I_0(1 + k)] - I(1 + k) \\
&= I^*(1 + R) + I_0(1 + k) - (I_0 + I^*)(1 + k) \\
&= I^*(R - k) \tag{11}
\end{aligned}
$$

As Equation 12 indicates, the present value of ΔEVA_1 or incremental market value (ΔMVA) at period 0 is:

$$\text{Incremental or } \Delta MVA_0 = \Delta EVA_1/(1 + k) \tag{12}$$

Substituting the value of ΔEVA_1 from Equation 11 into Equation 12, results in

$$\text{Incremental or } \Delta MVA_0 = I^*(R - k)/(1 + k) \tag{13}$$

We derive expressions for FCFF ($V_{1,c}$ and V_1^*) as discussed in deriving Equations 4 and 5, NPV (Equation 10), ΔEVA (Equation 12), and ΔMVA (Equation 14) using the same basic theoretical economic framework. As Equations 10 and 12 show, NPV and EVA basically use the same financial information but differ in two ways. First, NPV sums up the present value of future cash flows net of investment but ΔEVA sums up the future cash flows. Second, NPV is calculated over the entire life of the project/firm but ΔEVA is calculated for each year. However, ΔMVA is the sum of the present values of $\Delta EVAs$ over the entire life of the project/firm and is equivalent to the NPV. The sum of the ΔMVA over the entire life of the project/firm equals NPV. In other words, both MVA and NPV are not "total" but "net" or "additional" values created. In conclusion, these financial and economic measures are related because they originate from the same economic model of investment and production theory of a firm. Thus, the divergent viewpoints among the experts appear to be attributable to their varied interpretations and the measurements of these metrics with exclusive adjustments to comply with their respective distinct definitions using accounting and financial information.

Financial Measures in a Multi-Period World

In a single-period world, we use the Equation 5 and partition the current market value into the current capital investment and incremental value. Rewriting Equation 5

$$
\begin{aligned}
P_0^* \quad &= V_1^*/(1 + k) = I^*(1 + R)/(1 + k), \text{ and rearranging} \\
P_0^*/I^* \quad &= (1 + R)/(1 + k)
\end{aligned}
$$

Adding and subtracting the cost of capital k in the numerator of the right hand side of the equation and rearranging results in $P_0^*/I^* = [(1 + k) + (R - k)]/(1 + k)$, or $P_0^*/I^* = [(1 + (R - k)]/(1 + k)$. Solving for $P_0^* = I^* + I^*(R - k)/(1 + k)$, and substituting it in Equation 7 and noting that $I^* + I_0 = I$:

$$P_{max} = I^* + I^*(R - k)/(1 + k) + I_0 \tag{14}$$

$$= I + I^*(R - k)/(1 + k) \tag{15}$$

That is, the current market value (P_{max}) = Current capital stock or endowment (I) + Incremental value created due to return in excess of the risk-adjusted cost of capital [$I^*(R - k)/(1 + k)$]. As long as ($R - k$) > 0 for a project, the firm will invest in the project. If a project return R = k, then the value of the second term [($R - k$)$I_0/(1 + k)$] is zero. Thus, the present or market value of the project P_{max} will equal the initial capital stock or endowment (I) and no incremental value is created (or NPV = 0). Of course, this discussion can be extended to the firm level as it is an aggregation of all projects within the firm.

To maintain and improve the excess return (R > k) over time or profit in every unit of time, the firm strives to attain a sustainable competitive advantage in the market place for its products and services through such ways as product differentiation, cost minimization, and continuous innovation to satisfy its customers. Any above-normal returns tend to revert to the normal return in due course because of fierce competition in conjunction with technological innovation and obsolescence (Bradley and Jarrell, 2008). Of course, the firm must commit additional resources overtime to production processes.

In a multi-period world, the expressions may be derived using the common assumptions of super-normal growth, normal growth, and zero growth in the future cash flows depending on the values of R over time. These are evolved derivations of the Gordon model of valuation of common stocks based on growth rates in future dividends and are explained in most basic corporate and investment textbooks. Assuming a constant growth rate of g and g < k for future incremental EVA (ΔEVA_1) and using Equation 12, we can derive an expression for current total incremental market value (MVA_0) as

$$MVA_0 = \sum \Delta MVA_0 = \Delta EVA_1 (1 + g)/(k - g) \tag{16}$$

Bradley and Jarrell (2008) and Loderer et al. (2010) provide additional information on valuation in the multi-period world. Others investigating this topic include Kim et al. (2004), Harper (2005), Martin et al. (2005), Ferguson et al. (2005), Griffith (2006), and Mir and Seboui (2006).

Examples 1 and 2 substantiate these derivations with an example and help to explain these relationships. Example 1 shows the financial information for a hypothetical firm with a single product/service business opportunity requires initial capital investment of $400. The firm could earn a 12% return via investment in capital market or a 25% return by pursuing this business opportunity. Using what-if-analysis and conducting numerous iterations, the firm expects a growth rate (g) in next year's incremental EVA of 5% for the foreseeable future. The firm's risk-adjusted WACC is 12% and the one-year expected rate of return on invested capital (real assets) is 25% with a higher associated risk. The firm makes an initial (time 0) investment of $400 in pursuing the business opportunity and the remainder $600 is invested in the capital markets, and therefore the FCFF at time 0 is −$1,000. If the firm were to make the entire investment in the capital markets, its FCFF would be $1,120 [$1000(1 + 0.12)] at the end-of-the year. On the other hand, if the firm were to make $400 investment in the real assets and $600 in the capital markets, its FCFF would be $1,172 [($400 (1 + 0.25)] + $600(1 + 0.12) at the end−of-the year. The sum of the present values of these FCFFs using the Equation 9 at time 0 is: $600 + $400 (1.25)/(1.12) = $1,046.43. The NPV using Equation 10 is $46.43 ($1,046.43 − $1,000). The ΔEVA using the Equation 11 is $400(0.25 − 0.12) = $52. Using Equation 12, the incremental MVA, which is the sum of the present values of ΔEVAs, is $52/1.12 = $46.43. Alternatively, using the Equation 13, the incremental MVA can be calculated as $400(0.25 − 0.12)/1.12 = $46.43.

Example 1 Derivation of FCFF, NPV, ΔEVA, and ΔMVA

This example shows the derivation of several financial performance measures (FCFF, ΔEVA, NPV, and ΔMVA) given a set of values for the variables using the relationships (equations) derived in this paper. The variables have the following values: initial stock or endowment at time 0, I = $1,000, rate of return in the capital market, k = 12%, constant rate of growth for future incremental EVA, g = 5%, marginal return on

investment in real assets, R = 25%, portion of total initial endowment invested in real assets, I* = $400, and the portion of initial endowment invested in the capital market, I_0 = $600.

FCFF

FCFF at time $0 = P_0 = -I = -\$1,000$; FCFF at the end-of-year.

Investments only in the capital market: FCFF at the end-of-year with investment only in the capital market. $V_{1,C} = I(1 + k) = \$1,000(1.12) = \$1,120$.

Investments in real assets and the capital market: FCFF at the end-of-year with optimal investment (I^*) in real assets. $V_1^* = I^*(1 + R) = \$400(1.25) = \$500$.

FCFF at the end-of-year with the remainder investment (I_0) in the capital market. $V_1 = I_0(1 + k) = \$600(1 + 0.12) = \$672$

Total FFCF at the end-of-period 1: $V_1^* + V_1 = \$1,172$

NPV

The present value of the FCFF with investment in real assets and the capital market is: $\mathbf{P_{max} - P_0} = I*(R - k)/(1 + k) = \$400[(0.25 - 0.12)]/(1 + 0.12) = \$52/(1.12) = \$46.43$. Note: The investment in the capital market does not create a positive NPV.

ΔEVA

The value created at period 1 is: $\Delta EVA_1 = I*(R - k) = \$400(0.25 - 0.12) = \$52$.

ΔMVA

The present value of ΔEVA_1 or incremental market value (Incremental ΔMVA_0) at period 0 is: $\Delta MVA_0 = I*(R - k)/(1 + k) = \$400[(0.25 - 0.12)]/1.12 = \$52/(1/12) = \$46.43$.

Example 2 Partitioning the Total Value with Breakeven Return and Constant Growth in Future Incremental EVA

Example 2 shows the partitioning of the total current value ($1,045.43) of the firm. Using Equation 15, this value is calculated as $1,000 + [($400(0.25 − 0.12)/1.12)] and is the sum of current capital endowment ($1,000) plus the $46.43 value created by the firm by investing in real assets.

If the firm earns a ROIC that equals the firm's WACC (i.e., R = k), the firm earns a breakeven return and its total current values can be parsed into current capital endowment of $1,000 and incremental value of $0 created by the firm, that is, $1000 + [$400(0.12 − 0.12)/1.12] = $1,000. Because no value is created, the current market value equals the initial capital endowment.

In a multi-period world, assuming next year's ΔEVA_1 ($52) of the firm is expected to grow at a constant rate of 5% and g < k for the foreseeable future, then using the Equation 16, the firm's current incremental MVA (ΔMVA_0) is $52(1.05)/(0.12 − 0.05) = $780. Then, the total current market value of the firm equals $1,780, which is a combination of the initial endowment ($1,000) plus the incremental market value added ($780).

This example shows the partitioning of total value and the derivation of the breakeven return and the market value given a set of values for the variables using the relationships (equations) derived in the paper. The variables have the following values: I_0 = $1,000, k = 12%, R = 25%, the growth rate (g) in next year's

FCFF and for the foreseeable future = 5%, and the growth rate (g) in next year's EVA and for the foreseeable future = 5.33%

Partitioning the Total Value

$$P_{max} = I + I^*(R - k)/(1 + k)$$

Current market value ($1,046.43) = Current capital investment ($1,000) + Incremental value created due to the return in excess of the cost of capital ($46.43).

Breakeven Return

If R equals k, $P_{max} = I + I^*(R - k)/(1 + k) = \$1,000 + \$400(0.12 - 0.12)/1.12 = \$1,000$. That is, current market value ($1,000) = Initial capital investment ($1,000).

Constant Growth in Cash Flow

If the firm's future incremental EVA (ΔEVA_1 of $52) is expected to grow at a constant rate of 5% for the foreseeable future, the current total incremental market value of the firm is:

$$MVA_0 = \sum \Delta MVA_0 = \Delta EVA_1 (1 + g)/(k - g) = \$52(1.05)/(0.12 - 0.05) = \$780.$$

The total value of the firm = Initial endowment (I) + Total incremental market value added (MVA_0). The total market value of the firm = $1,000 + $780 = $1,780.

Summary and Conclusions

Many measures are available to evaluate a firm's financial performance. We review some important measures including FCFF, NPV, ROIC, EVA, and MVA. These measures are economically related to each other. Yet, defining them and using subsets of accounting information and adjustments in their computations result in divergent viewpoints and perspectives. We show that a theoretical framework is available to help reconcile differences among these measures.

We examine these measures in both a single-period and multi-period world. In a single-period world, we conclude that measures are related because they originate from the same economic model of investment and production theory of a firm. These relationships hold in the multi-period world assuming constant growth and using a popular valuation model. Overall, our main conclusion is that no single measure is fully adequate for measuring financial performance. Hence, we recommend using multiple measures to provide a fuller picture of a firm's performance.

References

Arzac, Enrique R. 2007. *Valuation for Mergers, Buyouts and Restructuring*. Hoboken, NJ: John Wiley & Sons, Inc.

Bacidore, Jeffrey M., John A. Boquist, Todd T. Milbourn, and Anjan V. Thakor. 1997. "The Search for the Best Financial Performance Measure." *Financial Analysts Journal* 53(3): 11–20.

Baker, H. Kent, Prakash Deo, and Tarun Mukherjee. 2009. "EVA Revisited." *Journal of Financial Education* 35(Fall): 1–22.

Baker, H. Kent and G. E. Powell. 2005. *Understanding Financial Management: A Practical Guide*. Oxford: Blackwell Publishing.

Baker, H. Kent, J. Clay Singleton, and E. Theodore Veit. 2011. *Survey Research in Corporate Finance – Bridging the Gap between Theory and Practice*. Oxford: Oxford University Press.

Bowen, Robert M. and James S. Wallace. 1999. "Inferior Systems, Inc.: The Decision to Adopt EVA." *Issues in Accounting Education* 14(3): 518–541.

Bradley, Michael and Gregg A. Jarrell. 2008. "Expected Inflation and the Constant-Growth Valuation Model." *Journal of Applied Corporate Finance* 20(2): 66–78.

Brealey, Richard A., Stewart C. Myers, and Alan J. Marcus. 2004. *Fundamentals of Corporate Finance*. New York: McGraw-Hill.

Clinton, D. B., and S. Chen. 1998. "Do New Performance Measures Measure Up?" *Management Accounting* 80(4): 38−43.

Copeland, Tom and Aaron D. Dolgoff. 2006. "Expectation-Based Management." *Journal of Applied Corporate Finance* 18(2): 82−97.

Dillion, Ray D. and James E. Owers. 1997. "EVA as a Financial Metric: Attributes, Utilization, and Relationship to NPV." *Financial Practice and Education* 7(1): 32−40.

Dodd, James L. and Jason Johns. 1999. "EVA Reconsidered." *Business and Economic Review* 45(3): 13−18.

Estridge, Juliet and Barbara A. Lougee. 2007. "Measuring Free Cash Flows for Equity Valuation: Pitfalls and Possible Solutions." *Journal of Applied Corporate Finance* 19(2): 60−71.

Fama, Eugene F. and Merton H. Miller. 1972. *The Theory of Finance*. New York: Holt, Rinehart and Winston.

Ferguson, Robert and Dean Leistikow. 1998. "Search for the Best Financial Performance Measure: Basics Are Better." *Financial Analysts Journal* 54(1): 81−86.

Ferguson, Robert, Joel Rentzler, and Susana Yu. 2005. "Does Economic Value Added (EVA) Improve Stock Performance Profitability?" *Journal of Applied Finance* 15(2): 101−113
.
Financial Management Association. 2006. "Roundtable on Stock Market Pricing and Value-Based Management." *Journal of Applied Corporate Finance* 18(2): 57−81
.
Graham, John R. and Campbell R. Harvey. 2001. "The Theory and Practice of Corporate Finance: Evidence from the Field." *Journal of Financial Economics* 60(2−3): 187−243.

Griffith, John M. 2006. "EVA and Stock Performance." *Journal of Investing* 15(2): 75−78.

Harper, David. 2005. "Understanding Economic Value Added." Available at http://www.investopedia.com/university/EVA.

Hartman, Joseph C. 2000. "On the Equivalence of Net Present Value and Market Value Added as Measures of a Project's Economic Worth." *Engineering Economist* 45(2): 158−164.

Jensen, Michael C. and William H. Meckling. 2009. "Specific Knowledge and Divisional Performance Measurement." *Journal of Applied Corporate Finance* 21(2): 49−57.

Jensen, Michael C. and Kevin J. Murphy. 1990. "Performance Pay and Top-Manager Incentives." *Journal of Political Economy* 98(2): 225−264.

Kim, John J., Jae-Hyeon Ahn, and J. K. Yun. 2004. "Economic Value Added (EVA) as a Proxy for Market Value Added (MVA) and Accounting Earnings: Empirical Evidence from the Business Cycle." *Journal of Accounting & Finance Research* 12(1): 40−48.

Koller, Tim, Marc Goedhart, and David Wessels. 2010. *Valuation: Measuring and Managing the Value of Companies*, 5th Edition. Hoboken, NJ: John Wiley & Sons, Inc.

Lambert, Richard A., David F. Larcker, and Raul Guerrero. 1985. "Executive Compensation, Corporate Decision-Making and Shareholder Wealth: A Review of the Evidence." *Midland Corporate Finance Journal* 2(4): 6−22.

Laughton, David, Raul Guerrero, and Donald R. Lessard. 2008. "Real Asset Valuation: A Back-to-Basics Approach." *Journal of Applied Corporate Finance* 20(2): 46−65.

Loderer, Claudio, John B. Long, Jr., and Lukas Roth. 2010. "Implementing Fischer Black's Simple Discounting Rule." *Journal of Applied Corporate Finance* 22(2): 60−68.

Martin, John D., J. William Petty, and Stephen P. Rich. 2005. "A Survey of EVA® and Other Residual Income Models of Firm Performance." *Journal of Financial Literature* 1(January): 1−20.

Martin, John D., J. William Petty, and James S. Wallace. 2009. "Shareholder Value Maximization: Is There a Role for Corporate Social Responsibility." *Journal of Applied Corporate Finance* 21(2): 110−118.

Milbourn, Todd T. 1996. "The Executive Compensation Puzzle: Theory and Evidence." *IFA Working Paper* No. 235, London Business School.

Mir, Ali El and Souad Seboui. 2006. "Corporate Governance and Earnings Management and the Relationship between Economic Value Added and Created Shareholder Value." *Journal of Asset Management* 7(September): 242−254.

Mulford, Charles W. and Eugene E. Comiskey. 2005. *Creative Cash Flow Reporting Uncovering Sustainable Financial Performance.* Hoboken, NJ: John Wiley & Sons, Inc.

Nurnberg, Hugo. 2006. "Perspectives on the Cash Flow Statement under FASB Statement No. 95." Occasional Paper, Center for Excellence in Accounting and Security Analysis, Columbia University.

Penman, Stephen H. 2006. "Handling Valuation Models." *Journal of Applied Corporate Finance* 18(2): 48−55.

Penman, Stephen H. 2007. *Financial Statement Analysis and Security Valuation*, 3rd Edition. New York: McGraw-Hill Irwin.

Pinto, Jerald F., Elaine Henry, Thomas R. Robinson, and John D. Stowe. 2010. *Equity Asset Valuation*, 2nd Edition. Hoboken, NJ: John Wiley & Sons, Inc.

Rappaport, Alfred. 1998. *Creating Shareholder Value.* New York: The Free Press.

Rappaport, Alfred. 1999. "New Thinking on How to Link Executive Pay with Performance." *Harvard Business Review* 77(2): 91−101, 186.

Shrieves, Ronald E. and John M. Wachowicz, Jr. 2001. "Free Cash Flow, EVA^{TM} and NPV: A Reconciliation of Variations of Discounted-Cash-Flow Valuation." *Engineering Economist* 46(1): 33−52.

Stewart, G. Bennett, III. 1991. *The Quest for Value.* New York: Collins Business Publishers Inc.

Stowe John D. and J. R. Gagne. 2013. *Capital Budgeting CFA Curriculum, Level II*. Hoboken, NJ: John Wiley & Sons, Inc.

Young, S. David. 1999. "Some Reflections on Accounting Adjustments and Economic Value Added." *Journal of Financial Statement Analysis* 4(2): 7−13.

Young, S. David and Stephen F. O'Bryne. 2001. *EVA$^{\circledR}$ and Value-Based Management: A Practical Guide to Implementation.* New York: McGraw-Hill.

Zenner, Marc, Tomer Berkovitz, and John H. S Clark. 2009. "Creating Value through Best-in Class Capital Allocation." *Journal of Applied Corporate Finance* 21(4): 89−96.

Figure 1
The Relationship between Present and Future Value of Cash Flows
via Investment in Capital Markets

This figure illustrates how capital markets allow tradeoffs between investment today and expected cash flow in the future. Note that $-(1+k)$ is the slope of the line between the current present value and the end-of
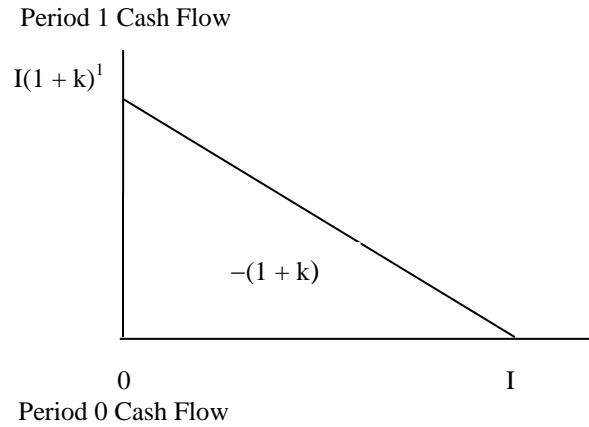
Period 1 Cash Flow

$I(1+k)^1$

$-(1+k)$

0   I

Period 0 Cash Flow

Figure 2
Value Maximization Decision-Making Process for Investing in Real Assets
Depicted by a Production or Transformation Function

This figure shows period 1 cash flows as a result of investment in real assets at period 0 and the diminishing returns on successive investments.

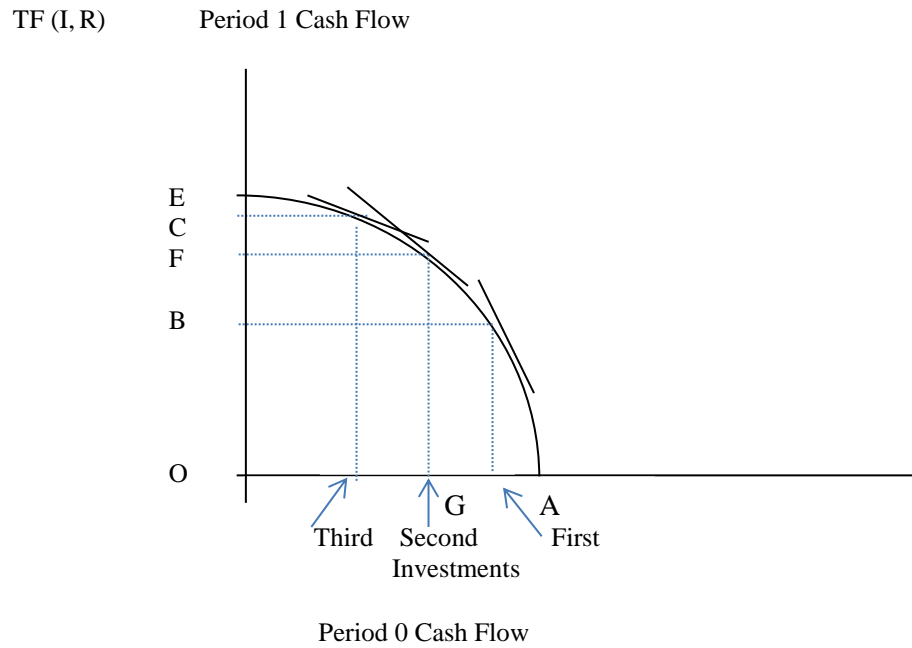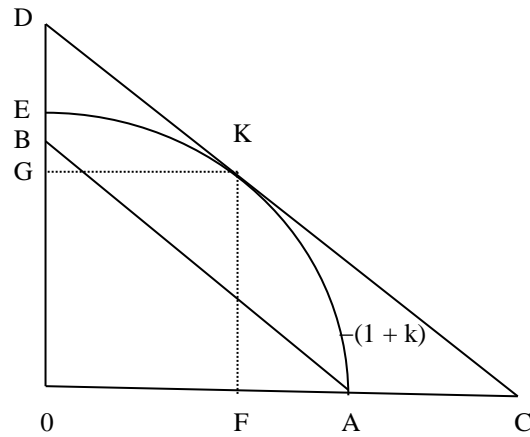TF (I, R)   Period 1 Cash Flow

Period 0 Cash Flow

Figure 3
Comparing Cash Flows When Investing Them in the Capital Market versus Real Assets

This figure delineates how combining a production function and DKC provides some decision rules. DKC is a line with slope $-(1 + k)$ from Figure 1 that is tangent to the firm's production function.

Period 1 Cash Flow

Period 0 Cash Flow

Gains from Specialization and Trade Revisited: "How" is Done and "Why" Must be Explained *

X. Henry Wang,[1] Bill Z. Yang[2] and Binglin Li [3]

ABSTRACT

Most textbooks have shown mutual gains from trade without explaining the source of the gains. Formally deriving the *combined* PPF from two individual PPFs, this paper demonstrates that the economy of two producers reaches their combined PPF *if and only if* at least one of them fully specializes according to her comparative advantage. Such specialization causes the total production to rise, as it is maximized on the combined PPF. It also shows how such specialization is endogenously determined under the perfect competition. It also explains who (and how to) benefit more from specialization in international trade and in labor market.

Introduction

Almost all textbooks of principles of economics as well as international economics have discussed how specialization according to comparative advantage and trade result in mutual gains. Using the Ricardian model in numerical examples and/or graphs, authors show that if each producer specializes in a good that she or he has a comparative advantage and trades with the other, then both producers can consume a bundle that is beyond the *individual* production possibilities frontier (PPF, hereafter). This treatment (only) verifies the gains from doing so, but it does not clarify *why* the gains are generated.[4]

What is the source to the gains? Trade itself does not increase production. It only allows one to specialize. The issue is why specialization according to comparative advantage increases the total production, which seems to be overlooked. In this paper, we show in a Ricardian model that an economy of two producers (or countries) reaches their combined PPF *if and only if* at least one of them fully specializes according to her or his comparative advantage. No matter whether the two merge into one economy or they are viewed as an economy, as long as one or two of them specialize based on each individual comparative advantage, their total production is on the *combined* PPF and hence rises. This mechanic is the root source for the (total) gains from the specialization in terms of comparative advantage, regardless how their production activities are coordinated institutionally.

Total gains must be properly shared to yield mutual benefits for both parties so that specialization and trade are voluntary. Many, if not most, textbooks simply compare the two regimes between "autarky" and "trade" by assumption,[5] and hence they essentially address a *normative* issue that producers *should* specialize and trade. A related *positive* issue is whether they *would* do so? Some more-careful authors tell

[1] Professor of Economics, Department of Economics, University of Missouri, Columbia, MO 65211 USA, wangx@missouri.edu
[2] Professor of Economics, Department of Finance and Economics, Georgia Southern University, Statesboro, GA 30460 USA, billyang@georgiasouthern.edu. The corresponding author.
[3] Associate Professor of Economics, Department of Economics, Chongqing University of Science and Technology, Chongqing, 401331 China
[4] One of the authors of this note was asked by a student from his class, "I see they both gain, but where do the gains come from?" It motivated this study, because the author could not immediately find an answer to this question from any textbooks, principles or international economics, available on his bookshelves.
[5] For example, see Krugman and Wells (2012, p.50) and Hubbard and O'Brian (2008, p.177).

a (more) complete story by assuming that two producers can reach collaboration through talk and negotiation.[6] To our knowledge, no current textbook has addressed how proper specialization is chosen through decentralized decisions. We also demonstrate that the perfect competition under free trade induces each producer to specialize in a good that she or he has a comparative advantage. What is more, such endogenously determined specialization also warrants a term of trade between the individual opportunity costs of the two producers so that both of them will benefit. Therefore, the specialization in terms of comparative advantage and trade are voluntary.

Fung and Reddy (2004) also present a graphic treatment for combined PPF for this purpose.[7] So, what are our contributions to this classic issue? (1) We formally derive the combined PPF and provide an intuitive interpretation for the shape of the resulting combined PPF under an operational definition of PPF (section 3). (2) We articulate why it only needs one producer to fully specialize so as to reach the combined PPF. (3) We provide an explanation for endogenously determination of specialization given the difference between individual PPFs. This point seems to be ignored in many textbooks (section 4). (4) We also apply our analysis and treatment to nonlinear individual PPF cases, either concave (decreasing return to scale) or convex (increasing return to scale), to explain partial specialization, trade under increasing return to scale, and who can benefit more from specialization and trade in international trade and in labor market.

Current Treatment: Only "How" and Not "Why"

When showing the *gains from trade*, most textbook authors have employed the standard Ricardian model with labor as the single input (i.e., the PPFs are linear). In this model, two producers (or countries), A and B, each produce two goods, X and Y. Their individual PPFs are PPF_A and PPF_B, respectively. Assume that A has a comparative advantage in producing good X.

		Without Trade		With Trade and Specialization			Gains from Trade
		Production	Consumption	Production	Trade	Consumption	
A	X	9	9	15	-5	10	+ 1
	Y	8	8	0	+10	10	+ 2
B	X	4	4	0	+ 5	5	+ 1
	Y	3	3	15	-10	5	+ 2

Table 1. A numerical example for gains from trade

Almost all authors have used similar numerical examples to demonstrate the gains from trade. For instance, A can produce up to 15 units of X or 20 units of Y, while B can produce up to 5 X or 15 Y. In

---

[6] For example, see Mankiw (2012, p. 50), and Parkin (2008, p. 42).

[7] We also find some sources in the form of supplementary course materials that used combined PPF to explain gains from trade (see, for example, http://www2.econ.iastate.edu/classes/econ355/choi/ric2.htm, http://www.pitt.edu/~upjecon/MCG/MICRO/COMPADV/CompAdv.html.) Like Fung and Reddy (2004), they only have drawn a graph for the combined PPF without a proof for its shape.

the benchmark without trade, each producer diversifies in consumption and hence in production as well. To show the gains from trade, it is assumes that A specializes in X and B specializes in Y, and then they trade with each other. As illustrated in Table 1, both gain from such arrangement in specialization and trade. Note that in this example the term of trade of X is assumed to be 2Y, which is between A's opportunity cost of X (= 4/3 Y) and B's opportunity cost of X (= 3Y).[8]

The above treatment indeed confirms the gains from trade when each producer specializes according to her or his comparative advantage. However, it does not explain *why* such specialization can generate gains, though it is noted. For example, after presenting a similar numerical example for gains from trade, Mankiw (2012, p.53) wrote

> "When each person specializes in producing the good for which he or she has a comparative advantage, *total production in the economy rises*. This increase in the size of the economic pie can be used to make everyone better off." (*Italic* added)

But *why* does such specialization cause "*total production in the economy to rise?*" No discussion is provided. This overlook is not only in principles textbooks due to the "level issue," but also in more advanced texts of international economics.[9] Since the topic "gains from trade due to comparative advantage" is one of the fundamental principles in economics, it is necessary to clarify it thoroughly.

Specialization with Comparative Advantage Maximizes Total Production

Why does specialization in terms of comparative advantage increase total production? In general, total production of an economy is maximized on its PPF. In particular, total production of an economy with two producers is maximized on their *combined* PPF. In this section, we show in Ricardian model that the combined PPF of two producers is reached if and only if at least one of them specializes according to her or his comparative advantage. Therefore, specialization of a producer in terms of comparative advantage moves the total production toward the combined PPF, and hence, total production rises.

For the convenience of discussions, we give an operational definition of PPF below:[10]

Definition of PPF. A PPF gives the maximum of one good that can be produced given the amount of the other good.

Let PPF_A and PPF_B be the individual PPF of producer A and B, respectively. What is their combined PPF (denoted PPF_{AB})? Why does specialization in terms of comparative advantage help reach such combined PPF? We first draw the combined PPF graphically and then discuss the intuition behind the graph (with the formal proof relegated in the Appendix). As shown in Figure 1 (a) below, PPF_{AB} consists of two segments: *ac* and *cd* with a kinked point *c*. Its Y-intercept (point *a*) is the sum of Y-intercepts of PPF_A and PPF_B, and its X-intercept (point *e*) is the sum of individual X-intercepts, when both A and B exclusively produce good Y or X, respectively. Segment *ac* is parallel to PPF_A and *ce* is parallel to PPF_B.

---

[8] Similar examples can be easily found in prevailing textbooks. For example, see Mankiw (2012, p.51), Hubbard and O'Brien (2008, p. 250), Krugman and Wells (2012, p. 34), O'Sullivan *et al* (2008, p.427), Baumol and Blinder (2000, p. 735), Gwartney and Stroup (1997, p.850), among many others.

[9] See, for example, Krugman and Obstfeld (2009, pp. 36-37), Feenstra and Taylor (2008, pp.40-45), Carbough (2009, pp. 36-39), among others.

[10] See Krugman and Obstfeld (2009, p.30) and Krugman and Wells (2012, p. 28), for example. Another definition of PPF usually used in textbooks is that PPF gives "the combinations of output that an economy can possibly produce." For example, see Mankiw (2012, p.24), O'Sullivan et al (2008, p.32), and Hubbard and O'Brien (2008, p. 38), among others. The latter version is not as operational as the former, however.
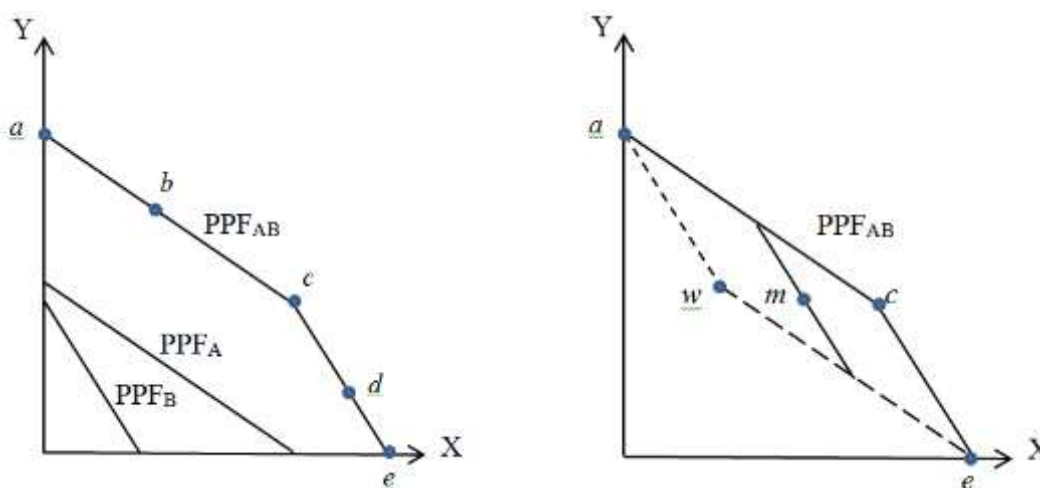
(a) From individual PPFs to combined PPF   (b) On and below the combined PPF

Figure 1. Combined PPF

We start with the Y-intercept (point *a*) in which both producers produce good Y exclusively. If the economy wants to consume and hence produce some X, who will do the job first to maintain maximum amount of Y? It should be producer A, since she has lower opportunity cost in producing good X. Therefore, the frontier should be parallel to PPF$_A$ when A is assigned to do it (as indicated at point *b*) until point *c* is reached. At point *c* producer A fully specializes in good X and producer B makes good Y completely. If X is so large that A's production cannot meet, then producer B has to make some of it as well (as shown in point *d*). In this case, the opportunity cost to produce good X is the same as B's. Hence, segment *ce* is parallel to PPF$_B$. Intuitively, the shape of PPF$_{AB}$ can be explained by the definition of PPF: given a certain amount of X, how to produce the maximum of Y?

From the construction of PPF$_{AB}$, we see that when at least one of the two producers specializes in producing the good for which he has a comparative advantage, the total production is on PPF$_{AB}$. When neither does so, the resulting total production is below PPF$_{AB}$. For example, if each producer diversifies in the middle point of her or his individual PPF, then the joint production is at point *m*, as shown in Figure 1 (b). Also, if each producer specializes in the good for which she or he has a comparative *dis*advantage, then the total production is at point *w*.

From the above discussions, we have the following (the proof is relegated to Appendix):

Proposition 1. In Ricardian model with linear individual PPFs, an economy consisting of two producers reaches their combined PPF, *if and only if*, at least one of them fully specializes according to her comparative advantage and the other operates on his individual PPF.

Proposition 1 essentially answers why specialization based on each producer's comparative advantage causes the production of the economy to rise. It is because when at least one producer specializes according to her comparative advantage, it enables the total production of the two to be on their combined PPF. That is, their total production is maximized. If neither producer specializes so, then the resulting total outputs must be below the combined PPF. In that case, if one or both of them reallocate labor input to specialize in terms of their individual comparative advantage, total production rises as it moves toward the combined PPF. Consequently, specialization based on comparative advantage generates total gains.

Corollary 1. In Ricardian model with two producers in an economy, if at least one of them specializes according to her or his comparative advantage, total production is maximized.

It is worth noting that Proposition 1 shows how individual PPFs *mechanically* determine the combined PPF_{AB}. It does not specify or require how divisions of labor and hence specialization are coordinated *institutionally*. For example, it does not demand that the two producers can collaborate and trade with each other. As long as at least one of them *somehow* specializes in the good with comparative advantage, the total production is on the combined PPF. They may agree to do so collaboratively or they each choose to do so individually under certain incentive scheme. Also, it is about the total production of the economy, and not about the final consumption for each party. In other words, Proposition 1 explains why specialization according to comparative advantage increases total production, and hence two producers *should* do so. It does not address whether they would do so or how the gains are shared between them.

How does Market Force Determine Specialization?

Total production is on the combined PPF if the two producers are *somehow* coordinated in their specialization according to each producer's comparative advantage. Why would they do so? Nevertheless, one's choice is determined by whether or not she or he will benefit from doing so. This *positive* issue has to be addressed, in particular, in a decentralized market system. That is, how does a producer decide her/his specialization under the market force? Do such individual choices follow the principle of comparative advantage?

Suppose that the term of trade (i.e., relative price) between the two goods is given by market. Let P_X (P_Y) be the price of good X (Y). Then, the term of trade of X for Y is P_X/P_Y. Denote c_A and c_B the slopes of PPF_A and PPF_B, respectively, and without losing generality assume that $c_A < c_B$. Then, producer A decides her specialization by comparing c_A with P_X/P_Y, rather than c_B. More specifically, if $c_A < P_X/P_Y$, A will specialize in good X and trade it for Y, as shown in Figure 2 (a); if instead, $c_A > P_X/P_Y$, A will produce good Y only and trade it for X (Figure 2 (b)). Likewise, B will choose specialization by comparing c_B with P_X/P_Y. We summarize the above discussions in the next proposition (the proof is relegated in the Appendix).

Proposition 2. A producer chooses to specialize in a good if her/his opportunity cost is lower than the term of trade (i.e., the relative price in the market).

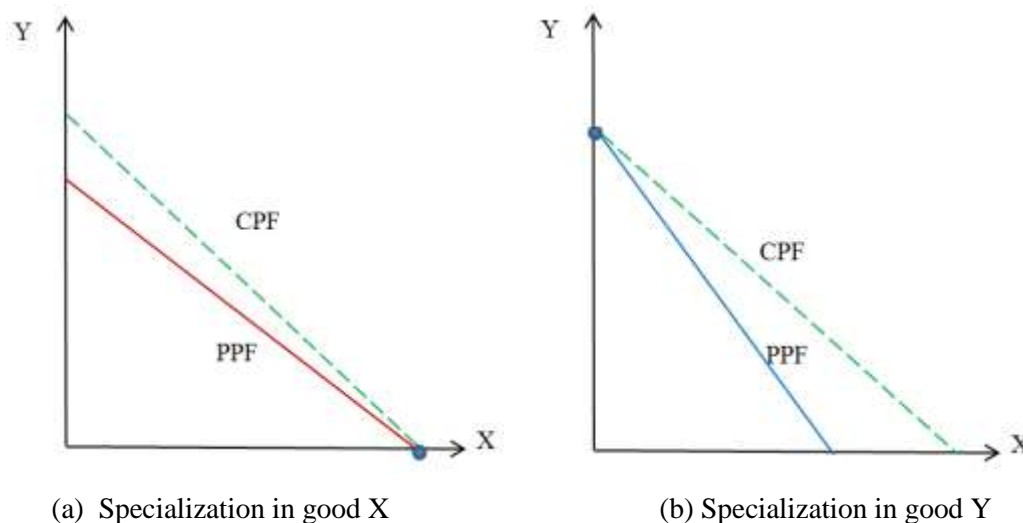(a) Specialization in good X   (b) Specialization in good Y

Figure 2. PPF and CPF

Then, do such individual choices in specialization follow the principle of comparative advantage? That is, do producers actually specialize in what they should do according to their comparative advantages? The answer is "Yes" in the economy with two producers, because we must have $c_A \leq P_X/P_Y \leq c_B$. Suppose that $P_X/P_Y < c_A < c_B$. It follows from Proposition 2 that both will produce good Y exclusively. It will drive P_X up unless good X is not in demand at all. Likewise, $c_A < c_B < P_X/P_Y$ is impossible, too. Therefore, the term of trade must be between the slopes of the two PPFs in the case with only two producers.[11]

Lemma 1. Assume that there are only two producers A and B with $c_A < c_B$. Then, under perfect competition, $c_A \leq P_X/P_Y \leq c_B$.

If $P_X/P_Y \in (c_A, c_B)$, it follows from Proposition 2 that A chooses to specialize in good X and B in good Y. If $c_A < P_X/P_Y = c_B$, then A will specialize in X and B may mix. Similarly, $P_X/P_Y = c_A < c_B$, then A may mix and producer B will specialize in Y. In either case, they do as what they would do by following the principle of comparative advantage. It follows from Proposition 1 that the total production is on the combined PPF. We summarize this outcome in the following

Proposition 3. Assume that there are only two producers A and B with $c_A < c_B$. The market force under perfect competition will induce each producer to specialize according to her or his comparative advantage.

The market term of trade not only guides both producers to specialize in terms of their individual comparative advantage and increases total production, but also warrants mutual gains. For each producer, the price line that passes the production point with specialization becomes the consumption possibilities frontier (CPF). From Proposition 2, we know that each producer's CPF is above her PPF. Then, mutual gains from trade are attained.

Proposition 4. Assume that there are only two producers A and B with $c_A < c_B$. Free trade and perfect competition will induce each producer to specialize in the good according to her or his comparative advantage and yield mutual gains for both producers.

The logic for mutual gains from trade and specialization in the Ricardian model is as follows. Difference in opportunity costs between the two producers ($c_A < c_B$) is the source. Trade allows producers to specialize and the market force ($P_X/P_Y \in (c_A, c_B)$) induces them to specialize in terms of comparative advantage. As a result, total production is on the combined PPF and hence maximized. What is more, the market price $P_X/P_Y \in (c_A, c_B)$ warrants the total gains shared through voluntary trade. Consequently, mutual gains are attained.

It is also worth noting that our treatment above on the choice of specialization does not involve the indifference curve, as usually used in optimal choice problem. Instead, we only need to use the term of trade and PPF for specialization choice issue, provided that the preference satisfies the property of non-satiation.

Discussions on Some Related Issues

Why does Only One Producer Fully Specialize?

Some textbook authors carefully exemplify the gains from trade by assuming that both producers fully specialize (e.g., see Krugman and Wells, 2012, p. 34), which corresponds to the kinked point on the

---

[11] If the economy has more than two producers, the slope of the price line can be beyond the range between the slopes of a specific pair of PPFs. Also, note that the result applies when producer is replaced by country in an international-trade environment.

combined PPF (see Figure 3(a)). Other authors *deliberately* choose to arrange only one producer to fully specialize and the other to diversify in production (e.g., see Mankiw, 2012, p. 51), which is denoted by some point on a segment of the combined PPF (as shown in Figure 3(b)). Either way, all authors *essentially* mean to demonstrate the total gains from specialization and trade by comparing a point on the combined PPF with a benchmark point below it with both producers diversifying in productions, though they have not done it explicitly with the setup of combined PPF.
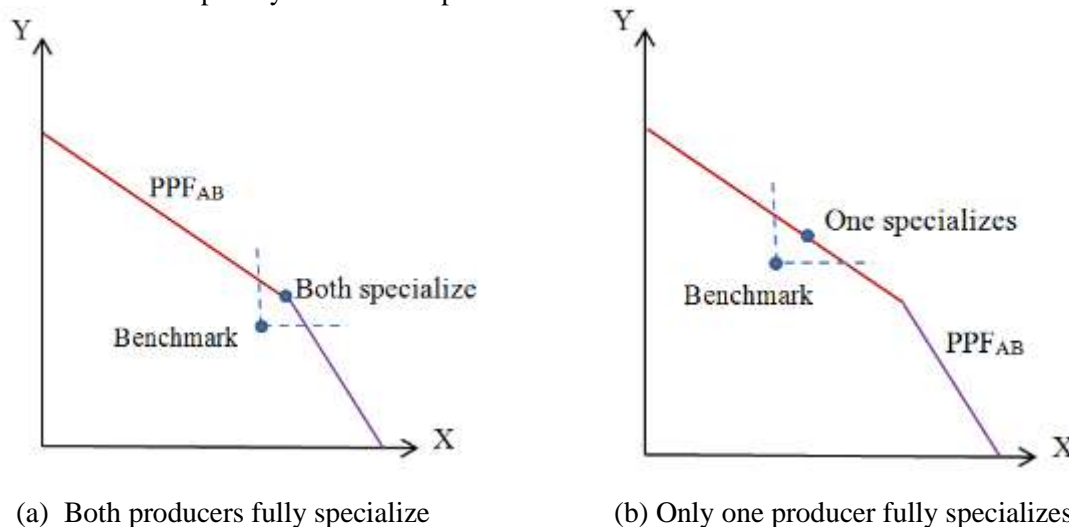

(a) Both producers fully specialize   (b) Only one producer fully specializes

Figure 3. Two different treatments to show total gains from specialization

The case with only one producer fully specializing may confuse many students.[12] But it helps address and emphasize an interesting point: to reach the combined PPF, it does not require both producers to specialize.[13] In the extreme case when both producers fully specialize, the total production is at the kinked point on the combined PPF.

Under the market force, it follows from Proposition 2 that a producer would diversify in production only when the price line (i.e., the term of trade) is parallel to her or his individual PPF. In that special case, the producer with such an individual PPF will not benefit from trade at all, because the PPF and the CPF coincide with each other. This point may partially explain why Mankiw (2012, pp. 52-54) and Parkin (2008, p.43) have adopted the treatment with talk and negotiation instead of market force, because they have to.

Who (and How to) Benefit More from Trade?[14]

The analysis of previous sections can also be used to address who (between the producers) may benefit *more* from trade. Intuitively, a producer with individual PPF further away from the given term of trade may potentially benefit more from specialization and trade. This point can be illustrated in Figure 2. Dynamically, if one can improve her or his individual PPF, she or he could benefit more from further developing the production potential in the activity with comparative advantage. It is particularly valid for

---

[12] One of the authors of this paper uses a textbook with only one producer fully specializing. Almost every time at this point some students would ask "how come that producer does not need to specialize?"

[13] More generally, if there are N producers, it needs at least N – 1 of them to specialize based on "pairwise comparative advantage". That is, between any two producers with different specializations, they each follow the principle of comparative advantage. This more general case can be easily used to explain "optimal" division of labor by the market force: when each person chooses specialization by comparing her individual PPF with the term of trade between the two goods, the economy operates on its (combined) PPF.

[14] Again, this topic seems to be missed in textbooks and students frequently asked about it.

a small open economy in international trade environment under the perfect competition as well as for individuals in labor market.
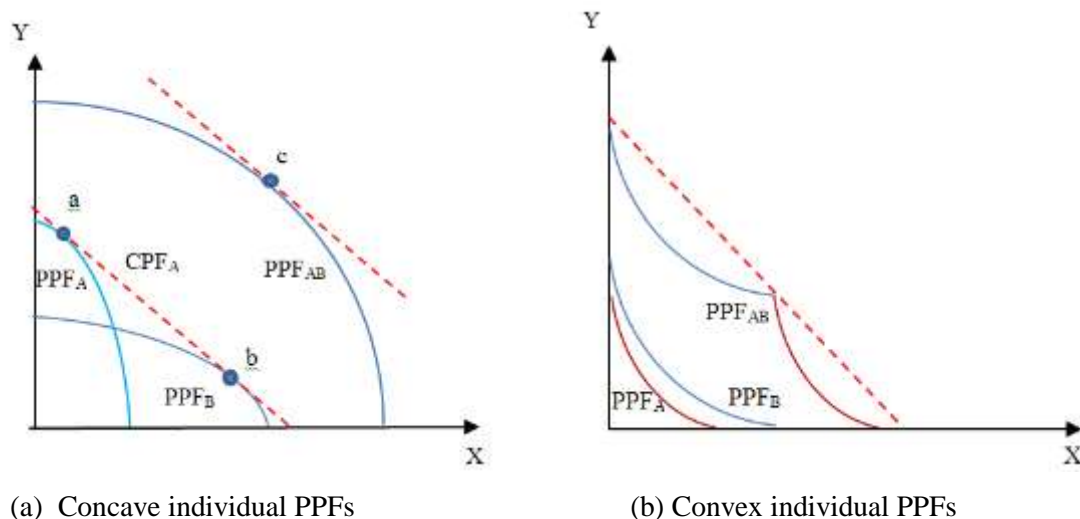

(a) Concave individual PPFs   (b) Convex individual PPFs

Figure 4. Nonlinear individual PPFs and resulting combined PPF

Though our analysis in this note focuses on Ricardian model, the principle (of employing the combined PPF) can also be applied to other shapes of individual PPFs. For example, if both individual PPFs are concave (to the origin), then it follows from our analysis that neither of them would fully specialize to maximize the total production (see Figure 4(a), point c on PPF$_{AB}$ corresponds to the combination of a on PPF$_A$ and b on PPF$_B$). On the other hand, if both individual PPFs are convex (to the origin due to increasing return to scale), then both producers can significantly benefit from specialization and trade, even if the two individual PPFs are identical and the two goods (X and Y) are very similar (see Figure 4(b), the kicked point on PPF$_{AB}$ obtains when producer A specializes in good Y and B specializes in good X).

Concluding Remarks

The intention of this paper is to explain "why there are gains from specialization and trade," as current textbooks have only shown that "there are gains from specialization and trade." As one of fundamental principles taught in economics, we believe it is necessary to clarify it in our teaching and learning. To answer this question, the concept and structure of combined PPF are introduced. This tool is feasible and suitable for a principles course as well as for a more advanced upper-level classes in economics. Though graphic presentations may be (and should be) used in teaching, we have also provided formal proofs for the derivation of combined PPF and endogenous choice on specialization under the market force for the purpose of vigor. Also, we have offered intuitive interpretations for the shape of the combined PPF based on the operational definition of PPF.

Appendix: Proofs for Propositions

Proof for Proposition 1.

Let producer k's PPF be PPF_k: $y_k = b_k - c_k x_k$, (k = 1, 2).[15] Then, b_k is the Y-intercept, $a_k \equiv b_k/c_k$ is the X-intercept of PPF_k, and c_k is the opportunity cost of good X for producer k. Assume that $c_1 < c_2$ (i.e., producer 1 has comparative advantage in good X). Let the combined PPF be described by function y = F(x). By definition, given any x ∈ $[0, a_1 + a_2]$, F(x) can be found from solving the following program

$$F(x) = \max_{x_1, x_2} \sum_{k=1}^{2} y_k = \sum_{k=1}^{2}(b_k - c_k x_k)$$

$$\text{s.t.} \qquad \sum_{k=1}^{2} x_k = x, \qquad 0 \le x_k \le a_k, \quad k = 1, 2.$$

Obviously, F(0) = b_1 + b_2 and F($a_1 + a_2$) = 0. For x ∈ (0, $a_1 + a_2$), we set the Lagrangian function as follows:

$$L = \sum_{k=1}^{2}(b_k - c_k x_k) + \lambda(x - \sum_{k=1}^{2} x_k) + \sum_{k=1}^{2} \mu_k x_k + \sum_{k=1}^{2} \gamma_k(a_k - x_k)$$

The first-order conditions are

$$\frac{\partial L}{\partial x_k} = -c_k - \lambda + \mu_k - \gamma_k = 0, \qquad k = 1, 2; \tag{1}$$

$$\sum_{k=1}^{2} x_k = x; \tag{2}$$

$$\mu_k x_k = 0, \ \mu_k \ge 0, \quad x_k \ge 0, \qquad k = 1, 2; \tag{3}$$

$$\gamma_k(a_k - x_k) = 0, \ \gamma_k \ge 0, \ a_k - x_k \ge 0, \qquad k = 1, 2; \tag{4}$$

Depending on the value of x, we derive F(x) in two segments from the above FOCs:

For x ∈ (0, a_1], we show that x_2 = 0. Suppose x_2 > 0. Then, 0 ≤ x_1 < x ≤ a_1. It implies from (3) and (4) that $\mu_2 = \gamma_1 = 0$. Thus, $c_1 = \lambda + \mu_1 \ge \lambda - \gamma_2 = c_2$, from (1). It contradicts $c_1 < c_2$. Therefore, x_2 = 0, and x_1 = x, from (2). That is, F(x) = $b_1 + b_2 - a_1$ x, for x ∈ (0, a_1].

For x ∈ (a_1, $a_1 + a_2$], we show that $x_1 = a_1$. Suppose $x_1 < a_1$. Then, γ_1 = 0, x_2 > 0, and μ_2 = 0 from (3) and (4). It implies from (1) that $a_1 = \lambda + \mu_1 \ge \lambda - \gamma_2 = a_2$. It contradicts the assumption $c_1 < c_2$. Therefore, $x_1 = a_1$, and $x_2 = x - a_1$ from (2). So, we have F(x) = $b_1 \left(\frac{c_2}{c_1}\right) + b_2 - c_2 x$, $for\ x$ ∈ ($a_1, a_1 + a_2$].

Combining the results from above, we obtain the combined PPF function F(x) as follows:

$$F(x) = \begin{cases} b_1 + b_2 - c_1 x, & for\ x \in [0,\ a_1] \\ b_1\left(\frac{c_2}{c_1}\right) + b_2 - c_2 x, & for\ x \in (a_1, a_1 + a_2] \end{cases} \qquad Q.E.D.$$

Proof for Proposition 2

Let y = b − c x be the PPF of the producer and P_X/P_Y be the term of trade of X for Y. The producer wants to reach the consumption possibilities frontier (CPF) by choosing a production plan (x_p, y_p) along the PPF, ie., $y_p = b - c x_p$. That is, given the consumption of x (⩾ 0), the producer chooses x_p for as much

---

[15] For mathematical expressions, we label producers 1 and 2, instead of A and B in this proof.

consumption of y as possible, either from her/his own production ($b - c\, x_p$) or traded ($x_p - x$) (P_X/P_Y). Formally, the producer solves the following program:

$$\max_{x_p} y = b - c\, x_p + (x_p - x)(P_X/P_Y)$$

$$\text{s.t.} \qquad 0 \leqslant x_p \leqslant b/c$$

The first-order condition gives

$$\frac{dy}{dx_p} = -c + \frac{P_X}{P_Y} \gtreqless 0$$

It implies that

$$x_p \begin{cases} = b/c \\ \in [0,\ b/c] \\ = 0 \end{cases} \quad \Leftrightarrow \quad \frac{P_X}{P_Y} \gtreqless c$$

Therefore, the producer specializes in X (Y) if $P_X/P_Y > c$ ($P_X/P_Y < c$). *Q.E.D.*

References

Baumol and Blinder (2000). Economics: Principles and Policy, 8th Edition, The Dryden Press Orlando, FL

Carbough, Robert J. (2009). International Economics, 12th Edition, South-Western Cengage Learning, Mason OH

Feenstra, Robert C. and Alan M. Taylor (2008). International Economics, Worth Publisher, New York

Fung, K.K. and Manjunath Reddy (2004). Comparative advantage and gains from specialization – Flash, Journal of Economic Education, 35(1), 104

Gwartney, James D. and Richard L. Stroup (1997). Economics: Private and Public Choice, 8th Edition, The Dryden Press, Orlando, FL

Hubbard, R. Glenn and Anthony Patrick O'Brien (2008). Microeconomics, 2nd Edition, Pearson Prentice Hall, Upper Saddle River, NJ

Krugman, Paul and Maurice Obstfeld, (2009). International Economics: Theory and Policy, 8th Edition, Pearson Addison Wesley, Boston

Krugman, Paul and Robin Wells (2012). Microeconomics, 3rd Edition, Worth Publisher, New York

Mankiw, N. Gregory, (2012). Principles of Economics, 7th Edition, Cengage Learning, Stamford, CT

O'Sullivan, Arthur, Steven M. Sheffrin and Stephen J. Perez (2008). Survey of Economics: Principles, Applications, and Tools, 3rd Edition, Pearson Prentice Hall, Upper Saddle River, NJ

Parkin, Michael (2008). Microeconomics, 8th edition, Pearson Addison Wesley

Classroom Analysis of How to Value Shares of Public Corporations: A Pedagogical Endeavor Including Earnings and Dividends Expectations Formation and Hybrid Modeling

By Richard J. Cebula[1], Luther Lawson[2], Ira S. Saltz[3], and John Buck[4]

Abstract. This paper endeavors to render the evaluation of shares in publicly-traded corporations simpler and broader by: (a) developing a more useful and understandable version of the application of price-earnings ratios to stock valuation; (b) acknowledging the existence of the price-dividend ratio and its applications; (c) demonstrating formally how future dividends expectations and future earnings expectation can be formed; (d) expounding upon the dividend discount and earnings discount models and how a hybrid model can be formed; and (e) elaborating how the dividend discount model, the earnings discount model, and the price earnings framework can be synthesized into a hybrid model.

Introduction

Students in both undergraduate and graduate-level Corporate Finance classes are inevitably destined to encounter the issue and various theories of how to undertake evaluation of shares of publicly traded corporations. Understanding the nature of such valuation approaches often is part of the academic heart and soul of such courses. The purposes of the present pedagogical paper are to clarify, simplify, extend, and provide fuller background for students seeking to better understand the world of corporate valuation.

The Price/Earnings PE Approach

Perhaps the oldest and arguably the simplest method for evaluating the present value (PV) or market price of a share of equity stock in a public corporation is the price/earnings approach, or simply, PE approach. Assume that the task at hand is the valuation of shares of "Corporation ABC" stock. There are essentially three similar but nonetheless different theories of the PE approach that can potentially be adopted in pursuit of achieving this task, the "simple PE method," the "equal-industry distribution PE method," and the "unequal-industry distribution PE method," the last of which may not be found elsewhere than in this paper. The first of these three approaches can be commonly found in Corporate Finance textbooks (Berk and DeMarzo 2014); (Keown, Martin, and Petty 2014); (Berk and DeMarzo 2011); (Ross, Westerfield, and Jaffe 2010); (Ross, Westerfield, and Jordan 2010); (Gittman and Zutter 2012).

Simple PE Method

Assume Corporation ABC can be classified as belonging in a single industry, industry j. If that is the case, then the diligent investor or analyst would begin by computing the average/mean PE of all the publicly-traded firms in that industry (j), yielding *PEj**. According to this simple method, the market price of a share of Corporation ABC's stock, *PABC*, is given by:

PABC = PEj* x EEABC

where *EEABC* is the *expected* future earnings per share of ABC stock over the *next* year. Interestingly, it is unclear how an investor or analyst arrives at the value of these expected earnings. One method explaining how such expectations can potentially be estimated/computed is expressly described in section 3 of this paper.

In any event, if the mean *PEj** is 20 and *EEABC* is the expected earnings per share of Corporation ABC stock is $5, then the "correct" market price per share of ABC stock is computed simply as:

PABC = PEj* x EEABC = 20 x $5 = $100

This method underscores that expected earnings per share of equity stock are an important determinant of the correct market price of a corporation's stock. Should the market price being transacted exceed this price ($100), the wise strategy would be not to buy; conversely, if the market price is less than $100, then a purchase *may be* appropriate, depending upon such factors as one's resources and one's opportunity costs. Clearly, should the PE ratio be miscomputed or the firm mistakenly be classified in the wrong industry so

---

[1] Wells Fargo Endowed Chair in Finance, Jacksonville University.

[2] Professor Emeritus, University of North Carolina-Wilmington.

[3] Professor of Economics, Penn State University.

[4] Professor of Economics, Jacksonville University.

that the computed PE is irrelevant, then this technique yield spurious results. Similarly, if the value of the *expected* earnings per share prove incorrect, then the computation will be incorrect.

The Equal-industry Distribution PE Method

If Corporation ABC is very small or very specialized or for whatever reasons can legitimately be so classified as belonging only (or at least principally) to a single industry, then the simple PE method can, at least in theory, be useful. However, if Corporation ABC is large or if it engages in significant magnitudes of activities in multiple industries, the simple PE method would not be useful for valuation purposes. Under these conditions, it may be possible to assume that Corporation ABC might be more or less equally classified as belonging in to exactly n industries ($n > 1$). Accordingly, the per share stock price (*PABC*) would be expressed as:

$$PABC = \sum_{f=1}^{n} (EEABC \times PE_f)/n, \text{ so that}$$

$$PABC = (EEABC \times PE1 + EEABC \times PE2 + \ldots + EEABC \times PEn)/n$$

Thus, if n = 3, and if *PE1* =17, *PE2* =19, and *PE3* =21, while *EEABC* = \$5, then it follows that the share price of the stock is, as follows:

$$PABC = (17 \times \$5 + 19 \times \$5 + 21 \times \$5)/3 = (\$85 + \$95 + \$105)/3 = \$95.$$

Naturally, although it is easy to imagine a firm, especially a larger firm as belonging to a variety of industries ($n > 1$), intuitively it seems much less plausible that the firm is *equally* divided among all of the n industries. This leads to the next category of PE theories of stock valuation.

The Unequal-industry Distribution PE Method

Clearly if Corporation ABC belongs to several different industries, it seems intuitively plausible that the firm would participate (belong) *unequally* in these various industries. Thus, if the corporation belongs unequally in n different industries and if a_f is the decimal corresponding to the percentage of the corporation that is classified as belong in industry f, $f = 1, \ldots, n$, the share price would be computed as follows:

$$PABC = a_1 \, EEABC \times PE_1 + a_2 \, EEABC \times PE_2 + \ldots + a_z \, EEABC \times PE_n ,$$

where $\sum_{f=1}^{n} a_f = 1$ and $1 > a_f > 0$

This formulation of the PE framework is referred to here as "the unequal-industry distribution PE method."
  Thus, if n =3, and if *EEABC* = \$5, and if *PE1* =17, *PE2* =19, and *PE3* =21, while $a_1 = 0.50$, $a_2 = 0.30$, and $a_3 = 0.20$, then it follows that the price per share is:

$$PABC = 0.5 \times \$5 \times 17 + 0.3 \times \$5 \times 19 + 0.2 \times \$5 \times 21$$

$$PABC = \$42.50 + \$28.50 + \$21.00 = \$92$$

While all of this may seem straightforward, it must be remembered that computing each of the percentages of the corporation that belongs in each industry may be a challenging if not daunting undertaking, especially if the firm is very large and diverse in its industrial composition; furthermore, the number of industries to which the firm belongs and the extent of the firm's "presence" in various industries will likely change over time as a result of technology, market forces, and other factors. Moreover, it remains unclear where the value of the expected dividend for the next year comes from, although a methodology for estimating *EEABC is developed* in a different context later in this paper.[5]

The Dividend Discount Model: Overview

Underlying the dividend discount model (DDM) is an assumption that the market value of a share of stock of a public corporation is fundamentally tied to its *expected future dividend distributions*, EFD. This section of the paper first focuses upon how the EFD might be determined; subsequently, the focus will be upon how the price per share of a public corporation is determined once the EFD is computed.

Computing the Expected Future Dividend: A Simple Method

The computation of a corporation's *expected* future dividend (*EFD*) is based upon its actual past and recent dividend record. Using information about actual recent dividend distributions, say over the most recent five years, an application of the linear weighted average method (LWA) to those past dividends can yield a reasonable assessment about the future dividend that can be expected for the coming year(s).

---

[5] It is noteworthy that as an alternative to the PE method, the PD, price-to-dividend, method can be adopted in a fashion paralleling the PE approaches illustrated here.

To demonstrate the LWA method applied to *EFD*, an example is now provided. The reader is refereed to Table 1. Assume that Corporation ABC has the following record of *actual* dividends per share for years 1 through 5, with year 1 corresponding to the most recent year (the present), year 2 corresponding to the previous year, year 3 corresponding to the year before that, and so forth. These figures are shown in column (a) of Table 1. Next, in column (b) of the table, observe the numbers 1 through 5, which are used to weight each of the dividends paid in years 1 through 5. Note that the more recent the dividend record of the firm, the more heavily it is weighted, whereas the further in the past a dividend was paid the lower it is weighted. In column (c) of the table, the products of columns (a) and (b) are provided.

Table 1. Estimating the EFD Per Share

	(a)	(b)	(c)
Year 5	$4	1	$4
Year 4	$4	2	$8
Year 3	$6	3	$18
Year 2	$5	4	$20
Year 1	$5	5	$25
Totals	$25	15	$75

Having completed these weighted estimates, computing the *EFD* for next year now involves simply dividing the total for column (c) by the total for column (b), as follows:

EFD = $75/15= $5

Thus, given the *actual* dividend pattern for the past five years for Corporation ABC, the expected dividend for the firm for next year is $5 per share. The LWA technique is not the only technique for estimating the following year's *EFD*, but it is direct and very easy to follow. Moreover, it is in principle consistent the technique recommended by the Internal Revenue Service, namely, Revenue Ruling 59-60, 1959-1 CB 237, 5(a), which states that prior "…records are the most reliable guide as to future expectancy" (Goldberg 1984, p. 143).

Of course, alternatives to the approach demonstrated above exist. For example, consider the following formulation, which systematically estimates *EFD* by using a weighting factor that declines exponentially as the number of years into the past (μ)taken into consideration increases:

$$\text{EFD} = \sum_{£=0}^{\mu} Z^{£}AD_{t-£}, \; 0 < Z < 1$$

In this case, $AD_{t-£}$ refers to the actual dividend in year t-£ and Z is a coefficient that is positive but less than unity.

Computing the Present Value of a Flow of Funds into an Infinite Future

The next step in understanding how to compute the value of a stock share is gaining an understanding of the implication of computing a given sum into an infinite future. It is helpful at this point to refer to what is known as a consol. A consol is a unique form of bond because it has:
  (a) no maturity date;
  (b) no repayment of principal; and
  (c) a fixed coupon of $*C forever*, i.e., the coupon is paid into "infinity."

The present value (price) of a consol (*Pc*) is given by:

$$Pc = C/(1+k) + C/(1+k)^2 + C/(1+k)^3 + C/(1+k)^4 \ldots$$

where *k* is the discount rate and the exponent on the denominator approaches ∞. It is well established (Copeland, Weston, and Shastri 2005, p. 884) that "…if the number of payments is infinite, then the present value of the annuity becomes…" the following:

$$Pc = C/k$$

What this simple mathematical process implies, then, is that if one computes the value of a given sum paid annually into the future for infinity, the value of the denominator in the present value formula actually becomes the discount rate itself. Thus, if the annual distribution is a fixed amount, say $100, and the discount rate is 10%, then the price of the consol is $100/0.1= $1,000.

Valuing the Share Price Using the DDM

The underlying assumption of the DDM is that the price of a share of the publicly traded stock for Corporation ABC reflects the present value of the stock's future expected dividends *into infinity*:

$$PABC_{share} = \sum_{t=1}^{\infty} EFD_t/(1+k)^t = EFD/k$$

where EFD$_t$ = expected future dividend (in period t) per share, perhaps derived using one of the two methods outlined in section 3a of this paper; and *k* = discount rate, which reflects what is referred to as the *required rate of return*, which is discussed later in this paper.

Hence, if k= 10% and EFD =$5, then PABC$_{share}$ = $5/0.1= $50.

The dividend yield is $5/$50 = 0.1, which equals k.   Thus, this investor does not require a capital gain to be satisfied. The entire demanded rate of return is achieved simply by the dividend payment. Therefore, *if dividend remains constant, the price will remain constant*.

Of course, the DDM as expressed in this equation assumes the EFD will remain unchanged, i.e., its annual percentage growth rate, g, equals 0. Since the market may regard Corporation ABC's dividend as either rising, perhaps as a result of good leadership, increased market share, or other financial considerations, or as decreasing, possibly because of perceived increased competition, weak management, or other factors, the *generalized version of the DDM* is given by:

PABC$_{share}$ = EFD/(k −g),

such that *g* > 0 for the firm if its dividends are expected for whatever reasons to rise by a certain percentage annually over time or *g* < 0 for the firm if its dividends are expected for whatever reasons to decline by a certain percentage annually over time.

Two examples may be useful. First, let us assume again that *k*= 10% and EFD =$5, but that for whatever reason the market believes that Corporation ABC is likely to be able to *elevate* its dividends over time by say 2% per year. In this case the computation is given by:

PABC$_{share}$ = EFD/(k −g) = $5/(0.1-0.02) = $5/0.08 = $62.50,

rather than $50 when g = 0 (see above), an outcome that is intuitively logical because a higher long term dividend pattern should enhance the value of the stock share price.

In this example, the dividend yield is $5/$62.50 = 0.08 or 8%. However, the investor is demanding a 10% rate of return, so this investor must also expect the price of the stock to increase 2% per year. Let us see if that happens. In the next year, the dividend will be 2% higher or $5 x 1.02 = $5.10. If the dividend is $5.10 the price of the stock will be

PABC$_{share}$ = $5.10/0.08 = $63.75.

Thus, the stock's price increases from $62.50 to $63.75 in one year. The percentage change (%Δ) in the stock price can be found as:

$$\%\Delta\text{PABC}_{share} = \frac{(\$63.75 - \$62.50)}{\$62.50} = 0.02 \text{ or } 2\%.$$

We see that the dividend yield plus the annual rate of capital gain = 8% + 2% = 10%, the rate of return demanded by investors.

As a counter-example, let us assume again that *k*= 10% and EFD =$5, but that for whatever reason the market believes differently that Corporation ABC is likely to *reduce* its dividends over time by say 2% per year. In this case the computation is given by:

PABC$_{share}$ = EFD/(k −g) = $5/[0.1-(-0.02)] = $5/0.12 = $41.66

Thus, as logic would seem to dictate, if Corporation ABC becomes more parsimonious regarding dividend distributions and if the DDM is valid, then the stock price for Corporation ABC per share should be lower. In this example, that price falls from $50 per share (*g*=0) to $41.66. In this example, the dividend yield is $5/$41.66 = 0.12 or 12%. In the next year, the dividend will be 2% lower or $5 x 0.98 = $4.90. If the dividend is $4.90 the price of the stock will be

PABC$_{share}$ = $4.90/0.12 = $40.83.

Thus, the stock's price decreases from $41.66 to $40.83 in one year. The % change in the stock price can be found as:

$$\%\Delta\text{PABC}_{share} = \frac{(\$40.83 - \$41.66)}{\$41.66} = -0.02 \text{ or } -2\%.$$

In this case, the dividend yield plus the annual rate of capital gain (loss) = 12% + -2% = 10%, the rate of return demanded/required by investors. The investor was willing to accept a capital loss because he or she received a dividend yield that was more than the required rate of return.

The Earnings Discount Model

The analysis in the preceding section is predicated upon the market's subscribing to the DDM model. Accordingly, because the DDM model focuses upon dividends as the driver of market value, it overlooks the possibility that earnings per share may be more relevant than dividends per share. Earnings per share over time consist effectively of dividends *and* retained earnings. Since earnings over time provide the funding not only for dividend pay-outs but also for internally financed capital projects and stabilization of dividends through the various phases of the business cycle so as to help stabilize share prices, it can be

argued that the earnings discount model (EDM) may have advantages over the DDM. Of course, to those investors using dividends extensively to live on or as a significant source of current income, dividends may be the more relevant consideration. Of course, for corporations that do not have a history of paying dividends or are relatively new, the Discounted Dividends Model is of little use.

The general lay-out of the EDM parallels that of the DDM. One can imagining diligent investors or money managers adopting the LWA approach (or a similar approach such as that shown in section 3a above) and applying it, in this case to earnings per share rather than dividends per share. Thus, it is easy to visualize how to estimate *expected* earnings (*EFE*) per share for the coming year.

To demonstrate this visualization, consider Table 2, where five years of earnings data are used to determine the expected earnings for next year. In column (a) of Table 2, the earnings records for Corporation ABC are provided for years 1 (the most recent, i.e., the past, year) through 5 (four years prior to the most recent year). As with the expected dividend approach, the expected earnings approach attaches a higher value to more recent earnings than for less recent earnings.

Table 2. Estimating the EFE Per Share

	(a)	(b)	(c)
Year 5	$6	1	$ 6
Year 4	$6	2	$12
Year 3	$7	3	$21
Year 2	$7	4	$28
Year 1	$6.60	5	$33
Totals	$32.60	15	$100

Computing the *EFE* per share for next year involves dividing the total for column (c) by the total for column (b):

$$EFD = \$100/15 = \$6.67$$

This amount, $6.67, constitutes the *EFE*, the expected earnings for the next year, for Corporation ABC. Observe that this amount exceeds the *EFD* of $5 per share for Corporation ABC, which over the long run must in theory always be the case for a firm that has not become insolvent.

In any case, the earnings discount model (EDM) can be expressed in general form as the following:

$$PABC_{share} = \sum_{t=1}^{\infty} EFE_t/(1+k)^t = EFE/(k-g)$$

As with the DDM, in the EDM the value of g can be either positive (implying that earnings per share are expected to grow in the future), zero (future earnings per share are not expected to rise or fall), or negative (future earnings per share are expected to decline).

The Hybrid DDM/EDM Model

The DDM and EDM paradigms each constitutes a different perspective that the other does not. Those subscribing exclusively on the DDM to determine the *PABC_{share}* focus upon the importance of dividend distributions and implicitly are less concerned or not directly concerned with the issues of retained earnings, internally financed capital formation, and other dimensions of corporate earnings. It can be inferred that investors adopting this approach are *de facto* solely concerned with the dividends expected from the stock. By contrast, those subscribing exclusively on earnings are less interested in dividend dispersals *per se* and more concerned with a broader perspective of retained earnings and their usage in internally financed capital formation, to the *de facto* accumulation of funds to stabilize dividends over the course of business cycles, as well as actual dividends *per se*. The issue is one in which the latter is simply not the *sole* concern or focus.

A reasonable perspective is that the market consists of both DDM subscribers and EDM subscribers. Hence, the market as a whole actually subscribes to a synthesized hybrid of the two approaches. That is, the

$$PABC_{share} = \alpha[DDM/(k-g)] + \theta[EFD/(k-g)], \quad \alpha + \theta = 1, 0 < \alpha, \theta < 1$$

In this specification, the "hybrid DDM/EDM model" provides a balance between that part of the market assigning primary weight on the more myopic valuation criterion of dividends and that part of the market assigning weight on the much broader valuation criterion of earnings. The relative magnitudes of α and θ may vary over time and reflect a variety of factors, including demographic traits as such the age distribution of the population and the relative magnitudes of institutional versus non-institutional buyers in the marketplace.

The Capital Asset Pricing Model

Possibly the best known model for providing the value of the "required rate of return" (*k*), whether or use in the dividend discount model, the earnings discount model, or what is referred to in this paper as the "hybrid DDM/EDM model," is the capital asset pricing model, or simply "CAPM." Essentially, it may be summarized as follows:

$$k = R_{RF} + \beta(R_{AM} - R_{RF}),$$

where R_{RF} = the risk-free rate of return, R_{AM} = the average rate of return in the market, and β = a measure of the responsiveness of the rate of return on the publicly traded corporation in question, Corporation ABC in our example (R_{ABC}), to changes in the market as a whole.

The value of β is computed, as follows:

$\beta = \text{COV}(\text{R}_{\text{RF}}, \text{R}_{\text{AM}})/\sigma^2(\text{R}_{\text{AM}})$

When examining the CAPM, an obvious question would be: How does one precisely identify a risk-free rate of return? Is there really such a thing? Although most textbooks do not treat this as a challenging issue, it is unclear as to how we can precisely measure R_{RF}. It is not uncommon to treat the interest rate yield on the 3-month Treasury bill is typically used as R_{RF}. Nevertheless, if one can resolve this issue, one can potentially apply the CAPM to the three models shown in Sections 3, 4, and 5 of this paper to estimate the value of a share of publicly traded stock.

As an aside, historically stocks have had a larger risk premium than bonds. For example, the historic risk premium for stocks is 6.02% and for Treasury bonds only 1.40%.[6] Some of the difference can be explained by the lower risk of default on Treasury bonds, but some of that difference is also attributable to the fact that all of the future cash flows for bonds are arguably known at the time of purchase, whereas for stocks we can only estimate future cash flows.

An Expanded Synthesis

Finally, although one can think in term of a synthesis of the DDM and EDM models, one can also proceed further to synthesize the models described here to also include one of the PE models. For example, integrating the unequal- industry distribution PE model developed in this paper with the DDM and the EDM could yield a composite valuation formula such as:

$\alpha_1[\text{DDM}/(\text{k-g})] + \alpha_2 \,[\text{EFD}/(\text{k-g})] +$

$\alpha_3 \,[\text{PABC} = a_1 \,\text{EEABC X PE}_1 +\ldots+ a_z \,\text{EEABC X PE}_n],$

$$\sum_{f=1}^{n} a_f = 1 \text{ and } 1> a_f > 0, \; 0 < \alpha_1, \alpha_2, \alpha_3 < 1, \; \alpha_1 + \alpha_2 + \alpha_3 =1$$

Such a composite model could be a broad and practical (useful) approach to and could provide flexibility, balance, and insights to a still imperfect process of valuation.

---

[6] From http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/histretSP.html. Figures are for the return on stocks minus the 3 month T-bill interest rate and return on the 10-year Treasury bond minus the 3-month T-bill interest rate.

References

Berk, Jonathan and Peter Demarzo. 2011. *Corporate Finance.* 2nd edition. New York Prentice Hall.

Berk, Jonathan and Peter Demarzo, 2014. *Corporate Finance. 3rd* edition. New York: Pearson.

Copeland, Thomas E., J. Fred Weston, and Kuldeep Shastri. 2005. *Financial Theory and Corporate Policy*. Boston: Addison-Wesley.

Goldberg, Barth H. 1984. *Valuation of Divorce Assets*. St. Paul, MN: West Publishing Co.

Gittman, Lawrence J. and Chad J. Zutter. 2012. *Principles of Managerial Finance*, 13th edition. Pearson.

http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/histretSP.html. "Annaul Returns on Stock, T.Bonds, and T.Bills: 1928-Current," *FRED*, St. Louis Federal Reserve Bank.

Keown, Arthur J., J. William Petty, and John D. Martin. 2014. *Foundations of Finance*. 8th edition. New York: Pearson.

Ross, Stephen A., Randolph Westerfield, and Jeffrey F. Jaffe. 2010. *Corporate Finance*. 9th edition. New York: McGraw-Hill/Irwin.

Ross, Stephen A., Randolph Westerfield, and Bradford D. Jordan. 2010. *Fundamentals of Corporate Finance*. 9th edition. New York: McGraw-Hill/Irwin.